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House Prices: Changing the City World

The Global Urban Competitiveness Report (2017–2018)

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Prologue I

Today's world is undergoing fundamental changes. On one hand, globalization is reaching a new level despite some ups and downs, emerging economies represented by China are growing rapidly, and the global landscape has experienced and will continue to see more changes to come. On the other hand, technology innovation is striving to come up with breakthroughs; it has changed and will continue to reshape the forms and landscape of global economy. In the twenty-first century, cities have become the mainstream carrier and platform for human activities. Globalization, technology innovation, and changes into the global economic landscape will determine the future of global cities and urban system. Therefore, studying the development environment, living environment, competitiveness, and sustainable development of global cities and urban system, and accordingly proposing innovative theories and countermeasures, will mean a lot for improving the business environment and living environment in cities, promoting urban prosperity, reducing urban poverty, and increasing the benefits of urban residents on a global scale.

Residential property has multiple attributes. It is an indispensable condition for human survival and development, immobile, and valuable. It is also an important investment and economic sector. Its influence is felt by households at the micro-level and the economy and society at the macro-level at the same time. For this reason, the housing issue is one of the most important and challenging issues in the universe of cities. Worldwide, nearly one billion urban residents are crowded in slums, and billions more are overwhelmed by the sky-high housing price. A great concern shared by urban residents across the world, the housing price exerts impact on the global urban landscape and its changes. Governments, international organizations, and numerous scholars and experts have long been dedicated to the studies of the housing issue. Despite some progress, deeper theoretical research, comprehensive policy evaluation, extensive experience summarization, and constant innovation and exploration are still needed to obtain a fundamental solution. International collaborative theoretical, policy, and experience research among scholars in related fields is a particularly important part of the efforts.

Chinese Academy of Social Sciences (CASS) is China's top research institute dedicated to philosophy and social sciences and one of the world's most influential think tanks. Our mission is to promote the studies of philosophy and social sciences in China, offer policy consultation on matters of national interests, and help advance international academic development in philosophy and social sciences and address global issues. We are proud to have a highly capable research team for urban and housing issues, who have produced significant research findings through partnership with other prestigious research teams and international organizations over the years.

The UN-Habitat is the world's most important international organization in the field of human settlement and urban development. It has been long committed to academic studies and the delivery of assistance in urban development and the improvement of the living environment, and produced remarkable achievements.

For this research project, the CASS National Academy of Economic Strategy and the UN-Habitat recruited noted scholars and experts in related fields from worldwide to form the research team. After long-term research, they have come to many original conclusions and findings regarding global urban competitiveness and cities' business environment, living environment, and sustainable development. These findings will serve as valuable reference for us to develop a new understanding of the changing urban world, formulating new policies in favor of urban development, and promoting global urban prosperity. In particular, in the 2017–2018 project year, the research team focused on the housing price, examined the pattern and causes of changes in global housing prices and their influence on the urban world, drew many valuable conclusions, and summarized experience in how the urban housing price has reshaped the urban world. Their efforts will be helpful for easing and solving the housing issue amid the process of urban development.

We will continue to support this collaborative research project as always and hope that it will continue to build up its international influence and contribute to making cities better.

October 2017

Wang Weiguang
President of the CASS

Prologue II

I am pleased to present to you this publication entitled *Global Urban Competitiveness Report 2017–2018 with Special Topic on Real Estate and Competitiveness*. This is the second publication jointly produced by the Chinese Academy of Social Sciences and UN-Habitat on global urban competitiveness. In early 2017, these two institutions jointly published the *Global Urban Competitiveness Report 2016–2017*.

In October 2016, world leaders adopted the New Urban Agenda, the outcome document of Habitat III. This New Urban Agenda clearly recognizes that urbanization is a strategic issue for both local and national governments and that it can be a source of development and employment. The implementation of this Agenda will contribute to the implementation and localization of the 2030 Agenda for Sustainable Development, and to the achievement of the Sustainable Development Goals, including Goal 11: making cities and human settlements inclusive, safe, resilient, and sustainable.

Urban competitiveness and economic and social development are closely related. Cities with better infrastructure generate higher urban productivity. Higher urban productivity in turn brings about higher incomes for all segments of society: individual citizens, government, and the private sector. More competitive cities also attract skills and capital, thus creating a virtuous cycle of prosperity for all. In this regard, the real estate and land markets have a strong influence on city competitiveness; they determine residential and commercial prices, affect the mobility of people and goods, and draw in high-level, skilled laborers.

In general, demographics, interest rates, government policies such as subsidies, and the overall economy influence the real estate market. Overall economic health implies urban economic competitiveness or lack of it. Highly competitive economies are reflected in higher real estate prices, and vice versa.

This report examines the urban space and land situation in some selected cities in the world. It also examines the relationship between real estate prices and the transformational upgrading of selected world's cities. More than 11 cities have been covered and competitiveness indexes compiled for 1038 cities worldwide.

The *Global Urban Competitiveness Report 2017–2018* captures these complex issues, and it is an authoritative study that presents the main topics developed by senior Chinese researchers with UN-Habitat experts. I welcome this joint effort, as the world's cities continue their work in implementing the New Urban Agenda.

October 2017

Dr. Joan Clos
Under-Secretary-General, United Nations
Executive Director, UN-HABITAT

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Part I
General Report

Chapter 1
Annual Ranking of Global Urban Competitiveness 2017–2018

The Whole Group

See Table 1.1.

The Whole Group
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Table 1.1 Annual ranking of global urban competitiveness 2017–2018

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
New York	A+	United States	1.0000	1	1.0000	1
Los Angeles	A	United States	0.9992	2	0.6519	16
Singapore	A	Singapore	0.9708	3	0.7082	5
London	A+	United Kingdom	0.9578	4	0.8756	2
San Francisco	A	United States	0.9408	5	0.6554	14
Shenzhen	B	China	0.9337	6	0.5761	35
Tokyo	A−	Japan	0.9205	7	0.7371	3
San Jose	A	United States	0.9158	8	0.6342	22
Munich	B+	Germany	0.9053	9	0.6402	18
Dallas	A−	United States	0.9026	10	0.5805	32
Houston	A−	United States	0.9000	11	0.6792	8
Hong Kong	A	Hong Kong, China	0.8873	12	0.6581	13
Seoul	A−	Korea, South	0.8478	13	0.7023	7
Shanghai	A−	China	0.8367	14	0.6110	27
Guangzhou	B+	China	0.8346	15	0.5746	36
Miami	B+	United States	0.8162	16	0.5305	53
Chicago	A−	United States	0.8151	17	0.6711	10
Boston	A−	United States	0.8121	18	0.7166	4
Dublin	A−	Ireland	0.8109	19	0.5796	33
Beijing	A−	China	0.8102	20	0.6708	11
Paris	A−	France	0.8060	21	0.6771	9
Frankfurt	A−	Germany	0.7993	22	0.6305	23
Tianjin	B−	China	0.7866	23	0.4735	93

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Stockholm	B+	Sweden	0.7862	24	0.6373	21
Philadelphia	B+	United States	0.7837	25	0.6232	24
Seattle	B+	United States	0.7808	26	0.6530	15
Kinki	B−	Japan	0.7699	27	0.5826	31
Suzhou	C+	China	0.7648	28	0.4227	160
Stamford	B	United States	0.7644	29	0.4751	90
Tel Aviv-Yafo	B−	Israel	0.7642	30	0.4018	189
Baltimore	B−	United States	0.7602	31	0.5738	37
Stuttgart	B−	Germany	0.7497	32	0.5482	48
Istanbul	B	Turkey	0.7480	33	0.5850	30
Geneva	B	Switzerland	0.7449	34	0.5496	47
Toronto	B+	Canada	0.7414	35	0.6431	17
Cleveland	B−	United States	0.7366	36	0.4779	85
Atlanta	B+	United States	0.7351	37	0.6397	19
Dusseldorf	B−	Germany	0.7333	38	0.5187	62
Perth	B	Australia	0.7326	39	0.4413	131
Wuhan	C+	China	0.7310	40	0.4535	116
Vienna	B−	Austria	0.7300	41	0.5690	41
San Diego	B	United States	0.7291	42	0.6148	25
Denver	B	United States	0.7272	43	0.4879	76
Nanjing	B−	China	0.7261	44	0.4845	79
Doha	B−	Qatar	0.7261	45	0.4358	140
Detroit	B−	United States	0.7247	46	0.4652	102

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Taipei	B−	Taiwan, China	0.7232	47	0.5255	57
Hamburg	B−	Germany	0.7175	48	0.5587	45
Cologne	C+	Germany	0.7151	49	0.4867	77
Zurich	A−	Switzerland	0.7147	50	0.7063	6
Nashville	B−	United States	0.7132	51	0.4085	178
Minneapolis	A−	United States	0.7090	52	0.5346	51
Berlin	C+	Germany	0.7055	53	0.5628	43
Charlotte	B−	United States	0.7048	54	0.5062	67
Moscow	B	Russia	0.7042	55	0.5231	59
Las Vegas	C+	United States	0.6990	56	0.4154	168
Raleigh	C+	United States	0.6973	57	0.5111	66
Abu Dhabi	B+	United Arab Emirates	0.6959	58	0.5198	60
Milwaukee	C+	United States	0.6908	59	0.4083	180
Austin	B−	United States	0.6835	60	0.5736	38
Salt Lake City	C+	United States	0.6816	61	0.5263	56
Chengdu	C+	China	0.6775	62	0.4315	148
Copenhagen	B	Denmark	0.6773	63	0.6016	29
Orlando	C+	United States	0.6772	64	0.4815	82
Sydney	A−	Australia	0.6730	65	0.6071	28
Richmond	C+	United States	0.6704	66	0.4558	112
Dubai	B+	United Arab Emirates	0.6701	67	0.4982	71

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Wuxi	C−	China	0.6697	68	0.3553	268
Birmingham	B−	United Kingdom	0.6694	69	0.5170	63
Brussels	B	Belgium	0.6657	70	0.5311	52
Changsha	C	China	0.6657	71	0.4125	173
Hannover	C	Germany	0.6655	72	0.4668	100
Vancouver	B−	Canada	0.6616	73	0.5709	40
Hangzhou	C+	China	0.6601	74	0.4655	101
Essen	C	Germany	0.6598	75	0.4688	98
Columbus	B−	United States	0.6597	76	0.4752	89
Riyadh	B−	Saudi Arabia	0.6589	77	0.3924	202
Baton Rouge	C+	United States	0.6586	78	0.4083	179
Louisville	C+	United States	0.6585	79	0.3804	224
Barcelona	B−	Spain	0.6580	80	0.5714	39
Calgary	B−	Canada	0.6557	81	0.5444	49
Ulsan	C	Korea, South	0.6527	82	0.4525	117
Oslo	A−	Norway	0.6513	83	0.6138	26
Manchester	C+	United Kingdom	0.6471	84	0.5762	34
Qingdao	C+	China	0.6462	85	0.4202	164
Chongqing	C+	China	0.6461	86	0.4545	114
Dortmund	C+	Germany	0.6454	87	0.4673	99
Chukyo	C+	Japan	0.6451	88	0.5051	69
Kuala Lumpur	B−	Malaysia	0.6351	89	0.4773	86
Amsterdam	B+	Netherlands	0.6346	90	0.6378	20

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Foshan	C	China	0.6319	91	0.3805	221
Antwerp	C+	Belgium	0.6285	92	0.4118	174
Washington	A−	United States	0.6257	93	0.6606	12
Oklahoma City	C+	United States	0.6228	94	0.3890	209
Sendai	C	Japan	0.6186	95	0.4514	118
Melbourne	B	Australia	0.6182	96	0.5376	50
Virginia Beach	C	United States	0.6165	97	0.3850	214
Phoenix	C+	United States	0.6160	98	0.4453	127
Zhengzhou	C	China	0.6151	99	0.3824	217
Tampa	C+	United States	0.6149	100	0.4220	161
Ningbo	C	China	0.6144	101	0.3625	258
Changzhou	C	China	0.6125	102	0.3450	289
Jedda	C	Saudi Arabia	0.6075	103	0.3359	303
Hamilton	B−	Canada	0.6066	104	0.4906	75
Hiroshima	C−	Japan	0.6065	105	0.3991	192
Jakarta	B−	Indonesia	0.6055	106	0.4370	138
Montreal	B−	Canada	0.6048	107	0.5546	46
Indianapolis	B−	United States	0.6038	108	0.4266	156
Macao	B−	Macao, China	0.6029	109	0.3962	196
Gold Coast	C	Australia	0.6025	110	0.3782	230
Bristol	C+	United Kingdom	0.6003	111	0.5243	58
San Antonio	C+	United States	0.5985	112	0.4344	141
Cincinnati	B−	United States	0.5962	113	0.4859	78

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Kansas City	C+	United States	0.5955	114	0.4087	177
Kaosiung	C	Taiwan, China	0.5951	115	0.4001	191
Haifa	C	Israel	0.5945	116	0.4235	159
Hague, The	C+	Netherlands	0.5936	117	0.4456	125
Birmingham	C+	United States	0.5932	118	0.4411	132
Madrid	B−	Spain	0.5904	119	0.5663	42
Rome	C+	Italy	0.5896	120	0.4793	84
Pittsburgh	C+	United States	0.5896	121	0.5288	55
Provo-Orem	C	United States	0.5893	122	0.3253	321
Hartford	C	United States	0.5891	123	0.4027	185
Dongguan	C	China	0.5885	124	0.4257	157
Dalian	C−	China	0.5876	125	0.3908	204
Nantong	C−	China	0.5874	126	0.3583	264
Ottawa	C+	Canada	0.5838	127	0.5137	65
Rotterdam	C+	Netherlands	0.5820	128	0.4619	105
Mexico City	B−	Mexico	0.5793	129	0.4126	172
Dresden	C	Germany	0.5786	130	0.4631	104
Buenos Aires	C+	Argentina	0.5770	131	0.4031	184
Bangkok	C+	Thailand	0.5740	132	0.5060	68
Charleston	C	United States	0.5727	133	0.3837	216
Helsinki	B−	Finland	0.5693	134	0.5608	44
Incheon	C	Korea, South	0.5693	135	0.4974	72
Leipzig	C	Germany	0.5688	136	0.4501	122

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Hefei	C	China	0.5686	137	0.4026	187
Providence	C+	United States	0.5674	138	0.4751	91
Sapporo	C+	Japan	0.5673	139	0.4715	96
Glasgow	C+	United Kingdom	0.5665	140	0.4972	73
Xiamen	C	China	0.5660	141	0.4692	97
Brisbane	C	Australia	0.5660	142	0.5192	61
Milan	B−	Italy	0.5657	143	0.4970	74
Allentown	C	United States	0.5649	144	0.3526	273
Lille	C−	France	0.5626	145	0.3902	206
Worcester	C+	United States	0.5623	146	0.4336	145
Colorado Springs	C	United States	0.5606	147	0.3458	286
West Yorkshire	C	United Kingdom	0.5590	148	0.4285	152
Riverside-San Bernardino	C	United States	0.5584	149	0.3707	240
Jinan	C	China	0.5570	150	0.3949	197
Grand Rapids	C	United States	0.5570	151	0.3768	232
Gothenburg	C+	Sweden	0.5559	152	0.4750	92
San Jose	C	Costa Rica	0.5554	153	0.3093	347
Liverpool	C+	United Kingdom	0.5538	154	0.4570	109
Zhenjiang	C−	China	0.5518	155	0.3234	323
Quanzhou	C−	China	0.5513	156	0.3383	298
New Haven	C	United States	0.5455	157	0.5018	70
Xi’an	C	China	0.5454	158	0.4043	182

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Shenyang	C	China	0.5442	159	0.3876	211
Dayton	C	United States	0.5431	160	0.3891	208
Edmonton	C	Canada	0.5429	161	0.4808	83
Fuzhou(Fj)	C−	China	0.5420	162	0.3706	242
Changwon	C−	Korea, South	0.5415	163	0.4252	158
Lyon	C+	France	0.5413	164	0.4838	80
Fort Myers	C	United States	0.5399	165	0.3261	319
Yantai	C−	China	0.5391	166	0.3628	257
Knoxville	C	United States	0.5388	167	0.4214	162
Samut Prakan	C−	Thailand	0.5386	168	0.3632	255
Fukuoka	C	Japan	0.5373	169	0.4368	139
Honolulu	C+	United States	0.5371	170	0.3494	277
Columbia	C	United States	0.5371	171	0.4303	149
Zhongshan	C−	China	0.5371	172	0.3881	210
Santiago	C+	Chile	0.5364	173	0.3665	245
Mecca	C−	Saudi Arabia	0.5363	174	0.2905	408
Medina	C−	Saudi Arabia	0.5352	175	0.3274	315
Busan	C−	Korea, South	0.5336	176	0.4570	110
Yangzhou	C−	China	0.5327	177	0.3176	331
Akron	C	United States	0.5291	178	0.3805	223
Delhi	C+	India	0.5282	179	0.3817	218
Adelaide	C	Australia	0.5253	180	0.4573	108
Gebze	C	Turkey	0.5241	181	0.3863	213

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Auckland	C+	New Zealand	0.5239	182	0.5168	64
Lima	C+	Peru	0.5233	183	0.3457	288
Ogden	C−	United States	0.5232	184	0.3643	250
Bogota	C+	Colombia	0.5214	185	0.3630	256
Jerusalem	C−	Israel	0.5201	186	0.4115	175
Xuzhou	C−	China	0.5201	187	0.3300	311
Bucharest	C	Romania	0.5199	188	0.4151	169
Zhuhai	C−	China	0.5186	189	0.3534	272
Buffalo	C	United States	0.5181	190	0.3985	193
Marseille	C	France	0.5179	191	0.4209	163
Nottingham	C−	United Kingdom	0.5168	192	0.4562	111
Omaha	C+	United States	0.5158	193	0.3799	225
Shaoxing	C−	China	0.5157	194	0.2953	384
Leicester	C	United Kingdom	0.5156	195	0.4341	143
Daegu	C	Korea, South	0.5155	196	0.4504	121
Montevideo	C	Uruguay	0.5140	197	0.3447	290
Dongying	C−	China	0.5132	198	0.2717	514
Taizhou(Js)	C−	China	0.5128	199	0.2991	373
Panama City	C	Panama	0.5114	200	0.3728	236
Nanchang	C−	China	0.5114	201	0.3915	203
Kuwait City	C+	Kuwait	0.5110	202	0.3190	330
Manila	C+	Philippines	0.5096	203	0.3845	215
Belfast	C	United Kingdom	0.5088	204	0.4373	136

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Gwangju	C−	Korea, South	0.5079	205	0.4341	144
Daejeon	C−	Korea, South	0.5070	206	0.5294	54
Venice	C	Italy	0.5070	207	0.3934	199
Valencia	C−	Spain	0.5041	208	0.4454	126
Astana	C−	Kazakhstan	0.5038	209	0.2893	413
Memphis	C	United States	0.5032	210	0.3619	260
Sao Paulo	C−	Brazil	0.4999	211	0.3473	279
Sheffield	C	United Kingdom	0.4999	212	0.4717	95
Hsinchu	C−	Taiwan, China	0.4983	213	0.4159	167
Sacramento	B−	United States	0.4979	214	0.4329	147
Changchun	C−	China	0.4979	215	0.3728	235
Toulouse	C	France	0.4974	216	0.4280	154
Monterrey	C	Mexico	0.4958	217	0.3276	314
Prague	C+	Czech Republic	0.4956	218	0.4818	81
Zibo	C−	China	0.4940	219	0.3036	366
Warsaw	B−	Poland	0.4935	220	0.4770	87
Bursa	C−	Turkey	0.4929	221	0.3872	212
Rosario	C−	Argentina	0.4928	222	0.2700	531
Guiyang	C−	China	0.4925	223	0.3240	322
Jiaxing	C−	China	0.4907	224	0.3059	359
Zaragoza (Saragossa)	C−	Spain	0.4904	225	0.3806	220
Tangshan	C−	China	0.4887	226	0.2806	458
Tulsa	C+	United States	0.4884	227	0.3724	238

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Nantes	C	France	0.4883	228	0.4393	135
Liege	C−	Belgium	0.4839	229	0.3727	237
Weihai	C−	China	0.4836	230	0.3356	305
Weifang	C−	China	0.4794	231	0.3140	339
Bordeaux	C	France	0.4776	232	0.4281	153
Nice	C−	France	0.4757	233	0.4115	176
Poznan	C−	Poland	0.4754	234	0.3632	254
Naples	C	Italy	0.4735	235	0.3790	228
Hamamatsu	C	Japan	0.4728	236	0.4404	134
Toulon	C−	France	0.4728	237	0.3363	301
Izmir	C−	Turkey	0.4726	238	0.3683	244
Taichung-Changhua	C−	Taiwan, China	0.4723	239	0.3462	281
Winnipeg	C	Canada	0.4723	240	0.3784	229
Verona	C	Italy	0.4721	241	0.3906	205
Sarasota	C−	United States	0.4692	242	0.3687	243
Yichang	C−	China	0.4689	243	0.2695	536
Ankara	C	Turkey	0.4686	244	0.4267	155
Sharjah	C−	United Arab Emirates	0.4678	245	0.4148	170
Shijiazhuang	C−	China	0.4671	246	0.3270	317
Bologna	C	Italy	0.4658	247	0.4509	120
Lisbon	C+	Portugal	0.4651	248	0.4419	129
Mumbai	B−	India	0.4647	249	0.4640	103

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Quebec City	C	Canada	0.4636	250	0.4553	113
Kumamoto	C−	Japan	0.4630	251	0.3938	198
Rochester	C	United States	0.4622	252	0.4471	123
Maracaibo	C−	Venezuela	0.4612	253	0.1449	979
Wuhu	C−	China	0.4611	254	0.3420	294
Yancheng	C−	China	0.4604	255	0.2935	393
Tongling	C−	China	0.4599	256	0.2411	727
Jundiai	C−	Brazil	0.4551	257	0.2095	864
Budapest	C	Hungary	0.4545	258	0.4414	130
Tainan	C−	Taiwan, China	0.4535	259	0.3652	247
Saint Petersburg	C−	Russia	0.4532	260	0.3623	259
Wenzhou	C−	China	0.4531	261	0.3461	282
Tripoli	C−	Libya	0.4524	262	0.1759	937
Santa Fe	C−	Argentina	0.4523	263	0.2698	535
Surabaya	C−	Indonesia	0.4514	264	0.2962	380
Bremen	C	Germany	0.4495	265	0.4373	137
Erdos	C−	China	0.4493	266	0.2820	448
Baotou	C−	China	0.4484	267	0.2874	421
Xiangyang	C−	China	0.4483	268	0.2740	498
Malaga	C−	Spain	0.4478	269	0.4027	186
Maracay	C−	Venezuela	0.4471	270	0.1360	989
Niigata	C	Japan	0.4470	271	0.4181	165
Florence	C	Italy	0.4470	272	0.3929	200

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Kunming	C	China	0.4460	273	0.3971	195
Ad Dammam	C−	Saudi Arabia	0.4459	274	0.2766	482
Huizhou	C−	China	0.4453	275	0.3711	239
Pretoria	C−	South Africa	0.4448	276	0.2327	772
Hohhot	C−	China	0.4421	277	0.3302	310
Albany	C	United States	0.4416	278	0.4463	124
Guadalajara	C−	Mexico	0.4390	279	0.3362	302
Muscat	C−	Oman	0.4350	280	0.3651	248
Harbin	C−	China	0.4349	281	0.3791	227
Genoa	C−	Italy	0.4348	282	0.3427	292
Zhoushan	C−	China	0.4338	283	0.2699	533
Jinhua	C−	China	0.4331	284	0.2704	524
El Paso	C−	United States	0.4314	285	0.3325	309
Johannesburg	C+	South Africa	0.4303	286	0.3048	362
Urumqi	C	China	0.4297	287	0.2876	420
Newcastle	C	United Kingdom	0.4289	288	0.4022	188
Valencia	C−	Venezuela	0.4288	289	0.2242	821
Jining	C−	China	0.4286	290	0.2749	491
Huaian	C−	China	0.4278	291	0.3091	349
Buraydah	C−	Saudi Arabia	0.4270	292	0.2263	813
Barcelona-Puerto La Cruz	C−	Venezuela	0.4257	293	0.2170	843
Rio De Janeiro	C	Brazil	0.4243	294	0.2961	381

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Tyumen	C−	Russia	0.4242	295	0.2656	560
Santo Domingo	C−	Dominican Republic	0.4235	296	0.2712	519
San Juan	C−	Puerto Rico	0.4229	297	0.2341	768
Turin	C−	Italy	0.4229	298	0.3899	207
Baku	C−	Azerbaijan	0.4225	299	0.3333	306
Luanda	C−	Angola	0.4215	300	0.1399	984
Mendoza	C−	Argentina	0.4207	301	0.2495	674
Taizhou(Zj)	C−	China	0.4202	302	0.2749	492
Tai'an	C−	China	0.4199	303	0.2802	461
Langfang	C−	China	0.4193	304	0.3389	296
Johor Bahru	C−	Malaysia	0.4190	305	0.3285	312
Krakow	C−	Poland	0.4174	306	0.3633	253
Ahvaz	C−	Iran	0.4162	307	0.1986	896
Taiyuan	C−	China	0.4160	308	0.3225	325
Nanning	C−	China	0.4138	309	0.3459	285
Zhangzhou	C−	China	0.4133	310	0.3216	328
Bakersfield	C	United States	0.4130	311	0.3387	297
New Orleans	C	United States	0.4110	312	0.3981	194
Leon	C−	Mexico	0.4079	313	0.3127	342
Minsk	C−	Belarus	0.4079	314	0.3552	269
Lodz	C−	Poland	0.4078	315	0.3155	336
Huzhou	C−	China	0.4069	316	0.2856	428
Almaty	C	Kazakhstan	0.4048	317	0.3139	340

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Yueyang	C−	China	0.4043	318	0.2860	427
Bangalore	C	India	0.4040	319	0.4031	183
Medellin	C−	Colombia	0.4031	320	0.2825	445
Putian	C−	China	0.3992	321	0.2990	374
Cairo	C	Egypt	0.3974	322	0.3741	233
Xiangtan	C−	China	0.3964	323	0.3166	334
Karaj	C−	Iran	0.3951	324	0.2655	563
Zhuzhou	C−	China	0.3948	325	0.2934	394
Adana	C−	Turkey	0.3948	326	0.2894	412
Catania	C−	Italy	0.3947	327	0.3493	278
Caracas	C−	Venezuela	0.3934	328	0.1999	894
Mcallen	C	United States	0.3932	329	0.3169	333
Ashgabat	C−	Turkmenistan	0.3927	330	0.1454	977
Xuchang	D	China	0.3922	331	0.2833	441
Fresno	C−	United States	0.3915	332	0.3278	313
Porto	C	Portugal	0.3915	333	0.4148	171
Vitoria	C−	Brazil	0.3905	334	0.2020	882
Luoyang	C−	China	0.3901	335	0.2914	402
Dezhou	C−	China	0.3898	336	0.2807	457
Antalya	C−	Turkey	0.3895	337	0.3328	307
Albuquerque	C	United States	0.3881	338	0.3590	263
Sofia	C−	Bulgaria	0.3859	339	0.3649	249
Jiaozuo	C−	China	0.3854	340	0.2525	656

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Liaocheng	C−	China	0.3849	341	0.2654	564
Ipoh	C−	Malaysia	0.3848	342	0.2783	472
Be'er Sheva	C	Israel	0.3847	343	0.3461	283
Amman	C−	Jordan	0.3844	344	0.3602	262
Lianyungang	C−	China	0.3840	345	0.3212	329
Campinas	C−	Brazil	0.3829	346	0.2808	456
Suqian	C−	China	0.3803	347	0.2792	468
Linyi	C−	China	0.3798	348	0.3046	363
Binzhou	C−	China	0.3791	349	0.2530	648
Portland	C+	United States	0.3790	350	0.4595	107
Cangzhou	C−	China	0.3788	351	0.2523	657
Padova	C−	Italy	0.3783	352	0.3807	219
Mar Del Plata	C−	Argentina	0.3782	353	0.2313	782
Zaozhuang	C−	China	0.3774	354	0.2700	532
Oran	C−	Algeria	0.3773	355	0.2374	746
Lanzhou	C−	China	0.3770	356	0.3270	316
Quito	C	Ecuador	0.3759	357	0.2814	453
Dhaka	C−	Bangladesh	0.3756	358	0.2855	429
Haikou	C−	China	0.3751	359	0.3465	280
Changde	C−	China	0.3748	360	0.2907	406
Tijuana	C	Mexico	0.3746	361	0.3134	341
Porto Alegre	D	Brazil	0.3742	362	0.2569	617
Xianyang	C−	China	0.3727	363	0.3079	355

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Merida	C–	Mexico	0.3718	364	0.2977	376
Guatemala City	C–	Guatemala	0.3715	365	0.2155	848
Rizhao	C–	China	0.3714	366	0.2869	423
Pekanbaru	C–	Indonesia	0.3704	367	0.2634	576
San Luis Potosi	C–	Mexico	0.3700	368	0.2704	523
Cordoba	C–	Argentina	0.3695	369	0.2650	567
Torreon	C–	Mexico	0.3695	370	0.2491	679
Ezhou	C–	China	0.3693	371	0.2415	723
Cancun	C–	Mexico	0.3691	372	0.2759	487
Maanshan	C–	China	0.3689	373	0.2864	425
Sao Jose Dos Campos	C–	Brazil	0.3688	374	0.1990	895
Yinchuan	C–	China	0.3686	375	0.2998	371
Asuncion	C–	Paraguay	0.3685	376	0.2469	692
Panjin	C–	China	0.3674	377	0.2418	720
Lagos	C	Nigeria	0.3670	378	0.2244	819
Liuzhou	C–	China	0.3664	379	0.2622	581
Villahermosa	C–	Mexico	0.3648	380	0.2565	620
Bari	C–	Italy	0.3644	381	0.3230	324
Cali	C–	Colombia	0.3644	382	0.2377	744
Nairobi	C–	Kenya	0.3640	383	0.2286	804
Havana	C	Cuba	0.3639	384	0.1943	903
Shantou	C–	China	0.3630	385	0.3358	304
Ribeirao Preto	C–	Brazil	0.3629	386	0.1731	942

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Wuhai	C−	China	0.3622	387	0.2390	736
Xinyu	C−	China	0.3598	388	0.2510	666
Thessaloniki	D	Greece	0.3585	389	0.3433	291
Queretaro	C−	Mexico	0.3583	390	0.2770	480
Yingkou	C−	China	0.3582	391	0.2783	473
Hengyang	C−	China	0.3581	392	0.2911	405
Chennai	C	India	0.3576	393	0.3929	201
Maoming	C−	China	0.3554	394	0.2877	419
Batam	C−	Indonesia	0.3547	395	0.2762	486
Belo Horizonte	C−	Brazil	0.3513	396	0.2473	689
Samarinda	C−	Indonesia	0.3513	397	0.2327	773
Deyang	C−	China	0.3507	398	0.2494	676
Zagreb	C	Croatia	0.3495	399	0.3640	251
Ufa	C−	Russia	0.3492	400	0.2785	470
Jieyang	C−	China	0.3484	401	0.3102	346
Beihai	C−	China	0.3472	402	0.2831	442
Zhaoqing	C−	China	0.3471	403	0.2963	379
Jiangmen	C−	China	0.3461	404	0.3080	353
Heze	C−	China	0.3457	405	0.2564	621
Huangshi	C−	China	0.3427	406	0.2646	571
San Miguel De Tucuman	D	Argentina	0.3418	407	0.2004	888
Curitiba	C−	Brazil	0.3414	408	0.2584	601

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Longyan	C−	China	0.3413	409	0.2743	496
Baghdad	C−	Iraq	0.3401	410	0.1702	948
Yulin(Sx)	C−	China	0.3401	411	0.2935	392
Joinville	C−	Brazil	0.3398	412	0.2517	661
Santiago De Los Caballeros	C−	Dominican Republic	0.3393	413	0.2652	565
Tucson	C	United States	0.3379	414	0.4409	133
Riga	C−	Latvia	0.3366	415	0.4002	190
Matamoros	C−	Mexico	0.3365	416	0.2311	783
Valparaiso	C−	Chile	0.3364	417	0.3031	367
Hufuf-Mubarraz	C−	Saudi Arabia	0.3359	418	0.2686	541
Zhanjiang	C−	China	0.3356	419	0.3123	344
Zunyi	C−	China	0.3351	420	0.2518	660
Sorocaba	C−	Brazil	0.3332	421	0.2315	779
Brasilia	C−	Brazil	0.3332	422	0.2701	528
Ningde	D	China	0.3332	423	0.2772	478
Recife	C−	Brazil	0.3331	424	0.1830	926
Chenzhou	C−	China	0.3327	425	0.2598	596
Sanming	C−	China	0.3325	426	0.2631	579
Xinxiang	C−	China	0.3322	427	0.2828	443
Port Harcourt	C−	Nigeria	0.3311	428	0.1250	1000
Toluca	D	Mexico	0.3307	429	0.2816	452
Yangjiang	C−	China	0.3298	430	0.2729	505

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Wroclaw	C−	Poland	0.3293	431	0.3612	261
Samara	C−	Russia	0.3288	432	0.2775	477
Palermo	C−	Italy	0.3282	433	0.3328	308
Cape Town	C	South Africa	0.3282	434	0.2643	572
Baoji	C−	China	0.3275	435	0.2467	695
Erbil	C−	Iraq	0.3275	436	0.2034	880
Benin City	C−	Nigeria	0.3274	437	0.1145	1011
Panzhihua	C−	China	0.3267	438	0.2346	761
Kaifeng	C−	China	0.3259	439	0.2746	493
Handan	C−	China	0.3250	440	0.2616	585
Samsun	C−	Turkey	0.3241	441	0.2956	382
Puyang	C−	China	0.3241	442	0.2339	769
Kuching	C−	Malaysia	0.3232	443	0.2671	552
Ta’if	C−	Saudi Arabia	0.3224	444	0.2583	605
Beirut	C	Lebanon	0.3219	445	0.3659	246
Durban	C−	South Africa	0.3216	446	0.2374	745
Bengbu	C−	China	0.3212	447	0.2740	499
Zigong	C−	China	0.3212	448	0.2310	785
Guayaquil	C−	Ecuador	0.3209	449	0.2532	645
Jiujiang	C−	China	0.3208	450	0.2884	414
Shangrao	D	China	0.3188	451	0.2600	594
Jingmen	C−	China	0.3185	452	0.2413	726
Pingxiang	C−	China	0.3181	453	0.2352	759

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Balikpapan	C−	Indonesia	0.3180	454	0.2405	731
Bandung	C−	Indonesia	0.3176	455	0.3000	370
Liupanshui	C−	China	0.3172	456	0.2301	793
San Salvador	D	El Salvador	0.3157	457	0.2423	717
Perm	C−	Russia	0.3157	458	0.2683	546
Anyang	D	China	0.3153	459	0.2820	450
Xining	C−	China	0.3139	460	0.2575	611
Saltillo	C−	Mexico	0.3135	461	0.2476	686
Sevilla	C−	Spain	0.3122	462	0.3706	241
Hebi	C−	China	0.3115	463	0.2450	704
Liaoyang	C−	China	0.3115	464	0.2357	758
Juarez	C−	Mexico	0.3110	465	0.2542	637
Londrina	C−	Brazil	0.3109	466	0.2404	733
Colombo	C−	Sri Lanka	0.3091	467	0.3116	345
Yichun(Jx)	D	China	0.3087	468	0.2587	599
Sanya	C−	China	0.3085	469	0.3060	358
Benxi	C−	China	0.3082	470	0.2531	647
Cartagena	D	Colombia	0.3082	471	0.2573	614
Ho Chi Minh City	C	Vietnam	0.3071	472	0.3793	226
Belgrade	C−	Serbia	0.3069	473	0.3638	252
Tehran	C−	Iran	0.3059	474	0.2950	385
Anshan	D	China	0.3058	475	0.2526	653
Jilin	C−	China	0.3055	476	0.2933	395

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Liaoyuan	C−	China	0.3051	477	0.2135	854
Ziyang	C−	China	0.3051	478	0.2827	444
Luohe	D	China	0.3039	479	0.2008	887
Aguascalientes	C−	Mexico	0.3032	480	0.2701	530
Guilin	C−	China	0.3032	481	0.2768	481
Karachi	C	Pakistan	0.3027	482	0.2711	521
Baoding	D	China	0.3024	483	0.2884	415
Songyuan	D	China	0.3013	484	0.2668	555
Quzhou	C−	China	0.3006	485	0.2441	709
Denizli	C−	Turkey	0.3001	486	0.2627	580
Loudi	C−	China	0.2999	487	0.2499	669
Belem	C−	Brazil	0.2998	488	0.1641	956
Zhoukou	D	China	0.2996	489	0.2573	613
Huainan	C−	China	0.2993	490	0.2599	595
Nanyang	D	China	0.2992	491	0.2882	416
Hanoi	C	Vietnam	0.2989	492	0.3741	234
Villavicencio	C−	Colombia	0.2981	493	0.2256	816
Fangchenggang	C−	China	0.2976	494	0.2495	675
Ganzhou	C−	China	0.2974	495	0.2998	372
Sanmenxia	D	China	0.2971	496	0.2178	838
Xiaogan	D	China	0.2965	497	0.2772	479
Neijiang	C−	China	0.2962	498	0.2113	857
Yuxi	C−	China	0.2952	499	0.2796	464

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Uberlandia	C−	Brazil	0.2948	500	0.1860	919
Algiers	C−	Algeria	0.2945	501	0.2411	728
Mianyang	C−	China	0.2942	502	0.2813	454
Semarang	D	Indonesia	0.2939	503	0.2512	663
Manaus	C−	Brazil	0.2936	504	0.1967	897
Yibin	C−	China	0.2934	505	0.2544	635
Yaroslavl	D	Russia	0.2932	506	0.2533	643
Coimbatore	D	India	0.2931	507	0.3267	318
Chaozhou	D	China	0.2925	508	0.2932	396
Phnom Penh	C−	Cambodia	0.2924	509	0.2943	389
Owerri	C−	Nigeria	0.2921	510	0.1001	1021
Concepcion	C−	Chile	0.2915	511	0.2641	573
Tunis	C−	Tunisia	0.2912	512	0.3541	270
Xinyang	C−	China	0.2905	513	0.2723	509
Leshan	C−	China	0.2905	514	0.2319	778
Laiwu	C−	China	0.2899	515	0.2344	763
Jingzhou	C−	China	0.2892	516	0.2605	590
Fushun	C−	China	0.2892	517	0.2663	557
Goiania	C−	Brazil	0.2890	518	0.1922	906
Xianning	D	China	0.2886	519	0.2849	431
Tbilisi	D	Georgia	0.2885	520	0.3556	267
Daqing	C−	China	0.2885	521	0.2864	426
Jinzhou	C−	China	0.2879	522	0.2762	485

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Kochi	D	India	0.2875	523	0.3159	335
Jingdezhen	C−	China	0.2874	524	0.2562	623
Kolkata	C−	India	0.2871	525	0.3126	343
Tolyatti	C−	Russia	0.2867	526	0.2493	677
Huaibei	C−	China	0.2862	527	0.2780	476
Pune	C−	India	0.2861	528	0.3458	287
Luzhou	C−	China	0.2860	529	0.2462	696
Nanping	D	China	0.2859	530	0.2544	636
Reynosa	C−	Mexico	0.2853	531	0.2419	719
La Plata	C−	Argentina	0.2850	532	0.2821	447
Zhumadian	D	China	0.2847	533	0.2265	812
Yiyang	C−	China	0.2841	534	0.2686	540
Meishan	C−	China	0.2837	535	0.2405	732
Tongliao	C−	China	0.2835	536	0.2603	592
Makassar	C−	Indonesia	0.2834	537	0.2532	646
Uyo	C−	Nigeria	0.2832	538	0.1157	1008
Shangqiu	D	China	0.2828	539	0.2710	522
Pingdingshan	D	China	0.2819	540	0.2557	626
Culiacan	C−	Mexico	0.2818	541	0.2578	609
Karamay	C−	China	0.2812	542	0.1889	913
Gaziantep	C−	Turkey	0.2812	543	0.2660	559
Gaza	D	Palestine	0.2807	544	0.2323	775
Chuzhou	D	China	0.2806	545	0.2685	544

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Aba	D	Nigeria	0.2803	546	0.1196	1004
Hyderabad	C−	India	0.2798	547	0.3536	271
Arequipa	D	Peru	0.2797	548	0.2084	867
Alexandria	C−	Egypt	0.2796	549	0.3223	326
Trujillo	C−	Peru	0.2793	550	0.2488	681
Palembang	D	Indonesia	0.2789	551	0.2785	471
Weinan	D	China	0.2788	552	0.2468	694
Guangan	C−	China	0.2782	553	0.2234	822
Saratov	D	Russia	0.2780	554	0.2737	500
Malappuram	D	India	0.2779	555	0.2583	604
Mersin	C−	Turkey	0.2779	556	0.2903	409
Qinhuangdao	C−	China	0.2772	557	0.3029	368
Lishui	D	China	0.2762	558	0.2835	439
Port Elizabeth	D	South Africa	0.2757	559	0.1836	924
Ahmedabad	C−	India	0.2744	560	0.2973	377
Warri	C−	Nigeria	0.2739	561	0.1525	968
Nanchong	C−	China	0.2733	562	0.2685	543
Abuja	C−	Nigeria	0.2732	563	0.1250	1001
Huanggang	D	China	0.2724	564	0.3081	352
Wuzhou	C−	China	0.2710	565	0.2574	612
Jincheng	D	China	0.2707	566	0.2691	538
Shizuishan	C−	China	0.2704	567	0.2490	680
Barnaul	D	Russia	0.2701	568	0.2192	834

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Ikorodu	D	Nigeria	0.2693	569	0.1513	969
Veracruz	C−	Mexico	0.2683	570	0.2527	651
Siping	D	China	0.2681	571	0.2728	506
Suining	C−	China	0.2672	572	0.2448	705
Medan	C−	Indonesia	0.2667	573	0.2848	432
Yulin(Gx)	D	China	0.2662	574	0.2676	549
Fortaleza	D	Brazil	0.2658	575	0.1627	958
Shiyan	C−	China	0.2658	576	0.2818	451
Sao Luis	C−	Brazil	0.2656	577	0.1493	972
Xuancheng	D	China	0.2646	578	0.2612	589
Port Said	D	Egypt	0.2644	579	0.2441	710
Tegucigalpa	C−	Honduras	0.2633	580	0.1947	902
Krasnodar	C−	Russia	0.2632	581	0.2680	547
Hermosillo	C−	Mexico	0.2632	582	0.2963	378
San Pedro Sula	D	Honduras	0.2628	583	0.1742	941
Puebla	C−	Mexico	0.2619	584	0.2878	418
Chihuahua	C−	Mexico	0.2618	585	0.2456	699
Xingtai	D	China	0.2613	586	0.2468	693
Lahore	D	Pakistan	0.2610	587	0.2648	570
Mudanjiang	D	China	0.2610	588	0.2477	685
Shaoguan	C−	China	0.2606	589	0.2801	463
Santa Cruz	C−	Bolivia	0.2603	590	0.2795	465
Suzhou (Ah)	C−	China	0.2598	591	0.2616	584

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Cochabamba	D	Bolivia	0.2596	592	0.1433	981
Tonghua	C–	China	0.2596	593	0.2366	751
Kampala	D	Uganda	0.2595	594	0.1347	992
Hengshui	D	China	0.2592	595	0.2701	529
Kano	D	Nigeria	0.2590	596	0.1148	1009
Shuozhou	C–	China	0.2587	597	0.2665	556
Maturín	C–	Venezuela	0.2580	598	0.1863	917
Zaria	D	Nigeria	0.2576	599	0.1532	967
Chifeng	C–	China	0.2572	600	0.2701	527
Juiz De Fora	D	Brazil	0.2560	601	0.1929	905
Suizhou	C–	China	0.2560	602	0.2216	824
Sulaymaniyah	C–	Iraq	0.2560	603	0.2038	877
Yangquan	C–	China	0.2551	604	0.2270	810
Xalapa	C–	Mexico	0.2550	605	0.2614	588
Yongzhou	C–	China	0.2549	606	0.2438	711
Pachuca	C–	Mexico	0.2544	607	0.2750	490
Tomsk	C–	Russia	0.2542	608	0.2201	828
Qujing	C–	China	0.2528	609	0.2445	706
Shiraz	D	Iran	0.2525	610	0.2474	688
Cuernavaca	C–	Mexico	0.2521	611	0.2650	568
Ibadan	D	Nigeria	0.2516	612	0.1555	963
Celaya	C–	Mexico	0.2511	613	0.2501	668
Padang	D	Indonesia	0.2506	614	0.2553	628

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Ryazan	D	Russia	0.2505	615	0.2896	411
Qinzhou	C−	China	0.2490	616	0.2741	497
Chittagong	C−	Bangladesh	0.2481	617	0.2469	691
Kiev	C−	Ukraine	0.2475	618	0.3405	295
Kazan	C−	Russia	0.2473	619	0.2898	410
Khartoum	D	Sudan	0.2464	620	0.2110	858
Shymkent	D	Kazakhstan	0.2451	621	0.2549	631
Bucaramanga	C−	Colombia	0.2450	622	0.2631	578
Jiayuguan	D	China	0.2447	623	0.2088	865
Dazhou	D	China	0.2446	624	0.2370	749
Kemerovo	D	Russia	0.2438	625	0.1920	907
Kozhikode	D	India	0.2424	626	0.2673	551
Hanzhong	D	China	0.2412	627	0.2283	805
Emfuleni	D	South Africa	0.2411	628	0.1847	921
Can Tho	D	Vietnam	0.2405	629	0.3046	364
Orenburg	D	Russia	0.2404	630	0.2560	624
Cebu	D	Philippines	0.2402	631	0.3089	350
Anqing	D	China	0.2402	632	0.2822	446
Huaihua	D	China	0.2398	633	0.2298	796
Shanwei	D	China	0.2381	634	0.3026	369
Shaoyang	D	China	0.2378	635	0.2362	755
Changzhi	D	China	0.2374	636	0.2786	469
Kollam	D	India	0.2373	637	0.2874	422

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Datong	C−	China	0.2372	638	0.2756	488
Chengde	D	China	0.2365	639	0.2698	534
Dandong	D	China	0.2363	640	0.2545	633
Yunfu	D	China	0.2360	641	0.2669	554
Malang	D	Indonesia	0.2359	642	0.2491	678
Pereira	D	Colombia	0.2353	643	0.2291	799
Chizhou	C−	China	0.2342	644	0.2525	655
Irkutsk	C−	Russia	0.2334	645	0.2511	664
Puducherry	D	India	0.2331	646	0.2656	561
Anshun	D	China	0.2331	647	0.2380	740
Casablanca	C−	Morocco	0.2330	648	0.3506	275
Yan'an	D	China	0.2330	649	0.2782	474
Ulaanbaatar	C−	Mongolia	0.2330	650	0.2304	790
Tabriz	D	Iran	0.2328	651	0.2534	642
Barranquilla	C−	Colombia	0.2327	652	0.2563	622
Joao Pessoa	D	Brazil	0.2323	653	0.1347	993
Baishan	C−	China	0.2319	654	0.2259	815
Fuyang	C−	China	0.2312	655	0.2593	598
Dehra Dun	D	India	0.2311	656	0.1937	904
Florianopolis	C−	Brazil	0.2300	657	0.2272	807
Tongchuan	C−	China	0.2288	658	0.1949	901
Ji'an	D	China	0.2286	659	0.2717	513
Teresina	D	Brazil	0.2286	660	0.1379	988

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Barquisimeto	C–	Venezuela	0.2280	661	0.1067	1019
Cuiaba	D	Brazil	0.2279	662	0.1661	954
Bhiwandi	D	India	0.2267	663	0.2905	407
Bozhou	D	China	0.2260	664	0.2382	739
Feira De Santana	D	Brazil	0.2256	665	0.1390	986
Huangshan	C–	China	0.2251	666	0.2847	433
Enugu	D	Nigeria	0.2247	667	0.1205	1003
Campo Grande	D	Brazil	0.2243	668	0.2000	893
Konya	C–	Turkey	0.2240	669	0.3045	365
Port-Au-Prince	C–	Haiti	0.2233	670	0.1289	996
Mexicali	C–	Mexico	0.2229	671	0.2635	575
Davao	D	Philippines	0.2223	672	0.2940	390
Jinzhong	D	China	0.2221	673	0.2527	650
Ankang	D	China	0.2200	674	0.2342	766
Acapulco	D	Mexico	0.2193	675	0.2228	823
Cagayan De Oro	D	Philippines	0.2191	676	0.2496	672
Denpasar	D	Indonesia	0.2184	677	0.2717	515
Astrakhan'	D	Russia	0.2182	678	0.1954	900
Kannur	D	India	0.2182	679	0.2579	608
Suihua	D	China	0.2181	680	0.2360	756
Oshogbo	D	Nigeria	0.2168	681	0.1394	985
Zhangjiakou	D	China	0.2164	682	0.2764	483
Hulunbuir	D	China	0.2160	683	0.2383	738

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Yuncheng	D	China	0.2158	684	0.2834	440
Kayseri	D	Turkey	0.2156	685	0.2879	417
Haiphong	D	Vietnam	0.2153	686	0.2847	434
General Santos City	D	Philippines	0.2147	687	0.2733	504
Managua	C−	Nicaragua	0.2146	688	0.2720	511
Poza Rica	C−	Mexico	0.2142	689	0.2097	862
Mashhad	D	Iran	0.2141	690	0.2805	459
Da Nang	D	Vietnam	0.2140	691	0.3065	357
Libreville	C−	Gabon	0.2137	692	0.2347	760
Heyuan	C−	China	0.2136	693	0.2838	437
Chongzuo	D	China	0.2132	694	0.2167	844
Morelia	C−	Mexico	0.2131	695	0.2557	627
Khabarovsk	C−	Russia	0.2131	696	0.2471	690
Eskisehir	D	Turkey	0.2130	697	0.3254	320
Jos	D	Nigeria	0.2122	698	0.0950	1023
Diyarbakir	C−	Turkey	0.2122	699	0.2525	654
Thrissur	D	India	0.2120	700	0.2621	582
Ibague	C−	Colombia	0.2117	701	0.2369	750
Qingyuan	C−	China	0.2115	702	0.3145	338
Abidjan	C−	Cote D'ivoire	0.2112	703	0.2443	707
Accra	D	Ghana	0.2108	704	0.2673	550
Kingston	D	Jamaica	0.2105	705	0.3377	299
Meizhou	D	China	0.2077	706	0.2866	424

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Thiruvananthapuram	D	India	0.2075	707	0.2917	400
Guigang	D	China	0.2074	708	0.2417	722
Huludao	D	China	0.2062	709	0.2136	852
Cucuta	D	Colombia	0.2055	710	0.2304	791
Marrakech	C−	Morocco	0.2049	711	0.3055	360
Baise	D	China	0.2046	712	0.2319	776
Linfen	D	China	0.2042	713	0.2711	520
Tampico	C−	Mexico	0.2042	714	0.2385	737
Ludhiana	D	India	0.2041	715	0.2300	794
Surat	C−	India	0.2032	716	0.3510	274
Novosibirsk	C−	Russia	0.2031	717	0.2536	641
Kota	D	India	0.2022	718	0.2722	510
Huambo	D	Angola	0.2022	719	0.0869	1026
Nagpur	D	India	0.2016	720	0.2820	449
Zhangjiajie	D	China	0.2011	721	0.2294	797
Shangluo	D	China	0.2001	722	0.2287	803
Rostov	C−	Russia	0.1999	723	0.2184	837
Jiamusi	C−	China	0.1999	724	0.2109	859
Mombasa	D	Kenya	0.1999	725	0.1385	987
Ulanqab	D	China	0.1994	726	0.2527	652
Visakhapatnam	D	India	0.1990	727	0.2988	375
Fuzhou(Jx)	D	China	0.1988	728	0.2551	629
Baicheng	D	China	0.1985	729	0.2291	800

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Novokuznetsk	C−	Russia	0.1982	730	0.2036	878
Hamadan	D	Iran	0.1976	731	0.2146	850
Chisinau	D	Moldova	0.1975	732	0.3221	327
Krasnoyarsk	C−	Russia	0.1970	733	0.2436	712
Rajshahi	D	Bangladesh	0.1968	734	0.2278	806
Ya’an	D	China	0.1967	735	0.2542	638
Tangier	C−	Morocco	0.1964	736	0.2925	398
Sanliurfa	D	Turkey	0.1963	737	0.2160	847
Oaxaca	D	Mexico	0.1963	738	0.2583	603
Asansol	D	India	0.1960	739	0.2135	853
Bayannur	C−	China	0.1960	740	0.2206	826
Akure	D	Nigeria	0.1958	741	0.1263	998
Qiqihar	D	China	0.1958	742	0.2662	558
Fuxin	C−	China	0.1941	743	0.2572	615
Chaoyang	D	China	0.1929	744	0.3150	337
Tlaxcala	C−	Mexico	0.1923	745	0.2580	607
La Paz	C−	Bolivia	0.1922	746	0.1857	920
Izhevsk	D	Russia	0.1921	747	0.2436	713
Rabat	C−	Morocco	0.1920	748	0.3366	300
Meknes	C−	Morocco	0.1918	749	0.2919	399
Kitwe	D	Zambia	0.1911	750	0.1549	964
Liuan	C−	China	0.1901	751	0.2522	659
Tiruppur	D	India	0.1897	752	0.2632	577

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Nizhny Novgorod	D	Russia	0.1895	753	0.2690	539
Guangyuan	C–	China	0.1892	754	0.2498	670
Tasikmalaya	D	Indonesia	0.1872	755	0.2617	583
Pointe-Noire	D	Congo-Brazzaville	0.1866	756	0.1077	1017
Harare	C–	Zimbabwe	0.1860	757	0.1860	918
Chiclayo	D	Peru	0.1857	758	0.2306	788
Kayamkulam	D	India	0.1851	759	0.2841	436
Madurai	D	India	0.1844	760	0.2928	397
Maceio	D	Brazil	0.1843	761	0.1192	1005
Durg-Bhilai Nagar	D	India	0.1843	762	0.2205	827
Tuxtla Gutierrez	C–	Mexico	0.1842	763	0.2102	861
Omsk	D	Russia	0.1839	764	0.2955	383
Patna	D	India	0.1836	765	0.2048	875
Aracaju	D	Brazil	0.1827	766	0.1246	1002
Nouakchott	D	Mauritania	0.1824	767	0.1563	961
Kabul	D	Afghanistan	0.1822	768	0.1402	983
Karbala	D	Iraq	0.1820	769	0.1546	966
Kirkuk	D	Iraq	0.1808	770	0.2059	872
Ciudad Guayana	C–	Venezuela	0.1801	771	0.1668	952
Namangan	D	Uzbekistan	0.1800	772	0.2407	730
Volgograd	C–	Russia	0.1798	773	0.2171	842
Laibin	D	China	0.1794	774	0.2539	640
Asmara	D	Eritrea	0.1790	775	0.1100	1014

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Douala	D	Cameroon	0.1786	776	0.2197	830
Guwahati	D	India	0.1786	777	0.2727	507
Qingyang	D	China	0.1783	778	0.2945	388
Bandar Lampung	D	Indonesia	0.1783	779	0.2495	673
Baoshan	D	China	0.1782	780	0.2836	438
Bacolod	D	Philippines	0.1778	781	0.2486	682
Chelyabinsk	D	Russia	0.1773	782	0.2313	781
Ilorin	D	Nigeria	0.1771	783	0.1164	1007
Jinchang	D	China	0.1770	784	0.2001	891
Wuzhong	D	China	0.1767	785	0.2342	767
Mangalore	D	India	0.1763	786	0.2812	455
Hezhou	D	China	0.1755	787	0.2594	597
Rajkot	D	India	0.1749	788	0.2845	435
Bogor	D	Indonesia	0.1745	789	0.2719	512
Jalandhar	D	India	0.1742	790	0.2192	833
Dar Es Salaam	D	Tanzania	0.1734	791	0.1744	940
Jodhpur	D	India	0.1727	792	0.2431	715
Brazzaville	D	Congo-Brazzaville	0.1726	793	0.0678	1028
Mosul	C−	Iraq	0.1723	794	0.2103	860
Voronezh	D	Russia	0.1714	795	0.2453	702
Basra	D	Iraq	0.1712	796	0.1427	982
Vladivostok	C−	Russia	0.1709	797	0.2691	537
Krivoi Rog	D	Ukraine	0.1703	798	0.2762	484

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Tieling	D	China	0.1703	799	0.2378	742
Zamboanga	D	Philippines	0.1700	800	0.2635	574
Xinzhou	D	China	0.1699	801	0.2915	401
Santa Marta	D	Colombia	0.1699	802	0.2289	801
Luliang	D	China	0.1697	803	0.2781	475
Amritsar	D	India	0.1694	804	0.2193	832
Zhongwei	D	China	0.1688	805	0.2323	774
Bahawalpur	D	Pakistan	0.1678	806	0.2115	856
Tianshui	C–	China	0.1676	807	0.2533	644
Kathmandu	D	Nepal	0.1669	808	0.2427	716
Tashkent	D	Uzbekistan	0.1666	809	0.2912	404
Fes	D	Morocco	0.1662	810	0.2937	391
Natal	D	Brazil	0.1661	811	0.1753	939
Vijayawada	C–	India	0.1656	812	0.2949	386
Vientiane	D	Laos	0.1656	813	0.2364	753
Erode	D	India	0.1655	814	0.2801	462
Hyderabad	C–	Pakistan	0.1654	815	0.2548	632
Lincang	D	China	0.1650	816	0.2343	765
Faisalabad	D	Pakistan	0.1646	817	0.2422	718
Orumiyeh	D	Iran	0.1633	818	0.2580	606
Jamnagar	D	India	0.1632	819	0.2704	525
Onitsha	D	Nigeria	0.1632	820	0.0866	1027
Jaipur	D	India	0.1625	821	0.2481	684

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Safaqis	D	Tunisia	0.1621	822	0.2714	517
Salvador	D	Brazil	0.1619	823	0.1898	911
Raurkela	D	India	0.1602	824	0.2615	587
Kaduna	D	Nigeria	0.1600	825	0.0936	1024
Siliguri	D	India	0.1584	826	0.2458	698
Bazhong	D	China	0.1582	827	0.2311	784
Salem	D	India	0.1577	828	0.3171	332
Jambi	D	Indonesia	0.1577	829	0.2545	634
Zhaotong	D	China	0.1575	830	0.2397	735
Yekaterinburg	C−	Russia	0.1572	831	0.2289	802
Tiruchirappalli	D	India	0.1567	832	0.2454	701
Jixi	D	China	0.1566	833	0.2013	885
Tirupati	D	India	0.1549	834	0.2670	553
Kolhapur	D	India	0.1545	835	0.2541	639
Nasiriyah	D	Iraq	0.1541	836	0.1464	976
Bhubaneswar	D	India	0.1535	837	0.3050	361
Misratah	D	Libya	0.1534	838	0.1493	973
Baiyin	D	China	0.1530	839	0.2314	780
Sylhet	D	Bangladesh	0.1530	840	0.2189	835
Rasht	D	Iran	0.1527	841	0.2305	789
Nasik	D	India	0.1526	842	0.2584	602
Ulyanovsk	D	Russia	0.1523	843	0.2724	508
Meerut	D	India	0.1518	844	0.2306	787

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Dakar	D	Senegal	0.1516	845	0.1842	922
Islamabad	C−	Pakistan	0.1511	846	0.2568	618
Gwalior	D	India	0.1504	847	0.1637	957
Makhachkala	D	Russia	0.1494	848	0.2177	839
Jamshedpur	D	India	0.1483	849	0.2685	545
Kumasi	D	Ghana	0.1482	850	0.2459	697
Rangoon	C−	Myanmar	0.1466	851	0.1451	978
Najaf	D	Iraq	0.1462	852	0.1775	931
Agadir	D	Morocco	0.1458	853	0.2947	387
Lucknow	D	India	0.1458	854	0.2358	757
Kinshasa	D	Congo-Kinshasa	0.1457	855	0.0165	1033
Rawalpindi	D	Pakistan	0.1454	856	0.2036	879
Pu’er	D	China	0.1444	857	0.2343	764
Indore	D	India	0.1439	858	0.2254	817
Vellore	D	India	0.1432	859	0.2804	460
Wuwei	C−	China	0.1431	860	0.2414	725
Kigali	D	Rwanda	0.1431	861	0.1548	965
Shuangyashan	D	China	0.1423	862	0.2054	873
Pingliang	D	China	0.1415	863	0.2434	714
Cherthala	D	India	0.1413	864	0.2716	516
Sokoto	D	Nigeria	0.1412	865	0.1558	962
Zhangye	D	China	0.1411	866	0.2147	849
Latakia	D	Syria	0.1408	867	0.1771	934

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Kurnool	D	India	0.1408	868	0.2418	721
Tabuk	C–	Saudi Arabia	0.1404	869	0.2558	625
Lijiang	D	China	0.1397	870	0.2853	430
Athens	C–	Greece	0.1393	871	0.4513	119
Lome	D	Togo	0.1390	872	0.1709	946
Mysore	D	India	0.1381	873	0.2745	494
Lusaka	D	Zambia	0.1377	874	0.1678	951
Yingtan	D	China	0.1373	875	0.2378	743
Freetown	D	Sierra Leone	0.1369	876	0.2363	754
Khulna	D	Bangladesh	0.1364	877	0.2166	845
Bhopal	D	India	0.1364	878	0.2443	708
Aurangabad	D	India	0.1361	879	0.3082	351
Gujranwala	D	Pakistan	0.1359	880	0.2079	868
Suez	D	Egypt	0.1358	881	0.2308	786
Chandigarh	D	India	0.1356	882	0.2655	562
Sialkot	D	Pakistan	0.1352	883	0.2030	881
Sangli	D	India	0.1348	884	0.2509	667
Hechi	D	China	0.1347	885	0.2194	831
Maiduguri	D	Nigeria	0.1347	886	0.1076	1018
Banjarmasin	D	Indonesia	0.1343	887	0.2578	610
Bokaro Steel City	D	India	0.1339	888	0.2370	748
Peshawar	D	Pakistan	0.1339	889	0.2197	829
Vadodara	D	India	0.1337	890	0.3079	354

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Srinagar	D	India	0.1317	891	0.2300	795
Hegang	D	China	0.1309	892	0.1501	971
Qitaihe	D	China	0.1309	893	0.1772	933
Sana‘a’	D	Yemen	0.1303	894	0.1729	943
Sekondi Takoradi	D	Ghana	0.1298	895	0.2271	809
Qom	D	Iran	0.1294	896	0.2172	841
Imphal	D	India	0.1293	897	0.2513	662
Esfahan	D	Iran	0.1291	898	0.2704	526
Yerevan	D	Armenia	0.1291	899	0.3575	266
Guntur	D	India	0.1289	900	0.2714	518
Warangal	D	India	0.1287	901	0.2913	403
Ranchi	D	India	0.1286	902	0.2333	771
Heihe	D	China	0.1286	903	0.2096	863
Saharanpur	D	India	0.1282	904	0.2068	870
Bien Hoa	D	Vietnam	0.1272	905	0.3092	348
Hubli-Dharwad	D	India	0.1267	906	0.2451	703
Aden	D	Yemen	0.1241	907	0.2212	825
Damascus	D	Syria	0.1240	908	0.1892	912
Pontianak	D	Indonesia	0.1236	909	0.2455	700
Bogra	D	Bangladesh	0.1233	910	0.2002	890
Nyala	D	Sudan	0.1221	911	0.1272	997
Sukkur	D	Pakistan	0.1221	912	0.1835	925
Bhavnagar	D	India	0.1220	913	0.2497	671

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Kerman	C–	Iran	0.1209	914	0.2615	586
Hamah	D	Syria	0.1203	915	0.2068	871
Varanasi	D	India	0.1196	916	0.2475	687
Solapur	D	India	0.1195	917	0.2737	501
Guyuan	D	China	0.1178	918	0.2414	724
Salta	C–	Argentina	0.1174	919	0.2073	869
Durango	C–	Mexico	0.1167	920	0.2680	548
Lubumbashi	D	Congo-Kinshasa	0.1166	921	0.0562	1029
Niamey	D	Niger	0.1148	922	0.1874	916
Dhanbad	D	India	0.1129	923	0.2272	808
Ardabil	D	Iran	0.1129	924	0.2482	683
Agra	D	India	0.1129	925	0.2041	876
Jabalpur	D	India	0.1128	926	0.2571	616
Cuttack	D	India	0.1127	927	0.2753	489
Amravati	D	India	0.1126	928	0.2734	503
Malegaon	D	India	0.1119	929	0.2603	591
Nellore	D	India	0.1116	930	0.2584	600
Multan	D	Pakistan	0.1110	931	0.2261	814
Addis Ababa	D	Ethiopia	0.1104	932	0.2551	630
Al-Raqqa	D	Syria	0.1103	933	0.1359	990
Jiuquan	D	China	0.1102	934	0.2139	851
Zanzibar	D	Tanzania	0.1102	935	0.1508	970
Donetsk	D	Ukraine	0.1095	936	0.2365	752

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Dingxi	D	China	0.1090	937	0.2651	566
Ujjain	D	India	0.1089	938	0.2243	820
Aligarh	D	India	0.1082	939	0.2000	892
Yazd	D	Iran	0.1076	940	0.2302	792
Kermanshah	D	Iran	0.1073	941	0.2123	855
Bareilly	D	India	0.1073	942	0.2086	866
Moradabad	D	India	0.1064	943	0.2188	836
Longnan	D	China	0.1060	944	0.2409	729
Kanpur	D	India	0.1057	945	0.2267	811
Nnewi	D	Nigeria	0.1045	946	0.1004	1020
Tirunelveli	D	India	0.1023	947	0.2744	495
Yichun(Hlj)	D	China	0.1015	948	0.1838	923
Mwanza	D	Tanzania	0.0998	949	0.1879	914
Quetta	D	Pakistan	0.0995	950	0.1913	909
Ajmer	D	India	0.0991	951	0.2246	818
Nanded	D	India	0.0989	952	0.2685	542
Allahabad	D	India	0.0986	953	0.1712	945
Belgaum	D	India	0.0982	954	0.2401	734
Firozabad	D	India	0.0959	955	0.1804	928
Bulawayo	D	Zimbabwe	0.0951	956	0.1474	975
Muzaffarnagar	D	India	0.0938	957	0.1707	947
Cotonou	D	Benin	0.0937	958	0.1961	898
Mogadishu	D	Somalia	0.0924	959	0.1312	995

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Mathura	D	India	0.0915	960	0.2528	649
Jhansi	D	India	0.0904	961	0.2293	798
Jammu	D	India	0.0903	962	0.2372	747
Gulbarga	D	India	0.0900	963	0.2794	466
Durgapur	D	India	0.0875	964	0.2602	593
Blantyre	C−	Malawi	0.0869	965	0.1691	949
Bishkek	D	Kyrgyzstan	0.0859	966	0.2014	884
Lvov	C−	Ukraine	0.0839	967	0.2736	502
Dnipropetrovsk	D	Ukraine	0.0829	968	0.2510	665
Zaporizhzhya	D	Ukraine	0.0827	969	0.2319	777
Yaounde	D	Cameroon	0.0824	970	0.2050	874
Kharkov	D	Ukraine	0.0815	971	0.2649	569
Nay Pyi Taw	D	Myanmar	0.0802	972	0.1128	1012
Hargeysa	D	Somalia	0.0769	973	0.1620	959
Odesa	D	Ukraine	0.0761	974	0.2793	467
Bouake	D	Cote D'ivoire	0.0731	975	0.2011	886
Benghazi	D	Libya	0.0727	976	0.1098	1015
Mandalay	D	Myanmar	0.0721	977	0.1335	994
Ouagadougou	D	Burkina Faso	0.0718	978	0.1877	915
Djibouti	D	Djibouti	0.0716	979	0.1434	980
Matola	D	Mozambique	0.0709	980	0.1799	929
Zahedan	D	Iran	0.0701	981	0.1656	955
Bikaner	D	India	0.0688	982	0.2566	619

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Lilongwe	D	Malawi	0.0670	983	0.1148	1010
Maputo	D	Mozambique	0.0645	984	0.1758	938
Sargodha	D	Pakistan	0.0644	985	0.2003	889
Abomey-Calavi	D	Benin	0.0634	986	0.1956	899
Gorakhpur	D	India	0.0628	987	0.1915	908
Aleppo	D	Syria	0.0586	988	0.1480	974
Homs	D	Syria	0.0575	989	0.1774	932
Bamako	D	Mali	0.0563	990	0.1564	960
Tshikapa	D	Congo-Kinshasa	0.0559	991	0.0069	1034
Antananarivo	D	Madagascar	0.0551	992	0.1688	950
Taiz	D	Yemen	0.0524	993	0.2019	883
Dushanbe	C−	Tajikistan	0.0509	994	0.1717	944
Bujumbura	D	Burundi	0.0502	995	0.1086	1016
Raipur	D	India	0.0500	996	0.2334	770
Nampula	D	Mozambique	0.0489	997	0.1667	953
Monrovia	D	Liberia	0.0470	998	0.1359	991
Mbuji-Mayi	D	Congo-Kinshasa	0.0454	999	0.0214	1031
Hodeidah	D	Yemen	0.0441	1000	0.1793	930
Bobo Dioulasso	D	Burkina Faso	0.0436	1001	0.1811	927
Conakry	D	Guinea	0.0395	1002	0.1185	1006
Kananga	D	Congo-Kinshasa	0.0328	1003	0.0210	1032
Bukavu	D	Congo-Kinshasa	0.0233	1004	0.0000	1035
N'djamena	D	Chad	0.0052	1005	0.1108	1013

(continued)

Table 1.1 (continued)

Metropolitan area	Metropolitan area level	Country/Area	Economic competitiveness index	Rank	Sustainable competitiveness index	Rank
Bangui	D	Central African Republic	0.0036	1006	0.1256	999
Kisangani	D	Congo-Kinshasa	0.0000	1007	0.0456	1030

Chapter 2
Reviews of Global Urban Competitiveness 2017–2018 Driving Force, Agglomeration, Connectivity and the New Global City

Pengfei Ni, Marco Kamiya, Li Shen, Weijin Gong and Haidong Xu

At present, 54% of the world's population lives in cities and the global urbanization process is accelerating. According to the latest United Nations report, it is expected that the proportion of urban population in the world will set a record of 66% by 2050. With an unprecedented wave of urbanization, the city's victory is becoming a living reality. The development of science and technology and economy has promoted the accelerated development of urbanization and the rapid rise of cities. The city has become an important carrier of global economy and scientific and technological activities. The development extent and link range of global science and technology and economy determine the development pattern and connection of global cities. Globalization, a result of economic and sci-tech development, is the fundamental driving force behind the formation of the global urban system, and the different stages of globalization are bound to different global urban systems. Along with the four stages of globalization—goods globalization, capital globalization, information globalization and talents globalization, the corresponding global urban systems and global cities are produced. Withal, Peter Hall, Friedman, Scott, Sassen and Peter Taylor have given definition and made analysis on global city from different angles. With over 20 years' development, the driving force of global city development shows new trend, and the link between global cities and the global urban pattern have undergone new changes, which has led to a great change in the connotation of global city. Based on the new changes that are taking place in the global urban system, after lucubrating from the four aspects of new driving force, new centralization, new connection and new global city, we have found that

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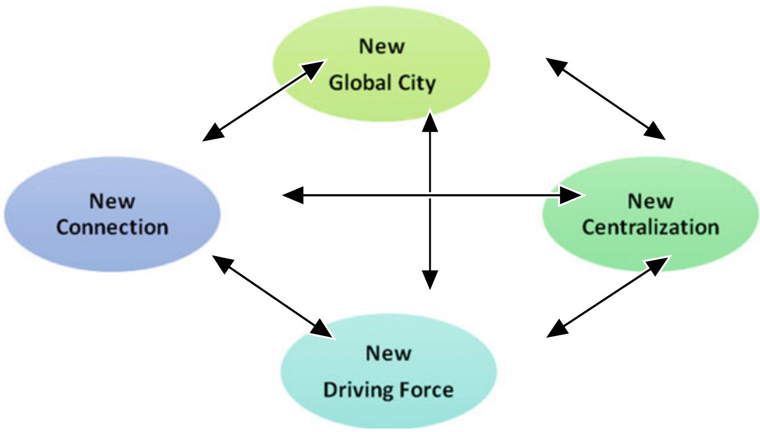

Fig. 2.1 Research framework

information technology is becoming the primary driving force of global urban development. It changes the connection between cities, re-shapes the cities' centralization, and thus creates new global cities. At the same time, the four aspects also interact with each other to create a new global urban system (see Fig. 2.1).

2.1 The Power of Reshaping the World of Cities

2.1.1 Basic Driving Force of Urban Development

Scientific and technological progress is an important source of urban development

In the long course of human history, scientific and technological progress plays a fundamental role in the development of human civilization. It is the primary driving force of human civilization changes, and the history of human civilization development is essentially a history of urban civilization development. Therefore, scientific and technological progress is also the primary driving force of urban development. Scientific and technological progress has greatly enhanced the city's development space, strengthened the link between cities, changed the fate of many cities, getting more and more cities involved in the international flow of goods, services, capital, manpower and ideology. As can be seen from Fig. 2.2, there is a strong correlation between science and technology innovation and average per capita income of a city, which indirectly illustrates the important role of science and technology in urban development.

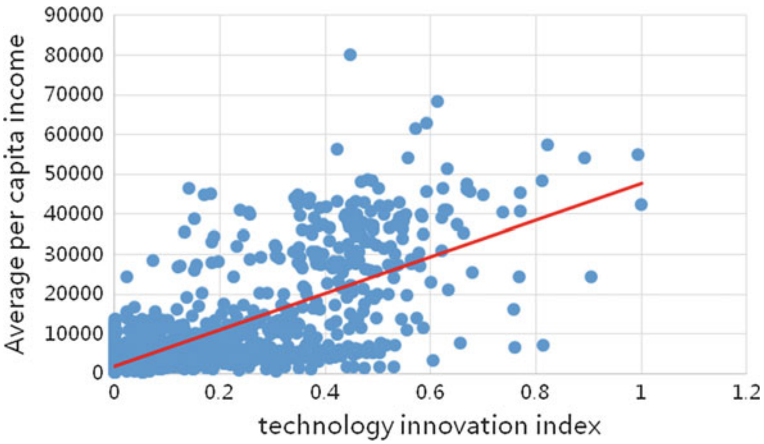

Fig. 2.2 The relationship between technology innovation and average per capita income of the city. *Data source* Global urban competitiveness database of CASS

From the current distribution of science and technology innovation centers, North America, Western Europe and East Asia are well-deserved centers of science and technology development. Half of the top 10 cities are in the United States, followed by East Asia which has 4 cities shortlisted, and Western Europe only has one city—London on the list, which reflects that the US cities are still far ahead in science and technology, East Asian cities are catching up, while Western European cities have a poor overall performance due to enormous challenges from the economy and society. As for a country or region to become a technology center, a strong economic strength is the foundation, a stable social environment is the prerequisite, and a relaxed cultural environment is the guarantee. Only with all the above conditions can a country or city gradually become a scientific and technological center (Fig. 2.3 and Table 2.1).

Viewing from the distribution of "unicorn enterprises" in the science and technology industry, there are 213 unlisted technology enterprises (i.e., unicorn enterprises) with value of assessment above USD100 million, and 8 cities with five or more unicorn enterprises. Specifically, San Francisco, Beijing and New York have 31, 28 and 16 unicorn enterprises respectively, ranking the top three. Among the eight cities, four cities are from China, three are from America, and one is from the UK. It indicates that America and China have become the world's two major sources of scientific and technological innovation (Table 2.2).

As can be seen from the transfer of science and technology center, technological revolution can greatly change the development track of a region, thus changing the pattern of global urban development. Japanese scholar Yuasa Mitsutomo found the transfer phenomenon of science and technology center in 1962. He believed that when the number of scientific and technological achievements and scientists in a region exceeds a quarter of the total number of scientists worldwide, the region was the

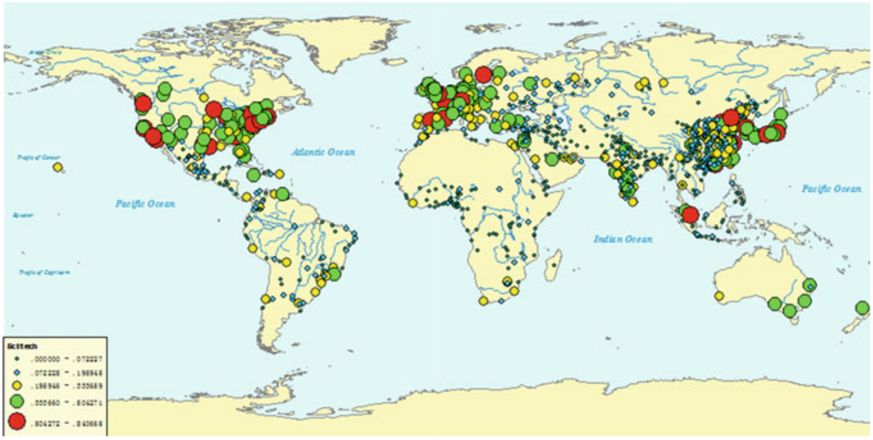

Fig. 2.3 Technology innovation. *Data source* Global urban competitiveness database of CASS

Table 2.1 Ranking of science and technology innovation index

Ranking	City	City name	Country
1	Tokyo	Tokyo	Japan
2	New York	New York	America
3	London	London	Britain
4	Beijing	Beijing	China
5	Boston	Boston	America
6	Seattle	Seattle	America
7	Singapore	Singapore	Singapore
8	Washington, D. C.	Washington, D. C.	America
9	Seoul	Seoul	South Korea
10	Philadelphia	Philadelphia	America

Data source Global urban competitiveness database of CASS

Table 2.2 Distribution of unicorn enterprises in the technology industry

Ranking	City	Number of unicorn enterprise
1	San Francisco	31
2	Beijing	28
3	New York	16
4	Shanghai	13
5	London	7
6	Palo Alto	6
7	Hangzhou	6
8	Shenzhen	5

Data source Global urban competitiveness database of CASS "science and technology center" of that time. From the historical point of view, there exists a regional transfer of the science and technology center. Along with the Renaissance movement, Italy became the world's first science and technology center. Following that, the UK, France, Germany had become the world's science and technology center successively. At present, the United States is still the undisputed world science and technology center, but with the revival of East Asian civilization, the world's science and technology center is tending to transfer to East Asia.

The most typical examples of cities being changed by science and technology are Bangalore, Tsukuba, San Francisco, etc. **Indian Bangalore** was an ordinary industrial and commercial city before the mid-20th century. However, since 1958, with the aggregating of information technology companies and government research institutions, it has gradually developed into the world's fifth largest information technology center, known as India's "Silicon Valley". Today's Bangalore has become India's richest and most dynamic city. **Tsukuba of Japan** is a small town located about 50 km northeast of Tokyo. It is also a city of scientific research, which was established by the government in 1968. It is now Japan's scientific research center, gathering 40% of Japan's scientific research institutions and accommodating University of Tsukuba and other world's top universities and many advanced scientific facilities, and is Japan's national strategy to challenge European and North American countries in the field of advanced technologies. **San Francisco Bay Area of America** was still a desolate place in the mid-19th century when people discovered gold there. Along with the exploitation of gold, the Bay Area gradually developed into a small city. But it is the era of information technology that really makes the Bay Area world famous. Information technology companies have sprung up, making San Francisco Bay Area the world's high-tech industry center, known as "Silicon Valley". Through these two examples we can clearly see that the progress of science and technology plays a vital role in the city's formation and development.

Financial capital is the key power in the development of modern city

Finance is the blood of modern economy, and the city is a product of modern economic development, therefore, it is no exaggeration to say that finance determines the height of a city's economic development and is important to city development. It can be seen from the diagram that the higher the financial index, the higher the per capita income, and there is a strong correlation between them, which implies the important role of Finance in promoting the urban development (Fig. 2.4).

As can be seen from the distribution of current major securities markets in the world, due to the existence of global financial market segmentation, the current world's financial system basically takes on the coexistence of several major global financial centers and regional financial centers. Up to now, there are 60 major stock exchanges in the world, with the stock market turnover accounting for 93% of the global trading volume. In these stock exchanges, there are 16 exchanges with the market value above USD1 trillion, accounting for 87% of the global market capitalization, and they constitute the "USD1 Trillion Club" of the stock market. They

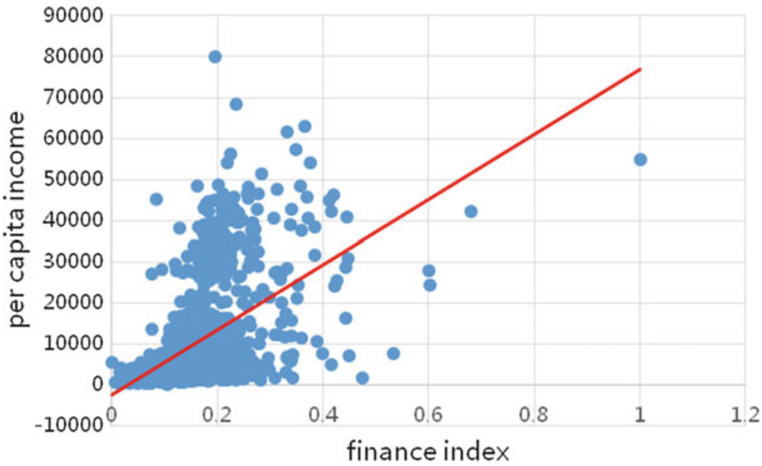

Fig. 2.4 The relationship between finance and urban per capita income. *Data source* Global urban competitiveness database of CASS

are mainly distributed in three regions: North America, Western Europe and East Asia. In North America, the market value of New York Stock Exchange (NYSE) has reached a staggering USD18.486 trillion, topping the list, followed by that of National Association of Securities Deal Automated Quotations (NASDAQ-US) and TMX Group, which is USD7.449 trillion and USD1.697 trillion respectively. In Western Europe, in terms of market capitalization, the top five exchanges are Euronext (USD3.379 trillion), London Stock Exchange (USD3.272 trillion), Deutsche Böerse (USD1.738 trillion), SIX Swiss Exchange (USD1.479 trillion), NASDAQ OMX Nordic Exchange (USD1.253 trillion). In East Asia, the total market value of Japan Exchange Group has reached USD4.9 trillion, ranking first in East Asia, followed by Shanghai Stock Exchange, Shenzhen Stock Exchange, and Hong Kong Exchanges and Clearing, with the market value of USD4.46 trillion, USD3.42 trillion, and USD3.17 trillion respectively (Fig. 2.5).

From the view of the transfer of global financial resources, at present, the center of the world economy continues to move eastward, basically forming a situation of the tripartite confrontation of North America, Western Europe, East Asia. Meanwhile, the three plates have formed their own financial center respectively, such as New York of North America, London of Western Europe, Tokyo and Hongkong in East Asia. In addition, many regions or countries also have their own financial centers, such as Shanghai of China, Mumbai of India, Singapore in Southeast Asia, Paris of France, Frankfurt of Germany, Toronto of Canada, Sydney of Australia. These global and regional financial center cities have formed a global financial system with clear structure and reasonable layout. But from a global perspective, such cities are very few, while most cities have a pretty low financial index which is nearly 0 (Fig. 2.6).

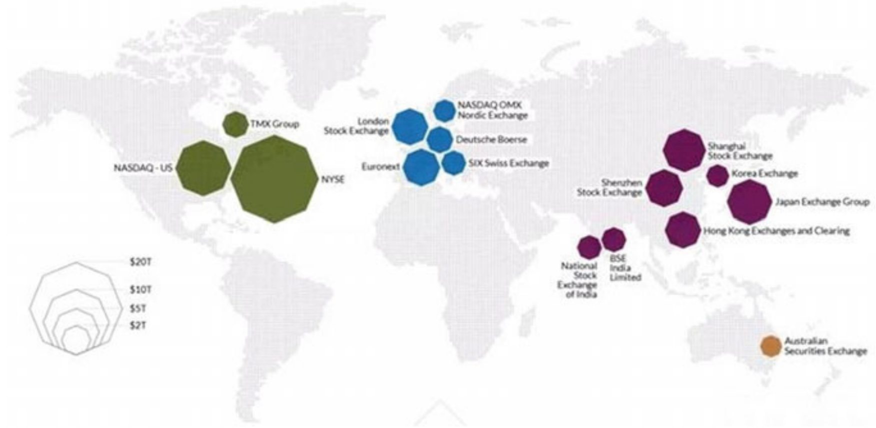

Fig. 2.5 Global distribution of major stock exchanges. *Data source* Visual Capitalist

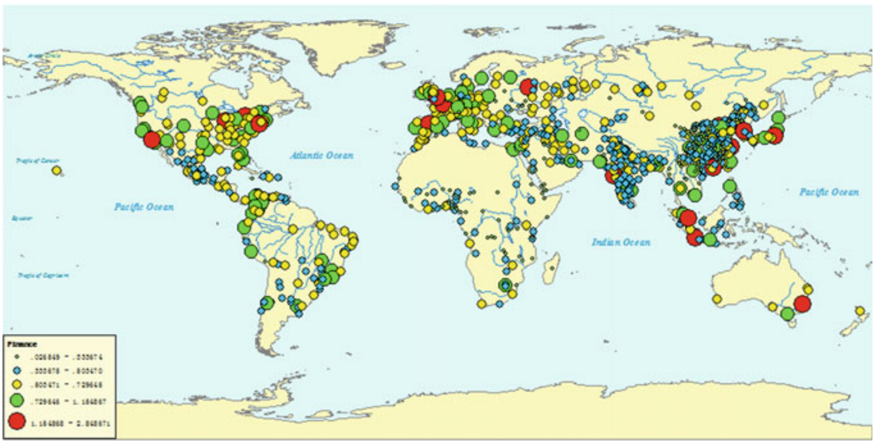

Fig. 2.6 Financial resources. *Data source* Global urban competitiveness database of CASS

Good climate and ecological environment is the precondition for urban development

Good ecological environment is a necessary condition for the development of a city. Especially for high-end talents, a good ecological environment is essential and directly related to whether it can attract adequate talents to promote the rapid development of the city.

From the status of ecological environment, the areas where the environmental quality is good and suitable for human habitation are mainly in the north temperate zone and the south temperate zone. Especially in Europe, North America and South America, the climate or ecological environment is more suitable for human habitation,

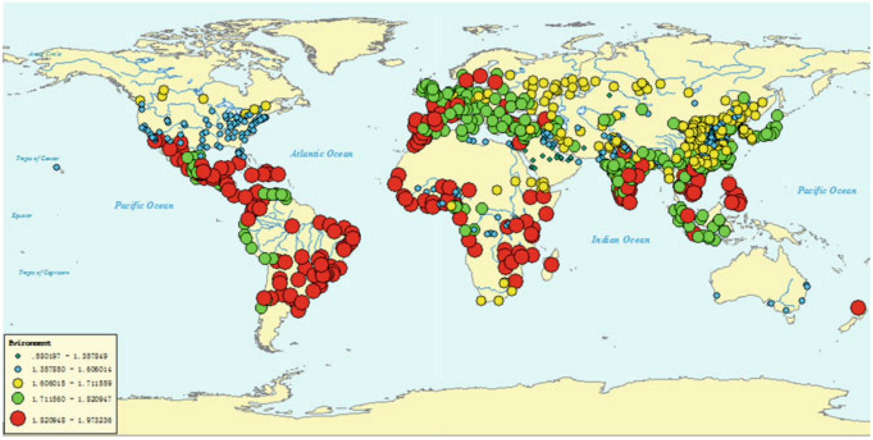

Fig. 2.7 Environmental quality. *Data source* Global urban competitiveness database of CASS

therefore, most of the world's cities are gathered in these areas. Nevertheless, a good ecological environment is not a sufficient condition for urban development, for example in South America, despite the particularly favorable ecological environment, its urban development level is far from the due prosperity (Fig. 2.7).

In the long course of history, there are many examples that changes in the ecological environment lead to the alteration of the city fate. Batty (2006), by analyzing the ranking of population size, found that none of the top 50 global cities in terms of the population size in 430BC had entered the list of the world's largest 50 cities in 2000AD. Among the reasons, suitable climate environment and good ecological environment, as the immovable element, is an important one.

As early as the 8th Century BC, Pompeii was the second largest city next to Rome in Italy, but in 79AD, the unexpected eruption of Vesuvius Volcano destroyed this ancient city, and buried it forever. The ancient Egyptian city Tanis was the capital of ancient Egypt and the richest trade center, but in the 6th century, Lake Manzala flood threatened the living in the city, leading to its abandonment by the people. The once-glorious ancient city of Lolan in Xinjiang, China, was once the hub of trade between the East and the West and played an extremely important role in the ancient Silk Road. But with the deterioration of ecological environment, it was gradually abandoned and now becomes a ruin in the vast desert. By contrast, Guangzhou of China was once a wild malaria land far away from the Central Plains 2,000 years ago, but after long-term development, the ecological environment has gradually become suitable for human habitation, and now it is one of China's most developed cities. Before Columbus discovered the American Continent, New York, the largest city of the United States, had been the place where the Indian tribes lived. With the arrival of Europeans, New York has developed into a well-deserved global first city by virtue of its good environment and superior location. The above examples prove that good climate and ecological environment are the necessary conditions for urban development (Fig. 2.8).

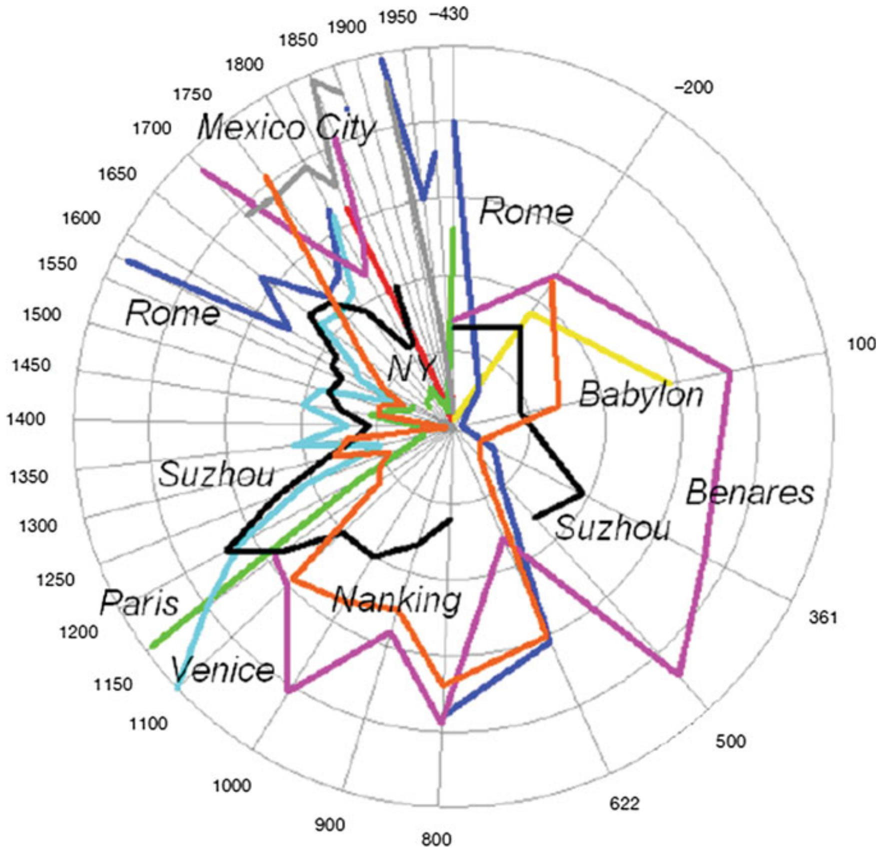

Fig. 2.8 The bell diagram of the ranking of some cities in the world (430BC–AD2000). *Data source* Nature

The culture and institution are the fundamental driving force of urban prosperity

As the basic system of human society, the culture and institution exerts a subtle influence on every citizen in a city. The culture and institution are the soul of a city, the embodiment of the value of the city, and reflects the fundamental difference between it and other cities. It plays a nonnegligible role in the formation and development of a city. Advanced cities always have a set of advanced culture system as the support, and it is the fundamental reason that a city can go through times and never lose its strength. The Figure below shows, there is a positive correlation between the business environment index and per capita income of a city. The better the business environment, the more active the market, and the higher the per capita income (Fig. 2.9).

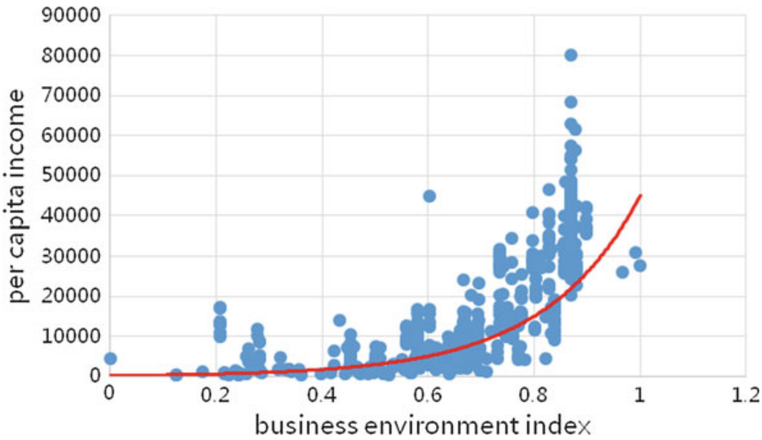

Fig. 2.9 The relationship between the business environment index and per capita income. *Data source* Global urban competitiveness database of CASS

From the perspective of business environment index, in North America, Europe and Australia the legal institution is perfect and the business environment is relatively good. But the situation in East Asia, South Asia and South America is imperfect which needs to be improved. From the perspective of urban cultural diversity, Europe, South America and Africa have significant cultural diversity, however, the cultural diversity in Australia and Europe is relatively weak. In general, the gap of cultural diversity between global regions is not obvious. However, the gap between large cities and small cities in cultural diversity is obvious. The culture of large cities is more diversified and the degree of social inclusion is higher. On the contrary, the culture of small cities is relatively conservative and the society lacks the inclusiveness (Figs. 2.10 and 2.11).

From a historical point of view, the cultural system is crucial to the long-term development of a city. In the 8th century, China was the world's most developed country and Chinese civilization was in full flourish. Both the institution and culture were the world's most advanced at that time, which made Chang'an one of the largest cities in the world. In the 11th century, after centuries of war, China again became the economically most prosperous, culturally most flourishing, and institutionally most advanced country in the world. The famous Chinese historian Chen Yinque argued, "With thousands of years of development, Chinese national culture reached its peak in Song Dynasty." Thereby, then Chinese capital Bianjing had a good reason to become one of the most prosperous metropolis. In the 17th century, with the rise of the capitalist system and the prosperity of culture, the industrial revolution took place. The boom of industry and commerce made the population of London soar, and the city gradually developed into the center of the world. In early 1980s, Shenzhen was a small fishing village near Hong Kong, but grasping the opportunity of China's reform and opening-up, it became one of the four special economic zones and entered a mode of rapid development. After nearly 40 years of

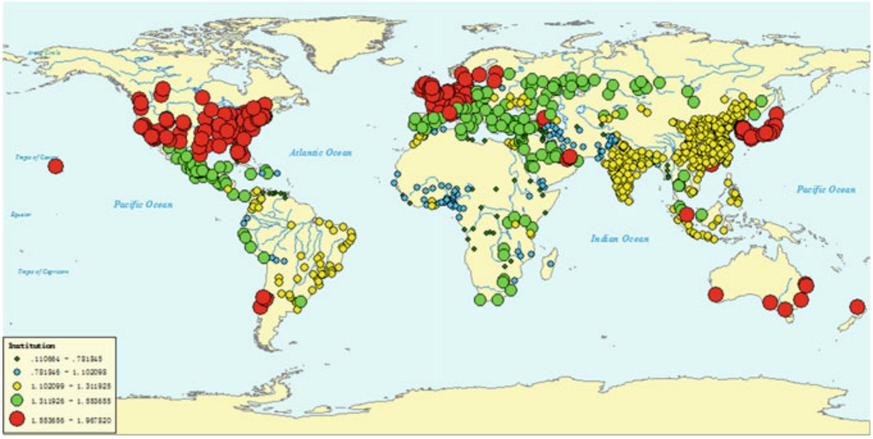

Fig. 2.10 Business environment index. *Data source* Global urban competitiveness database of CASS

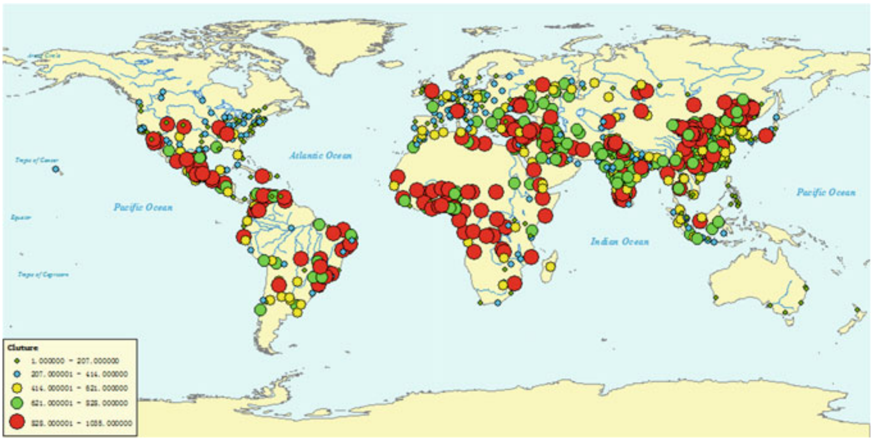

Fig. 2.11 Cultural diversity index. *Data source* Global urban competitiveness database of CASS

development, Shenzhen has become one of the richest and most dynamic cities in China. The above examples show that advanced institutional culture is an important condition for urban development.

Housing price is an important force affecting the urban development and changing the urban layout

The housing market, as the core element of urban competitiveness, constitutes an important part of the competitiveness of global cities. For the city, the house price can skillfully regulate the industrial development. Besides, changes in house prices will have a great impact on the urban institution.

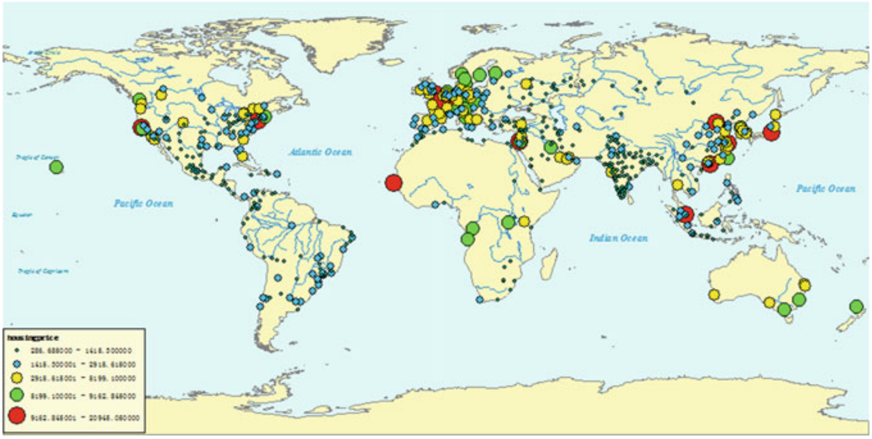

Fig. 2.12 The housing price distribution. *Data source* Global urban competitiveness database of CASS

As to the status of global city prices, the price aggregation effect is obvious. Cities with high prices are almost concentrated in areas such as Western Europe, and East Asia. In North America, except for large cities such as New York and Los Angeles where the house prices are particularly high, the housing prices of the remaining areas are relatively low. In addition, the housing prices in Africa, South Asia, Middle East, and South America is low (Fig. 2.12).

In terms of the impact of housing prices on urban economy, moderate housing prices are conducive to the economic growth, transformation and upgrading, but too high housing prices will inhibit the development of urban economy. As shown in Fig. 2.13, when house prices are in a reasonable range, the rise in house prices will help increase the per capita income, enhance the city's economic competitiveness and sustainable competitiveness and promote sci-tech innovation. However, when house prices go beyond this reasonable range, it will inhibit the growth of per capita income, thereby reducing the city's economic competitiveness and sustainable competitiveness and curbing the technological innovation. Taking Singapore as an example, the Singapore government, through the HDB system, not only effectively controls the housing prices to protect the rights and interests of common residents, but also promotes the technological innovation in the development of economy. Since the management and control of the property market in Singapore in 2013, its housing price saw three years of decline. By 2016, the price had decreased by 11%, which allows the Singapore government to create an environment favorable for living, industry and business, thus attracting many high-grade overseas talents and transnational enterprises and boosting the rapid development of sci-tech innovation industry. So it is with Shenzhen of China. To avoid the rapid rise in house prices which gives rise to a great increase of living cost and crowds out the needed talents of transformation and upgrading, Shenzhen municipal government has issued a series of measures to curb the housing prices whilst increasing the supply of social

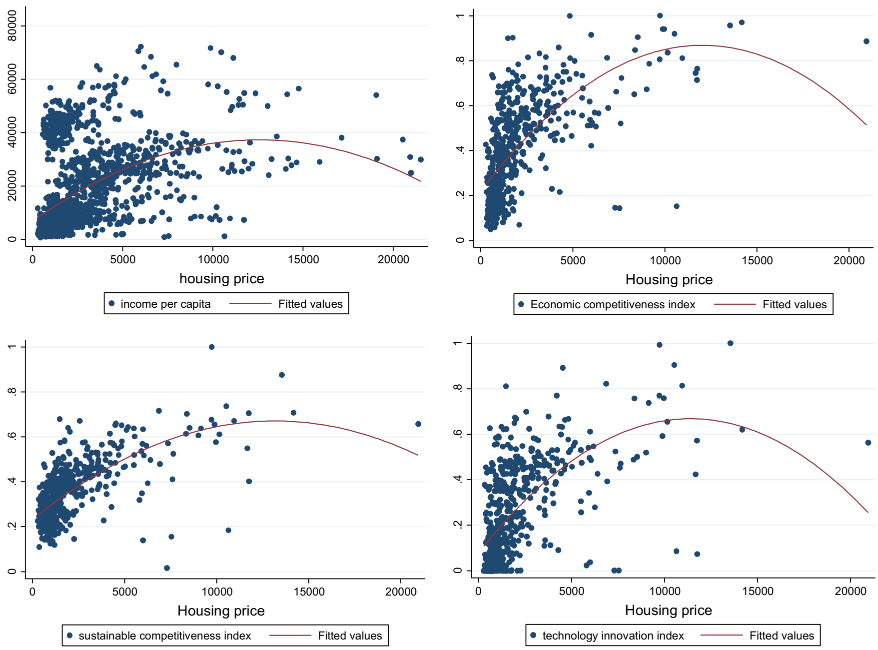

Fig. 2.13 The relationship between housing price and per capita income, economic competitiveness, sustainable competitiveness and technological innovation. *Data source* Global urban competitiveness database of CASS

security housing for talents, thus keeping the housing price at a relatively stable level and gathering lots of talents. This has effectively promoted the industrial transformation and upgrading and made Shenzhen the center of innovation in China.

Among the top 10 cities in economic competitiveness, except for Singapore, London, Shenzhen and Munich, the housing price to income ratios of the rest cities are smaller than 10 and in a reasonable range. In addition, among the top 10 cities in sustainable competitiveness, except for London, Singapore, Seoul and Paris, the housing price to income ratios of the other cities are relatively reasonable. Particularly, the housing price to income ratios in the world's leading cities such as New York, Los Angeles, San Francisco, Tokyo are quite reasonable. It indicates that moderate housing prices are conducive to the enhancement of city competitiveness, while too high or low housing prices may damage the urban competitiveness (Tables 2.3 and 2.4).

In terms of the impact of housing prices on the global city pattern, as housing prices have an important impact on urban development, changes in house prices will also affect the regional urban development pattern. When a city's housing prices grow too fast, it will have a crowding-out effect on the city's population, making the population flow to other cities where the prices are lower, thereby

Table 2.3 The housing price to income ratio in the top ten cities of economic competitiveness

Ranking	City	House price to income ratio
1	New York–Newark	8.93
2	Los Angeles–Long Beach–Santa Ana	5.17
3	Singapore	21.76
4	London	16.56
5	San Francisco–Oakland	8.28
6	Shenzhen	20.75
7	Tokyo	8.66
8	San Jose	6.66
9	Munich	13.09
10	Dallas–Fort Worth	2.65

Data source Global urban competitiveness database of CASS

Table 2.4 The housing price to income ratio in the top ten cities of sustainable competitiveness

Ranking	City	House price to income ratio
1	New York–Newark	8.93
2	London	16.56
3	Tokyo	8.66
4	Boston	3.2
5	Singapore	21.76
6	Zurich	8.07
7	Seoul	14.17
8	Houston	2.65
9	Paris	17.23
10	Chicago	3.61

Data source Global urban competitiveness database of CASS

changing the distribution of population and ultimately changing the pattern of cities. Taking Silicon Valley as an example, according to the report of Joint Center for Housing Studies, the residential affordable rate at the Bay Area is far lower than the national average level. Among the 100 large cities in America, the growth rate of housing prices in West Coast cities, most of which exceeding 40%, is far above that in other areas of America. Among them, in San Jose, the housing price has risen by 73.6% since 2000, and in San Francisco, the growth rate is more astonishing, reaching 84.3%. As housing prices continue to rise in Silicon Valley, many sci-tech practitioners have left Silicon Valley, seeking for development in other areas. Among them, many sci-tech practitioners eventually flow to New York and other East Coast areas. It is easy to identify that housing prices are becoming an important force to change the pattern of urban development (Fig. 2.14).

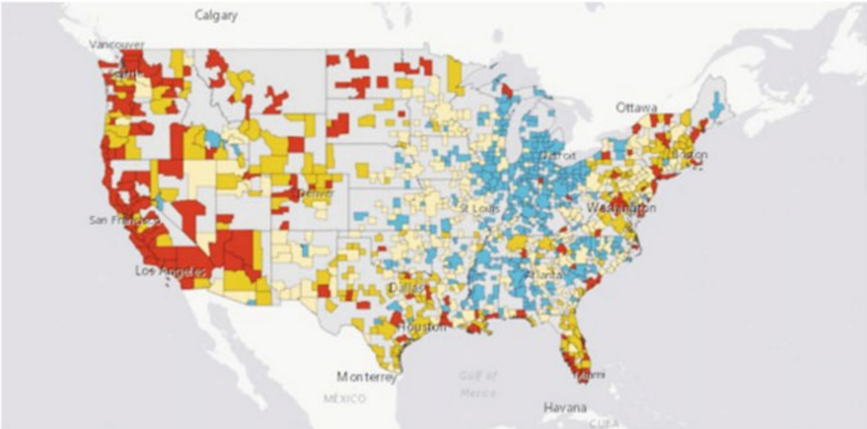

Fig. 2.14 The growth rate of regional housing prices in America since 2000. *Data source* http://www.jchs.harvard.edu/research/state_nations_housing

2.1.2 Information Technology Is Reshaping the Global Urban System

Information technology is the general term for various technologies used to manage and process information, including sensing technology, computer and intelligent technology, communication technology and control technology. The global strategic analyst Parag Khanna in his *Connectography: Mapping the Future of Global Civilization* argues that cities are gradually replacing the nations as the main player on the world stage, and connectivity will be the key to the future of a city. Information technology makes the connection between cities in the world more and more convenient and close, greatly enhances the density of global urban network system. In addition, information technology will change the position of each city in the whole urban network system and the center nodes, and lead to the transfer of center of the global urban network. Information technology has also changed the form of global cities, with the rising of urban agglomerations and super urban agglomerations. In short, the rapid development of information technology is profoundly changing the global urban system, and for any city with great ambition, this is an unprecedented opportunity and challenge. Only by seizing the opportunity brought about by the technological revolution can the city achieve transformation and overtaking.

Information technology changes direct connection between global cities to indirect connection, the connection of several cities to a full-scale connection, loose connection to close connection, slow connection to instantaneous connection, and high-cost connection to low-cost connection.

Information technology, through the knowledge media, information network and other intangible carriers, accelerates the formation of new thinking, the spread of new technology and the flow of new ideas to achieve the sharing of information, idea and technology and other production factors, allowing people around the world to connect more frequently, closely, and widely. This also further brings forth the demand for and enhances the hard connection which achieves information and technology sharing through tangible carriers such as the flow of materials and people. Besides, the original indirect connection between cities is becoming a direct one, and the network is more delayering and well-suited. The low-level cities which merely served the high-level cities in the same area in the past are gradually getting involved in the network of global cities, thereby establishing contact with the high-level and low-level cities in other regions, transforming from the indirect involvement in the global urban system to a direct one, as a result, a more delayering global urban network shows up (Figs. 2.15 and 2.16).

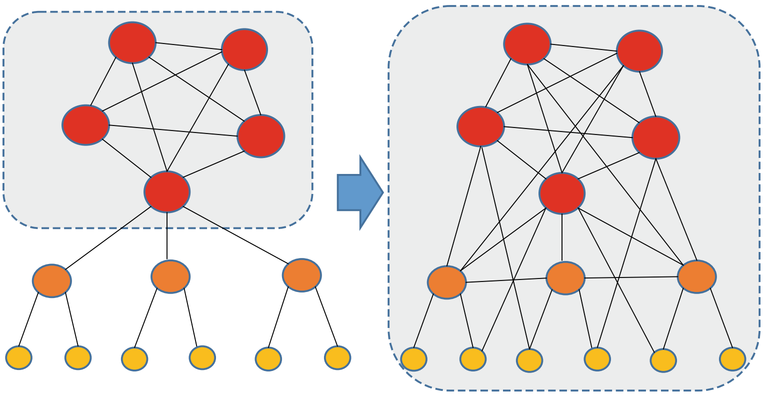

Fig. 2.15 Changes in urban network. *Data source* Drawn by the Author

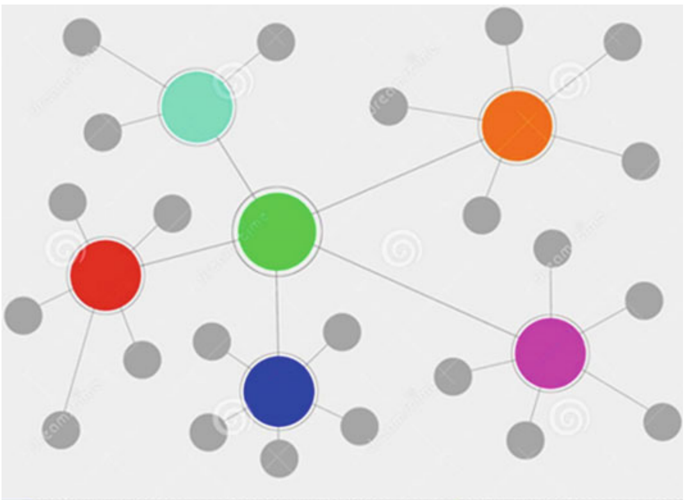

Fig. 2.16 Schematic diagram of urban network. *Data source* Dreamstime.com

Since the industrial revolution, sea transportation has been the world's main means of transport, which was the main mode of transport for the trade and personnel exchanges between continents hundreds of years ago. Until now, it is still the preferred means of transport for bulk cargo. Therefore, the global urban connection pattern shows remarkable centralization and hierarchy. In the 20th century, with the invention of airplane, people have one more choice in the intercontinental travel. As the air transportation is more fast and convenient than the sea transportation, the former has gradually replaced the latter. This has greatly promoted the commodity trade and personnel exchange between cities in the world. Figure 2.17 is a global flight route map of visualized display produced by the network analyst Matrin Grandjean with the route data of the world's 3,275 airports. This map shows closer connection between various regions in the world. More and more cities are joining the global city network, and the global city network density is greatly enhanced.

In the 21st century, the mankind enters the era of information technology. The interpersonal communication has overcome geographical distance and people can communicate anytime and anywhere. At present, the number of people joining the global network through information technology is increasing. According to the data released by China industry research institution—qianzhan.com, in 2014, the global social network users reached 1.91 billion, of which 1.41 billion are mobile social network users, and the two indicators will continue to rise. By 2020, the number of global social network users will reach 7.07 billion, of which mobile social network users will account for nearly 1/3. It is particularly alarming that, as at 2017, Facebook's global users have exceeded 2 billion, indicating that the rapid

Fig. 2.17 Global air routes. *Data source* Drawn by the data visualization network analyst Matrin Grandjean

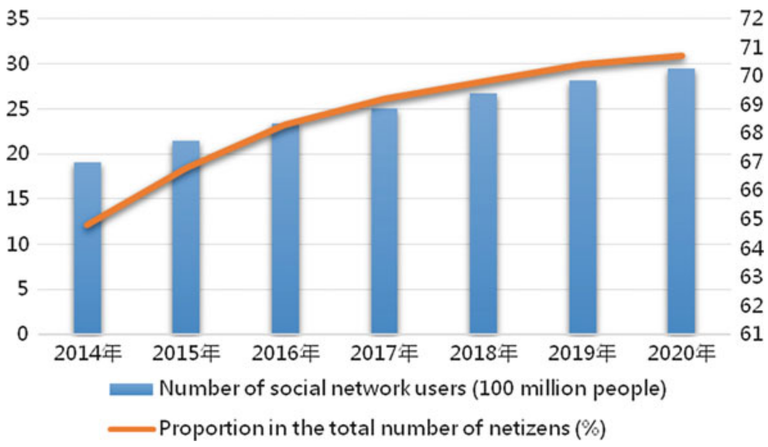

Fig. 2.18 Changes and forecast of the scale of global social network users in 2014–2020. *Data source* qianzhan.com

development of internet technology is making the connection between users around the world more convenient and closer (Fig. 2.18).

Figure 2.19 is a visualized map developed by Facebook engineer Paul Butler with the company's Apache database. He randomly selected 10 million pairs of friends from different cities and hide their personal information, and calculated the number of friends of each city pair based on the location data of each user. As shown in Fig. 2.19, except for Russia and China, more and more cities in the world are joining the global network which is characterized by more equality, inconspicuous inter-city hierarchy and a delayering trend. At the same time, the geographical segment is no longer obvious, the geographical distance is no longer an obstacle to the exchange between people in the world, and the interpersonal connection is getting closer. For example, the Six Degrees of Separation of social network argues that any two people can be connected by no more than six people. However, after the advent of the Internet, the world becomes smaller. Facebook's core data science team, after analyzing the friend map data, finds that the average distance between people has narrowed to just 3.57 people. In short, the emergence of the Internet has greatly changed the connection pattern of global cities and the city connection has become closer and more frequent. Figure 2.20 is the interconnected device location map released by Shodan founder John Matherly based on the GeoIP of all connected devices. As can be seen from Fig. 2.20, most networking devices are concentrated in the developed areas and large metropolitan areas, especially in North America and Europe, and this is basically consistent with Fig. 2.19. It also illustrates that cities in the developed areas take more in-depth and equal participation in the global city network than those in the less developed areas.

Fig. 2.19 Global social networking of Facebook. *Data source* Drawn by Facebook Engineer Paul Butler

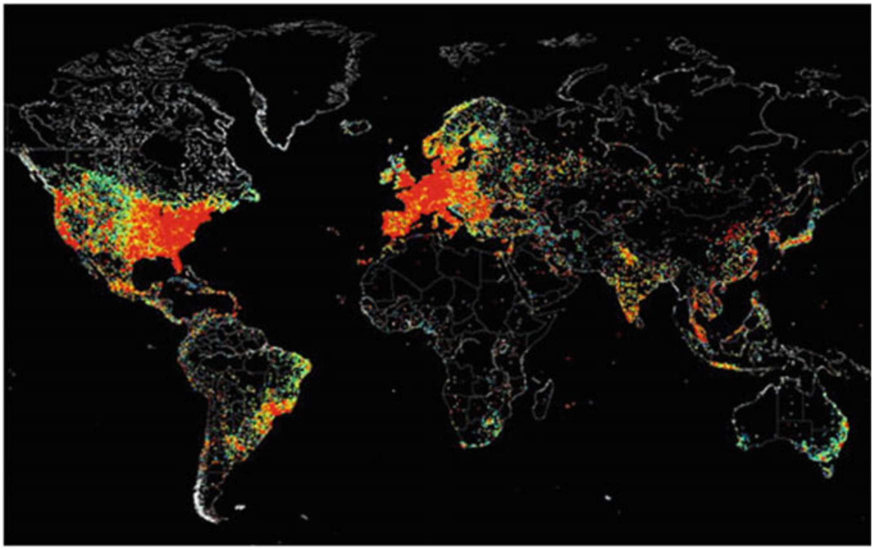

Fig. 2.20 All network-connected equipment in the world and the geographical distribution. *Data source* Released by Shodan founder John Matherly

Information technology is changing the focus of the global urban network system, which is transferring from coastal areas to inland areas, from Europe and North America to Asia.

Information technology makes the exchange between people faster and more convenient, which, on one hand, has greatly changed the global urban network from dendritical structure to delayering structure, on the other, changed the position of different cities in the network, hence the center of the global city network. Comparing with Fig. 2.19, we can see clearly that, with the development of science and technology, the contact has become increasingly convenient. More and more cities are joining the global city network, the center of which is changing from coastal areas to inland areas, from Europe and North America to Asia.

In the shipping era, cities in the global network are generally large port cities and sea forts, such as New York, London, Los Angeles, Tokyo, and Singapore. These cities serve as portals in the interaction between countries and their exchanges formed a prototype of global urban network. Meanwhile, many cities in a country rarely have an opportunity to establish global contact, instead, they can only get in touch with other cities in the world via portal cities. On the whole, it shows a hierarchical global urban network.

In the era of aviation, global contact has become more convenient and efficient, and more inland cities are joining the global network which shows closer ties. With excellent geographical location, Europe has become a well-deserved aviation hub. Typically, for Moscow, an inland city, it was difficult to join the global production and trade network in the era of navigation, however, it has become the Eurasian aviation hub city with its superior geographical location as Eurasian hinterland in the aviation age. Another city changed by the aviation technology is Memphis. As Memphis is in the geographical center of America, many airlines choose it as a transit base for logistics, thus making it a center in North American city network. On the whole, the number of node cities in the global city network has increased, and the center of the network is shifting from coastal areas to inland areas, as a result, the gap between their positions in the network is narrowing.

In the 21st century, the large-scale outbreak of information technology has greatly changed the global urban network. More and more small and medium-sized cities join the global network, the contact between large cities and small and medium-sized cities, as well as between small and medium-sized cities, is no longer maintained through central node cities. The connection of them has become unprecedentedly close, along with the decline in position of central node cities, greatly weakening hierarchy and delayering global urban network. Many cities in developing countries have become the new focus of the global network. Despite the dominant position of European and American cities in the global urban network, the status of cities in South America, South Asia, East Asia, Africa and other areas is significantly improved.

Information technology is changing the spatial pattern of global cities

Since the 1980s, with the development of information technology, network communication has become increasingly popular, gradually penetrated every aspect of the society, and greatly changed people's work, life and entertainment. Besides, it is changing the spatial pattern of cities in the industrial economy era at tremendous speed. The essence of the city is gathering materials, personnel, information and other resources, especially in the era of industrial economy, the city's agglomeration effect and scale effect are obvious. Therefore, in the industrial age, the urban spatial pattern features unrestrained expansion and constant aggregation of people and materials as well as increasingly severe metropolitan malaise. However, with the advent of the network communication era, the aggregation of digital information has replaced the spatial convergence of people and materials in cities. As a result, the enterprise's agglomeration effect and scale effect gradually fade, the interpersonal contact via transport facilities gradually decreases, while physical connection is gradually replaced by electronic communication and the restriction of traffic and location conditions to people's production and life is greatly reduced. In the meantime, due to the constant improvement of material conditions, people's desire to return to nature is growing and they are more and more inclined to life close to nature. Based on the above changes, the spatial distribution of cities is increasingly decentralized and networked, with the rising of metropolitan areas, urban agglomerations and super urban agglomerations which are gradually becoming the mainstream forms in urban spatial distribution.

2.2 Three Longitudes Have Divided the Differentiated Agglomeration of Global Urban Population and Economy

Urban agglomeration is the first feature of a city, and the global urban agglomeration comprehensively reflects the spatial differences and changes of the global economy. As the economic globalization further develops and global economic integration progress keeps deepening, Western Europe, North America, and East Asia, while leading global economic growth, remain at the center of the global economy. One thousand and seven very populous sample cities across the world are mainly located near 40°N, of which those with a high GDP density are bounded by three dividing lines: 20°E, 110°E, and 100°W. The cities with a high GDP density are mainly situated in Western Europe to the west of 20°E, East Asian region to the east of 110° E, and the Northeastern United States to the east of 100°W. There is a sharp difference in GDP density between them and those located in areas to the east of 20°E, to the west of 110°E, and to the west of 100°W In addition, the agglomeration of sample cities across the world develops from West to East and from coast to inland, with the world landscape featured by new multi-polar agglomeration.

2.2.1 Most Urban Population Growth Is Faster, Coastal Accumulation Is Stronger

From the perspective of spatial dimension, the population distribution of global sample cities is extremely uneven, but those sample cities near 40°N are densely

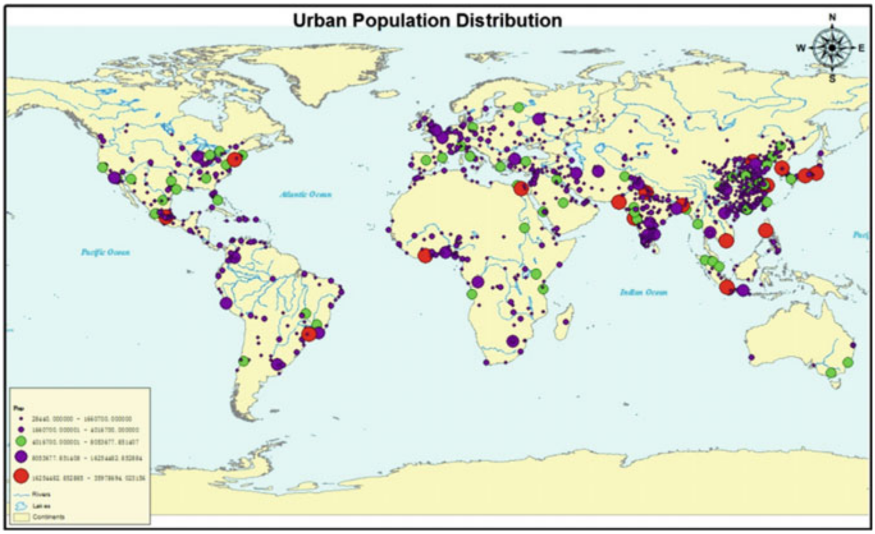

Fig. 2.21 Distribution of global urban population

populated. Figure 2.21 gives the spatial distribution of the population size of global sample cities. Among the global sample cities, regional hub cities have a large population size. As far as a city is concerned, the cities with a large population are mainly located in Asia. Table 2.5 gives statistical information about the population size and growth of the global sample cities. In 2015, the global sample cities have a total population of 2.13 billion people, of which 1.18 billion people live in Asian cities, accounting for 55% of the global total. Of the world's top 20 populous cities, 16 are located in Asia, whose population accounts for 19.3% of the global total. Tokyo has the largest population of 35.97 million, followed by Jakarta (30.45 million), Seoul (24.13 million), Manila (23.57 million), Osaka (22.75 million), Shanghai (22.70 million), Bombay (19.50 million), Beijing (19.33 million), Cairo (19.13 million), Dhaka (18.24 million), and Delhi (18.17 million). These cities rank from No. 2 to No. 15. In addition to Asia, a relatively large population can be seen in New York and Mexico City in North America and Sao Paulo in South America.

Viewed from the time dimension, the population growth rate of 1,007 sample cities across the world was 1.58% in 2015. San Jose, due to baby boom and influx of immigrants, has become the global fastest-growing city with a population growth rate of 14.19% and the only one with a population growth rate exceeding 10% in

Table 2.5 Global urban population size and growth

	Mean	Variance	Minimum	Maximum
Urban population size	2,959,124	1.2.e+13	243,900	3.59e+07
Growth of population size	0.0158	0.0002	−0.0983	0.1419

Source City and Competitiveness Index Database, CASS

the world. Unlike the spatial aggregation of the global urban population in coastal cities, the population of inland cities in South Asia and West Asia, from the perspective of the time dimension, grows at a fast pace and becomes an important source of the global urban population. The population growth rate of Samut Prakan reaches 8.9% and Batan Island 7.5%. The figure is above 6% in such cities as Disha, Malappuram, Kayamkulam, Trishul, Al Rayyan, Ar Raqqah, Ougadougou, Burkina Faso, Bujumbura, and Mwanza. On the contrary, the population declines at a negative growth rate of nearly 2%, in such cities as Jixi, Yichun, and Liaoyuan in Northeast China, Kurta in Bangladesh, and Agadir in Morocco. The urban population of Africa increases at a growth rate ranging from 2 to 6%, that of North America grows at a positive rate of less than 2%, and that of Western and Southern Europe at a positive rate of below 1%. As the urban population growth rate of Russia is most polarized, almost 50% of cities increase their population at a negative growth rate of nearly 1%.

Seen from the time-space dimension, the growth rate of global urban population size shows that cities with a small population have evolved into those with a large population. Figure 2.22 has two scatter diagrams respectively showing the population size and growth rate of 1,007 sample cities in the world, and the population growth rate of 325 sample cities with a population of over 15 million. Therefore, sample cities with a smaller population in the world have pulled down the population growth rate of those sample cities with a larger population size. The reason is that the increased population of cities with a smaller population mainly comes from the growing birth rate, while that of cities with a larger population not only originates from the increased birth rate but is driven by accelerated urbanization and influx of immigrants.

Population aggregation of global tiered cities: high-tier cities continue to grow, and low-tier cities polarize. Section 1.1 of Chap. 1 defines tiers of the world's 1,007 sample cities. Among the global sample cities, tier-3 cities have the largest population, high-tier cities have increased their population sizes, and low-tier cities have started to polarize their population sizes and especially cities from tier-6 to tier 10. Figure 2.23 has two scatter diagrams respectively reflecting

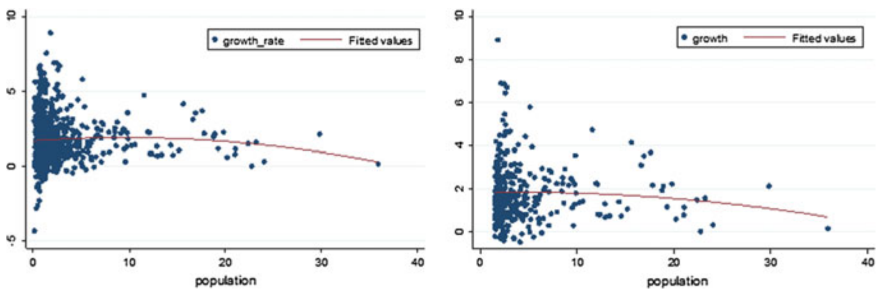

Fig. 2.22 Scatter diagram for population, size and growth of global sample cities. *Source* City and Competitiveness Index Database, CASS

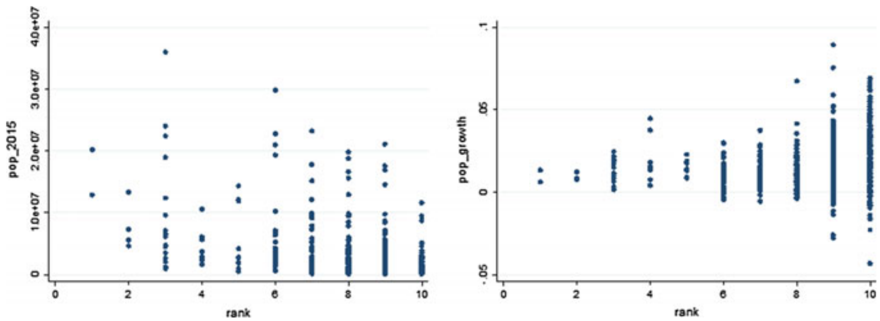

Fig. 2.23 Scatter diagram for global urban tiers and population size and growth. *Source* City and Competitiveness Index Database, CASS

the global urban population size and the relationship between the urban population size growth and urban tiers.

Among the global sample cities, the most populous ones are not at the highest tier. Some tier-3 cities have a relatively large population, and Tokyo is No. 1 city across the world in terms of population size. New York and London belonging to tier-1 cities respectively have a population of 20.19 million and 12.89 million, which are respectively equivalent to 56% and 35% of Tokyo's population. At tier 2, Los Angeles, San Francisco, Hong Kong, and Singapore have a population respectively equaling to 37, 12, 20, and 15% of Tokyo's population. Jakarta, Osaka, Mexico City, Bombay, and Tianjin at tier 6 have a relatively large population. From tier 7 to tier 10, the corresponding relationship between urban population and urban tiers is relatively stable.

As the people from developing countries flow from low-tier cities to high-tier cities, the population of cities from tier 1 to tier 5 has a positive growth rate, while that of cities from tier 6 to tier 10 has a negative growth rate. Still, the negative growth of urban population is polarized. At tier 6, Madrid, Detroit, Milan, and Cleveland have negative growth, while over 30 cities at the tier 9 and tier 10 have negative growth. In addition, the population growth rate of tier-9 and tier-10 cities has seen obvious polarization. Some tier-10 cities, including Wuzhong, Mudanjiang, Siping, and Nizhny Novgorod, have a growth rate lower than -1%. Cities in the central and western of China and Eastern Europe have a positive growth rate of below 1%, while the vast majority of tier-9 and tier-10 cities in South Asia are growing at a positive rate of more than 2%.

The increased growth rate of the global urban population shows a trend of shifting from low-tier cities to high-tier ones. A siphon effect exists in the higher-tier international metropolises, represented by Dublin, Beijing, Houston, and Stockholm respectively with a population growth rate of 2.47, 0.21, 1.96, and 0.18%. It has contributed to cities' own growth and their international influence. At the same time, the rapid population growth of low-tier cities is mainly driven by the higher birth rate, while that of high-tier cities by urbanization, population influx, and birth rate.

New urban population aggregation is Europe small, America slow, China big and India faster. Among the 1,007 sample cities, European sample cities had a relatively smallest population averaging 1.7376 million in 2015, with the lowest growth rate of urban population in the world. Table 2.6 gives statistical information about the population size and growth of European cities. London is the Europe's most populous city with a population of 12.89 million, followed by Paris (12.33 million) and Moscow (12.17 million). Following the three cities, Madrid, Berlin, Barcelona, Rome, Athens, and Milan mainly located in Western Europe had a population of more than 4 million. A relatively smaller population size is seen in Irkutsk, Khabarovsk, and Ryazan in Eastern Europe, Verona, Bergamo, and Seregno in Southern Europe, and Geneva in Central Europe.

Viewed from the time dimension, sample cities in Europe have a relatively slower overall population growth at a rate of only 0.5%. Among 130 European sample cities, Dublin is the only city with a population growth rate of over 2%, followed by Stockholm, Makhachkala, and Brussels as well as other 21 cities with a population growth rate of over 1%, accounting for 18.46% of the total number of sample cities. A growth rate less than 0 is seen in Kemerovo, Samarra, Novokuznetsk, and Kharkov in Eastern Europe, Genoa and Naples in Southern Europe and other European cities, accounting for 23.6% of the total.

Among the 1,007 sample cities, the average population size of the US sample cities is 2.645767 million, slightly larger than that of the European cities. The size and growth rate of urban population in the US are smaller than those in India and China. Table 2.7 gives statistical information about the population size and growth of the US cities. The relatively populous cities in the United States are mainly located in the northeast coastal region and some cities with a large population in the northwest coastal region. Cities in the southern US have a relatively small population size. The two most populous cities in the United States are New York (20.19 million) and Los Angeles (13.35 million) followed by Chicago, Dallas, Houston, Washington, Miami, Philadelphia, and Atlanta whose populations all exceed 5 million. St. Louis, Temecula, Mission Viejo, and Concord have a population size of less than 500,000.

Among US sample cities, those with faster population growth are mainly coastal cities in the southern United States. Only San Jose has a population growth rate of over 10%; there are five other cities whose populations increase at a rate of more than 2%: Austin, Raleigh, North Charleston, Orem, and Houston. Of the 79 sample cities, 30 have a population growth rate of 1–2%, accounting for 39%. In contrast, a growth rate of slightly less than 0 is seen in Buffalo, Akron, Detroit, and Cleveland. It is worth mentioning that larger American cities such as Houston, Dallas, and some cities in the states of Washington and Miami have faster population growth at a rate of above 1.5%.

Compared with European, American, and Indian sample cities, the Chinese counterparts have an average population of 4.43 million, the largest in the world. China's urban population growth rate is 1.1% points lower than India's, but 1.1 and

Table 2.6 Europe's urban population size and growth

	Mean	Variance	Minimum	Maximum
Urban population size	1,737,634	4.02e+12	512,800	1.29e+07
Urban population growth	0.0051	0.00004	−0.0983	0.026

Source City and Competitiveness Index Database, CASS

Table 2.7 US urban population size and growth

	Mean	Variance	Minimum	Maximum
Urban population size	2,645,767	9.12e+12	522,700	2.02e+07
Urban population growth	0.0118	0.0004	−0.0028	0.1419

Source City and Competitiveness Index Database, CASS

0.5% point higher than those of Europe and the United States, respectively. Table 2.8 gives statistical information about China's urban population size and growth. Except Chongqing and Chengdu in the central-western region, most of Chinese populous cities are located in the eastern coastal areas. The most populous city in China is Chongqing whose population is about 30.17 million, followed by Shanghai (24.15 million), and Beijing (21.70 million). Shenzhen, Guangzhou, Tianjin, and Chengdu each have a population of more than 10 million. The population of Karamay, Jinchang, Wuhai, and Tongling cities in the central-western region exceeds 400,000 each.

Different from the case of eastern coastal and central-region cities whose population is on steady rise, the population of sample cities in Western China and Northeast China is on the decline, with residents continuously migrating to the eastern cities. A population growth rate of more than 2% is seen in Tianjin, Macao, Beijing, Guangzhou, and Shenzhen, all of which are in the eastern region, and this figure is nearly 2% in central-region cities such as Zhengzhou, Hefei, and Wuhan. On the contrary, western-region cities such as Zhongwei, Guyuan, Wuzhong, and Shizuishan all suffer a negative growth rate of worse than −4%, and this figure is lower than −2% for northeastern cities including Jiamusi, Qitaihe, Mudanjiang, and Daqing.

The average population size of Indian sample cities is 2.045 million, only next to China's, but larger than those of Europe and the United States. Table 2.9 gives statistical information about the population size and growth of Indian sample cities. Bombay is the country's most populous city with a population of 19.28 million, followed by Delhi (17.79 million) and Calcutta (14.55 million). All the sample cities except Imphal have a population of more than half a million. Unlike the case of Europe, U.S., and China, the population gap between Indian cities is small. The population of a city decreases gradually instead of sharply with the increase in its distance from big cities such as Delhi, Bombay, Calcutta, and Bangalore.

The average population growth rate of Indian sample cities is 2.85%, the highest in the world. Inland cities have a higher growth rate than coastal ones, and all sample cities have a positive growth rate. A rate of more than 5% is seen in Malappuram,

Table 2.8 China's urban population size and growth

	Mean	Variance	Minimum	Maximum
Urban population size	4,438,452	5.77+12	401,468	3.02e+07
Urban population growth	0.017	0.0001	-0.09	0.0529

Source City and Competitiveness Index Database, CASS

Table 2.9 India's urban population size and growth

	Mean	Variance	Minimum	Maximum
Urban population size	2,045,398	1.01e+13	496,314	1.93e+07
Urban population growth	0.0285	0.0001	0.0068	0.1229

Source City and Competitiveness Index Database, CASS

Kayamkulam, Trissur, Cherthala, Quilon, and Tirupur. This figure is above 2% in 52 other cities including Raipur, Saharpram, Surat, and Saligari, and these cities account for 50.98% of the total sample size. Less populous cities such as Sholapur, Jamnagar, Jammu, and Calcutta have a population growth rate of nearly 0.1%.

From a spatial-temporal perspective, urban population in Europe, the United States, China, and India shows different trends of agglomeration. Restricted by national administrative boundaries, Western European cities have a larger population size but slower population growth than Eastern European ones. Cities in the United States, China, and India, however, are not subject to the restriction of administrative boundaries, so the population can flow freely between cities. In the US, the population has been gathering in northeastern cities and is now beginning to spread to southern cities; the Chinese population has been concentrating in eastern coastal cities and is now starting to flow to central-western ones gradually; the Indian population is beginning to diffuse from coastal to inland cities.

The new round of population agglomeration in global city clusters: sustained siphon effect of city clusters. A city cluster (CC) is not only an area with high GDP density but also one where population aggregates. Table 2.10 provides statistical information about the population size and population growth of global CCs. The average population size of global sample CCs is 4,888,304, larger than that of cities in Europe, the United States, China, and India. Most of the densely populated global CCs are located in North America and East Asia. CCs in the north eastern region, the Midwest, the state of New Mexico, and Southern California of

Table 2.10 Population size and population growth of global CCs

	Mean	Variance	Minimum	Maximum
Urban population size	4,888,304	1.01e+13	522,700	3.59e+07
Urban population growth	0.0134	0.0001	−0.016	0.1419

Source City and Competitiveness Index Database, CASS

Table 2.11 Classification of global CCs

Diffusive	CCs with faster diffusion: Ahmedabad metropolitan area; Bangalore metropolitan area; Beibu Gulf CC; Bombay metropolitan area; Mexico Megalopolis; Southern California CC; Shandong Peninsula CC; CCs in the middle reaches of the Yangtze River; Yangtze River Delta CC; CCs in China's central plains; Pearl River Delta CC CCs with slower diffusion: Northern California CC; Chengdu-Chongqing CC; Texas Delta CC; Rhine-Ruhr CC in Germany; Harbin-Changchun CC; CCs on the west side of the Taiwan Straits; Liaodong Peninsula CC; London-Liverpool urban belt; Medellin metropolitan area; Northeast U.S. CCs; Sao Paulo metropolitan area; Arizona sunshine corridor CC
Polarized	CCs with faster polarization: Beijing-Tianjin-Hebei CC; Cascadia ecological CC; Colorado CC; Midwest U.S. CCs; Seoul metropolitan area; Xi'an CC CCs with slower polarization: Piedmont CC on the Atlantic coast; Toronto metropolitan area; Netherlands-Belgium CCs; Jakarta metropolitan area

Source City and Competitiveness Index Database, CASS

the United States have a population of 47.76 million, 33.34 million, 27.69 million, and 29.14 million, respectively; CCs in the Sao Paulo metropolitan area of Brazil have a population of 42.41 million; those in the London-Liverpool urban belt 23.46 million; those in China's Yangtze River Delta, Pearl River Delta, and Beijing-Tianjin-Hebei regions have a population of 64.93 million, 49.83 million, and 38.92 million, respectively; the CCs of Bombay, Seoul, and Jakarta are home to a population of 27.76 million, 30.92 million, and 45.37 million, respectively.

Global CCs witnessed an average population growth rate of 1.34% in 2015, lower than that of Chinese and Indian CCs, but higher than that of American and European CCs, showing an obvious trend that population flows to and aggregates in CCs. Another trend is that there appear two types of CCs: diffusive CCs and polarized CCs. The former are those where core cities have faster population growth than other cities within the CC, while the latter's case is just the opposite. Most of the global CCs are diffusive ones, with some polarized ones seen in Europe, North America, and Asia. See Table 2.11 for the world's main diffusive and polarized CCs.

2.2.2 Double-Crescent Distribution and Three-Longitude Distribution

The new round of agglomeration of the global economy presents two distinct features: the double-crescent distribution and the three-longitude distribution. The former means that cities with the highest GDP density and higher income levels are mainly distributed in Europe, Asia, and the southern coastal areas of North America, presenting a two crescent agglomeration areas, one big and the other small. The latter means that cities with a higher GDP density are mainly located in the vicinity of three longitudinal lines: 20°E, 100°W, and 110°E. To analyze the

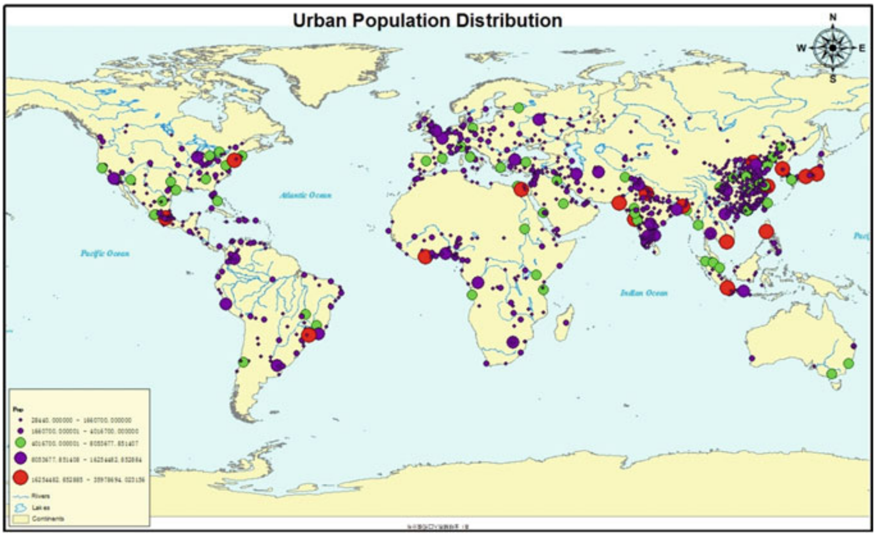

Fig. 2.24 City GDP density distribution across the world. *Source* City and Competitiveness Index Database, CASS

new aggregation and new pattern of global new cities based on available data, in this section the author uses the ArcGIS10.2 software to visualize the year 2015 GDP density of 1007 global sample cities, as shown in Fig. 2.24.

In 2015 the average GDP density of the world's 1,007 sample cities was 1,400 US dollars per km^2. The highest densities were seen mainly in some West European, South American, and East Asian cities, and in some German and British cities in Western Europe. Singapore and Munich boasted the highest GDP density in the world, both exceeding 30,000 US dollars per km^2, followed by Hong Kong and Austria with a GDP density of over 20,000 US dollars per km^2. Another 23 cities including Frankfurt, Taipei, Geneva, Macao, Shenzhen, and Tokyo had a GDP density of more than 10,000 US dollars per km^2, accounting for 2.28% of the total number of sample cities. Relatively small GDP densities were witnessed in West Asian, African, and East European cities, among which 260 including Bukavu, Al Hudaydah, Conakry, and Jiuquan had a density of less than 100 US dollars per km^2, accounting for 25.82% of the total sample size (Table 2.12).

In 2015 the average GDP growth rate of global sample cities was 2.1%. Seen from a temporal perspective, cities with a smaller GDP scale achieved faster GDP

Table 2.12 Density and growth of Global urban GDP

	Mean	Variance	Minimum	Maximum
Urban GDP density	1399.525	1.01e+13	4.310	41,458
Urban GDP growth	0.021	0.0001	−0.1949	0.1532

Source City and Competitiveness Index Database, CASS

growth than those with a larger GDP scale. Chinese and Indian cities, in particular, witnessed faster economic growth than their European and North American counterparts, and Asian cities as a whole enjoyed the fastest growth in the world. Twenty-two cities small in economic scale realized a GDP growth rate of over 15%, including Nande, Kolhapur County, Mwanza, Shantou, Tripoli, Cuttack, Puducherry, Gwalior, Haiphong, Zanzibar, Billy Nagor, Guiyang, Bogra, Indore, Anshun, Beihai, Mbuji-Mayi, Zunyi, Liupanshui, Ankang, Bhopal, and Bikaner. Of these 22 cities, 19 are in China and India. The top 379 cities among the world's 1,035 fastest-growing cities are in Asia, and most of the top 454 are Asian cities except Quito (380th), Villavicencio (397th), Medellin (442nd), Cucuta (438th), Guayaquil (440th), and Cartagena (446th). Figure 2.25 shows the distribution of global urban GDP growth, where red color represents the cities with the highest GDP growth rates, most of which are in Asia. In terms of city GDP growth rate, of the global total sample cities, 2.19% recorded a GDP growth rate of over 15%; more than 1/2 registered a GDP growth rate of above 4%; more than 2/3 had a growth rate of over 2%; and more than 90% saw a positive GDP growth rate. In contrast, negative GDP growth was seen in 5.99% of sample cities including Krivoy Rog, Ar Raqqah, Odessa, Kharkov, Zaporizhia in Europe, and Hama, Lattakia, Aleppo, Sanaa, Hodeidah, Tayizi, Misurata, Aden, and Benghazi in Asia. More detailed information is shown in Table 2.13.

Seen from a temporal-spatial perspective, the world's cities with larger GDP density gradually make up three blocks that form two crescents—one big and the other small. Specifically, the first block is mainly composed of western and southeastern US cities and those in northern Mexico, and these cities have formed

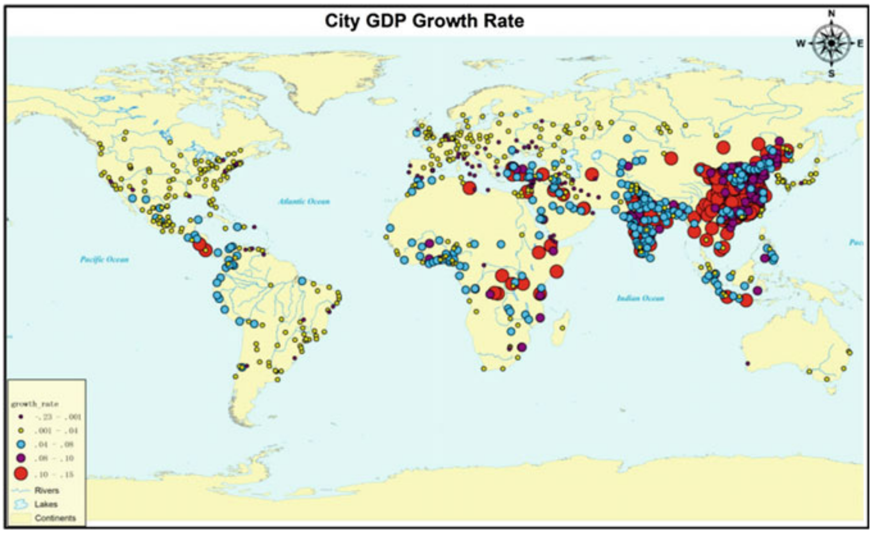

Fig. 2.25 Distribution of global urban GDP growth

Table 2.13 Distribution of global GDP growth rates

Growth rate	Above 0.15	0.10–0.15	0.08–0.10	0.06–0.08	0.04–0.06	0.02–0.04	0–0.02	Negative
Proportion (%)	2.19	19.39	10.91	11.98	11.29	12.08	26.07	5.99
Accumulative (%)	2.19	21.58	32.49	44.47	55.76	67.84	93.91	100

Source City and Competitiveness Index Database, CASS

the above-mentioned small crescent with the rise of southern United States. The second block mainly comprises cities in Southwestern Europe, and the third mainly consists of cities in the southeast part of Asia. With the continuous development of the Southeast European and South Asian economies, the second and third blocks are gradually linked together to form the above-mentioned big crescent. As a result, the new agglomeration of global cities finally forms a double-crescent distribution.

Seen from a spatial perspective, global sample cities with a higher GDP density are mainly concentrated on one side of three longitudinal lines. The first block of those cities is located in Western Europe west of the longitudinal line of 20°E; the second block comprises US cities east of 100°W; the third block is composed of East Asian cities east of 110°E. All these sample cities near the three longitudinal lines not only have a high GDP density themselves but also have strong influence on the formation and development of CCs, or even global economic growth. Figure 2.26 shows the afore-said three longitudinal lines from the left to the right: 100°W, 20°E, and 110°E.

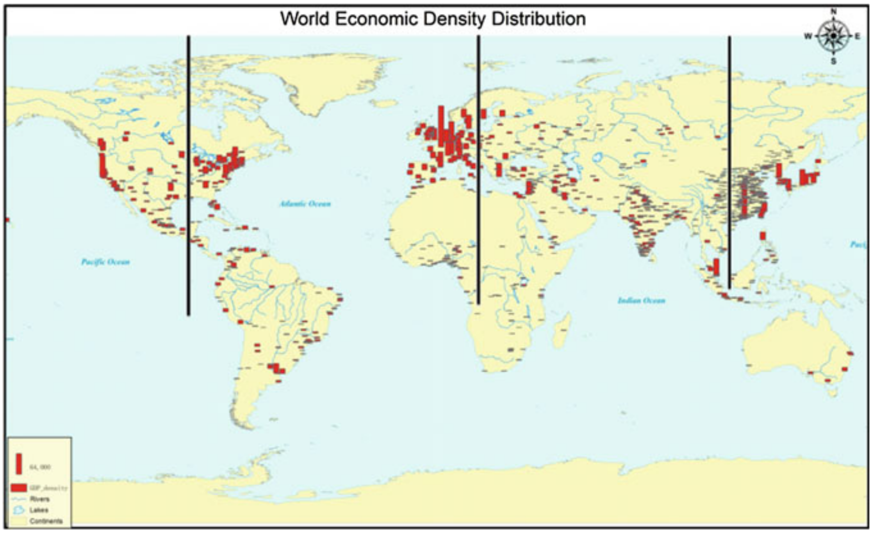

Fig. 2.26 World economic density distribution. *Source* City and Competitiveness Index Database, CASS

Seen from a temporal perspective, the agglomeration of global cities with higher GDP density shows a trend of shifting from the west to the east. Before the 20th century, cities west of 20°E on the east coast of the Atlantic used to be the global economic center. These cities are mainly developed sample cities in Western Europe, including Dublin in Ireland; London, Edinburgh, Bristol, etc. in the UK; Paris, Brest, etc. in France; Amsterdam in the Netherlands; Berlin, Hamburg, Munich, Stuttgart, and some other cities in Germany. These cities were then much more developed than those to the east of 20°E.

From the beginning of the 20th century till the present day, sample cities east of the second longitudinal line (100°W) are the center of economic growth. They are mainly big developed cities in North America, especially in the United States, such as Washington, Seattle, San Francisco, San Luis Obispo, Los Angeles, Santiago, Austen, Houston, Miami, Atlanta, Pittsburgh, New York in the United States, and Toronto in Canada. These cities, with a very high GDP density, are significantly different from those to west of the 100°W longitudinal line.

Since the advent of the 21st century, East Asian cities east of the third longitudinal line (110°E) have been the new center of global economic growth. They are mainly high-income Japanese, Chinese, and Korean cities, including Tokyo and Osaka in Japan, Seoul in the Republic of Korea, and Beijing, Shanghai, Hangzhou, Guangzhou, Shenzhen, and Hong Kong in China. With time passing by, therefore, the global economic center marked by one of the three longitudinal lines has been shifting from the west to the east.

From the perspective of time and space, the cities with globally highest income are mainly concentrated in three regions: West Europe on the east coast of the Atlantic to the west of 20°E longitudinal line; North America near the 100°W; and East Asia to the east of 110°E. The three regions have gradually become the world's three major areas of economic aggregation, forming two crescents, one of which is big and the other small.

2.2.3 Economy of High and Low-Ranked Cities Growing in Relay

New agglomeration of economy of global hierarchical cities is mainly embodied in rise of economy of low-ranked cities and growth of economic size of high and low-ranked cities in relay. If the 1,007 sample cities globally are categorized into ten tiers by economic development level, the first tier refers to cities with the highest economic development level globally and the tenth tier refers to those with the lowest economic level. The tiers and quantities of the sample cities are displayed in a pyramid structure and their spatial distribution is quite noticeable. Figure 2.27 shows the distribution of global hierarchical cities.

It's known from Fig. 2.27 that hierarchical spatial agglomeration of global cities is distinct and North America and Western Europe remain global economic centers.

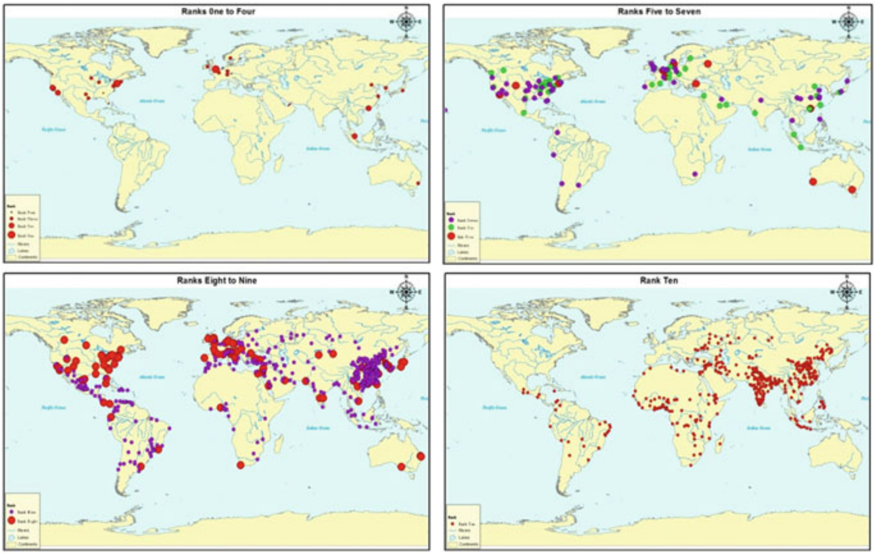

Fig. 2.27 Spatial distribution of global hierarchical cities. *Source* City and Competitiveness Index Database, CASS

The first to fourth tiers of cities are mainly distributed in the south of North America, Western Europe and coastal area of East Asia, the fifth to seventh tiers in USA in the southwest of North America, Western Europe and some areas in East Asia, the eighth and ninth tiers in the border area of South America and North America, Eastern Europe and Southeast Asia and the tenth tier in Eastern Europe, South Africa, South Asia and Southeast Asia.

Figure 2.28 shows the corresponding relationship between economic density of global cities and their economic size growth with tiers of the cities. It's inferred

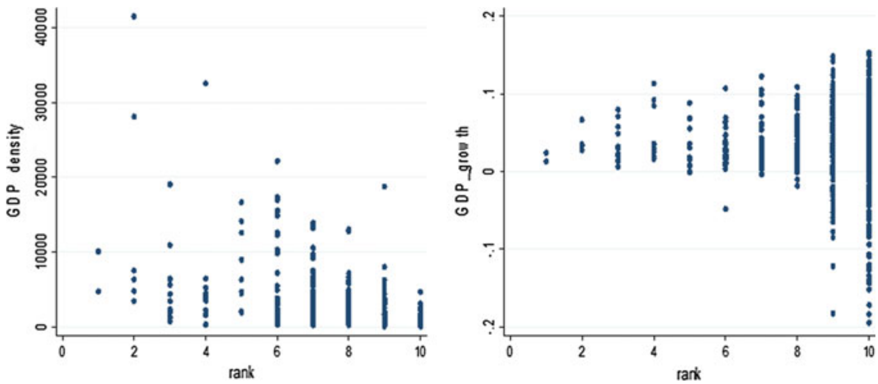

Fig. 2.28 Scatter diagram of economic density and growth of global cities and their hierarchies. *Source* City and Competitiveness Index Database, CASS

from the figure that the majority of the first to sixth tier of cities globally are relatively high in economic density, while the seventh to tenth tier of cities are low. Regarding growth of the cities' economic size, as hierarchy declines, gap in the growth gradually widens. Tripoli, Shuozhou and Lviv of the ninth tier and Tieling, Hegang, Bangui and Hodeida of the tenth tier especially show a negative growth of economic size, which is lower than 5%.

In the time and space dimension, high-ranked cities in Western Europe, North America and East Asia and neighboring low-ranked cities show a trend of economic growth in relay. Western European cities with high economic density such as London, Paris, Frankfurt, Dublin, Amsterdam and Stockholm, North American cities with high economic density such as New York, Washington, San Francisco, Los Angeles and San Jose and East Asian cities with high economic density such as Tokyo, Osaka, Hong Kong, Beijing, Shanghai and Seoul remain global economic centers, which shows a visible corresponding relationship with their high city ranks. While the cities as global economic centers continue to lead global economic growth, some cities of relatively lower ranks such as Macao and Nanjing of the sixth tier and Salt Lake City, San Antonio, Chongqing and Suzhou of the seventh tier start to rise. They become new forces of sustained global economic growth after the high-ranked cities in North America, Western Europe and East Asia and show a trend of growth in relay with the latter in space.

2.2.4 City Agglomeration in Major Countries Globally, Western European Cities Advancing Together to Lead the Entire Europe, America Cities as Technological and Financial Centers Showing High Economic Density and High Growth, Chinese Economic Center Expanding from the East to the Middle, Indian Cities Is Economic Growth Expanding from Western Coastal Area to the Inland and the East

While high-ranked cities in North America, Western Europe and East Asia lead global economic growth, low-ranked ones within regions and especially within large powers such as in Eastern Europe, southern area of USA and central and western China start to rise. They show a trend of regional relayed growth of economy after high-ranked cities and become new forces of sustained global economic growth. Rise of low-ranked cities is reflected by the development of USA from the northeast to the west and south in North America, the development of Europe from the south to the east and the development of Asia from southeastern coastal area to central and western inland.

Western European cities advancing together to lead the entire Europe. Table 2.14 displays statistics on economic density and growth of economic size of

Table 2.14 Economic density and economic size growth of European cities

	Mean value	Variance	Minimum value	Maximum value
Economic density	3674.24	2.24e+08	8.41	32479.90
Economic size growth	0.0082	0.0001	−0.027	0.057

Source City and Competitiveness Index Database, CASS

European sample cities. Spatially speaking, economic density of European cities is the highest across the globe and the mean value is USD3,674.53/km^2. Meanwhile, Western European cities and Eastern European cities have a wide gap in economic density, which is because the administrative border between different countries obstructs the free flow of elements. Germany in Western Europe and southern European cities are high in economic density as the center of European economy, while Russia and Ukraine in Eastern Europe are relatively low in economic density. Figure 2.29 shows the spatial distribution of economic density of European cities in 2015. In that year, Munich in Europe had the highest economic density of USD32,497/km^2 and the following Vienna also exceeded USD20,000/km^2. Among the 126 European sample cities, economic density of 16 cities such as Frankfurt, Geneva, Berlin and Hamburg all surpassed USD10,000/km^2, accounting for 12.69% of the European sample cities. Economic density of cities in Russia and

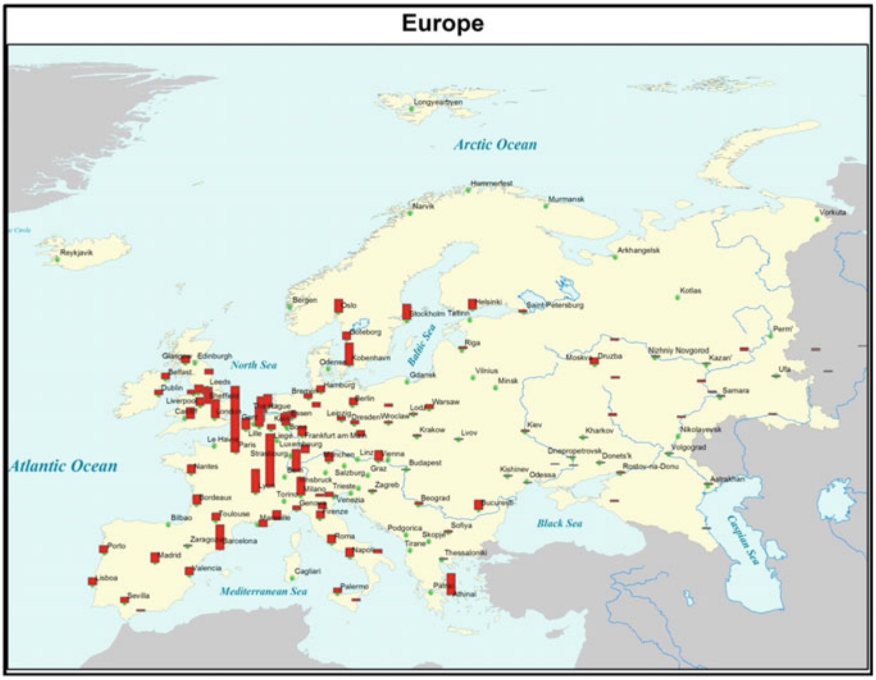

Fig. 2.29 Spatial distribution of economic density of European cities. *Source* City and Competitiveness Index Database, CASS

Ukraine in Eastern Europe was relatively low and that of 26 cities such as Kazan, Astrakhan, Novokuznetsk, Omsk, Donetsk and Kharkov was all lower than USD100/km^2.

In the time dimension, globally speaking, economic size growth of European cities is slightly lower than that of North American cities and noticeably lower than that of other regions, especially Asian cities. In 2015, annual average growth of city size in Europe was only 0.82%. The European city with the highest annual average growth of economic size, 5.70%, was Dublin and the growth of other cities was all lower than 5%. Among the 126 European sample cities, only 21 cities had an economic size growth of over 2%, accounting for 16.94% of the total. Only 26 cities had a growth of more than 1%, accounting for 20.97% of the total. 50 cities such as Nottingham, Glasgow, Vienna, Hamburg, Amsterdam, Geneva, Frankfurt, Stuttgart and Zurich had a positive growth of economic size, but the growth was lower than 1%. Moreover, 26 European cities experienced negative growth, including some Western European and Southern European cities with high economic density such as Valencia, Oporto, Florence, Thessaloniki and Sevilla. In the meantime, within Europe, economic growth of Eastern European cities was slightly higher than that in Western and Southern European cities. Growth of Eastern European cities such as Togliatti, Astrakhan, Ufa, Samara and Orenburg was slightly higher than 2%, while in Western Europe and Southern Europe, only 4 cities, namely Wrocław, Leicester, Warsaw and Poznan, experienced a growth of slightly higher than 2%.

In the time-space dimension, new agglomeration of economy of European cities is mainly embodied by the fact that while Western European and Southern European cities continue to lead European economic development, growth starts to slowly expand from Southern Europe to Eastern Europe and from Atlantic coastal area to inland cities in Eastern Europe. Regarding city agglomeration in Europe, cities with high economic density are basically concentrated in Western Europe and Southern Europe and low-ranked cities in Eastern Europe slowly rise with relatively high economic growth. To be specific, following such Western European cities as Dublin, London, Paris and Munich, those in central Europe such as Vienna, Seregno, Florence and Moscow show a relatively high economic growth and gradually become one of major economic drivers in Europe.

Cities as technological and financial centers showing high economic density and high growth. Economic density of US cities is lower than that in European cities, but far higher than that in Chinese and Indian cities. In 2015, economic density of US cities was on average at USD2,800/km^2, slightly lower than that in Europe but far higher than in China and India, and the density gap among the cities was the smallest worldwide. Figure 2.30 shows the spatial distribution of economic density of US cities. In the spatial dimension, cities in the northeast of USA remain the economic center of the country. Economic density of Los Angeles was the highest at USD12,557/km^2, while that of other cities was all lower than USD10,000/km^2. Miami, San Francisco, New York, Boston and San Jose all had a density of higher than USD5,000/km^2, while Tucson, Portland, Albuquerque, Sacramento and Tulsa all had a density of lower than USD500/km^2 (Table 2.15).

Fig. 2.30 Spatial distribution of economic density of US cities. *Source* City and Competitiveness Index Database, CASS

Table 2.15 Economic density and economic size growth of US cities

	Mean value	Variance	Minimum value	Maximum value
Economic density	2800.38	1.34e+08	152.9517	12557.74
Economic size growth	0.0073	0.00009	−0.004	0.067

Source City and Competitiveness Index Database, CASS

Similarly to Europe, in the time dimension, economic size growth of US is relatively low and only San Antonio and Austin have a growth of higher than 2%. Among the 65 sample cities, only 12 cities such as El Paso, Oklahoma City, Orem, Nashville and Tulsa show a growth of over 1%, accounting for 10.95% of the total. And 56 cities including large-sized ones such as New York, San Francisco, Los Angeles, Washington, D.C., Seattle, Chicago and Detroit as well as Grand Rapids, Las Vegas, Baton Rouge, Akron and Salt Lake City experience positive growth, which is only slightly higher than zero, accounting for 74.67% of the total. On the contrary, New Haven, Hartford and New Orleans show a negative growth of slightly lower than zero.

In the time-space dimension, US cities with relatively high per capita income are mostly concentrated in the northeast, but low-ranked inland cities in the south and east start to rise. To be specific, growth starts to expand from Washington, D.C. and San Jose in the northeast to Milwaukee, Indianapolis, Cleveland, Cincinnati, Richmond and Detroit in the east and to Baton Rouge, New Orleans and Honolulu in the south.

Chinese economic center expanding from the east to the middle. Economic density of Chinese cities is lower than that of European and US cities, but higher than that of Indian cities. Table 2.16 displays the statistics on economic density and economic size growth of Chinese cities. In 2015, the mean value of economic density of Chinese cities was USD780/km^2, around one fourth of that of USA or one fifth of that of Europe. The density gap among Chinese cities was the widest worldwide and this is because the vast and sparsely populated area in western China drove down the overall economic density of Chinese cities. Cities with high economic density were concentrated in eastern coastal area and Hong Kong, Macau and Taiwan and those in the west and northeast had a relatively low density. In the country, the city with the highest economic density was Hong Kong, whose density was USD28,023/km^2, and it was followed by Hsinchu, Taipei, Macau and Shenzhen, all of which exceeded USD10,000/km^2. Eastern cities such as Shanghai, Guangzhou, Beijing and Suzhou had a density of slightly lower than USD10,000/km^2. On the contrary, western cities such as Jiuquan, Heihe, Zhangye, Longnan and Wuwei and northeastern cities such as Yichun, Hegang, Shuangyashan and Jiamusi had an economic density of lower than USD50/km^2.

In the time dimension, compared with other countries and regions in the world, Chinese cities show relatively high economic growth. The growth of Chinese cities starts to transfer from the eastern area to central and western areas and from the coastal area to the inland and meanwhile, economic growth in the inland area is severely polarized. In 2015, the mean value of the economic size growth of Chinese cities was 8.27%. Among the 292 sample cities, 37 cities such as Anshun, Zunyi, Liupanshui, Dingxi, Pu'er, Chongqing and Baoshan in the west and Ganzhou, Suqian, Huai'an, Changde, Shaoyang, Xuancheng and Yichun in the central area had an economic size growth of over 10%, accounting for 12.63% of the total. Meanwhile, 64 cities such as Heze, Jieyang, Chenzhou and Shiyan showed a growth rate of over 8%, 60 cities such as Hengshui, Jinzhou, Zigong and Lanzhou over 6%, 46 cities such as Deyang, Qinhuangdao, Suzhou and Zhongshan over 4%, 33 cities such as Liaoyuan, Puyang, Jiamusi and Tainan over 2% and 13 cities such as Changde, Xinzhou and Changzhi higher than 0, accounting for 21.92, 20.55, 15.75, 11.30 and 4.45% of the total respectively. Panjin, Benxi and Luohe in the west and northeast experienced a negative growth.

In the spatial dimension, unlike North America which develops from the northeast to the south and east, or Europe which develops from Southern Europe to Eastern Europe, eastern China is the economic center of the country, while growth starts to expand from the east to the west and from coastal area to the inland. Chinese cities with high economic density such as Hong Kong, Shenzhen, Guangzhou, Shanghai and Nanjing are concentrated in eastern coastal area. As low-ranked cities rise, growth of Chinese cities starts to expand to some lower-rank cities in the central area such as Wuhan, Xi'an, Hefei, Zhengzhou and Nanchang, to Chongqing and Chengdu in the southwest and to Lanzhou and Urumqi in the west.

Economic growth expanding from western coastal area to the inland and the east. Economic density of Indian cities is generally low. Compared with Europe, USA and China, the mean value of economic density of Indian cities is USD325/km^2, two fifth, one tenth and one twelfth of the value of China, USA and Europe, respectively. Meanwhile, the density gap among Indian cities is wide. Table 2.17 shows the statistics on economic density and economic size growth of

Table 2.16 Economic density and economic size growth of Chinese cities

	Mean value	Variance	Minimum value	Maximum value
Economic density	780.96	6,553,581	12.1258	28023.55
Economic growth of city	0.0827	0.003	−0.19	0.18

Source City and Competitiveness Index Database, CASS

Table 2.17 Economic density and economic size growth of Indian cities

	Mean value	Variance	Minimum value	Maximum value
Economic density	325.47	5,408,157	2.2499	6697.63
Economic size growth of city	0.075	0.0011	0.007	0.15

Source City and Competitiveness Index Database, CASS

Indian cities. In 2015, the highest density, USD6,698/km^2, was experienced by Delhi, followed by Bangalore, Chennai, Mumbai, Cochin and Coimbatore at USD3,769, USD3,017, USD2,343, USD1,694 and USD1,615/km^2 respectively. Other cities had a density of lower than USD1,000/km^2. On the contrary, among the 100 sample cities, 14 inland cities such as Raipur, Bikaner, Chandigarh and Malegaon had a density of lower than USD50/km^2, accounting for 14% of the total.

In the time dimension, in 2015, economic growth of Indian cities was relatively high in general. Unlike Europe, USA and China, all sample cities in India showed a positive growth in economic size. Nande, Kolhapur County, Cuttack, Pondicherry, Gwalior, Billy Nagor, Indore and Bhopal had a growth of over 15% and Bikaner, Mathura, Hubli-Dharwad, Aurangabad, Jabalpur, Cherthala and Mysore over 10%. On the contrary, Amritsar, Patna, Kolkata, Jammu and Malappuram showed a relatively low growth of smaller than 2%. Regarding proportion by economic size growth, among the Indian sample cities, those with over 10% growth accounted for 14%, those over 6% accounted for 29% and those over 4% accounted for 69%. Among them, 40% cities showed a growth between 2 and 4% and see Table 2.18 for detailed proportion by the growth.

Unlike the USA, Europe and China, the overall rank of Indian cities is low and the cities show a slightly visible trend of developing from western coastal area to inland and eastern coastal area. Cities with high income are concentrated in

Table 2.18 Distribution of economic size growth of Indian cities

Growth (%)	0.10–0.15	0.08–0.10	0.06–0.08	0.04–0.06	0.02–0.04	0–0.02
Proportion	0.07	0.07	0.15	0.40	0.20	0.11
Accumulative	0.07	0.14	0.29	0.69	0.89	1

Source City and Competitiveness Index Database, CASS

Mumbai Metropolitan Region in the eastern coastal area, Ahmedabad city ring, Bangalore Metropolitan Region and Delhi Metropolitan Region centering on the capital city of Delhi. As low-ranked cities rise, economic density of cities starts to develop from western coast to Kolkata in West Bengal in the eastern coastal area and to Punjab Pradesh and Chandīgarh in Haryana in the inland area.

2.2.5 *Economic Agglomeration of Urban Agglomerations*

High in the west and low in the east in density, large in the west and small in the east in size. Mean value of economic density of global urban agglomerations is lower than that of European and US cities, but higher than that of Chinese and Indian cities. Table 2.19 displays the statistics on economic density and economic size growth of global urban agglomerations. In 2015, mean value of the density of global urban agglomerations was USD1,936/km^2, 2.48 and 5.96 times that of Chinese and Indian cities respectively. However, mean value of economic size growth of global urban agglomerations was 0.0417, around half of China and four seventh of India, but far higher than the growth of Europe and USA. This was because expansion and growth of economic size of central cities in urban agglomerations helped expansion within the groups, which drove the expansion and growth of economic size of entire urban agglomerations.

As shown by the spatial distribution of urban agglomerations, density of global urban agglomerations is high in the west and low in the east, while size of the urban agglomerations is large in the west and small in the east. Figure 2.31 shows the spatial distribution of 54 urban agglomerations across the globe.

In Fig. 2.31, larger area of red circles indicates higher economic density and larger size of urban agglomerations. Therefore, in spatial distribution, global urban agglomerations are high in the west and low in the east in density and large in the west and small in the east in size. In North America, there are totally 13 urban agglomerations, which are mainly distributed in USA, making the country the economic center not only of North America but also of the world. Global economic centers include South California Urban Agglomeration, North California Urban Agglomeration, Mid-West U.S. urban agglomeration, Northeast U.S. Urban

Table 2.19 Economic density and economic size growth of cities in global urban agglomerations

	Mean value	Variance	Minimum value	Maximum value
Economic density of city	1936	1.01e+13	124.6451	3.59e+07
Economic size growth of urban agglomeration	0.0417	0.0001	−0.1222	0.1310

Source City and Competitiveness Index Database, CASS

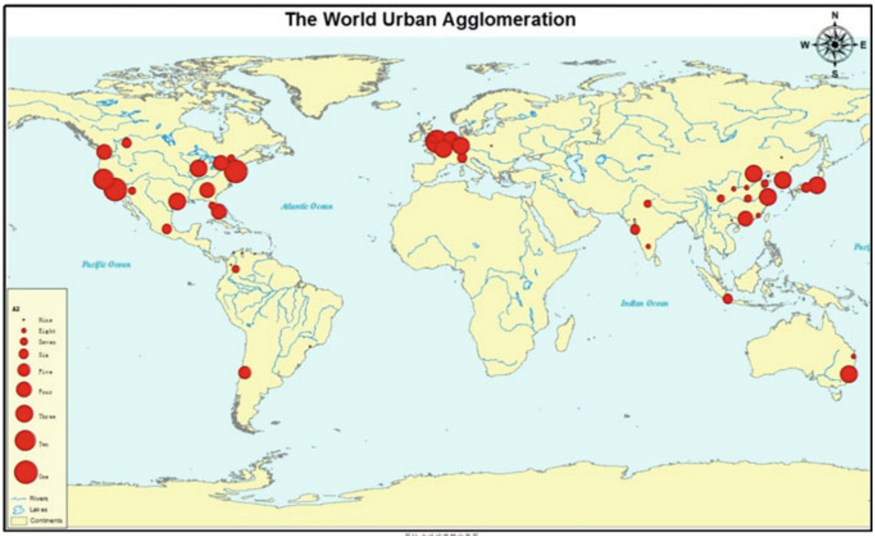

Fig. 2.31 Distribution of global urban agglomerations. *Source* City and Competitiveness Index Database, CASS

Agglomeration, Texas Delta Urban Agglomeration, Piedmont Atlantic Mega Region, Arizona Sunshine Corridor Urban Agglomeration, Saint Paul Metropolitan Area and South Florida Urban Agglomeration. Other urban agglomerations include Ottawa Metropolitan Area in Canada, Kharkhar Metropolitan Area, Toronto Metropolitan Area and Mexico City Metropolitan Area, all of which constitute global economic centers together. There are only two urban agglomerations in South America: Medellin Metropolitan Area and Bogota Metropolitan Area in Colombia. Major urban agglomerations in Europe include Milan Metropolitan Area, London—Liverpool City Zone, Cracow Metropolitan Area in Poland, the Netherlands—Belgium Urban Agglomeration, Paris—Rouans—Le Havre Urban Agglomeration in France, Rhine—Ruhr Urban Agglomeration in Germany and Frankfurt am Main Metropolitan Area. Main urban agglomerations in East Asia include Nagoya metropolitan area and Osaka Metropolitan Area in Japan, Seoul State Capital Area, Yangtze River Delta Urban Agglomerations, Pearl River Delta Urban Agglomeration, Beijing-Tianjin-Hebei Urban Agglomeration, Central Plans Urban Agglomeration, Urban Agglomeration in the Middle Reaches of Yangtze River, Xi'an Urban Agglomeration, Shandong Peninsula Urban Agglomeration, Liaodong Peninsula Urban Agglomeration, West Taiwan Strait City Belt, Harbin-Changchun Megalopolis Area and Chengdu-Chongqing Urban Agglomeration in China and Jakarta Metropolitan Area in Indonesia. Other urban agglomerations include Mumbai Metropolitan Area, Delhi Metropolitan Area and Bangalore Metropolitan Area in South Asia and Brisbane Metropolitan Area in Australia.

Diffusion and polarization co-existing. In the time dimension, global urban agglomerations are both diffused and polarized. It's seen from Table 2.19 that in

2015, economic size growth of global urban agglomerations was registered at 4.17% in mean value. Individually speaking, most advanced urban agglomerations are basically diffused, i.e. non-central cities within the urban agglomeration show higher economic size growth than central cities. Most backward urban agglomerations are basically polarized, i.e. central cities in the agglomeration enjoy higher economic size growth than non-central cities. In general, the majority of US and Chinese urban agglomerations, especially growing agglomerations in central and western China, are diffused, while the majority of urban agglomerations in other areas are polarized. If the average growth difference of higher than 1% between central cities and urban agglomerations is defined as fast diffusion or polarization and the difference of lower than 1% as slow diffusion, Table 2.20 showcases the situation of global major urban agglomerations in diffusion and polarization.

Expanding fast in the east and slowly in the west. In the time-space dimension, cities of high economic density globally are mainly concentrated in "old-brand" urban agglomerations, while fast-growing cities concentrated in emerging urban agglomerations. Growth of global old-brand urban agglomerations is relatively low. North California Urban Agglomeration centered on San Jose and Kharkhar Metropolitan Area centered on Kharkhari both have relatively high growth of 3.22 and 3.4% respectively. Northeast U.S. Urban Agglomeration centered on Washington, D.C., New York and Boston has a growth of 1.82%, South California Urban Agglomeration centered on Los Angeles 1.6%, Texas Delta Urban Agglomeration centered on Houston and Dallas 1.59%, Mid-West U.S. Urban Agglomeration centered on Minneapolis and Saint Paul 1.3% and Piedmont Atlantic Mega Region centered on Charlotte only 1.2%. Besides US urban agglomerations, Frankfurt am Main Metropolitan Area centered on Frankfurt and Munich shows a growth of only 2.2%.

Emerging urban agglomerations in East Asia are growing relatively fast. As driven by Yangtze River Delta Urban Agglomerations, Pearl River Delta Urban Agglomeration and Beijing-Tianjin-Hebei Urban Agglomeration, West Taiwan Strait City Belt and Shandong Peninsula Urban Agglomeration in southeastern coastal area, Urban Agglomeration in the Middle Reaches of Yangtze River, Central Plans Urban Agglomeration and Harbin-Changchun Megalopolis Area in the central area and Xi'an Urban Agglomeration and Chengdu-Chongqing Urban Agglomeration in the western area are gradually shaped and their growth rates all exceed 5%. Moreover, urban agglomerations in East Asia are basically growing diffused ones. As old-brand urban agglomerations in Europe, London—Liverpool City Zone, Paris—Rouen—Le Havre Urban Agglomeration in France and Rhine—Ruhr Urban Agglomeration in Germany are always the core of European economic growth. As driven by their development, the Netherlands—Belgium Urban Agglomeration, Milan Metropolitan Area and Piedmont Atlantic Mega Region are gradually shaped and they are all at the stage of growing with a growth of slightly higher than 1%. In India, except for Delhi Metropolitan Area, Mumbai Metropolitan Region, Bangalore Metropolitan Area and Ahmedabad City Zone, there is no other new-type growing urban agglomeration.

Table 2.20 Diffusion and polarization of global major urban agglomerations

Type	Urban agglomerations
Diffused	Fast diffusion: North California Urban Agglomeration, London—Liverpool City Zone, Mumbai Metropolitan Region, 以及中国的 Yangtze River Delta Urban Agglomerations, Pearl River Delta Urban Agglomeration, Beijing-Tianjin-Hebei Urban Agglomeration, Central Plans Urban Agglomeration, Urban Agglomeration in the Middle Reaches of Yangtze River, Xi'an Urban Agglomeration, Liaodong Peninsula Urban Agglomeration, West Taiwan Strait City Belt, Harbin-Changchun Megalopolis and Chengdu-Chongqing Urban Agglomeration, Beibu Gulf Urban Agglomeration Slow diffusion: Northeast U.S. Urban Agglomeration, South California Urban Agglomeration, Mid-West U.S. Urban Agglomeration, Toronto Metropolitan Area, Rhine—Ruhr Urban Agglomeration in Germany, Milan Metropolitan Area
Polarized	Fast polarization: Bangalore Metropolitan Area, Medellin Metropolitan Area, Seoul State Capital Area, Arizona Sunshine Corridor Urban Agglomeration, Mexico City Metropolitan Area, Ahmedabad City Zone Slow polarization: Saint Paul Metropolitan Area, North California Urban Agglomeration, Piedmont Atlantic Mega Region, Shandong Peninsula Urban Agglomeration, the Netherlands—Belgium Urban Agglomeration

Source City and Competitiveness Index Database, CASS

2.3 New Connectivity of Global Cities: Soft Connectivity Are Gradually Dominating the Global Urban System

Urban connectivity is the second feature of cities and one of their basic functions. In the global urban network, urban connectivity determines the status of a city. Global urban connectivity also reflects global economic interconnection and interaction. Global urban connectivity is not just the reflection of the structural relationship of global urban system, but also the expression of that of global spatial economy.

Complete global (urban) connectivity includes not just hard connectivity of tangible objects, but also soft connectivity of intangible ones. Though hard connectivity, integral part and basis of connectivity, remains critical, soft connectivity is gaining importance as we enter into the knowledge and information economy. We invented methods to measure soft connectivity by drawing from traditional measurements of hard connectivity, calculated and analyzed global (urban) connectivity and found: despite their geographical limits, elements of hard connectivity such as ports, railways and resources are still important, and elements of soft connectivity such as information technology and education have broken the limits of time and space and are gradually changing and dominating the global urban system.

2.3.1 Soft Connectivity Are Becoming More and More Important

The new-type global urban connectivity is divided into hard and soft connectivity based on whether the vehicles carrying elements such as production factors, logistics, technology, information and knowledge are tangible or not. Hard connectivity connects different market players, or market players in different areas, with goods, capital, talents and services. Key physical infrastructure of hard connectivity includes: transport infrastructure (aviation, highway and railway transportation), energy transmission systems and logistics systems, so hard connectivity is geographically limited to certain extent. Soft connectivity connects the technology, knowledge, information and thoughts of different market players and regions, through vehicles of press media, magnetic media and electronics. It is supported by both tangible and intangible infrastructure such as communications systems, Internet facilities, cultural and educational facilities, etc. Thus soft connectivity can be understood as the extension of hard connectivity, its development is based on the latter, and the two are mutually inclusive and reinforce each other. Hard connectivity still matters in today's world, but in the 21st century, soft connectivity is taking the upper hand for it is less restricted by the time and space.

By examining their respective features, we find some similarities and differences between hard and soft connectivity. They share three things in common. First, the purpose. Both hard and soft connectivity aims to share resources. Resource sharing between cities can save tangible and intangible costs and allow cities to better play their roles and tap their potentials. Second, the result. Urban connectivity is for better agglomeration and likewise, urban agglomeration is for better connectivity. Hence whether the cities are connected in a hard or soft way for resource sharing, the ultimate result is enhanced connectivity and agglomeration. Third, the reliance on vehicles. Whether the resources shared among cities are tangible or intangible, the sharing can only be realized via certain vehicles. The differences between hard and soft connectivity are as follows: First, hard connectivity is the basis while soft connectivity is its extension. Urban connectivity starts from hard connectivity and gradually focuses on soft connectivity. Second, they have different vehicles for resource sharing. In the case of hard connectivity, resources are shared among cities by means of tangible vehicles such as the flow of goods, the flow of people, and multinational corporations, but in the case of soft connectivity, this is realized by intangible vehicles such as information and networks. Third, their coverage varies. Hard connectivity depends on tangible vehicles for resource sharing, so it takes longer time and covers a smaller area. But soft connectivity depends on intangible vehicles for resource sharing, so it takes shorter time and covers a wider area. Fourth, they have different directions for resource sharing. Soft connectivity such as the reputation of a city is generally not directional. Hard connectivity and soft connectivity are both necessary for resource sharing among cities. It is especially so when the resources shared include both coded and uncoded knowledge and information for coded knowledge and information can be shared via hard and soft connectivity, but uncoded knowledge and information can only be shared via hard connectivity.

2.3.2 Hard Connectivity: Distribution Balance, with a Small Gap Between Cities

As the basis of soft connectivity, hard connectivity still plays a significant role in the global urban network. The more advanced the transport, energy and logistics infrastructure is in a city, the more likely the city has strong connectivity with other cities. Hence we use the shipping convenience index, aviation convenience index, and related charts to reflect the hard connectivity between new-type global cities.

Hard connectivity supported by railways and shipping: such connectivity is strong on a global scale, with a small gap between cities, but it is stronger in coastal cities than in inland cities, in across the North Pacific Ocean than in across the North Atlantic Ocean.

Since the Industrial Revolution, railways and shipping, as integral parts of hard connectivity and the mainstream means of transportation for the flow of goods, have shown strong geographical limits. This is clear from the global chart of railway systems and shipping systems (see Fig. 2.32). The railway systems mainly focus on interior connectivity inside a region, such as European Continent, eastern and western North America, southern South America and East Asia. The shipping systems are mainly for cross-region connectivity which shows more geographical limits, such as connectivity between Europe and eastern North America, East Asia and western North America, mainly connectivity across the North Pacific Ocean and across the North Atlantic Ocean. Inside each region, coastal areas are more closely and extensively connected by railway and shipping systems than inland areas. The difference is reflected between coastal cities and inland cities at about west longitude 100 degrees, between inland cities on the right and coastal cities on the left of east longitude 20 degrees, between inland cities on the left and coastal cities on the right of east longitude 110 degrees, and inland cities and coastal cities across the South Atlantic Ocean.

With the altitude and the longitude of global cities and their shortest distance to the nearest port, we can calculate their respective shipping convenience index. Port cities have the highest shipping convenience index 1, including 64 major cities such as London, Los Angeles, Montreal, New York, Hong Kong, Singapore, Shanghai, Taichung, and Pusan. It shows that the more widely and conveniently connected a city is, the easier it is for it to develop. Then we charted the distribution of city rankings (see Fig. 2.33—left) and kernel density distribution (see Fig. 2.33—right). It is clear that the global shipping convenience index is generally high, with nearly 80% of the cities above the level of 0.75. The average shipping convenience index of global cities is 0.8403, backing the above conclusion. The variation coefficient of

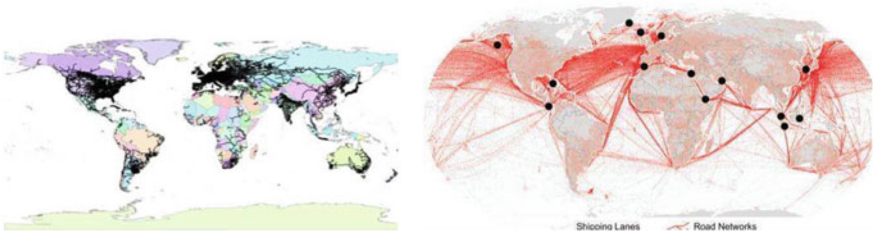

Fig. 2.32 Global railway and shipping systems. *Photo credit* http://www.sohu.com/a/195776941_714463

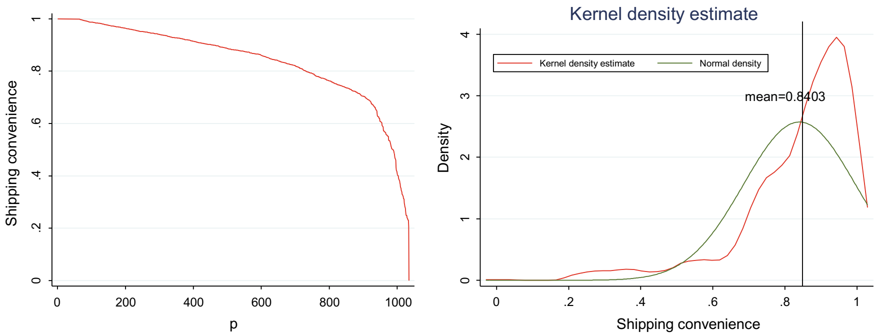

Fig. 2.33 Global shipping convenience distribution and kernel density distribution. *Source* Global Urban Competitiveness Database, CASS

global shipping convenience is 0.184, with little degree of dispersion between cities.

By region, Asia, North America and Europe enjoy greater shipping convenience (see Fig. 2.34 and Table 2.21). Asia, in particular East Asia, has the highest shipping convenience index, followed by North America and Europe. Except for a few port cities, Africa and South America generally suffer from poor shipping convenience, with the worst case in South America. As to international organizations, G7 and BRICS countries generally have great shipping convenience, with G7 countries outperforming BRICS countries. It means that developed economies have better infrastructure of hard connectivity. As to countries and urban agglomerations, major countries generally have sound shipping convenience with little difference in between, and almost all the major urban agglomerations in the world have a shipping convenience index approximate to 1, at the same level with or on the heels of port cities.

Aviation connectivity: big cities are closely connected, but the global aviation connectivity is poor on the whole, with a big inter-city gap and distinct polarization. Developed economies in West Europe and North America significantly outperform developing economies in Asia and Africa in this regard.

Fig. 2.34 Distance from the port

Table 2.21 Shipping convenience by region

Region	Sample	Average value	Region	Sample	Average value
Global	1035	0.8403	USA	79	0.8661
North America	126	**0.8541**	India	102	0.8585
Oceania	7	0.8336	China	292	0.8826
Africa	103	0.7416	UK	13	0.9406
South America	84	0.7007	Northeast U.S. agglomeration	12	0.9544
Europe	130	**0.8381**	London-Liverpool agglomeration	9	0.9613
Asia	585	**0.8755**	Yangtze River Delta urban agglomeration	26	0.9755
G7 countries	149	0.9001	Pearl River Delta urban agglomeration	13	0.9855
BRICS	465	0.8296	Northwest Europe agglomeration	11	0.9882

Source Global Urban Competitiveness Database, CASS

The global aviation network, another part of hard connectivity, is less restricted by spatial and geographical limits than the shipping network, and thus shows completely different results. We calculated the global aviation convenience index based on the data derived from major airport websites, wikipedia, and the websites of international aviation associations. A high aviation convenience index means that the city in question has advanced transportation system and network, and indicates its position in global exchange and activities. The chart of global aviation convenience distribution (see Fig. 2.35-left) shows that West Europe, North America and East Asia enjoy greater aviation convenience than the rest of the world. From the

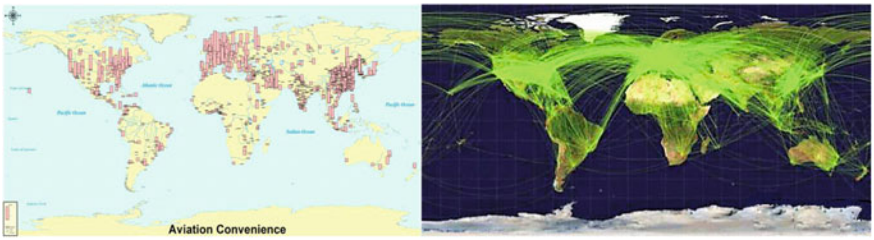

Fig. 2.35 Global aviation convenience and global air routes. *Photo credit* The author and http://www.sohu.com/a/195776941_714463

chart of global air routes (see Fig. 2.35-right) we can clearly see that, air routes connecting West Europe and North America, including cities such as Paris, London, Frankfurt, New York, Chicago and Montreal, air routes connecting West Europe, Middle East and Far East including Hong Kong, Beijing, and Tokyo, and air routes connecting Far East and North America including Beijing, Hong Kong, Tokyo, Seattle, San Francisco and Los Angeles are the busiest. They connect major cities in the world. Figure 2.35 shows that cities with greater aviation convenience are concentrated in coastal areas, with only a few in inland areas.

Among the world's top 10 cities (see Table 2.22), Paris has the highest aviation convenience index 1, followed by Istanbul (0.908), Frankfurt (0.859), Beijing (0.809), Moscow (0.806), Amsterdam (0.767), London (0.740), Atlanta (0.737), New York (0.734) and Shanghai (0.724). It thus can be seen that cities with a higher aviation convenience index tend to be in a higher position in the urban hierarchy. Five of the top 10 cities are in Europe, three in Asia and two in North America, meaning that Europe has the greatest aviation convenience. Since the flow of passengers is the key to the global aviation network, aviation convenience and the

Table 2.22 Top 10 cities with the greatest aviation convenience and their respective population

City	Country	Region	Aviation convenience	Ranking	Population	Ranking
Paris	France	Europe	1	1	12,338,600	25
Istanbul	Turkey	Asia	0.9082	2	14,292,800	21
Frankfurt	Germany	Europe	0.8590	3	2,642,300	179
Beijing	China	Asia	0.8098	4	18,925,239	12
Moscow	Russia	Europe	0.8066	5	12,165,700	26
Amsterdam	Holland	Europe	0.7672	6	1,563,100	312
London	UK	Europe	0.7410	7	12,890,800	24
Atlanta	USA	North America	0.7377	8	5,690,800	68
New York	USA	North America	0.7344	9	20,190,500	9
Shanghai	China	Asia	0.7246	10	22,365,818	6

Source Global Urban Competitiveness Database, CASS

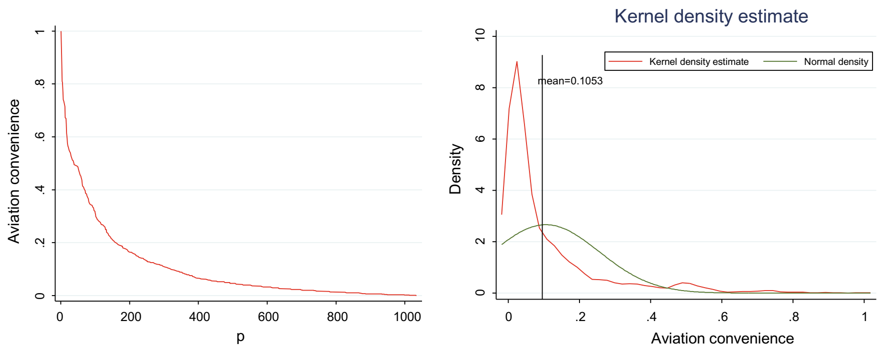

Fig. 2.36 Global aviation convenience distribution and kernel density distribution. *Source* Global Urban Competitiveness Database, CASS

urban population are closely correlated, with the correlation coefficient of 0.4620, indicating significant positive correlation. It means that the bigger a city's population is, the greater its aviation convenience and connectivity with other cities are.

As to the overall aviation convenience (see Fig. 2.36), the world's average aviation convenience index is 0.105, but nearly about 70% of the cities are below the average and the average is high thanks to the outstanding performance of a few cities. The variation coefficient is 1.42, indicating severe fragmentation on the global scale and a huge inter-city gap. From Fig. 2.36 we can see that most of the cities have a low aviation convenience index, with the peak value on the far left, and only a few cities have a high index.

By region (see Table 2.23), Europe enjoys the greatest aviation convenience with the average index of 0.2358, followed by Oceania and North America; at the bottom are Africa, South America and Asia, with the lowest average index of 0.0497 in Africa. By international organization, the average aviation convenience index of G7 is 0.2222, and that of BRICS 0.07. In other words, G7 enjoys much greater aviation convenience than BRICS and developed economies have more mature infrastructure for external connectivity. By country, developed countries such as the UK and the United States have much better aviation convenience than developing countries such as China: the index of the UK is 0.2778, that of the United States 0.1824, and India has the lowest index, 0.0306. It shows that a country's economic development level is to certain extent positively correlated with its aviation convenience. Last but not least, major urban agglomerations in the world all enjoy sound aviation convenience, but there is still a gap between those in developing countries and those in developed countries. For instance, the Northwest Europe agglomeration has the highest index of 0.3718 while the Yangtze River Delta agglomeration has the lowest of 0.113.

Table 2.23 Aviation convenience by region

Region	Sample size	Average value	Region	Sample size	Average value
Global	1035	0.1053	USA	79	0.1824
North America	126	**0.1391**	India	102	0.0306
Oceania	7	0.1625	China	292	0.0799
Africa	103	0.0493	UK	13	0.2778
South America	84	0.0709	Northeast U.S. agglomeration	12	0.2224
Europe	130	**0.2358**	London-Liverpool agglomeration	9	0.3087
Asia	585	0.0831	Yangtze River Delta urban agglomeration	26	0.1130
G7 countries	149	0.2222	Pearl River Delta urban agglomeration	13	0.1178
BRICS	465	0.0700	Northwest Europe agglomeration	11	0.3718

Source Global Urban Competitiveness Database, CASS

2.3.3 Soft Connectivity of Global Cities: IT-Driven Cities, Supercities Dominate Internal and External Urban Connectivity

It is difficult to identify or accurately measure soft connectivity of knowledge, thoughts and information among cities, but it can be reflected in the media influence and reputation of these cities. Hence we used big data, googled the English names of every two cities and found out their connectivity based on the search results shown. Specifically we have 137 pairs out of the 138 sample cities, and the sum of search results of the 137 inquiries represents the total urban connectivity. On the whole (see Table 2.24), among the 138 cities we chose with the highest global connectivity, 12 are in North America, 12 in South America, 27 in Europe, two in Oceania, 40 in Africa and 45 in Asia.

General pattern: the global soft urban connectivity is generally poor, the inter-city gap is huge, the urban hierarchy rigid, and fragmentation severe; Europe significantly outperforms Asia and Americas, Africa is at the bottom and lags far behind the rest regions, and developed economies are much superior than developing economies.

Globally speaking, the average soft connectivity index is 0.1245, with 47 cities above the average and 91 below it, accounting for nearly 66% of the total sample. The root cause is that the connectivity among a handful of super-cities is extremely

Table 2.24 Connectivity index by region and city

Region	Sample size	Average connectivity index	Urban hierarchy	Sample size	Average connectivity index
Global	138	0.1245	A+	2	**0.9351**
North America	12	0.1210	A	2	**0.5801**
Oceania	**2**	0.3229	A−	8	0.3488
Africa	40	0.0345	B+	4	0.3444
South America	12	0.1091	B	4	0.2825
Europe	27	**0.2861**	B−	12	0.1905
Asia	45	0.1038	C+	13	0.2049
G7 countries	7	**0.6288**	C	13	0.0879
BRICS	7	0.2733	C−	80	0.0346

Source Collected, sorted and calculated by the author based on big data

extensive and close, which drives up the average level. The variation coefficient is 1.44, indicating severe fragmentation on the global scale and a huge inter-city gap.

By region (see Table 2.24), Oceania has the highest average index because of the small sample size, followed by Europe (0.2861) and North America (0.121); the index is around 0.1 in both South America and Asia, and Africa has the lowest index of 0.0345, with a huge gap with the rest regions. It shows that major European cities are more closely connected with cities in other regions. In other words, global urban connectivity centers are concentrated in Europe, followed by North America. Africa's external connectivity index is only one tenth of Europe's, which reveals a very huge gap between African cities and European cities in the global urban connectivity network. This finding is consistent with the fact that cities with high income and position in the urban hierarchy are concentrated in West Europe and North America and those with lower income and at the bottom of the urban hierarchy are mostly in Africa. As to international organizations, the average connectivity index is 0.6288 in G7 and 0.2733 in BRICS. It shows that cities in developed countries have much stronger external connectivity than those in developing countries. As to the urban hierarchy of the 138 sample cities, the higher the city is in the hierarchy, the higher its urban connectivity index is; the lead of top-ranking cities is obvious: the average urban connectivity index of A+ cities is 0.9351, that of A cities 0.5801 and that of A− cities 0.3488, and the inter-city gap is also big.

Factor analysis: IT-driven cities, financial cities and educational cities, especially IT-driven cities, dominate the global urban connectivity, and the city size bears little association with the city's total contact

To grasp the total contact of each city, we list in Table 2.25 the total contact and relevant indicators of the top 20 cities among the 138 primate cities in the world.

Table 2.25 Top 20 cities by total contact and relevant indicators (unit: million)

City	Country	Total contact	City size	Per capita income	Financial index	Technology index	Paper index	University index
London	UK	**53.85**	**1306.14**	**38085.36**	**0.6794**	**1.0000**	**1.0000**	**0.8410**
New York	USA	**46.90**	**2031.16**	**57451.77**	**1.0000**	**0.9927**	**0.9140**	**0.9437**
Paris	France	**42.92**	1244.03	**33726.66**	0.4453	**0.7703**	0.2206	0.2168
Singapore	Singapore	**31.38**	564.73	30060.00	0.4473	0.6210	0.1139	0.6418
Hong Kong	China	31.34	736.84	30160.00	**0.6002**	0.5630	0.1155	0.5186
Madrid	Spain	29.46	634.82	22439.47	0.4263	0.6781	**0.4166**	0.3283
Amsterdam	Holland	29.28	157.49	27020.12	0.2677	0.5314	0.1259	0.5624
Berlin	Germany	27.49	524.51	20691.67	0.2363	0.5998	0.1209	0.3829
Sydney	Australia	24.72	454.26	**36463.88**	0.4164	0.5194	0.1664	0.6068
Toronto	Canada	24.08	608.45	25420.77	0.4428	0.5634	0.1648	**0.8553**
Rome	Italy	22.42	441.54	24465.85	0.3204	0.3917	0.1039	0.4426
Tokyo	Japan	20.14	**3597.87**	24532.03	**0.6033**	**0.9041**	0.2003	**0.6811**
Dublin	Ireland	19.70	207.36	26805.06	0.3129	0.5203	0.0582	0.3420
Istanbul	Turkey	19.01	**1449.29**	9687.03	0.358407	0.586308	0.209431	0.1612
Bangkok	Thailand	17.90	1238.31	6297.33	0.3319	0.3616	0.1172	0.1795
Vienna	Austria	17.48	251.70	28567.00	0.2768	0.4965	0.0814	0.4486
Stockholm	Sweden	17.24	232.83	33355.89	0.3064	0.7380	**0.2464**	0.3889
Budapest	Hungary	17.00	264.03	8687.77	0.2333	0.4231	0.0399	0.1920
Brussels	Belgium	16.11	279.50	24224.27	0.3319	0.4635	0.0096	0.2532
Taipei	Taiwan, China	15.42	708.82	15642.04	0.3393	0.4715	0.0965	0.5995

Source Collected, sorted and calculated by the author based on big data

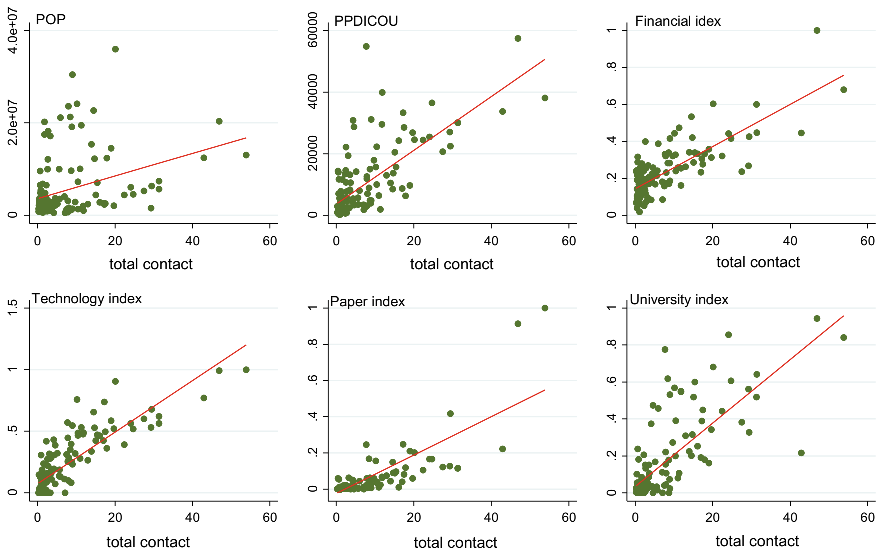

Fig. 2.37 Scatter diagram of total contact and relevant indicators. *Source* Collected, sorted and calculated by the author based on big data

From Table 2.25 we can see that the world's top most connected cities are widely distributed in Europe (11), Asia (6), Oceania (1) and North America (2). Table 2.24 shows that the total contact of a city is strongly associated with its per capita income, financial index and technology index; cities with stronger external connectivity tend to be bigger in size, richer and more advanced in finance, S&T and education. For instance, London, New York and Paris are the top three cities in terms of total contact; they are also in the front rank in relevant indicators, in particular the technology index. It shows that cities which are the financial, S&T, knowledge and education hubs are more connected than other cities.

From the scatter diagram of total external connectivity and relevant indicators (see Fig. 2.37), the city size, per capita income, financial index, technology index, paper index and university index have significant positive correlation with the total contact: the bigger they are, the more external connectivity the city has. Figure 2.37 also shows that the financial index and the technology index have much more correlation than the rest, as their scatter fluctuates slightly around the fitted curve. As to relevant coefficients (see Table 2.26), the correlation coefficient between total contact and the technology index is the highest, 0.846, followed by that between it and the paper index, the financial index, the university index and per capita income, at 0.7978, 0.7894, 0.7602, and 0.7343, respectively, and that between total contact and the city size is only 0.3515. This echoes the conclusion above: cities which are the financial, S&T, knowledge and education hubs are more connected than other cities.

Based on big data search, after removing the mutual connectivity and interior connectivity data of the 138 sample cities, we have 9,453 data samples of different

Table 2.26 Coefficient of correlation between total contact and relevant indicators

Correlation coefficient	City size	Per capita income	Financial index	Technology index	Paper index	University index
Total contact	0.3515	0.7343	**0.7894**	**0.8460**	0.7978	0.7602

Source Collected, sorted and calculated by the author based on big data

city pairs. Now let's look at the soft connectivity between every two of the 138 sample cities from perspectives of region, urban hierarchy, city-to-city distance, city development level, city size and city functions.

General regional pattern: Europe, as the hub of soft connectivity, dominates internal and external urban connectivity, followed by North America, South America and Asia, and Africa is at the bottom and far below the global average level.

From the perspective of internal connectivity of each region (see Table 2.27), Oceania has only two sample cities, both of which are top ranking in the urban hierarchy and closely connected, placing Oceania top of the ranking, with the index of 64.7. Except for Oceania, the internal connectivity of Europe is much stronger than that in North America, South America, Asia and Africa, even by several or dozens of folds. The gap between North America, South America and Asia is not big, but the internal connectivity of North America is clearly stronger than that in the other two regions. Africa is at the bottom with the internal connectivity index of 1.1504. From the perspective of cross-region connectivity (see Table 2.27), except for Oceania, the interconnectivity between Europe and North America is the strongest, at 10.2626, followed by that between Europe and South America, 8.6653, that between Europe and Asia at 7.4802 and that between North America and South America at 6.5541. The interconnectivity between the rest of the world is poor, with the poorest between Africa and the rest of the world. It shows that Europe is at the center of global connectivity and connects major primate cities in North America, South America and Asia, and Africa has the poorest external connectivity.

Connectivity between every pair of cities and between ranks of urban hierarchy: the global connectivity between every pair of cities is generally low and severely fragmented, and the connectivity gap between different ranks of cities is big: supercities dominate internal and external urban connectivity, big cities are more closely and extensively connected to each other, and the connectivity between big cities and small cities and among small cities is poor.

The average connectivity quantity between every pair of cities is 5.042 million, with the maximum of 497 million and the minimum of 0.0000006 million. The soft connectivity of nearly 85% of the city pairs is below the average level, with only 15% of them, mostly pairs of big cities, above the level. The variation coefficient is 3.23, indicating a very big soft connectivity gap and extremely severe

Table 2.27 Interconnectivity of different regions

	North America	Oceania	Africa	South America	Europe	Asia
North America	**7.4830 (66)**					
Oceania	**12.3567 (24)**	64.7000 (1)				
Africa	1.2402 (480)	2.8326 (80)	1.1504 (780)			
South America	6.5541 (144)	10.7411 (24)	1.4516 (480)	6.4071 (66)		
Europe	**10.2626 (324)**	**25.9778 (54)**	2.3423 (1080)	**8.6653 (324)**	**32.7814 (351)**	
Asia	3.6638 (540)	13.3745 (90)	1.5143 (1800)	3.3507 (540)	**7.4802 (1215)**	4.4356 (990)
Regional average	**4.8372 (1578)**	12.64527 (273)	1.632233 (4700)	4.396781 (1578)	**9.157678 (3348)**	4.096053 (5175)

Note The above table lists the data of connectivity with the unit of million, and the data within brackets represents the sample size
Source Collected, sorted and calculated by the author based on big data

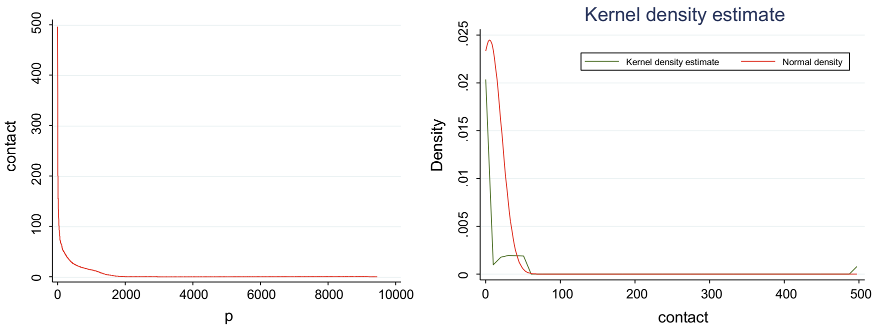

Fig. 2.38 Global distribution of soft connectivity between every pair of cities and kernel density distribution

fragmentation, which is shown in the distribution of soft connectivity between every pair of cities and the kernel density distribution (see Fig. 2.38).

As to the internal connectivity of each rank of cities (see Table 2.28), the internal connectivity of the top rank of cities obviously outnumbers that of lower ranks: A+ cities have 497 contacts among them, A cities 329, and A− cities 38.95. It shows that the internal connectivity gap between high-ranking cities and low-ranking ones is huge and the higher the rank, the bigger the difference. The connectivity between different ranks of cities also varies greatly (see Table 2.28). A+ cities have the most and closest external connectivity, followed by A cities and D cities are at the

Table 2.28 Connectivity between different ranks of the global urban hierarchy

	A+	A	A−	B+	B	B−	C+	C	C−	D
A+	**497 (1)**	**170.70 (4)**	**106.85 (16)**	**116.09 (8)**	**77.38 (8)**	55.59 (24)	59.75 (26)	30.44 (26)	14.98 (74)	4.11 (86)
A		**329 (1)**	**65.05 (14)**	56.31 (258)	42.63 (8)	34.04 (24)	31.01 (26)	12.94 (26)	7.03 (74)	7.20 (86)
A−			38.95 (28)	43.03 (32)	34.50 (32)	22.28 (96)	24.71 (104)	9.15 (104)	5.79 (296)	1.14 (344)
B+				35.23 (6)	35.68 (16)	19.92 (48)	22.82 (52)	10.04 (52)	4.84 (148)	2.12 (172)
B					28.48 (6)	17.90 (48)	21.05 (52)	7.42 (52)	4.52 (148)	1.06 (172)
B−						9.46 (66)	12.83 (156)	4.93 (156)	3.03 (444)	0.71 (516)
C+							13.10 (78)	6.22 (169)	3.63 (481)	1.06 (559)
C								2.41 (78)	1.92 (481)	0.70 (559)
C−									1.15 (666)	0.73 (1591)
D										0.72 (903)

Note The above table lists the data of connectivity with the unit of million, and the data within brackets represents the sample size
Source Collected, sorted and calculated by the author based on big data

bottom. What's more, A+, A, A− and B+ cities control most of the global urban connectivity while C− and D cities have only loose connectivity between them and with higher-ranking cities. It shows that big cities are more widely and closely connected with each other, but the connectivity between big cities and small cities and among small cities is poor.

Factor analysis: the city size and the city-to-city distance bear almost no impact on the soft connectivity between every pair of cities, but information technology, finance, education and the city development level are significantly positively correlated with the latter, especially in the case of IT-driven cities; equivalent functional cities are more closely connected.

The city-to-city distance has little to do with the total contact between cities, which is clearly shown in the first chart of Fig. 2.39. The distribution of the distance and the total contact between cities is random, and their correlation coefficient is −0.0674, showing little correlation between them (see Table 2.29). The city development level is positively correlated with inter-city connectivity: the higher the city development level, the more connectivity between the two cities concerned. From the third chart of Fig. 2.39 we can see that balanced economic development of the two cities bears more influence on their connectivity, with the sum correlation coefficient of 0.4174 and the multiplication correlation coefficient of 0.5095. In

Table 2.29 The coefficient of correlation between inter-city connectivity and the city-to-city distance, the city development level and the city size

Inter-city connectivity	City-to-city distance	The sum of economic development level	The multiplication of economic development level	The sum of city size
Correlation coefficient	−0.0674	0.4174	0.5095	0.2129

Source Collected, sorted and calculated by the author based on big data

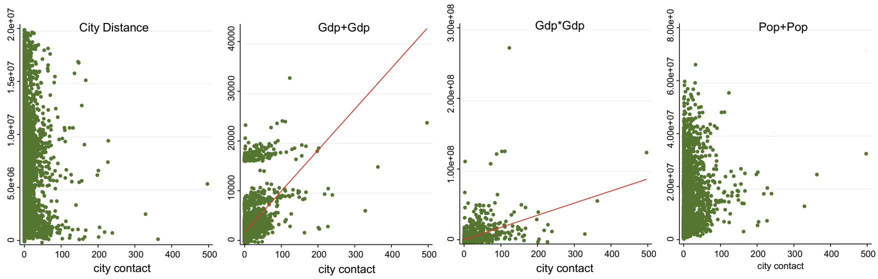

Fig. 2.39 The relationship between the city-to-city distance, the city's economic development level and inter-city connectivity

other words, the closer they are at the development level, the more connected they are. The city size has little to do with inter-city connectivity (see Fig. 2.39-4): the city size and the inter-city connectivity are randomly distributed, with the correlation coefficient of 0.2129.

To examine the size, income and functions of each city on the inter-city connectivity, we first looked at the top 20 cities with the strongest inter-city connectivity (see Table 2.30).[1] P1 represents the ranking of population balance between the two cities in each pair, P2 the per capita income balance, P3 the financial index balance, P4 the technology index balance, P5 the paper index balance, and P6 the university index balance.

Table 2.26 shows that, London and New York, two top cities in the world, without doubt top the ranking with 497 million contacts between them, followed by London and Paris (363 million contacts), Hong Kong and Singapore (329 million contacts), London and Berlin (239 million contacts) and London and Hong Kong (228 million contacts). The ranking is dominated by connectivity between a few supercities and between big cities. We also notice that New York is connected to six of the top 20 cities and London, eight of them. It means that London and New York are still at the center of urban connectivity. As to relevant indicators, the inter-city

[1]Then we used the multiplication of the two cities' respective data of each indicator to measure the general balance between them in each indicator in question.

Table 2.30 Top 20 cities with the strongest inter-city connectivity

City 1	City 2	Total contact (million)	P1	P2	P3	P4	P5	P6
New York	London	**497**	153	**3**	**1**	**1**	**1**	**2**
London	Paris	**363**	305	44	39	**4**	**8**	323
Hong Kong	Singapore	**329**	1471	120	58	191	326	107
London	Berlin	**239**	822	181	289	**20**	25	120
London	Hong Kong	**228**	561	62	**15**	30	27	51
Paris	Berlin	218	874	238	872	79	151	748
Athens	Vienna	204	3944	321	1563	612	547	232
New York	Toronto	202	430	31	**9**	32	**20**	**1**
New York	Berlin	198	505	57	94	21	30	86
Paris	Madrid	167	703	199	178	45	39	833
New York	Singapore	167	466	**15**	**6**	**18**	33	**8**
Paris	Amsterdam	164	2753	118	627	117	147	514
Dublin	Colombo	163	7320	2617	3258	900	1655	2281
London	Amsterdam	159	2652	87	206	38	24	35
New York	Amsterdam	156	1855	26	59	42	28	**17**
New York	Hong Kong	156	337	**14**	**3**	34	32	30
London	Toronto	149	699	103	41	29	**16**	**4**
London	Brussels	149	1656	116	104	78	441	257
London	Sydney	148	988	37	49	47	**15**	25
London	Madrid	146	671	146	42	**12**	**2**	171

Source Collected, sorted and calculated by the author based on big data

connectivity has little to do with the city size, but is more correlated to the financial index, the technology index and the knowledge and education index; as to the inter-city connectivity gap, the higher the per capita income, the financial index, the technology index, the paper index and the university index, the more connectivity between the cities. In general, for each pair of cities, the bigger their respective financial index, technology index and education index and the smaller their gap, the more connected they are. In other words, big cities are more widely and closely connected to each other.

From the scatter diagram and correlation coefficients of connectivity and indicators of each pair of cities (see Fig. 2.40 and Table 2.31) we can see that the

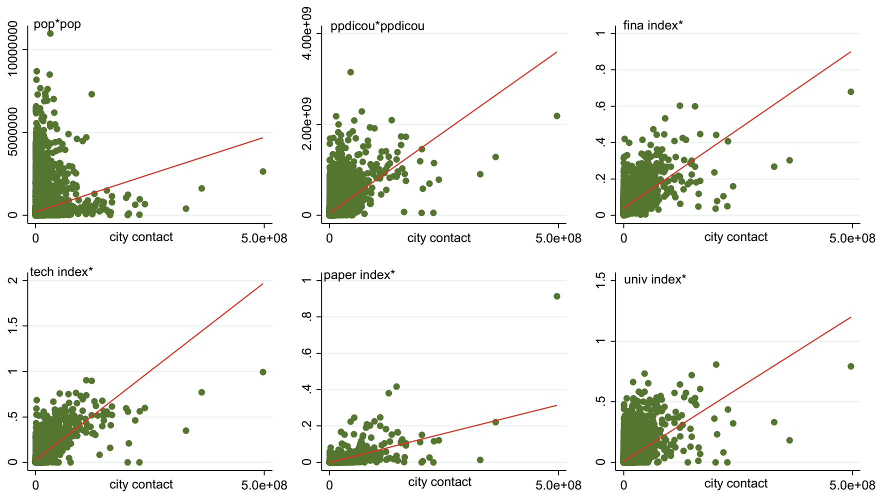

Fig. 2.40 Scatter diagram of connectivity and relevant indicators of each pair of cities. *Source* Collected, sorted and calculated by the author based on big data

inter-city connectivity has little to do with the balance in city size, with the correlation coefficient of only 0.2236 and great deviation from the fitted curve; but it has much to do with the balance in S&T, finance, education and income, with the correlation coefficient of 0.6936, 0.6027, 0.5984 and 0.583, respectively, and fluctuation around the fitted curve. Based on that we come to the conclusion that: the inter-city connectivity is highly homogeneous—the smaller the difference and the bigger the index, the more closely the two cities are connected.

Global soft urban connectivity: a multi-center landscape is taking shape

Neal (2011) pointed out that urban development was moving from hierarchical development to networked development. To analyze and visualize the soft connectivity between primate cities in the world,[2] we used Ucinet 6 to chart the network structure of primate cities based on their interconnectivity. Due to the space limit, we list only the connectivity network structure of top 10, top 20, top 30, top 40 primate cities and all the primate cities, respectively. Consistent with the global hard urban connectivity result, North America, West Europe and East Asia, three major economic powerhouses in the world, occupy all the key nodes in the soft connectivity network structure, indicating that a global multi-center landscape is taking shape. From new urban agglomerations worldwide we can see that a multi-center network structure has formed with New York in North America, London in West Europe, Paris in France and Hong Kong in East Asia as the centers,

[2]Based on research needs and data availability, we assume that the most populous city in a country is the primate city of that country. For countries with a big population such as China, we assume their two most populous cities as primate cities.

Table 2.31 Correlation coefficient of inter-city connectivity and relevant factors

Correlation coefficient	Population aggregation degree	Income aggregation degree	Financial index aggregation degree	Technology index aggregation degree	Paper index aggregation degree	University index aggregation degree
Degree of connectivity between each pair of cities	0.2236	0.5830	**0.6027**	**0.6936**	**0.6532**	**0.5984**

Source Collected, sorted and calculated by the author based on big data

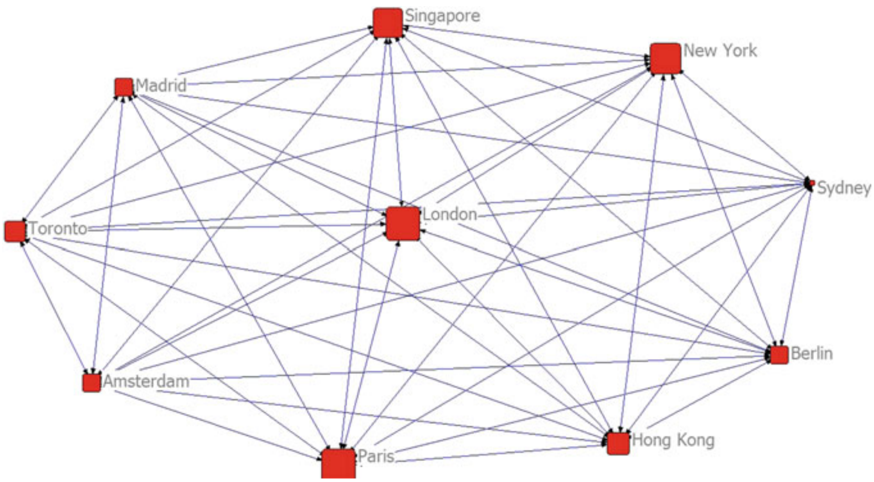

Fig. 2.41 The connectivity network structure of the world's top 10 primate cities

and other cities in North America, Europe and Asia as the margin. Figure 2.41 the connectivity network structure of the world's top 10 primate cities.

Figure 2.41 shows the spatial network structure of the world's top 10 primate cities formed by their interconnectivity. Each of these cities is a node of the network and affects the whole network through its connectivity with the rest cities. London is at the center and the biggest node of the network, with strong connectivity with each of the other nine cities. In the descending order of the size of nodes they represent, these nine cities are New York, Paris, Singapore, Hong Kong, Madrid, Amsterdam, Berlin, Sydney and Toronto. Their connectivity network structure is consistent with the result of Table 2.23. Similarly, these nine cities are also mutually connected, constituting and affecting the inter-city connectivity network.

Figure 2.42 shows the spatial network of the world's top 20 primate cities formed by their interconnectivity. In this network, London is still the biggest and the central node, with soft connectivity with the other 19 cities. So London is the center of the universe of cities. Similarly, sub-centers New York, Paris, Singapore and Hong Kong each forms a spatial network through their respective connectivity with the rest 19 cities. It's noteworthy that the connectivity network of the top 20 primate cities is denser than that of the top 10 cities. It thus can be seen that the more primate cities the network has, the more frequent interconnectivity these cities have, and the denser the network is.

Figures 2.43 and 2.44 show the connectivity network of the top 30 and top 40 primate cities, respectively. Like Figs. 2.41 and 2.42, London is still the central node of the two networks, with soft connectivity with the other 29 and 39 cities, respectively. Sub-centers New York, Paris, Singapore and Hong Kong each forms a spatial network through their respective connectivity with the rest 29 and 39 cities, respectively, and affects the whole network through it. Meanwhile as the number of

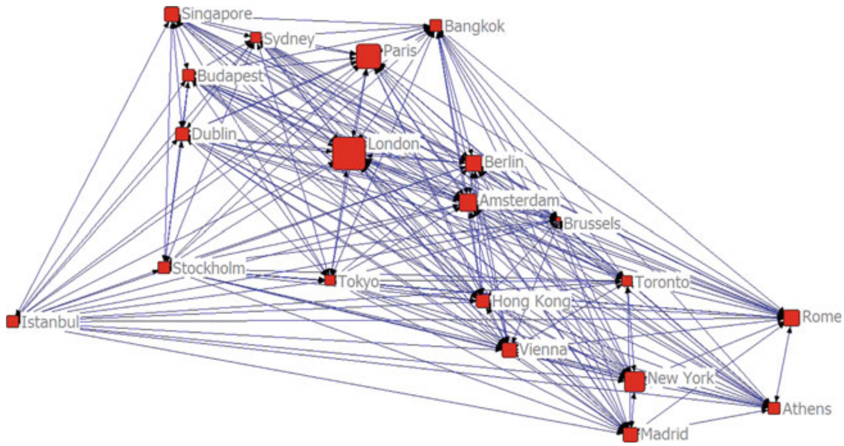

Fig. 2.42 The connectivity network structure of the world's top 20 primate cities

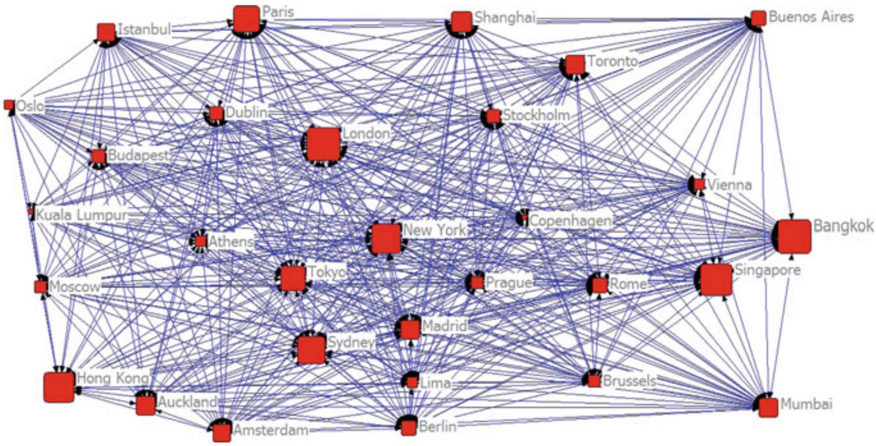

Fig. 2.43 The connectivity network structure of the world's top 30 primate cities

primate cities grows, their interconnectivity intensifies, and their connectivity network becomes denser (Fig. 2.45).

Global distribution of international visibility: the distribution of international visibility is severely fragmented among cities; for top-ranking cities, their visibility has little to do with relevant indicators but for low-ranking cities, the two are positively correlated.

We used big data and googled the city name to calculate the international visibility index of each sample city based on the search results. From its general distribution (see Table 2.32), we can see that international visibility varies greatly from city to city. Only two cities have the international visibility index between 0.1

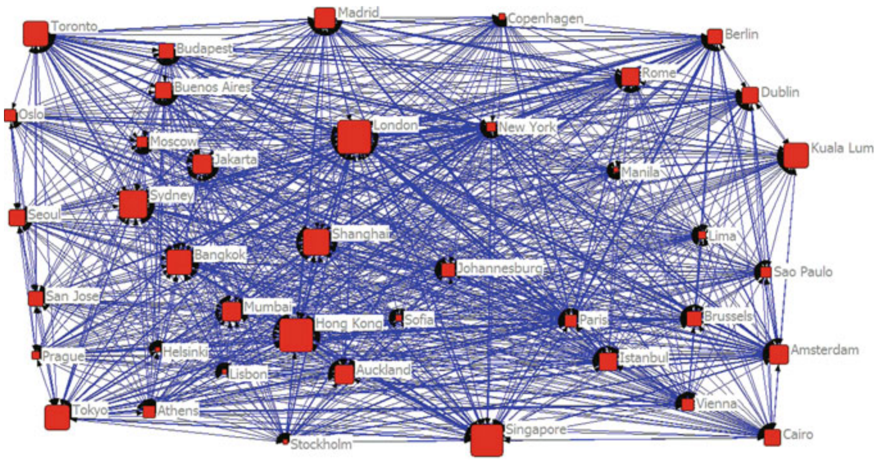

Fig. 2.44 The connectivity network structure of the world's top 40 primate cities

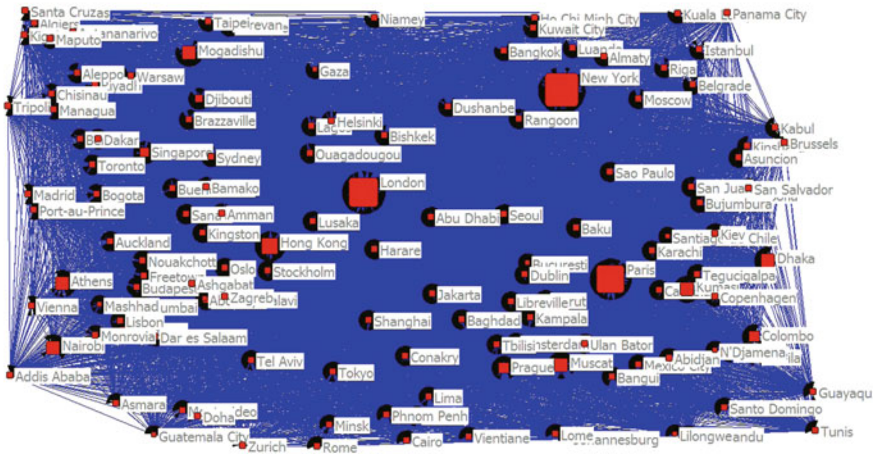

Fig. 2.45 The connectivity network structure of the world's top 138 primate cities

Table 2.32 General distribution of international visibility among cities

Value range of the visibility index	(0.1, 1]	(0.01, 0.1]	(0.001, 0.01]	(0.0001, 0.001]	[0, 0.0001]
Sample size	2	21	299	592	121

Source Collected, sorted and calculated by the author based on big data

Table 2.33 The world's 10 most famous cities

City	Country	The visibility index	Ranking of per capita GDP	Ranking of city size	Ranking of the university index	Ranking of the financial index	Ranking of the technology index
New York	USA	1.0000	11	9	4	1	2
Manchester	UK	0.2400	126	162	30	115	64
Leicester	UK	0.0907	136	576	95	336	197
Quebec	Canada	0.0496	154	641	111	419	96
London	UK	0.0484	31	23	11	2	1
Columbia	USA	0.0412	100	640	51	357	36
Taipei	Taiwan, China	0.0325	195	54	29	37	103
Los Angeles	USA	0.0316	19	22	203	14	17
Birmingham	UK	0.0316	148	155	92	54	59
Orlando	USA	0.0270	83	208	96	108	107

and 1, only 21 between 0.01 and 0.1 and the majority of cities have the index between 0.0001 and 0.01.

Among the world's 10 most famous cities (see Table 2.33), New York claims the highest international visibility, with the standard index of 1. It is followed by Manchester (0.24), Leicester (0.0907), Quebec (0.0496), London (0.0484), Columbia (0.0412), Taipei (0.0325), Los Angeles (0.0316), Birmingham (0.0316) and Orlando (0.027). They are mostly distributed in the United States and the UK. As to specific indicators, New York is in the front row in the ranking of indicators such as the city size, per capita income, finance, S&T and education. But for the other cities, these indicators have little impact on their international visibility. This might be due to the small difference in international visibility among the top 10 cities, which makes it impossible to determine the relevance of each indicator. To solve the problem, we drew a scatter diagram of these indicators with the international visibility index less than 0.01 (see Fig. 2.46). It is clear that in this case, the

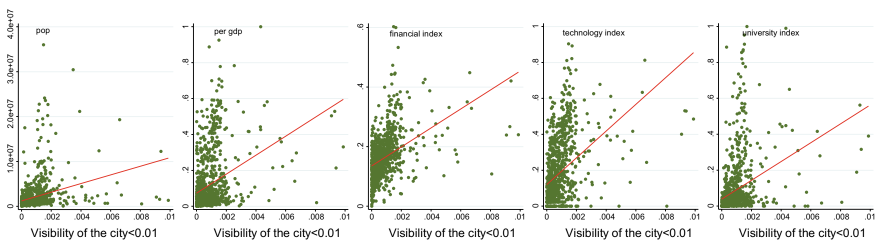

Fig. 2.46 Scatter diagram of relevant indicators with the international visibility index less than 0.01. *Source* Collected, sorted and calculated by the author based on big data

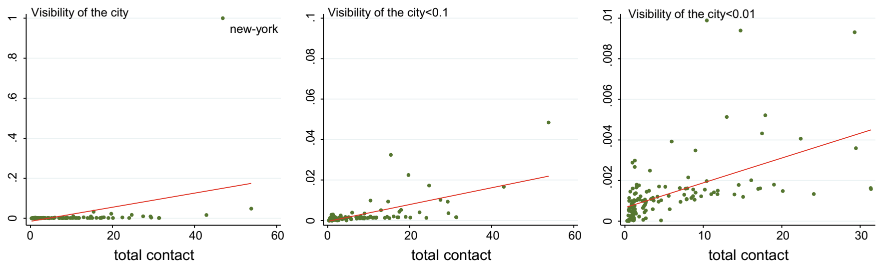

Fig. 2.47 Scatter diagram of international visibility and urban connectivity. *Source* Collected, sorted and calculated by the author based on big data

correlation between the international visibility and the city size, income, financial index, technology index, and university index is significantly augmented, with the coefficient of 0.302, 0.3486, 0.4475, 0.4178 and 0.3641, respectively. It means that the bigger the city is and the more advanced its finance, S&T and education are, the more famous the city is.

Comparison of international visibility with soft and hard connectivity: for top-ranking cities, international visibility has little to do with soft and hard connectivity; for medium- and low-ranking cities, it has much to do with soft connectivity, but little to do with hard connectivity.

As to the association between the visibility and the soft connectivity of a city, the international visibility index is generally highly consistent with the global soft connectivity index (see Fig. 2.47). From left to right of Fig. 2.47 are scatter diagrams of the soft connectivity index with the international visibility index less than 1, 0.1 and 0.01, respectively. We can see that after a few extreme values are removed, the international visibility of a city shows strong correlation with its external connectivity, which is reflected in the correlation coefficient. The general correlation coefficient is 0.3968; when the international visibility index is less than 0.1, the coefficient is 0.6570; when it is less than 0.01, the coefficient is 0.5327. It shows that the more famous a city is, the more it is connected to the outside world and the stronger its soft connectivity is.

As to the association between the visibility and the hard connectivity of a city, the international visibility index has clear association with the global aviation connectivity index (see Fig. 2.48-top) but weak association with the shipping connectivity index (see Fig. 2.48-bottom). From left to right of Fig. 2.48 are scatter diagrams of the hard connectivity index and the international visibility search result when the sum is considered, or when it is less than 10 (million), or less than one (million), respectively. We can see that after a few extreme values are removed, the international visibility of a city shows certain correlation with its aviation connectivity, which is reflected in the correlation coefficient (see Table 2.34). The general correlation coefficient is 0.2396; when the international visibility search

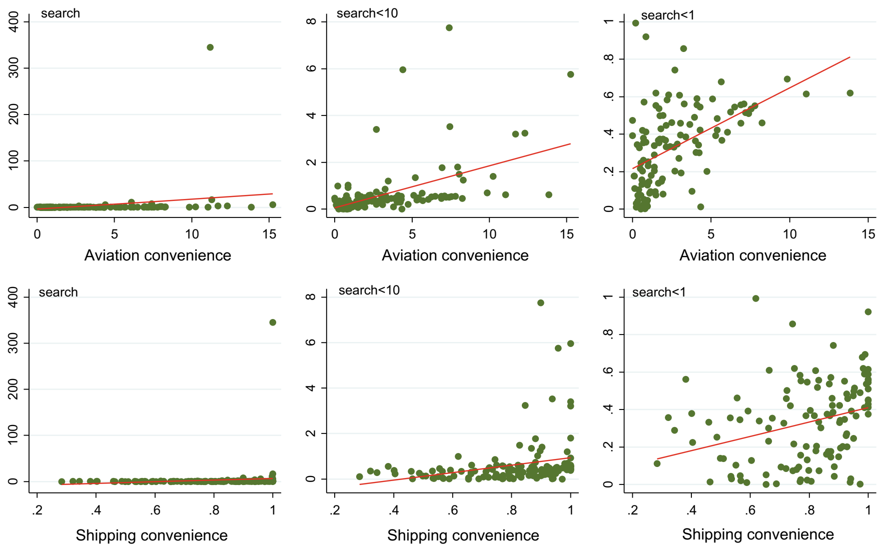

Fig. 2.48 Scatter diagram of international visibility and hard connectivity

Table 2.34 Correlation coefficient between international visibility and hard connectivity

Correlation coefficient	Measurement of international visibility	Measurement of international visibility <10	Measurement of international visibility <1
Aviation connectivity	0.2396	0.5149	0.4982
Shipping connectivity	0.1107	0.2649	0.3095

Source Global Urban Competitiveness Database, CASS

result is less than 1 (million), the coefficient is 0.4982. It means that the city's visibility has certain association with its aviation connectivity. The international visibility of a city has little to do with its shipping connectivity, which is also shown in the correlation coefficient (see Table 2.34). The general correlation coefficient is 0.1107, indicating very weak correlation; when the international visibility search result is less than 1 (million), the coefficient is 0.3095, and the correlation is still very weak. It means that the city's visibility has little association with its shipping connectivity.

2.3.4 The Relationship Between Soft and Hard Connectivity: Soft Connectivity Are More Extensive, More Unbalanced, and More Visible in Relation to Hard Connectivity

Based on the above analysis, we find not just similarities but also more distinct differences between hard connectivity and soft connectivity. First, we notice that the global gap of soft urban connectivity and that of hard aviation connectivity are both huge, featuring severe fragmentation. But given the same sample cities, we find that the variation coefficient of soft connectivity is 1.38 while that of hard connectivity 0.97, meaning that soft connectivity is more unevenly distributed than hard connectivity.

In terms of differences: the global landscape remains the same, with Europe as the center and Africa on the margin; Asia, South America and in particular Oceania are approaching the center of the global urban network through soft connectivity; the hard connectivity gap between different ranks of cities is small, but the soft connectivity hierarchy is rigid and severely fragmented.

By region, Oceania tops the world in terms of soft connectivity and Europe, hard connectivity, and the rest regions differ little in hard connectivity but greatly in soft connectivity. Asia is above the global average in hard connectivity but below it in soft connectivity, which means that Asia has sound infrastructure but lags behind the world average in aspects of IT and electronic technology. Compared with Asia, North America has poorer hard connectivity but stronger soft connectivity, meaning that it has an edge in IT. Africa is at the bottom of the global ranking of both hard and soft connectivity. G7 countries have stronger soft and hard connectivity than BRICS countries. It means that developed countries have more mature infrastructure and IT. We also notice that the soft connectivity difference is greater than the hard connectivity difference, indicating an even bigger IT gap. The soft connectivity is hierarchical: the higher a city ranks, the stronger its soft connectivity is and the bigger its gap with low-ranking cities; but in case of hard connectivity, the difference is not so distinct, with only small difference between medium- and high-ranking cities (Table 2.35).

In terms of correlation: the higher a city ranks, the weaker the correlation between its soft and hard connectivity.

North America and Oceania have the strongest correlation between hard connectivity and soft connectivity, followed by South America, Europe and Asia. The correlation is the poorest in Africa. The correlation coefficient between hard and soft connectivity in G7 countries is bigger than it is in BRICS countries, meaning that developed economies have closer correlation between hard and soft connectivity. The higher a city ranks, the weaker the correlation between its soft and hard connectivity: the correlation coefficient of first-category cities is 0.5566, that of

Table 2.35 Comparison of soft connectivity and hard connectivity of different regions and ranks

Region	Sample size	Average soft connectivity index	Average hard connectivity index	Urban hierarchy	Sample size	Soft connectivity	Average hard connectivity index
Global	138	6.9624	3.3010	A+	2	50.3753	11.2500
North America	12	6.7724	2.7000	A	2	31.3599	6.8000
Oceania	2	**17.5843**	3.5500	A−	8	18.9725	8.3875
Africa	40	2.1422	1.2183	B+	4	18.7381	7.9875
South America	12	6.1342	2.6917	B	4	15.4206	10.7250
Europe	27	**15.6171**	**6.7722**	B−	12	10.4929	5.6292
Asia	45	5.8536	3.3813	C+	13	11.2642	4.9923
G7 countries	7	33.9723	10.1571	C	13	4.9980	2.6192
BRICS	7	14.9303	7.1571	C−\D	80	2.1450	1.3874

Source Sorted and calculated by the author

Table 2.36 Correlation coefficient of soft connectivity and hard connectivity of different regions and ranks

Soft connectivity and hard connectivity	Global	North America	Oceania	Africa	South America	Europe	Asia
Correlation coefficient	0.8195	0.9000	1.0000	**0.7006**	0.8612	0.7800	0.7435

Soft connectivity and hard connectivity	G7 countries	BRICS	First-category cities (A+\A\A−)	Second-category cities (B+\B\B−)	Third-category cities (C+\C\C−)	Fourth-category cities (D)
Correlation coefficient	0.6813	0.2434	0.5566	0.6502	0.8061	**−0.0212**

Source Sorted and calculated by the author

second-category cities 0.6502, and that of third-category cities 0.8061. In other words, the lower a city ranks, the more its soft connectivity relies on its hard connectivity; but when the city is at the bottom of the ranking, its soft connectivity has little to do with hard connectivity (Table 2.36).

2.4 New Global City

2.4.1 The Global City System Is a Function System

Cities play a very important role in technological innovation and economic development. Especially since the era of industrial economy, almost all technological innovations derive from cities, and the majority of economic activities are concentrated in cities. Thus, the pattern and connection of global economic development and technological innovation are mainly reflected on the city level. Therefore, the content and scope of globalization directly determine the scope of global city system.

The rapid development of globalization is integrating global cities into an organic whole. An interconnected global city system has already taken shape. A city system refers to a group of cities in the same space that are functionally differentiated and hierarchically ordered in terms of size. It encompasses the city size system and city function system. The city size system usually refers to the system formed by the hierarchical distribution of population among the cities. The city function system refers to the system of inter-city functions. Different cities play different functions in the whole city system due to their different statuses in the industrial chain. These cities with different functions couple with each other to form a stable function system.

Globally speaking, due to the existence of national boundaries, labor forces are unable to move freely as industries and capital do; therefore, the city size system and city function system are separated. Take the world's top ten cities in population size for example. In 2015, the world's top ten cities in population size were Tokyo, Delhi, Shanghai, São Paulo, Mumbai, Mexico City, Beijing, Osaka, Cairo, and New York. Tokyo ranks the first in the world with a population of 38 million, and New York at No. 10 also has a population of 18.59 million. In terms of population size, Delhi, São Paulo, Mumbai, Mexico City and Cairo should all be global cities; but in terms of the cities' role in world economy, these cities are not so important in global economy. On the contrary, New York and London, which have a smaller population, play an important role in allocating global resources and controlling global economy. Therefore, as far as function is concerned, New York and London are truly global cities. Thus, the true sense of global city system is not the size system but the function system.

With the continuous deepening of economic globalization, the intra-industry trade is growing rapidly, the internal trade of transnational corporations is occupying the primary position in world trade, industrial specialization among cities is further strengthened, economic activities proliferate widely in the geographical sense and integrate in depth in the functional sense. These lead to tremendous changes in the global city system, and preliminarily give rise to the city system characterized by function system. Friedmann (1986) studies world cities from the perspective of international division of labor. He believes that the new international division of labor and economic globalization lead to the formation and development of world cities. They play a central role in the global enterprise network and control and dominate the global economy. Sassen (2001) analyzes global cities from the perspective of high-end producer service industries. She believes that global cities are the gathering places of headquarters of transnational corporations. High-end producer service industries provide quality modern service facilities such as financial, communication, legal, and accounting services for the economic operation and management of transnational corporations. Knox and Taylor (1995) examines world cities within the world economic system, and analyzes the global city system from the perspective of transnational enterprises' connections. Taylor et al. (2002) analyzes the distribution and connections of four advanced producer services, i.e., accounting, financial, advertising, and legal, among the main cities in the world, and explores the relationships among the world cities from the perspective of organization. In a word, all the above studies approach global cities and global city system from the perspective of city function system. Thus, theoretically speaking, the present global city system is more of a function system.

According to the distribution of the six industries around the world, the majority of the major cities in the world have already joined in the globalization process. The global city system is actually a function system. Figure 2.49 shows the global connections indexes of the six industries according to the number of branches distributed in cities worldwide for the main transnational corporations in these industries. It can effectively reflect the involvement of a city in global industrial specialization. According to the connection degrees of transnational enterprises in 2017, among the 1035 cities worldwide, 968 cities have accommodated the headquarters or branches of transnational enterprises. This indicates that the majority of the major cities worldwide have been involved in the global city function system. Currently, the regions with the densest concentration of

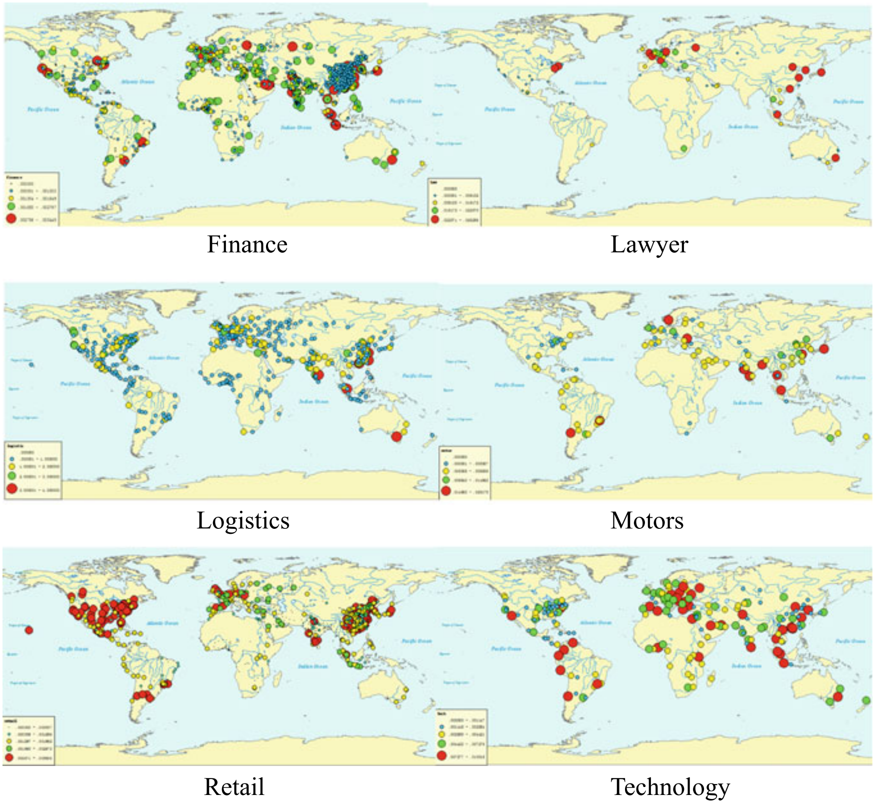

Fig. 2.49 Connection degrees of transnational enterprises in six industries. *Source* Drawn by the author

transnational enterprises include the North America, Europe, and Asia. The ten cities with the highest connection degree of transnational enterprises are London, New York, Hong Kong, Singapore, Shanghai, Beijing, Tokyo, Paris, Sydney, and Dubai. These cities also reflect the depth of their own region's involvement in the global city function system. For the automobile industry, the four major transnational automobile enterprises, i.e., Ford, GM, Volkswagen, and Toyota, are mainly distributed in 103 major cities such as Shanghai, Bangkok, Tokyo, and Bangalore. For the consumer-oriented businesses, the four major transnational consumer-oriented enterprises, i.e., Wal-Mart, Auchan, Carrefour, and Starbucks, are mainly distributed in 489 cities such as Shanghai, Beijing, Nanjing, and Chengdu. For the logistics industry, logistics enterprises such as UPS are mainly concentrated in 483 cities such as Shanghai, Singapore, Chennai, and Shenzhen. For the science and technology industry, the four renowned high-tech enterprises, i.e., Huawei, Microsoft, Intel, and Facebook, are mainly distributed in 206 cities such as San Francisco, San Jose, Singapore, and Boston. For the financial institutions, HSBC, Citigroup, ICBC, and Standard Chartered Bank are mainly distributed in 672 cities such as New York, London, and Tokyo. For the law firms, the four major law firms are mainly distributed in 69 cities such as Singapore, New York, Hong Kong, and London.

2.4.2 The Global City Function System Is a Chain-Network System

With the deepening of globalization, it is increasingly common for production factors especially capital and technology to move globally. The rapid development of transnational corporations leads to the further specialization of international trade and international industrial division of labor. The pattern of global division of labor and collaboration has basically taken shape. Since cities are the main carriers of economic activities, the changes in the world economic development pattern will inevitably cause profound changes in the global city system.

In the context of continuous deepening of globalization, due to the heterogeneity of global factors distribution, the vertical industrial specialization and horizontal industrial specialization are interwoven within the global production network, and become two prominent trends in the process of economic globalization. Bingrong (2014) believes that the current city system is transitioning from a hierarchical system to a network system. The hierarchical system emphasizes the city as a center, while the network system emphasizes the city as a node. The connection channel is also transitioning from being one-way, asymmetrical, and scarce to being two-way, symmetrical, and diversified. Therefore, the current global city system is neither a hierarchical system determined by vertical industrial specialization, nor a network system determined by horizontal industrial specialization. Specifically speaking, it should be a chain-network system and a combination of hierarchical system and network system. In addition, the spatial economic structure of global economy is transitioning from the current industrial-chain-based structure to a value-chain-based structure. This also further strengthens the chain-network structure of the global city system.

According to the city concentration degree (Fig. 2.50) and inter-city connection degree (Fig. 2.51), the current global city system has prominent characteristics of a chain-network. According to the graded rankings of global cities in terms of comprehensive economic competitiveness, the 1035 cities worldwide can be classified into ten levels. The first level includes New York and London. The second Level includes Hong Kong, Singapore, San Jose, San Francisco, and Los Angeles. The third level includes 16 cities such as Sydney, Beijing, Shanghai, and Paris. The fourth level includes 11 cities such as Toronto and Guangzhou. The fifth level includes 11 cities such as Melbourne and Moscow. The sixth level includes 36 cities such as Vienna. The seventh level includes 58 cities such as Buenos Aires.

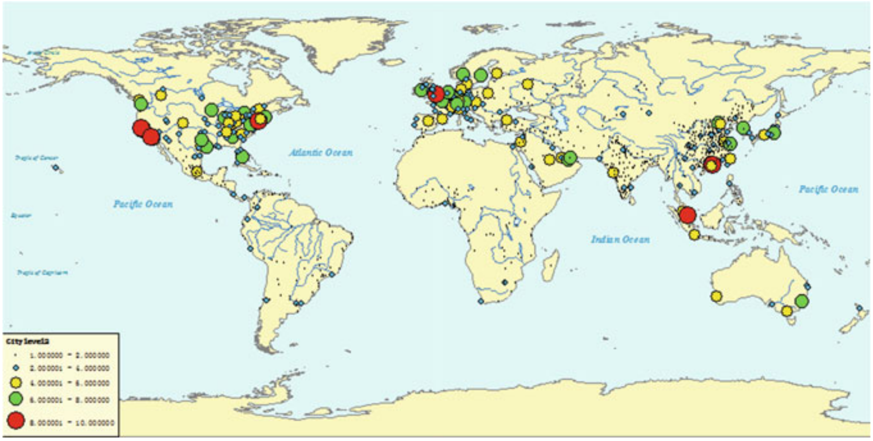

Fig. 2.50 Hierarchies of global cities. *Source* Drawn by the author

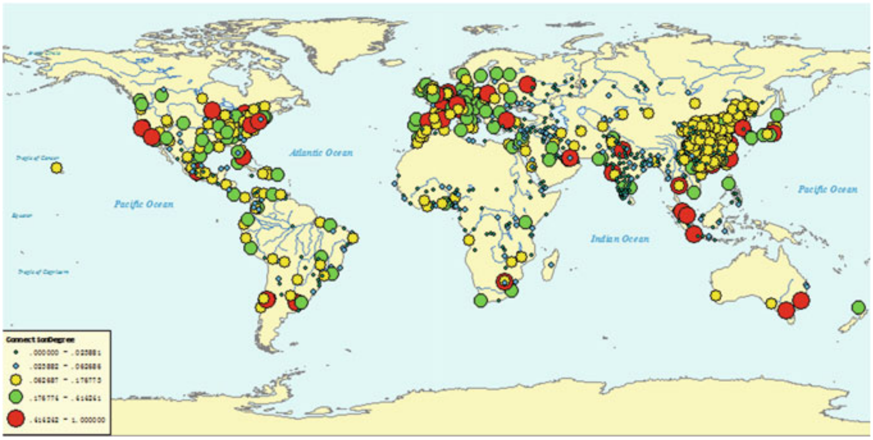

Fig. 2.51 Connection degrees of transnational enterprises. *Source* Drawn by the author

The eighth level includes 99 cities such as Adelaide. The ninth level includes 399 cities such as Algiers. The rest of the cities belong to the tenth level. On the whole, the global city system generally shows prominent hierarchical nature. Meanwhile, in terms of the connection degree of transnational enterprises, the majority of the cities have been involved in the connection network of transnational enterprises. The cities with a higher level of comprehensive economic competitiveness tend to have a higher connection degree of transnational enterprises as well. London, New York, Hong Kong, Singapore, San Francisco, and Los Angeles have the highest connection degree of transnational enterprises among all the cities. This also reflect

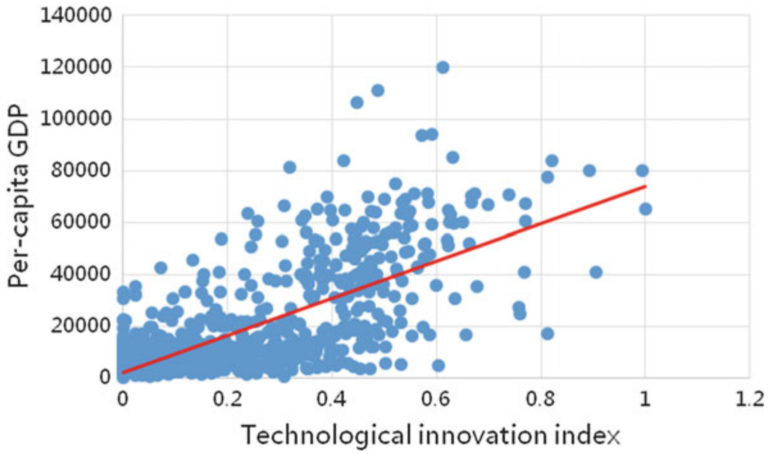

Fig. 2.52 Relationship between technological innovation and per-capita GDP. *Source* Global city competitiveness database of CASS

that the global cities are in extensive and hierarchical connection with one another. In a word, the global city system is more of a chain-network system.

2.4.3 *New Global Cities Are Taking Shape*

Theoretical logic of new global cities

We can divide the globalization process into three stages: from commodity globalization to capital globalization, and then to information globalization. During the commodity globalization stage, commodity trade is the main content of globalization; global cities are mainly connected by commodity flows; and the main functions of nodal cities are commercial and financial. During the capital globalization stage, capital movement becomes the main content of globalization; capital flow occupies the main position in the connection among global cities; and the main functions of nodal cities are financial services. During the information globalization stage, information movement becomes the main content of globalization; information flow occupies the dominant position in the connection among global cities; and the main function of nodal cities is informational. During different stages of globalization, the key factors of global economy are also different. During the commodity globalization stage, resource and commodity are the key factors of economy. Whoever controls the commodity flow can dominate and integrate the value chain and thus control the global economy. During the capital globalization stage, capital is the key factor of economy. Whoever controls the capital flow can dominate and integrate the global value chain and thus control the global economy.

During the information globalization stage, capital and information are the key factors of economy. Whoever controls the information flow and capital flow can dominate and integrate the global value chain and thus control the global economy. Therefore, during different stages of globalization, there are different dominant driving forces of global economy. During the commodity globalization stage, the global economy is mainly driven by resources, and resource-based enterprises occupy the dominant position in the globalization process of this stage. During the capital globalization stage, the global economy is mainly driven by capital, and the financial enterprises are the dominant force at this stage of globalization. During the information globalization stage, the global economy is mainly driven by technological innovation and financial capital. At this stage, the high-tech enterprises and financial enterprises will be the dominant force for globalization.

In the 20th century, high-end producer service industries especially the financial industry as the key industries controlling the allocation of global resources played a vital role in the global production network. Sassen (2001) believes that the controlling forces of economic activities have already transferred from producing areas to service areas where financial and other advanced specialized sectors are integrated. Therefore, she identifies global cities in terms of high-end producer service industries, and characterizes them as developed financial and commercial service centers. From the perspective of new international division of labor, Friedman characterizes global cities as major financial centers, transnational corporation headquarters, locations of international organizations, commercial centers, important manufacturing centers, and major traffic hubs. As a matter of fact, global cities in the past were mostly major international financial and commercial centers such as New York, London, Tokyo, Hong Kong, Paris, and Frankfurt, which were all developed financial centers and commercial centers.

In the 21st century, the humankind encounters the fourth industrial revolution, which is unprecedented. IT companies such as Google, Facebook, Alibaba, and Amazon are profoundly changing people's way of living and producing at an unprecedented speed. They begin to control the allocation of global resources by way of platform economy. Therefore, the distribution of IT companies around the world will greatly change the pattern of global city system. The cities where many IT companies concentrate will have a much greater say in the global city system. The global economy is not solely driven by a few financial centers such as New York, London, and Tokyo. The IT industry and high-end producer service industries together will become an important force that determines the global status of a city. The future top global cities will be the cities in the leading position in both high-end producer service industries such as finance and IT industry. In a word, the traditional concept of global city will be overthrown, and a new type of global city will rise. The new global cities are new mainly in the sense of organic superposition of the technological center function and the financial center function. The combination of technology and finance will further improve the global city function system, and enable it to play a better role in global economy.

Practical proof of new global cities

Information flow plays a more and more important role in the global economy

Information is becoming a basic resource of the future economy, who has mastered the information, who occupy the commanding heights. We are now ushering in the fourth industrial revolution. In this revolution, the Internet has become infrastructure, data becomes production, and computing becomes public services (Jian 2016). At present, Alibaba, Tencent, Amazon, Google and other world-class Internet Corporation are relying on the mobile Internet, cloud computing, big data, networking and other information technology penetration and diffusion, in the development and utilization of information interoperability and information sources as the core, to promote the integration of information network technology and the traditional industry, promote the transformation and upgrading of traditional industries. According to the famous analysis agency IDC, it is expected that the number of global production will be increased to 44ZB in 2020, beyond the storage space of 6ZB (1ZB storage capacity equivalent to 34.36 billion 32 GB intelligent mobile phone), the market of data analysis will be increased to $203 billion in 2020. Through the application of "big data + AI", Google can optimize the search engine service, and develop the" evolutionary system of semantic search." Cainiao Company can forecast the entire package transfer link for the logistics company by big data analysis so that it can integrated supply chain. Therefore we can conclude that information and data plays a very important role in the global economy.

Technology and finance are dominating global economy and occupying the main part of global value chain

In terms of the distribution of the world's top 500 companies by industry, the IT companies are dominating the global economy. In the list of Fortune Global 500 in 2007, the top ten companies were Wal-Mart Stores, Exxon Mobil, Royal Dutch Shell, BP, GM, Toyota Motor, Chevron, Daimler Chrysler, ConocoPhillips, and Total. Among these companies, 6 were in the oil industry, and 3 were in the automobile industry. The hundred-year-old oil and automobile industries were still thriving. As far as the whole list was concerned, the seven industries with the most nominated companies were banking (59), insurance (45), oil (41), food (31), automobile (27), retailing (21), and telecommunications (20). These industries were mostly time-honored traditional industries. In contrast, high-tech companies in computer, software, and internet were very few. With regard to the profit amount, the top ten companies with the largest profit were Exxon Mobil, Royal Dutch Shell, United Airlines, BP, Citigroup, Bank of America, General Electric, the Gazprom, Pfizer, and Chevron. Most of these companies were in the oil or financial industry. They were basically the product of the third industrial revolution. This suffices to indicate that only ten years ago, our society was still working and living in the way shaped by the third industrial revolution. However, after ten years in 2017, in the list of Fortune Global 500, Wal-Mart Stores is still an unquestionable overlord. But it is worth noting that Apple company as a representative of high-tech companies has landed among the top ten; meanwhile, Amazon is at the 26th, Google 65th, Microsoft 69th, SoftBank 72nd, and a large group of other IT companies have also entered into the top 500. In particular, the IT companies in China are also rising rapidly. Alibaba and Tencent have entered into the global top 500 for the first time. This was unimaginable ten years ago. It can be predicted that in another ten years, more IT companies will enter into this list.

In terms of the global value chain, massive wealth is rapidly flowing into the technological enterprises. By comparing the top ten public companies with the highest market value in the Forbes list in 2007 and 2017, we find that the companies with the highest market value in 2007 were all energy and financial companies except for Microsoft, GE, and AT&T; but in 2017, the situation has changed radically. Massive wealth has begun to flow into technological enterprises. Six of the top ten companies are IT companies. This also reflects the current situation in which IT companies are much favored by the capital market. In the meantime, with the help of the massive funds raised from the capital market, these high-tech companies are further scrambling for larger markets and developing a newer generation of advanced technologies, so as to secure a more powerful market status (Table 2.37).

Information technology is showing more and more influence in the global economy

In terms of the influence of global companies, IT companies are gaining more and more influence. By comparing the lists of top 10 world brands in 2004 and 2016 issued by the World Brand Lab (WBL), we can clearly find that in such a short period of 12 years, the top 10 companies have changed fundamentally. What lies behind this is the industry reshuffle caused by technological changes. In 2004, the most influential brands to the human society were basically consumer brands of food, mobile phone, and automobile. But in 2016, half of the top ten brands are IT

Table 2.37 World's top 10 companies for market value in 2007 and 2017

Ranking	Top 10 in 2007	Ranking	Top 10 in 2017
1	ExxonMobil	1	Apple
2	General Electric	2	Alphabet
3	Microsoft	3	Microsoft
4	Citigroup	4	Amazon.com
5	Gazprom	5	Berkshire Hathaway
6	PetroChina	6	Facebook
7	ICBC	7	ExxonMobil
8	Bank of America	8	Johnson & Johnson
9	AT&T	9	JPMorgan Chase
10	BP	10	Tencent

Source http://www.forbes.com

Table 2.38 World's top 10 brands in 2004 and 2016

Ranking	2004	Ranking	2016
1	Coca-Cola	1	Apple
2	McDonald's	2	Google
3	Nokia	3	Amazon
4	Pepsi	4	Microsoft
5	Apple	5	Coca-Cola
6	SONY	6	Facebook
7	Microsoft	7	Mercedes-Benz
8	IBM	8	Walmart
9	Mercedes-Benz	9	GE
10	BMW	10	McDonald's

Source http://www.worldbrandlab.com

companies; especially the top three are all IT companies. When we look at the world's top 10 most valuable brands in 2007 and 2017 issued by Brand Finance, we can still see a similar phenomenon. This is a powerful illustration that the human society is undergoing tremendous changes in the recent decade. Information technology is exerting unprecedented strong influence on human life (Tables 2.38 and 2.39).

Traditional global cities are relatively declining and are transitioning to technological innovation cities.

In the 20th century, traditional global cities such as New York, London, and Tokyo used to tower over their competitors in the global city system with their strong financial service capacity, and was unshakable. However, as technological innovation plays an increasingly important role in global economy, the status of

Table 2.39 World's top 10 most valuable brands in 2007 and 2017

Ranking	Top 10 in 2007	Brand value ($1M)	Ranking	Top 10 in 2017	Brand value ($1M)
1	Coca-Cola	43,146	1	Google	109,470
2	Microsoft	37,074	2	Apple	107,141
3	Citi	35,148	3	Amazon.com	106,396
4	Walmart	34,898	4	AT&T	87,016
5	IBM	34,074	5	Microsoft	76,265
6	HSBC	33,495	6	Samsung Group	66,219
7	GE	31,850	7	Verizon	65,875
8	Bank of America	31,426	8	Walmart	62,211
9	HP	29,445	9	Facebook	61,998
10	Marlboro	26,990	10	ICBC	47,832

Source Brand Finance

technological innovation cities keeps improving in the global city system; correspondingly, the status of traditional financial center cities declines relatively. In order to maintain their previous top position, traditional global cities such as New York and London are continuously improving their technological innovation capacity and striving to transition to technological innovation cities.

New York is one of the three financial centers in the world. The financial industry has always been the pillar industry of New York, but the technological industry is also rising rapidly in this city. After the financial crisis in 2008, the technological industry is gradually taking over the financial industry to become the main jobs provider in New York. From 2009 to 2013, the employment growth rate of the high-tech industry in New York is 33%, which is higher than the average level of 8% in the city. In 2016, the number of jobs created by technological companies in New York has surpassed that of the financial industry. As a result, New York earns the reputation of "Silicon Alley". Moreover, as high-tech companies flood in, the high-end office building market in New York also heats up rapidly. According to the Q1 data of 2017 issued by the real-estate consultant company Colliers International, the rent of office buildings in Manhattan, New York has hit a new high, as the ask price increases from 72.24 dollars per square foot in the last fourth quarter to 73.92 dollars.

London, as another global financial center, has very developed financial industry, but its technological innovation industry is relatively weak. In 2010, the then British Prime Minister David Cameron proposed the vision of building London into the "Silicon Valley of the East". After five years of efforts, currently London has gathered a number of technological giants such as Intel, Google, and Facebook, and has given birth to more than 4000 technological start-ups. In the analysis of the global technological entrepreneurial ecosystem issued by Compass, London has become the largest technological entrepreneurial ecosystem in Europe with its great number of technological start-ups and high ecosystem value.

Technological center cities are occupying an increasingly higher status in the global city system, and also improving their financial center function.

In recent years, the cities standing out in technological innovation are improving rapidly in their competitiveness. Technological cities are showing prominent advantages in the competition among global cities. In terms of per-capita GDP, the cities with higher technological innovation index also have higher per-capita GDP. These two show very strong correlation. This indicates that technological innovation cities take up a large proportion in the global value chain and therefore occupy a higher position in the global city system. In terms of the global city competitiveness rankings in 2017, the cities with better comprehensive economic competitiveness and sustainable competitiveness mostly also have greater strength in technological innovation. From Figs. 2.53 and 2.54, we can see that the technological innovation strength of a city is very significantly positively correlated with its comprehensive economic competitiveness and sustainable competitiveness. As a matter of fact, the correlations of technological innovation with economic

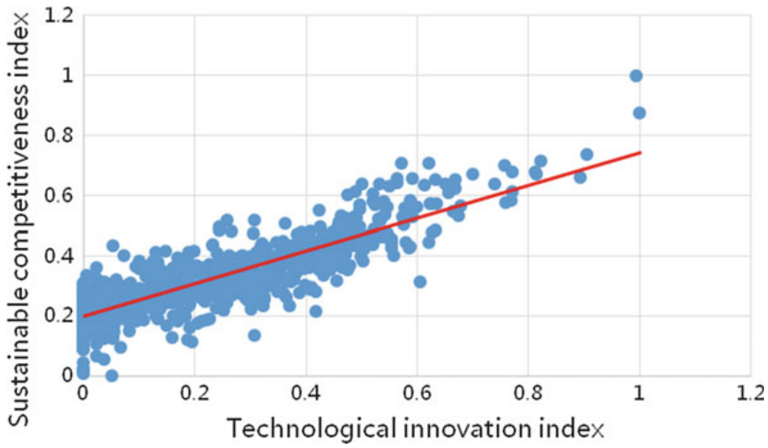

Fig. 2.53 Relationship between technological innovation index and sustainable competitiveness index. *Source* Global city competitiveness database of CASS

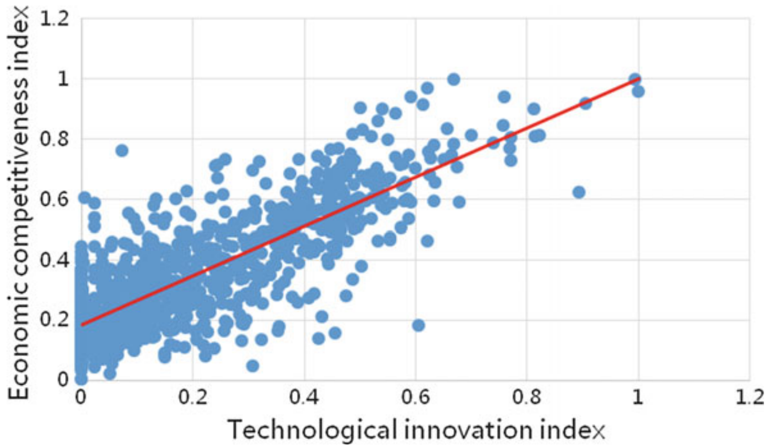

Fig. 2.54 Relationship between technological innovation index and economic competitiveness index. *Source* Global city competitiveness database of CASS

competitiveness index and sustainable competitiveness index are as high as 0.7646 and 0.8624 (Fig. 2.52).

The most typical examples are emerging technological cities such as San Francisco and San Jose. San Jose and San Francisco as the technological innovation centers of the US and even the world have the world's top universities such as Stanford University and University of California Berkeley. They also accommodate a large number of the world's top IT companies such as Google, Facebook, Apple,

Table 2.40 World's top ten cities for per-capita GDP

Ranking	Top ten cities for per-capita GDP
1	San Jose
2	Oslo
3	Bridgeport
4	San Francisco
5	Zurich
6	Seattle
7	Geneva
8	Boston
9	Doha
10	Washington, D.C.

Source Global city competitiveness database of CASS

HP, Intel, Cisco, NVIDIA, Oracle, and Yahoo. They have taken a qualitative leap in economic development with their strong technological innovation capacity. Their per-capita GDP is 120,000 dollars and 94,000 dollars respectively, ranking the first and the fourth in the world. Moreover, these two cities are also home to most of the venture investment funds in the US, making them essentially the largest venture investment centers in the US and even the world. Their financial center function is continuously improving. Therefore, they are gaining an increasingly bigger say in the allocation of global resources, and naturally become the new nobles of the new-type global cities (Table 2.40).

Identification and distribution of new global cities

As science and technology is exerting increasingly greater influence on the human society, more and more technological companies are standing out from the crowd. By comparing the world's 500 most valuable brands in 2008 and 2017, we find that more and more technological companies come to the top of the list. This well reflects the reality of the growing influence of technological companies. Therefore, to some extent, we can identify new global cities according to the amount of the world's most valuable brands they own. By comparing the distribution of the most valuable brands in 2008 and 2017, we find that the number of brands owned by traditional global cities such as London, Paris, and Tokyo is declining, whereas the number of brands owned by such cities as San Jose, Shenzhen, and Beijing is increasing sharply. This reflects such a fact. Due to the rise of high-tech industry, the strength of the global cities featuring traditional high-end services is relatively weakening, whereas the strength of the cities featuring emerging technological industry is improving greatly. Especially San Jose and Shenzhen, as renowned technological innovation centers, are standing out conspicuously as new global cities. Based on the number of the most valuable brands owned by each city in 2017 and the changes in the recent decade, we have selected the top 50 cities as new global cities, as seen in Table 2.41.

Table 2.41 Rankings of new global cities

Rank	City	Rank	City
1	New York–Newark	26	Minneapolis–St. Paul
2	Beijing	27	Amsterdam
3	Paris	28	New Delhi
4	Tokyo	29	Houston
5	London	30	Austin
6	San Jose	31	Munich
7	Seoul	32	Singapore
8	Shenzhen	33	Frankfurt
9	San Francisco–Oakland	34	Hartford
10	Dallas–Fort Worth	35	Richmond
11	Washington	36	São Paulo
12	St. Louis	37	Jacksonville
13	Zurich	38	Calgary
14	Cincinnati	39	Birmingham
15	Shanghai	40	Montreal
16	Toronto	41	Detroit
17	Chicago	42	Stockholm
18	Seattle	43	Nagoya
19	Atlanta	44	Bilbao
20	Mumbai	45	Quebec city
21	Los Angeles–Long Beach	46	Winston–Salem
22	Melbourne	47	Hong Kong
23	Stuttgart	48	Kansas City
24	Guangzhou	49	Hamburg
25	Hangzhou	50	Louisville

Source Global city competitiveness database of CASS

By comparing the distribution of the world's 500 most valuable brands in 2008 and 2017 among global cities (Fig. 2.55), we also find the following phenomena. Firstly, the world's top 500 brands are highly concentrated, showing strong polarization. Regionally, they are mainly located in Europe, North America, and East Asia. These three regions own the majority of the brands. On the city level, they are mainly located in global metropolises such as New York, London, Paris, and Tokyo. These four cities own nearly 30% of the world's top 500 brands. Secondly, the global cities layout is changing quietly. Generally speaking, the number of brands in East Asia, especially in China, is increasing strikingly from 20 in 2008 to 57 in 2017. This is also a result of the eastward shift of the global economic center.

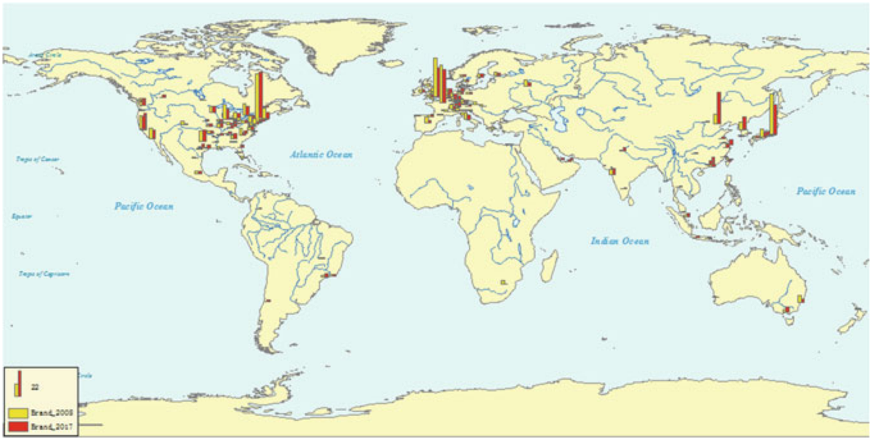

Fig. 2.55 Distribution of the world's 500 most valuable brands in 2008 and 2017. *Source* Brand Finance

In the future, cities will be more intelligent, and have the characteristics of Metropolis. In the future, internet will be the infrastructure, data will be the means of production, and computing will be public services. Based on big data, technologies such as Internet of Things and artificial intelligence are employed to connect all infrastructure in the city to form a new generation of intelligent infrastructure, so that the city can independently command, make decision, give prompt response, and coordinate with others. And the city will realize "independent thinking" to make use of resources more rationally, make better management decisions, and timely predict and respond to emergencies. On the other hand, due to the development of information technology and transportation technology, the spatial distribution of urban areas will be increasingly decentralized, networked, urban spatial form will be developed into a metropolis.

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Part II
Relationship Between House Price and Urban Competitiveness

Chapter 3
Research Background and Literature Review

Pengfei Ni and Yangzi Zhang

3.1 Research Background

3.1.1 Urban Competitiveness Is the Foundation of Sustainable Prosperity of Cities

As the world ushers into the urban age, cities have played an important role in human life and economic development. As the improvement of transportation means and the development of Internet and other information technologies, the space-time distance between people has been narrowing, and cities have become increasingly interrelated and significantly interactive, which intensifies intercity competition for factors and industries. For a city, cultivating its economic competitiveness is the key for it to stand out in competition and realize sustainable economic growth. Looking into the urban development in the future, according to the *New Urban Agenda* approved by Habitat III in 2016, by 2050, the world's urban population is expected to nearly double, and urbanization will be one of the most transformative trends in the twenty-first century. With the sharp increase of urban population, cities have also faced increasingly severe challenges in sustainable development in aspects of housing, infrastructure and public services. Therefore, it is necessary to continuously improve sustainable competitiveness of global cities in new situations.

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3.1.2 Housing Price Impacts Households, Cities and the World

Because the housing sector is an important sector in urban economy, housing and its prices have important influence on households, cities and the world. First, housing, as a kind of durable consumer goods, is a necessity for residents, and often occupies a large proportion of common residents' wealth. Furthermore, because housing consumption is a very important consumption decision for households, the level of housing price has direct influence on their welfare level. Second, unlike common consumer goods, housing also has the attribute of investment goods. Due to this attribute of housing, housing price is always highly fluctuated and unpredictable. Moreover, because housing belongs to non-trading goods, the fluctuation of housing price increases the uncertainty and risks of local economic development, and then impacts the development of cities. Third, because the housing sector is always closely linked with the financial sector, which would expand the risks of the housing market through the leverage effect of the financial sector, so as to have significant influence on the national and even global macro-economy.

3.1.3 Influence of Housing Price on Urban Competitiveness

In the current context, housing price of cities in many developed countries and developing countries have risen and boomed, which increases residents' housing burden, affects enterprises' profit margin, and even threatens the social stability, with negative impact on the improvement of urban competitiveness. In reality, housing price makes significant impact on urban competitiveness. In theory, housing price has two impacts on urban competitiveness. First, housing price impacts the living cost of urban residents. That is to say, the level of housing price has direct influence on residents' utility level in city life, and further impacts enterprises' production cost and the human capital quantity they can obtain through the labor market. Second, housing price impacts enterprises' investment decisions in cities. A high rate of return on investment in real estate brought by high housing price always tempts enterprises to invest more in real estate, which would take away their investment in R&D and technological innovation, and is unfavorable to sustainable growth of urban economy. An excessive proportion of investment in real estate would also cause deformed development of urban economy, which is unfavorable for its transformation and upgrading. Therefore, no matter in theory or in reality, housing price has great influence on urban competitiveness.

3.1.4 The Complicated Relationship Between Housing Price and Urban Competitiveness

The complicated relationship between housing price and urban competitiveness mainly lies in the following aspects. For one thing, when housing price is within a reasonable range, housing price and its fluctuation would promote urban economic development, scientific and technological innovation and industrial upgrading, thus improving urban competitiveness. For another, when housing price is excessively high or low, it is unfavorable for improving urban competitiveness. Specifically, excessively low housing price is unfavorable for squeezing out low-end industries in cities, and makes scientific and technological innovation in cities short of external pressure; whereas excessively high housing price would squeeze high-end, middle-end and low-end industries and factors out of cities, and even cause industry hollowing and housing price bubbles in cities. There are similar situations in reality. Some cities' competitiveness and housing price realize common benign growth, while other cities' excessively high or low housing price hinders the improvement of urban competitiveness. For example, in late 1980s, Silicon Valley, Manhattan, Munich and other regions witnessed a rising economy and a booming real estate industry; in 1990s, Tokyo, Osaka and other cities in Japan underwent the burst of housing price bubbles, which had significantly negative impact on urban development; in the twenty-first century, Madrid suffered from sharp increase in housing price and overstock of buildings left unfinished, and even had been on the verge of bankruptcy; in the US subprime mortgage crisis, real estate recession even caused severe economic fluctuations, and Warsaw, Budapest and other eastern European cities were affected by both the low housing price and the stagnation of urban economy. Therefore, the housing price, as an important force to change cities and the world, has complex impact on urban competitiveness. If such complexity is ignored, it would be hard to comprehensively examine the housing price's power and explain the complicated expression of competitiveness of different cities in reality. Nevertheless, existing relevant studies are either superficial or misleading, and could not explain the complicated reality. Currently, it is necessary to conduct theoretical, empirical and policy analysis of the complicated influence of housing price on urban competitiveness. For this purpose, let's first review relevant literature.

3.2 Composition and Expression of the Housing Price's Influence on Urban Competitiveness

The influence of housing price on urban competitiveness is reflected in both internal composition of competitiveness and external expression of competitiveness. Therefore, relevant studies for connotation, composition and expression of urban competitiveness are summarized.

3.2.1 Basic Connotation of Urban Competitiveness

Urban competitiveness has abundant meanings. Its basic connotation is reflected a city's capacities of creating value and improving welfare. The existing studies have explored it from different angles. Kresl and Balwant (1995) defined urban competitiveness as a city's capacities of creating wealth and increasing revenue. Similarly, Lever and Turok (1999) considered that urban competitiveness referred to a city's capacities of producing products and services required by regional, national and global markets. Webster (2000) thought that urban competitiveness referred to a city's capacities of producing and selling better commodities and services than other cities; therefore, the improvement of urban residents' living standard is the main purpose for enhancing urban competitiveness. Furthermore, Ni (2002) summarized the connotation of urban competitiveness as a city's capacities of attracting, competing for, possessing, controlling and converting resources, scrambling, occupying and controlling markets, creating value, and thus providing welfare to its residents compared with other cities in the process of competition and development.

In addition, Porter (1990), European Commission (1999), Begg (1999), Webster (2000), OECD (1999), Lever and Turok (1999), Budd and Hirmis (2004), Hao (1999), et al. also conducted studies on the connotation of urban competitiveness. Because they share the basic viewpoint that urban competitiveness is a city's capacities of creating value and improving welfare, we would not repeat it again here.

3.2.2 Internal Composition of Urban Competitiveness

According to the existing studies, urban competitiveness consists of urban factor endowment, industrial development conditions and urban value. Specifically, Hao (1999) pointed out from the perspective of factor endowment that a city's economic competitiveness mainly reflected its various factors' capacities of increasing urban economic benefits; therefore, the internal composition of urban economic competitiveness was embodied in technology, capital, infrastructure, organizational structure and other factors. Martin and Simmie (2008) emphasized the influence of industrial structure and output capacity on urban competitiveness, and considered that such factors as quality, efficiency and potential of industrial development in cities would impact and decide a city's competitiveness level. Porter (1990) put forward the theory of competitive advantage based on value chain, and emphasized the role of value creation in promoting competitiveness. Ni (2015) systematically defined the relationship between factors, industry and urban value, and considered that factors decided industry and industry decided urban value. The internal logic is that an enterprise's business choice depends on the environmental conditions of its location, and decides the level of its added value. In a city, local environment and available external environment decide the scale, structure and efficiency of its industrial system (including industry and industrial links); the conditions of the industrial system decide the creation of urban value.

3.2.3 External Expression of Urban Competitiveness

The external expression of urban competitiveness could be summarized in three aspects, namely the market scale, long-term economic prosperity and economic efficiency. Firstly, in terms of the market scale, Deas and Giordano (2001) emphasized that urban competitiveness depended on market scale and growth, and was intensively reflected in enterprises with more market shares. Second, judging from long-term economic prosperity, Kitson (2005) and Begg (1999) believed that urban competitiveness was reflected in not only short-term competition for resources and market shares, but also long-term economic prosperity. Third, from the perspective of economic efficiency, Kresl and Balwant (1995) considered that a city's labor productivity as an important expression of urban competitiveness. Hao (1999) had similar viewpoints. OECD (1999) considered that urban competitiveness was reflected in a city's capacities of producing high revenue and high employment and maintaining competitive advantages in local and international markets.

3.3 Influence of Real Estate Industry on Urban Competitiveness

The housing price is an important, but not the only element of the real estate industry. In addition to the housing price, existing literature has studied the influence of the real estate industry on urban competitiveness from perspectives of physical assets, real estate market and real estate development. First, housing, as an important physical asset, has influence on urban competitiveness. Housing, as a physical asset, has such characteristics as high durability, spatial fixation, low supply elasticity, strong value preservation function and appreciation potential. Begg (1999) regarded housing as a type of "hard" assets of a city, with an important role in urban competitiveness. Second, regarding the role of the real estate market in building urban competitiveness, Second, regarding the role of the real estate market in building urban competitiveness, D'Arcy and Keogh (2000) considered that transactions in the real estate market included a series of formal and informal complex transaction systems, through which the real estate market played an important role in urban economic activities, and had direct impact on urban competitiveness. Third, in terms of real estate development, Turok (1996) pointed out that urban development needed to balance the relationship between the real estate development and other forms of development, in a bid to ensure positive effect on urban competitiveness. Turok (1996) especially emphasized that due to incomplete information and other reasons, price signal in the real estate market as misleading for the real estate development.

3.4 Influence of the Housing Price on Key Factors of Urban Competitiveness

Currently, there is little literature on the influence of the housing price on urban competitiveness. Although Begg (1999) stressed the housing price's influence on urban competitiveness, they failed to well demonstrate the relationship and interaction between housing price and urban competitiveness. If we open the black box formed by the competitiveness of cities, the impact of housing prices on the key elements of urban competitiveness has rich content. This part reviews relevant studies from the perspective of the influence of housing price on key factors of urban competitiveness, specifically including urban output (economic growth), industrial structure and productivity. A detailed account is given below.

3.4.1 Influence of Housing Price on Urban Output (Economic Growth)

Housing price could impact urban output by affecting investments of households and enterprises in cities. According to traditional viewpoints, housing price has influence on investments of households and enterprises through credit contraction and expansion. With the rise of housing price, real estate value, as the main collateral in economy, also increases. This means that households and enterprises own increased net assets, and could get more loans by taking advantage of real estate mortgage, which results in increase in investment (Chaney 2012). On the contrary, when the housing price falls, households and enterprises own decreased net assets, and get less credit, and banks tend to tighten credit, which result in scale-down in investment (Bernanke and Friedman, 1991).

However, traditional studies only focus on partial balance of real estate mortgage credit, but are hard to explain the changes in the total investment of households and enterprises along with the fluctuation of housing price. Ting et al. (2016) pointed out that the rise in housing price encouraged enterprises to invest heavily in the real estate sector, which resulted in the imbalance of investment structure and unfavorable impact on urban economic growth. Ting et al. (2016) emphasized that in addition to the credit channel, the rise of housing price could encourage enterprises to invest more in real estate, and force those without land property to reduce investment. Nevertheless, further studies shall be conducted for the rational increment of housing price on investment.

3.4.2 Influence of Housing Price on Urban Industrial Structure

Whether housing price promotes the upgrading of urban industrial structure or not has always been the focus of existing studies, with greatly different research findings. The affirmative viewpoint considers that the rise of housing price promotes the upgrading of industrial structure through population and industrial transfer. According to the findings of Blackaby and Manning (1992) on the U.K., the rise of housing price would promote the agglomeration of high-end industries and the revenue increase in the region through the correlation effect between demands and costs. Gao and Zou (2012) drew a similar conclusion in his studies on China, finding that the difference in housing price between cities could lead to labor mobility and industrial transfer, and the rise of housing price promoted cities to move further along the industrial value chain.

However, on the opposite, some scholars 'viewpoint considers that a high housing price does not necessarily lead to population and industrial transfer. According to the findings of Saiz (2007) on U.S. metropolitan areas, housing costs do not have significant influence on immigrants, because immigrants attach more importance to the amenities and social network of the receiving area. Meanwhile, a high housing price does not always squeeze out the low-end industry. Jeanty et al. (2010) pointed out that the rise of housing price would play a role in boosting local economy, which will attract immigrants and businesses. Moreover, even if a high housing price could lead to urban industrial relocation, it might also cause urban industrial hollowing-out. According to the findings of Brakman and Garretsen (2004) on Germany, the difference in housing price between East Germany and West Germany caused a large number of manufacturing enterprises to move from West Germany to East Germany. This indicates that the influence of housing price on urban industrial structure could not be generalized.

3.4.3 Influence of Housing Price on Urban Productivity

First of all, the influence of housing price on urban labor productivity is specifically reflected in the wage gap. According to the findings of Gianmarco and Ottaviano (2006) on American cities, housing price and average wage are positively correlated in labor forces with different skills. In contrast, Suedekum (2010) built a core-periphery model which included the housing sector, and found that if other fectors do not change, the higher housing price, the lower the actual wage in the core area.

Second, the housing price can affect the total factor productivity of cities. On the basis of the findings of Nuño (2011), a high housing price leads to an obvious deviation between housing price and total factor productivity in the U.S. and Germany. According to the findings of Chen et al. (2015) on China, a high housing price leads to resource mismatch, reduces resource allocation efficiency, and thus decreases the total factor productivity. In addition, a high housing price would impact the total factor productivity by reducing enterprises' investment in R&D and innovation. According to the findings of Wang Wenchun and Rong Zhao (2014) on China, the faster the housing price rises, the more reluctantly and the less enterprises invest in innovation and R&D.

3.4.4 Influence of Housing Price on Urban Competitiveness: Linear or Multi-faceted

Regarding key factors of urban competitiveness, the influence of housing price on urban competitiveness is complicated and multi-faceted, not simply linear. The existing studies mostly emphasize only one aspect of the influence of housing price on urban competitiveness. Empirical evidence shows that the housing price has played multiple roles in the development history of such international cities as London, Hong Kong, Tokyo and Geneva (United Bank of Switzerland, 2016). Just as Ni (2017) pointed out, an excessively low or high housing price is not favorable for the improvement of urban competitiveness; only maintained within a certain range could the housing price contributes to the improvement of urban competitiveness. However, because there is only a little literature on the multi-faceted influence of housing price on urban competitiveness and a few studies on the rational range of housing price, this report tries to make up for that.

3.5 The Transmission Mechanism for the Housing Price to Influence Urban Competitiveness

Although existing research involves the influence of housing price on key elements of urban competitiveness, there is still a lack of studies on the theoretical transmission mechanism between housing price and urban competitiveness. Nevertheless, from the perspective of theoretical development of urban and regional economics, the following model provides conditions for our further study on the transmission mechanism for the influence of housing price on urban competitiveness.

First, under a complete competition framework, Roback (1982) model introduced the housing sector under a general spatial equilibrium framework. The model analyzes residents' choice from revenue, urban amenity and housing cost in different cities. At this moment, the difference in housing price could be regarded as the compensation for livability of different cities.

Second, literature of new economic geography studies the influence of housing price on city competitiveness from the perspective of monopolistic competition and increasing returns to scale. Specifically, Helpman (1998) introduced the housing factor in the model of Krugman (1991a, b), and discussed the relationship between labor mobility, housing price and product diversification. Different from the thinking of Helpman (1998), Tabuchi (1998) introduced the housing sector by combining the single central city model structure of Alonso (1964) and the model of Krugman (1991a, b). Tabuchi and Thisse (2002) also conducted similar studies. It is important to note that all of the above studies adopt the assumption of homogenous economic subjects; that is to say, the heterogeneity of enterprises and labor forces is not taken into account.

Third, under the framework of labor heterogeneity, Graser (2001) considered the rent factor in its urban system model, and pointed out that laborers with high production efficiency were concentrated in high-wage cities, whereas those with low production efficiency in low-wage cities. Davis (2014) also considered the housing factor in his study, and found that large cities had a higher proportion of high-skilled talents and comparative advantages in technology-intensive industries.

So far we've combed existing studies. The above models could be taken as the foundation for our further studies.

3.6 Relevant Policies for Housing Price and Urban Competitiveness

Regarding relevant policies for housing price and urban competitiveness, the government mainly regulates housing supply and demand with land, taxation and financial policies, and finally controls the housing price and impacts urban competitiveness. This paper analyzes as follows:

In terms of land policy, the findings of Quigley (2005) on California, the U.S., show that restriction of land approval, reduction of housing supply and other regulatory actions may lead to the rise of real estate price, which increases residents' living cost and enterprises' production cost, and is unfavorable for economic growth and industrial upgrading. Kulish (2011) emphasized the importance of rational use of land zoning policies. With limited land resources, it is necessary to meet people's demands for land and guide the rationalization of land demand.

With respect to fiscal and taxation policies, David (2011) conducted a study on the real estate market in New York, finding that due to housing's dual attributes of residence and investment, when housing serves as a kind of investment goods, investors' expectation for return plays a key role in making decision for housing purchase. Therefore, the real estate tax has the effect of regulating the housing demand. Sullivan (2014) studied the influence of various taxation reform schemes on the real estate market, finding that the real estate tax could raise the rent and reduce the housing supply equilibrium in the short term, and decrease the price equilibrium of housing assets.

Regarding the financial policy, specifically the timing for financial policy intervention, Lamont and Stein (1999) found that after the introduction of financing effect, the real estate price becomes more sensitive to the changes in per capita income; therefore, the timing and intensity of financial policy is vital.

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Chapter 4
The Relationship Between Housing Prices and Urban Competitiveness: A Theoretical Framework

Qingfeng Cao

Housing is a necessity for human's living and development. In the urban world, housing has multiple impacts. Accordingly, the housing price that involves benefits and costs has an important influence on market agents. As far as cities are concerned, the housing price and its volatility are closely related to the rise and fall of cities, the volatility of the world's economy, as well as the evolution of economic space and pattern.[1] For a single city, housing has dual attributes of consumer goods and investment goods. For one thing, the housing sector is an important sector for providing residents with basic housing services in urban economy, and directly affects the utility level of urban residents; meanwhile, housing investment is an important component in urban fixed asset investment, and can exert a significant influence on urban economic growth through the multiplier effect of investment. For another, the volatility of the housing price can affect the living cost of residents and the production cost of firms, and then changes the human capital quantity and industrial structure in cities. In addition, due to its attribute of investment goods, housing prices also affect macroeconomics through the financial market. Therefore, housing and its price are always important factors for urban economic growth and structural transformation.

In the current context of globalization, with the increasing integration of interregional markets, the spatial flowing and interactions of factors and industries between cities have become more active and frequent. Housing, as a kind of non-tradable goods that often results in great differences in living and production conditions between regions, has a significant influence on spatial flowing of factors and industries and their interactions. Particularly in the urban system, because the flowing between different product and factor markets is much stronger, the changes

[1]The theoretical analysis of this paper applies mainly to the industrial society. In the agricultural society, the under-developed urban and real estate sector is not the focus of the theoretical analysis.

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of relative housing prices between cities always make significant impacts on the structure and scale of urban system through the flowing of factors and industries.

In view of the important influences of housing prices on cities and urban system, we build a model based on relevant basic economic theories, and try to explain the relationships between housing price and urban competitiveness in this part. Nevertheless, to reach a wide readability, we express relevant mathematical models in qualitative terms.

4.1 Basic Assumption

Suppose there are two cities in the region (city 1 and city 2), and there are trades and factors' flowing between the two cities. Each of the two cities has manufacturing and housing sectors. The manufacturing sector produces differentiated manufacturing goods, and each firm produces only one type of manufacturing goods; while the housing sector produces housing commodities. Meanwhile, manufacturing firms are homogeneous between cities, and only use labors as input factors; labors are classified into two categories: skilled labors and unskilled labors. Specifically, manufacturing firms use unskilled labors as variable inputs and one unit of skilled labors as fixed inputs, which means the number of skilled labors equals the number of manufacturing firms. Because skilled labors could freely flow between cities, the city with a larger number of skilled labors has a bigger share of manufacturing industry. Moreover, unskilled labors are evenly distributed between cities, and their supplies in each city are perfect elastic. This means the wage of unskilled labors is constant and equal between cities. The basic assumptions of residential sector, manufacturing sector and real estate sector are explained respectively as follows.

1. **Residential Sector**

Residents have diversified preferences, and consume differentiated manufacturing goods and housing services subject to certain income constraints. Then we can derive residents' demand function for housing and manufacturing goods. Specifically, when residents' income is higher and the price of housing and manufacturing goods is lower, residents' utility level and demands for housing and manufacturing goods are greater.

2. **Manufacturing Sector**

The manufacturing sector is monopolistic competition. Manufacturing firms produce manufacturing goods using the technology of increasing returns to scale. The trade of manufacturing goods exists iceberg transportation cost. Therefore, we can derive the pricing of manufacturing goods is a constant in the city where it is produced, while the pricing in other cities is a linear function of the transportation cost. The higher the transportation cost, the higher the pricing in other cities.

3. **Housing Sector**

The housing sector is perfect competition. Based on the assumption of Helpman (1998), the total housing supply of city 1 and city 2 is completely inelastic and is an exogenous variable. The equilibrium of the housing market can directly determine the equilibrium housing price in each city. In this case, the higher the resident income and the smaller the total housing supply, the higher the housing price.

4. **Long-term Equilibrium**

The long-term equilibrium for the flowing of skilled labors is determined by their utilities in cities. Specifically, in each city, skilled labors' utility equals the city's aggregated price index divided by the nominal wage, which the city's aggregated price index is composed of the housing price and the manufacturing goods price. Therefore, in the long run equilibrium, the utility level of skilled labors in city 1 and city 2 is the same.

5. **The Determinants of Urban Competitiveness**

We take each city's residents income as the proxy variable for urban competitiveness. In the model, it is assumed that the residents income only comes from wage. Because city 1 and city 2 have the same wage of unskilled labors, but different wage of skilled labors. Therefore, we measure the competitiveness of each city by the nominal wage of the skilled labors.

In the theoretical model, because each manufacturing firm only uses one unit of skilled labors as fixed cost, all of its operating profits (operating profits = total revenues − total variable costs) are used to pay the wage of skilled labors. Specifically, the operating profits of a single manufacturing firm in the model (namely the urban competitiveness) depend on two factors:

(1) **Total urban income**. Because residents have diversified preferences, manufacturing goods produced by a single manufacturing firm would be consumed by all the residents. Accordingly, the higher the total residents' income in the city is, the greater demands for each manufacturing firm, the higher its operating profits become, and the higher wage it pays to skilled labors. By then, the city becomes more competitive. The city's total income consists of the following two parts:

$$\text{Total urban income} = \text{total wage} + \text{total income from the housing sector}$$

Specifically, the larger number of manufacturing firms or skilled labors in the city, the higher total wage. Like the assumption of Helpman (1998), we assume that the total income from housing sector in the economy is evenly distributed among skilled labors. Therefore, the cities with a larger number of skilled labors (namely the larger number of manufacturing firms) could obtain more housing revenue. Accordingly, we derive the following conclusion:
Cities with a bigger share of manufacturing industry (in terms of the total number of manufacturing firms) have higher total urban income and a larger

demand for each manufacturing firm. In this case, skilled labors could obtain higher wages, which therefore contributes to higher urban competitiveness.

(2) **The total number of manufacturing firms**. The demand for a single manufacturing goods depends on both the manufacturing goods price and the total number of manufacturing firms in the city where the firm is located. Specifically, the larger number of manufacturing firms in the city is, the more differentiated products residents could consume, and the lower demands for each manufacturing goods becomes. The negative correlation between the demands for a single manufacturing goods and the total number of firms is called the "market congest effect", which is also a typical characteristic of the monopolistic competition model of Dixit and Stiglitz (1977). Accordingly, we conclude that:

Cities with a bigger share of manufacturing industry (in terms of the total number of manufacturing firms) have a bigger market congest effect, a lower demand for each manufacturing goods and a reduced wage for skilled labors, and then lower urban competitiveness.

It can be found that the share of manufacturing sector has two opposite effects for urban competitiveness, which also complicates the analysis on urban competitiveness.

4.2 Two Effects of Housing Prices[2] on Urban Competitiveness

The volatility of housing prices would result in the changes of utility level of skilled labors, the flowing of manufacturing firms between city 1 and city 2, and then the changes of urban manufacturing sector's share. Specifically, the impact of housing prices on urban competitiveness has two opposite effects as shown in Fig. 4.1.

4.2.1 "Market Congest Effect"

Specifically, the rise of housing prices would force manufacturing firms leave the local market, and causes a decreasing "market congest effect". Hence, the demand for each manufacturing firm becomes bigger, leading to the increase of skilled labors' wage, and finally improve the urban competitiveness.

[2]Because there are two cities in the model, only the changes of relative housing price make sense. Therefore, the housing price mentioned here refers to the housing price of city 1 relative to that of city 2.

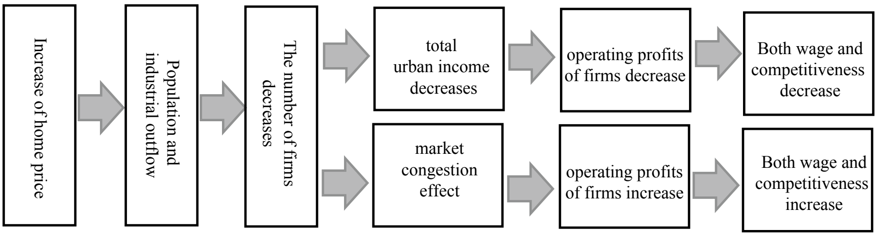

Fig. 4.1 Two effects of the housing price on urban competitiveness

4.2.2 *"Income Effect"*

The rise of housing prices would force manufacturing firms out of the local market, causes the number of manufacturing firms decrease, then reduces total urban income and product demand of each manufacturing firm, finally leading to the decrease of wage of skilled labors and urban competitiveness. In contrast, the fall in housing prices attracts manufacturing firms into the local market, increases urban income and urban competitiveness.

In the following chart, the increase of housing prices is taken as example to illustrate the two effects that the housing price on urban competitiveness.

Obviously, the changes in housing prices have two opposite effects on urban competitiveness, indicating a nonlinear relationship between housing price and urban competitiveness.

4.3 Simulation Results for Relationships Between Housing Price and Urban Competitiveness in the Long-Term Equilibrium

To simulate the changes in housing prices, we suppose the total housing supply of city 2 keeps constant, the total housing supply of city 1 is smaller than that of city 2 at first, and then gradually increases until it is larger than city 2. This means we impose a growing negative shock on the housing price of city 1. That is to say, we first lower the housing price of city 1,[3] and then observe the relationship between the housing price and urban competitiveness in long-term equilibrium.

It needs to be emphasized that a negative shock on the housing price of city 1 means the utility level of skilled labors in city 1 increases, which would cause the skilled labors flow from city 2 to city 1, leading to a larger industrial share of city 1. Therefore, in the following analysis, the industry always shifts from city 2 to city 1.

[3]The same conclusion can also be derived by imposing a positive shock on the housing price of city 1.

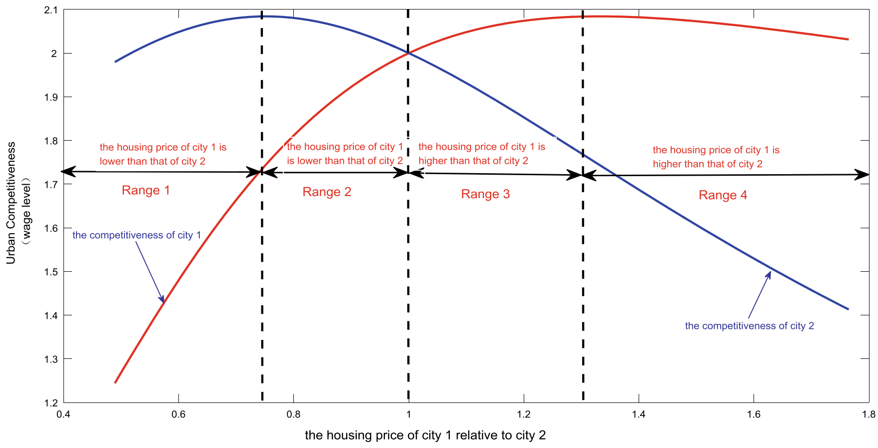

Fig. 4.2 Different impacts of the housing price on urban competitiveness

In other words, the industrial share of city 1 keeps increasing, while that of city 2 keeps decreasing. It needs to be emphasized again that all of the following conclusions are based on the long-term equilibrium. The simulation results are shown in Fig. 4.2.

4.3.1 There Exists an Inverted "U" Relationship Between a City's Housing Price and Its Competitiveness

According to Fig. 4.2, the changes of urban competitiveness in city 1 and city 2 are both the shape of inverted "U". That is to say, if one city has a higher housing price than other cities, the city's competitiveness will increase and then decrease. Specifically, when the housing price of city 1 is located in different ranges, there are four changes in the competitiveness of city 1 and city 2:

Range 1: In the case that city 1 has a higher housing price than city 2, the competitiveness of city 1 and city 2 would both increase. This is because that as the industrial share of city 1 keeps increasing, the "Income effect" plays the leading role, the total income of city 1 increases, which improves the urban competitiveness. In the meantime, because the "market congest effect" of city 2 plays a leading role, decreasing industry share of city 2 would increase competitiveness. In this case, because the industrial share of city 2 is significantly bigger than that of city 1, city 1 could be regarded as a small city in the region, whereas city 2 a big city.

Range 2: In the case that city 1 has a higher housing price than city 2, the competitiveness of city 1 would increase, whereas that of city 2 would decrease. In the range, the industrial share of city 2 shrinks, whereas that of city 1 expands. Because the "Income effect" of in both cities plays a leading role, the competitiveness of city

1 would increase, whereas that of city 2 would decrease. In this case, because the industrial share of city 2 is still higher than that of city 1, city 1 could be regarded as a small city in the area, whereas city 2 a big city.

Range 3: In the case that city 1 has a higher housing price than city 2, the competitiveness of city 1 would continue to increase, whereas that of city 2 would continue to decrease. This is because that the "Income effect" still plays a leading role in the range. However, unlike range 2, range 3 shows the continuous industrial transfer from city 2 to city 1; in this case, the housing price of city 1 is higher than that of city 2. In terms of industrial share, city 1 is a big city, city 2 is a small city.

Range 4: In the case that city 1 has a higher housing price than city 2, the competitiveness of both city 1 and city 2 would decrease. In the range, the "market congest effect" plays a leading role in city 1, whereas the "Income effect" plays a leading role in city 2, both of which would cause a downtrend in the competitiveness of city 1 and city 2. In the meantime, because the industrial share of city 1 is significantly larger than that of city 2, city 1 is a big city, whereas city 2 is a small city.

We will further summarize the above four cases in Table 4.1.

Table 4.1 Changes in competitiveness of city 1 and city 2 within different ranges

City 1's housing price relative to that of city 2	Range 1	Range 2	Range 3	Range 4
Urban competitiveness level	City 1 < city 2	City 1 < city 2	City 1 > city 2	City 1 > city 2
Competitiveness of city 1	Increase	Increase	Increase	Decrease
Competitiveness of city 2	Increase	Decrease	Decrease	Decrease
Housing price	city 1 < city 2	city 1 < city 2	city 1 > city 2	city 1 > city 2
Industrial share	city 1 < city 2	city 1 < city 2	city 1 > city 2	city 1 > city 2
Skilled labors and industrial flow direction	Flow from city 2 to city 1	Flow from city 2 to city 1	Flow from city 2 to city 1	Flow from city 2 to city 1
Leading effect in city 1	Income effect	Income effect	Income effect	Market congest effect
Leading effect in city 2	Market congest effect	Income effect	Income effect	Income effect

4.3.2 The Higher a City's Housing Price Is, the More Competitive the City Is

As shown in Fig. 4.2, when the housing price of city 1 is lower than that of city 2, the competitiveness of city 1 is also lower than that of city 2; when the housing price of city 1 is higher than that of city 2, the competitiveness of city 1 is also higher than that of city 2.

4.4 Conclusions

Through the above theoretical analysis, we infer that.

4.4.1 There Exists an Inverted "U" Relationship Between a City's Relative Housing Price and Its Urban Competitiveness, Indicating Either Excessively High or Excessively Low Housing Price Is Unfavorable to the Improvement of Urban Competitiveness

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4.4.2 The City with a Higher Relative Housing Price Is More Competitive

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4.4.3 In the Case of Significant Disparities of Housing Price Between the Large and Small Cities in a Region, the Competitiveness of All Cities Decreases

When the housing price of the big city is significantly higher than that of the small city, the increase of housing price in small city's relative to the big city indicates the housing price differences between cities become smaller, and will improve the competitiveness of all cities. On the contrary, the increase of housing price in big city relative to small city will decrease the competitiveness of all cities.

4.4.4 In the Case of Weak Disparities of Housing Price Between the Large and Small Cities, the City's Own Housing Price Has a Negative Correlation with the Competitiveness of Other Cities

When the housing price of the big city is higher than that of the small city, the increase of housing price in small city's is favorable to the improvement of the small city's competitiveness, but unfavorable to the improvement of the big city's competitiveness; contrarily, the increase of housing price in big city is favorable to the improvement of the big city's competitiveness, but unfavorable to the improvement of the small city's competitiveness. This indicates that the changes of housing price would lead to the competitions on urban competitiveness between different cities.

Through the above analysis, we could conclude that the housing price is an important force to change cities and the world, and has a significant influence on urban competitiveness. For a single city, because housing price and competitiveness have an inverted "U" relationship, so both excessively high and low housing price are not good for the improvement of urban competitiveness. In the urban system, housing price differences between cities can affect the competitiveness of all cities. This is mainly because the housing price is an important force affecting intercity flowing of factors and goods. In the case of significant disparities of housing price between large and small cities, all cities' competitiveness decreases. Hence, the housing price within a rational range is favorable to improve the competitiveness of a single city or city system. As the most important form of agglomeration economies in a region or country, cities play an important role in the regional and national economic development. In this sense, the urban housing price would also have an important influence on the economic development of a country and the overall economic structure of the world.

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Chapter 5
Global Urban Real Estate Market Status

Hongyu Guo

The global urban real estate layout is closely related to the global urban layout, and the urban agglomeration area is also a hot area of urban real estate. However, the global urban real estate layout is not completely coincident with the global urban layout, but with higher differences and more extensive links. At present, hotspot cities in the global urban real estate market are highly concentrated, and the real estate correlation between cities is extended to the globe, featuring such two characteristics as the centralization of hotspot regions and the global correlation. The centralization of hotspot regions makes a small number of cities with high housing prices the main representatives in global urban real estate scene, which leads the development direction of global urban real estate market.

The difference between global urban real estate markets is based on their economic geography features, and the development of the real estate market in hotspot cities also verifies this view. However, when viewing the development of urban real estate from a global perspective, it is found that there is significant deviation between the real estate market and the economic geography features. On one hand, the development level of the real estate market in hotspot cities is far beyond their economic geography advantages; on the other, the development level of the real estate market in some cities is not enough to reflect its economic geography orientation. For example, the urban center housing price of Hong Kong in 2016 reached USD23,783/m^2, which was 185% of the urban center housing price of New York over the same period, but the per capita disposable income of Hong Kong was USD30,160, which was only 52% of that of New York. In Houston of America, the

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per capita disposable income in 2016 reached USD51,161, while the urban center housing price in the same period was merely USD1, 807/m^2.[1]

The significant deviation between the real estate market and the economic geography means that the urban real estate market condition should be interpreted in accordance with both local features and factors aside from the economic geography. In the contemporary world with increasing degree of globalization, the mutual influence of urban real estate markets covers four dimensions: the globe, cities, nations, and urban agglomerations. In the contemporary world with financialized real estate market, the sequential trend characteristics of urban real estate market are more important. In the contemporary world with the increasing impact of policy regulation, policies at the global, national and municipal levels also have significant impacts on the development of urban real estate market.

Based on the above viewpoint, this part of the report gives a more comprehensive description of the layout of global urban real estate market. On basis of this, multi-dimension analysis of the association of global urban real estate market is made, and the driving force of global urban real estate market is concluded from three aspects—the characteristics of economic geography, sequential trend, and policy regulation. We believe that hotspot regions of the global urban real estate market are highly centralized, forming the circum-ocean pattern of "three centers and four zones". The siphon, diffusion, migration and contagion effects also expand from urban agglomerations to multiple dimensions including the global region, making the original urban agglomerations show obvious transnational characteristics. The driving force of urban real estate market is the combined effect of economic geography, sequential trend and policy regulation, and is mainly reflected in hotspot cities with high housing prices.

This part of the report uses data and charts to illustrate the main features of global urban real estate in aspects of spatial distribution and correlation from such four dimensions as the global region, city category, nation, and urban agglomeration. The data of urban housing prices is from the Numbeo website, the data on the growth of urban housing prices is published by governments, large bank groups and large real estate enterprises, and other data is from the database of the research group.

[1]The urban center housing price data in the report is from the Numbeo website (https://www.numbeo.com). To ensure the comparability of the data, the disposable income is also quoted from the website. The official data is not adopted for the adjustment of the urban per capita disposable income.

5.1 The Global High Housing Price Area: Circum-Ocean "Three Centers and Four Zones"

The development of global urban real estate markets is highly uneven: on the one hand, there are many dispersed cities with low housing prices, and on the other hand, there are a small number of concentrated cities with high housing prices. Cities with low housing prices are almost ignored, while the supply side, the demand side and the policy regulators all focus and place emphasis on hotspot cities with high housing prices, and make the real estate market of such cities more prominent, forming a highly centralized global real estate market. On the whole, these real estate hotspot cities are concentrated in the circum-ocean "three centers and four zones", namely, they are around the ocean, gathering in three major transnational urban real estate centers of four longitude zones.

5.1.1 Three Global Centers: The Agglomeration Areas of Cities with High Housing Prices

Cities with high housing prices have an entire different distribution pattern from those with low housing prices. The global distribution of cities with low housing prices is highly even, while cities with high housing prices show significant central agglomeration.

The central agglomeration of cities with high housing prices reflects the multi-polar side of the world economy. Taking the leading position in global urban real estate market, cities with high housing prices are not concentrated in one area, but gathered in North America and West Europe[2] which are centers of developed economies as well as East Asia and Southeast Asia which are centers of emerging economies, covering cities with extremely high housing prices, such as Hong Kong, Beijing, Shanghai, Shenzhen, Singapore, London, Paris, Zurich, New York, and San Francisco (Fig. 5.1). Although there are cities with high housing prices in other areas, the housing prices and the number of cities are significantly lower than those in the three regions.

There are big differences in the geographical layout of the three major centers of the global urban real estate market. The real estate center of West Europe stretches in a block into the Continental Europe and reaches the Central Europe. Compared with other real estate centers, the West European center of real estate generally has higher housing prices, and the distribution of real estate markets between cities is relatively average, with little difference between central cities, as well as between central cities and peripheral cities. In 2007, the standard deviation of housing prices

[2]Broadly, West Europe covers part of Central Europe and South Europe.

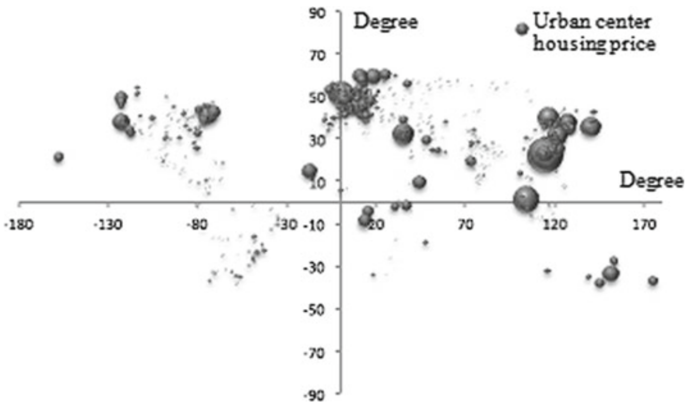

Fig. 5.1 The latitudinal and longitudinal distribution of global urban housing prices in 2017. *Note* There are a total of 563 sample cities, the housing price is measured by urban center housing price, and the circular area that represents each city is proportional to the housing price. As to the longitude, positive number represents east longitude and negative number represents west longitude. As to the latitude, positive number represents north latitude and negative number represents south latitude. *Source* Numbeo website

of the top 20 cities among major cities[3] in the West European real estate center was only USD3,331/m^2.[4] The North American real estate center is not deep into the North American continent, but stretches along the ocean coast in two strips. Cities along the eastern coast show stronger centrality, with short strip of cities with high housing prices, while the centrality of cities along the western coast is weaker, with long strip of cities with high housing prices. And the two strips are almost independently developed, lacking cities of high housing prices that connect them. The distribution of real estate markets in the core areas of North American real estate center is more balanced, and the real estate market gap of central cities is very small. In 2007, the standard deviation of housing prices of the top 20 cities among major cities[5] in North American real estate center was merely USD2,689/m^2. The East Asian real estate center is not expanded to the interior of Asian continent, but merely concentrates in the single strip area along the ocean coast, including the metropolitan and economic central cities of China, Japan and the Republic of Korea. Compared with other real estate centers, the urban real estate market gap of East Asian real estate center is relatively large. In 2007, the standard deviation of housing prices of the top 20 cities among major cities[6] of East Asian real estate

[3]Major cities are selected from cities within the scope of global competitiveness report and with urban center housing prices available on the Numbeo website.

[4]The data on 2017 urban center housing price was collected from the Numbeo website in August 2017, which is not the annual average of 2017. The same below.

[5]The choice of major cities is the same as above.

[6]The choice of major cities is the same as above.

center was USD5,434/m^2, far higher than that of North American and West European centers.

The three urban real estate centers not only have long-term accumulative high housing prices, but also bear strong development momentum of urban real estate. Comparing with the emerging and developed economies such as South Africa, Brazil, Australia, we find the 5-year cumulative growth rate[7] of the housing prices of the three urban real estate centers is also in the forefront of the world. Although the 5-year cumulative growth rate of the housing prices of Fortaleza of Brazil, Cochin of India, Cape Town of South Africa, Sydney of Australia approaches or exceeds 50%,[8] the price increase of cities of the three real estate centers is particularly remarkable. For instance, in terms of the 5-year cumulative housing price, Macau rose by 124%, Shenzhen rose by 116%, Las Vegas rose by 74%, San Francisco rose by 69%, and London rose by 59%.

The growth trends of the three urban real estate centers are quite different. The growth trend of West European real estate center shows differentiation. In the crisis region, the urban real estate market appears downturn under the impact of European debt crisis: for example, the 5-year cumulative housing price growth rate of the Ile-de-France with Paris as the center is −2.45%. In contrast, the urban real estate market of the non-crisis region still upsurges: for instance, the 5-year cumulative housing price growth rate of Hannover, Germany, has reached 50%, and that of Berlin, Germany has reached 47%. In contrast to West European real estate center, the housing price growth of North American real estate center covering both the coastal cities and the inland cities is generally high. For example, the 5-year accumulative housing price of the landlocked Denver—Aurora metropolitan area of the U.S. has risen by 58%, and that of Dallas—Fort Worth metropolitan area by 46%. The real estate market hotspots of East Asian real estate center are concentrated in the coastal or offshore cities of China, such as Shanghai, Beijing and Zhengzhou. The 5-year cumulative housing price growth rate of many cities is above 50%, and some cities even see an increase of more than 100% (Fig. 5.2).

5.1.2 *Four Longitude Zones: The Extension Direction of Urban Real Estate Hotspots*

Cities with high housing prices form certain spatial shape in the agglomeration area, which reflects the spatially extended state of urban real estate hotspots. Among the

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[7]The 5-year interval is from 2012 to 2016, and the growth rate of urban real estate price is measured by the housing price index or the apartment price index.

[8]The real estate market of most Indian cities saw a sharp fall in price in the first half of 2013, but steadily climbed up from 2014. From the second half of 2013, there appears significant growth of housing prices. However, as at the first quarter of 2017, the housing prices in most of the cities did not rise to the peak of the first quarter of 2013. Therefore, the analysis in the report covers this falling period, considering the cumulative growth rate of 2012–2016.

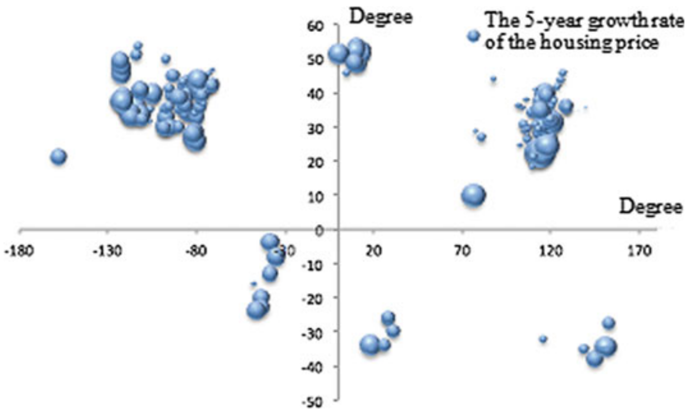

Fig. 5.2 The latitudinal and longitudinal distribution of the growth rate of global urban housing prices 2012–2016. *Note* The sum of the 5-year growth rate of the housing price index or the apartment price index of a total of 204 sample cities and areas is adopted to measure the housing price growth rate. As to the longitude, positive number represents east longitude and negative number represents west longitude. As to the latitude, positive number represents north latitude and negative number represents south latitude. *Sources* Statistical bureau of various countries (regions), central banks, Japan's National Institute for Land and Infrastructure Management (NILIM), Federal Housing Finance Agency (FHFA), and Amalgamated Banks of South Africa (ABSA)

three real estate centers, only cities with high housing prices in the West European real estate center form a block, while cities with high housing prices in other economic real estate centers constitute the belt-shape area. The belt zone is at the continental margin, reflecting the economic geography advantages of coastal cities; however, in spite of a large number of band regions in the continental margin, only a few latitudes and longitudes become the main direction of extension of urban real estate hotspots.

The urban center housing price of USD3,000/m^2 is an important dividing line of urban housing prices. Cities under this price have a very average longitudinal distribution, and except for a few longitudinal positions that are occupied by the ocean, most longitudinal locations have many cities with low housing prices. Cities above this price are highly concentrated at the longitudes, mainly distributed at 120° west longitude, 80° west longitude, 20° east longitude, and 110° east longitude, and are separated by the housing price bargain between the longitudes.

Among the four longitude zones, 120° west longitude and 80° west longitude correspond to North American real estate center. The city housing price distribution is similar, and the longitudinal distribution is narrower. It shows that the real estate hotspots of North American real estate center lack the latitudinal extension, but concentrate along the Pacific and the Atlantic coast. The 20° east longitude corresponds with West European real estate center, and the longitude distribution is wide, showing that the hotspots of West European real estate center have a very good latitudinal extension. The 110° east longitude corresponds with East Asian real estate center, and the distribution of housing price is wider. Though it has a good latitudinal extension, it is divided into two regions with the urban center housing price of USD10,000/m^2 as the boundary. It shows that despite the good latitudinal extension of real estate hotspots of East Asian real estate center, there exist obvious differences in the housing prices, and the latitudinal extension of areas with extremely high housing prices is relatively weak. Comparing 20° east longitude with 110° east longitude, we find there exists similar prices and longitudinal distribution of cities with urban center housing price of USD10,000 to 15,000/m^2. It shows that the real estate hotspots of West European and East Asian real estate centers are closely related, which reflects the close connection between European economic circle and East Asian economic circle (Fig. 5.3).

Compared with the longitudinal distribution, the dimensional distribution of global urban real estate hotspots is relatively even. With the urban center housing price USD3,000/m^2 as the dividing line, except for high latitudes, cities under this price are evenly distributed at various latitudes. Cities above this price are concentrated around 35° south latitude and 40° north latitude. However, high-price cities with urban center housing price of USD10,000/m^2 are mainly distributed in the northern hemisphere. Therefore, the more significant distribution of real estate market hotspots is 40° north latitude. Compared with the longitudinal distribution, the latitudinal distribution of cities with high housing prices is more dispersed. With 40° north latitude as the center, they cover a wider area from 20° north latitude to 60° north latitude (Fig. 5.4).

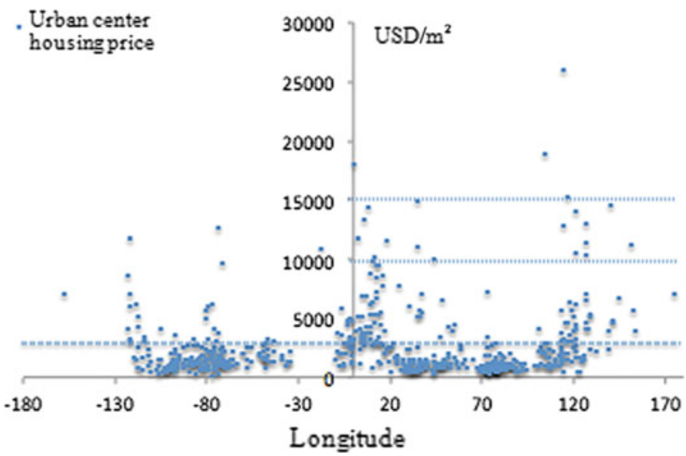

Fig. 5.3 2017 urban housing price—urban longitudinal position scatter diagram. *Note* There are a total of 563 sample cities, and the housing price is measured by the urban center housing price. As to the longitude, positive number represents east longitude while negative number represents west longitude. *Source* Numbeo website

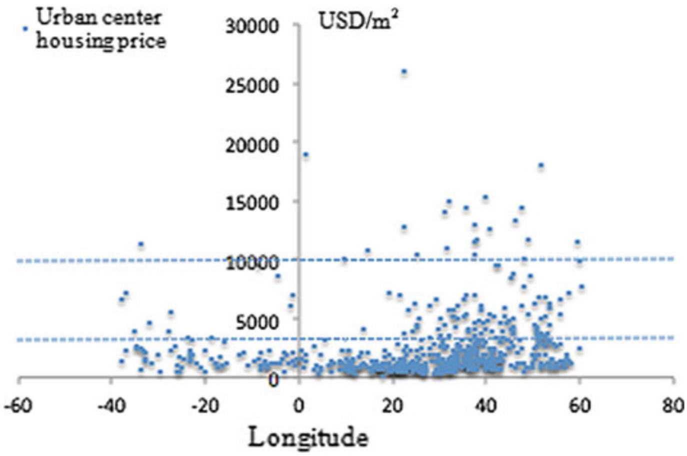

Fig. 5.4 2017 urban housing price—urban latitudinal position scatter diagram. *Note* There are a total of 563 sample cities, and the housing price is measured by the urban center housing price. As to the latitude, positive number represents north latitude and negative number represents south latitude. *Source* Numbeo website

5.1.3 The Circum-Ocean Urban Belt: Transnational Urban Agglomerations that Transcend National Boundaries

The circum-ocean urban belt is the result of the aggregation and extension of global real estate markets. Most central cities in the circum-ocean urban belt cross national boundaries and have formed transnational urban agglomerations.

The circum-ocean urban belt is the gathering of cities with high housing prices in the three real estate centers and four longitude zones. In Fig. 5.1, cities with high housing prices basically outline the contours of continents. However, the real estate development levels of cities in different circum-ocean urban belts are quite different. The circum-Arctic Ocean urban belt is mainly composed of cities of four Nordic countries and Russia. It is the extension of West European real estate center, and rests on the circum-Atlantic urban belt. Cities with high housing prices in this urban belt are few, but the prices in a small number of central cities are still high. Specifically, the city with the highest housing price is Sweden's capital Stockholm: in 2016 the city center house price was USD10,953.1/m^2. As the circum-Arctic Ocean urban belt rests on the circum-Atlantic urban belt, this report considers the former part of the latter. The circum-Indian Ocean urban belt consists of cities in South Asia, Southeast Asia, West Australia and East Africa, all of which are far from three real estate centers and four longitude zones. This urban belt has very few cities with high housing prices, mainly distributed in the junction of West European real estate center and East Asian real estate center. For instance, the urban center housing prices of Singapore and Tel Aviv-Jaffa in 2016 were USD17,951/m^2 and USD9,639/m^2 respectively. As the circum-Indian Ocean urban belt connects the

Table 5.1 The 2016 statistical characteristics of housing prices in the urban belts around the oceans

	Average house price in urban centers (USD/ m^2)	Standard deviation of house prices in urban centers (USD/ m^2)	Coefficient of variation (%)
Circum-Pacific urban belt	7340	5821	79.31
Circum-Atlantic urban belt	4201	4079	97.10
Circum-Indian Ocean urban belt	3062	2309	75.41

Note There are a total of 74 port cities. Among them, 42 cities are in the circum-Atlantic urban belt, 22 cities are in the circum-Pacific urban belt, and 10 cities are in the circum-Indian Ocean urban belt
Source Numbeo website

real estate centers of East Asia and West Europe, it has good development potential under China's Belt and Road Initiative despite the overall low urban housing prices. The circum-Pacific urban belt and the circum-Atlantic urban belt are the best developed urban belts of urban real estate, gathering most of the world's cities of high housing prices. The urban housing price level of the circum-Pacific urban belt is significantly higher than that of the circum-Atlantic urban belt, and the degree of differentiation is also small (Table 5.1).

The transnationalization of urban agglomeration is a prominent feature of the circum-ocean urban belt. Although the national boundaries have segmented the urban agglomerations to some extent, the effect is weakening and urban agglomerations along borders have integrated into transnational large urban agglomerations. The North American real estate center spans the circum-Pacific urban belts and the circum-Atlantic urban belts, as well as Canada and the United States. Along the U.S.-Canada borderline, a transnational urban agglomeration is formed along the Pacific coast and the Atlantic coast, as the origin of large rivers running through both countries. In contrast, the inland urban agglomerations of the United States and Canada lack the trend of large urban agglomerations (Fig. 5.5). The East Asian real estate center is located at the circum-Pacific urban belt, forming the China-ROK-Japan urban agglomeration. Central cities are separated by oceans rather than land cities, so the compactness is higher than it appears despite the long distance between them (Fig. 5.6). The West European real estate center extends from the circum-Atlantic urban belt to the interior, and the transnational features of large urban agglomerations are more prominent, such as the UK-France urban agglomeration and the Germany-Italy urban agglomeration. Cities of high housing prices in these countries are mainly located in the border areas between countries, while cities with low housing prices show the characteristics of being far away from the borders of countries (Fig. 5.7).

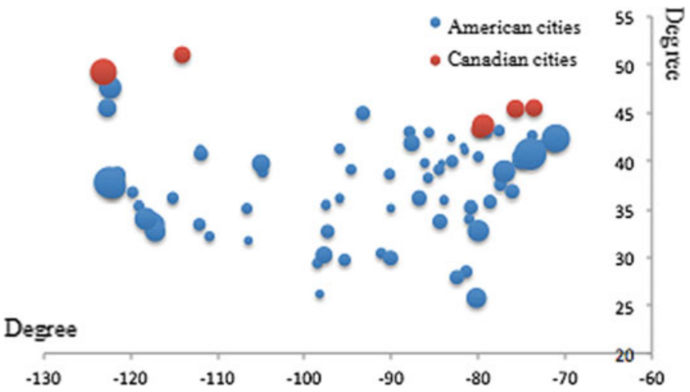

Fig. 5.5 America—Canada urban agglomeration distribution. *Note* There are a total of 79 sample cities, and the housing price is measured by house prices in urban centers. As to the longitude, positive number represents east longitude and negative number represents west longitude. As to the latitude, positive number represents north latitude and negative number represents south latitude. *Source* Numbeo website

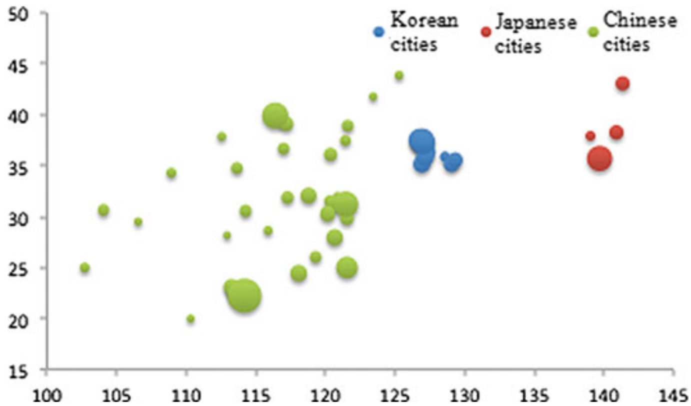

Fig. 5.6 China-ROK-Japan urban agglomeration distribution. *Note* There are a total of 52 sample cities, and the housing price is measured by house prices in urban centers. As to the longitude, positive number represents east longitude and negative number represents west longitude. As to the latitude, positive number represents north latitude and negative number represents south latitude. *Source* Numbeo website

5.2 The Global Urban Real Estate Market Shows Extensive Correlation: Three Dimensions of City Correlation

The correlation between urban real estate is often described as the correlation between urban agglomerations and the correlation within each urban agglomeration. According to the influential direction, there are contagion effect and migration

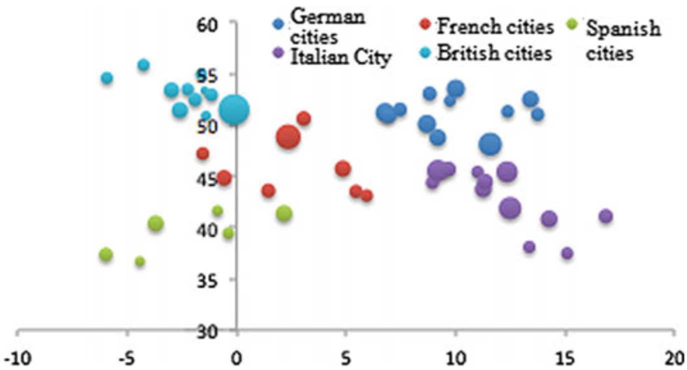

Fig. 5.7 West Europe urban agglomerations distribution. *Note* Broadly, the scope of West Europe covers some countries in Central Europe and South Europe. There are a total of 49 sample cities, the housing price is measured by urban center housing price, and the circular area that represents each city is proportional to the housing price. As to the longitude, positive number represents east longitude and negative number represents west longitude. As to the latitude, positive number represents north latitude and negative number represents south latitude. *Source* Numbeo website

effect for the former, and diffusion effect and siphon effect for the latter.[9] However, with economic globalization, it is necessary to consider the correlation of urban real estate markets in a wider scope. The linkage of urban real estate markets between one city and another needs to be synthesized from such three dimensions as the distance from real estate center, the level of urban development, and the status in urban agglomerations.

5.2.1 *The Distance from the Global Center: Contagion Effect and Migration Effect Worldwide*

The correlation between and within urban agglomerations has extended to the globe, showing the urban real estate correlation between central regions (the circum-ocean three centers and four zones) and within central regions. According to

[9]The influence between the real estate markets of the cities is usually described as four effects: the siphon effect, the diffusion effect, the contagion effect and the transfer effect. The siphon effect and the diffusion effect usually refers to the interaction of city group or within the area of the cities, such as the housing prices of the central city have inhibitory effect on prices of the around cities, known as the siphon effect, such ashousing prices rose in the central city to drive the housing prices of the around cities, as the diffusion effect. The contagion effect and transfer effect usually refers to the influence between city groups or between regions, such as the housing prices in a regional central city have inhibitory effect on the housing prices in the center city of other areas, is called migration effect, such as the housing prices in a regional central city leads the housing prices in another area rose, it is called the contagion effect.

the description of global real estate market central regions in the first part of this chapter, the real estate market hotspots of the three real estate centers show the trend of outward extension. Northern European cities and some cities of West Asia, Southeast Asia and Oceania, driven by the three real estate centers, emerge cities with high housing prices. Correspondingly, cities closer to the three real estate centers are more likely to be driven, showing the contagion effect of the three major real estate centers on the real estate markets of the surrounding areas.

However, when a city is far from the three major real estate centers, the regional migration effect will become significant. Affected by this, cities in the marginal areas lack sufficient growth in the recovery of real estate market while see more rapid decline during the market downturn. Brazil and India are two representative countries. The former is facing severe economic recession recently, and the latter is on the path of rapid growth. However, the real estate markets in the two countries have been greatly inhibited. Brazil's urban housing prices once experienced a period of high growth, reaching the peak in the third quarter of 2011, and then began to continue to fall. From the beginning of 2016 to the mid-2017, the growth rate of housing prices in major cities of Brazil had dropped to an extremely low level. In comparison, the urban real estate of the United States and Canada in North American real estate center has entered the stage of high growth, which surpassed cities of Brazil in the first and third quarters of 2015 (Fig. 5.8). The phenomenon of North America exceeding South America in the urban real estate growth shows that, the real estate market of North American real estate center inhibits that of South

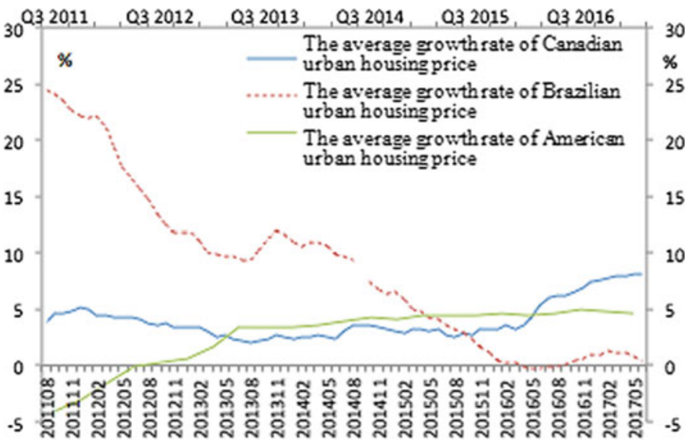

Fig. 5.8 Comparison between the average growth rate of Canadian, American and Brazilian urban housing prices. *Note* The average growth rate of Canada's urban housing prices adopts the arithmetic mean value of the annual year-on-year growth rate of housing indexes of 11 cities in Canada. The average growth rate of American urban housing prices adopts the arithmetic mean value of the annual year-on-year growth rate of housing indexes of 401 cities in America. The average growth rate of Brazil's urban housing prices adopts the arithmetic mean value of the year-on-year growth rate of the FipeZap real estate index of 7 cities in Brazil. *Source* Teranet—National Bank, FHFA, Fipe

Fig. 5.9 Comparison between the average growth rate of house prices in London, Paris, and India. *Note* 1 The urban housing price of London adopts the annual year-on-year growth rate of its housing indexes. The urban housing price of Paris adopts the annual year-on-year growth rate of its apartment price indexes. The average growth rate of Indian urban housing prices adopts the arithmetic mean value of the annual year-on-year growth rate of housing indexes of 10 cities in India. *Source* Nationwide of the UK, National Institute of Statistics and Economic Studies of France, and Reserve Bank of India (RBI)

American cities, which are farther from the three real estate centers, to some extent. India's urban housing prices have maintained a high growth rate in most of the time since 2008, but there appeared a sharp decline in the second quarter of 2013 due to substantial economic downturn over a long period of time. Although the housing prices of main cities of India have resumed rapid growth since the second quarter of 2014, the average growth rate is significantly lower than that before 2013, and the urban housing prices show greater volatility. In comparison, the housing price of London has entered a stage of high growth since the first quarter of 2013. From the second quarter of 2014–2017, the housing price growth rates of the two were close and they took a leading position alternately. The housing price of Paris stopped falling from the third quarter of 2015 (Fig. 5.9). The different trends of global real estate market central areas and other areas show that, as the global real estate market center, the three real estate centers not only lead the growth of global urban real estate markets but also restrain the real estate markets of cities far from the real estate centers.

5.2.2 Urban Hierarchy: The Higher the Level of Development, the Greater the Price Differentiation

Viewing global urban real estate markets, we find that cities with high development levels always receive more attention, and the transfer of production elements and

Table 5.2 The 2017 statistical indicators of housing prices of cities at different tiers

	Tier-A cities	Tier-B cities	Tier-C cities	Tier-D cities
Average value of housing price (USD/m^2)	12,037	5126	2318	1286
Standard deviation of housing price (USD/m^2)	5913	3252	1858	1458

Note There are a total of 524 sample cities, including 17 tier-A cities, 51 tier-B cities, 303 tier-C cities, and 153 tier-D cities
Source Numbeo website

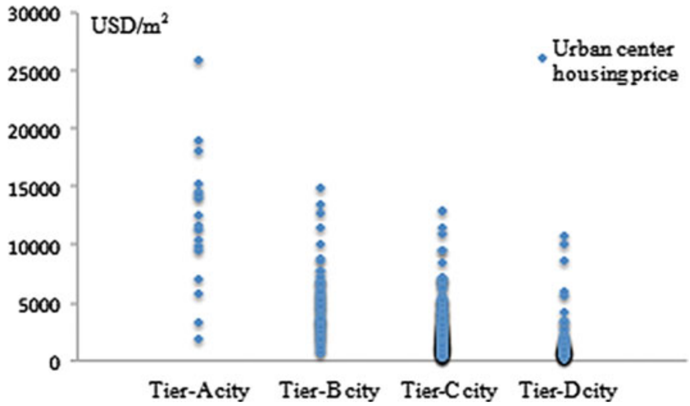

Fig. 5.10 Distribution of housing prices of cities at different tiers. *Source* Numbeo website

market demand between developed cities is more flexible than that of the less developed cities. Intuitively, the correlation degree of real estate markets between developed cities is generally greater than that between the less developed cities, and the house prices of developed cities are higher. The report divides global cities into four tiers—A, B, C, and D according to the degree of development.[10] Among cities of the four tiers, the average level of housing prices of tier-A city is far higher than that of cities at other tiers. In the first half of 2017, the average urban center house price of tier-A cities was USD12,037/m^2, that of tier-B cities was USD5,126/m^2, that of tier-C cities was USD2,318/m^2, and that of tier-D cities was USD1,286/m^2 (Table 5.2).

However, cities with higher development levels are not necessarily bound to higher housing prices. At each city tier, the urban housing prices are distributed in a relatively large range, and the higher the level of development, the greater the distribution range of housing prices (Fig. 5.10). Houston of the USA is such a city.

[10]The methods and results are reported in appendix and Chap. 1. In this part, we combines A+, class A and class A- into class A, combines B+, B and B− into class B, and combines C+, C and C − into C class.

Although Houston is considered a highly developed tier-A city, the city center house price in 2007 was only USD1,909.93/m^2, which was not only a low level among that of tier-A cities, but also lower than that of Anyang of China, Salvador of Brazil, and other tier-D cities.

5.2.3 Position in the Urban Agglomeration: High Housing Prices Raised by Siphon Effect

When a city belongs to an urban agglomeration, the real estate market of the city depends largely on the position of the city in the urban agglomeration. In general, most cities at the center of the urban agglomeration show siphon effect, which leads to a large house price gap between it and other cities in the urban agglomeration. Among the 27 urban agglomerations selected, except for Ahmedabad metropolitan area of India, Medellin metropolitan area of Colombia, large metropolitan area of Mexico, and Arizona sunshine corridor urban agglomeration, the largest gap between urban center house prices of sample cities in the urban circle is above USD1,000/m^2. Specifically, the largest gap between urban center house prices of sample cities in London—Liverpool urban belt is USD16,758/m^2. This shows that the siphon effect in urban agglomeration is dominant on the global scale, which makes central cities of each urban agglomeration have more prosperous real estate market.

The urban agglomerations in the three real estate centers show stronger siphon effect. The highest price and the lowest price of central urban areas of each urban agglomeration are included in the candlestick chart. On the right side of the dotted line are the urban agglomerations of the three real estate centers and on the left side are urban agglomerations of other regions. It shows that the housing price gap of urban agglomerations in the three real estate centers are far higher than that of other regions (Fig. 5.11). Among the three real estate centers, the housing price gap in urban agglomerations of North American real estate center is relatively small: for example, the urban center house price gap in Arizona sunshine corridor urban agglomeration was only USD374/m^2. By contrast, the housing price gap in urban agglomerations of East Asian real estate center is huge, with the urban center house price gap of Beijing—Tianjin—Hebei urban agglomeration, Pearl River Delta urban agglomeration and Yangtze River Delta urban agglomeration above USD10,000/m^2. West European real estate center is between the two; however, the biggest gap between city center house prices in London-Liverpool urban belt ranks the first among global urban agglomerations.

The siphon effect in urban agglomerations of developing and emerging economies is more obvious. Among the sample urban agglomerations, the following seven urban agglomerations have the most conspicuous siphon effect: London—Liverpool urban belt, Northeast U.S. urban agglomeration, Yangtze River Delta urban agglomeration, Pearl River Delta urban agglomeration, Beijing -Tianjin—

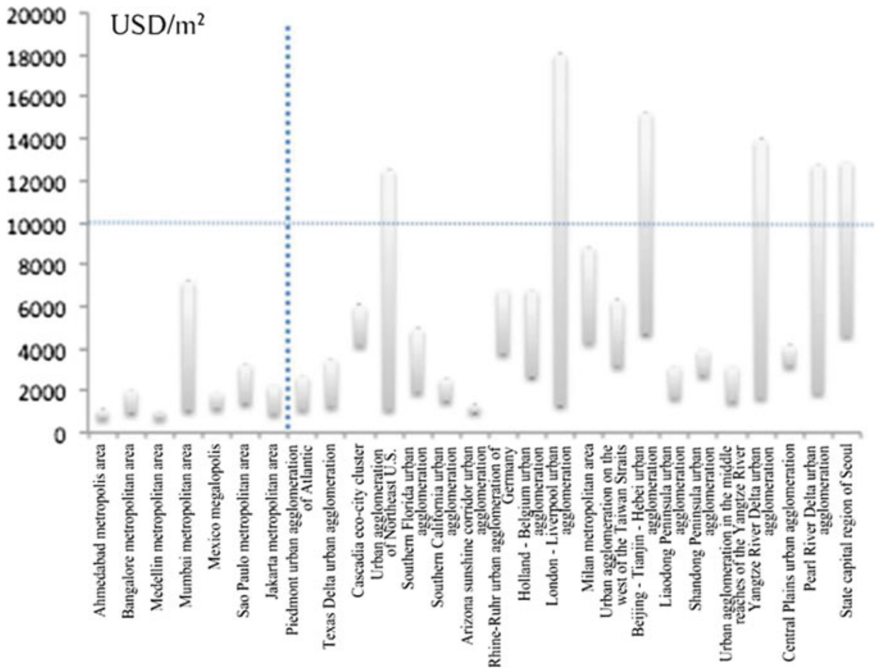

Fig. 5.11 Comparison of the housing price distribution interval of urban agglomerations. *Source* Numbeo website

Hebei urban agglomeration of China, Seoul urban agglomeration of the Republic of Korea, and Mumbai urban agglomeration of India (Fig. 5.11). Four of the seven urban agglomerations belong to developing economies, and the Republic of Korea was identified as a developed economy by United Nations Conference on Trade and Development (UNCTAD) in 2005, not a traditional developed economy. Therefore, on the whole, the siphon effect of developing economies (especially emerging economies) will be stronger.

The siphon effect of urban agglomerations can support higher housing prices. Among the 27 urban agglomerations, urban agglomerations with weak siphon effect correspond to central cities with relatively low housing prices, while urban agglomerations with strong siphon effect correspond to central cities with relatively high housing prices. Central cities with urban center house price above USD10,000/m^2 show extremely strong siphon effect (Fig. 5.11).

5.3 The Driving Force of Global Urban Real Estate: Economic Geography, Tim Series Trend and Policy Regulation

The development of urban real estate market is the result of multiple factors, and the most important driving forces are the city's economic geography, sequential trend and policy regulation.

5.3.1 Economic Geography: The Basic Impetus to the Development of Urban Real Estate

Cities are always developed in areas with economical or geographical advantages; therefore, despite certain deviation between the development level of real estate market and the economic geography feature, the latter can still provide strong explanation for the development level and trend of urban real estate.

5.3.1.1 Geographical Driving Force: Transportation Determines the Upper and Lower Limits of Urban Real Estate Market

Among the geographical elements, transportation is the most important one affecting the urban real estate. The fact that global urban real estate markets are mainly located at the ocean rims reflects the driving force of transportation. Shipping and aviation are the main means of transportation. The former is cheaper and the main way of commodity transportation in the world, while the latter is the fastest and the main form of the global flow of high-quality human capital elements.

For low housing price cities, the advantages of maritime transportation usually have no significant impact on the real estate market. The scatter diagram of "urban housing price—distance from the port" shows that the distribution of cities with low housing prices is very even. From cities with ports to cities far away from ports, there are many cities with low housing prices. However, the highest development level of urban real estate market is limited by the distance from ports. The envelope line of the upper bound of urban housing price shows that, at each distance interval, the highest urban housing prices drop significantly with the increase of the distance from ports (Fig. 5.12).

Aviation advantage has more significant impact on urban housing prices. Air transportation is often more conducive to high-end business or overcoming geographical obstacles and the nodes for shipping and land transportation are often used for air transportation, so cities with convenient air transportation usually have greater economic geography advantages. The "urban housing prices—number of air routes" scatter diagram of high-end industries shows that the two have a strong linear trend. The more the number of routes, the higher the average price level of

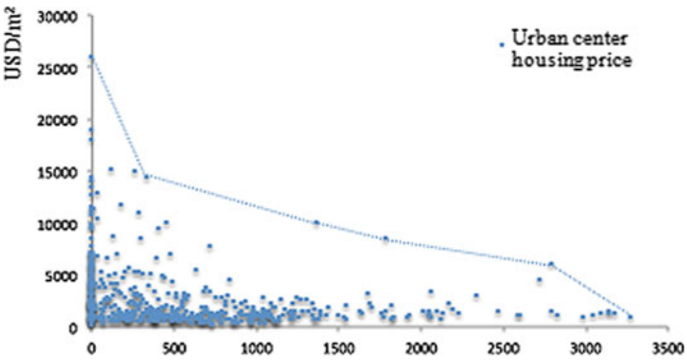

Fig. 5.12 2007 scatter diagram of urban housing price—the distance from major ports. *Note* There are a total of 523 sample cities, and the housing price is measured by the urban center housing price. *Source* Numbeo website. Global urban competitiveness database of Chinese Academy of Social Sciences

urban real estate (Fig. 5.13). The advantage of aviation convenience to some extent can offset the disadvantage of maritime transportation: for example, in Kigali, the capital of Rwanda, an important airport city deep in the African continent, the housing price stands at a relatively high level among cities in Sub-Saharan Africa. The aviation convenience also supports the lower limit of the housing price level. The envelope line at the lower bound of the housing price shows that the lowest level of the housing price in cities with more air routes is higher than that of cities with fewer routes. However, the demand for air transportation is relatively low. When the number of routes reaches a certain level, air transportation is saturated. Thus, excessive air routes will not bring up the urban housing prices too greatly,

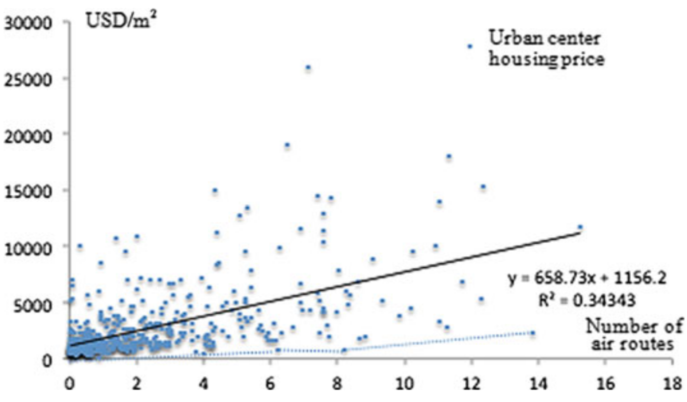

Fig. 5.13 2017 urban housing price—number of air routes scatter diagram. *Note* There are a total of 523 sample cities, and the housing price is measured by the urban center housing price. *Source* Numbeo website. Global urban competitiveness database of Chinese Academy of Social Sciences

and for cities with the highest housing prices, the number of air routes is at a medium level.

5.3.1.2 Economic and Social Driving Force: Economic and Social Development Causes Differentiation of the Real Estate Market

As a gathering place of population and economic activities, the city has a higher level of development, as well as a bigger population and economic aggregate, which are conducive to the development of urban real estate market.

There is positive correlation between economic development level and urban real estate market. However, the improvement of the economic development level also intensifies the real estate market differentiation. The differentiation of the real estate market at different levels of economic development is roughly divided by the per capita GDP of USD20,000/year. When the per capita GDP is lower than USD20,000/year, the urban housing prices are highly concentrated; however, when the per capita GDP is higher than USD20,000/year, the dispersion of city housing prices significantly intensifies (Fig. 5.14).

There is a similar phenomenon between the population size and the urban real estate market. The rising population brings up the urban housing prices, but when the city population exceeds 2.5 million, the distribution of housing prices is very decentralized, showing no distinct pattern (Fig. 5.15).

The decentralization of housing prices at higher economic and social development level does not mean the real estate market is irrelevant to the level of economic and social development. Instead, these factors can replace each other at a higher level, i.e., as to the city's economic development level or population size,

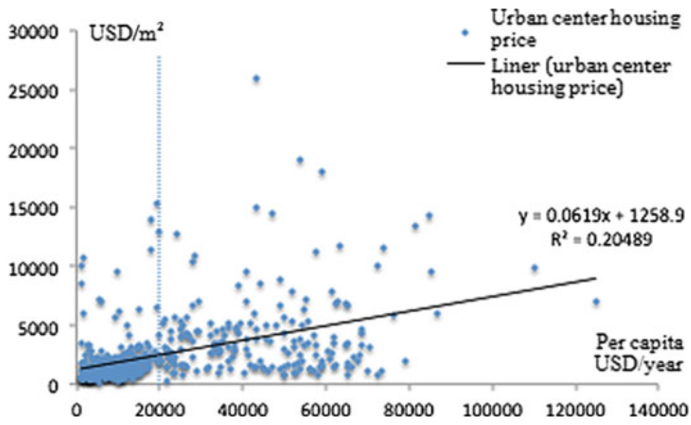

Fig. 5.14 2017 urban housing price—per capita GDP scatter diagram. *Note* There are a total of 523 sample cities, and the housing price is measured by the urban center housing price. *Source* Numbeo website. Global urban competitiveness database of Chinese Academy of Social Sciences

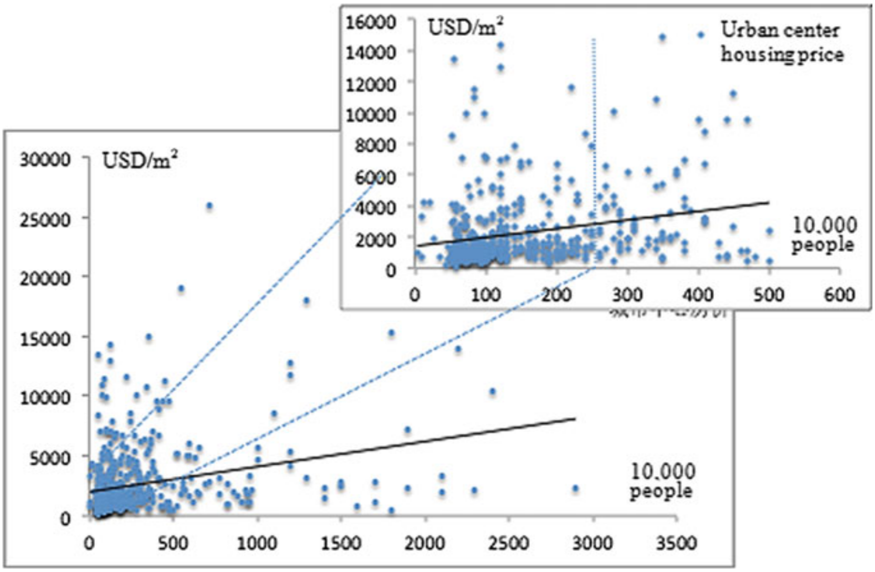

Fig. 5.15 2017 urban housing price—population size scatter diagram. *Note* There are a total of 523 sample cities, and the housing price is measured by the urban center housing price. *Source* Numbeo website. Global urban competitiveness database of Chinese Academy of Social Sciences

when one is at a low level and the other is at a high level, the urban real estate market price can still be high. Obviously, when both the economic development level and the population size are at a high level, the housing prices have the greatest potential for development, so global urban real estate centers gather in areas with a higher economic development level and a larger population size.

5.3.1.3 Service Driving Force: A Sound Public Service System Is the Basic Guarantee of the Real Estate Market

The city is a concentrated area of public services, and perfect public services can ensure the realization of basic functions of the city and bring about more real estate demand. The perfection degree of public services can be measured from the three aspects of input, output and effect. In this part of the report, the driving force of public services to the real estate market is measured through the effect of public services.

The perfect public service system not only ensures the implementation of city functions, but also brings better social order to the city. Therefore, the crime rate can be used as the contrarian indicator to measure public services. The "urban housing price—crime rate" scatter diagram shows that, with the decline of urban crime rate (from right to left), the city's housing prices show an overall upward trend. The intervals with extremely high and extremely low crime rates are the most

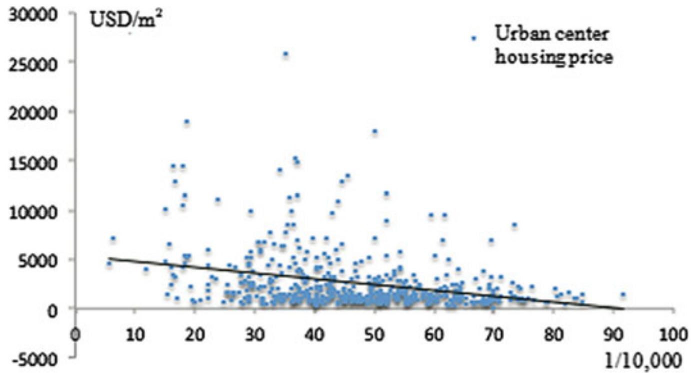

Fig. 5.16 2017 urban housing price—crime rate scatter diagram. *Note* There are a total of 523 sample cities. *Source* Numbeo website. Global urban competitiveness database of Chinese Academy of Social Sciences

conspicuous. The city housing price of the former is very low, while that of the latter is generally high. However, at the medium level of crime rate, the distribution of urban housing prices is relatively even (Fig. 5.16). This shows that the urban real estate market is sensitive to the ranges of very perfect and imperfect public services, and the improvement of general public services has little impact on the urban real estate market.

The relatively good public service system is an important reason for the aggregation of global urban real estate to the three major centers. The central cities of West Europe, North America, and East Asia all have higher public service levels. Even for developing economies in East Asia, the city's public service level is high enough to support the urban real estate market.

5.3.2 *Sequential Trend: The Effect Amplified or Reduced by Matthew Effect*

In the global urban real estate market, the biggest difference is between cities with high housing prices and cities with low housing prices. The former has obvious distribution characteristics and is more easily influenced by economic geography factors, while the latter has no obvious feature in terms of economic geography distribution and economic geography influence. The explanation is, there exists strong Matthew Effect in the urban real estate market; as a result, the market with strong sequential trend continuously grows stronger, and the effects brought by economic geography factors are more significant; while the market with weak sequential trend continually weakens, and the effects brought by economic geography factors are reduced.

5.3.2.1 Matthew Effect Intensifies the Differentiation of Urban Real Estate

The direct expression of Matthew Effect is the positive correlation between the fluctuation trend of housing prices and the level of housing prices. The 5-year growth of the housing price represents the housing price trend, and the "price level—change trend" scatter diagram shows that the city with high housing price shows a rapid growth trend (Fig. 5.17). Therefore, the degree of differentiation of the urban real estate market will continue to deepen after it appears, showing economic geography effects of constantly expanding differences.

As a long-term result of Matthew Effect, the global urban real estate shows a strong polarization. Ranking the urban center housing prices of 523 sample cities from low to high, we find that aside from the huge difference between the highest and the lowest housing prices, there is significant concave on the histogram of urban housing price, showing a severe shortage of cities with medium housing prices (Fig. 5.18). The Matthew Effect of urban real estate is a result of the self-fulfilled market expectation. When the price trend of urban real estate market shows long-term characteristics, the main body of the real estate market will consider it ongoing and adjust the demand and supply accordingly, thus bringing about the expected price in the real estate market. Therefore, Matthew Effect reflects the strong capacity of self-circulation and self-development of the urban real estate market.

The Matthew Effect of urban real estate is not immutable but shows differences at different stages of economic development and levels of urban development. From the perspective of the economic development stage, the histogram of urban housing prices of developed economies has smaller concave compared with that of the developing economies. It shows that with the economy entering the developed

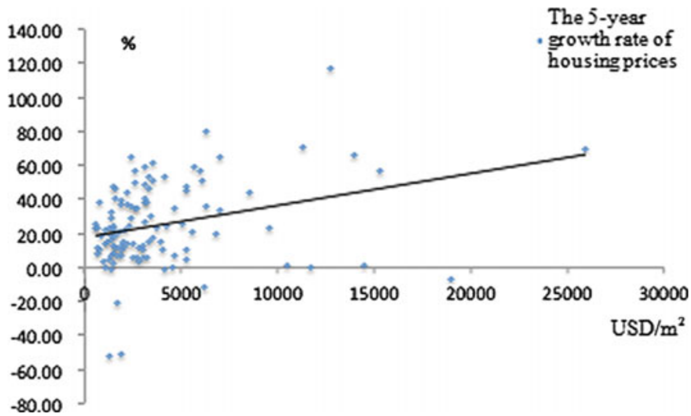

Fig. 5.17 Urban housing price level—change trend scatter diagram. *Note* There are a total of 523 sample cities. *Source* Numbeo website, statistical bureaus of various countries (regions), central banks, NILIM, FHFA, and ABSA

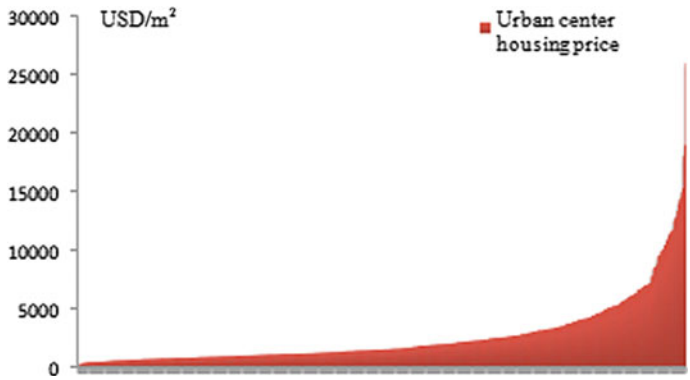

Fig. 5.18 The ranking of urban housing prices in 2017. *Note* There are a total of 523 sample cities. *Source* Numbeo website

stage, the Matthew Effect in the real estate market is gradually weakening (Fig. 5.19). Cities are divided into four tiers in accordance with their development level, and the Matthew Effect shows more remarkable differences at different tiers. The lower the city tier, the more obvious the concave trend of the histogram of housing prices, and the stronger the Matthew Effect in the real estate market (Fig. 5.20).

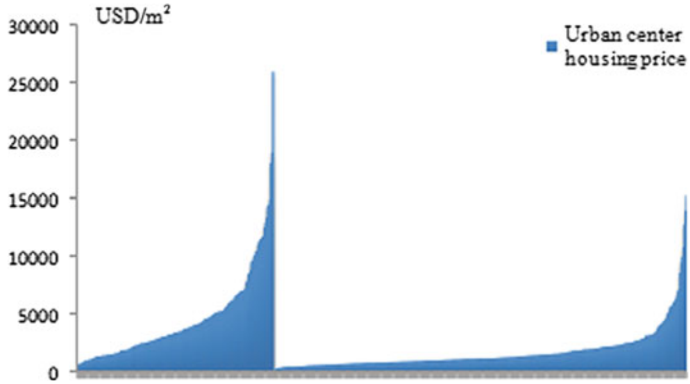

Fig. 5.19 The 2017 ranking of urban housing prices in developed and developing economies. *Note* The division of developed economies and developing economies adopts that of IMF2016. The left side represents the developed economies and the right side represents the developing economies. *Source* Numbeo website

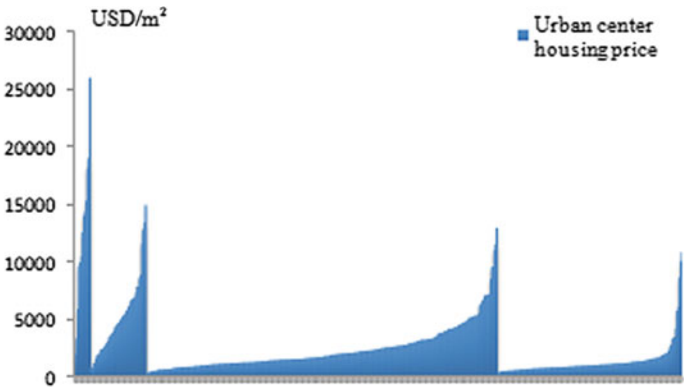

Fig. 5.20 The 2017 ranking of housing prices of different tiers of cities. *Note* From left to right are tier-A cities, tier-B cities, tier-C cities, and tier-D cities. *Source* Numbeo website

5.3.2.2 The Real Estate Market Bubble Deviates from Economic Geography Features

Due to the Matthew Effect, cities with high housing prices will increasingly deviate from their basic economic geography conditions and there will appear the real estate bubble. Taking the housing price to income ratio as a measure gauge of the real estate bubble, cities of the developing economies and the developed economies are compared. In developed economies and developing economies, the urban real estate market price and the housing price to income ratio are positively correlated, i.e., the higher the urban housing price, the more prominent the urban real estate bubble. However, there are huge differences between the developed economies and the developing economies in urban real estate. Taking the housing price to income ratio of 3–6 as the reasonable interval, a large proportion of cities in the developing economies display a large real estate bubble, while the bubble in the developed economies is relatively small (Figs. 5.21 and 5.22).

The big difference of the city real estate bubble between developing economies indicates that the development of urban real estate market deviates greatly from its economic geography advantages; nevertheless, such deviation does not mean that cities with disadvantageous economic geography will realize prosperity in the real estate market. On the contrary, only cities with greater economic geography advantages have higher real estate market prices, such as Beijing of China, Mumbai of India, and Dubai of the United Arab Emirates. Therefore, the real estate market bubble phenomenon can be mainly attributed to Matthew Effect in the real estate market: the city's economic geography advantages continue to be enlarged in the self-circulation and self-development process of the real estate market.

Fig. 5.21 The housing price—housing price to income ratio scatter diagram of developing economies. *Source* Numbeo website

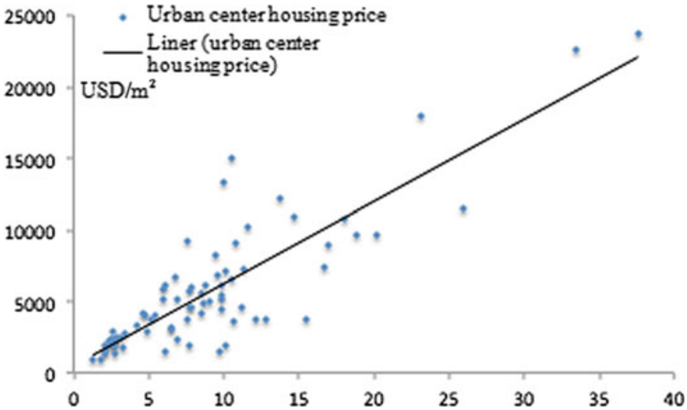

Fig. 5.22 The housing price—housing price to income ratio scatter diagram of developed economies. *Source* Numbeo website

5.3.3 The Government Policy: The Effectiveness Is Based on the Long-Term Expectation and Decentralization Degree

The government policies that affect the urban real estate can be divided into three categories: monetary policy, fiscal policy and administrative policy, but these policies are not all effective for the urban real estate market. On the whole, the government policy that can effectively regulate the real estate market must form long-term policy expectation or be based on higher governmental financial capacity. The administrative policy is only effective in the short term, and it can hardly change the long-term trend of the real estate market unless the policy is implemented for a long period.

5.3.3.1 Monetary Policy: Changing the Long-Term Expectation for the Fund Inflow in the Real Estate Market

The expansion of the monetary policy will lead to that of the price level, which will provide the real estate finance with stronger monetary and credit support. The monetary expansion trend can also be seen in the rapid rise stage of the urban real estate of all countries. However, the monetary expansion is not entirely consistent with the change direction of the urban real estate market. Japanese cities have such typical features. Although the money supply before 1990 grew in pace with the housing price, the money supply saw no significant increase in the housing price rising period during 1973–1974 and the preceding years, but maintained a growth trend during the period of housing price fall and becoming stable during 1975–1978. A bigger difference turned up after 1990, when Japan's housing prices showed a downward trend, whilst the overall money supply saw an increase despite a slight decline in 2001 but resumed an upward trend in 2002–2009.

The different effects of the monetary expansion during different periods are due to the different impacts on the long-term expectation for inflow of funds in the real estate market. Long-term expectation originates from credible policy commitment that is from stable institutions and policy makers. The urban real estate bubble period started when Japan bore tremendous internal and external pressure due to the continuous appreciation of Japanese yen, and the *Plaza Accord* of 1985 restricted the direction of Japan's monetary policy; meanwhile, the bank credit funds also showed a long-term surplus trend, making the monetary policy for urban real estate during the bubble period highly long-term expectable institutionally. Another factor supporting long-term policy anticipation is the stabilization of policy makers. After frequent reshuffle of the cabinet, Yasuhiro Nakasone and Noboru Takeshita each served as Prime Minister of Japan over a long period of time, which made the monetary policy commitment more reliable.

The monetary policy plays an important role in the correlation of real estate markets worldwide. Against the background of economic globalization, to ensure the relatively free flow of capital elements and the stability of exchange rate, major economies have to more or less give up the independence of monetary policy, paying high attention to monetary policies of the core developed economies and taking them as the main basis of the adjustment of their own monetary policies. Since the 2008 financial crisis, major economies of the global centers of urban real estate, such as the United States, Canada, the European Union, the UK, Japan, the Republic of Korea, have changed the expansion of their own monetary policy based on each other's dynamics. Only mainland China shows relatively great independence in the monetary policy. The monetary policy connection of global centers of urban real estate has formed the long-term stable expectation of monetary policy by all countries. When core developed economies adjust the monetary policy, the global urban real estate market, especially the real estate market of the three global centers will make adjustment accordingly.

5.3.3.2 Fiscal and Taxation Policy: Differences in Government Financial Capacity Exacerbate the Difference in the Real Estate Market

In addition to economic geography characteristics, the cities' government finance also results in differences in urban real estate market which are magnified by Matthew Effect in the real estate market. Take mainland China as an example. Shenzhen and Guangzhou in Guangdong Province of China fall into the first-tier cities and are close to each other geographically and economically, but their general public budget revenues in 2016 were RMB313.6 billion and RMB139.4 billion respectively, and their general public budget expenditure was RMB421.1 billion and RMB194.3 billion respectively. The government financial capacity difference was very significant. Correspondingly, the urban center housing prices of Shenzhen and Guangzhou in 2017 were USD12,792/m^2 and USD5,712/m^2 respectively, showing great differences.

The influence of government finance on the real estate market can be explained from two aspects. First, the government's capability of city building. The government is the main sponsor of urban infrastructure and the main provider of urban public services. Its financial capacity level directly determines the level of infrastructure and public services, thereby affecting the urban real estate market. The second is the government's intervention capacity in the real estate market. Because administrative intervention and economic intervention incur costs, the government with strong financial capacity will be more capable of regulating the real estate market.

The regulating capacity and driving force of the government depends on the financial system, fiscal and taxation system and policy of a country. In terms of the financial system, the higher the degree of decentralization, the greater the proportion of local government finance, hence the stronger its financial capacity. However, for an economy with the city as the administrative center or economic center and implementing preferential policies and financial support, the upward trend of financial resources will lead to its centralization in the city, while the higher degree of centralization in the fiscal system will also promote the development of urban real estate market. In terms of the fiscal and taxation system, when the government' fiscal and taxation revenue is highly correlated to the real estate market, the government will be more motivated to promote the development of the real estate market, to obtain higher fiscal and taxation income. About the fiscal and taxation policy, the government is free to adopt any kind of fiscal and taxation policy to regulate the real estate market, which determines the final effect of government regulation.

Fiscal and taxation policy and other factors can explain the differences of real estate market between East Asia, West Europe and North America to a large extent, as well as the urban real estate differences within the global real estate center areas. In respect to the financial system, the UK, mainland China and Japan have a stronger degree of fiscal centralization, so the central cities benefit more, the real estate market of which has greater differences from that of the surrounding cities

(Fig. 5.11). With respect to the fiscal and taxation system, the local governmental financial capacity of China is highly dependent on land-transfer fees,[11] while the fiscal revenue of Japan's local government during the real estate bubble period includes a large proportion of land-related taxes and the transfer payment that is highly related to the city infrastructure construction. As a result, mainland China and Japan in the real estate bubble period have more power to develop the real estate market. Regarding the fiscal and taxation policy, as of the third quarter of 2017, mainland China had not yet fully levied the property tax, resulting in the lack of automatic stabilization mechanism for the urban real estate and the medium and long-term growth rate of urban real estate ranking at the forefront of the world. In comparison, American local governments widely implement the tax credit policy to meet the housing demand, and Germany provides extensive financial subsidies for housing lease, which plays a leveling role in the urban real estate market.

5.3.3.3 Administrative Policy: More Effective, but Difficult to Change the Long-Term Trend

Real estate policies in most countries swing between direct administrative intervention and indirect market regulation. In comparison, direct intervention is often more effective, but the administrative cost and the economic cost are high. Indirect regulation is more helpful to reduce the cost burden of the government in regulating the real estate market, but is difficult to follow the defined policy target to realize effective regulation.

When the urban real estate market faces strong impact or the government is trying to achieve the leap-forward development of economy, governments often take direct administrative intervention measures. For example, the United States after World War II and Germany after unification both launched a big housing construction plan to address the short-term urban housing shortage. Administrative intervention usually brings about short-term fluctuation in the urban real estate market, although it helps to level the short-term fluctuation in the real estate market, but in the long run, the driving force affecting the real estate market has not changed. At the end of the administrative intervention, both the basic economic geography feature and the Matthew Effect associated with the sequential trend of real estate market will remain at the level before the intervention, and the urban real estate market will tend to rebound greatly.

Nevertheless, if the administrative intervention is long-term and solidified into the institution of the real estate market, then the administrative intervention can have a long-term impact on the urban real estate market. There are two approaches to the long-term administration intervention. One way is the extension of administrative intervention, such as the Japanese administrative intervention of land development in the long run, the development of urban land should be carried out

[11]It is called "land finance".

by the governments of the state, Tokyo, Hokkaido, Kyoto and Osaka, and local governments make full payment for the public housing construction. And Singapore has developed a series of laws and regulations on land acquisition as well as demolition regulations to ensure that the Housing & Development Board (HDB) can efficiently obtain low-cost land. Another way is based on urban development planning, such as the *German Civil Code* stipulates in Article 903 that, the use of housing cannot be arbitrarily changed, and the territorial planning and the state planning must be followed. Landowners are required to bear the responsibility of urban renewal. The transfer of land for agriculture and forestry is restricted. Meanwhile, it requires that the exercise of land ownership must conform to the public and social interests. These policies are generally considered effective, especially Germany's direct control over the price of the real estate market, which is generally deemed to be a strong guarantee for the stability of German housing prices.

Chapter 6
Relationship Between the Housing Price and Competitiveness: Empirical Analysis

Pengfei Ni, Haidong Xu and Haibo Wang

We have sorted out literature on the house price and urban competitiveness and presented the current status of the land market and the house price in cities around the world. Based on that, we will discuss the global impact of the house price on urban competitiveness. Urban competitiveness is measured by the competitiveness index and based on a city's income level and population size. In this chapter, we first look at the relationship between the house price to income ratio, the house price, the income and the population on the whole, then describes the pattern and trend shown in each region, country, city and urban agglomeration, reveals the impact of the house price on urban competitiveness and population, and concludes that the effect of the house price on urban competitiveness is in an inverted U shape: it goes up first and then declines along with the trade-off between the aggregation force and the dispersion force.

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6.1 A Global Description of the House Price to Income Ratio: The Global House Price Is Unreasonable

6.1.1 The Global House Price Is Unreasonable, and the House Price to Income Ratio Is the Highest in Asia and Africa, Lower in Inland Areas and Developed Countries Than in Coastal Areas and Developing Countries

Out of the 311 sample cities we chose, Havana, the capital, biggest city and economic, cultural and business hub of Cuba, had the highest house price to income ratio in 2015, that is 50.36, an extremely unreasonable figure. Besides the gross rental yield in the city proper was 35.36, compared to 31.4 in the urban periphery. The difference was small and the yield was handsome, meaning that the urban periphery was as popular as the city proper and could generate considerable yields from real estate investment. The price to rent ratio was 2.83 in the city proper, compared to 3.18 in the urban periphery, both at a low level. It means that buying is a better deal than renting. The mortgage as a percentage of income was 335.14 in urban Havana, meaning that nearly all of people's income was spent repaying the mortgage, so the city's housing affordability index was 0.3, at a very low level. Based on the above analysis we can see that the house price is vital for the city of Havana.

Second only to Havana was Kathmandu. It is the capital and biggest city of Nepal. With a land of 50.67 km^2, it is home to five million residents, with nearly 100,000 residents per square kilometers. Its house price to income ratio was 40.67. As a densely populated city, Kathmandu had a gross rental yield of 1.53 in its city proper and 2.92 in the urban periphery, both at a low level; the price to rental ratio was 65.38 in its city proper, compared to 34.27 in the urban periphery, meaning that renting is a better deal than buying. The city's housing affordability index was 0.19, lower than Havana's, meaning that residents in Kathmandu are more sensitive to the house price.

We also introduced the house price to income ratio of all our sample cities to tell whether the global urban house price was reasonable or not. Among the 10 cities with the highest price to income ratio (see Table 6.1), seven are in Asia, two in Africa, and one in North America; five are in BRICS countries, compared to zero in G7 countries, showing that most of these 10 cities are from developing countries.

Then we took a closer look at the global house price to income ratio (see Table 6.2) and found the average value of 10.62, meaning that the house price was not reasonable from the global perspective. Besides, out of the 311 sample cities, 41 had a ratio less than 3, 52 no less than 3 but no more than 6, 76 larger than 6 but no more than 10, 112 larger than 10 but no more than 20, and 30 larger than 20. It means that only 16.7% of the sample cities had a house price to income ratio at a

Table 6.1 Cities with the highest housing price to income ratio in 2015

City	Country	Housing price to income ratio	Region	BRICS country (Yes/No)	G7 country (Yes/No)
Havana	Cuba	50.36	North America	No	No
Kathmandu	Nepal	40.67	Asia	No	No
Hong Kong	China	36.83	Asia	Yes	No
Kampala	Uganda	36.53	Africa	No	No
Beijing	China	33.06	Asia	Yes	No
Mumbai	India	32.54	Asia	Yes	No
Accra	Ghana	31.1	Africa	No	No
Damascus	Syria	30.57	Asia	No	No
Macao	China	30.5	Asia	Yes	No
Dalian	China	28.8	Asia	Yes	No

Source City and Competitiveness Index Database, CASS

reasonable range, compared to nearly 83% with an unreasonable ratio, meaning that the global house price was too high and extremely unreasonable on the whole.

Based on the above descriptive analysis of the price to income ratio, we drew a chart of global distribution of the ratio (see Fig. 6.1). Areas in black are where the ratio is less than 3; those in green where it is no less than 3 but no more than 6; those in blue, larger than 6 but no more than 10; those in pink, larger than 10 but less than 20; and those in red larger than 20. Figure 6.1 shows that by region, most European and Asian cities have a relatively high and obviously unreasonable price-to-income ratio, with a worse case in Asia—the figure shows that most of the cities with a ratio higher than 20 are in Asia; the ratio in Oceania cities falls between 6 and 10; that in South American cities mostly fall between 10 and 20, also unreasonable; and that in North American cities noticeably lower than that in other regions and in a reasonable range. By country, the USA has a low and reasonable price-to-income ratio on the whole, and the ratio is unreasonably less than 3 in some American cities; in Brazil the ratio falls unreasonably between 10 and 20 in most cities; the ratio falls unreasonably between 6 and 20 in the UK, France, Germany, Poland and their neighboring countries in Europe; and it remains above 10 in China, India, Japan, Thailand and some of their neighboring countries in Asia. Besides, we can also see that the price-to-income ratio is much higher in coastal cities than in inland cities. The red columns are mostly in coastal areas, meaning that cities with the price-to-income ratio above 20 are mostly coastal cities.

We then compared the price-to-income ratio of different areas to specify the global relationship of price-to-income ratios (see Table 6.3). Table 6.3 shows that the average value of the price-to-income ratio in North America is 4.66; that in Ocean, 6.91; that in Africa, 12.24; Europe, 11.03; Asia, 14.14; and out of the 311 sample cities, the average value of the price-to-income ratio in G7 countries is 5.75,

Table 6.2 The description of the housing price to income ratio in different ranges of values

Range of values	Variables	Average value	Standard error	Minimum value	Maximum value
Global	311	10.6245	7.491411	0.44	50.36
HPIR < 3	41 (13.18%)	2.163171	0.604332	0.44	2.97
$3 \leq$ HPIR ≤ 6	52 (16.72%)	4.450192	0.894814	3.03	6.00
6 < HPIR $\leq$ 10	76 (24.44%)	8.112500	1.182139	6.12	10.00
$10 \leq$ HPIR ≤ 15	74 (23.79%)	12.08216	1.364829	10.01	14.95
$15 \leq$ HPIR ≤ 20	38 (12.22%)	17.00842	1.367765	15.06	19.93
$20 \leq$ HPIR ≤ 25	13 (4.18%)	22.55077	1.405901	20.06	24.55
$25 \leq$ HPIR ≤ 30	8 (2.57%)	26.48125	1.162748	25.42	28.80
$30 \leq$ HPIR ≤ 35	5 (1.61%)	31.55400	1.175322	30.50	33.06
HPIR > 35	4 (1.29%)	41.09750	6.456270	36.53	50.36

Source City and Competitiveness Index Database, CASS

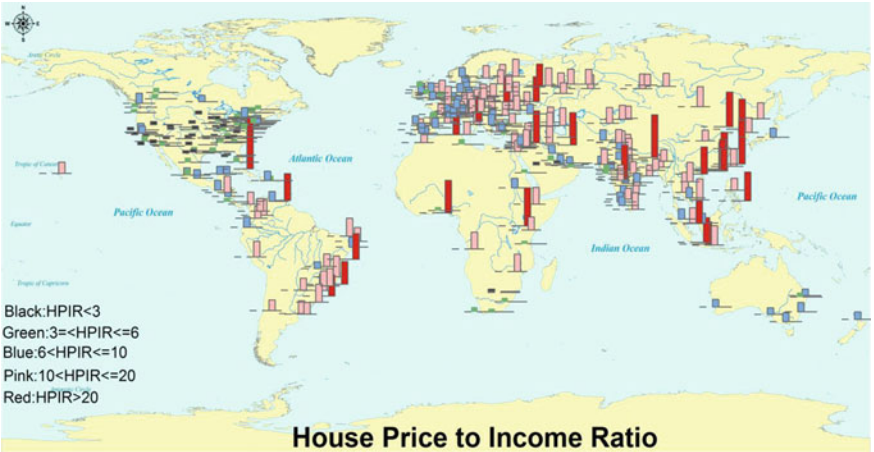


Fig. 6.1 Global distribution of the price-to-income ratio

compared to 14.10 in BRICS countries. It shows that North America is the only region with a reasonable price-to-income ratio and 21 out of the 70 sample cities have a reasonable price-to-income ratio, 36 have a ratio less than 3—together they

Table 6.3 Description of the price-to-income ratio in different regions

Region	Variables	HPIR < 3	3 ≤ HPIR ≤ 6	Average value	Standard error	Minimum value	Maximum value
North America	70	36	21	4.658286	6.198342	1.1	50.36
Oceania	7	0	1	6.911429	1.449338	4.45	8.76
Africa	20	2	6	12.2365	9.809248	2.13	36.53
South America	34	0	6	12.16941	5.873588	4.2	25.73
Europe	88	1	8	11.02818	4.592166	0.44	24.2
Asia	92	2	10	14.13902	8.16093	2.26	40.67
G7	102	37	29	5.749412	4.470155	0.44	24.2
BRICS	66	2	6	14.10061	7.777817	2.13	36.83

Source City and Competitiveness Index Database, CASS

take up 81% of the total; the price-to-income ratio is unreasonably above 10 in Africa, South America, Europe and Africa, with exceptions in six African cities, six South American cities, eight European cities, and 10 Asian cities; and Asia has the highest average value of price-to-income ratio, followed by Africa. By international organization, the price-to-income ratio is generally reasonable in G7 countries, but unreasonable in BRICS countries.

By urban agglomeration, the Boston-Washington agglomeration, Chicago-Pittsburgh agglomeration, North California agglomeration and the Texas Delta agglomeration have an average value of the price-to-income ratio of 3.964, 2.345, 5.837 and 3.002, respectively, showing that the ratio is basically reasonable in major US cities, consistent with the above observation. The average value of the price-to-income ratio in São Paulo metropolitan area in Brazil is 16.705, indicating that the ratio is unreasonably high in Brazilian cities. The price-to-income ratio is 18.373 and 16.705 in Mumbai metropolitan area and Bangalore metropolitan area, India, respectively, meaning that the ratio is unreasonable in Indian cities. The figure is 7.8 and 7.626 in London-Liverpool agglomeration in the UK and in the Northwest Europe agglomeration (covering France, Germany, Netherlands and Belgium), respectively, meaning that the ratio falls unreasonably between 6 and 10 in major European countries (Table 6.4).

Table 6.4 Description of the price-to-income ratio in different urban agglomerations

Agglomeration	Sample	Average value of the price-to-income ratio	Variance	Minimum value	Maximum value
Boston-Washington agglomeration	8	3.964	2.629	1.16	8.93
Chicago-Pittsburgh agglomeration	11	2.345	0.863	1.10	3.61
North California agglomeration	3	5.837	2.943	2.57	8.28
Mumbai metropolitan area	3	18.373	12.269	11.25	32.54
London-Liverpool agglomeration	7	7.800	5.842	0.44	16.56
São Paulo metropolitan area	4	16.705	5.197	9.61	21.87
Texas Delta agglomeration	6	3.002	0.793	2.28	4.11
Bangalore metropolitan area	5	9.798	2.792	6.57	14.04
Northwest Europe agglomeration	8	7.626	4.194	4.29	17.23

Source City and Competitiveness Index Database, CASS

6.1.2 The Price-to-Income Ratio Fluctuates Upward in Developing Countries and Cities and Remains Basically the Same in Developed Countries and Cities

After looking at the global price-to-income ratio of 2015, we charted the trajectory of changes to the global price-to-income ratio in recent years (see Figs. 6.2 and 6.4). As far as changes to the price-to-income ratio in different regions (Fig. 6.2) are concerned, the figure has been low in North America and Oceania, lower in the former than in the latter; it peaked in 2011 in Africa and have been dropping slowly since then, but still in an unreasonable range; it has been climbing up in South America and approximated 15 in 2016; it shows little fluctuation in Europe and Asia, fluctuating around 10 in Europe and around 15 in Asia.

As far as changes to the price-to-income ratio in different countries (Fig. 6.3) are concerned, the figure has remained basically the same in Australia, Canada, France, Italy, Mexico, New Zealand, South Africa, Turkey and the United States in recent years; it is reasonably low in the United States and South Africa; it has been increasing and remaining unreasonably above 10 in Brazil, China, India, Japan, Singapore and the UK, meaning that the price-to-income ratio is more unreasonable in Asia; the figure has been falling in Pakistan and Poland over the years.

As to global cities (see Fig. 6.4), Beijing—the capital city of China, one of its municipalities directly under the central government, central cities, super cities and international metropolises, and the political, cultural, international exchange and innovation hub of China—has seen its price-to-income ratio going up from year to year. In 2016, Beijing's price-to-income ratio was 33.45, quite unreasonable, the gross rental yield of its city proper and urban periphery was 2.25 and 2.61, and the price-to-rental ratio 44.41 and 38.38, respectively, meaning that in Beijing, renting is a better deal than buying. The price-to-income ratio has been growing over the years in Beijing, meaning that the house price has been increasingly important for local residents.

The price-to-income ratio has also been growing in Hong Kong, Shanghai, Singapore and Tokyo in recent years, but slightly falling in Guangzhou, and shown little fluctuation in other major cities.

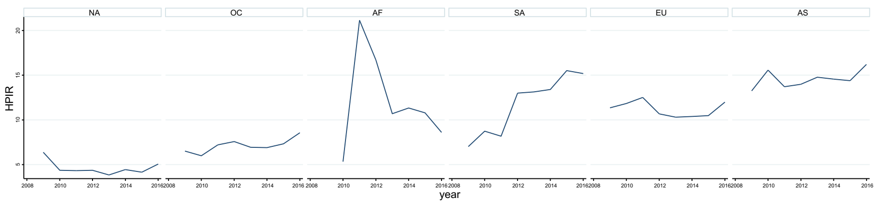


Fig. 6.2 Changes to the price-to-income ratio in different regions. *Source* City and Competitiveness Index Database, CASS

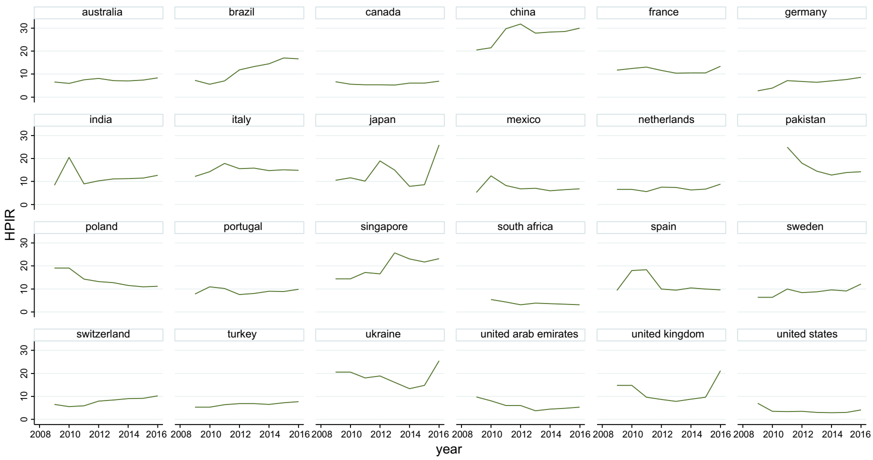


Fig. 6.3 Changes to the price-to-income ratio in major countries. *Source* City and Competitiveness Index Database, CASS

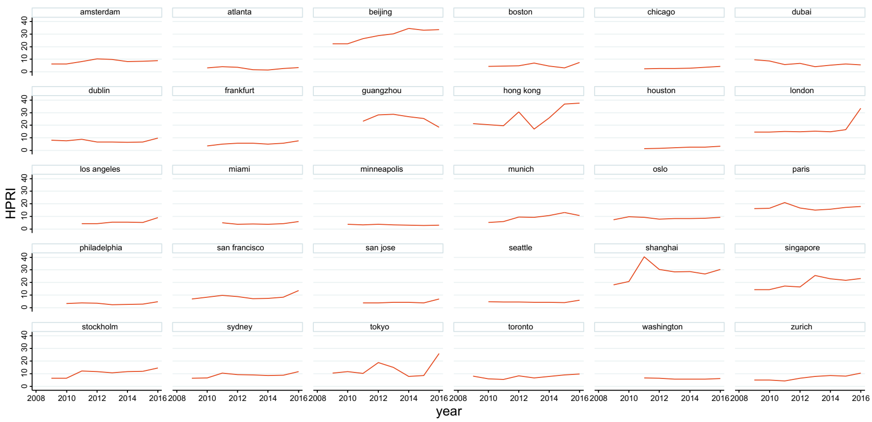


Fig. 6.4 Changes to the price-to-income ratio in major cities. *Source* City and Competitiveness Index Database, CASS

6.1.3 *The House Price Is a Stimulus for Income Growth in Most of the World, but a Restraint in Asia and Europe, in Particular in Europe*

Based on the analysis of the global price-income ratio, we chose 246 sample cities across the world according to data availability to study the relationship between the house price and income (see Fig. 6.5). Areas in blue are where the house price has negative impact on the income, those in red, positive impact, and those in green, the

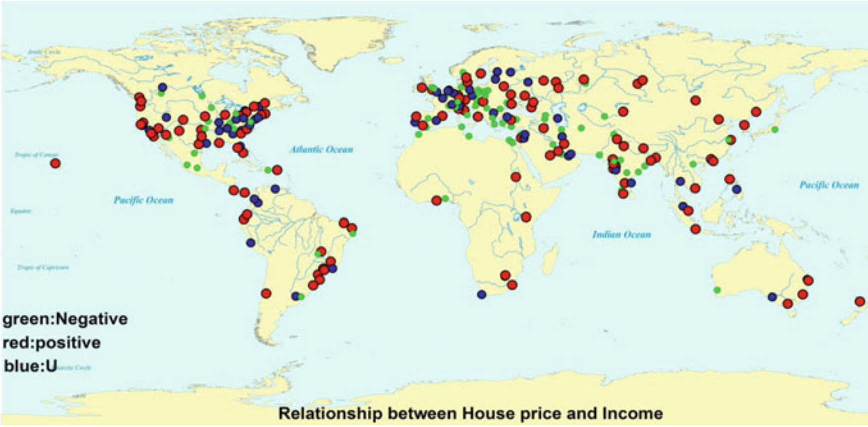


Fig. 6.5 The price-income relationship. *Source* City and Competitiveness Index Database, CASS

two are in a U-shaped relationship. Figure 6.5 shows that the house price has positive impact on the income in most cities, that is, the higher the house price, the higher the income. By region, Oceania, Europe and America have seen an inverted U-shaped relationship between the two in some cities—when the house price is sky-high, the income will fall down, but such a relationship is rarely seen in Asia and Africa. In North America, South America and Asia, the house price is mostly a stimulus for income growth; in Europe, it is a restraint in quite a number of cities but becomes a stimulus in only a few cities; in Asia, the house price has negative impact on the income, meaning a growing house price will lead to less income. By country, in the United States, the house price stimulates income growth in most cities, but suppresses it in some cities and the two are in an inverted U-shaped relationship in part of Northwest US. The case is similar in Brazil where the house price mainly stimulates income growth, but suppresses it in only a few cities. The house price is an income stimulus too in most Asian countries. But unlike Asia, North America and South America, in Europe, the house price suppresses income growth, such as in Spain, France, Germany, Italy and some neighboring countries. In particular, the two show an inverted U-shaped relationship in France and Germany, and the house price drives up income only in a few cities.

To specify the price-income relationship, we examined region by region to see whether the house price stimulates or suppresses income growth or they are in an inverted U-shaped relationship (see Table 6.5). Table 6.5 shows that the house price mainly stimulates income growth in North America, Oceania, and South America, but suppresses it in Africa; in Europe and Asia, the difference between the two effects is small. By international organization, in G7 and BRICS, the house price is dominantly a stimulus for income growth. But G7 countries obviously have more cases of inverted U-shaped relationship between the house price and income than BRICS countries.

Table 6.5 The price-income relationship in different regions

Region	Sample size	The house price stimulates income growth	The house price suppresses income growth	The house price and income in an inverted U-shaped relationship
North America	58	13	30	15
Oceania	7	1	4	2
Africa	13	8	3	2
South America	30	6	15	9
Europe	71	27	28	16
Asia	67	24	29	14
G7	81	21	37	23
BRICS	50	12	31	7

Source City and Competitiveness Index Database, CASS

6.2 The General Picture: The House Price Is in an Inverted U-Shaped Relationship with Urban Per Capita Income and Competitiveness

The top 10 cities with the highest house price are somehow overlapped with those with the highest per capita income, the biggest population and the highest competitiveness index; a high house price is associated with high competitiveness (see Table 6.6). Take a close look at the top ten cities in these aspects, and we will find certain relationship between the house price and these three factors. Specifically among the top 10 cities with highest house prices, Hong Kong, London and New York take the top three places, five are Asian cities, three European cities and two North American cities. Among the top 10 cities in terms of per capita income, San Francisco, Zurich and Geneva are also ranked among the top 10 with most expensive house prices. Among the top 10 most populated cities, Tokyo and New York are also among the top 10 cities with highest house prices; out of the 10 most competitive cities, six are among the top 10 most expensive cities to buy a home: New York, London, San Francisco, Singapore, Hong Kong and Tokyo. In particular, because of its special location, Hong Kong is ranked the most expensive city to buy a home, and Shenzhen and Beijing are also among the top 10 cities with highest house prices.

Table 6.6 Top 10 cities by house price, per capita income, population and competitiveness

Ranking	House price	Per capita income	Population	Competitiveness index
1	Hong Kong	Stamford	Tokyo	New York
2	London	San Jose	Jakarta	London
3	New York	San Francisco	Seoul	San Francisco
4	Singapore	Boston	Manila	Los Angeles
5	Zürich	Washington	Shanghai	Singapore
6	Tokyo	New York	Sao Paulo	Hong Kong
7	Geneva	Zürich	Mexico City	San Jose
8	San Francisco	Hartford	New York	Paris
9	Shenzhen	Seattle	Mumbai	Tokyo
10	Beijing	Geneva	Beijing	Chicago

Source City and Competitiveness Index Database, CASS

6.2.1 The House Price Is in an Inverted U-Shaped Relationship with Competitiveness

Globally speaking, the house price is closely related to the income level and competitiveness. Based on the data of per capita income and house prices of all sample cities, we drew a scatter diagram (Fig. 6.6). The diagram shows certain inverted U-shaped relationship between the two indicators. (1) Generally speaking, a city's per capita income will increase along with the rise in the house price, but when it hit certain point, the stimulus of a rising house price will be damaged and even turned into a negative force. (2) Though cities with a lower house price are more even in income distribution, cities with more expensive house prices tend to earn more, which proves that the house price has certain positive impact on the

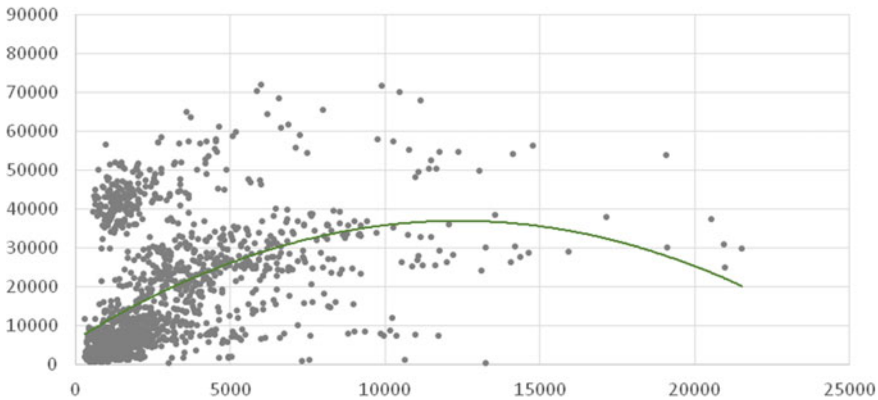


Fig. 6.6 Scatter diagram of global per capita disposable income and house prices. *Source* City and Competitiveness Index Database, CASS

income level in certain stage. (3) After calculating the correlation coefficient between the house price and the income level of all sample cities, we found the coefficient between 2010 and 2017 was 0.4273, revealing certain positive correlation between the two. But we also noticed certain dispersion of sample cities. It means that a city's income is affected by other factors in addition to the house price, resulting in great deviation from the fitted line.

Out of all the sample cities, Hong Kong was the most expensive city to buy a home in 2015, with the average house price of 21,525.2 US dollars/m^2, and its per capita disposable income was 29,460 US dollars, ranking the 52nd in the world. The house price exerted obvious negative impact on its per capita income. The top-ranking property price in Hong Kong can be explained by the following three reasons. First, Hong Kong is a global financial capital and attracts a lot of multinational corporations and immigrants who have strong housing demand. Secondly, Hong Kong has only a small land of 1105.6 km^2 and the Hong Kong government has tight control over land supply, leading to insufficient house supply. Thirdly, the Hong Kong property market is highly liberalized, free from strong government regulation. All these factors have combined to drive up the house price, threatening Hong Kong's urban competitiveness.

San Jose ranks the world's top with the per capita income of 73,921. 49 US dollars, and the 23rd with the average house price of 5866.395 US dollars/m^2, in the forefront of the 202 sample cities. San Jose is the biggest city in the Silicon Valley, known as the capital of Silicon Valley. It houses headquarters of major high-tech companies such as Cisco and eBay and welcomes new entrants such as Google and Apple. The high-tech boom is transmitted to the real estate market. The flooding of high-income earners makes it the most expensive city to buy a home. In 2016, the median apartment price in San Jose was 850,000 US dollars and now it has jumped to 1085,000 US dollars.

We drew a scatter diagram based on the house prices, the economic competitiveness index and the sustainable competitiveness index of all sample cities in 2016 (see Figs. 6.7 and 6.8) to probe into the relationship between a city's house

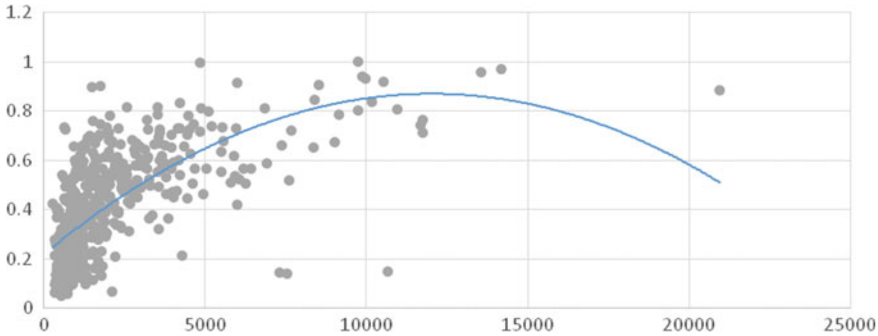


Fig. 6.7 Scatter diagram of economic competitiveness and house prices. *Source* City and Competitiveness Index Database, CASS

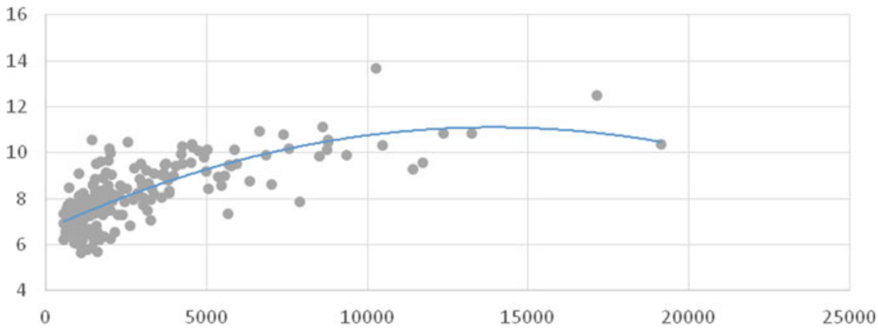


Fig. 6.8 Scatter diagram of sustainable competitiveness and house prices. *Source* City and Competitiveness Index Database, CASS

price and its competitiveness index. Figure 6.7 shows the relationship between the economic competitiveness index and the house price and Fig. 6.8, the sustainable competitiveness index and the house price. It can be clearly seen that the house price is significantly correlated, and in certain inverted U-shaped relationship, with the economic competitiveness index and the sustainable competitiveness index. From Figs. 6.7 and 6.8 we can see that: (1) Generally speaking, a city's economic competitiveness index and sustainable competitiveness index will go up along with the rise in its house price. (2) The sample cities are more densely distributed in the range of lower house prices and competitiveness index than in the range of higher house prices and competitiveness index. Out of the 202 sample cities, 31 have a house price above 5000 US dollars/m^2, compared to 171 less than that. (3) After calculating the correlation coefficient between the house price and the economic competitiveness index and the sustainable competitiveness index of all sample cities, we found the coefficient of correlation between the house price and the economic competitiveness index in 2016 was 0.7138, and that between the house price and the sustainable competitiveness index, 0.7121, revealing significantly positive correlation between them. The house price has significant impact on urban competitiveness and plays a vital role in reshaping the urban world.

New York ranks the world's top in terms of the comprehensive economic competitiveness index and the sustainable competitiveness index, with outstanding performance in both scale and quality of each indicator. It is the world's 8th most expensive city with the average house price of 10,267.33 US dollars/m^2. As the biggest and busiest city in the US, New York is also one of the world's financial centers, home to the headquarters of over 30% of prestigious enterprises, and known for its cultural diversity. The high house price and the high competitiveness of New York reinforce and complement each other. The property price in Manhattan, the heart of New York, has long been under the spotlight of the world. Despite the price fall following the financial crisis, New York, especially Manhattan, is still one of the most expensive cities to buy a home in the world.

6.2.2 The Global Relationship Between Income, Population and House Price: Regression-Based Analysis

To specify the relationship, we did a regression of per capita disposable income, the population, economic competitiveness, sustainable competitiveness and house prices on a global scale. The results are shown in Table 6.7. The results show that from a global perspective, the first power of the house price will have significant positive impact while the square house price will have significant negative impact on the income, population and competitiveness, revealing an inverted U-shaped relationship between income, population, competitiveness and house prices on the whole; when the house price is low, the per capita disposable income, population, economic competitiveness and sustainable competitiveness will go up as the house price increases; when the house price hits a certain point, its further rise will damage the per capita disposable income, population, economic competitiveness and sustainable competitiveness. The house price's coefficient of determination for per capita disposable income is 0.2113; that for population, 0.0528; that for economic competitiveness, 0.4567; and that for sustainable competitiveness, 0.4475.

The regression analysis of economic competitiveness, sustainable competitiveness and the high-income population is shown in Table 6.8. It shows that economic competitiveness has significant positive impact on the size of high-income population, which means that the more economically competitive a city is, the larger high-income population it has—it will have 92,369.48 more high-income residents for every 0.01 unit of economic competitiveness increased. Sustainable competitiveness also has significant positive impact on the size of high-income population, which means that the more economically competitive a city is, the larger high-income population it has—it will have 16,634.59 more high-income residents

Table 6.7 Regression analysis of income, population, competitiveness and house prices

Variable	Per capita disposable income	Population	Economic competitiveness	Sustainable competitiveness
House price	0.574*** (7.96)	135.0*** (6.10)	0.0001085*** (16.02)	0.000641*** (15.93)
Square house price	−0.0000141*** (−4.23)	−0.00334** (−3.24)	−4.51e−09*** (−8.45)	−2.62e−08*** (−8.23)
Constant	15842.8*** (98.46)	2591361.8*** (15.63)	0.2194595*** (18.39)	6.190*** (87.25)
Adjusted R^2	0.2113	0.0528	0.4467	0.4475
N	1570	1570	553	563

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS

Table 6.8 Regression analysis of the high-income population and competitiveness

Variable	High-income population
Economic competitiveness	9236948*** (12.50)
Sustainable competitiveness	1663459** (2.27)
Constant	−2362151*** (−13.49)
Adjusted R^2	0.4633
N	1035

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%
Source City and Competitiveness Index Database, CASS

for every 0.01 unit of sustainable competitiveness increased. In terms of coefficient, the economic competitiveness coefficient is obviously larger than the sustainable competitiveness coefficient, meaning that though economic competitiveness and sustainable competitiveness both have impact on the structure of high-income population, a higher economic competitiveness index will pay off more.

6.2.3 The House Price, the Price-to-Income Ratio and the Size of a City Are in a Wavelike Pattern of Positive Correlation

In term of population, Tokyo metropolitan area is the biggest urban area in the world. It is Japan's capital area, political, economic and cultural center, as well as sea, land and air transportation hub. In 2016, its population amounted to 35.978 million, its average house price in the city proper was 11,444 US dollars/m^2, and 5744.18 US dollars/m^2 in non-city proper, ranking the 6th in the world. Despite the low fertility rate and the aging population, Tokyo is still a huge magnet for young immigrants who have strong housing demands. Its house price has been going up and will continue the momentum as it will host the 2020 Olympic Games. This in turn reinforces people's desire to move in Tokyo.

Of the top 10 most populated cities in the world in 2016 (see Table 6.9), Tokyo, Seoul, Shanghai, New York and Mumbai are known for their high property prices, and Jakarta, Manila, Mexico City, Sao Paulo, and Ho Chi Minh City have cheaper houses. The relationship of their population size and house price is not clear.

As far as the coefficient of correlation between the size of a city and its house price, the population size and the house price have certain positive correlation which grows stronger year by year. To get a comprehensive and correct picture of the relationship between the population and the house price of a city, we used the fixed gap of one million people to study changes to the house price given the same scale of change (see Table 6.10 and Fig. 6.9). Table 6.10 shows that along with

Table 6.9 House prices in the top 10 most populated cities in 2016

City	House price in city proper	House price in non-city proper	City	House price in city proper	House price in non-city proper
Tokyo	11444	5744.18	Mexico City	1700.52	986.45
Jakarta	2763.58	1372.33	Sao Paulo	2805.65	1916.25
Seoul	10562.20	4212.99	New York	12807.3	7727.35
Manila	1622.22	1144.24	Ho Chi Minh City	2184.94	975.00
Shanghai	13144.5	5566.17	Mumbai	7474.67	2593.27

Source City and Competitiveness Index Database, CASS

Table 6.10 The relationship between the average house price and the population size

The size of urban population	The number of cities	The average house price	Standard error	Minimum value	Maximum value
No more than one million people	269	1996.59	2083.91	286.69	13041.30
1–2 million people	437	2325.92	2097.37	402.43	19072.15
2–3 million people	250	2668.90	1949.98	293.06	9162.85
3–4 million people	105	2893.76	2103.21	472.33	11756.88
4–5 million people	103	4022.93	3049.33	338.16	11142.48
5–6 million people	61	4097.99	3608.50	544.63	14373.05
6–7 million people	48	2729.23	1855.35	689.53	11054.24
6–8 million people	23	6171.53	7443.71	488.29	21525.20
8–9 million people	28	1451.71	639.02	653.83	2750.00
10–15 million people	101	4343.07	3797.50	692.80	20536.25
15–20 million people	60	1941.59	1753.80	403.65	9839.79
20–25 million people	48	4442.94	3380.81	389.80	14763.80
25–30 million people	6	4948.50	3655.62	1569.52	8981.82
More than 30 million people	12	7231.21	5672.75	1701.95	20987.45

Source City and Competitiveness Index Database, CASS

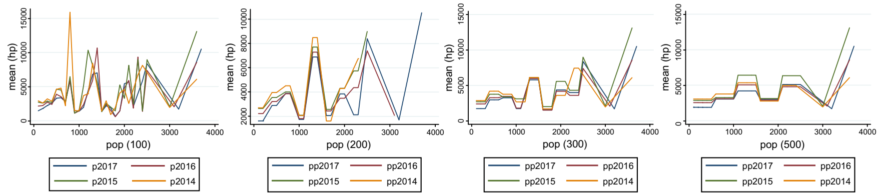


Fig. 6.9 The average house price and the population size. *Source* City and Competitiveness Index Database, CASS

changes to the population size, the house price first goes up, then goes down and then increases again. Figure 6.9 reveals the trend of changes to the house price given different population sizes and in different periods. We can see that given a fixed gap of population size, the house price has displayed a basically similar trend of changes over the years, going up first, then going down and then going up again. As to the coefficient of correlation between the population size and the house price, it was 0.0876 in 2013, 0.1550 in 2014, 0.2600 in 2015, 0.2273 in 2016, and 0.3100 in 2017. The average coefficient for all sample cities is 0.2334.

When we expanded the population size and used the spot house price of August 2017, we found that in terms of the relationship between the city size and the house price (Table 6.11), the house price is generally low in small- and medium-sized cities and high in big cities, especially megacities. Besides, the average house price and the city size shown in Table 6.6 indicate that the population of major cities is between one to five million. After comparing the average house price of cities of different population sizes, we found obvious staircase differences in house prices: cities with a population between one and five million tend to be about 900 US

Table 6.11 The average house price of cities of different sizes

The size of urban population	The number of cities	The average house price	Standard error	Minimum value	Maximum value
Less than 0.5 million people	11	1598.136	1222.753	440.765	3469.65
0.5–1 million people	162	1446.442	1483.913	286.685	11665.15
1–5 million people	307	2132.019	2020.983	338.155	11756.88
5–10 million people	39	3060.972	3816.705	582.66	20945.05
10–20 million people	25	3828.354	3660.756	389.8	13542.62
More than 20 million people	9	5337.087	4193.608	1551.095	10524.93

Source City and Competitiveness Index Database, CASS

dollars cheaper than cities with a population between five and 10 million; cities with a population above 20 million tend to be more expensive, by about 1500 US dollars, than cities with a population less than 20 million.

Meanwhile, we introduced the income level of each sample city to study the relationship between the price-to-income ratio and the city size. According to the relationship between the population size and the price-to-income ratio (Fig. 6.10), the price-to-income ratio and the city size are in positive correlation: when a city has a small population, its price-to-income ratio will be low; when its population is big, its price-to-income ratio will be high. We can see clearly from the figure that the correlation was particularly significant in 2016. In terms of the coefficient of correlation between the population size and the price-to-income ratio, it was 0.2306 in 2012, 0.2967 in 2013, 0.2867 in 2014, 0.2879 in 2015, and 0.4967 in 2016, the highest of all the years, which is consistent with the result of Fig. 6.6.

Later we looked at the relationship between the price-to-income ratio and the population size given different populations (Fig. 6.11). From Fig. 6.11 we can see that when the population gap is one million, the relationship between the population size and the price-to-income ratio is in a wavelike upward trend: as the population grows, the price-to-income ratio will go up, then go down, and then pick up the speed of growth; when the population gap is between three and five million, the wavelike trend will fade and eventually the two will display positive correlation. This is particularly noticeable in the far right of Fig. 6.6: when the population gap is five million, the price-to-income ratio and the population are in positive correlation.

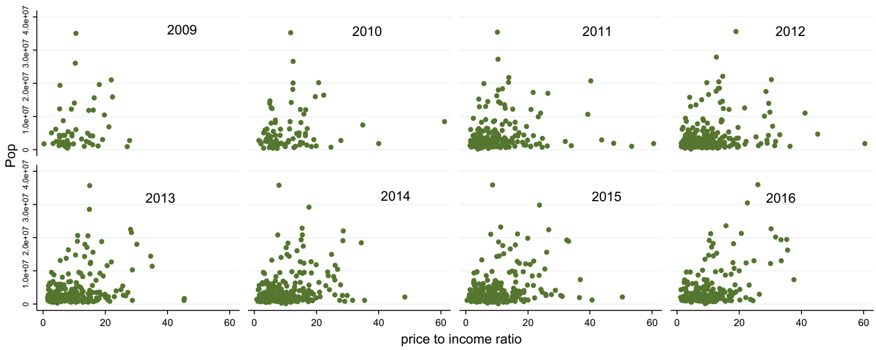


Fig. 6.10 Scatter diagram of the population size and the price-to-income ratio. *Source* City and Competitiveness Index Database, CASS

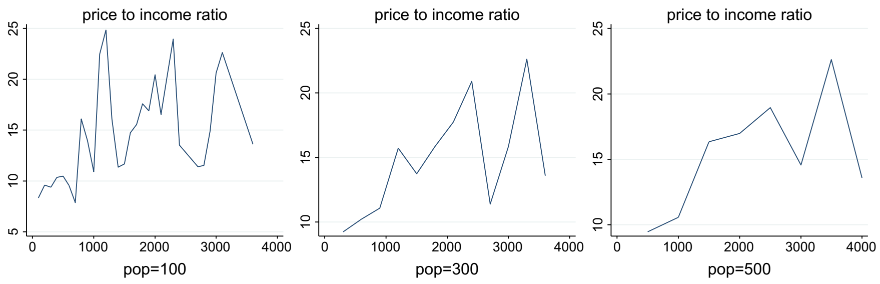


Fig. 6.11 Scatter diagram of given population gaps and the price-to-income ratio (one million, three million, and five million). *Source* City and Competitiveness Index Database, CASS

6.2.4 The Income Growth, Population Growth and Price Growth Are in Positive Correlation

To find out the global relationship between the price growth, income growth and population growth, based on data availability, we used the data of 394 sample cities, covering major countries and regions in the world. Based on the sample data, we charted the relationship between the population growth, income growth and price growth (Fig. 6.12): the left side shows the relationship between population growth and price growth and the right side that between income growth and price growth between 2002 and 2016. Figure 6.12 shows certain positive correlation between population growth and house price growth on a global scale, with the coefficient of 0.4039; and also positive correlation between income growth and house price growth, with the coefficient of 0.2993: when the house price growth slows down, income growth slows down too; when the house price picks up growth, income growth accelerates too. In addition, income growth lags behind house price growth: income growth will be more noticeable one phase behind price growth.

Fig. 6.12 The relationship between population growth, income growth and price growth. *Source* City and Competitiveness Index Database, CASS

Then we charted the relationship between population growth, income growth and house price growth given the fixed population gap of one million, three million and five million, respectively, based on available sample data (see Figs. 6.13 and 6.15). The conclusion based on the city size is the same as that drawn from the global perspective. From Figs. 6.8 to 6.15 we can see positive correlation between price growth and population growth, and also between price growth and income growth: be the fixed population gap of one million, three million or five million, when the growth of house prices accelerates, the population and income will see faster growth; when the growth of house prices slows down, the population and income will see slower growth.

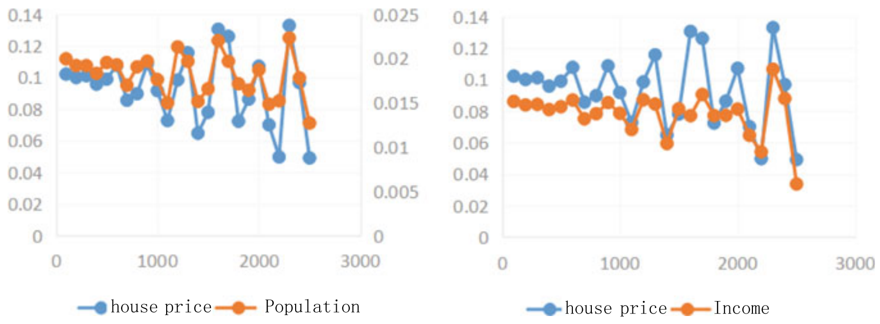


Fig. 6.13 The relationship between population growth, income growth and price growth (given the population gap of one million)

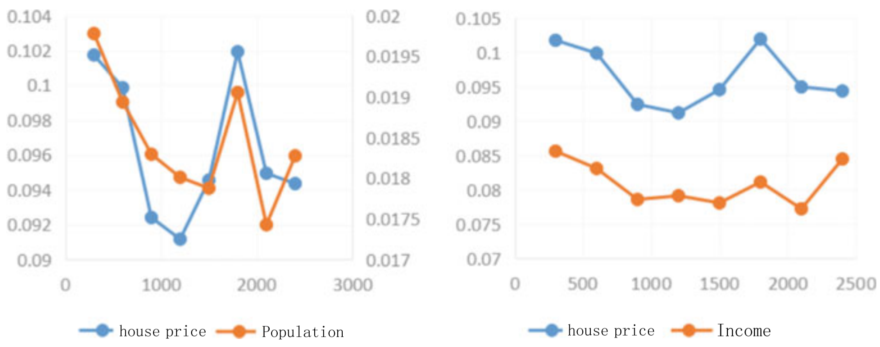


Fig. 6.14 The relationship between population growth, income growth and price growth (given the population gap of three million)

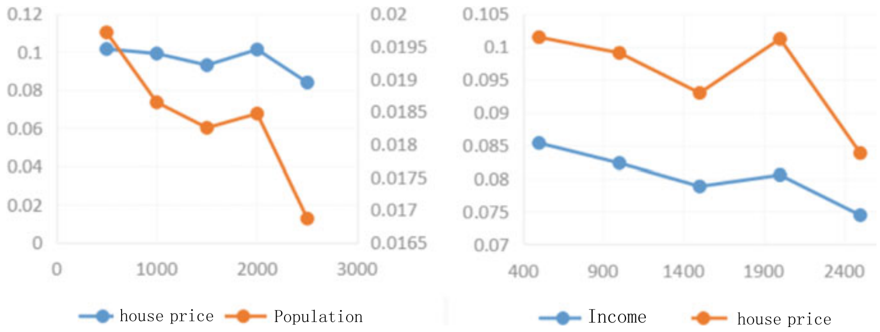


Fig. 6.15 The relationship between population growth, income growth and price growth (given the population gap of five million). *Source* City and Competitiveness Index Database, CASS

6.3 The Relationship of House Prices, Competitiveness and Regional Patterns: Global Regions, the City Basically Presents the Inverted U Relationship Between House Price and Income

6.3.1 Asia, Americas and Europe Display the Inverted U Trend Relationship in Size, Competitiveness Index and Housing Prices

Descriptive analysis by region: Asia, Americas and Europe display the inverted U-shaped relationship while in Africa, house prices and competitiveness are low, and the income and the population are evenly distributed.

To understand the relationship of income, competitiveness and house prices in each region, we charted the scatter diagrams of per capita disposable income, economic competitiveness and sustainable competitiveness of North America, Africa, South America, Europe and Asia based on the house price data from 2010 to 2017. Figure 6.16 shows that in North America and Europe, per capita disposable income and house prices are clearly in the inverted U-shaped relationship; in South America and Asia, the relationship displays a slightly downward trend; in Africa, the fitting curve leans downward, but the scatter diagram of per capita disposable income and house prices shows that Africa is characterized by low house prices and uneven income distribution. Figure 6.17 shows that in Asia, economic competitiveness and house prices are in obvious inverted U-shaped relationship; in North America, South America and Europe, they are more positively correlated to each other—the higher the house prices, the stronger the economic competitiveness, and as house prices go up, economic competitiveness will grow at a decreasing pace; in Africa, house prices are low and economic competitiveness is unevenly distributed, as in the case of income distribution.

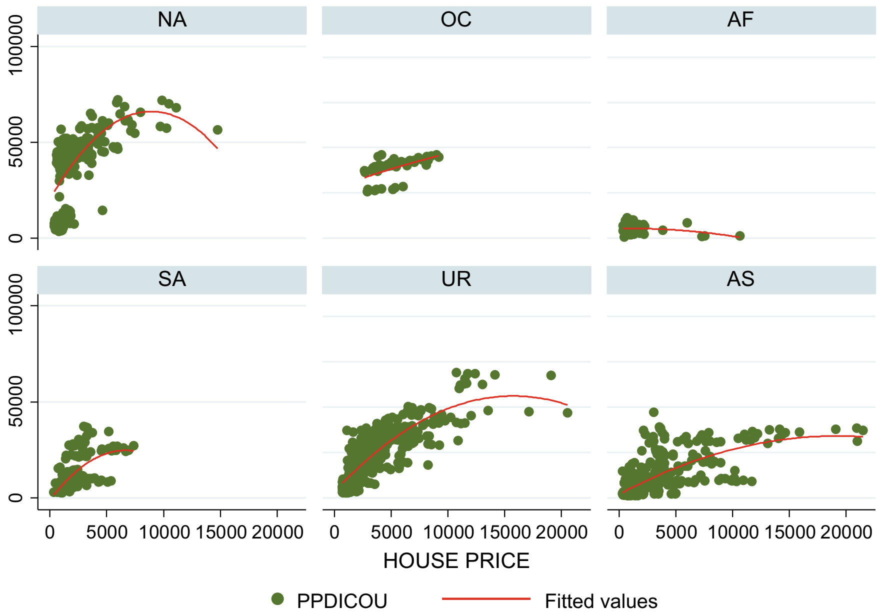


Fig. 6.16 Scatter diagram of per capita disposable income and house prices

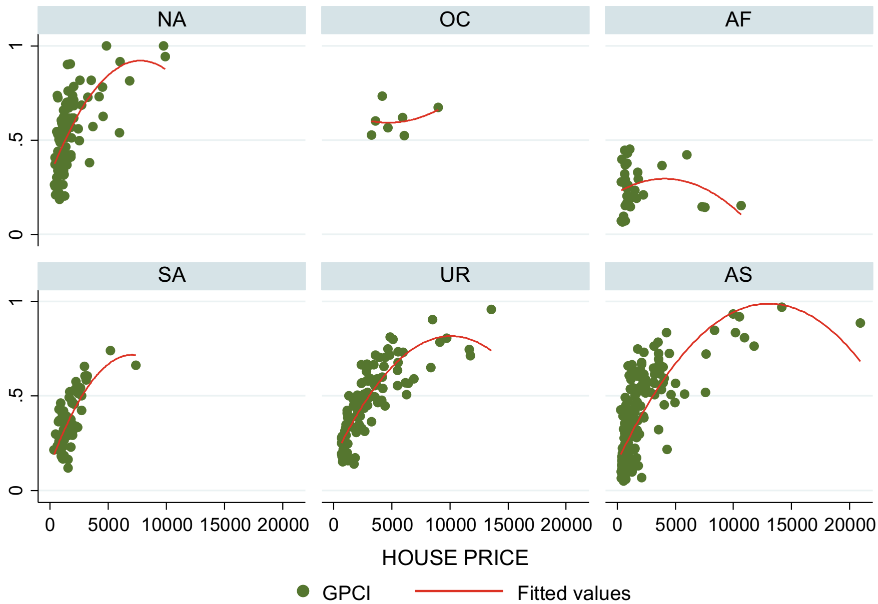


Fig. 6.17 Scatter diagram of economic competitiveness and house prices. *Source* City and Competitiveness Index Database, CASS

Based on the above analysis, we failed to find a clear relationship between house prices, income and competitiveness in Africa, so we examined house prices, income and competitiveness of African cities one by one (see Fig. 6.18). Figure 6.18 is a histogram of per capita disposable income, house prices, economic competitiveness and sustainable competitiveness in Africa. As far as house prices are concerned,

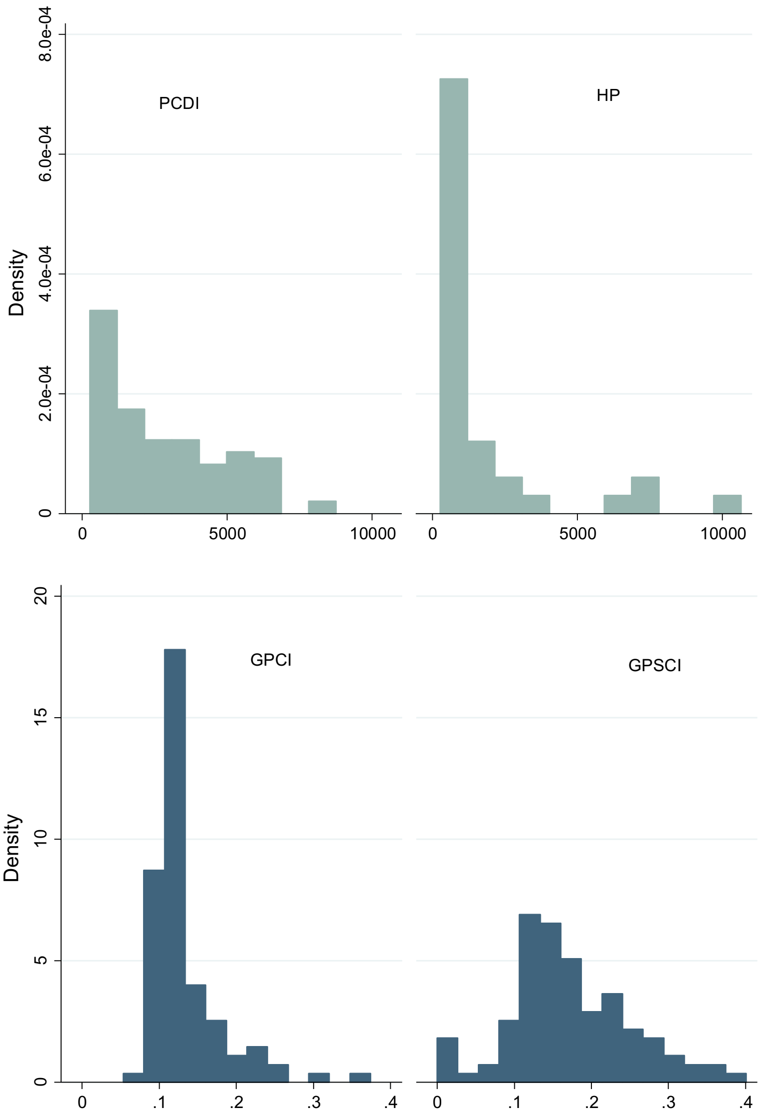


Fig. 6.18 Histogram of house prices, income and competitiveness in Africa. *Source* City and Competitiveness Index Database, CASS

Africa's house prices are low, mostly below 1000 US dollars/m^2; in terms of competitiveness, Africa generally suffers from a low level of economic and sustainable competitiveness as well as low house prices. It can also be seen that per capita disposable income is relatively evenly distributed in Africa, mostly below 6000 US dollars. It means that changes to house prices have no significant impact on Africa's per capita disposable income. In 2014, Africa's urbanization rate was only about 40%. Generally speaking, Africa hasn't entered the industrialization stage, preventing house prices from playing their due role and causing significant impact on the income level.[1]

To track the changes to population distribution in each region, we charted the relationship between the high-income population and house prices in different regions (see Fig. 6.19). Without extreme values, scatter diagrams of regional relationships between the high-income population and house prices show certain differences between different regions. Specifically in Oceania and Asia, the high-income population and house prices are obviously positively correlated—the higher the house prices, the bigger the high-income population; in North America, Africa, South America and Europe, the two display signs or the trend of inverted U-shaped relationship—as house prices go up, the high-income population will first increase and then drop slowly. It's worth mentioning that Africa has a much smaller high-income population than other regions, meaning that Africa's income is generally low. Besides, the diagram of the relationship between the high-income population and house prices in Africa shows that due to the low urbanization rate, house prices haven't worked their effect on income and the population, so there exist a certain number of high-income people at different levels of house prices. It means that house prices have little impact on the size of the high-income population and the high-income population is evenly distributed among different levels of house prices.

The regional relationship between income and house price: Regression-based analysis.

From the above descriptive analysis we can tell that income and house prices are in a sort of inverted U-shaped relationship in each region, and there exists certain association between competitiveness and the population. To specify such association, we used linear regression for analysis.

Based on sample availability, we chose regional samples of North America, Africa, South America, Europe and Asia for analysis and the regression result is shown in Table 6.12. It's clear that the first power of the house price in North America, South America, Europe and Asia has significant positive impact on the per capita disposable income in these regions, and its square, significant negative impact. Specifically the house price has a coefficient of determination of 0.3506 in North America, 0.3763 in South America, 0.7101 in Europe and 0.5072 in Asia. It reveals an inverted U-shaped relationship between the per capita disposable income

[1]2014 UN World Urbanization Prospects.

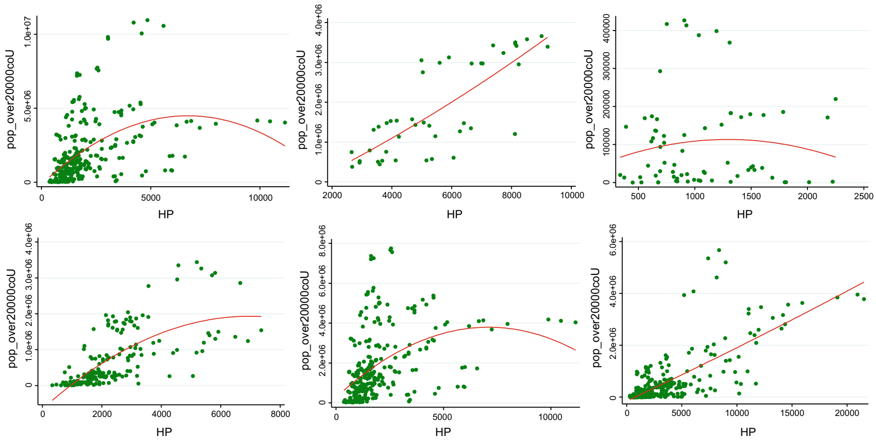


Fig. 6.19 The relationship between the high-income population and house prices. *Source* City and Competitiveness Index Database, CASS

Table 6.12 Regression analysis of income and house prices

Region	North America	Africa	South America	Europe	Asia
Variable	Per capita disposable income	Per capita disposable income	Per capita disposable income	Per capita disposable income	Per capita disposable income
House price	2.368*** (7.01)	−0.193672 (−0.92)	2.122*** (4.92)	0.516*** (4.57)	0.578*** (6.42)
Square house price	−0.0000837*** (−3.62)	3.45e−06 (0.12)	−0.000208*** (−3.68)	−0.0000135** (−2.68)	−0.0000136*** (−3.51)
Constant	28357.6*** (18.84)	3597.483*** (8.83)	7176.8*** (7.75)	16133.5*** (21.89)	4681.5*** (13.72)
Adjusted R^2	0.3506	0.0285	0.3763	0.7101	0.5072
N	288	79	193	437	529

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%
Source City and Competitiveness Index Database, CASS

and the house price in these regions: as the property price goes up, it will first exert positive impact on and drive up the per capita disposable income, but when it becomes too high, it will drag down the latter. Such a pattern is more prominent in Europe and Asian than in North America and South America. Besides, the regression analysis result of Table 6.12 is consistent with the above descriptive analysis: in African countries where industrialization hasn't begun, the house price has no impact on per capita disposable income and competitiveness, so the association between per capita disposable income and the house price is weak.

6.3.2 *The Characteristics of the Top Cities Are Obvious and There has been an Inverted Price Relationship*

Obvious patterns in first-, second-, third- and fourth-tier cities.

From the perspective of urban hierarchy, the relationship between income, population and house price is shown as follows: first-tier cities display no obvious distribution pattern of per capita disposable income, population and house price; second-tier cities have a concentrated and small population; third-tier cities tend to have low income; and fourth-tier cities are characterized by low house price, low income and a small population.

From Figs. 6.14 to 6.15 we can see that in first-tier cities, there's no obvious distribution pattern of per capita disposable income, population and house price, with cities of different house prices, income levels and population sizes. For second-tier cities, there's certain positive correlation between the house price and the income—the higher the house price, the higher the income. And most second-tier cities have a small population and varying house prices, meaning that their population gap is small but their house price gap is huge. The positive correlation between the house price and the income also exists in third-tier cities which tend to have low house prices and a big population gap. Fourth-tier cities tend to have low income, a small population and low house prices, as shown in Figs. 6.20 and 6.21.

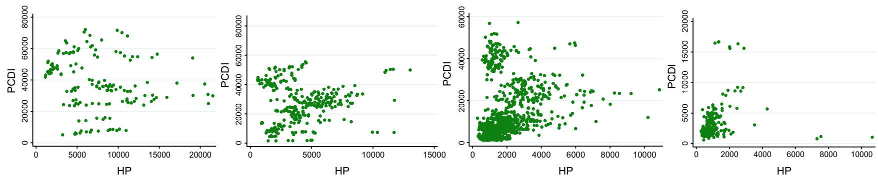


Fig. 6.20 The income-price relationship in first-, second-, third- and fourth-tier cities

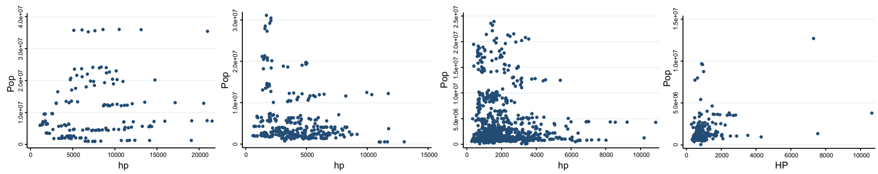


Fig. 6.21 The population-price relationship in first-, second-, third- and fourth-tier cities. *Source* City and Competitiveness Index Database, CASS

Top cities have seen the inverted U-shaped relationship between income and house prices and major cities have seen this trend.

Take first-tier cities for example. By examining their income-price relationship we can see that (Table 6.13), among first-tier cities, there are London, Hong Kong and Singapore where house prices are high while income is low, and also San Jose, Los Angeles, Dallas, Huston, Minneapolis and Chicago where house prices are low while income is high. It means that house prices and per capita disposable income have multiple relationships instead of a simple linear relationship. We grouped first-tier cities into A+, A and A− types for analysis.

For London and New York in Type A+, between 2010 and 2017, their average house price was 11,761.74 US dollars/m^2, with the lowest 7117.14 US dollars/m^2 and the highest 20,536.25 US dollars/m^2. Specifically, in London, the average house price in the city proper was 17,176 US dollars/m^2 and that in urban periphery 9045.78 US dollars/m^2; in New York, 12,592.89 US dollars/m^2 and 6785.3 US dollars/m^2. We drew a scatter diagram of the income and house prices in London and New York based on historical data (Fig. 6.22) and found that in the past eight years, both cities have seen the inverted U-shaped relationship between income and house prices: when the house price gets too high, the per capita disposable income drops.

Figure 6.23 shows the scatter diagram and the fitting curve of per capita disposable income and house prices of Hong Kong, Singapore, San Jose, Los Angeles

Table 6.13 House prices and per capita disposable income of first-tier cities

City		Per capita disposable income	House price	City		Per capita disposable income	House price
Type A+	London	36637.35	13110.89	Type A−	Shanghai	7501.603	7043.56
	New York	55857.38	9872.94		Boston	59068.64	5281.00
Type A	Hong Kong	28966.09	15808.61		Dallas	42249.78	1642.82
	Singapore	27093.57	12446.02		Huston	46832.71	1556.22
	San Jose	65762.57	4746.73		Beijing	6863.297	7153.89
	San Francisco	65460.71	8220.62		Frankfurt	33692.9	4532.74
	Los Angeles	46186.82	4222.34		Washington	56980.02	4053.47
Type A−	Seoul	14859.7	7365.63		Minneapolis	47757.06	2024.77
	Tokyo	24811.48	9870.24		Chicago	46184.67	2119.07
	Paris	33322.47	9853.12		Dublin	25298.31	4518.57
	Oslo	38194.47	7303.77		Zürich	54178.08	13258.55
	Sydney	35881.78	8286.32				

Source City and Competitiveness Index Database, CASS

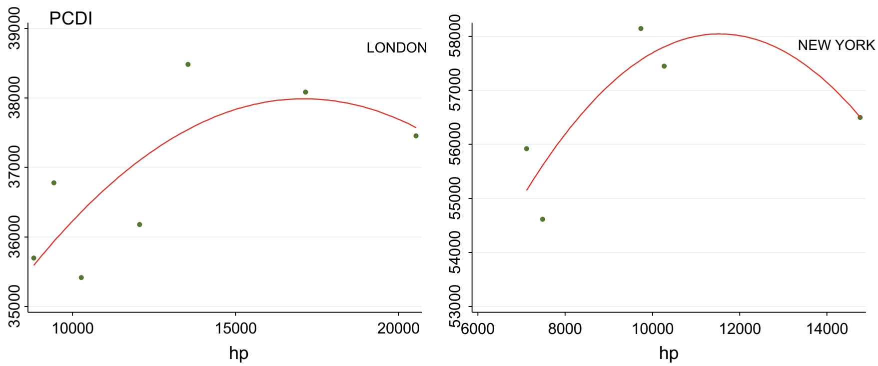


Fig. 6.22 Scatter diagrams of per capita disposable income and house prices. *Source* City and Competitiveness Index Database, CASS

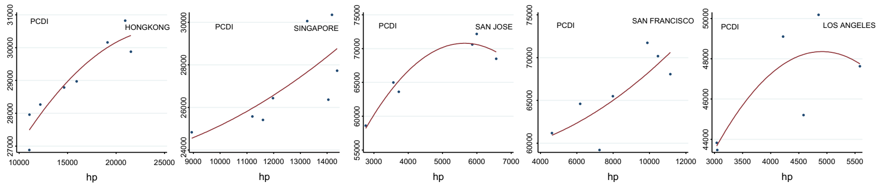


Fig. 6.23 Scatter diagrams of per capita disposable income and house prices. *Source* City and Competitiveness Index Database, CASS

and San Francisco in Type A. We can see that Los Angeles and San Jose have seen the inverted U-shaped relationship between per capita disposable income and house prices; in Singapore and Los Angeles, positive correlation between the two is dominant: the high the house price, the higher the income; in Hong Kong, as the house price continues to increase, per capita disposable income is outgrown by the house price, and the growth gap is narrowing until it disappears or reverses.

From Fig. 6.24 we can see that Sydney, Tokyo, Paris, Shanghai and Huston has seen obvious inverted U-shaped relationship between house prices and income; Seoul, Beijing, Chicago and Dublin have seen the convex income-price relationship —as the house price continues to increase, income will be outgrown by it until the growth gap disappear; Boston, Frankfurt, Washington and Dallas have seen the concave relationship between the two—as the house price picks up, it will be outgrown by per capita disposable income; in Zürich, the house price is already sky-high but its income low is falling, which means that as the house price goes up, the income goes the opposite way.

From Fig. 6.24 we can also see that in Oslo, per capita disposable income and the house price are in the U-shaped relationship—when the house price is low, the income is falling; when the house price is high, the income will go up as the house

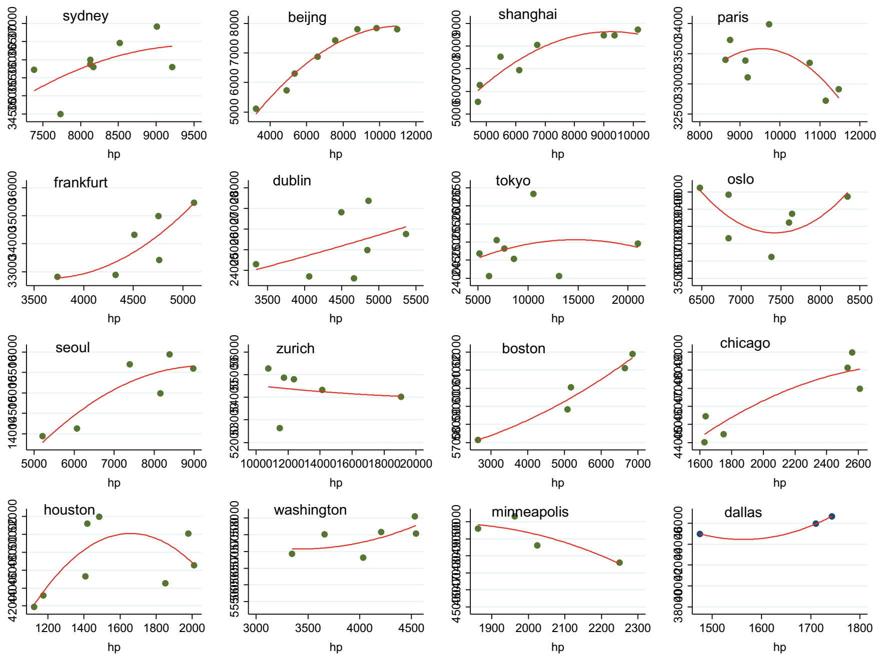


Fig. 6.24 Scatter diagrams of per capita disposable income and house prices. *Source* City and Competitiveness Index Database, CASS

price increases; in Minneapolis, when the house price is low, the income will fall when the house price increases, showing an opposite trend to other major cities in the world. We charted the wage-price relationship of the two cities (Fig. 6.25) for a closer look. It's clear that Oslo has seen the inverted U-shaped relationship between the wage and the house price while Minneapolis is displaying positive correlation between them.

6.3.3 National and Global Patterns: Major Developed and Developing Countries Generally have a Clear Income-Price Relationship; India Suffers from an Extremely Uneven Income-Price Relationship

Given the large number of countries around the world, it's hard to consider the income-price relationship in each country, so we chose 15 typical countries for our study: China, India, Indonesia, Brazil, the UK, the USA, France, the Republic of Korea, Russia, Canada, Italy, Australia, Germany, Mexico and Japan. They cover all the continents and all development levels, including both developing and developed countries.

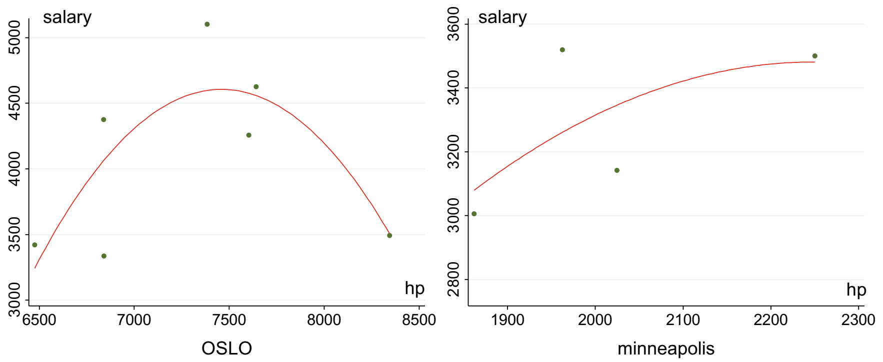


Fig. 6.25 Scatter diagrams of wage and house prices in Oslo and Minneapolis. *Source* City and Competitiveness Index Database, CASS

From the scatter diagrams of per capita disposable income and house prices from 2010 to 2017 in major cities of these countries (from Fig. 6.26) we can see that: (1) China, Brazil, the Republic of Korea, the USA, the UK, Italy, France and Japan have all seen the inverted U-shaped relationship between the per capita disposable income and house prices. (2) In Russia, Germany and Australia, income and house prices are positively correlated—the higher the house prices, the higher the income.

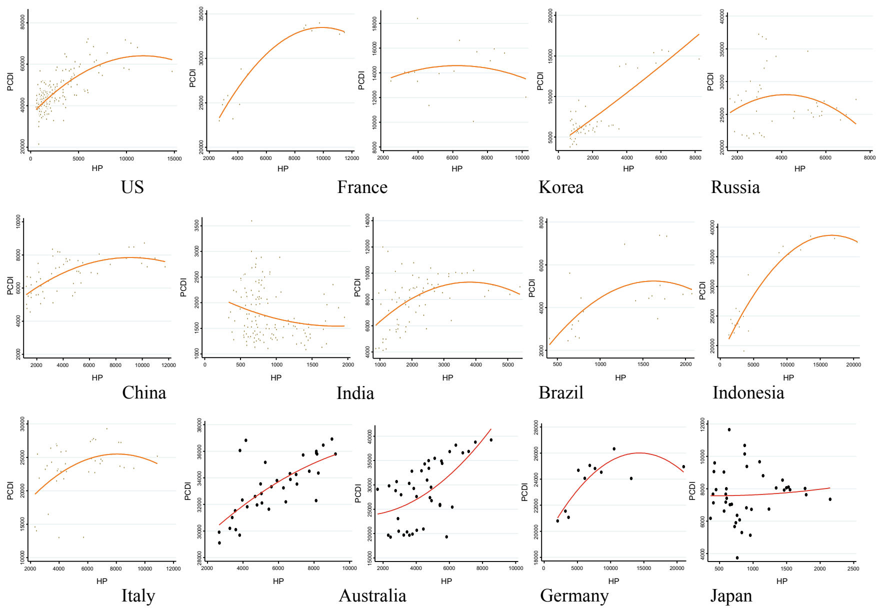


Fig. 6.26 Scatter diagrams of income and house prices. *Source* City and Competitiveness Index Database, CASS

(3) India and Mexico show no significant correlation between house prices and per capita disposable income—as house prices go up, the income distribution shows no obvious pattern. According to the data, the house prices in India and Mexico are low, at about 1000 US dollars/m^2, meaning that there is little price fluctuation; and the income level is concentrated at about 2000 US dollars in India and 8000 US dollars in Mexico, showing little income fluctuation, too, as seen in the figure. (4) In the rest countries, the per capita disposable income and house prices are in the inverted U-shaped relationship.

6.3.4 House Price Correlation Between Major Cities in the World: The Wage-Price Relationship Is not Clear for Major Cities

At the national and municipal levels, house prices around the world bear strong spatial association. At the national level, after the financial crisis broke out in 2007, the United States was the first to see the house price plummeting, followed by Spain, France and the UK and most of the rest countries. At the city level, major cities in the world saw significant rise in house prices in 2015. Specifically, the house price at the city proper of Hong Kong rose to 27,001 US dollars/m^2, up by around 6800 US dollars/m^2 from 2014, that of London to 27,668 US dollars/m^2, up by about 12,000 US dollars/m^2, and that of Tokyo to 18,219 US dollars/m^2, up by 11,000 US dollars. It shows that house prices of major cities are highly correlated, but their wage relationship remains unclear. Therefore we need to examine the wage relationship between global cities and their relative house prices.

For this purpose, we chose eight cities as samples: Hong Kong, London, Los Angeles, New York, Paris, Singapore, Sydney and Tokyo and drew the scatter diagram of their respective wage and relative house price (see Fig. 6.27): the horizontal axis represents the relative house prices of city 1 and city 2, the blue curve the fitted curve of city 1's wage, and the red curve, that of city 2's wage. From Fig. 6.27 we can see that, in the case of Hong Kong, its home are generally more expensive, but its wage lower than the other cities; the rise in the relative house price of Hong Kong will have positive impact on the wage in Los Angeles, New York, and Singapore, and negative impact on that in Paris, Sydney and Tokyo, and will drive up the wage in London first and then bring it down. In the case of London, its homes are the second most expensive, and as its relative house price increases, the wage in Paris, Sydney and Tokyo will fall, that in Los Angeles and Singapore will go up first and then down. Following this line of reasoning, we can reveal the relationship between every pair of the cities. Figure 6.27 also shows that even if certain mutual influence exists between each pair of these cities, their wage and house price relationship doesn't fit our model specification aforementioned. It means that given different geographical locations, resource endowment and industrial structures, these cities have their respective development mode, so even

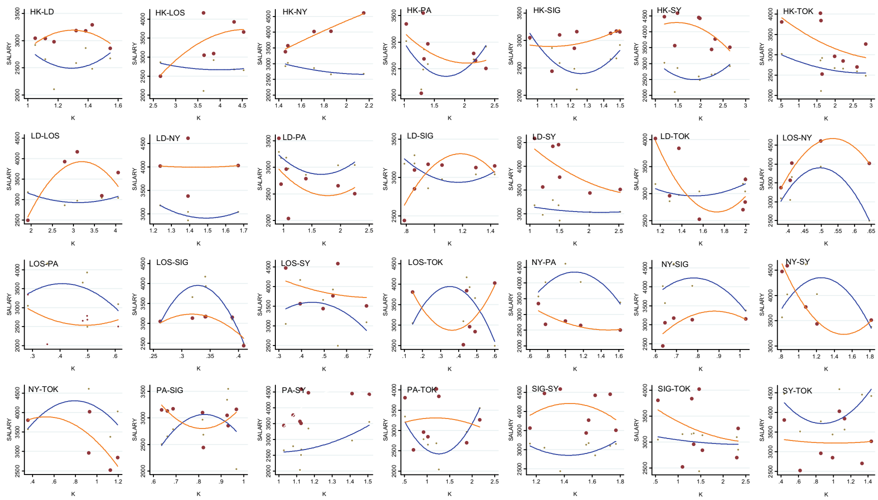


Fig. 6.27 Scatter diagrams of income and relative house prices. *Source* City and Competitiveness Index Database, CASS

when their house prices are at the same level, their wage income may vary, and when their wage level is the same, their house prices are not.

Similar to the above approach, we c harted the relationship between the high-income population and the relative house price (see Fig. 6.28). Specifically, the horizontal axis represents relative house prices of city 1 and city 2, the blue curve the fitted curve of the high-income population of city 1 and the red curve, that of city 2. In the case of Hong Kong, as its relative house price goes up, the high-income population in Los Angeles, Sydney and Singapore will increase, with little impact on the rest cities. In the case of London, as its relative house price goes up, the high-income population in Los Angeles and New York will increase, that in Paris will go up first and then go down, with little impact on the rest cities. Following this line of reasoning, we can grasp the relationship between the high-income population and the relative house price of these cities. In addition, when their high-income population is of the same size, their relative house price are not at the same level; when their relative house price is the same, their high-income population varies.

To specify the relationship between the wage income, the high-income population and the house price, we take New York and Hong Kong for example. Table 6.14 shows that the house price in Hong Kong will have significant positive impact on its wage income and high-income population and on the house price and wage income in New York; the house price in New York will have significant negative impact on the wage income and high-income population in both cities. It means that when the house price in New York is taken into account, the rise in the house price in Hong Kong will increase the income and the high-income population in both cities; when that in Hong Kong is taken into consideration, the rise in the

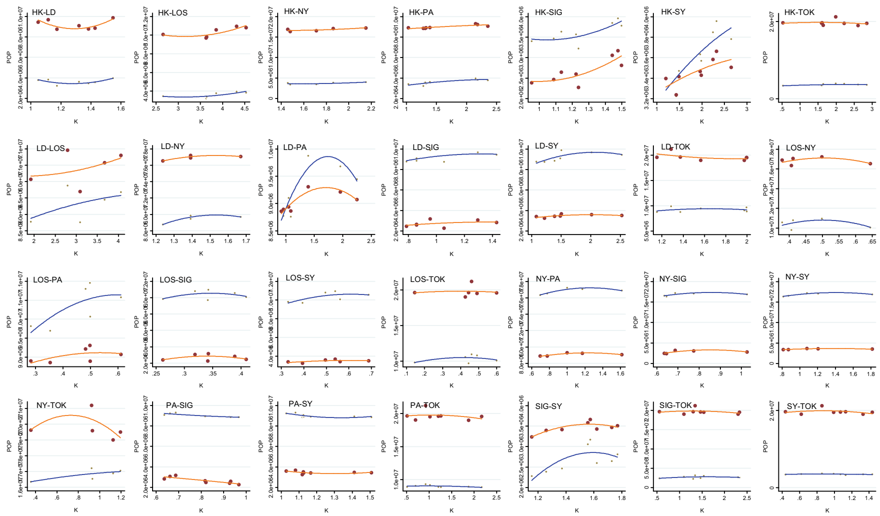


Fig. 6.28 Scatter diagrams of the high-income population and house prices. *Source* City and Competitiveness Index Database, CASS

Table 6.14 Regression analysis of income, high-income population and house price

City	Hong Kong	Hong Kong	New York	New York
Variable	Wage income	High-income population	Wage income	High-income population
House price in Hong Kong	0.351**	68.47**	0.437*	108.2**
	(19.09)	(15.90)	(6.75)	(12.53)
House price in New York	−0.227*	−44.06*	−0.416	−83.88*
	(−7.60)	(−6.29)	(−3.95)	(−5.97)
Constant	25704.6***	2964263.0***	53215.9***	15798296.0***
	(136.18)	(67.07)	(80.02)	(178.27)
N	5	5	5	5

Source City and Competitiveness Index Database, CASS

house price in New York will bring down the income and the high-income population in both cities.

Analysis of major urban agglomerations in the world: Developed large urban groups basically show inverted U relationship between housing prices and income.

Yangtze River Delta urban agglomeration: Peripheral cities are playing an increasing role, the rising house price in small cities will increase the overall income of the agglomeration.

The Yangtze River Delta urban agglomeration is a highly developed agglomeration in coastal East China, the biggest economic circle and hub in China, a global manufacturing hub and one of the world's six biggest urban agglomerations. It is expected to become the world's biggest metropolitan area by 2018. It consists of Shanghai, Jiangsu, Zhejiang and Anhui, with a territory of 354,400 square kilometers. In 2014, its GDP stood at 12.67 trillion yuan and its population 150 million, accounting for 18.5% and 11.0% of the national total, respectively.

The description of the Yangtze River Delta urban agglomeration shows that (see Table 6.15), the central position of Shanghai is very obvious, both in terms of income, population, housing prices and housing prices. From the overall point of view of urban agglomeration, the per capita disposable income of urban agglomerations is in the middle lower level, and the coefficient of variation shows that the per capita disposable income of each city in urban agglomeration is not very big. From the perspective of urban scale, the urban agglomeration shows the characteristics of mega cities and small cities (coefficient of variation is 1.76). The overall price level is relatively low, the average is 7809 yuan per square meter, the coefficient of variation was 0.47, indicating the city various groups within the city housing price gap is relatively large, the price is more obvious differentiation, from the highest prices in the city group and the lowest price gap can also see this point. From the perspective of housing price income ratio, the urban agglomeration is in an irrational state (Fig. 6.29).

From the per capita disposable income, population, housing prices and housing price to income ratio fluctuations over time (see Fig. 6.30), in the 2010–2017 years, per capita disposable income and population showed a linear upward trend. Housing prices in the urban agglomeration have been rising in 2010–2015 years,

Table 6.15 Basic description of Yangtze River Delta urban agglomeration in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	6422.61	1438.35	3998.15 (Anqing)	8724.51 (Shanghai)	0.22
Pop	2577397	4527809	350528 (Chizhou)	2.30e+07 (Shanghai)	1.76
House price (yuan)	7809.92	3726.96	4269.29 (Chuzhou)	20949.38 (Shanghai)	0.47
House price income ratio	10.88	3.11	6.84 (Maanshan)	21.91 (Shanghai)	0.28
Economic competitiveness index	0.504	0.157	0.2342 (Chizhou)	0.8367 (Shanghai)	0.31

Note The city is located in brackets, due to the availability of data, the ratio of house prices to house prices in the table is 2015 data, the unit price is RMB, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS

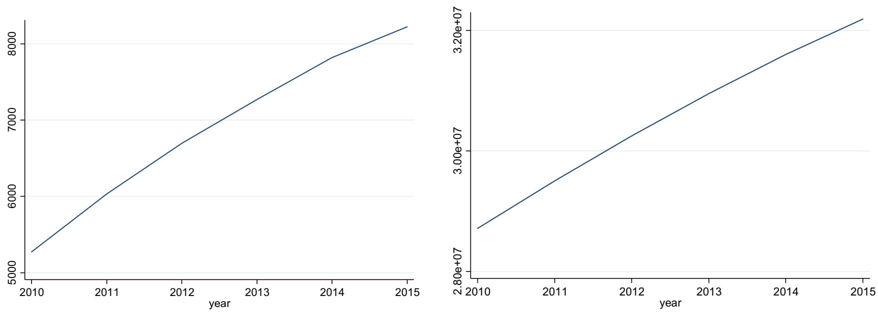


Fig. 6.29 Trends of income and population in the Yangtze River Delta urban agglomeration

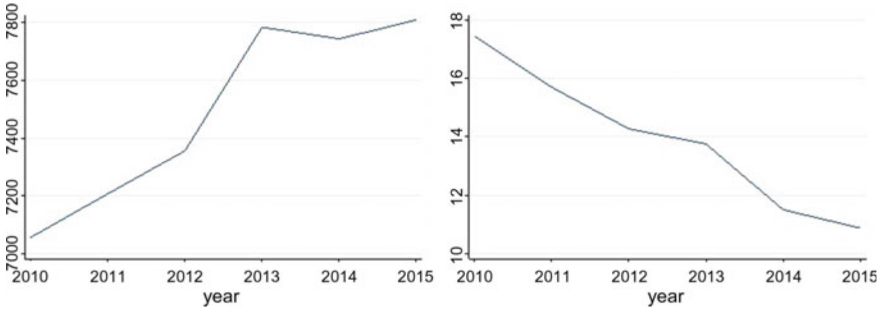


Fig. 6.30 Trends of price and housing income ratio in the Yangtze River Delta urban agglomeration. *Source* City and Competitiveness Index Database, CASS

and the average level is not high, fluctuations in 7000–8000 yuan per square meter. From the perspective of real income than the average income, the whole city group 2010–2015 years lower than has been in the stage, from around 18 in 2010 fell to about 10 in 2015, indicating that the Yangtze River Delta city group prices gradually rationalize.

The relationship between per capita disposable income and the house price of all cities in the agglomeration is shown in Fig. 6.31. We can see that the whole agglomeration has seen the inverted U-shaped relationship between the house price and income: the lower the house price in a city, the less the per capita disposable income it has, and as the house price increases, the per capita disposable income will rise too. But when the house price hits a certain point, its further increase will only bring down the per capita disposable income.

The regression analysis of the per capita disposable income and the house price of all cities in the agglomeration (see Table 6.16) shows that, the first power of the house price has significant positive impact on the per capita disposable income, and the square of the house price has significant negative impact on the house price. It means that the whole agglomeration has seen the inverted U-shaped relationship between its house price and per capita disposable income. The right column of

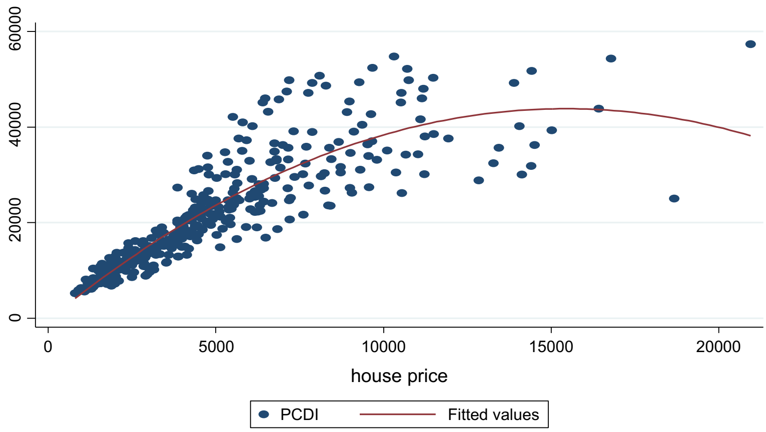


Fig. 6.31 Scatter diagram of income and house prices. *Source* City and Competitiveness Index Database, CASS

Table 6.16 Regression analysis of income, population and house price

Variable	Per capita disposable income	Population
house price	5.728***	−26.55
	(23.26)	(−1.28)
Square of house price	−0.000186***	0.0121***
	(−11.67)	(9.01)
Constant	-355.8	1788892.9***
	(−0.47)	(4.30)
R^2	0.7885	0.5445

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%
Source City and Competitiveness Index Database, CASS

Table 6.15 represents the price-population relationship. We can see that the square of the house price has significant positive impact on the population size: when the house price increases, the population will shrink at first, but when the house price hits a certain point, its further increase will expand the population. The reasons are as follows: when the house price starts to rise, the living cost will increase and people will migrate; but when the house price maintains at a very high level, it is often associated with strong economic vitality, a high city reputation, a better social and living environment. These factors appeal to immigrants and will increase the population.

Peripheral cities are playing an increasing role. To probe into the income-price relationship between cities with high house prices and those with low house prices, we drew a scatter diagram of income and the relative house price (see

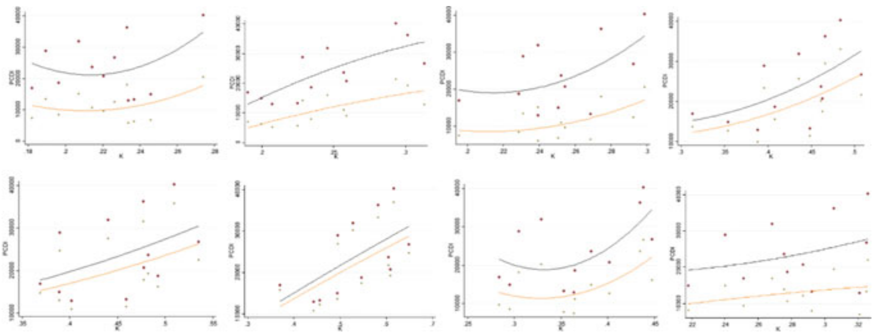


Fig. 6.32 Scatter diagrams of income and relative house prices. *Source* City and Competitiveness Index Database, CASS

Fig. 6.32). The figure shows the house price and income of Anqing, Chizhou, Chuzhou, Huzhou, Jiaxing, Shaoxing, Taizhou and Yancheng relative to those of Shanghai. We can see that as the relative house price increases in these small cities where house prices are low, their per capita disposable income will increase, so will that in Shanghai. It means that when the house price gap is big between big and small cities, the rising house price in small cities will increase the overall income of the agglomeration, highlighting the increasing role of small cities in it.

***Pearl River Delta urban agglomeration: The overall development is not high, the price difference is obvious, housing prices and income have a positive impact on the population*.**

The Pearl River Delta urban agglomeration is a highly developed economic region in coastal South China, with Hong Kong, Macao and Guangzhou as its geographical centers. It consists of two deputy provincial-level cities and seven prefecture-level cities in Hong Kong, Macao and Guangdong. The Pearl River Delta is one of the most densely populated areas in China and even in the world. Its population growth is mainly driven by the inflow of immigrants. A 2014 report shows that the Pearl River Delta is "overloaded" with population. Among the world's most densely populated areas, the top four are all in the Pearl River Delta: Luohu district of Shenzhen (56,482 persons/km^2), Kwun Tong of Hong Kong (56,303 persons/km^2), Yantian district of Shenzhen (56,004 persons/km^2) and Yuexiu district of Guangzhou (52,834 persons/km^2).

From the table of statistical description of the Pearl River Delta urban agglomeration (see Table 6.17), we can see that the highest per capita disposable income of the Pearl River Delta urban agglomeration is Guangzhou with a value of US$ 7765. Shenzhen, as the central city of the Pearl River Delta urban agglomeration, Its population, housing prices and house prices are the largest income. From the overall urban agglomeration, urban per capita disposable income in a relatively low state, the per capita disposable income of urban agglomerations averaged 5293 US dollars. From the perspective of overall housing prices in the

Table 6.17 Basic description of Pearl River Delta urban agglomeration in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	5293.76	1625.03	3350.399 (Yunfu)	7765.39 (Guangzhou)	0.30
Pop	3989320	4428526	269555 (Yunfu)	1.25e+07 (Shenzhen)	1.11
House price (yuan)	9351.51	8205.39	4043.70 (Yunfu)	33942.16 (Shenzhen)	0.88
House price income ratio	15.12	8.72	8.86 (Zhongshan)	42.28 (Shenzhen)	0.58
Economic competitiveness index	0.468	0.235	0.2115 (Qingyuan)	0.9337 (Shenzhen)	0.50

Note The city is located in brackets, due to the availability of data, the ratio of house prices to house prices in the table is 2015 data, the unit price is RMB, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS

urban agglomeration, housing prices in the urban agglomerations of the Pearl River Delta are generally at a medium level, with an average value of 9351 yuan per square meter and a coefficient of variation of house prices of 0.88, indicating that housing prices in various cities within the urban agglomerations are relatively large and vary greatly. From the perspective of the price-to-income ratio, the price-to-income ratio of urban agglomerations in the Pearl River Delta is in an unreasonable state with an overall average of 15.12.

From the per capita disposable income, population, housing prices and housing price-earnings ratio fluctuations over time, from 2010 to 2017, the average per capita disposable income of urban agglomerations in the Pearl River Delta rose first, and then remained essentially unchanged; urban population in 2010–2017 showed a linear trend of growth (see Fig. 6.33). From the point of view of housing prices and

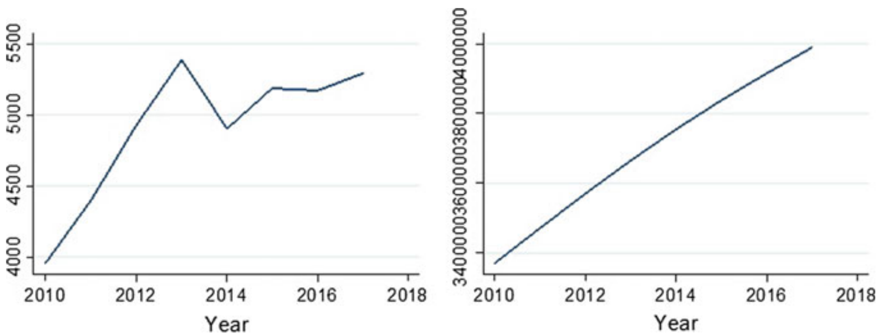


Fig. 6.33 Trends of revenue (USD) and population in the Pearl River Delta urban agglomeration

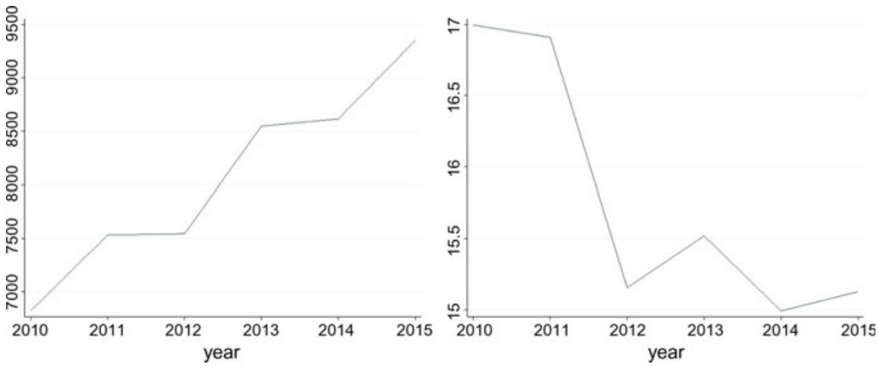


Fig. 6.34 Trend of house prices (yuan) and house price income in the Pearl River Delta urban agglomeration. *Source* City and Competitiveness Index Database, CASS

house prices in the Pearl River Delta urban agglomeration (see Fig. 6.34), house prices in the urban agglomerations of the Pearl River Delta have been gradually rising from 2010 to 2015; their house price income ratio has been gradually decreasing from 2010 to 2015 but still in a very unreasonable area.

The relationship between per capita disposable income and the house price of all cities in the agglomeration is shown in Fig. 6.35. We can see that the whole agglomeration displays the inverted U-shaped relationship between the house price and income: the lower the house price in a city, the less the per capita disposable income it has, and as the house price increases, the per capita disposable income will rise too. But when the house price hits a certain point, its further increase will only bring down the per capita disposable income.

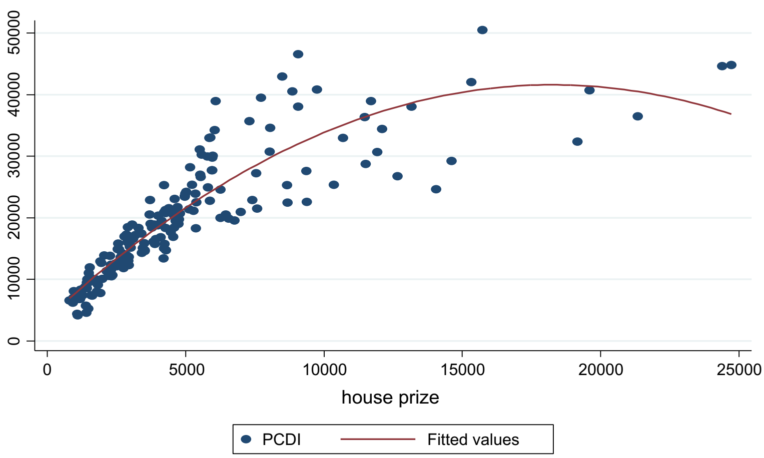


Fig. 6.35 Scatter diagram of income and house prices. *Source* City and Competitiveness Index Database, CASS

Table 6.18 Regression analysis of population and house prices

Variable	Population	Per capita disposable income	Population
House price	204.9*** (19.06)	4.209*** (22.48)	
Square of house price		−0.0000970*** (−11.60)	
Per capita disposable income			70.54*** (15.00)
Constant	2024954.3*** (3.72)	2688.9** (2.63)	1666050.4** (2.99)
Adjusted R^2	0.6755	0.7930	0.4416
N	182	182	182

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS

We then analyzed the population-price relationship of each city in the agglomeration to find out its spatial structure. The analysis result is shown in Table 6.18. It shows that the house price and the per capita disposable income are in an inverted U-shaped relationship, consistent with the findings of Fig. 6.35; both the house price and the per capita disposable income have significant positive impact on the population size: the higher the house price and the income, the bigger the population.

***Beijing-Tianjin-Hebei urban agglomeration: Economic competitiveness is generally low, and there is a significant inverted U relationship between house prices and per capita disposable income*.**

The Beijing-Tianjin-Hebei urban agglomeration is also known as the capital economic circle, composed of Beijing, Tianjin, Shijiazhuang, Tangshan, Qinhuangdao, Baoding, Zhangjiakou, Chengde, Cangzhou and Langfang. From the descriptive statistics table of the Beijing-Tianjin-Hebei urban agglomerations (see Table 6.19), we can see that Beijing-Tianjin-Hebei urban agglomeration has the highest per capita disposable income, population, housing price and house price income ratio in Beijing. This shows that Beijing The central city status is very obvious. From the perspective of per capita disposable income of Beijing-Tianjin-Hebei urban agglomeration, the overall income level of urban agglomerations is relatively low, with an average of US$ 4978. From the perspective of housing prices, the average price level of the urban agglomerations in Beijing, Tianjin and Jihun is not high, with an overall average of only 7761 yuan per square meter, but the coefficient of variation of housing prices is 0.72, indicating that housing prices in various cities in the urban agglomerations are widening and severely differentiated. From the overall price-earnings ratio, Beijing-Tianjin-Hebei housing prices than the overall income in an unreasonable state, the overall average of 13.24.

Table 6.19 Basic description of Beijing-Tianjin-Hebei urban agglomeration in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	4978.229	1174.694	3858.006 (Chengde)	7799.244 (Beijing)	0.24
Pop	4021144	6279807	530273 (Cangzhou)	1.97e+07 (Beijing)	1.56
House price (yuan)	7761.74	5619.48	3976.86 (Baoding)	22625.91 (Beijing)	0.72
House price income ratio	13.24	5.25	9.19 (Baoding)	25.88 (Beijing)	0.40
Economic competitiveness index	0.438	0.211	0.2164 (Zhangjiakou)	0.8102 (Beijing)	0.48

Note The city is located in brackets, due to the availability of data, the ratio of house prices to house prices in the table is 2015 data, the unit price is RMB, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS

From per capita disposable income, population, housing prices and housing price-earnings ratio fluctuations over time, in 2010–2017, per capita disposable income and population showed a gradual rise over time (see Fig. 6.36). From the time trend of housing price and house price to income ratio (see Fig. 6.37), during 2010–2015, the housing prices in Beijing-Tianjin-Hebei urban agglomeration show a gradual upward trend while the price-income ratio shows a gradual downward trend.

On the whole, the agglomeration displays an inverted U-shaped relationship between income and the house price (see Fig. 6.38): as the house price goes up, the income will first increase and then decline; the scatter of income and the house price is mostly concentrated in the range of low house price and low income, indicating much room for improvement. From regression analysis of the income, population

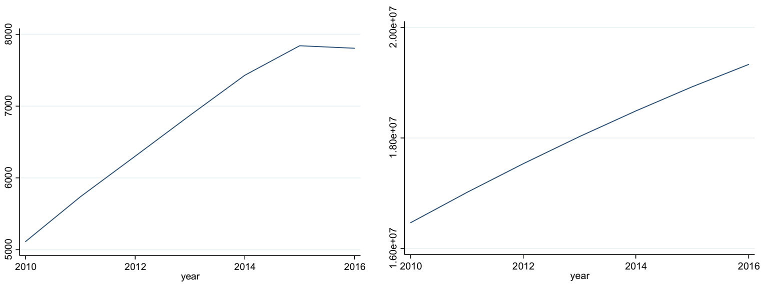


Fig. 6.36 Per capita disposable income (USD) and population trend in Beijing, Tianjin and Hebei urban agglomeration

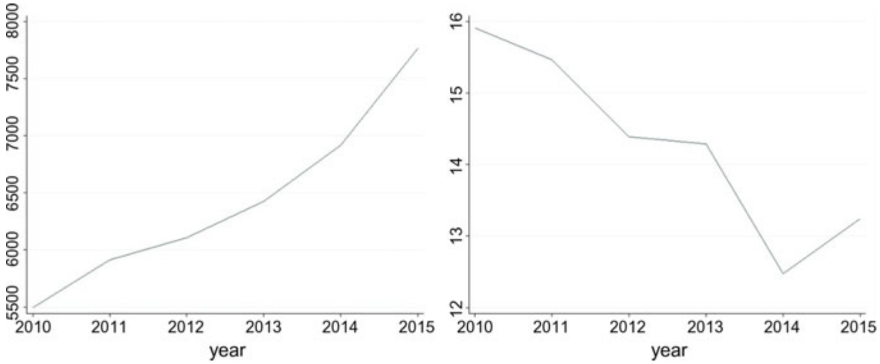


Fig. 6.37 Trend of house price (yuan) and house price income ratio in Beijing-Tianjin-Jihcheng urban agglomeration

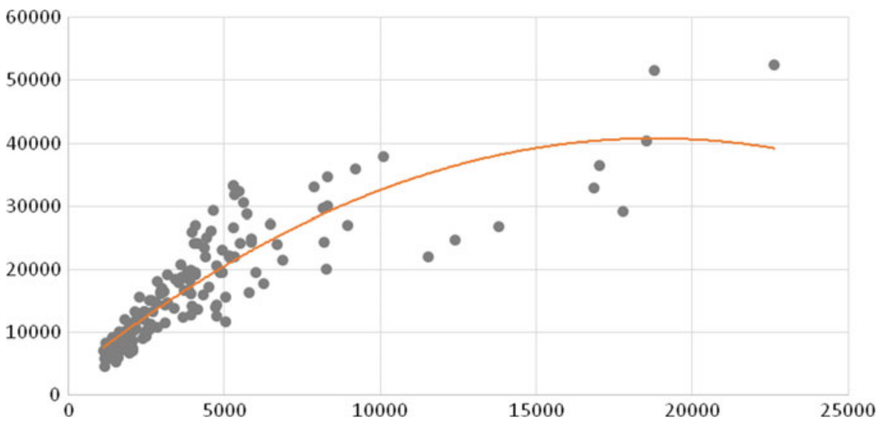


Fig. 6.38 Scatter diagram of income and house prices. *Source* City and Competitiveness Index Database, CASS

and house price (see Table 6.20) we can see that the square of the house price has significant negative impact on the per capita disposable income and the house price's coefficient of determination for income is 0.7617, meaning that the house price and the per capita disposable income are in a significant inverted U-shaped relationship; the square of the house price has significant positive impact on the population size within the agglomeration, and the house price's coefficient of determination for population is 0.6157, revealing significant U-shaped relationship between the population and the house price: as the house price goes up, the population will first decline and then increase.

Table 6.20 Regression analysis of house prices, income and population

	Per capita disposable income	Population
House price	4.006*** (12.98)	52.53* (1.74)
Square of house price	−0.000107*** (−6.64)	0.0135*** (9.09)
Constant	3128.7*** (3.36)	2594352.0*** (4.35)
Adjusted R^2	0.7617	0.6157
Sample size	150	150

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS

***Analysis of Two Major Urban Agglomerations in India: The overall development is low; The rapid rise of metropolises suppresses the development of peripheral cities*.**

***Mumbai metropolitan area: The metropolitan area as a whole has a relatively low level of development. Mumbai, a metropolitan center city, has a siphon effect on the surrounding cities*.**

The Mumbai metropolitan area consists of Mumbai, the central city, and peripheral cities such as Nashik, Tiruchirappalli and Pune. Mumbai is the capital city of Indian state Maharashtra, the most important port city on the western coast of India, facing the Arabian Sea. It is the most populated city in India, with the population of over 12 million. It is also India's business, financial and entertainment center and houses Bollywood, the heart of India's film industry.

From the descriptive statistics of the metropolitan area of Mumbai (see Table 6.21), we can see that the overall per capita disposable income of the Mumbai metropolitan area is very low at only US$ 1990, of which Nashik per capita in the urban agglomerations The highest disposable income was $ 2241 and the coefficient of variation of per capita disposable income was 0.14, indicating that disposable income per capita in cities in the Mumbai metropolitan area was at a low level. From the housing price point of view, Mumbai metropolitan area housing prices at a relatively low level, price coefficient of variation was 1.05, indicating that the urban agglomeration of various cities housing prices gap is very large, the differentiation is particularly obvious. In addition, Mumbai, the center city of the metropolitan area, has a higher population, house price and house price income ratio in the urban agglomeration. From the perspective of overall housing price-earnings ratio in the metropolitan area of Mumbai, the overall house price-earnings ratio of the Mumbai metropolitan area is in a serious and unreasonable range. In 2017, the overall average is 19.16.

From per capita disposable income, population, housing prices and housing price-earnings ratio fluctuations over time, per capita disposable income and

Table 6.21 Basic description of Mumbai metropolitan area in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	1990.16	275.96	1597.58 (Pune)	2241.18 (Nashik)	0.14
Pop	7159693	8636346	1146700 (Tiruchirappalli)	1.97e+07 (Mumbai)	1.21
House price	1929.00	2033.90	650.74 (Nashik)	4948.3 (Mumbai)	1.05
House price income ratio	19.16	11.65	8.47 (Nashik)	31.58 (Mumbai)	0.61
Economic competitiveness index	0.265	0.147	0.1526 (Nashik)	0.4647 (Mumbai)	0.55

Note The city is located in brackets, due to the availability of data, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

population showed an upward trend in 2010–2017 (see Fig. 6.39), with a basically linear growth. From the perspective of the price and price-to-income ratio (see Fig. 6.40), housing prices in Mumbai metropolitan area first showed a downward trend of declining and the overall level was lower, while the price-income ratio showed a gradual upward trend. From 2011s 10 so has risen to 20 or so in 2017, that is, the price-to-income ratio tends to be more and more unreasonable.

As to the house price, in 2017, the highest house price occurred in the city proper of Mumbai, at 7221.75 US dollars/m^2, compared to 2674.8501 US dollars/m^2 in peripheral zones, revealing a huge price gap between the central zone and peripheral zones. In Pune, the house price in the city proper was 1775.14 US dollars/m^2, even lower than that in Mumbai's peripheral zones, highlighting the dominant position of Mumbai's city proper in the agglomeration. According to the

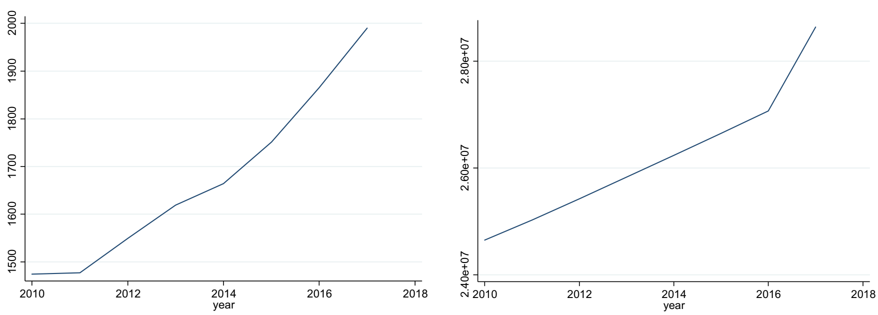


Fig. 6.39 Metropolitan Mumbai metropolitan area per capita disposable income and population trends

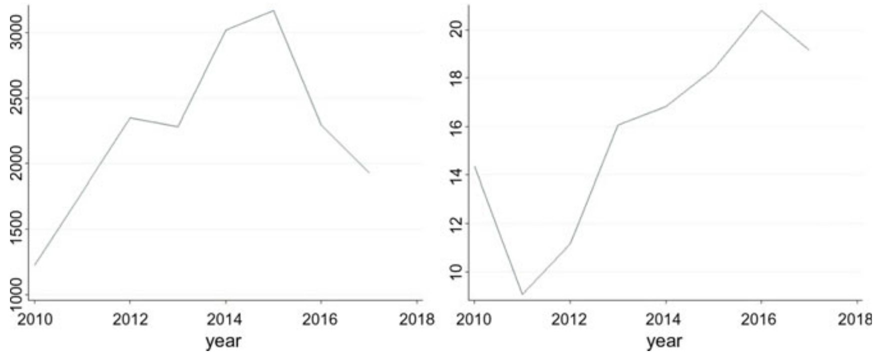
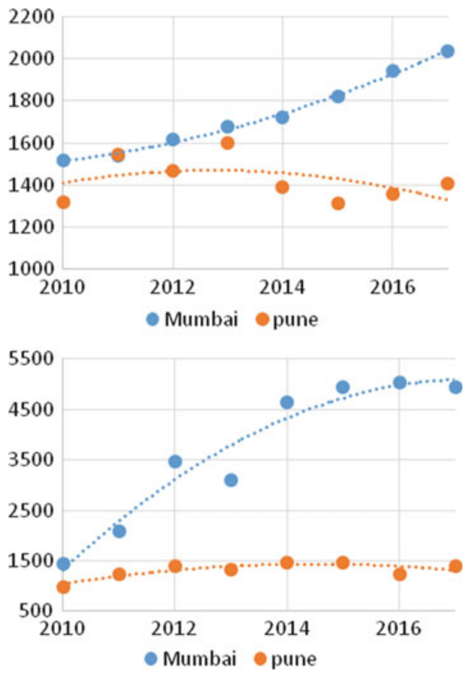


Fig. 6.40 Mumbai metropolitan area prices and house prices revenue trends. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

data of 2010–2017, the gap between Mumbai and Pune has been widening in terms of income and the house price (see Fig. 6.41). As time passes by, Mumbai has seen its house price and income increase at the same time while Pune has seen its income fall but house price slightly increases. In other words, the development of Pune is significantly outpaced by that of Mumbai.

To specify the correlation between cities in the Mumbai metropolitan area, we charted the scatter diagram of the income and relative house price in Mumbai and

Fig. 6.41 Scatter diagrams of income and house prices in Mumbai and Pune. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database



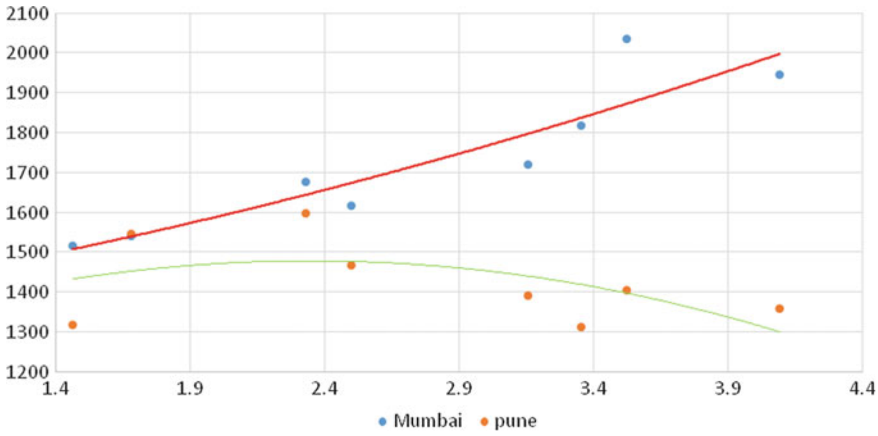


Fig. 6.42 Scatter diagram of per capita disposable income and house prices. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

Pune (see Fig. 6.42). It shows that as Mumbai's relative house price increases, its per capita disposable income is on the rise too, but that in Pune is in decline, revealing the siphon effect of Mumbai on Pune. In other words, the development of Mumbai is at the expense of Pune. It also shows that the higher the relative house price, the higher the per capita disposable income: as Mumbai's relative house price increases, the income gap between Mumbai and Pune is widening.

By examining the population structure and relative house prices in the Mumbai metropolitan area (Table 6.22), we find that Mumbai's relative house price to Pune has significant positive impact on its own population size, with the coefficient of determination of 0.8677: as the relative house price increases, Mumbai's population will increase. We also find that though the relative house price cannot explain changes to Pune's population, it can explain changes to the combined population in the metropolitan area, with the coefficient of determination of 0.4379. In other words, the relative house price has significant positive impact on the whole region,

Table 6.22 Regression analysis of relative house prices and the population size

City	Mumbai	Pune	Mumbai metropolitan area
Variable	Population	Population	Total population
Relative house price	550052.1*** (6.85)	−81974.7 (−0.57)	468077.4** (2.54)
Constant	17431091.3*** (74.98)	5617750.1*** (13.43)	23048841.1*** (43.21)
Adjusted R^2	0.8677	−0.1073	0.4379

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS

and the rise in Mumbai's house price will attract more immigrants to the region and thus drive up the total population.

***Bangalore metropolitan area: Relative increase in housing prices in the big city of Bengaluru led to an increase in population*.**

Bangalore metropolitan area is situated on the Deccan Plateau in South India, with the altitude over 3000 feet. It is the fifth biggest metropolitan area in India, with a population of about 8.5 million, including Bangalore, Hyderabad, Chennai, Kochi and a number of small cities. Bangalore is India's hub for information technology and aviation industry and home to numerous high-tech companies.

From the descriptive statistics table of the Bangalore metropolitan agglomerations (see Table 6.23), we can see that the overall per capita disposable income of the Bangalore urban agglomerations is relatively low and the housing prices are also at a relatively low level. The overall average of the housing prices in 2017 is $ 1060 per square meter. From the price-to-income ratio perspective, the overall housing-to-income ratio in the Bangalore city group is in an unreasonable range, with a overall average of 9.07 in 2017. However, from the perspective of coefficient of variation, the coefficient of variation of income, housing prices and population in Bangalore city group is not high, which shows that the overall Bangalore city group is characterized by low income, low price and the income, housing price and population size of each city The situation.

From per capita disposable income, population, housing prices and housing price-earnings ratio fluctuations over time, in 2010–2017, per capita disposable income and population showed an upward trend, and the basic linear growth (see Fig. 6.43). From the perspective of price and price-to-income ratio, the overall housing price in the Bangalore city group fluctuated over time, basically at around $

Table 6.23 Basic description of Bangalore metropolitan area in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	2017.53	658.42	1385.69 (Chennai)	2883.98 (Kochi)	0.33
Pop	6798847	4172150	1836900 (Kochi)	1.05e+07 (Bangalore)	0.61
House price	1060.23	361.15	726.37 (Hyderabad)	1473.38 (Chennai)	0.34
House price income ratio	9.07	2.08	7.17 (Hyderabad)	11.92 (Chennai)	0.23
Economic competitiveness index	0.324	0.054	0.2798 (Hyderabad)	0.4040 (Bangalore)	0.17

Note The city is located in brackets, due to the availability of data, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

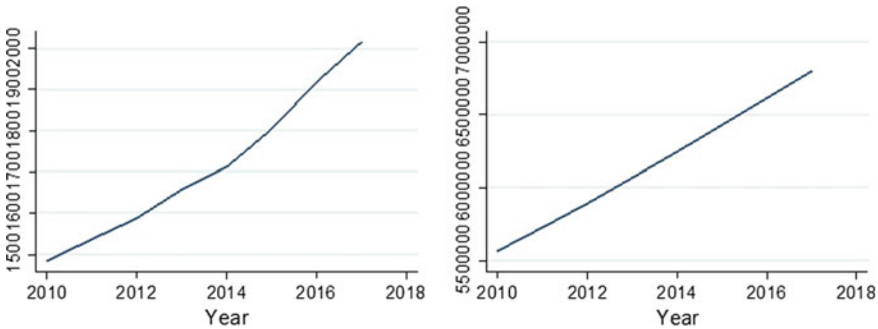


Fig. 6.43 Trends in per capita disposable income and population of the Bangalore city group

1000 per square meter (see Fig. 6.44); from the perspective of the price-to-income ratio, Price-earnings ratio decreased gradually, but still in an unreasonable area.

We chose Bangalore and Hyderabad as sample cities to examine the impact of big cities on small cities in the same region (see Fig. 6.45). The blue trend line represents Bangalore and the red one, Hyderabad. We can see that as Bangalore's relative house price increases, its wage income is also on the rise, but the wage income and the house price in Hyderabad are both in decline—specifically Hyderabad's house price fell from 942 US dollars/m^2 in 2010 to 726 US dollars/m^2 in 2017. It reveals the siphon effect in the region: as the relative house price of a city goes up, its development is at the expense of another city.

The regression analysis of the population in the two cities shows that the relative house price has positive impact on the city population (see Table 6.24): as Bangalore's relative house price goes up, the population in both Bangalore and Hyderabad will increase too. For Hyderabad, the fall in the relative house price will reduce the living cost and thus increase the population. For Bangalore, though the rise in the relative house price might add to the housing cost, it is compensated by

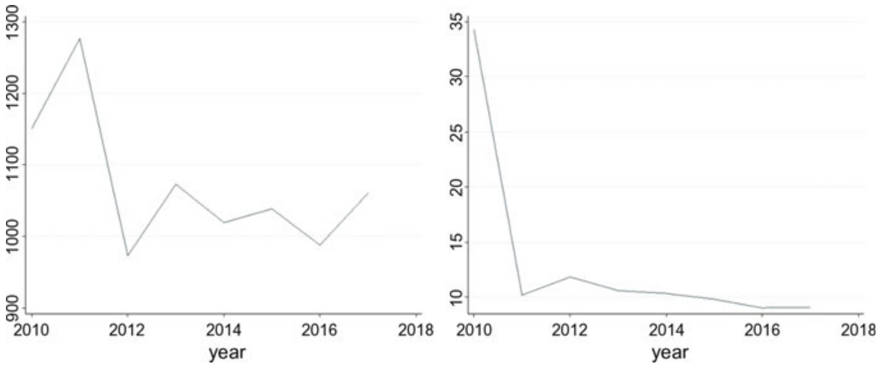


Fig. 6.44 Trend of house price and house price revenue in Bangalore city cluster

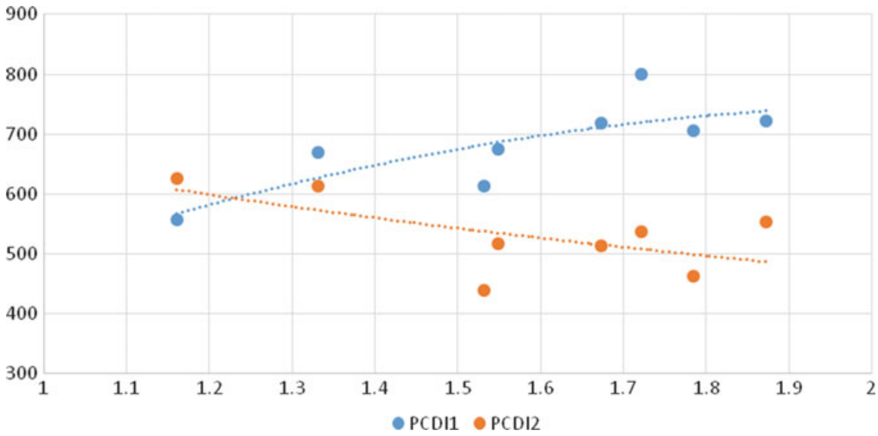


Fig. 6.45 Scatter diagram of income and relative house prices. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

Table 6.24 Regression analysis of population, relative house price and income

City	Bangalore	Hyderabad
Variable	Population	Population
K (Relative house price)	778011.6** (2.90)	504648.6** (2.95)
ppdicou1 (Income)	370.2 (0.40)	346.2 (0.58)
ppdicou2 (Income)	5808.8*** (6.86)	3510.3*** (6.50)
Constant	−619195.4 (-1.10)	1940940.0** (5.38)
Adjusted R^2	0.9858	0.9854

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

the wage increase, so as the city becomes more competitive, the rise in its house price will attract, instead of squeeze out, residents, and thus drive up the whole population in the region. When the income and relative house price are on the rise in the urban agglomeration, as the relative house price goes up, the total population will increase. This is shown in the impulse response chart of the two cities (see Fig. 6.46). It shows that Bangalore's relative house price has significant positive impact on its own population growth. When Bangalore's relative house price increases, its population growth rate will increase by about 0.001 one lag later, and as the number of lags increases, the impact of the relative house price on the population growth will shrink until it disappear.

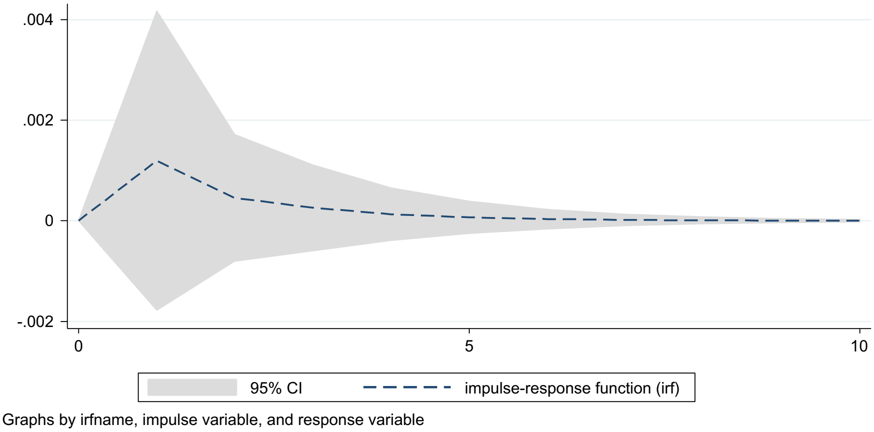


Fig. 6.46 The relative house price's impulse response to the population growth rate. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

Brazil São Paulo metropolitan area: The overall development is moderate, with the falling prices of Rio de Janeiro, the major metropolitan cities, leading to an increase in the income and population of urban agglomerations.

São Paulo metropolitan area includes cities such as Sao Paulo, Rio de Janeiro, Campinas, Curitiba, Sorocaba, San Jose dos Campos, and Jundiai. Sao Paulo is the financial and economic hub in Brazil and even in South America. It has an urban population of over 11 million and a suburban population of over 21 million. It is the richest city in South America and also the biggest city in Brazil and even the Southern Hemisphere. Rio de Janeiro is the second biggest city and a major industrial base in Brazil. It has the biggest sea harbor in Brazil, and is a major gateway to and one of the most developed areas in Brazil and even South America. Rio de Janeiro, the capital city of the eponymous state, boasts a territory of 1182 km^2 and a population of 6.3 million. In terms of the house price, in 2016, the highest house price occurred in the city proper of Rio de Janeiro, at 3186.26 US dollars/m^2, compared to the lowest of 979.86 US dollars/m^2 in the outskirts of San Jose dos Campos.

In addition, from the descriptive statistics of the metropolitan area of Sao Paulo (see Table 6.25), we can see that the overall per capita disposable income of urban agglomerations is at a high level, with an average value of $ 9120. As a central city in the metropolitan area, Sao Paulo has a high population, housing price and house price income ratio. From the housing price point of view, the overall housing prices at a low level, with an average value of only $ 1882 per square meter, metropolitan area in 2017 up to $ 2703 per square meter, the lowest for $ 1247 per square meter, indicating that the metropolitan area prices small differences. From the perspective of price-to-income ratio, the metropolitan area's price-to-income ratio is in an unreasonable state with an overall average of 12.64.

Table 6.25 Basic description of Brazil São Paulo metropolitan area in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	9120.01	1594.90	7152.51 (Sorocaba)	11664.06 (San Jose dos Campos)	0.17
Pop	6186843	8070040	579400 (San Jose dos Campos)	2.15e+07 (Sao Paulo)	1.30
House price	1882.82	619.14	1247.18 (Sorocaba)	2703.93 (Sao Paulo)	0.33
House price income ratio	12.64	4.37	6.41 (San Jose dos Campos)	18.83 (Sao Paulo)	0.35
Economic competitiveness index	0.401	0.062	0.3332 (Sorocaba)	0.4999 (Sao Paulo)	0.15

Note The city is located in brackets, due to the availability of data, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

We chose Sao Paulo and Rio de Janeiro as sample cities to study the income-price relationship among cities in the region. Figure 6.47 traces changes to the house price and income in Sao Paulo. We can see that from 2010 to 2017, the house price changed as the income changed in Sao Paulo: the higher the house price, the higher the per capita disposable income, and vice versa. This relationship is also revealed in the scatter diagram of per capita disposable income and the house price (see Fig. 6.48).

Figure 6.49 traces changes to the house price and per capita disposable income in Rio de Janeiro. We can see that from 2010 to 2017, the house price was in decline but the per capita disposable income increased first and then slowly declined. We drew a scatter diagram of the per capita disposable income and the

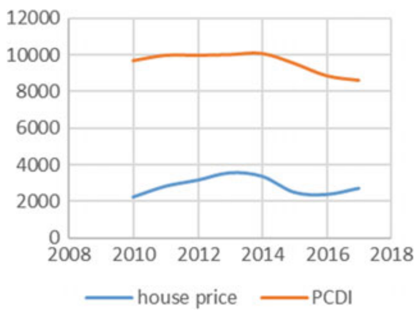


Fig. 6.47 Time series plot of the house price and income

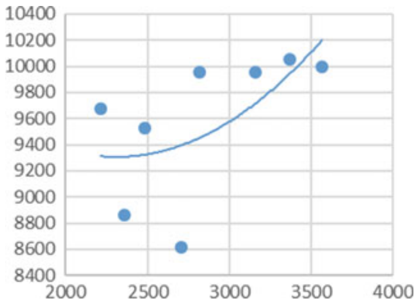


Fig. 6.48 Scatter diagram of income and the house price. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

house price (see Fig. 6.50) to correctly understand the relationship between the two. It shows that the per capita disposable income and the house price of Rio de Janeiro are in an inverted U-shaped relationship: when the house price is very low, the per capita disposable income increases as the house price goes up, but when the house price is too high, its further increase will only lead to the decline in the per capita disposable income. This also explains the phenomenon shown in Fig. 6.49—when the house price decreases, the per capita disposable income increases.

We drew a scatter diagram of the per capita disposable income and the relative house price (see Fig. 6.51) of Rio de Janeiro and Sao Paulo to probe into the relationship between the two in each city of the region. It shows that Rio de Janeiro has a higher relative house price but lower income while Sao Paulo has a lower relative house price but higher income. It means that the former is already in the ranks of high house price and low income and Sao Paulo is still slowly climbing up. It also shows that the per capita disposable income and the relative house price are in the inverted U-shaped relationship, which means that a relative house price that is too high or too low is bad for increasing the per capita disposable income. When we take into account the time series and the relative house price is falling, in case of the income and house price reverse in Rio de Janeiro, as the house price continues to fall, the per capita disposable income is increasing; meanwhile, in Sao Paulo, as the relative house price goes up, the per capita disposable income is

Fig. 6.49 Time series plot of the house price and income

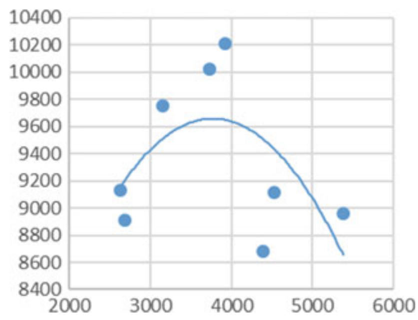


Fig. 6.50 Scatter diagram of income and the house price. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

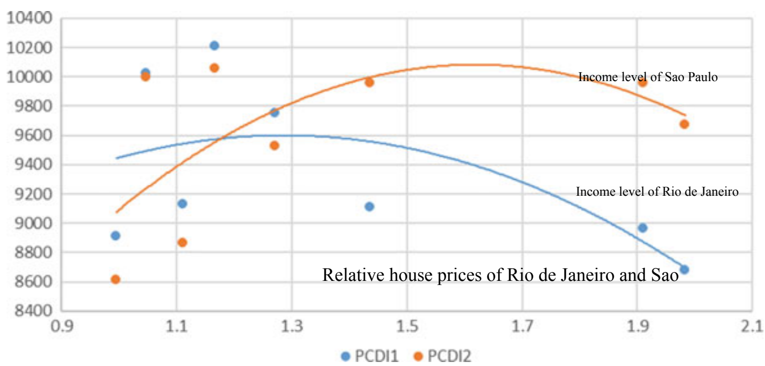


Fig. 6.51 The relationship between the income and the relative house price. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

increasing too. It means that the fall in the house price of more expensive cities will drive up the overall per capita disposable income of the whole region.

Specifically k represents Rio de Janeiro's relative house price to Sao Paulo, Salary 1 the actual wage income level of Rio de Janeiro and Salary 2 that of Sao Paulo. Table 6.26 shows that when the actual wage income level of the two cities is taken into account, the fall in Rio de Janeiro's relative house price has significant positive impact on the population of both cities. In other words, as the relative house price decreases in the two cities, the population in not just Rio de Janeiro but also Sao Paulo will increase, which will increase the total population, the population inflow and the appeal of the region. It thus can be seen that in an urban agglomeration where high and low house prices co-exist, the fall in the house price of more expensive cities will have positive impact on the whole region, attracting more immigrants. It is also clear that only Rio de Janeiro's wage income level, not Sao Paulo's, has significant negative impact on the two cities. It means that Rio de Janeiro's wage income level plays a dominant role in the region. In other words, the

Table 6.26 Regression analysis of population, relative house price and wage income

City	Rio de Janeiro	Sao Paulo	Agglomeration
Variable	Population	Population	Population
Relative house price (k)	−402045.4** (−4.04)	−1074838.2** (−3.98)	−2049520.8** (−3.88)
Wage income (Salary 1)	−387.1* (−2.91)	−1047.7* (−2.90)	−2002.0* (−2.84)
Wage income (Salary 2)	−176.3 (−1.17)	−480.0 (−1.18)	−910.9 (−1.14)
Constant	13802647.4*** (123.77)	23489118.4*** (77.72)	47031743.5*** (79.59)
Adjusted R^2	0.9556	0.9551	0.9528

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

Table 6.27 Basic description of Boston-Washington agglomeration in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	53852.27	11707.44	40848.70 (Concord)	84110.30 (Stamford)	0.22
Pop	4038423	5579212	91574 (Concord)	2.04e+07 (New York)	1.38
House price	3259.98	2759.04	984.3 (Hartford)	9735.54 (New York)	0.85
House price income ratio	3.69	2.71	1.04 (Hartford)	10.05 (New York)	0.73
Economic competitiveness index	0.703	0.136	0.5455 (New Haven)	1 (New York)	0.19

Note the city is located in brackets, due to the availability of data, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

wage income level of cities with high house prices will affect the population structure and thus the pattern of the whole agglomeration.

Based on the above analysis, we can see that the house price and the wage income level of cities with high house prices but low income will play a dominant role in and have significant impact on the whole agglomeration. When the relative house price of such cities decreases, the total population of the agglomeration will increase and the agglomeration will become more appealing to immigrants; but since these cities are already in the price-income trap, a slight increase in the wage won't be enough to challenge people's perception about the agglomeration.

Boston-Washington agglomeration: The overall development index is higher, Cities whose incomes have risen as house prices rise dominate.

The U.S. Boston-Washington agglomeration includes a total of 40 cities (cities with a population above 100,000) from the Boston region to the Washington region, such as Boston, New York, Philadelphia, Baltimore and Washington. It is the biggest international financial center in the world. It stretches 965 km long, 48–160 km wide and covers a territory of 138,000 km^2, taking up 1.5% of the U.S. Territory. It has a population of 65 million, accounting for 20% of the U.S. Population and its urbanization rate is above 90%. It is the heartland of the U.S. economy and the biggest production base and commercial center in the country. Its average home value is 3045 US dollars/m^2, with the highest of 9735 US dollars/m^2 and the lowest 984 US dollars/m^2.

From the general description of 2017 in the Boston-Washington metropolitan area (see Table 6.27), the per capita disposable income of the urban agglomerations is at a very high level but at a relatively low level. Among them, Stanford's per capita disposable income Highest, the center city of New York's population, housing prices and housing income is relatively high. From the price and price-income ratio point of view, Boston-Washington city group overall housing prices are not high, the average price in 2017 was 3259 US dollars per square meter, the maximum is 9735 US dollars per square meter, the minimum is 984 US dollars per square meter. However, the price-to-income ratio is generally within a reasonable range, with a value of 3.69. However, the price-to-income ratio in New York, an urban center within an urban agglomeration, is not reasonable and has a value of 10.05. From the perspective of coefficient of variation, the discrepancy in per capita disposable income within the entire urban agglomeration is not large, but the gap between housing prices in urban agglomerations is significant and the two levels are highly differentiated.

The Moran's I of the house price, economic competitiveness, sustainable competitiveness and the population size of the whole agglomeration shows that (see Fig. 6.52) the region is characterized with the high–high and low–low pattern. The Moran's I of the house price is 0.265, that of economic competitiveness 0.245, that of sustainable competitiveness 0.27 and that of the population size 0.251.

Figure 6.53 shows that the agglomeration as a whole has seen the inverted U-shaped relationship between the house price and the income. But we notice that most of the relationship falls on the left side of the inverted U, meaning that in most cities, as the house price increases, the income is on the rise too. This is also reflected in the overall population structure of the agglomeration. Table 6.28 shows that the increase in the house price and competitiveness will increase the total population of the whole region, and by a significant margin. It means that in an agglomeration where the house price and the income are mostly moving upward, even when the house price increases but the income decreases in some cities, it

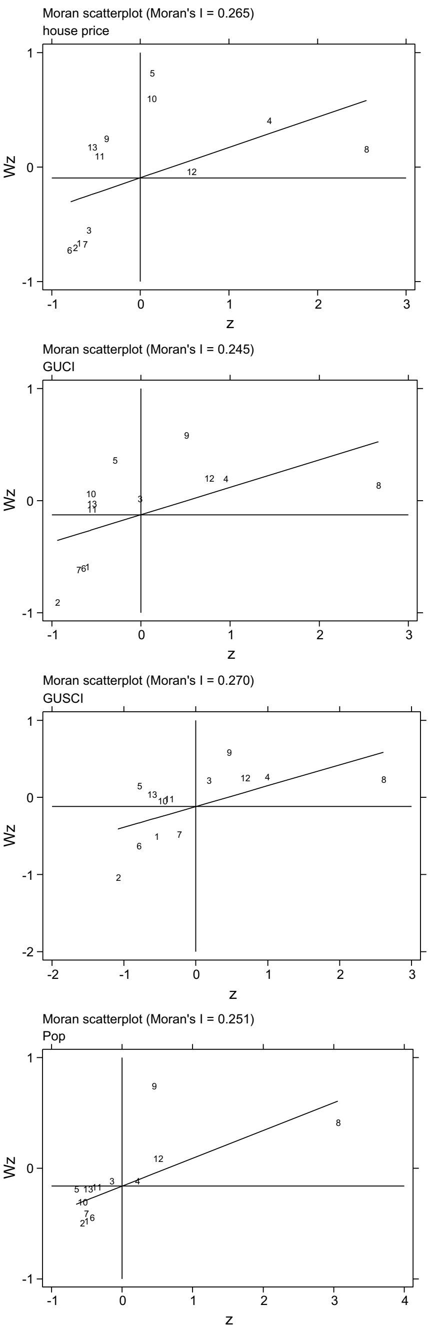


Fig. 6.52 Moran's I charts of the house price, competitiveness and population. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

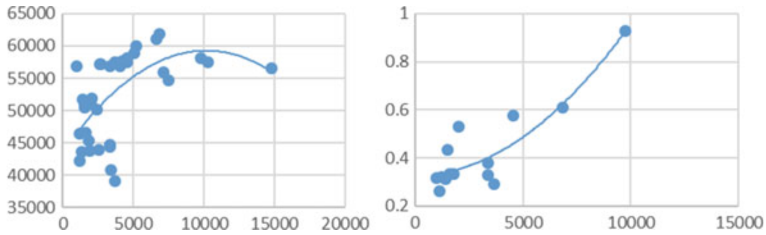


Fig. 6.53 The relationship between income, competitiveness and house price in the agglomeration. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

Table 6.28 Regression analysis of population, the house price and competitiveness

Variable	Population	Population	Population
House price	1741.6*** (5.00)		
Economic competitiveness		28104645.5*** (10.02)	
Sustainable competitiveness			2992162.9*** (8.89)
Constant	−1640318.6 (−1.19)	−8571249.5*** (−6.50)	−23920774.1*** (−7.59)
R^2	0.6666	0.8923	0.8667

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

won't have much impact on the whole region and the region will have a bigger population as its competitiveness improves.

Chicago-Pittsburgh agglomeration: House prices are too low, not conducive to per capita disposable income and population growth.

The Chicago-Pittsburgh agglomeration is situated along the Great Lakes in Central U.S., including cities such as Chicago, Pittsburgh, Akron, Cincinnati, Cleveland, Columbus, Dayton, Detroit, Grand Rapids and Milwaukee. It is the biggest manufacturing hub in the United States, with Pittsburgh and Detroit producing 70% of the iron & steel and 80% of the automobiles of the country. Chicago is home to CME, the world's biggest futures market. Its average home value is 1103 US dollars/m^2, with the highest of 2560 US dollars/m^2 and the lowest of 568 US dollars/m^2, generally at a low level.

From the description of the Chicago-Pittsburgh metropolitan area statistical table (see Table 6.29), we can see that the overall per capita disposable income of urban agglomerations is very high, of which the city Minneapolis has the highest per capita disposable income of 50,323 However, the overall housing prices in urban

Table 6.29 Basic description of Chicago-Pittsburgh agglomeration in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	43979.18	3748.39	38313.38 (Grand Rapids)	50323.72 (Minneapolis)	0.09
Pop	2584038	2361740	700200 (Akron)	9667800 (Chicago)	0.91
House price	1166.38	569.2151	568.62 (Dayton)	2560.48 (Chicago)	0.49
House price income ratio	1.56	0.65	0.83 (Cleveland)	3.13 (Chicago)	0.42
Economic competitiveness index	0.647	0.086	0.5291 (Akron)	0.8151 (Chicago)	0.13

Note The city is located in brackets, due to the availability of data, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

agglomerations are very low, with an overall average of $ 1166 per square meter in urban agglomerations, a ceiling of $ 2560 per square meter and a minimum of $ 568 per square meter. Chicago, the center of a metropolitan area, has a relatively high population and housing prices, and the price-to-income ratio in Chicago is at a reasonable level. From the overall point of view of price-to-income ratio, the overall price/income ratio of the Chicago-Pittsburgh metropolitan area is very low at a value of 1.56 and in a low unreasonable range.

The region is experiencing the growth of both the income and the house price and the two are positively correlated: as the house price goes up, the income increases too. The overall competitiveness of the region also reflects the trend, as shown in Fig. 6.54.

Table 6.30 shows that both the house price and competitiveness have significant positive impact on the population. The population will increase by 65.94 for every 1 dollar increase in the house price, and by 24,338,987 and 2,721,357 for every one unit increase in economic competitiveness and sustainable competitiveness, respectively.

***North California agglomeration: The stronger the city information technology, the higher the economic competitiveness*.**

The North California agglomeration is located in the north of California, the United States, including San Francisco, San Jose, Sacramento and a number of small peripheral cities, including the world-famous Bay Area in San Francisco. It is one of the 11 major metropolitan areas in the United States. It is also home to the Silicon Valley, the U.S. economic hub and a habitat of high-income earners. The house price has been soaring as the Silicon Valley rose to fame, making it the most

Table 6.30 Regression analysis of population, the house price and competitiveness

	Population	Population	Population
House price	65.94** (2.79)		
Economic competitiveness		24338987.3*** (8.65)	
Sustainable competitiveness			2721357.8*** (5.71)
Constant	2581954.0*** (3.87)	−7113371.4*** (−6.12)	−20406703.8*** (−5.03)

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

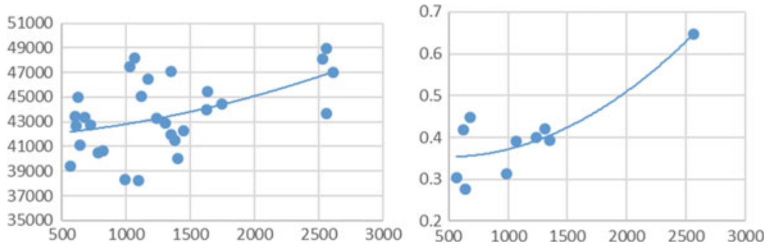


Fig. 6.54 Scatter diagrams of income, competitiveness and the house price. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

expensive place to buy a home in the United States and one of the most expensive places to live in the Bay Area.

From the descriptive statistics of northern California urban agglomerations (see Table 6.31), we can see that as a center of information technology, the total per capita disposable income and housing prices of the entire urban agglomerations are very high, with San Jose per capita disposable income The highest, reaching 72,171.98 US dollars, San Francisco's population, housing prices and house prices are higher than in the city group. From the point of view of the total housing price-to-income ratio of urban agglomerations, Northern California city group overall house price to income ratio in a reasonable range, the overall average of 5.48, but the central city of San Francisco, price-to-income ratio is in an unreasonable range. From the perspective of coefficient of variation, the income, population and housing price in each city in the urban agglomeration are not much different.

As to the house price, in 2016, the highest house price occurred in the city proper of San Francisco, which was 12,152.5 US dollars/m^2, compared to the lowest of 1766.67 US dollars/m^2 in the outskirts of Sacramento, revealing the price gap between the city proper of central cities and peripheral zones. By looking at the

Table 6.31 Basic description of North California agglomeration in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	63602.13	14454.71	46913.30 (Sacramento)	72171.98 (San Jose)	0.23
Pop	3022433	1488367	2028400 (San Jose)	4733600 (San Francisco)	0.49
House price	6124.99	3694.64	2495.96 (Sacramento)	9881.90 (San Francisco)	0.60
House price income ratio	5.48	2.57	3.19 (Sacramento)	8.27 (San Francisco)	0.47
Economic competitiveness index	0.785	0.249	0.4979 (Sacramento)	0.9408 (San Francisco)	0.32

Note The city is located in brackets, due to the availability of data, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

overall relationship between the per capita disposable income and the house price (see Fig. 6.55), we find that the agglomeration as a whole has seen the inverted U-shaped relationship between the two: when the house price is at the bottom, its increase will drive up the per capita disposable income; when the house price is already high, its further increase will bring down the latter (Table 6.32).

We chose San Francisco and San Jose as sample cities to examine their income-price relationship (see Fig. 6.56). The horizontal axis represents San Jose's relative house price to San Francisco and the vertical axis the per capita disposable income. We can see that San Jose's house price is only half of that in San Francisco, but its per capita disposable income is higher. It means that given the same house

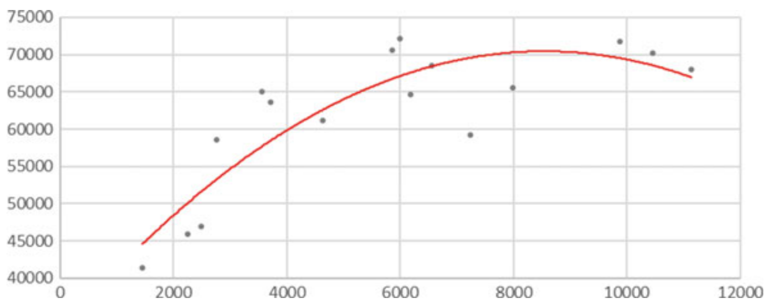


Fig. 6.55 Scatter diagram of income and house prices. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

Table 6.32 Regression analysis of the house price and the income

Explained variable	House price	Square of house price	Constant	Adjusted R^2	Sample size
Per capita disposable income	8.802*** (4.32)	-0.000515** (−3.25)	32859.8*** (5.84)	0.5590	16

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

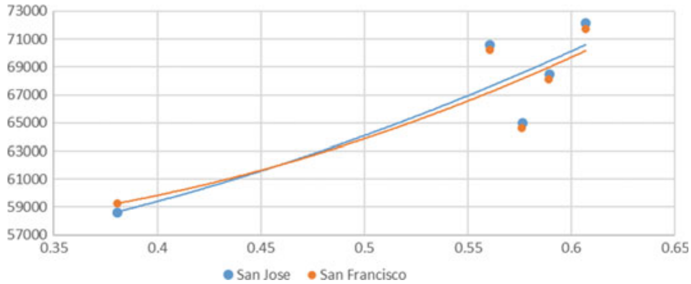


Fig. 6.56 The relationship between the income and the relative house price. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

Table 6.33 Regression analysis of the population and the relative house price

City	San Jose	San Francisco	Agglomeration
Variable	Population	Population	Population
Relative house price	3523159.4*** (16.01)	8254996.9*** (15.67)	4046756.1*** (15.10)
Adjusted R^2	0.9808	0.9785	0.9785

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

price level, an IT-driven city has much more per capita disposable income than functional cities. By examining the relationship between the population structure and the house price (see Table 6.33) we find that, the rise in San Jose's relative house price will have significant positive impact on not just the population size of its own, but also that of San Francisco; San Jose's relative house price has significant positive impact on the total population in the agglomeration: as it goes up, the whole agglomeration will become more appealing to outsiders and attract bigger inflow of immigrants.

The UK London-Liverpool agglomeration: Slightly uneven house price and population distribution in the urban agglomeration.

The London-Liverpool agglomeration consists of Greater London, Manchester (the world's textile capital), major textile and machinery cities such as Leeds, Birmingham, Sheffield and Liverpool as well as a number of small towns, with London as its center and the London-Liverpool line as the axis. With a territory of 45,000 km^2 and a population of 36.5 million, it is a major production base, industrial center and economic heartland in the UK. Its average home value is 4091 US dollars/m^2, with the highest of 13,542 US dollars/m^2 and the lowest 1288 US dollars/m^2, showing great differences.

From the descriptive statistics of the London-Liverpool metropolitan area in the United Kingdom (see Table 6.34), we can see that London, as the central city of the urban agglomeration, is both in terms of income, population, price and housing price Highest. From the overall urban agglomeration, urban population per capita disposable income and housing prices are at a high level, of which the average urban housing price of 4091.601 US dollars per square meter, the central city of London as high as 13,542 US dollars per square meter. From the perspective of price-to-income ratio, the urban-house price-to-income ratio is in an unreasonable state with an overall average of 8.63. Among them, the price-to-income ratio in London is very unreasonable with a value of 21.11. From the perspective of coefficient of variation, the income gap among cities in the urban agglomeration is not large, but the gap between housing prices is very large and the polarization between the two levels is very serious.

From per capita disposable income, population, housing prices and house price income over time fluctuations (see Fig. 6.57), in 2010–2017, per capita disposable income and population showed an upward trend, in which the urban population per

Table 6.34 Basic description of London-Liverpool agglomeration in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	25974.40	5876.65	19088.83 (Liverpool)	38483.96 (London)	0.23
Pop	2749487	4041251	273083 (Southampton)	1.32e+07 (London)	1.47
House price	4091.60	3933.68	1288.29 (Sheffield)	13542.62 (London)	0.96
House price income ratio	8.64	5.58	3.55 (Sheffield)	21.11 (London)	0.65
Economic competitiveness index	0.620	0.150	0.4999 (Sheffield)	0.9578 (London)	0.24

Note The city is located in brackets, due to the availability of data, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

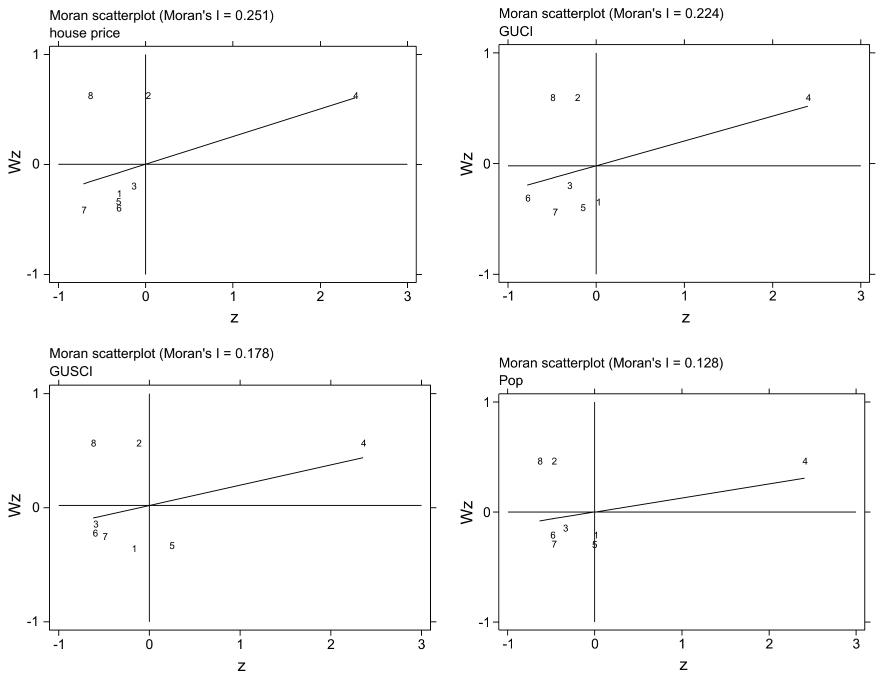


Fig. 6.58 Moran's I charts of the income, competitiveness and population. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

capita disposable The income has fluctuated and the population has shown a linear growth. Within the urban agglomeration, housing prices first rose and then dropped, at a relatively high level. From the perspective of the price-to-income ratio, the price-to-income ratio of the entire urban agglomeration has been in an unreasonable area during 2010–2017 and fluctuated around 10.

The Moran's I of the house price, economic competitiveness, sustainable competitiveness and the population size of the whole agglomeration shows that the region is characterized with the high-high and low-low pattern (see Fig. 6.58). The Moran's I of the house price is 0.251, that of economic competitiveness 0.224, that of sustainable competitiveness 0.178 and that of the population size 0.128. It shows that the house price is significantly more aggregated than the population, reflecting the uneven distribution of house prices and population to certain extent.

The empirical analysis of the house price, income and population shows that the house price has positive impact on the income. As shown in Fig. 6.59, when the house price increases, the income goes up; when the house price falls, the income declines too. The regression modeling of the house price, competitiveness and population (see Table 6.35) shows that the house price and competitiveness have positive impact on the population: the population will increase by 1038 for every

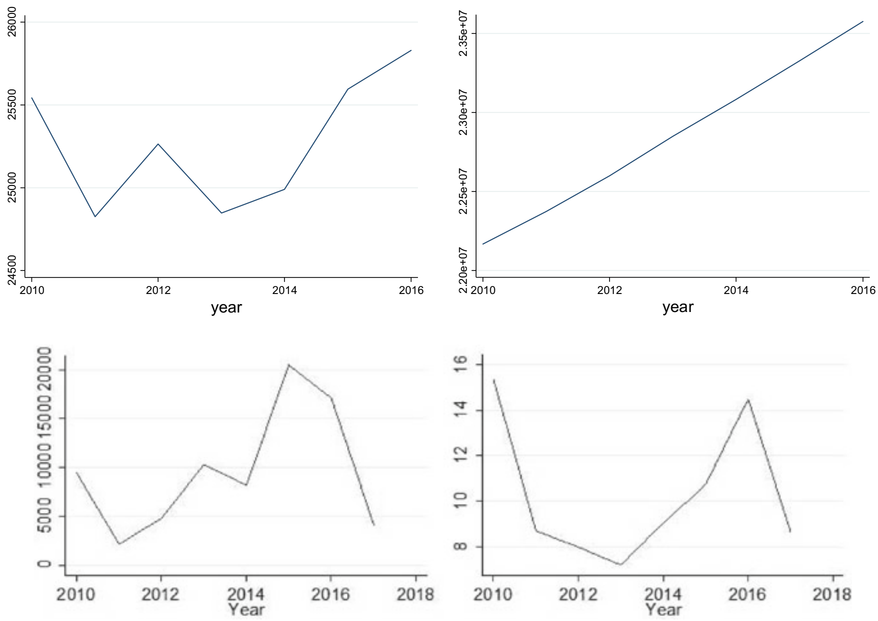


Fig. 6.57 Trend of London-Liverpool metropolitan area. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

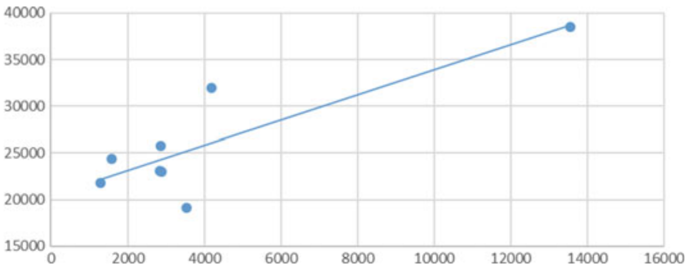


Fig. 6.59 Scatter diagram of income and house prices. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

one US dollar increase in the house price and by 219,000 for every 0.01 unit increase in the economic competitiveness index.

Table 6.35 Regression analysis of population, the house price and competitiveness

Variable	Population	Population
House price	1038.4*** (8.33)	
Economic competitiveness		2.19e+07*** 14.54
Constant	−1270752.1 (−1.85)	−5595810*** −8.63
Adjusted R^2	0.9071	0.9678

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

Northwest Europe agglomeration: The agglomeration features relatively balanced distribution of income, population and house prices and generally strong competitiveness.

As one of the six most famous metropolitan areas in the world, the Northwest Europe agglomeration consists of three parts: the Paris-Rouen-Le Havre metropolitan area in France, the Rhine-Ruhr metropolitan area in Germany and the Randstad-Belgium metropolitan area. It includes a number of major cities in France, Germany, Holland and Belgium, such as Paris, Amsterdam, Rotterdam, Hague, Antwerp, Brussels, and Cologne. It includes over 40 cities each with the population above 100,000 and covers a territory of 1.45 million square kilometers. Its total population is 46 million.

From the descriptive statistics of the urban agglomerations in the northwestern Europe (see Table 6.36), we can see that the per capita disposable income and

Table 6.36 Basic description of Northwest Europe agglomeration in 2017

Variable	Average value	Standard error	Minimum value	Maximum value	Coefficient of variation
Per capita disposable income (dollar)	27896.17	4500.21	20878.48 (Brussels)	34906.6 (Dusseldorf)	0.16
Pop	2577992	3398381	596007 (Dortmund)	1.25e+07 (Paris)	1.32
House price	4238.39	2131.13	2420.39 (Liege)	9733.71 (Paris)	0.50
House price income ratio	8.93	3.39	5.50 (Dortmund)	17.18 (Paris)	0.38
Economic competitiveness index	0.655	0.087	0.4839 (Liege)	0.8060 (Paris)	0.13

Note The city is located in brackets, due to the availability of data, the house price income ratio is calculated by the house price and income, and the living space is 60 m^2 per person
Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

housing prices of the entire urban agglomerations are at an average level, and the per capita disposable income of urban agglomerations is US$ 24,933.83, And a coefficient of variation of 0.16 indicates that there is a very small gap between cities in the urban agglomeration. Central city within the city group Paris its population, prices are at a high level. From the perspective of the price-to-income ratio, housing prices and incomes in the urban agglomerations of the northwestern Europe are generally unreasonable, but they are also very close to reasonable areas with an overall average of 8.05.

By examining the spatial structure of the house price, competitiveness and population of the region (see Fig. 6.60) we find that, the Moran's I of the house price is 0.381, that of economic competitiveness 0.4, that of sustainable competitiveness 0.262, and that of population size 0.478. It means that the house price, population and competitiveness are all highly aggregated in the region.

To illustrate the relationship between the house price, per capita disposable income, population and competitiveness of the region, we conducted regression analysis of the house price and all the related indicators (see Table 6.37). We find that the per capita disposable income and competitiveness are in the inverted U-shaped relationship with the house price: as the house price increases, the former two will go up at first, and when they hit a certain point, they will start to fall; the population size and the house price are in the U-shaped relationship: as the house

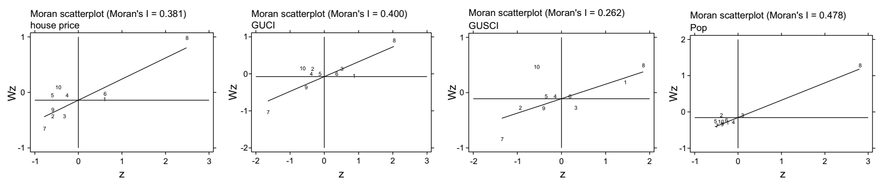


Fig. 6.60 Moran's I charts of the income, competitiveness and population. *Source* City and Competitiveness Index Database, CASS; NUMBEO official website or database

Table 6.37 Regression analysis of income, competitiveness, population and the house price

	Economic competitiveness	Sustainable competitiveness	Population
House price	0.000135*** (13.30)	0.00333*** (18.38)	−2162.3* (−2.77)
Square of house price	−7.10e−09*** (−5.05)	−0.000000238*** (−9.49)	0.300** (4.67)
Constant			4942766.1* (2.59)
N	10	10	10

Note In brackets is the statistical value of t; *stands for the 10% significance level, **5%, and ***1%

Source City and Competitiveness Index Database, CASS; NUMBEO official website or database

price grows, the population will at first decrease, but when the house price hits a certain point, the population will increase as the house price picks up, a sign of growing appeal of the agglomeration to immigrants.

6.4 Policy Recommendations

In light of the global real estate market and based on international experience, literature review, theoretical studies and empirical analysis, we believe that the government is capable to stabilize the development of the real estate market and keep the house price at a level in favor of urban competitiveness and income increase. To better regulate the real estate market, governments around the globe should combine fiscal policies, monetary policies, administrative regulations and taxation policies to exercise all-round regulation over links of land supply, transaction and consumption. They shall aim to suppress the real estate bubble, allow the house price to play its positive role in urban economy, meet the housing demand, improve people's wellbeing, and strengthen comprehensive urban competitiveness. The real estate market shall aim at equilibrium: equilibrium between the house price and the current price-to-income ratio, equilibrium between the inter-city gap of house price, price-to-income ratio and income growth expectation, and equilibrium between house price growth and income increase.

Let house price as both pressure and motivation for ordinary people and as leverage, not a trap for cities. The development of the real estate market shall give it full play to its role in economic development and livelihood improvement, as both pressure and motivation for ordinary people and as leverage, not a trap for cities. For ordinary households, they should realize that on one hand, a too high house price will increase their living cost, and on the other, squeeze out businesses, reduce jobs and make their life more challenging. They should also realize that a home is more than a habitat, that it is the basis for wealth accumulation and personal development, a safety net for the family and a spiritual haven, and that it is worth their hard working. For city governments, they should see the real estate market as the leverage, not a trap, of economic development. An excessive housing supply and a house price that is too low will lift the pressure on the city for further development and transformation; a short housing supply and an unaffordable house price will cost the city the ability for further development and transformation. Over-inflated house prices will increase the living cost, squeeze out high-end talents, and hinder the fostering of new economic growth points. The overshooting of house prices will also squeeze out productive investment and result in the flooding of capital in the real estate market, which is bad for the real economy and urban competitiveness. But moderately high house prices can attract capital for city development, increase local government revenue, improve public services, propel local governments and businesses to seek for further development and transformation, and thus enhance urban competitiveness. To sum up, local governments must not sit idle while watching the house price surge, or go to the other extreme and take on all things; instead they should try to keep the house price in a moderately high range so that it will instill both pressure and motivation for ordinary households and serve as leverage, not a trap, for city development.

Property speculation shall be checked by sound administrative policies and legal policies. First, local governments should specify that housing is mainly for the residential purpose, take proper administrative actions, such as purchase and price limits, monitor real estate speculation within their jurisdiction, keep an eye on speculative financial leverage and suppress speculation on residential housing. For instance, Singapore, the UK and China have introduced affordable housing for sale and for rent to meet the housing demand of low- to medium-income groups. In this context, it is vital to establish an efficient housing rent market and safeguard tenants' legitimate rights and interests. According to a 2015 survey by the U.S. Census Bureau, 36.6% of the American are tenants, compared to above 40% in France and Germany and over 10% in China. An efficient house renting market plays a key role in meeting the housing demand. The German government is vigorously pushing forward the affordable housing program, supporting non-for-profit public housing programs, and encouraging the competition between non-for-profit rental and for-profit rental. It has introduced the Residential Tenancies Law, stipulating the formulation, performance of the lease contract, the rent rate and its increase, and the termination of the contract. All these efforts have ensured the sound and smooth operation of German real estate market. Germany's experience in building an efficient house renting market is worth learning for the rest of the world, especially for cities in developing countries.

Secondly, local governments should introduce laws and regulations to check residential property speculation and the windfall profits of developers. For example, in Germany, the Constitution and the Residential Construction Act list the meeting of the residential housing demand as one of the top goals for the federal government. Strict policies are introduced to suppress residential property speculation and windfall profits of developers: developers will face heavy fines and a maximum of three years in prison if they set the house price beyond the reasonable limit. These laws and policies have prevented not only domestic but also overseas speculators from disturbing the German property market.

The land supply policy should be adjusted in light of the nature of land, improper regulation policies loosened and the housing supply and demand matched. Specifically, when the land is state-owned, the government should properly adjust the land supply in light of the changes to supply and demand; when the land is privately owned, the government should introduced anti-monopoly laws, introduce full competition into the land market as much as possible and prevent speculation; in case of market failure, the government should correct problems caused by the externality and information asymmetry of land allocation in the market through land control, to ensure market efficiency. Globally speaking, an increased supply of residential and can help ease the pressure of soaring house prices and stabilize public expectations. The surge in land and house prices is mainly driven by improper land control and urban planning. In the 1970s, to protect the environment and cultural legacies, the state of California rolled out a number of laws and regulations limiting the use of land, turning land into a scarce resource and driving up the land price and then the house price. In the 1980s, Tokyo saw massive speculation and a huge property bubble, for which many economists blamed the ill-thought planning and zoning policy as the root cause for the decreased housing supply. After the bubble burst, the Tokyo government loosed its grip on property development, and in 2002 introduced the City Revitalization Act, an overhaul of previous transitional regulation policies: office building plots were re-designated as residential zones, and construction was allowed on private land. As a result, the housing supply has significantly increased and the house price has been stabilized in Tokyo in recent years.

Prudential financial policies should be introduced to regulate housing finance. Governments around the world should improve the housing finance system, properly adjust the interest rate and down payment of home purchase, and meet the demand for housing consumption and development. They shall also tighten oversight over the real estate market, exercise prudency, build and improve the early warning mechanism based on the internal relations of the real estate market and its external economic and financial relations, to suppress real estate speculation and keep housing consumption in a reasonable range. The housing credit policy is vital for the real estate market and credit support can take various forms, such as subsidies and guarantees. Unchecked, excessive credit support for home purchase tends to aggravate the property bubble, or might even trigger a financial and economic crisis, as in the case of Japan's real estate bubble in the 1990s and the last international financial crisis triggered by the U.S. subprime mortgage bubble in 2008. In this regard, Germany has introduced the "deposit before loan" contract deposit mode and fixed interest rate for home loans, which is worth our learning.

Sound fiscal and taxation policies should be enforced and the taxation system improved to check property speculation. Local governments should establish a complete property taxation system and the fiscal and taxation support system to meet people's housing demand, and provide subsidies and tax benefits to low- and medium-income groups. For example, the U.S. government alleviates the pressure on low-income earners for home purchase or renting with tax credit. Besides, flexible transaction taxes should be introduced to check property speculation. For instance, Australia, Canada and Hong Kong have significantly increased the home transaction tax or tightened the loan policy for overseas buyers. The state of Queensland in Australia introduced a new taxation policy on October 1, 2016, increasing the extra stamp tax for overseas buyers to 3%; the Canadian government announced on October 17, 2016 that applicants for home loans must pass the stress test with the 4.64% interest rate before the loan is granted; Hong Kong also decided to increase the stamp tax rate for residential property to 15% of the transaction value from November 5, 2016. These policies have greatly reduced the profit space for property developers and speculators, leaving little profit to be gained from property speculation.

Chapter 7
City Story: House Prices and Competitiveness

The Whole Group

7.1 Silicon Valley, USA

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In this case study, we consider technology jobs and housing affordability trends in the Silicon Valley region. We estimate a vector error correction model using measures of housing affordability, GMP, start-ups and patent applications. Despite ever-higher housing prices and declining affordability, innovation, as measured by the number of technology jobs, as well as other metrics, continues to thrive.

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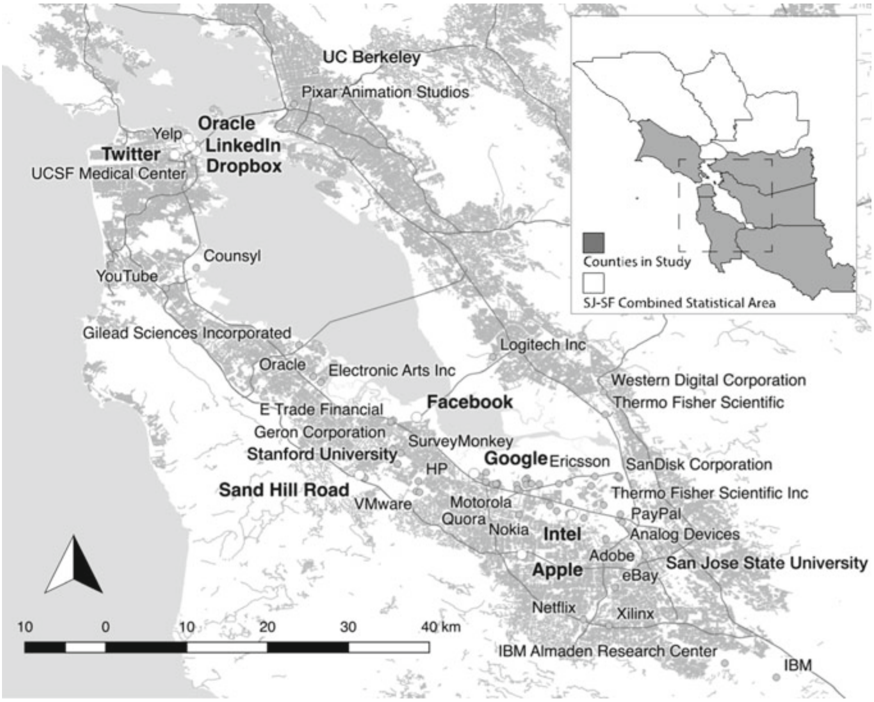


Map 7.1 Notable firms and institutions in silicon valley

7.1.1 *Introduction*

Silicon Valley is archetypal for IT development. Silicon Valley is also one of the most expensive places to live in the United States. We define Silicon Valley as an economic region spanning two Metropolitan Statistical Areas (MSAs): San Jose-Sunnyvale-Santa Clara and San Francisco-Oakland-Hayward. These MSAs contain an economic cluster comprising information technology and associated industries. High tech companies originally concentrated in the Santa Clara Valley (the original ‘Silicon Valley’), over time, have located closer to the Bay Area’s two other major cities—San Francisco and Oakland.[1] While the valley itself—in the San Jose MSA—is home to firms like Google and Apple, newer firms like Twitter and LinkedIn have chosen the San Francisco MSA for their headquarters (see Map 7.1). These MSAs are part of a larger Combined Statistical Area (CSA)—the San

[1]Thus, Silicon Valley has both the narrow geographic definition—referring to Santa Clara Valley—and the larger, geographical definition based on the broader clustering of high tech businesses in the Bay Area. In this case study, we use the latter. See Guzman and Stern (2015) for further discussion.

Jose-San Francisco-Oakland CSA (see Map 7.1).[2] This is a large region with much variation in population density, as shown by the concentrated transportation network indicated as grey on the Map.

This case study aims to analyze the relationship between housing affordability and economic competitiveness in the Silicon Valley. The Silicon Valley region provides insight as to the relationship between housing and urban competitiveness in the context of an area known throughout the world as a hub of technological innovation.[3]

In the following, Sect. 7.1.2 presents data on economic competitiveness of the region; Sect. 7.1.3 presents data on housing affordability; Sect. 7.1.4 discusses interactions between economic competitiveness and housing affordability; and Sect. 7.1.5 discusses the policy implications.

7.1.2 Economic Growth and Competitiveness in Silicon Valley

Gross Metropolitan Product (GMP) growth in Silicon Valley is high relative to the national average and has accelerated since the end of the Great Recession. As shown in Fig. 7.1, GMP growth (calculated as the real compound annual growth rate) since 2010 is 4.1% in San Jose and 3.2% in San Francisco, versus 1.7% for the US. Over a longer period, the past two decades, growth has been similarly high in San Jose at 4.2% and at 2.6% in San Francisco, near the US growth rate of 2.5%. As shown in Fig. 7.2, per capita GMP and per capita GMP growth is also high at 3.1% in San Jose and 1.9% in San Francisco over the longer period compared to the US growth rate of 1.6%, and, recently, 3% in San Jose and 2.1% in San Francisco, nearly double the US per capita growth rate of 1.1% (see Figs. 7.1 and 7.2).

Figure 7.3 shows labour productivity (competitiveness) over time for San Jose, San Francisco and the US. Labour productivity, measured as GMP per worker, is far higher in the Silicon Valley, as is expected, than in the U.S. as a whole. Technology job growth, as shown in Fig. 7.4, is also far higher and increasing at a rapid rate since the 2001 technology bubble. As shown in Table 7.1, which lists the 30 fastest growing regions for tech jobs from 2013 to 2015, San Francisco and San Jose areas added more than 31,000 and 27,000 thousand technology jobs, respectively, leading the nation in terms of technology job creation. Nearly 20% of the US post-crisis job creation in the technology sector took place in Silicon Valley (10%,

[2]The CSA also includes the two MSAs of study—with 7 counties—as well as 12 additional counties. But, high tech industry in this CSA is clustered in the San Francisco and San Jose MSAs.

[3]In Silicon Valley, we focus on information technology—a dynamic sector in the U.S. economy. San Francisco accounts for 25% of all venture capital investment in the nation; San Jose accounts for 15%. Thus combined, our area of study accounts for almost 40% of all venture capital investment in the United States (Florida and King 2016).

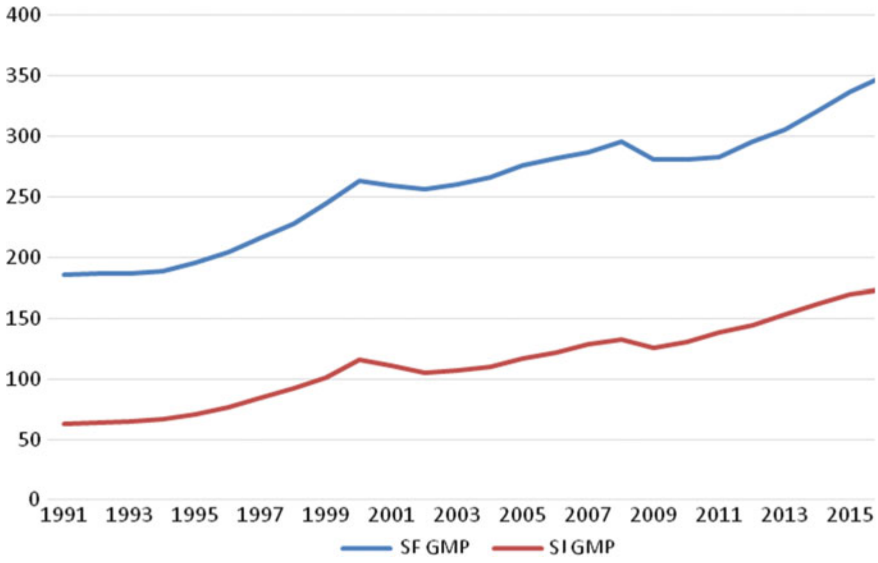


Fig. 7.1 GMP in San Francisco and San Jose MSAs (Billion $, chained 2009). *Source* BLS, CES, BEA, CBP

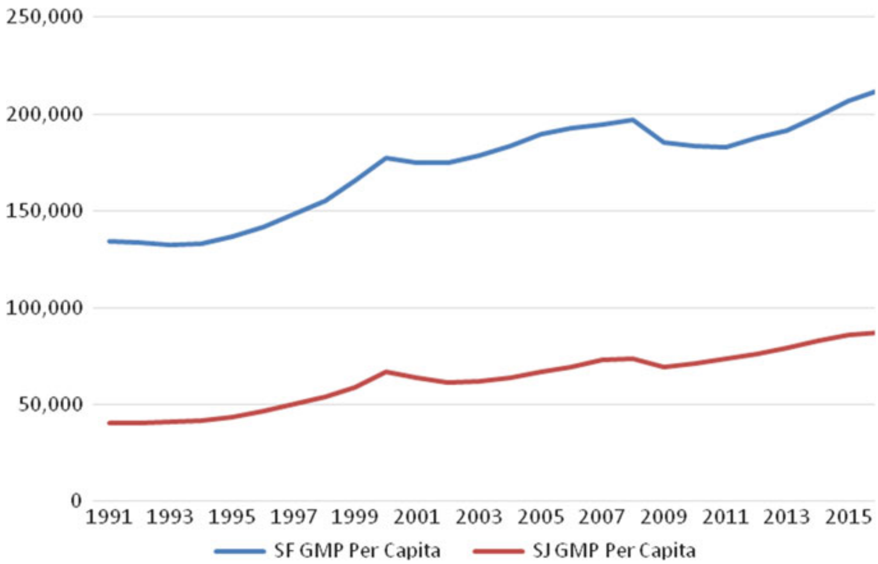


Fig. 7.2 GMP per Capita in San Francisco and San Jose MSAs ($, chained 2009). *Source* BOC, BLS, CES, BEA, CBP

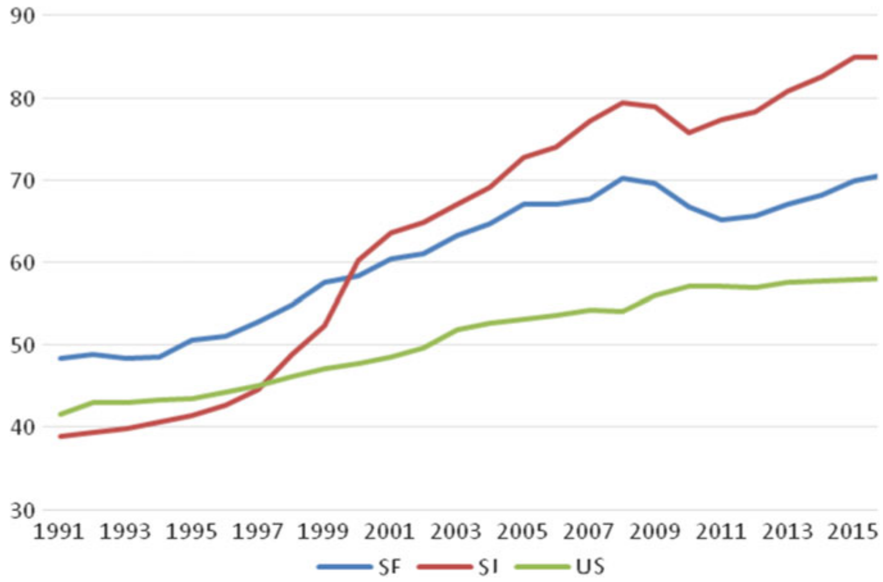


Fig. 7.3 Productivity in Silicon Valley. *Source* CES, QCEW, BLS and based on author's calculation. Productivity is measured by the ratio of GMP (billion $, chained 2009) and total working hours. Total working hours is approximated by total number of non-farm workers (seasonally adjusted) multiplied by 2,000 h per worker

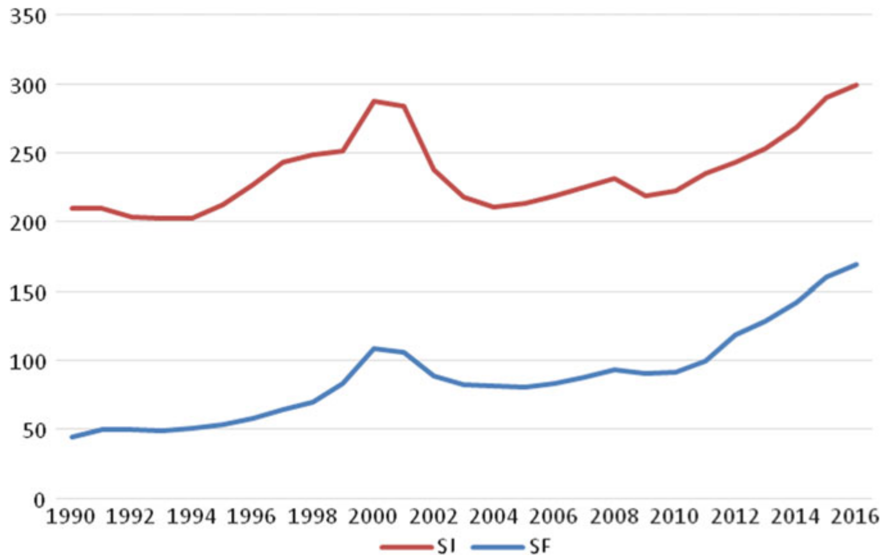


Fig. 7.4 Technology Jobs in San Francisco and San Jose MSAs (thousand). *Source* BLS, BEA, CES, QCEW, Moody's Analytics

Table 7.1 Thirty metropolitan statistical areas with the largest absolute increase in tech jobs

MSA	Absolute tech job growth, (thousand) 2013–2015	CAGR of tech jobs (%), 2013–2015	Change in share of national tech job total (%), 2010–2015
San Francisco-Oakland-Hayward, GA	31.5	12.9	1.51
San Jose-Sunnyvale-Santa Clara, CA	27.5	12.1	0.88
New York-Newark-Jersey City, NY-NJ-PA	24.2	6.1	−0.01
Dallas-Fort Worth-Arlington, TX	15.4	9	0.38
Boston-Cambridge-Newton, MA-NH	11.2	5.2	0.02
Austin-Round Rock, TX	11.1	16.1	0.52
Seattle-Tacoma-Bellevue, WA	10.9	5.3	−0.10
Los Angeles-Long Beach-Anaheim, CA	10.3	6.5	−0.05
Chicago-Naperville-Elgin, IL-IN-WI	10	5.8	0.24
Atlanta-Sandy Springs-Roswell, GA	9.5	6.4	0.03
Phoenix-Ides a-Scottsdale, AZ	7.7	11.5	0.29
Washington-Arlington-Alexandria, DC-VA-MD-WV	7.6	1.9	−1.65
Charlotte-Concord-Gastonia, NC-SC	5.6	14.5	0.17
Denver-Aurora-Lakewood, CO	5.4	6.3	0.06
Indianapolis-Carmel-Anderson, IN	5	13.9	0.18
Minneapolis-St. Paul-Bloomington, MN-WI	3.6	4.1	−0.11
Detroit-Warren-Dearborn, Ml	3.4	3.8	−0.07
Pittsburgh, PA	3.2	9	0.06
Miami-Fort Lauderdale-West Palm Beach, FL	3.1	5.4	0.00
Madison, WI	2.9	11	0.11
Portland-Vancouver-Hillsboro, OR-WA	2.8	5.9	0.01
Jacksonville, FL	2.7	11.9	0.02
Kansas City, MO-KS	2.7	4.6	0.00
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	2.5	2.3	−0.38
Provo-Orem, UT	2.3	7.7	0.07
Baltimore-Columbia-Towson, MD	1.9	2.6	−0.11
Cincinnati, OH-KY-IN	1.8	6.6	0.00
Raleigh, NC	1.8	3.7	0.09
Sacramento-Roseville-Arden-Arcade, CA	1.7	7.7	−0.03
Nashville-Davidson-Murfreesboro-Franklin, TN	1.7	6.7	0.04

Source Brookings Analysis of Moody's Analytics data. GAGR = compound annual growth rate or 67,000 jobs in San Francisco, and 7.6%, or 51,000 jobs, in San Jose), according to Brookings.[4]

Despite the dominance of the large tech firms, such as Google and Apple, job growth is occurring in small and m medium sized businesses. This is important since tech innovations often occur in small to mid-size firms. Since 2002, after the high tech bust, the number of established small businesses with 1–4 employees as well as businesses with 1–49 employees have experienced growth. The number of established small businesses, using the latest data available, is higher than at the peak of the tech boom, although there has been some recent decline consistent with that for the US as a whole[5] (see Fig. 7.5).

The dominance of Silicon Valley as a driver of tech innovation is also shown in trends in patent data: the two metropolitan areas have produced more than 233,000 patents since 2000—140,000 more than the second most prolific conurbation, New York City-Northern New Jersey-Long Island. Indeed, the Amtrak corridor stretching from Washington, D.C. to Boston, MA, which comprises the spine of the BosWas megalopolis, produced 245,000 patents over the same period—despite a population roughly 6 times as large. Patents awarded across the country indicate that, with San Jose and San Francisco outperforming the rest, the agglomeration is the driver of innovation in the nation. With 2% of the US population, Silicon Valley accounted for 17% of all patents in 2015. Outside of Silicon Valley, there is a steep drop in patent production in the United States[6] (see Figs. 7.6 and 7.7).

7.1.3 Housing Affordability in Silicon Valley

San Jose and adjacent areas show very little growth in housing supply relative to population growth over the last few decades, as shown in Fig. 7.8. This inevitably has and will result in higher housing prices over time.

Figure 7.9 shows the increase in housing prices over time as measured by a constant quality house price index. Over the 1991–2016 period, house prices in the San Jose and San Francisco MSAs have grown at an annual rate of 4.98 and 5.54%, respectively—with an annual growth of 3.33% in the U.S.[7] as shown in Fig. 7.9.

The National Association of Realtors data on median house price growth, which includes quality gains, shows median house prices of $1,062,698 and $1,022,928 for San Francisco and San Jose, respectively—far in excess of the $199,116 average

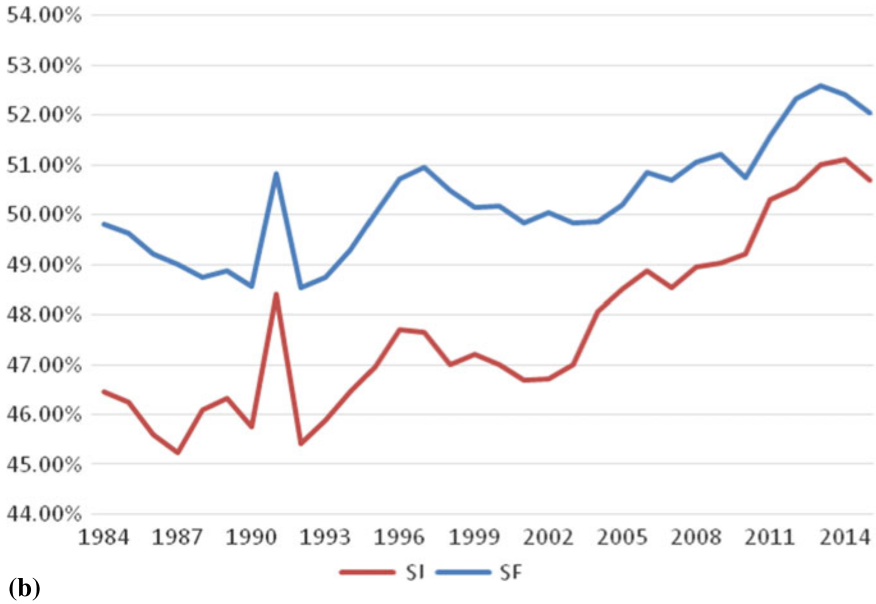
[4]Muro et al. (2017). Tech in Metros: the Strong are Getting Stronger. https://www.brookings.edu/blog/the-avenue/2017/03/08/tech-in-metros-the-strong-are-getting-stronger/

[5]The number of established small businesses appears to have declined recently (beginning in 2014), as it has for the nation as a whole. For discussion see Surowiecki (2016).

[6]United States Patent Office.

[7]House price growth measures are calculated using the FHFA Seasonally-Adjusted Purchase-Only Index.

(a)



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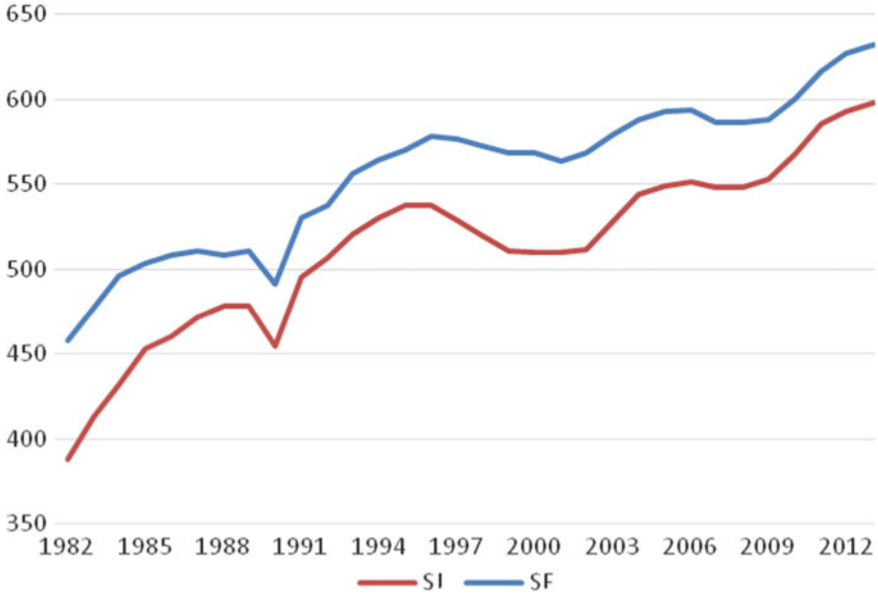

Fig. 7.5 **a** Established small businesses: share of size 1–4. *Source* Kauffman Foundation. Established small businesses are defined as businesses below the age of five and employing at least one, but less than fifty, employees. **b** Established Small Business Density. *Source* Kauffman Foundation. Established Small Business Density is defined as the number of established small businesses per 1,000 firms. Established small businesses are defined as businesses below the age of five and employing at least one, but less than fifty, employees

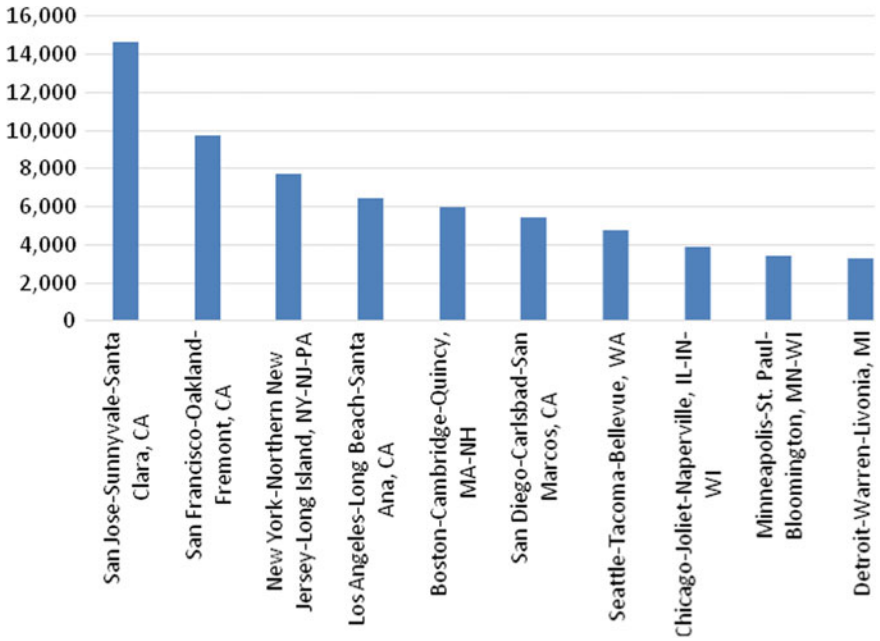

Fig. 7.6 Top 10 cities by patent applications in 2015. *Source* USPTO

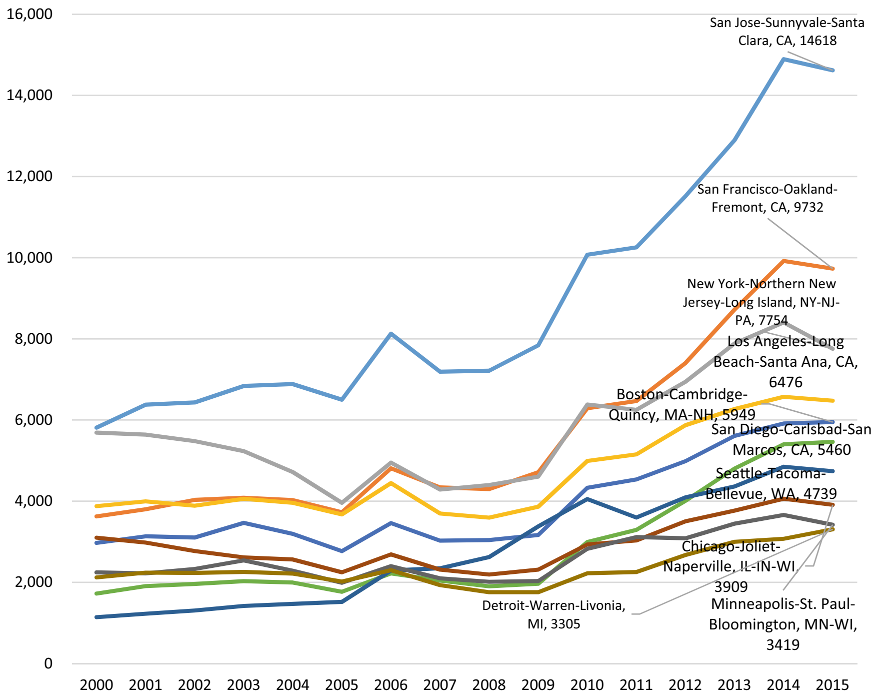

Fig. 7.7 Patents awarded across MSAs (2000–2015). *Source* USPTO

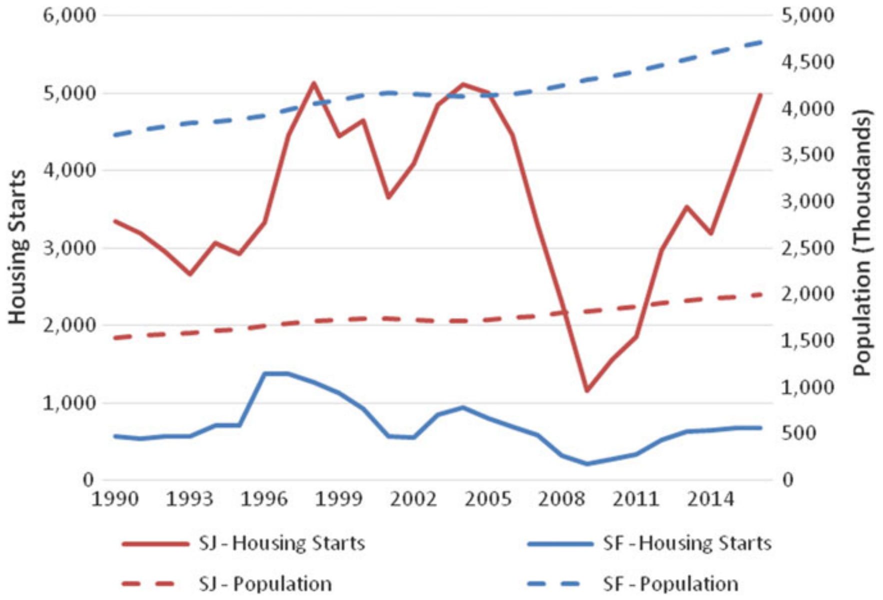

Fig. 7.8 Housing starts and population in San Francisco and San Jose MSAs. *Source* FRED, BOC, Moody's Analytics

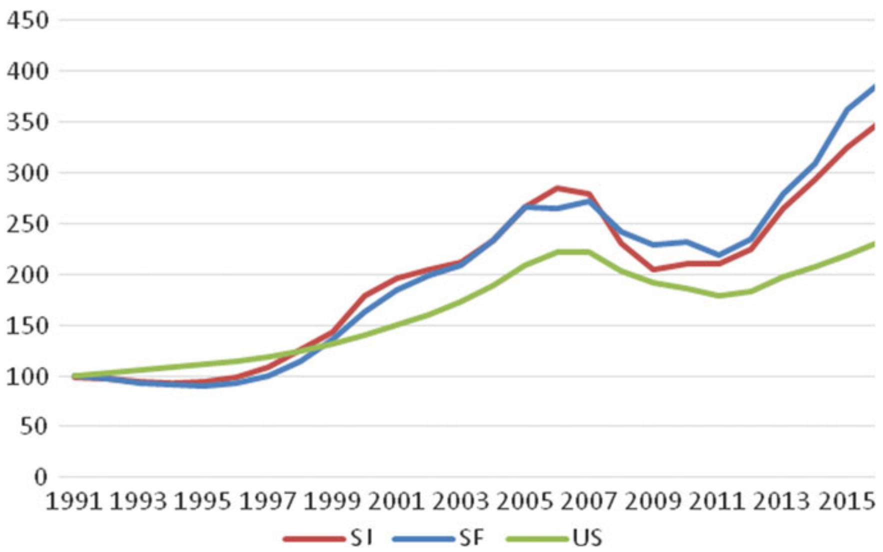

Fig. 7.9 House price indexes (seasonally adjusted). *Source* FHFA

Table 7.2 Median sales price existing single-family homes (thousand. $)

Ranking	Metro area	Median price
1	San Francisco-Redwood City-South San Francisco, CA	1173.9
2	San Rafael, CA	1087.4
3	San Jose-Sunnyvale-Santa Clara, CA	951.7
4	Oakland-Hayward-Berkeley, CA	772.4
5	Santa Cruz-Watsonville, CA	723.6
6	Urban Honolulu, HI	710.3
7	Anaheim-Santa Ana-Irvine, CA	706.6
8	Santa Maria-Santa Barbara, CA	676.3
9	Oxnard-Thousand Oaks-Ventura, CA	604.6
10	Napa, CA	595.1
11	Kahului-Wailuku-Lahaina, HI	583.3
12	Santa Rosa, CA	545.1
13	San Diego-Carlsbad, CA	540.1
14	San Luis Obispo-Paso Robles-Arroyo Grande, CA	503.2
15	New York-Jersey City-White Plains, NY-NJ	477.2
16	Salinas, CA	474.9
17	Los Angeles-Long Beach-Glendale, CA	463.3
18	Cambridge-Newton-Framingham, MA	451.4
19	Boulder, CO	451.2
20	Silver Spring-Frederick-Rockville, MD	429.4
21	Nassau County-Suffolk County, NY	420.9
22	Seattle-Bellevue-Everett, WA	417.8
23	Naples-Immokalee-Marco Island, FL	415.2
24	Boston, MA	410.1
25	Washington-Arlington-Alexandria, DC-VA-MD-WV	385.6
26	Newark, NJ-PA	380.2
27	Bridgeport-Stamford-Norwalk, CT	372.2
28	Barnstable Town, MA	363.6
29	Vallejo-Fairfield, CA	354.4
30	Denver-Aurora-Lakewood, CO	351.2

Source National Association of Realtors: Real Estate Outlook; Moody's Analytics

for the United States' metropolitan areas.[8] and among the top three in the nation, as shown in Table 7.2.[9] Weighing against the area's median income, San Francisco ranks as the least affordable metro in the nation, while San Jose is the sixth least affordable (see Table 7.3).

[8]It should be noted that the average value for U.S. metropolitan areas, while comparatively more useful, is higher than the average for the U.S. overall.

[9]Median house price data provided by Moody's Analytics and the National Association of Realtors (NAR).

Table 7.3 Top thirty least affordable metropolitan statistical areas in 2015

Ranking	Metro area	Housing affordability index
1	San Francisco-Redwood City-South San Francisco, CA	55.21
2	San Rafael, CA	63.92
3	Urban Honolulu, HI	65.45
4	Santa Cruz-Watsonville, CA	66.30
5	Santa Maria-Santa Barbara, CA	66.43
6	San Jose-Sunnyvale-Santa Clara, CA	66.68
7	Anaheim-Santa Ana-Irvine, CA	70.23
8	Oakland-Hayward-Berkeley, CA	71.25
9	Kahului-Wailuku-Lahaina, HI	75.16
10	Oxnard-Thousand Oaks-Ventura, CA	77.31
11	Los Angeles-Long Beach-Glendale, CA	77.12
12	Napa, CA	79.83
13	Salinas, CA	83.56
14	San Diego-Carlsbad, CA	84.19
15	New York-Jersey City-White Plains, NY-NJ	84.29
16	San Luis Obispo-Paso Robles-Arroyo Grande, CA	87.19
17	Santa Rosa, CA	89.28
18	Naples-Immokalee-Marco Island, FL	91.11
19	Miami-Miami Beach-Kendall, FL	104.02
20	Boulder, CO	114.58
21	Grants Pass, OR	117.13
22	Riverside-San Bernardino-Ontario, CA	121.84
23	Stockton-Lodi, CA	122.47
24	Barnstable Town, MA	125.14
25	West Palm Beach-Boca Raton-Delray Beach, FL	125.90
26	Fort Lauderdale-Pompano Beach-Deerfield Beach, FL	126.21
27	Denver-Aurora-Lakewood, CO	126.54
28	Vallejo-Fairfield, CA	127.54
29	Chico, CA	127.80
30	Seattle-Bellevue-Everett, WA	127.43

Source National Association of Realtors (NAR): Real Estate Outlook; U.S. Census Bureau; Bureau of Economic Analysis; Moody's Analytics. The degree to which a median income earning household can afford the median-priced, existing single-family home, assuming a 20% down payment with a 30-year fixed rate mortgage

The implications of these high and rising price increases are also shown in affordability measures. Using both median house price data and median household income data, we construct a house price-to-income ratio as shown in Fig. 7.11—showing the lack of affordability even as far back as 1990 as well as the rise to an even higher ratio in the bubble years (it declined during the 2008 crisis but has returned in recent years to near bubble levels). In addition, the elevated near-10

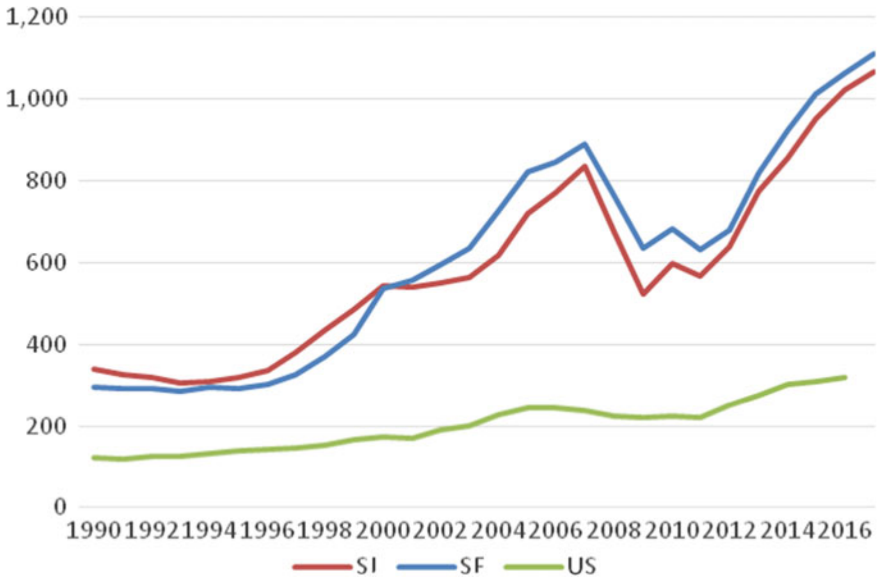

Fig. 7.10 Median sale price (thousand $). *Source* NAR: Real Estate Outlook, FRED, Moody's Analytics

ratios can be compared to a US ratio of around 3. Table 7.2 shows a ranking of the top 30 least affordable MSAs in the nation as of 2015. San Francisco ranks number 1 using this measure and San Jose, number 6 (Fig. 7.10).

We also compare data from a housing affordability index,[10] which represents the degree to which a household earning the median income can afford the median-priced home by purchasing using a 30-year, fixed-rate mortgage[11] with an 80% loan-to-value ratio at origination (index values of 100 or higher indicate affordability). As shown in Fig. 7.12, the housing affordability index values for San Jose and Francisco are 60.35 and 57.75, respectively—meaning that, holding house prices constant, median incomes would need to nearly double in order to achieve affordability by this measure. In context, the 2016 average housing affordability index value for U.S. metropolitan areas is 200.16. Moreover, the index assumes a mortgage with 80% loan-to-value at origination, or, put otherwise, a 20% down payment at purchase. The level of wealth required to make this down payment—which in 2016 would be $204,585 for San Jose and $212,539 for San Francisco—is a significant barrier to homeownership in the Silicon Valley region.

[10]Housing affordability index provided by Moody's Analytics, National Association of Realtors (NAR), U.S. Census Bureau and Bureau of Economic Analysis.

[11]The 30-year fixed-rate mortgage is the most appropriate mortgage product for housing finance analysis in the United States. Other countries with different mortgage product offerings may provide different outcomes. See Green and Wachter (2005) for a discussion of the 30-year fixed-rate mortgage.

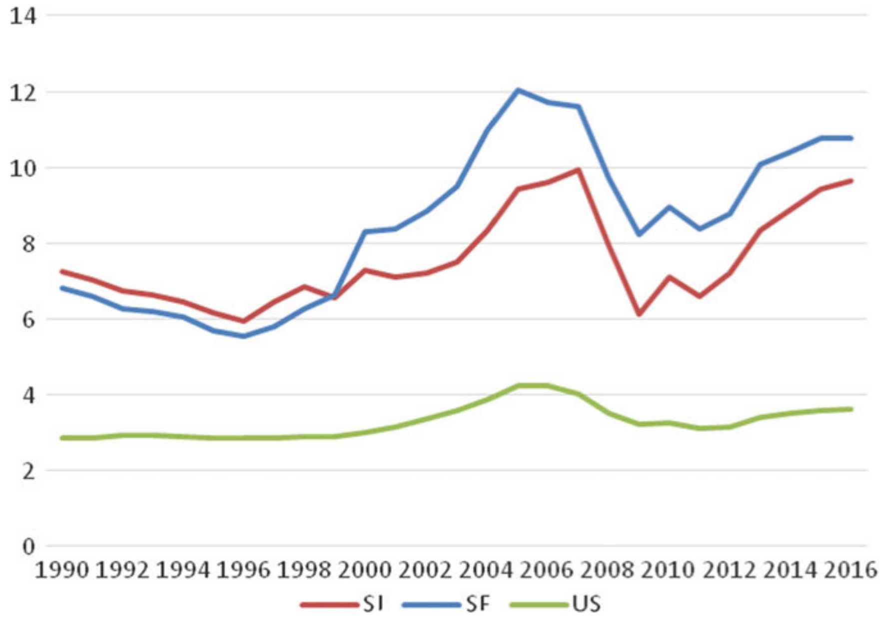

Fig. 7.11 House price-to-income ratio. *Source* NAR, US Census Bureau, and based on authors' calculation

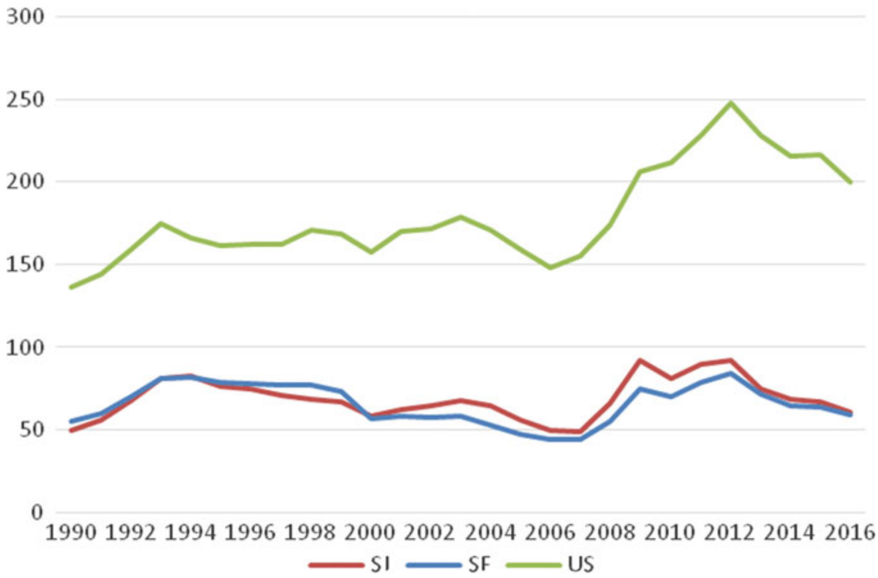

Fig. 7.12 Housing affordability index. *Source* National Association of Realtors (NAR): Real Estate Outlook, U.S. Census Bureau, BEA, Moody's Analytics

7.1.4 Model Results and Discussion

We perform a vector error correction model (VECM) using house prices, GMP, and start-up density (see Appendix). In the long run, the results show that, if both GMP and start-up density increase by 1%, this is associated with a 6–7% increase in equilibrium house prices for both MSAs, although start-up density growth is more important for San Jose, and, GMP for San Francisco, perhaps demonstrating the continued importance of incubating new firms in San Jose. This result is expected but does point out the large increase in housing prices associated with growth. On the other hand, the association of house price growth and start-up growth is unexpectedly positive although this association diminishes over time (for GMP this is not significant), but, in any case, there is no evidence that house price increases are associated with declines in either start-up density or GMP. We also see no decline in the absolute number of firms with 1–4 employees despite housing prices reaching new levels of unaffordability.[12]

Various initiatives have been taken in response to the affordability challenge, including producing dormitory housing and providing low-cost transportation options for employees (the famous ‘Google Bus’ being an example)—a form of subsidizing transportation costs to ease the necessity to locate further from the place of employment. Google, among other firms, is engaged in array of compensatory practices, adding 10,000 new homes alongside their headquarters and contributing to a high-speed rail project linking hubs across the region.[13] For newer firms, the homogenously high house prices across the San Jose MSA has led many businesses to locate in the urban center of San Francisco—allowing workers to live in San Francisco’s more inexpensive boundaries (a trend that has led to a high population growth in areas located on the BART such as Oakland). Moreover, many well-established technology firms are engaging in ‘in-country outsourcing.’ Specifically, firms are designating their Silicon Valley headquarters as a place of work for only the employees they deem critically important to their business, while creating secondary offices in areas such as Austin, Texas, Southern California (‘Silicon Beach’) and New York City (‘Silicon Alley’) to serve as space for their support staff. Only the highest valued employees remain.

While housing unaffordability does not appear to have undermined the competitiveness of Silicon Valley, which is the home to technology firms that require employees with high human capital (and compensate them accordingly), there is

[12]Alternatively, a linear regression of real housing price growth finds positive but weak association with productivity growth and start-up growth in San Francisco, with no significant association in San Jose. The linear regression model allows us to control more macroeconomic factors but may possibly ignores the effect of past housing prices on contemporaneous variables. VECM, on the other hand, allows us the take it into account, but due to data availability and concern of degree of freedom, we can only estimate a simple VECM. We regard two models as complement rather than substitute to understand the relation between competitiveness and affordability.

[13]Waters, Richard (24 August 2017). *The Great Silicon Valley Land Grab*. The Financial Times; London. https://www.ft.com/content/82bc282e-8790-11e7-bf50-e1c239b45787.

considerable concern about housing access for other workers. Although they may engage in work (largely in the service economy) demanded by the technology sector-led growth, it remains difficult to impossible for these workers to find affordable residences. More generally, in the US, regions with high wage job opportunities are becoming places with fewer housing options, decreasing access to these markets (Acolin et al. 2017). Silicon Valley exemplifies this.

7.1.5 Policy Implications

Rising housing prices have been of great concern to policy-makers all over the world, especially for emerging countries, like China, where housing prices have risen significantly in response to economic growth. Does the expensive real estate market become a deterrent to a city's competitiveness, hence threatening that growth?

Many existing studies seem to support this viewpoint. A study by the Global City Business Alliances (2016) concludes that high-cost housing can have a direct negative impact on the competitiveness of businesses in global cities. Effects include limitations to recruiting prospective employees. Expensive housing might also lead to accelerated staff turnover, and even lower labor productivity due to fatigue from long commutes in expensive cities—an important consideration as Silicon Valley sprawls past its transit shed. Schwartz also argues that quality of life and economic competitiveness will be compromised when households spend so much on housing (and transportation) that they make trade-offs with other spending, affecting markets further afield. High housing (and transportation) costs lowers discretionary spending, and increasing business hiring challenges may cause social problems in the long run, if not addressed properly. Housing for local providers of necessary first response for public safety and for health and education is also obviously challenged in high cost environments.

Nonetheless, technology job growth, and other measures of competitiveness, continues to thrive in Silicon Valley (the San Jose and San Francisco region) despite high housing prices. In cities or regions where high-tech innovation activities and high value-added services such as finance are predominant, the high land cost associated with high house prices may drive out the labor-intensive manufacturing and business activities but leave more space for technology and knowledge intensive activities, which require much higher skill levels and more sophisticated knowledge network and which are less sensitive to the housing prices. Silicon Valley is a perfect case study for illustrating this outcome.[14]

Local policy-makers need to examine a city's competitive advantages and take a differentiated approach. For high-tech or knowledge-intensive cities, governments need to recognize that high house prices will reflect higher land costs that derive from the

[14]A recent study by PwC (2016) titled "Cities of Opportunities 7: The Living City" also shows no direct correlation between "housing" and "productivity", nor "intellectual capital and innovation".

productivity of their economy to some degree. Yet cities still need to strike a balance and take measures to address the residential needs of workers, such as encouraging firms and city-wide efforts to provide low-cost transportation and affordable housing. Derivative industries, less lucrative than those at the core of an agglomeration, are still essential to its function: for these affordable housing options are needed.

7.2 Pittsburgh, USA

Peter Karl Kresh

Bucknell University, Lewisburg, USA

One of the most interesting and, for the purposes of this conference and project, instructive cities in the United States is Pittsburgh. Its history, economic development, planning initiatives, decline and, most recently, rebirth make application of some of the standard approaches to the relationship between property development and urban competitiveness that are relevant for other cities virtually irrelevant here. Specifically, I refer to the von Thünen-Alonso approach that proposes a spatial structuring of business and residence locations and of various business and agricultural activities according to their relation to distance from a central point, costs of commuting, cost of transporting goods and products, and the bid-price of land. (Discussed by McDonald, pp. 10–15) The classic representation of this is the map of Chicago done by Ernest Burgess in 1925 in "The Growth of the City". (Reprinted in LeGates, p. 165) Chicago is a space that has few irregularities—the Chicago River and its tributaries, and little else. The city stretches from Lake Michigan to the Mississippi River, for all intents and purposes, with land rents diminishing fairly steadily from the Lake through the metropolitan area. Over time, however, transportation lines and other features such as neighborhood 'red lining', and Joel Garreau's notion of the 'edge city', have made the relationship less than perfectly smooth.

7.2.1 Introduction to Pittsburgh: The Importance of Economic Space

Pittsburgh is quite different as can be seen in the topographic and political maps shown in Figs. 7.13 and 7.14. The city is broken up the Allegheny and Monongahela Rivers that join to form the Ohio River, and it has a very irregular topography, with major ravines making road travel difficult in places, escarpments, substantial hilly terrain, and other features that make rational residential planning a challenge. The Central Business District (CBD) is not really the center as we think of it. Established two centuries ago because of a fort and trading post situated at the confluence of the three rivers, it functioned as most central business districts do until the development of the steel

Fig. 7.13 Laser cut plywood topographic map of Pittsburgh. (By Sybertron)

Fig. 7.14 Pittsburgh districts

industry toward the middle of the 19th century. Stimulated by demands of the Civil War, the industrialization of the US economy in the decades that followed, and the needs of the two World Wars, the low-lying parts of the city along the rivers, including the CBD (known locally as the 'Golden Triangle'), became undesirable due to incomparable air pollution, as shown in Fig. 7.15; Pittsburgh was one of the most air

Image courtesy: Smoke Control Lantern Slide Collection, ca. 1940-1950, AIS.1978.22, Archives Service Center, University of Pittsburgh.

Fig. 7.15 Pittsburgh air pollution 1940s

polluted cities in the world. These areas were inhabited by low-income laborers who walked to the mills; wealthier families lived in more salubrious areas in high ground to the west of the CBD, or to areas on high ground two or more miles to the east of the CBD in districts such as Squirrel Hill.

It must be said that in Pittsburgh's 'Go3lden Period', from the 1860s well into the 1980s, housing prices were never a determining factor in the city's competitiveness. Sometimes 'location, location, location' is even more important for industrial activity than it is for real estate development. Pittsburgh's location was on two rivers that joined to create a third, and in proximity to the vast coal deposits of Pennsylvania. The rivers and then the railroads brought the iron ore and coal to the mills and then transported to markets the iron and steel, and industrial goods that were produced. Wealthy families lived where they wanted to, on high land where they could escape the pollution, and working class families lived where they had to, to gain easy access to the factories and mills. Land price had an allocative function within these districts rather than one throughout the city and the von Thünen-Alonso approach has little relevance here.

To the south of the CBD is a rail line and station on the south bank of the Monongahela and an escarpment of perhaps 500 feet with two cable cars and two two-lane roads giving limited access for residents of the Mt. Washington area to the retail and entertainment offerings of the CBD. To the north of the Allegheny city planners situated the Steelers football stadium and the Pirates baseball stadium, each with its expansive parking area. To the north of the stadia is multi-lane Interstate highway 279. This makes access to the city center from the north very difficult. Finally, immediately to the east there is another multi-lane Interstate highway 376, and then a low income African-American neighborhood, the Hill District, that has never had investment and that functionally impedes access to the city center for the mass of population that lives beyond it. Thus, the city center is cut off from all directions by transportation and sporting facilities actually put there by city planners.

A contrast can be found in Lyon, France, a city trifurcated by the Rhone and the Saone rivers. But here, as can be seen in Fig. 7.16, the escarpment to the west backs up not a railway but a UNESCO recognized Renaissance Historic Site—with restaurants, commercial outlets, residential areas and cultural facilities. To the east across the Rhone lies the major part of residential and commercial Lyon. From each direction the center of the city is linked by six or seven bridges and *passerelles*. The center itself thrives as a place of residences, retail, restaurants, and culture—quite in contrast with Pittsburgh's CBD.

7.2.2 Economic Growth and Competitiveness in Pittsburgh

Since the collapse of the steel industry in the 1970s and 1980s, a resurgent economy has been built on: (1) computer science, information security and robotics, and (2) medical technology and health care. In the crucial period 1976–1996 manufacturing employment fell by 52.7% while non-manufacturing grew by 31.5%. Housing attractiveness in the last decade or two in Pittsburgh has been, and continues to be, linked to the location of the two principal universities—Carnegie-Mellon University (computer science) and the University of Pittsburgh (medical technology). They are adjacent to one another in the Oakland and Squirrel Hill districts and are complemented by some of the city's principal museums and cultural sites, although these are secondary to those of 'cultural district' of the CBD. The tech workers in these two sectors are often graduates from CMU and UPitt, know the 'central east' part of Pittsburgh, like it very much, and are keen to find employment and housing there. One of the key figures in the CMU development, professor Red Whittaker, located his National Robotics Engineering Center in Lawrenceville, in an abandoned foundry from the previous economic strength of the city. He is quoted as saying: "The real estate and the culture of the neighborhood was a very big thing for robotics. And robotics was a very big thing for the neighborhood." (Kurutz) Young tech workers were attracted to the low rents and housing prices and to a somewhat distressed neighborhood they could re-shape to

Fig. 7.16 Map of Lyon, France

their tastes and life-style preferences, in something of a low-level gentrification process. The same is true for East Liberty, where Google located its Pittsburgh office, as have several tech start-ups. Apple has its office in the Strip District, and Pittsburgh joins Austin and Seattle as the company's only office locations outside of California. Steven Kurutz has observed that: "The big tech firms, along with their highly skilled, highly paid workers, have made Pittsburgh younger and more international and helped to transform once derelict neighborhoods like Lawrenceville and East Liberty." (Kurutz) As a consequence, Pittsburgh has been receiving national attention as a place with a good food culture and good neighborhoods, and, somewhat surprisingly to those who have known it for many decades, as a chic place to visit and to live. Young tech workers visit Silicon Valley and are turned off by the thought of a two-hour commute in a bus—they prefer to walk or bicycle to work in Lawrenceville or East Liberty. Fifty-eight percent of Pittsburgh's population is aged 40 and under, population is beginning to increase after decades of decline, and "(t)he bulk of that growth was driven by the 'young professional' category, aged 25–35" (Mullin & Lonergan Associates et al. 2016, p. 19).

7.2.3 Housing Affordability in Pittsburgh

The indicators given in the instructions for this presentation include (1) house price-to-income and (2) rental-to sales-price ratios. In Fig. 7.17, I have drawn a line from the CBD east-north-eastward through the university area to the preferred housing districts at the east end of the city. As can be seen in Table 7.4, for the house price-to-income ratio (Col. 5) of the 11 districts included, 7 are between the 'reasonable' values of 3:1–6:1, and only two are above this range. Calculations of the house sales price to rental ratios (Col. 8) indicated that house sales prices were above the figures that were considered to be 'reasonable' (between 200:1 and 300:1) in only four of the instances. The median house price in Pittsburgh is $130,000 in comparison with $235,000 for housing in the US. Affordability is such that a family income of $37,000 is sufficient to support purchase of a house. This is

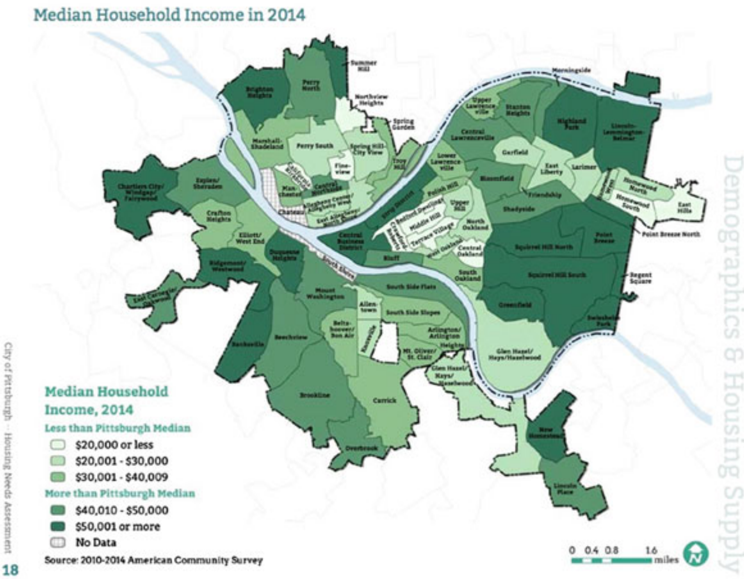

Fig. 7.17 Household income mapped by district, 2015

Table 7.4 Household income by district, 2015 (For a line running East by North-east from CBD through Shadyside to Homewood South, we get the following)

District	Income	Rent	House	House/y	House/yp	Rent/y	Rent/yp	Sale p/rent
CBD	57,456	1,174	127,818	2.22	3.09	.020	.028	109
Crawford-Roberts	23,169	611	127,777	5.51	3.09	.026	.015	209
Middle Hill	18,396	465	91,653	4.98	2.22	.025	.009	197
Terrace Village	20,037	361	98,798	4.93	2.39	.018	.009	273
North Oakland	38,975	1,241	183,065	4.70	3.43	.032	.030	148
Shadyside	52,819	1,130	649,246	12.29	15.723	.021	.027	575
Squirrel Hill North	96,920	1,356	703,803	7.26	7.26	.014	.033	519
Point Breeze	82,855	987	481,217	5.81	5.81	.012	.024	488
Homewood South	26,025	322	103,504	3.94	2.51	.012	.008	321
Central Lawrenceville	43,647	730	106,643	2.44	2.58	.017	.018	146
East Liberty	33,720	657	306,581	9.09	7.42	.019	.016	466

Notes 1) y and yp are income for the district and income for Pittsburgh. 2) Median family income in Pittsburgh is $41,318

all in conformity with the conclusion of the report to the Pittsburgh Affordable Housing Task Force that in Pittsburgh it is perhaps uniquely the situation "that homeowners have better affordable housing options than renters" (Mullin & Lonergan Associates et al. 2016, p. 66) So at this time housing affordability is indeed an element in Pittsburgh's competitiveness for the economy as a whole. This situation would seem to arise because of the changes that are occurring in many of these districts. Highly skilled and highly paid workers are replacing the industrial workers of the previous steel economy, houses are being renovated at high rates to meet the needs of this group, and the low income areas are characterized by significant numbers of social or subsidized low income accommodation. In some districts, such as Squirrel Hill, very costly mansions exist and distort the figures for the rest of the district. Finally it must be noted that these findings are limited to a narrow range of districts along the CBD-Homewood South line.

7.2.4 The Impacts of Housing Price on the Economic Growth and Competitiveness of Pittsburgh

Table 7.4, based on Fig. 7.17, gives in column 1 the household income of the districts touched by that line. It shows clearly the relative affluence of the CBD, the impoverished Crawford-Roberts and Terrace Village districts in the Hill District, then the affluent university areas in North Oakland and Shady Hill, the Squirrel Hill and Point Breeze districts, and finally low income Homewood South. Lawrenceville and East Liberty are to the north of this line. The varying income levels along the line show how irrelevant the von Thünen-Alonso approach is in the context of

Pittsburgh—there is no steady decline in bid-prices for land that emanate from the CBD. In fact, Pittsburgh has for at least the past century essentially been a multi-modal property model. It should also be noted that houses are rare in the CBD with apartment and condominium residences being preferred.

One important phenomenon in city economic development is the purchase of buildings that do not meet the needs of contemporary house and apartment purchasers, their renovation, and then a 'fast sale'. The result of this is an up-grading of the housing stock of the district, or city, and the enhancement of the city as a place that is competitive with other cities. In Pittsburgh these investors have a central role in turning struggling neighborhoods into attractive ones; "investors purchased 39% of the homes sold during the study period (2013–2015). In 23 neighborhoods investors purchased more than half of all of the homes sold". (Mullin & Lonergan Associates et al. 2016, p. 31) This indicates a strong effort to enhance the housing assets of the city, and to make it more attractive to the young, tech workers who are the key to the recent economic resurgence of the Pittsburgh economy. While they may become wealthy in a decade or two, they are not wealthy today and seek 'life style' housing rather than prestige housing. Median sales prices of resold houses have increased most significantly in the areas, e.g. Lawrenceville and East Liberty, in which these young workers have chosen to locate. Median building permits in these areas have ranged from $7,650 to $10,000, and $5,600 citywide, and these are clearly for renovations rather than for new house or apartment building construction. So it can indeed be stated that low housing prices in recent years have made Pittsburgh attractive to young tech workers and this, in turn, has stimulated investment in the housing stock.

7.2.5 Real Estate-Related Policies in Pittsburgh

All cities in the US have been characterized by legal, financial, zoning and other policies that have created and maintained racial and class segregation in living areas. Ernest Burgess' map of Chicago in 1925 identified the blackbelt on the south-side, ethnic neighborhoods of Germans, Italians, and Asians, as well as areas dominated by classes of housing—slums, rooming houses, apartment buildings and single family dwellings. The courts have legitimized zoning that would prohibit apartment buildings that would be attractive to lower income and minority individuals and families from being built in higher income single-family house areas. Local real estate associations in league with the banks have segregated cities by race, by ethnicity and by income, in the process known as "red lining". In Pittsburgh these measures have been augmented by the city's topographical features, such as steep hills, major ravines, and escarpments, that have the effect of creating barriers to entry for those with low incomes or who belong to minority racial or ethnic communities, and of creating the equivalence of walls around affluent white neighborhoods (Mullin & Lonergan Associates et al. 2016, p. 17).

While Pittsburgh is becoming an increasingly attractive city and place to live, it seems to have escaped the phenomenon of outsiders purchasing residences, whether houses or large apartments and condominiums as investment properties. The danger of this is the presence of residential units with no full-time occupants. These empty spaces deprive the local area of residents who would support the retail, dining, entertainment and street life of the neighborhood, celebrated so much by Jane Jacobs (Jacobs, Chap. 2). This phenomenon has led some Canadian cities to introduce taxes on purchase of these units, with the tax sometimes deductible from the resident's income tax —thus encouraging local but discouraging foreign ownership (Badger 2017).

7.2.6 Conclusion About the Relevance of the Pittsburgh Experience

From the above, it should be clear that Pittsburgh is far from a typical housing situation. Its economy did not gradually evolve from one stage to another, with output, incomes, and population developing accordingly, rather the economic history was of one powerful economy collapsing in one decade, to be replaced by another modern economy that had nothing to do with the earlier one. Housing prices are relatively low in Pittsburgh, but this is not enough to attract the young tech workers that have become the back bone of the contemporary Pittsburgh economy; these prices plus affinities such as 'cool' neighborhoods, good food culture, proximity of work to housing, access to university environments, and good recreation opportunities are at least equally necessary. This is one of the features of Pittsburgh's economy that makes it an interesting and instructive case to study.

7.3 Singapore

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Singapore is a tropical island city-state in Southeast Asia. It faces Malaysia in the north across the Johor Strait, Indonesia in the south across the Singapore Strait, and is adjacent to the southern mouth of the Malacca Strait. With a territory of only about 717.3 km^2, Singapore is home to 5.47 million permanent residents, with the population density of 7,257 persons per km^2 (estimated in 2011). It is a developed capitalist country operating under the mode of "state capitalism" and known as one of the "Four Asian Tigers." Despite the land shortage and the dense population, Singapore manages to keep the housing price in a reasonable range while maintaining its status as a world-class city and its top-notch urban competitiveness. Its experience is worth our probing.

7.3.1 *Review of Singapore's Housing Price and Urban Competitiveness*

Historical fluctuation of Singapore's housing price

The housing price in Singapore has been roughly spiraling up. Its fluctuation can be divided into three stages (see Fig. 7.18). Stage 1 (1970–1996): The housing price climbed up steadily. Between 1970 and 1989, the Singaporean government introduced the Home Ownership Scheme, provided low-interest loans to home buyers via the Housing and Development Board (HDB), and promoted and improved the Central Provident Fund (CPF), boosting the steady growth of the real estate market. The 1986–1996 period saw the housing price soar pushed by international hot money and local speculators and the private estate price went up by as much as 440%. Stage 2 (1996–2005): Hit by the Asian financial crisis in 1998 and the lift of HDB flat resale restrictions, the housing price plummeted and the private estate price fell by 45%. Stage 3 (2006–2014): The Singaporean real estate market started to rebound. After the US Federal Reserve introduced the quantitative easing policy, foreign capital flooded into the Singaporean real estate market and drove up the housing price by as much as 60%, making Singapore the second most expensive city in Asia. Its housing price peaked in 2014, and in the following three consecutive years it started to fall thanks to the cooling measures introduced by the government. According to the International Housing Affordability Survey released by Demographia in recent years, in 2010, 2012, 2015 and 2016, the housing price to income ratio in Singapore was 5.1, 4.4, 5.6 and 5, respectively, all within the internationally recognized reasonable range (3–6).

Historical changes to Singapore's urban competitiveness

Singapore's urban competitiveness has been growing on the whole, mainly reflected in three aspects: economic development, technological innovation and industrial upgrade. First, as to economic development, Singapore's per capita GDP has been growing (see Fig. 7.19). From 1976 to 1996, it increased from 10,000 US dollars to 30,000 US

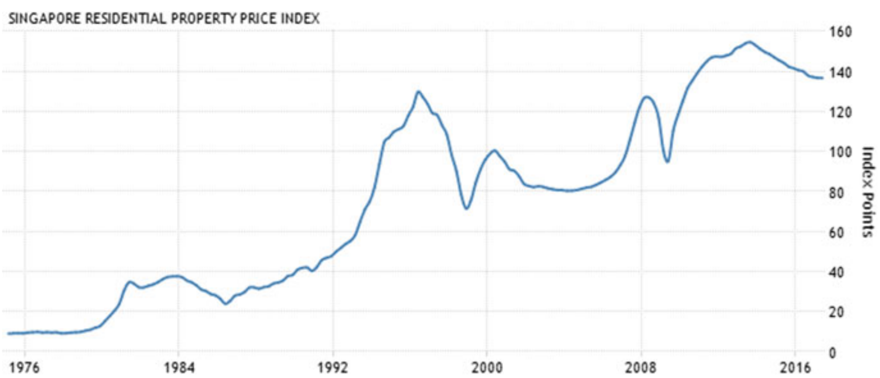

Fig. 7.18 Historical changes to Singapore's housing price. *Source* Trading economics

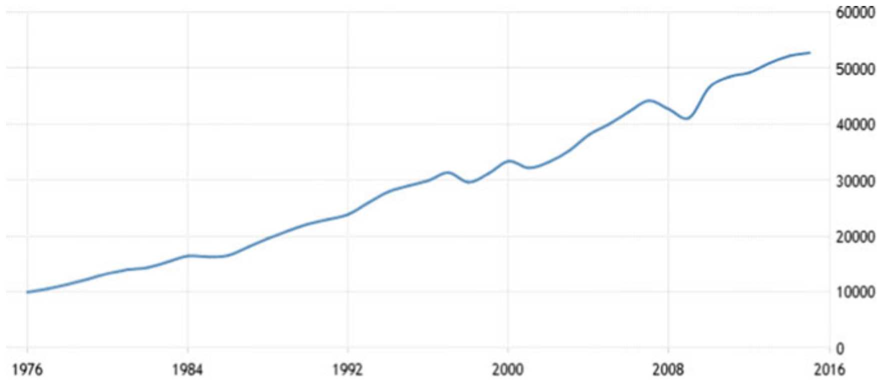

Fig. 7.19 Historical changes to Singapore's per capita GDP. *Source* Trading economics

dollars. Though it fell slightly in 1996 and 2009, it had hit 52,000 US dollars by 2016. The labor productivity also fluctuated upwards in Singapore (see Fig. 7.20). Secondly, as to home-grown innovation capacity, Singapore's R&D input amounted to only 572 million US dollars in 1990, jumped to 2.105 billion US dollars in 1997, and soared to 7.128 billion US dollars in 2007. Under the impact of the subprime mortgage crisis, it fell to 6.489 billion US dollars in 2010, but picked up to 7.245 billion US dollars in 2012, with the annual growth rate of 12.2% (Yang 2015). Thirdly, as to industrial structural upgrade, in 1970, 1980 and 1990, the portion of the tertiary sector was 67.5, 59.9 and 63.1%, that of the primary sector, 2.5, 1.4 and 0.3%, and that of the secondary sector, 30.2, 37.5 and 36.6%, respectively. In 2010, agriculture still took up only a little portion of the national economy which relied heavily on manufacturing, transportation and commercial services, and the portion of the secondary sector was 24%, and that of the tertiary sector 74.5% (Wang 2016).

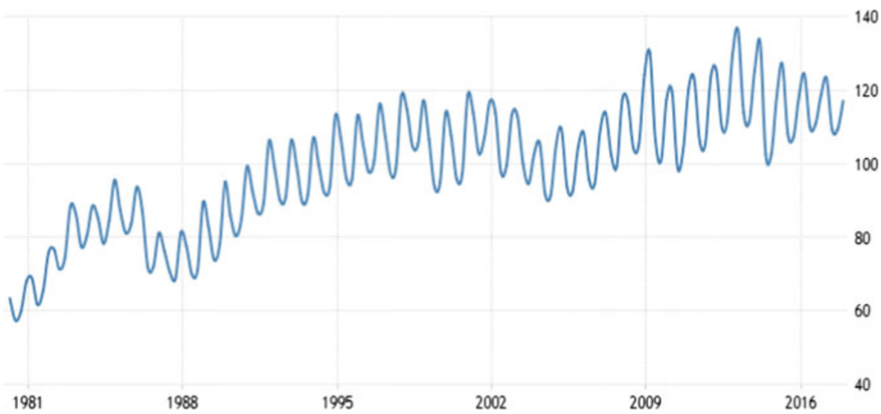

Fig. 7.20 Historical changes to Singapore's labor productivity. *Source* Trading economics

7.3.2 The Housing Price's Impact on Urban Competitiveness

On the whole, Singapore's housing price and its urban competitiveness have been growing—and falling during the Asian financial crisis—at basically the same pace. In Singapore, the impact of the housing price on urban competitiveness is reflected in the following three aspects.

First, the steady growth in the housing price has prompted the steady growth in the urban economy. As the housing price continues to grow, the real estate industry has become a pillar industry of Singapore's national economy and produced considerable economic benefits. It played a vital role in Singapore's economic recovery between 2008 and 2010 (Wei 2010). The steady growth in the housing price was taken as a sign of economic recovery and boosted market confidence. Companies reacted by expanding their business and hiring more. For instance, the number of employees in Retail and Commercial Banking of Barclays Bank increased from 350 in 2009 to 750 in 2010 (Wei 2010). Since 2010, the direct income the Singaporean government has made from the real estate industry has taken up 20–35% of its total revenue per year, making the housing industry the engine "accelerating the transformation of economic growth mode" and driving national economic development.

Secondly, the steady growth in the housing price has stimulated the transformation and upgrade of the industrial structure in the city. On one hand, a prospering housing industry has helped extended the industrial chain. It has not only facilitated the development of primary industries such as the construction industry, but also attracted a lot of financial, high-tech and service companies to Singapore, thus propelling the development of industries with high added-value (Seek 2016). For example, SP Service has rent a 9,290 m^2 office building in Maplestree Business City on Alexandra Road to provide Internet-based services; BHP has rent a 21,460 m^2 office building at Marina Bay Sands as the seat of its Singaporean division (Wei 2010). On the other, a relatively reasonable housing price can squeeze out backward industries and allow high-end industries to expand business, increase productivity and save costs (Che 2008). Therefore by keeping the housing price within a reasonable range, Singapore can upgrade its industrial structure from labor intensive to technology intensive.

Thirdly, a relatively reasonable housing price is a catalyst for human capital accumulation and technological innovation. For one thing, it saves the housing cost of high-end talents and entrepreneurs. In particular, the Singaporean government offers free housing or subsidized housing policy for high-end talents from overseas. For another, state-of-the-art medical and healthcare facilities, comfortable living space and convenient transport infrastructure brought by a prospering housing industry will help lure more high-end talents and multinational corporations to Singapore so as to produce industrial clustering effect and foster Singapore's technological advancement and home-grown innovation capacity (Sun 2016).

7.3.3 Success Factors: The Housing System and Policy Support

A sound housing system is the institutional guarantee for Singapore's success. It consists of three parts: HDB flats, the CPF and the property tax. First, HDB flats are the trunk of Singapore's public housing system. The mature HDB flat system is the guarantee for Singaporean people's basic rights to survival, with the home ownership rate of 91%. The Singaporean government imposes strict conditions on the sale and resale of subsidized HDB flats: they can be sold to only Singaporean citizens and permanent residents; each household is allowed to own only one HDB flat and must resell the HDB flat they own before purchasing a new home. Secondly, the CPF system, an institutional guarantee for contributors' pension, healthcare and savings, has extended from employees in public and private sectors to the self-employed. Years of practice have proved it vital for regulating the national economy, for Singapore's financial system, and for curbing consumption and inflation. Thirdly, Singapore adopts a progressive property tax system, levying more on the higher-income group and on non-residential property to promote social justice and optimize resource allocation.

Efficient government control has also played a vital role. First, from 2009 to 2011, the residential property market went up by nearly 50%, and the Singaporean government reacted by tightening credit, increasing the stamp tax and restricting the letting of HDB flats. In 2015, the actual housing price increased by about 15%, at a much reasonable pace than it did before the government stepped in. Secondly, in October 2013, the Singaporean Congress amended the property tax act (amendment) to introduce subsidized pricing and tax benefits for home buyers of small units of principal residence. Thirdly, since June 2017, the Singaporean housing market has seen a slowing decrease of housing price but much more trading volume, indicating a rebound of housing price. In response, the Monetary Authority of Singapore has recently released the 2016–2017 yearly report, stating that it would continue to cool the real estate market down. The prudent policies introduced by the Singaporean government have stabilized the market expectation and prevent the housing price from soaring.

7.3.4 Inspirations

Singapore owes its world-leading urban competitiveness despite land shortage and a dense population to the farsightedness of and reasonable measures introduced by its government. From its success, we can draw the following two inspirations.

A sound housing system is a key guarantee for stabilizing the housing price and enhancing urban competitiveness. For residents, the HDB flats are affordable housing options and the strict restrictions on their sale and resale have prevented housing speculation; the property tax and the CPF system help narrow the income gap, promote social justice, optimize resource allocation and motivate residents to work and earn more. For businesses, a sound housing system will keep the housing price in a reasonable range, and a reasonable housing price will help squeeze out backward industries and allow high-end industries to save the cost, expand business and improve productivity, thus prompting the industrial structure to upgrade. Meanwhile, a reasonable housing price will also help companies attract human capital and motivate them to innovate.

Efficient government control is vital for keeping the housing price in a reasonable range. The Singaporean government introduces multiple policies, such as tightening credit, increasing the stamp tax and restricting the letting of HDB flats, to regulate the supply and demand of housing, steps in where and when it is needed prudentially, and pays much attention to stabilizing market expectation. It thus can be seen that government control is vital for stabilizing the housing price and enhancing urban competitiveness.

7.4 Melbourne, Australia

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7.4.1 Introduction

This case study explores the impact of housing price on competitiveness in Greater Melbourne—the second largest metropolitan city in Australia. Greater Melbourne is the state capital city in Victoria, covering 9,990 km^2 (2011) with 4.5 million residents (2015). The area is divided into and governed by 31 Local Government Areas, among which urban physical, demographic and economic conditions vary widely. This paper makes use of aggregate metropolitan measures with no intension to examine the intra metropolitan disparities.

Key indicators include economic growth measured by GDP per capita and total and sectoral employment strength; competitiveness measured by the Global and World City (GaWC) and The Economist Intelligent Unit (EIU) ranking of cities, as well as Intellectual Property (IP) application numbers; housing affordability measured by house price to income ratio, and housing price movements measured by Residential Property Price Index (RPPI), Established Housing Price Index (HPI), and Attached Dwellings Price Index (ADPI). Quarterly housing price indices have been constructed since 1986 but amended over time due to changing definitions. As such only the latest data series (2003–2016) is selected as the observation period. Majority of the datasets have comparable data for this period; several indicators are presented in a longer time series when data is available but a few have data for a shorter time period and with irregular record intervals.

7.4.2 Economic Growth and Competitiveness in Melbourne

Melbourne has maintained moderate growth in GDP per capita and total employment, and a steady position in international rankings of competitiveness.

Economic growth. Figure 7.21 shows an upward trend in per capita GDP changes in the period 1996–2016. For the period 2003–2016, the average annual increase rate is calculated at 0.7%. Adjustments occurred in 2008 and 2013. The GDP equivalent increased 3% per annum in the observation period.

Total employment data (2006–2017) shows an average annual growth rate of 3.4%. There were 1.7 million jobs in 2006 and 2.4 million in 2017. Figure 7.22 shows the total employment in selected years.

There were seven employment sectors that each offered 150,000 or more jobs in 2017. They were health care and social assistances; retail trade; professional, scientific and technical services; manufacturing; education and training; construction; and accommodation and food services (Fig. 7.23). Asides from the manufacturing sector (where employment declined but also increased) and the construction sector (where most recent data showed a decline), all the other five sectors showed sharp increases in employment numbers. The average annual increase rates were 5.2%

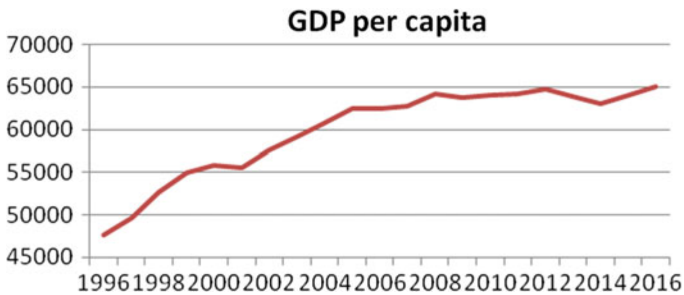

Fig. 7.21 GDP per capita. *Data source* SGS

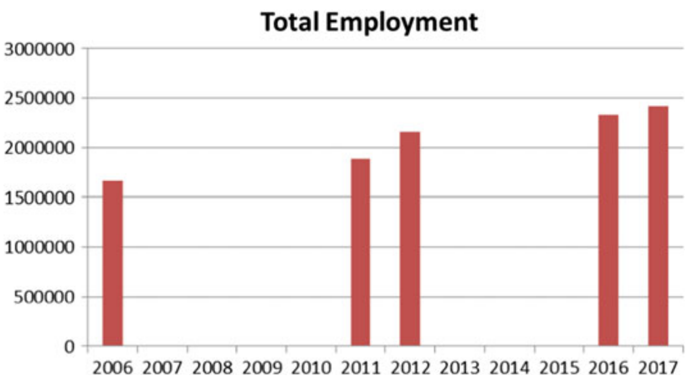

Fig. 7.22 Total employment. *Data source* ABS

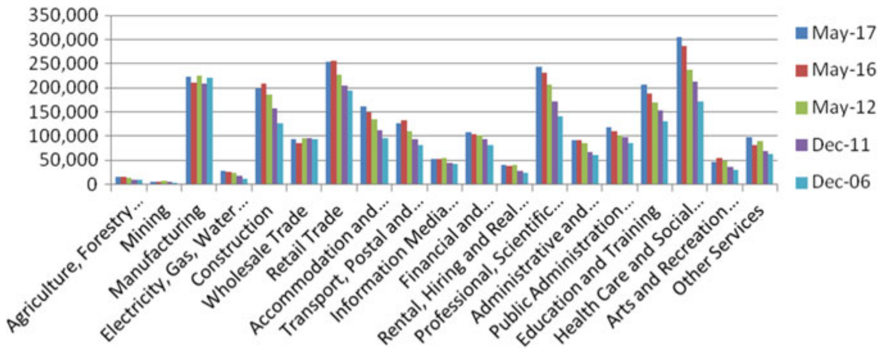

Fig. 7.23 Industrial structure changes (number of employment). *Data source* ABS

(construction), 2.8% (retail), 4.6% (accommodation and food services), 5% (professional, scientific and technical services), 3.8% (education and training), and 5.2% (healthcare and social assistance). Except retail, all job numbers in the four sectors above grew faster than the total employment.

Competitiveness. Melbourne is one of the cities in the broad Alpha category of the GaWC ranking. It has also maintained a top position in the world's most liveable cities ranking reported by EIU. As shown in Table 7.5, Melbourne is an 'Alpha −' city in almost all the years that a GaWC ranking is available; and is the No. 1 in the past seven consecutive years in the EIU ranking (Chalkley-Rhoden 2017).

Table 7.5 Melbourne's ranking by GaWC and the Economist Intelligence Unit

	GaWC	EIU
2000	Alpha−	
2001	–	
2002	–	1 (tied with Vancouver; this is the inaugural report)
2003	–	(Vancouver was 1)
2004	Alpha−	(Vancouver was 1)
2005	–	(Vancouver was 1)
2006	–	(Vancouver was 1)
2007	–	(Vancouver was 1)
2008	Beta+	(Vancouver was 1)
2009	–	(Vancouver was 1)
2010	Alpha−	(Vancouver was 1)
2011	–	1
2012	Alpha−	1
2013	–	1
2014	–	1
2015	–	1
2016	Alpha−	1
2017	–	1

Source Compiled by author based on data from the GaWC website and the EIU website

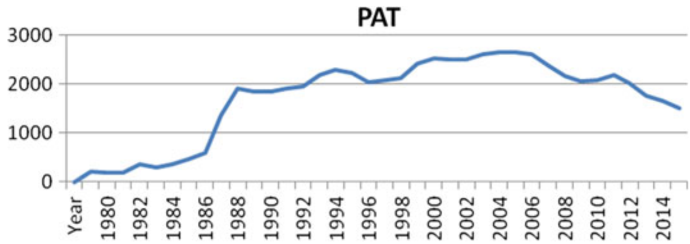

Fig. 7.24 Number of patents application. *Data source* IP Australia

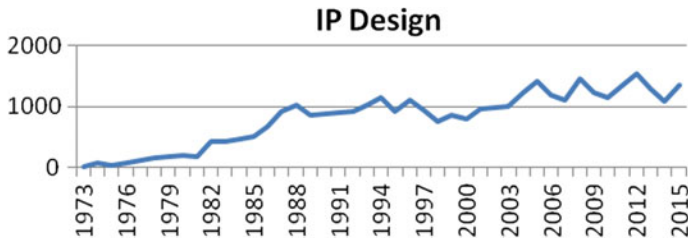

Fig. 7.25 The number of design licenses. *Data source* IP Australia

Apparently the competitiveness of Melbourne is associated with a moderate economic growth but remarkable restructuring of the economy as shown in sectoral employment. The usual competitiveness indicator, i.e., innovativeness of the economy, does not show extraordinary performance. Figure 7.24 shows that the number of applications for patents dropped sharply during the observation period (2003–2016), though historical data showed an overall pattern of upsurge. From 2003 to 2016, the average annual decline was 3.7%.

The number of design license applications fluctuated violently but an overall upward trend is discernible (Fig. 7.25). There was a moderate increase from 2003 to 2016 at an annual rate of 3.6%.

The number of Plant Breeders' Right (PBR) applications dropped in 2003 but increased sharply in the period 2004–2006 (Fig. 7.26). This was followed by another sharp drop in the period 2011–2013 before turning into another quick upsurge after 2013. The average annual increase rate of PBR numbers in the observation period was at 6%.

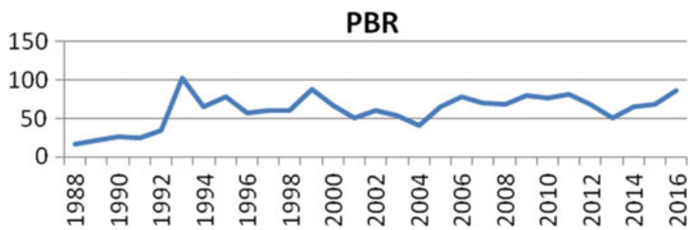

Fig. 7.26 The number of Plant Breeder's Rights applications. *Data source* IP Australia

7.4.3 Housing Affordability in Melbourne

Melbourne has been experiencing a housing affordability crisis. Its average house price to average household income ration changed from 2.3 in 1995 to 4.6 in 2010 (economics.hia.com.au) and further to 7.2 in 2016 (hunterwood.com.au).

Housing price movement. Figure 7.27 shows housing price movements represented by RPPI, HPI and ADPI for the period Sept. 2003 to Jan. 2017. The overall trend shows upsurges though price corrections occurred in 2007–2008 and 2010–2012 as well. The curves represent average annual increase rates at 6.4% (RPPI), 6.9% (HPI) and 4.6% (ADPI) for the observation period.

The demand side. First and foremost, housing price increases in Melbourne are due to strong demand, which in turn are caused by fast population growth, increases in purchasing power and the desire for capital gain.

Figure 7.28 shows the time-series chart for population growth in Melbourne. In the historical trend of continuous growth, the observation period 2003–2016 recorded an average annual growth rate of 1.6%.

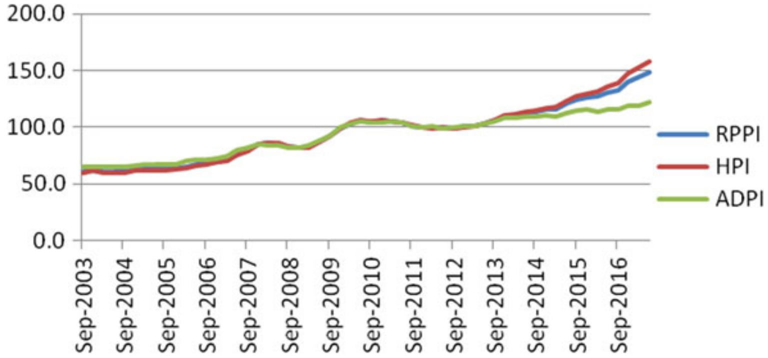

Fig. 7.27 Housing price movement Sept 2003–Jan 2017. *Data source* ABS

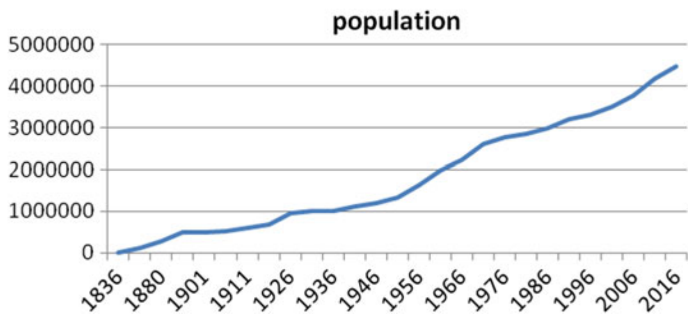

Fig. 7.28 Population changes in Greater Melbourne. *Data source* The Age

ABS Census reported that in 2011, 79.2% of the new resident population came from non-metropolitan Victoria, 7% from interstate, and 12.8% from overseas. Apparently, Melbourne's population growth was not mainly caused by immigration. The same is true to investment and housing price. Several researchers argue that foreign investment is not a sole or a central cause of price increases (Gauder et al. 2014; Buxton and Taylor 2011; Gurran and Whitehead 2011). In addition to its attractiveness, Melbourne's growth since the late 1990s was also a result of a spill-over effect from Sydney, which, as the biggest city in Australia, experienced sharp increase in housing price in 1980s while Melbourne did not. The house price to income ratio in Sydney was 7.4 in 2016 (hunterwood.com.au).

The continued economic growth in the past two decades increased household income (although moderately) and thus purchasing power as well (Abelson et al. 2005; Flood and Baker 2010). Low interest rates encourage households to borrow more money for a stronger financial position in the housing market (Berry and Dalton 2004; Otto 2006; Buxton and Taylor 2011). In addition, government policies such as the First Homebuyer's Fund encourage more people to enter the housing market (Birrell et al. 2012).

Furthermore, overvalued housing in Melbourne stimulates people's expectations for higher housing prices, thus generating bubbles by pushing them even higher (Birrell et al. 2012). Home owners want to grab the chance for investment for capital gain, while non home owners are afraid of losing the chance to enter the market (Shiller 2008). They rush to the housing market and make demand for housing increase sharply in a short time. Adding to the demand pressure from a capital gain perspective is the negative gearing policy which encourages home owners to invest in the housing market for tax savings. Taxation statistics show that almost all taxable individuals in the 2008–09 financial year reported lose from their rental properties; this represented 14.2% of all taxable individuals in Victoria (Birrell et al. 2012). This also pushes house price up.

The supply side. Investment in residential properties increased at an average annual rate of 7.5% in the period 2009–2016, according to permit application records (Fig. 7.29). However, land constraints and developers' reactions to

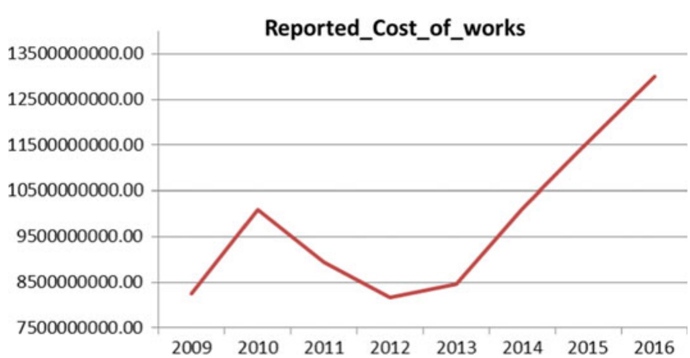

Fig. 7.29 Residential investment in Greater Melbourne. *Data source* Victorian Government

planning and market conditions generally place a constraint to housing supply. An Urban Growth Boundary (UGB) was introduced in the 2002 strategic plan for metropolitan Melbourne, aiming for better management of the outwards expansion of the city (https://vpa.vic.gov.au/greenfield/more-information/urban-growth-boundary-key-facts/). The UGB was reviewed in 2010 and consequently amended (by extending outward) to accommodate the unexpected population growth. Land supply scarcity leads to a high upsurge land and housing prices. In addition, residents' resistance against density increase restricts addition of new spaces for housing. There is a strong sentiment against higher density development in established neighbourhoods (Woodcock et al. 2011). Last but not least, the "interaction between the planning system and the development land market can often result in developers staggering permit completions to capitalise on rising market prices. … [This] drives up the costs of housing." (CEDA 2017, p. 7).

7.4.4 Interdependency and Impacts

In statistical terms, housing price movement is closely correlated (at 95% confidence level and above) with all the measurements except two IP indicators (Plant Breeders' Right and Design). The inverse relationship between housing price and the number of patent applications is statistically significant (Table 7.6).

The close association among economic indicators and housing price does not necessarily suggest causal relationships. However, several interdependencies have sufficed. The economic and liveability aspects of competitiveness, as shown by GaWC and EIU rankings, are mutually reinforcing. All changes in the major employment sectors (with 150,000 or more jobs in 2017) suggest that structural changes of the industries contribute directly to three measurements of liveability considered by the EIU Liveability Index. They are health care by 'health care and social assistance', education by 'education and training', and infrastructure by 'construction'. In addition, the expansion in labour force in 'retail trade', 'accommodation and food services', and 'professional, scientific and technical services' contribute to competitiveness by enhancing a mixture of local quality of living and global-oriented services. On the other hand, good liveability attracts talents and investment, which contribute to improving economic competitiveness. These talents and investment, together with the dependant population who would move along, will alter the supply and demand conditions of the housing market and consequently affect housing price. Changes in housing affordability will feedback to the liveability and economic competitiveness thus reshapes the overall competitiveness of the city (Fig. 7.30).

Strong links between Melbourne's liveability and the demand (and to a less extent supply) conditions are conceivable, leading to a clear pathway channelling economic development efforts to better liveability and consequently the demand and supply conditions which determine the housing price (Fig. 7.30). The effect of high housing price on competitiveness is not invisible. High labour cost is

Table 7.6 Correlation stats between housing price and selected indicators of competitiveness

	GDP per capita	PBR	Design	Patent	Construction	Retail trade	Accommodation and food services	Professional scientific and technical services	Education and training	Health care and social assistance
RPPI	0.774**	0.464	−0.388	−0.966**	0.887*	0.922*	0.945*	0.942*	0.975**	0.981**
	0.001	0.094	0.17	0	0.045	0.026	0.015	0.017	0.005	0.003
	14	14	14	14	5	5	5	5	5	5
HPI	0.767**	0.467	−0.414	−0.968**	0.875	0.922*	0.942*	0.937*	0.973**	0.979**
	0.001	0.092	0.141	0	0.052	0.026	0.016	0.019	0.005	0.004
	14	14	14	14	5	5	5	5	5	5
ADPI	0.787**	0.447	−0.283	−0.941**	0.922*	0.889*	0.928*	0.938*	0.951*	0.957*
	0.001	0.109	0.327	0	0.026	0.044	0.023	0.018	0.013	0.011
	14	14	14	14	5	5	5	5	5	5

Note RPPI stands for Residential Property Price Index; HPI stands for Established Housing Price Index; ADPI stands for Attached Dwellings Price Index
*Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)
Stats are reported in each cell in the following order: line 1 for Pearson Correlation, line 2 for Sig. (2-tailed); line 3 for N. Some of the indicators have a small N due to data limit

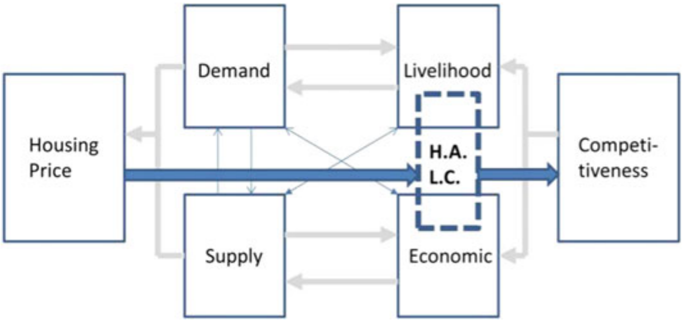

Fig. 7.30 Conceptual interdependencies between housing price and competitiveness. *Note* H.A. stands for Housing Affordability; L.C. stands for Labour Cost

associated with the general living cost, of which housing cost is a major component. This can be illustrated by the minimum wage standard in Australia. Currently at the rate of $17.70 per hour, Australian minimum wage is the world highest among the large economies such as the UK, France, Germany, Japan, Canada and the USA (http://www.abc.net.au/news/2016-05-31/minimum-wage-how-does-australia-compare/7461794). The philosophy behind minimum wage in Australia is not market value of labour but the need for a decent living standard. High labour cost leads to high product price. In car manufacturing, uncompetitive price leads to closure of car manufacturing factories in Melbourne and the whole Australia (http://www.adelaidenow.com.au/technology/why-australian-car-manufacturing-died-and-what-it-means-for-our-motoring-future/).

7.4.5 Policy Issues on Housing Price and Competitiveness

Housing policy levers. There is no shortage of policy initiatives to ease housing affordability, however, none of the policy efforts are explicitly expressed to aim at improving Melbourne's competitiveness. Instead, short term concerns of demand and supply conditions are targeted.

In terms of the power of intervention, '[t]he Commonwealth government has control over most (but not all) of the levers that affect demand and sub-national levels of government have control over most (but not all) of the levers that affect supply' Yates (2017, p. 24). The Commonwealth government decides on policies about immigration, first home buyers' subsidy and other direct housing assistance programs, negative gearing scheme, among other demand side levers. Sub-national governments decide on local planning restrictions regarding land supply and density patterns. Nevertheless, the effectiveness of public intervention in the housing market is debatable (Gurran and Whitehead 2011). There are also opportunities for both the Commonwealth and sub-national governments to make use of the levers outside of the conventional housing policies by coordinating policies, programs and schemes in sectors such as fiscal and monetary, transport, and income support.

Policy about competitiveness. In October 2014, the Commonwealth government announced its Industry Innovation and Competitiveness Agenda (Australia Government 2014). The Agenda includes four ambitions: a low cost, business friendly environment; a more skilled labour force; better economic infrastructure; and industrial policy that fosters innovation and entrepreneurship. However, a couple of the initiatives were cut within weeks of its launch for budget saving. This leaves questions to observers about the seriousness of the Australian government in building up competitiveness. The potential success of the Agenda is also challenged by the absence of acknowledgement and measures addressing the underlying reasons behind weak innovation performance. It is argued that the underlying risk-aversion culture among Australian businesses is a critical barrier against innovation and entrepreneurship, which is not addressed in the Agenda (Fife 2015).

The lack of entrepreneurial and risk taking culture is reported to be a major weakness in the business community in Greater Melbourne (SGS 2000). In addition, the lack of collaborative links between local businesses was identified a main obstacle against developing strong business clusters, thus acted against strengthening innovation in science and technologies.

7.4.6 Concluding Remarks

The Melbourne case study demonstrates a comprehensive nexus between housing price and competitiveness. Competitiveness affects housing price through altering the demand and supply conditions, while housing price changes housing affordability and labour cost which are at the core of competitiveness. There are evidences in Melbourne that high housing price is associated with a high level of minimum wage which has acted against the competitiveness of car manufacturing industry. Closure of car manufacturing factories adds to unemployment thus damages competitiveness in both liveability and economic prospects.

Despite the visible connection between housing price and competitiveness, there is no dedicated policy in Melbourne on using house price as a lever to improve competitiveness. The formulation of policies associated with housing and competitiveness in Melbourne is in a fragmented manner involving uncoordinated organizations and stakeholders. Policies are formulated to address short term concerns at the expense of long term plans. A strong and consistent leadership and a risk taking business culture are lacking in Melbourne, which is detrimental to competitiveness.

Melbourne's reliance on liveability as a main form of competitiveness is unique. However, there are serious questions to consider as how far will the liveability-based competitiveness travel in the rise of labour cost, decline of housing affordability, and absence of risk taking culture in businesses. Without proper policy guidance, a self-destruction process may set into play, leading to a downward spiral from high level of liveability attracting people and investment, to high housing price and low housing affordability deterring inflow of people and investment, to stagnation even decline in quality of living and economic competitiveness. The spill-over effect in population growth that has benefited Melbourne at the expense of Sydney shows that the above scenario is not unlikely to emerge in a foreseeable future.

In a broader context, competitiveness is determined by industrial structure, business culture, historical legacies of enterprises and institutions, natural environment and resource endowment, as well as housing affordability and labour costs. Similarly, housing price changes are determined by a range of demand and supply factors of which competitiveness is a part of the consideration. The relationship between housing price and competitiveness presented in this study highlights the importance of liveability (rather than economic competitiveness alone) as a critical component of competitiveness, but competitiveness supported merely by liveability indicators may not last long without an innovation-based viable economy.

7.5 Tokyo, Japan

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7.5.1 Introduction

Tokyo, the capital of Japan, is a global city with the largest size of population and Gross Regional Product (GRP or GDP) in the developed world. After the end of the Second World War, driven by Tokyo, Japan achieved surprising economic growth and kept the position of the world's second largest economy for 42 years (1968–2010). Meanwhile, Tokyo experienced dramatic rise of real estate prices and the bubble burst. Focusing on the housing price changes in the Tokyo Metropolitan Area (TMA), this case study tries to answer the following questions.

(1) How did housing affordability of the Tokyo Metropolitan Area change after Japan became the world's second largest economy and what are the underlying factors of the changes?
(2) What are the impacts of change in housing affordability on Tokyo's global competitiveness power?

This paper is organized into five sections. The following Sect. 7.5.2 introduces the process of population change and economic growth of Tokyo. Section 7.5.3 examines the change of housing affordability in Tokyo Metropolitan Area and its underlying factors. Section 7.5.4 examines the impacts of change in housing

Table 7.7 The selected indicators of Tokyo Metropolitan Area

	Land area (km^2, 2015)	Population (person 2015)	Per capita GDP (US$ 2014)
Saitama Prefecture	3,798	7,267	23856.1
Chiba Prefecture	5,158	6,223	26700.1
Tokyo Metropolis (Prefecture)	2,191	13,515	58206.1
Kanagawa Prefecture	2,416	9,126	27541.4
Tokyo Metropolitan Area	13,562	36,131	38125.6

Source Statistics Bureau (2017), IMF(2017)
Note The data for Per capita GDP is the value for 2014

affordability on Tokyo's global competitive power. Section 7.5.5 summarizes the main findings of this study.

Population change and economic growth in Tokyo

Geography coverage of Tokyo Metropolis and Tokyo Metropolitan Area

Japan consists of 47 prefectures, including the national capital Tokyo Metropolis (prefecture). After long-term development, Tokyo Metropolis and its three neighboring prefectures (Kanagawa, Chiba, Saitama) have been integrated as Tokyo Metropolitan Area, the most important one of the three major Metropolitan Areas in Japan (Table 7.7).

Population change in Tokyo and Tokyo Metropolitan Area

Regional population growth depends on the natural population growth and social population growth (net migration inflows). Since the natural population growth rate in Japan has turned to be negative since 2005, the impact of migration on regional population growth is becoming more and more important.

Figure 7.31 shows the changes in the net inflow size of migration to the three metropolitan areas (Tokyo Metropolitan Area, Nagoya Metropolitan Area, Osaka Metropolitan Area). From this figure we can see the following two trends.

(1) The net inflow size of the three metropolitan areas reached the peak in the mid-1960s, when the regional income disparity in Japan rose to the peak, and then narrowed rapidly from the late 1970s. After the 1980s, with the economic globalization the migration to the three metropolitan areas increased again, but the net inflow size is much smaller than that of the past.
(2) Before the 1980s, each of three metropolitan areas experienced a large scale net inflow. However, after the 1980s, only the Tokyo Metropolitan Area still kept a significant net inflow. In the era of economic globalization, as the capital of the second largest economy in the world and one of three major global cities,

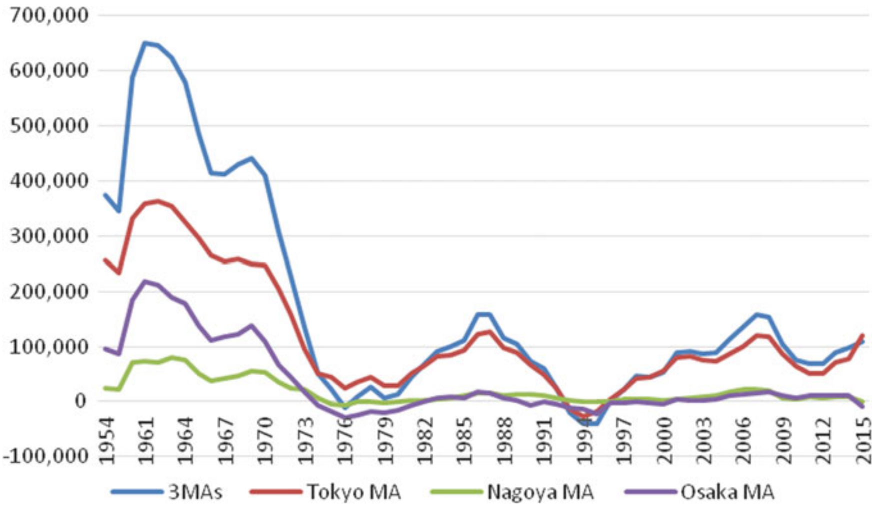

Fig. 7.31 Net migration inflows to the three Metropolitan Areas in Japan (unit: persons). *Source* The author (based on data of *Population Statistics*, National Institute of Population and Social Security Research (2017)

Tokyo could provide much more opportunities for domestic/international migrants than other two metropolitan areas.

The change in migration flow has given a direct impact on the regional population distribution in Japan. From Fig. 7.32, we can see the following features.

(1) After the World War II, Japan and the three metropolitan areas have experienced a long-term continued population growth, with the latter's growth rate exceeding the former. However, after 2005 Japan's total population began to decrease, while the population growth in the three major metropolitan areas also slowed down significantly in recent years.
(2) Among the three metropolitan areas, only the Tokyo metropolitan area still kept significant population growth. However, the total population of Tokyo Metropolis (prefecture), which is the core of Tokyo Metropolitan Area, remained stable from the 1970s to around 2010. Thus, the population growth in the Tokyo Metropolitan Area in this period was mainly contributed by other three prefectures.
(3) In recent years, however, with the regulation relaxation on the upper limit of floor space ratio and financial easing policy promoted by the Abenomics, there appeared a re-development boom in Tokyo Metropolis. Consequently, the population in Tokyo Metropolis also has increased again after 4 decades.

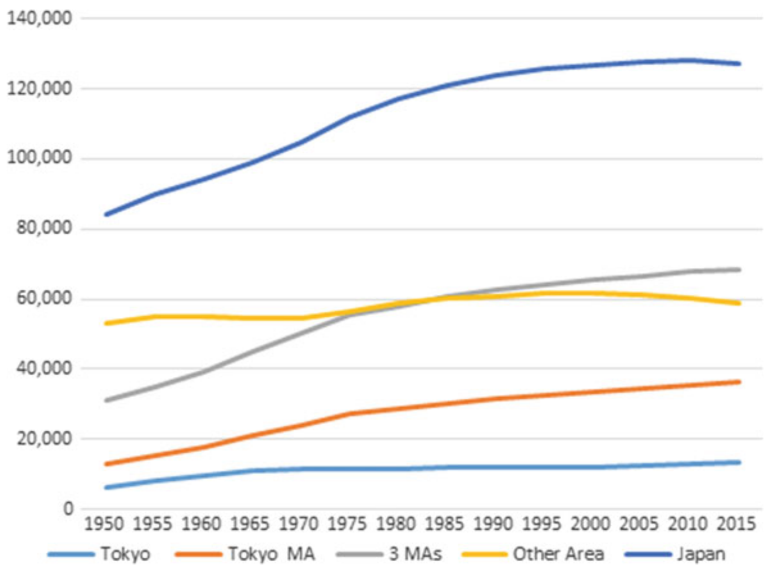

Fig. 7.32 Population change in Tokyo, Tokyo Metropolitan Areas, 3 MAs, and Other Area (unit: 1000 persons). *Source Population Statistics*, National Institute of Population and Social Security Research (2017)

7.5.2 The Economic Growth Trends in Tokyo and Tokyo Metropolitan Area

From Figs. 7.33 and 7.34, it is easy to identify that the economic growth in Tokyo has the following relationships with the economic growth of Tokyo Metropolitan Area and the economic growth of Japan

(1) The economic growth trend of Tokyo and the whole Tokyo Metropolitan Area is getting more and more close.
(2) The economic growth trend of Tokyo has been consistent with Japan's economic growth, but the volarity in Tokyo's growth rate seems to be slightly higher than the latter, reflecting Tokyo's leading role in Japan's economic growth.
(3) There are obvious downward trends in the economic growth of Tokyo and Tokyo Metropolitan Area during the past 6 decades. Since 2012, stimulated by the Abenomics, which is based upon the so-called "three arrows" of monetary easing, fiscal stimulus and structural reforms, the performance of economic growth in Tokyo was improved slightly.

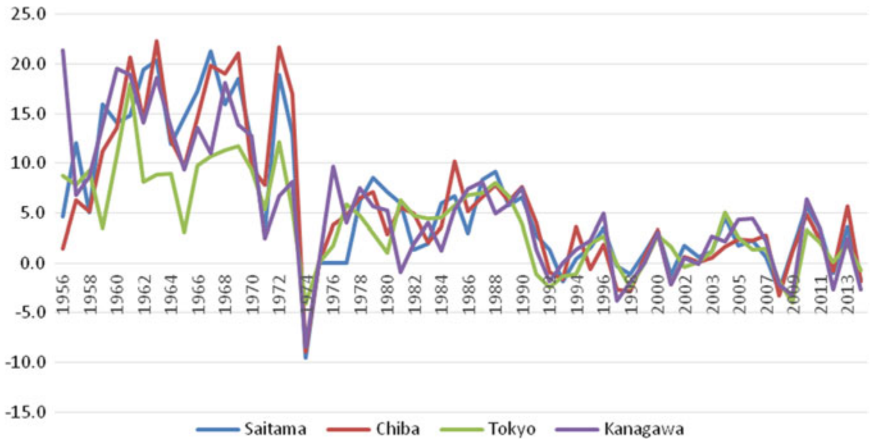

Fig. 7.33 GDP growth rate of Tokyo and other 3 prefectures in Tokyo MA (unit: %). *Source* Based on the data from the *Prefectural Accounts*, Cabinet Office (various years)

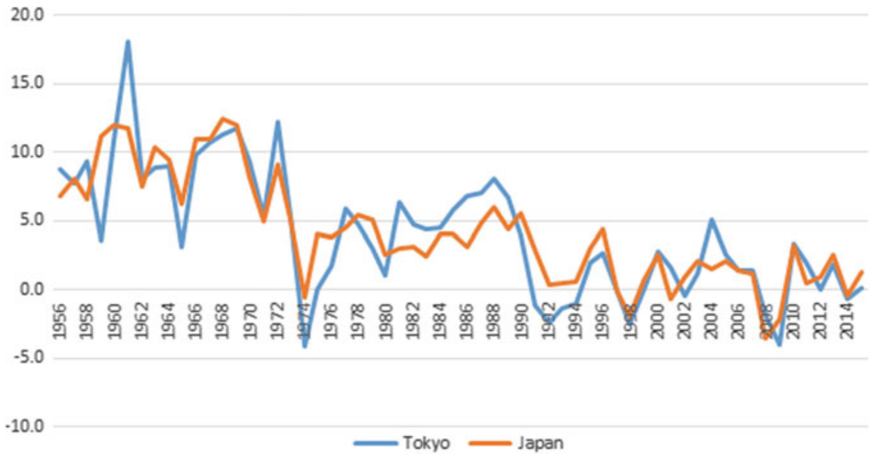

Fig. 7.34 Change of GDP growth rate in Tokyo and Japan (1956–2014) (unit: %). *Source* Based on the data from the *Prefectural Accounts*, Cabinet Office (various years)

7.5.3 Changes of Housing Affordability in Tokyo Metropolitan Area and the Underlying Factors

Changes of housing affordability

Housing affordability refers to the degree to which a typical family can afford the expenditure on a typical housing. In this section, we examine the change process of

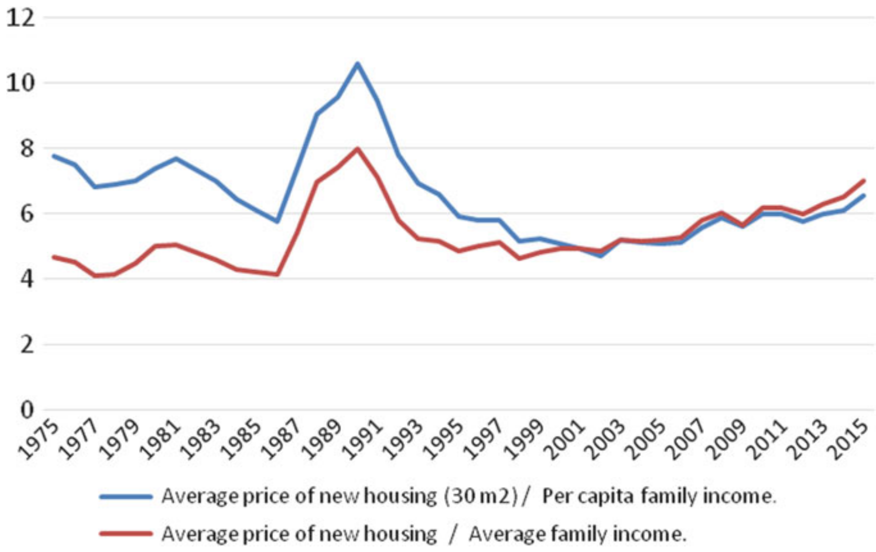

Fig. 7.35 Changes of housing affordability in Tokyo. *Source* The author (The original data are from MILT (2016))

housing affordability in Tokyo Metropolitan Area by using the following two indexes.

Index 1 (PI) = Average price for newly built housing/Average value of disposable family income
Index 2 (PI_{30}) = Average price for 30 m^2 floor area of newly built housing/Average value of per capita disposable family income.

Both the above two indexes are frequently used for analyzing whether the housing price level in a city is affordable or not. A higher index value means a lower affordability. While the Index 1 (PI) is more easy to calculate, the Index 2 (PI_{30}) has higher comparability because it has excluded the influence of housing size, which usually increases with time.

Figure 7.35 shows the changes of housing affordability in Tokyo from 1975 to 2015. It is easy to find that in the past decades, the housing price and housing affordability in Tokyo had experienced dramatic changes. After reaching the peak in 1991, both the two indexes of housing affordability experienced a sharp fall and then a continued decline until the early 2000s. Since the early 2000s the values of two indexes had been rising gradually for many years and then showed a more quick rise from 2012, when the Abenomics began to be implemented. However, compared to the soaring in some years before 1991, the rise in recent years is quite moderate. In 2015, the value of Index 1 (PI) and Index 2 (PI_{30}) rose to 7.0 and 6.5, respectively. Although these two values are a litter higher than the upper line of affordability recommended by the United Nations, they are much lower than the values of same indexes for major cities in China, which have exceeded 10. In this regard, the housing affordability in recent Tokyo is still at a rational level.

The underlying factors of housing affordability in Tokyo

What are the underlying factors of dramatic changes in Tokyo's housing affordability? As expressed in the calculation formula of the index 2 (PI_{30}), the housing affordability is directly affected by the change of housing price and per capita family income. While the change of per capita family income should has a positive correlation with the economic growth of Tokyo, the change of housing price was affected by more factors, mainly including economic growth, population growth, changes of land price, growth rate of money supply, change of mortgage rate, and reforms in real estate tax system. The influence of these factors on housing price in Tokyo can be summarized as follows.

Economic growth. Economic growth usually has a positive effect on housing demand and housing price. However, since Tokyo's economic growth rate has been hovering at a low level around 1% in recent years, its effect on Tokyo's housing price seems to be fairly weak (Fig. 7.36).

Population growth. Like economic growth, population growth also usually has a positive effect on housing demand and housing price. As the most important destination of domestic migration and international migration in Japan, the population growth in Tokyo metropolitan Area has been keeping positive (Fig. 7.32), which is a strong supporting force of housing price. On the other hand, however, total population of Japan has begun to decline since 2005. Unless Japanese government significantly reformed its immigration policy, it is difficult to expect that Tokyo can continue to keep the increase of population in the future. Such a future expectation has weakened the positive effect of population growth.

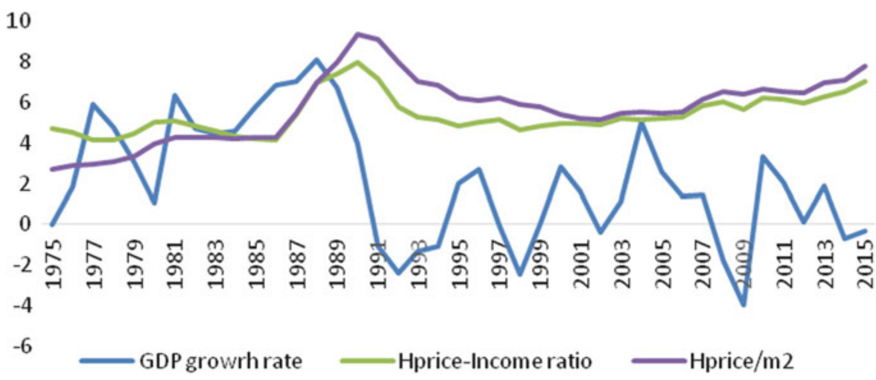

Fig. 7.36 Changes in housing price and GRDP growth rate of Tokyo (1975–2015). *Note* Hprice–Income ratio refers to the ratio of average price of newly built housing to the average family income; Hprice/m^2 (unit: 10,000 Yen) refers to the average price of newly built housing (1 m^2). *Source* The author

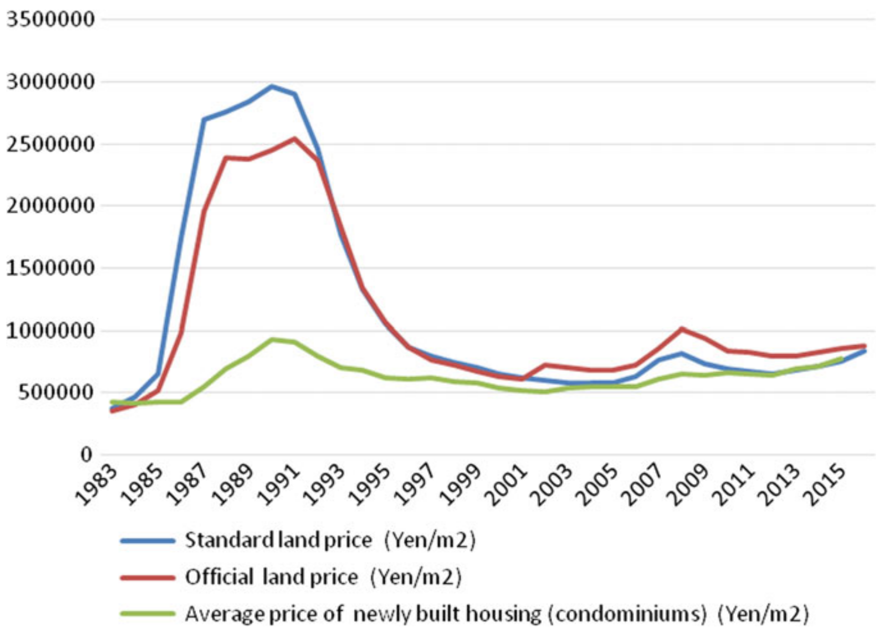

Fig. 7.37 Changes in land price and housing price in Tokyo Metropolitan Area. *Note* Official Land Price and Standard Land Prices are two most important benchmark land price indexes in Japan. They are evaluated/published by the central government and local (prefectural) government, respectively. *Source* Author. The original data are from MILT (2016)

Change of land price

Japan is a country with the highest population density in major developed countries, while Tokyo has an even higher population density. Therefore, in the housing price of Tokyo, land cost has a very high proportion. From Fig. 7.37, which shows the changes in the land price and housing price in Tokyo since the mid-1980s, we can find that the two kinds of price have a very similar change trend, although the volatility of land price is much higher. The positive correlation between them is very clear.

Growth rate of money supply

Figure 7.38 shows the yearly growth rate of M2 and M3 in Japan from 1965 to 2015. If we compare the trends of growth rate of M2 and M3 with the changes of housing/land prices shown in Fig. 7.37, it is easy to find that the growth rate of money supply has been positively affecting Tokyo's housing price since the 1980s.

Change of mortgage rate

Since the change of mortgage rate directly affects the cost of housing loan, a lower mortgage rate usually can raise the demand for purchasing housing. In the case of Tokyo, after the real estate bubble bursted in 1991, the continued decline of

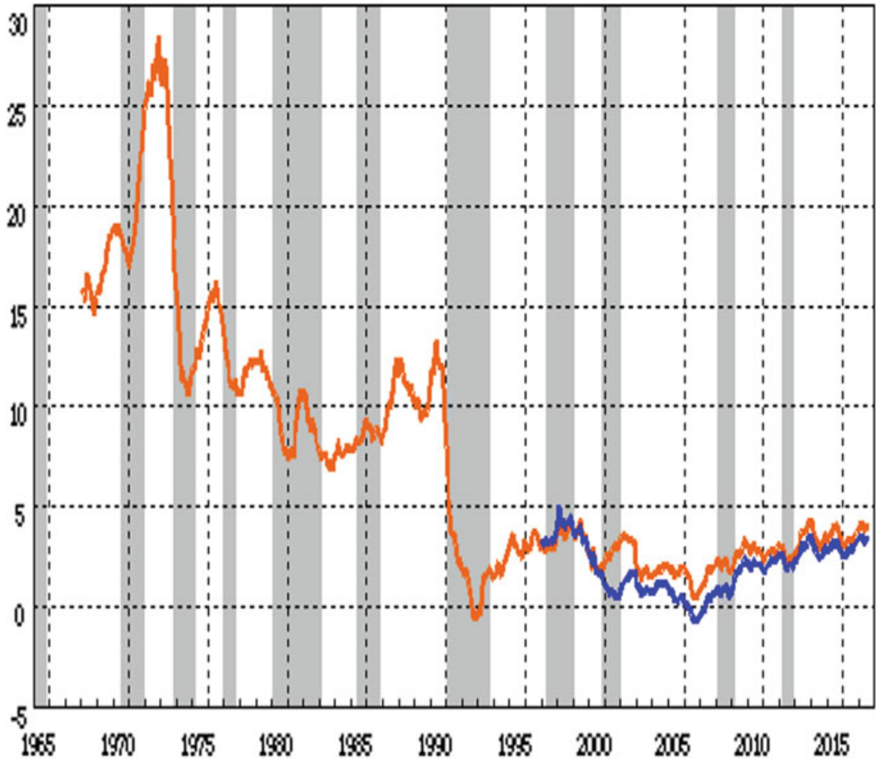

Fig. 7.38 Yearly growth rate of M2 and M3 in Japan's. *Note* Orange line refers to M2; Blue line refers to M3. *Source* Bank of Japan (2017). http://www.stat-search.boj.or.jp/ssi/cgi-bin/famecgi2?cgi=$graphwnd

mortgage rate has become an important factor supporting the housing price (Fig. 7.39). Particularly in recent years, under the financial policies of Abenomics, the money supply has increased significantly and the mortgage rate as well as official interest rate has declined to the historic low level. Such a trend in mortgage rate, of course, has a positive effect on the housing price in Tokyo.

7.5.4 The Reforms in Real Estate Tax System

In contrast to the above factors, which basically had positive impacts on housing prices in recent Tokyo, the reforms in real estate tax system after 1990 basically has a negative impact. In Japan, taxes are levied on land and the building standing on it for each stage of transaction, including buying/acquisition, possession, and selling. For example, taxes such as "registration and license tax" and "real estate acquisition tax" are levied when buying, "fixed asset tax" and "urban planning tax" are levied

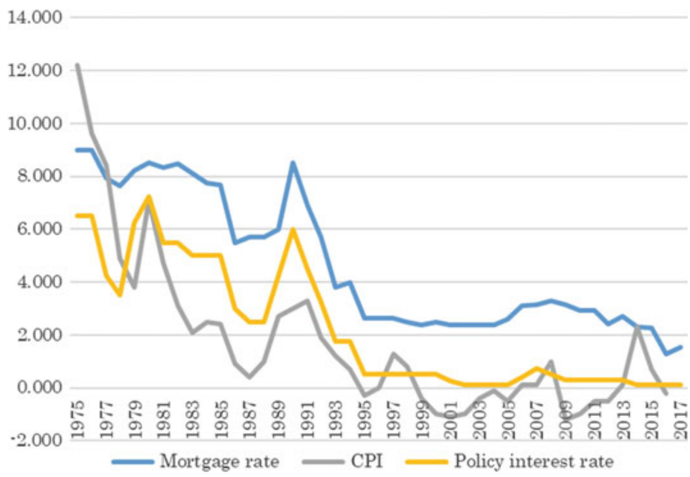

Fig. 7.39 Change of mortgage rate in Japan (unit: %). *Source* Bank of Japan (2017)

when owning, and "income tax" and "resident tax" are levied when selling. After 1990, some reforms were made and the real estate tax system became more strict against over-possession of land/housing and short time transaction. For example, income tax rate for the benefit from selling of land/ housing possessed within five years is as high as near 40%, while the income tax rate for the benefit from selling of land/housing possessed more than 5 years is nearly 20%. It is regarded that such a strict tax system has played an effective role in constraining the speculation behaviors in the real estate market and prevented rapid rise of housing price in recent Tokyo.

Since economic growth has positive effects on both the housing price and per capita family income, its overall effect on housing affordability is partially offset. Therefore, the trend of housing affordability in recent Tokyo is mainly determined by the rest factors discussed above. Among them, population growth, changes of land price, growth rate of money supply, and change of mortgage rates have been pushing the rise of housing price and price—income ratio in Tokyo since the early 2000s. However, the reforms in real estate tax system after 1990 should have been playing an important role in slowing down the speed of their rise.

7.5.5 The Impacts of Housing Affordability on Tokyo's Global Competitive Power

Housing price directly affects urban living cost and wage level (production cost). As a result of significant rise of housing price and land price, Tokyo's industrial structure has undergone dramatic transformation over the past decades (Table 7.8).

Table 7.8 Change in industry structure of Tokyo (1955–2015)

	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2010	2015
1. Industry	92.8	92.9	93.6	93.5	91.7	91.5	92.6	94.0	92.8	92.8	92.8	92.0	92.0	91.8
(1) Agriculture, forestry	1.5	0.9	0.4	0.4	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.1	0.1	0.1
(2) Mining	8.9	0.8	0.6	0.4	0.1	0.5	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0
(3) Manufacturing	*26.9*	*33.7*	*31.4*	*27.9*	*24.4*	*24.1*	*21.1*	*16.5*	*16.8*	*11.0*	*9.7*	*6.9*	*7.1*	*6.3*
(4) Construction	4.3	5.7	7.8	8.1	7.3	7.0	6.2	5.1	6.9	4.9	4.7	4.9	4.5	4.8
(5) Electricity, gas and water service	0.8	1.5	1.3	1.5	1.5	2.2	2.5	1.7	2.1	1.3	1.2	1.2	1.1	1.2
(6) Wholesale and retail trade	14.2	17.9	18.3	19.1	19.2	18.1	19.3	17.1	17.4	20.0	19.1	20.0	21.2	18.3
(7) Finance/insurance	*6.8*	*7.8*	*8.8*	*8.1*	*8.5*	*7.8*	*8.8*	*9.7*	*7.8*	*12.7*	*14.1*	*10.1*	*9.1*	*9.2*
(8) Real estate	**1.1**	**2.9**	**3.0**	**5.3**	**5.8**	**5.8**	**6.8**	**9.3**	**8.3**	**10.7**	**11.5**	**12.7**	**12.7**	**13.2**
(9) Transportation and communication	5.7	8.9	9.4	9.5	9.3	8.9	8.1	8.0	9.1	6.1	5.9	15.7	15.7	17.0
(10) Service	*22.6*	*12.9*	*12.7*	*13.3*	*15.3*	*16.7*	*19.3*	*23.4*	*24.2*	*26.0*	*26.7*	*20.5*	*20.5*	*21.7*
2. Government service	6.3	6.1	5.5	5.0	6.5	6.5	5.6	4.4	5.2	5.7	5.6	6.4	6.3	6.3
3. Households non-profit service	0.9	1.0	1.0	1.5	1.8	2.0	1.8	1.6	2.0	1.6	1.6	1.6	1.7	1.8
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source Calculated based on the data from cabinet (various years) and *Tokyo Statistical Yearbook (various years)*

Table 7.9 Regional distribution of foreign students and highly skilled labors in Japan

	2007			2016		
	All	Student	High Skilled	All	Student	High Skilled
Japan (persons)	2,152,973	132,460	172,524	2,382,822	277,331	271,288
Japan (%)	100.0	100.0	100.0	100.0	100.0	100.0
3 MAs (%)	70.3	71.1	78.4	65.2	74.2	79.1
Tokyo MA (%)	35.6	47.6	58.8	35.3	53.2	60.2
Tokyo (%)	17.8	30.7	35.3	21.0	36.1	36.3
Nagoya MA (%)	15.4	66	7.9	13.3	5.3	7.3
Osaka MA (%)	19.3	17.0	11.7	16.6	15.7	11.6
Other area (%)	29.7	28.9	21.6	34.8	25.8	20.9

Source The author. Original data are from MOJ (2017)

In 2015, the share of the manufacturing sector in the GDP of Tokyo has dropped to 6.3%. Therefore, the economic growth in Tokyo in recent years is mainly dependent on various service industries.

However, compared to manufacturing industry, most of local service sectors in Tokyo have relatively low productivity and lack strong international competitiveness. In order to raise the industry competitive power and keep its leading role in the global economy, Tokyo is trying to receive more excellent talents from the world. Fortunately, the improvement of housing affordability after the bubble crashed in 1991 has given some positive impacts on attracting global talents.

Although Tokyo was a city with very high housing price and low housing affordability around 1990, the situation has changed significantly in recent years. Compared to other major cities in East Asia, Tokyo has become a destination with a relatively low ratio of housing price to income, i.e. a higher housing affordability. This change has attracted increasing number of foreign students and foreign highly skilled workers studying and working in Tokyo.

From Table 7.9, which describes the change in the regional distribution of foreign talents in Japan, we can find that in the recent 10 years, the share/number of foreign students and highly skilled workers living in Tokyo has increased significantly. No doubt, such a change has contributed to the rise of Tokyo's global competitive power.

According to the yearly report of Z/Yen Group in the UK, who evaluates and publish the Global Financial Centres Index (GFCI) every year since 2007, Tokyo's ranking among the major global financial cities has risen from 7th in 2007 to top 5 after 2010 (Table 7.10).

Meanwhile, according to the Mori Memorial Foundation in Japan, who evaluates and publish Global Power City Index YEARBOOK every year since 2008, among the 44 major global cities, Tokyo's comprehensive ranking has risen from the 4 th to top 3 after 2016 (Table 7.11), with its R&D field being ranked the second and its economic field being ranked the top (Table 7.11, Mori Memorial Foundation 2017).

Table 7.10 Tokyo's ranking in the Global Financial Centres Index (GFCI)

Rank	2007	2010	2015	2017
1	London	London	New York	London
2	New York	New York	London	New York
3	Hong Kong	Hong Kong	Hong Kong	Hong Kong
4	Singapore	Singapore	Singapore	Singapore
5	Zurich	*Tokyo*	*Tokyo*	*Tokyo*
6	Frankfurt	Shanghai	Zurich	Shanghai
7	Sydney	Chicago	Seoul	Toronto
8	Chicago	Zurich	San Francisco	Sydney
9	*Tokyo*	Geneva.	Chicago	Zurich
10	Geneva	Sydney	Boston	Beijing

Source Z/Yen Group (various years)

Table 7.11 Top ten cities in MMF comprehensive ranking

	2010	2013	2016
1	New York	London	London
2	London	New York	New York
3	Paris	Paris	Tokyo
4	Tokyo	Tokyo	Paris
5	Singapore	Singapore	Singapore
6	Berlin	Seoul	Seoul
7	Amsterdam	Amsterdam	Hongkong
8	Seoul	Berlin	Amsterdam
9	Hongkong	Vienna	Berlin
10	Sydney	Hongkong	Vienna

Source The Mori Memorial Foundation (2017)

Although Z/Yen Group and the Mori Memorial Foundation gave different rankings for Tokyo, the same thing is that both of these ranking indicated the re-rise of Tokyo's role in the world city system.

7.5.6 Conclusions

The main finding of this case study can be summarized as follows.

(1) After the World War II, Japan achieved dramatic economic growth. In this process, Tokyo rose to be a global city with the highest land/housing prices in the world and low housing affordability. After the bubble bursted in 1991, Tokyo's housing price experienced a sharp drop, stagnation, and moderate

re-rise. However, despite the rise of housing price in recent years, Tokyo has been keeping a relatively rational level of housing affordability.

(2) The recent trend of housing affordability in Tokyo is mainly determined by population growth, changes of land price, growth rate of money supply, change of mortgage rates, and reforms in real estate tax system. While the first four factors have been pushing the rise of housing price and the price-income ratio in Tokyo since the early 2000s, the reforms in real estate tax system after 1990 has been playing an important role in slowing down the speed of its rise. That is a major reason why the housing affordability in recent Tokyo can keep at a fairly rational level.

(3) The improvement of housing affordability in recent years has given some positive impacts on attracting global talents. Consequently, such a change has also contributed to the rise of Tokyo's global competitive power against other rival cities in the world.

Tokyo's experience shows that the rapid rise in housing price poses a huge risk of sharp down. In contrast, a moderate rise of housing price usually symbolizes growth potential and seems to have positive effects on attracting talents, investors, and new industries. In order to prevent the excessive price changes, a set of well-designed real estate tax system is essential. Given the fact the rapid rise of housing prices have seriously lifted the cost of living in many major cities in China, which has negatively affected the attractiveness of these cities and weaken their global competitiveness, the experience and lessons from Tokyo are worthy of reference.

7.6 Guangzhou, China

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7.6.1 Introduction

Guangzhou, located in south China, is an important port city, airport city and commercial city in the world, a core city in Guangdong-Hong Kong-Macao Bay Area, and the starting point and birthplace of ancient Maritime Silk Road. Guangzhou has been one of the most open and market-oriented areas in China since ancient times, with profound historical and cultural heritage in international trade. In the 19th century, it became the fourth largest trade center in the world, with its commercial impact extending to East Asia, South Asia, the Middle East, Africa, Europe and other regions, and "Canton" is well known throughout the world. Since the reform and opening up, Guangzhou has taken the lead in breaking the shackles of the traditional system and become the forefront and vanguard of China's reform and opening up as well as the third largest city in China. The city's comprehensive competitiveness has grown steadily. At present, Guangzhou is in a new stage of developing from a national central city to a global one and has become a new first-tier city in the world.

7.6.2 *Analysis of Guangzhou's Economic Development and Urban Competitiveness*

In recent years, the comprehensive competitiveness of Guangzhou has been continuously enhanced. About the economic gross, the GDP of Guangzhou in 2016 was approximately RMB2 trillion (about USD290 billion), which was equivalent to that of Israel and exceeded that of Hong Kong and Singapore. It ranked 18th among global cities and has maintained the third place among cities in mainland China for 27 consecutive years. From the perspective of economic growth rate, the average annual growth rate of Guangzhou's economy reached 13% during 38 years from 1978 to 2016, which was nearly 4% points higher than that of the country over the same period, taking an obvious leading position in the economic growth in China. With regard to the per capita GDP, Guangzhou's per capita GDP has reached USD20,000, which has entered the rank of the world's high-income areas in accordance with the standards specified by the World Bank (Fig. 7.40).

In 2016, the industrial structure of Guangzhou was 1:31:68; specifically, the proportion of modern service industry in the service industry reached 65%, the total retail sales of social consumer goods ranked the third among cities nationwide for 29 consecutive years, and the growth rate ranked the first place among the five large cities—Beijing, Tianjin, Shanghai, Guangzhou and Shenzhen. The city's cross-border e-business scale ranked the first nationwide and the development of trade in services was at the forefront of pilot cities. With regard to technology innovation, the growth rate of both patent applications and patent of invention

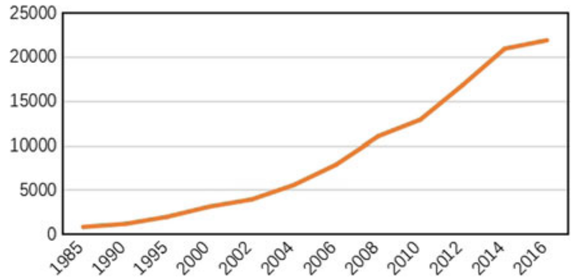

Fig. 7.40 The change of per capita GDP in Guangzhou (unit: USD). *Source* Guangzhou Statistical Yearbook 2016 and Statistical Bulletin on National Economic and Social Development of Guangzhou in 2016

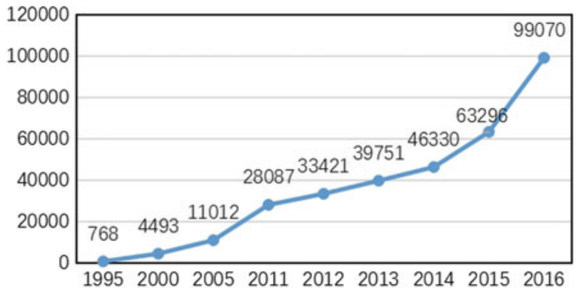

Fig. 7.41 The number of patent applications in Guangzhou in recent years. *Source* Statistical Bulletin on National Economic and Social Development of Guangzhou (1995, 2000, 2005, 2011–2016)

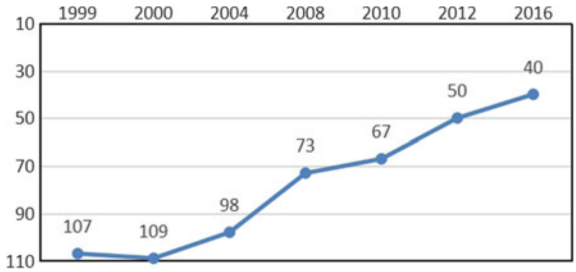

Fig. 7.42 Guangzhou's ranking changes in GaWC. *Source* Drawn according to the World Cities Rating Report issued by GaWC

applications of Guangzhou in 2016 ranked the first among 19 cities at the sub-provincial level and the above nationwide, and the number of its PCT applications ranked the third among major cities in China, next only to Beijing and Shenzhen. The enterprise invention patent applications accounted for 50.7% of the total patent applications, and the position of enterprise as the main innovator was further enhanced. The number of invention patents per 10,000 people was 22.4, 2.8 times that of the whole country and 1.4 times of that of Guangdong province. The output value of high-tech products accounted for 46% of the total output value of industrial enterprises above the designated size (Fig. 7.41).

The excellent performance of Guangzhou's urban development has been recognized by many well-known international institutions. According to the rating of major cities in the world by Globalization and World Cities Study Group and Network ("GaWC"), during the 16 years from 1999 to 2016, the ranking of Guangzhou in global cities had risen from 107th to 40th, next to Hong Kong (Alpha+), Beijing (Alpha+), Shanghai (Alpha+) and Taipei (Alpha−), entering the list of Alpha cities that symbolize the first-tier cities in the world. According to the *World Urbanization Prospects* issued by the United Nations, Guangzhou has been rated as the fastest growing megacity in the world. According to the global city ranking for 2017 released by the world's leading management consulting firm A. T. Kearney, the urban comprehensive strength of Guangzhou ranked the 71st among the world's major cities, while its development potential ranked the 56th (Fig. 7.42).

7.6.3 *Analysis of the Housing Price of Guangzhou and Its Impact on Economic Development*

Over the past ten years, the housing price in Guangzhou has shown steady growth. Exclusive of Zengcheng and Conghua districts, the first-hand housing prices had risen from RMB3,888/m^2 in 2003 to RMB17,133/m^2 in 2015, with an average annual growth of 13.2%. Meanwhile, the average annual growth rate of GDP in Guangzhou reached 14.8%, and the ratio of house price growth rate to GDP growth rate was 0.89, indicating that the development speed of the real estate market basically reflected the urban economic development level. However, compared with the average annual growth rate 9.9% of urban residents' per capita disposable income over the same period, the growth rate of first-hand housing prices in Guangzhou is still fast, which is an important reason for the increasing house-purchase pressure faced by local residents in recent years. According to the *Global Housing Watch Report* issued by International Monetary Fund (IMF) in 2016, and the *Ranking of Housing Price to Income Ratio of 45 Large and Medium-Sized Cities in China* released by E-house China R&D Institute, the housing price to income ratio in Guangzhou remained high on the whole but was the lowest among domestic first-tier cities, which was relatively reasonable [3]. In fact, from the perspective of absolute amount, the average first-hand residential housing prices of Beijing, Shanghai and Shenzhen in 2016 all exceeded RMB30,000/m^2, while it was less than RMB20,000/m^2 in Guangzhou: the price gap was obvious (Fig. 7.43).

In the context that housing prices in the world's first tier cities are generally soaring, the relatively affordable housing price in Guangzhou enhances the city's attractiveness to talent, capital, technology and other resources, which is conducive to the promotion of its economic development and city competitiveness.

Appropriate housing prices increase the attractiveness to population

In today's world, human resources are related to the rise and fall of a city. The city that talented people streamed in must be full of impetus, vitality and prospects. Against the background that the state encourages mass innovation and

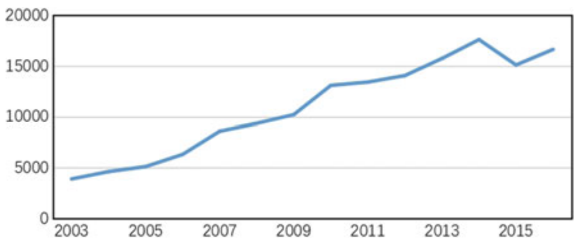

Fig. 7.43 The average contract price of first-hand residential properties in Guangzhou in 2003–2016 (RMB/m^2). *Source* Guangzhou Academy of Social Sciences. Guangzhou Economic Development Report. Beijing: Social Sciences Academic Press, 2011–2017

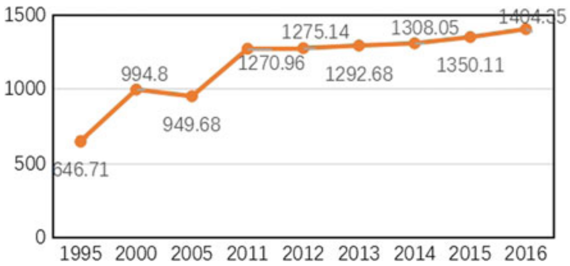

Fig. 7.44 The number of permanent residents in Guangzhou in recent years (10,000 people). *Source* Guangdong Statistical Yearbook 2016 and Statistical Bulletin on National Economic and Social Development of Guangzhou in 2016

entrepreneurship, cities with more opportunities for development and lower cost of living will consequentially become the preferred work and living place for graduates who have just joined the workforce and entrepreneurs in the initial stage of their pioneering work. Among China's first-tier cities, Guangzhou has the lowest housing prices and rental cost. According to the *Worldwide Cost of Living* 2017 issued by the Economist Intelligence Unit (EIU) in 2017, Guangzhou ranked the 69th, with the living cost far lower than that in Singapore, Hong Kong, Tokyo, Beijing, Shanghai and Shenzhen, which is very suitable for different levels and types of people to live, work and start a business. In December 2016, according to the *2016 Report on Urban Sustainable Development of China: Measuring Ecological Input and Human Development* released by the United Nations Development Programme (UNDP), the human development index of Guangzhou won the first place in China with 0.869 point. In fact, suitable housing prices and the low living cost have made Guangzhou the most attractive city in china. In 2016, the city's resident population was more than 14.04 million, a net increase of 542,400 people from 2015, with the increment ranking the first among cities nationwide (Fig. 7.44).

Appropriate land prices enhance the attractiveness to enterprises

Guangzhou covers an area of 7,434 km^2, with lots of land resources available for development and construction, and the price of industrial development land is relatively low, which can provide superior space for high-end, high-quality and high-tech projects. Especially in Huadu, Zengcheng, Panyu, Huangpu and Nansha, Guangzhou has reserved vast stretches of cultivated land, coupled with the open and liberal market environment and efficient and transparent governance, it allows quality projects that conform to the development trend of modern industry to settle down rapidly, avoiding the problems of long duration and high cost incurred in finding suitable fields after determining the projects which might be subject to land acquisition or demolition. Therefore, by 2016, there had been 288 *Fortune* 500 enterprises investing in about 800 projects in Guangzhou, of which 120 were headquartered or set regional headquarters in Guangzhou. In 2016, the city's newly registered domestic-funded market entities reached 242,100, with an average of 663 new registrations per day. With this advantage, Guangzhou was the first to put forward the construction of a number of value innovation parks, among which, the Foxconn 10.5 generation displayer full-eco industrial park, CISCO smart city, GE biological industrial park, Guangzhou LG flat panel display industrial park, GAC intelligent network new energy automobile industry park, BeiGene (China) biological medicine, and Nansha artificial intelligence industrial park have kicked off construction. After completion, these value innovation parks will be put into operation to aggregate quality enterprises of the upstream and downstream industry chains, form new industrial carriers with complete value creation system, innovation ecosystem and production and service system, and promote the city competitiveness at a faster pace.

An appropriate housing price growth rate provides a good environment for industrial transformation and upgrading

The housing price in Guangzhou has long maintained a mildly gradual growth, providing a relatively stable environment for urban economic and social development. In the past 6 years, Guangzhou has been named as "the Best Commercial City in Mainland China" by *Forbes* for 5 times. PwC and China Development Research Foundation jointly issued *Cities of Opportunity 2017*, and Guangzhou ranked the first among "Cities of Opportunity" in China for two consecutive years. A relatively relaxed development environment provides time and opportunities for the transformation and upgrading of Guangzhou urban industry and the change of development impetus. Since the reform and opening up, Guangzhou's economic scale has expanded constantly and entered a new stage; meanwhile, its industrial system has shifted from light industrial system to heavy industrial system then to modern comprehensive industrial system, forming such 10 RMB100-billion industrial clusters as the automobile industry, petrochemical engineering, electronics, electrical machinery and equipment manufacturing, power and heat production supply, transportation, wholesale and retail, finance, leasing and commercial services. Specifically, in central urban areas such as Tianhe and Yuexiu, high housing prices have crowded out general manufacturing industries with low land input–output benefit, while the modern service industry represented by financial and business services has seen rapid development and occupied a dominant position in the whole city's modern service industry. In Huangpu, Zengcheng, Nansha, Panyu, Baiyun and other peripheral regions, with the improvement of housing and the rising of housing prices, the general manufacturing industry continues to transfer to the relatively backward areas which are in the east, west, and north of Guangdong. The vacated space has gradually developed into the new strategic industrial base, advanced manufacturing base and high-tech industrial base. On the whole, through the housing price's screening mechanism, Guangzhou formed an industrial development spatial pattern with the central area dominated by modern service industry and the peripheral area dominated by advanced manufacturing, which jointly support the rational layout and structural optimization of urban industry.

Appropriate housing prices have effectively promoted the great leap of technological innovation capacity

In recent years, with the rapid growth of housing prices of other first-tier cities in China, the comparative advantages of Guangzhou's housing price continue to highlight, boosting an unprecedented leap in the city's technological innovation capacity. Firstly, the relatively appropriate housing prices have attracted lots of technological innovation enterprises to Guangzhou. In 2016, the city's high-tech enterprises showed explosive growth, with an average emergence of 7 high-tech enterprises per day and an annual net increase of 2,823 high-tech enterprises. The growth rate ranked the first among sub-provincial cities nationwide. By the end of 2016, the number of technology innovation enterprises in Guangzhou had reached 120,000. Secondly, the relatively appropriate housing price is more suitable for the construction and development of all kinds of technology incubation platforms and maker space. In 2016, the growth rate of technology business incubators in the city was 61.3% and the growth rate of maker space reached 229%. Thirdly, the relatively appropriate housing price facilitates enterprises to invest more in innovation activities, and the comprehensive innovation capability of enterprises will be continuously enhanced. The number of R&D platforms set up in the enterprises has increased rapidly, leading to the rapid growth of innovation enterprises. In 2016, the growth rate of the city's NEEQ (National Equities Exchange and Quotations) listed enterprises reached 84.4%, with the number of new listings and the total number of listings ranking the first among the provincial cities nationwide. PCT applications saw a year-on-year growth of 163.6%. The number of enterprises on the list of "top 50 innovation enterprises in China" ranked in the top three among major cities nationwide for three consecutive years. Fourthly, the relatively appropriate house price also leads to the rapid development of the technology innovation service industry. In 2016, the amount of foreign investment under the knowledge-intensive service contracts in Guangzhou reached USD8.24 billion, a year-on-year increase of 112.2%.

7.6.4 Guangzhou's Experience in Enhancing Urban Competitiveness Through Appropriate Housing Prices

Implementing strict and effective housing regulation policy

For a long time, to promote the healthy and orderly development of the real estate price, Guangzhou has strictly implemented the national macro-control policies, and proceeded from its own situation to introduce a series of targeted measures on land supply, market regulation, industry guidance, etc., effectively avoiding the drastic fluctuation of housing prices. In as early as 2012, Guangzhou took appropriate measures to limit the size of pre-sale and control the pace of transactions against several abnormally high-priced residential projects in the urban area, in an effort to address the city's average price rise due to structural imbalance, actively guide developers to make reasonable pricing and stabilize the expected housing price level, thus pioneering the "restricted sales" of new commercial housing nationwide. In 2013, Guangzhou laid down and achieved the regulation goal of keeping the growth rate of the city's newly-built commercial housing price lower than the actual growth rate of per capita disposable income of urban residents. Since 2016, against a new round of rising in housing prices, in accordance with the state's requirements of classified regulation and city-based policies, Guangzhou has strictly supervised the conduct of the supply side, the demand side and the intermediary through the policy portfolio of limiting the loan, the purchase, the price and the sale, market rectification, controlling land supply, and launching affordable housing projects, etc. It has effectively curbed the overheated development of the real estate market and maintained the dominant position of its housing price among first-tier cities in the country.

Implementing multi-level housing guarantee policies

Almost every year, Guangzhou has listed the housing security system as one of the livelihood projects, constantly increased the land reserve and supply of affordable housing, and input a large amount of money in it. In 2013, Guangzhou issued the *Implementing Measures for the Public Rental Housing Guarantee System in Guangzhou (Trial)* which formally incorporated the low-cost rental housing into the public rental housing for management. The eligible buyers of low-cost housing are also eligible to apply for public rental housing. It established the rent-dominated housing security system, and gradually established the housing supply system which provided government-based basic support and satisfied market-oriented multi-level demands. In the new era, to meet the needs of economic and social development and the attraction of talents, Guangzhou considers it an important issue related to urban development to solve the housing problems for talents. In 2017, Guangzhou has formulated the *Residential Land Supply Plan of Guangzhou for 2017–2021* to make it clear to provide a certain number of talent apartments in the future. As a pathfinder, Guangzhou development district has demanded that each real estate developer must bid for at least 5% of land for the construction of talent apartments in the process of land bidding. In the meantime, the Talent Services Group is established to decorate, distribute and manage the talent apartments, provide the elderly care apartments for the talents' parents and parents-in-law, and provide access to school education for their children. These policies and concepts are clearly in the forefront of the country.

Expanding the housing supply through regional integration

Guangzhou is located in the center of the Pearl River Delta and borders on Qingyuan, Shaoguan, Huizhou, Dongguan, Shenzhen, Zhongshan, and Foshan. Except for Shaoguan and Huizhou, the radius of 100 km with Guangzhou as the center can basically cover the neighboring city centers. In recent years, through vigorously promoting the transport infrastructure connectivity, the collaboration and division of labor in industrial chains, sharing and co-governance of public services, Guangzhou has enhanced its connection in people and goods with other cities in the Pearl River Delta, with the integration between cities continuing to increase. With the deepening of regional integration, the housing supply boundary of Guangzhou expands from the central area to the peripheral area and then to the surrounding cities, with a significant increase in the supply at the housing market. For example, the central urban areas of Guangzhou and Foshan are only 30 km apart, with the progress of the urban integration, the subways and high-speed network in the two cities have achieved efficient and convenient connection, and their population, industry and element exchanges are more frequently. The two cities have actually become an integral whole metropolitan area viewed from the urban forms and the commuting time. In the Guangzhou-Foshan metropolitan area, Foshan's housing supply is relatively adequate and the price is far lower than that of Guangzhou, resulting in that many people working in Guangzhou choose to live in Foshan. With the improvement of transport facilities and the improvement of commuting efficiency, there are similar situations between Guangzhou and Qingyuan, Guangzhou and Zhongshan. Obviously, regional integration has reduced the pressure of rapid rising house prices in Guangzhou by increasing the market supply and diverting the market demand.

Improving land efficiency with deep urbanization

Since the reform and opening up, the process of urbanization in Guangzhou has been rapid, the urban built-up area has expanded from more than 60–1,249.11 km^2, and the urbanization rate of the population is over 85%. In this process, Guangzhou, through the implementation of the spatial development strategy of "eastward advancing, westward connecting, southward expanding, northward optimizing, central adjustment", has successively built up major platforms and hub facilities including Guangzhou Development Area, Nansha New Area, Zengcheng National Economic and Technological Development Zone, airports and ports, which has improved the infrastructure, public services and industrial economic development levels of the urban peripheral areas. Besides, it guides people of the central urban area work and live in these regions with lower housing prices, which promotes the evolvement of urban spatial structure towards multi-center, multi-axis and multi-group hub network, and to a certain extent, eases a variety of urban diseases that are likely to appear in mono-centric cities. While emphasizing the expansion of new strategic space in urban development, unprecedented attention has been paid to the transformation and upgrading of central urban areas, especially the old urban areas, as well as the spatial transfer and functional enhancement. In 2016, Guangzhou took the lead in the country in establishing the Urban Renewal Bureau, and issued *Guangzhou Overall Urban Renewal Plan (2015–2020)*, *Opinions on Promoting Urban Renewal and Efficient and Intensive Land Use*, *Guangzhou Urban Renewal Measures*, and three supporting measures for old villages, factories and towns. The city has set up a RMB200-billion urban renewal fund and explores innovative policies integrating government leadership with market operation, and comprehensive transformation with mini-transformation. Guangzhou Venture Town, Redtory, 1978 Movie Town and other renovation projects are growing into the engine behind a new round of development in Guangzhou, promoting the growth of the city's land and space value.

7.6.5 Conclusions and Inspirations

In the context of globalization and information technology, the new scientific and technological revolution is driving new changes in the global economy and innovation, and the competition between cities worldwide is becoming increasingly fierce. As a latecomer city, Guangzhou has managed to enhance its urban competitiveness and status in the global urban system, which deserves our attention. Although there are many factors affecting the city competitiveness, it is found that the fastest growing period of urban competitiveness in Guangzhou is when its housing price advantages are prominent compared with other first-tier cities in China and the world. When the cost of production and living in some cities stays high due to precipitous rise of housing prices, Guangzhou has attracted global talents and enterprises with relatively appropriate housing prices to promote urban innovation and economic vitality and achieve healthy and rapid economic development. On the whole, through analyzing Guangzhou's experience in promoting urban competitiveness with appropriate housing prices, we can draw the following inspirations:

Firstly, our policy should always aim at the development of the real economy. When some cities "deviate from the real economy and turn to the virtual economy" because of excessive pursuit of virtual economy, Guangzhou, focusing on the long-term development goals and taking the real economy as the core, implements strict supervision and regulation policies on the real estate industry and the financial industry, so that more resources can flow to the real economy, which saves up strength for the enhancement of urban competitiveness. In fact, in 2016, Guangzhou's direct financing accounted for 65.7% of the social financing, close to that of the United States and other developed countries.

Secondly, we should take the initiative to develop from mono-centric city to mega urban area. Through collaborating with and leading the surrounding areas to build the urban agglomeration and metropolitan area, it not only effectively disperses the pressure of high cost of production and living due to the rising of housing prices in Guangzhou, but also fully promotes the development of the surrounding areas, thus promoting regional industrial division and complementation, cooperation and win-win development at a deeper level, which adds powerful regional driving force to the development of urban economy.

Thirdly, we should accurately grasp the law of urban development and timely promote in-depth urbanization. After rapid urbanization, some urban diseases begin to appear. In response to this, on the basis of the reform and innovation of land management system and focusing on the development and reuse of existing land space, Guangzhou has timely intensified efforts to speed up the pace of urban renewal and achieved a higher level of economic development, social progress and urban grade.

7.7 Taipei, China

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The housing price index in Taipei had gone up to 227.15 from 2000 to 2016, which cause some trouble for firms and people staying in Taipei if they try to own an office or a house. However, for some reasons, the rental price in 2016 is almost the same as in 2000. It means that the production cost will be reasonable if a firm rents an office, instead of owning one. Therefore, Taipei is still competitive in attracting firms in this sense. Moreover, since the average salary both for skilled or unskilled labor almost kept constant for the past sixteen years, along with abundant skilled labor, Taipei is also good for high tech firms to invest.

7.7.1 Introduction

A high housing price may influence the competitiveness for a city in two different ways: First, a higher housing price may attract more investment in housing market, and thus booms the city's economy. Moreover, a competitive city will attract more investment and skilled workers, and so the housing price will go up as well, and therefore the investment has to shift to more productive usage, such as high tech, financial industry, and so on.

On the other hand, a high housing price could raise business cost and deter investment in general, especially for small and medium firms (SMEs), and so it is no good for the city's competitiveness. At the meantime, a high housing cost will also make people more difficult to find a decent dwelling unit to live, especially for young generation or less skilled people, and thus cause some problems for firms to hire workers on the city. Therefore, the competitiveness of a city may be lower if the city has a very high housing price.

Competitiveness means a better ability to create values in different aspects. Owing to the two different impacts of housing price on competitiveness, the relationship between housing price and competitiveness of a city could be an inverted U-shape, in that housing price could be no good for a city's competitiveness if the housing price there is either too low or too high. However, the optimal housing price level (comparing to household income) could be different for city's different endowments.[15]

In this short paper, we like to examine the relationship of housing price and competitiveness for the city of Taipei. In Sect. 7.7.2, we will firstly examine the growth rate of housing price for Taiwan and Taipei from 2000 till now, and also examine housing affordability for people both in Taiwan and Taipei. In Sect. 7.7.3, we will show the economic performance for Taiwan and Taipei after the year of 2000, and we will also compare the structure of industry, especially for the high-tech industry and the service industry. Finally, the relationship of housing price and competitiveness of Taiwan and Taipei as a whole will be examined in Sect. 7.7.4. We will conclude this paper in Sect. 7.7.5.

7.7.2 Housing Market in Taiwan and Taipei

The housing price index since 2000 is shown in Table 7.12, where one could see that the growth rates of housing index and housing market both for Taiwan and Taipei were very slow in the first few years of the new century because of the dot-com bubble in 2001 and SARS in 2003. The housing indices went up quickly after the year of 2005, especially for Taipei, and they reached the peak at 2013 and then dropped a little. The housing index was 150.78 for Taiwan at 2017Q2, while it was much higher for Taipei as 227.15.

Table 7.12 shows that the growth rates of rent indices for both Taiwan and Taipei are much slower than that of housing price indices. One could see that the rent index for Taiwan was only 102.17 in 2016, which means that the average rent in Taiwan was almost the same as sixteen years ago. The rent index for Taipei was even worse comparing to that of Taiwan in that the index as low as 100.45 in 2016. It means that the annual grow rate of rent was near zero, though the housing price was doubled in Taipei at the same period of time. Unfortunately, the low growth rates of rent for Taiwan and Taipei are not an exception for those important indices in Taiwan at the same time span. We will show that the growth rates for income, inflation, and salary were very low as well later.

At the same time, the growth rate of land price index (164.03) for Taipei shown a similar pattern with a lower growth rate comparing to the housing price index. On the other hand, the growth rate of land index for Taiwan was much lower than that for Taipei. In Table 7.12, one could see that the land index of Taiwan kept under 100 until the year of 2013, and it still was only 110.35 in 2016. The results show that the economic performance in Taiwan as a whole was very poor after 2000.

[15]In some literature, someone argued that the optimal ratio of housing price is about 3 to 6 times of households' annual income. However, for most major cities in East Asian region, the ratio is much higher than that mainly because the land is so scarce in those cities.

Table 7.12 Housing price index of Taiwan and Taipei Base year: 2000 = 100

Year	Housing price index		Housing price-to-income ratio		Rent index		Urban land price Index	
	Taiwan	Taipei	Taiwan	Taipei	Taiwan	Taipei	Taiwan	Taipei
2000	100.00	100.00	–	–	100.00	100.00	100.00	100.00
2001	96.53	97.85	–	–	99.90	99.30	94.29	94.84
2002	89.46	92.55	4.33	6.02	97.97	97.54	87.11	92.15
2003	90.53	91.91	4.48	6.30	97.97	95.99	83.94	91.65
2004	96.83	97.52	4.72	6.18	97.34	94.87	83.93	95.11
2005	99.48	101.95	5.12	6.61	97.29	94.89	84.77	99.01
2006	105.88	116.48	5.16	7.12	97.49	95.19	85.82	101.37
2007	117.04	142.74	5.43	7.18	97.69	95.39	87.27	106.33
2008	123.68	159.20	6.09	7.57	97.29	96.55	87.63	111.26
2009	119.76	147.37	6.47	10.62	97.05	96.31	86.74	111.69
2010	136.01	173.43	6.98	12.66	97.09	96.38	87.09	120.34
2011	149.90	190.29	7.30	13.63	97.44	96.75	90.98	129.32
2012	157.87	207.86	7.69	15.05	99.05	97.40	94.43	136.90
2013	175.72	227.18	7.66	15.16	99.72	97.09	99.32	147.35
2014	183.74	225.62	7.16	14.94	100.45	97.83	103.97	160.10
2015	177.01	221.50	7.55	15.91	101.34	99.68	107.90	166.92
2016	147.00	206.12	9.03	15.16	102.17	100.45	110.35	164.03
2017Q1	147.28	211.26	9.24	15.52	–	–	–	–
2017Q2	150.78	227.15	–	–	–	–	–	–

Source Cathay Real Estate Development Co., Ltd.; Ministry of the Interior, Taiwan
Note Housing price-to-income ratio equals to medium housing price divided by medium household disposable income
However, the situation in Taipei is kind of interesting in that Taipei did experience a high growth rate of housing price from 2000 to 2017, but the rental price did not. It means that the production cost in Taipei will not be very high as long as the firm in question is to rent an office (or a factory), instead to acquire an office (or a factory)

While housing price was doubled in Taipei since 2000, with almost a same household income, the housing affordability has dropped sharply since 2000 till now. Table 7.12 shows that the housing price-to-income ratio of Taipei has increased from 6.02 in 2002 to 15.52 in 2017Q1, which is about the highest among some largest cities around East Asia, such as Tokyo, Seoul, HK, Shanghai, and so on. At the same time, the housing price-to-income ratio for Taiwan as a whole was also grown from 4.33 to 9.24.[16]

[16]Though the price-to-income ratio in Taiwan as a whole (9.24) is higher than international standard of optimal size (6 times), the average housing price in Taiwan is still affordable in general, except Taipei. It means that people in Taiwan usually believe that the housing price is not a negative factor for Taiwan's competitiveness.

The high housing price-to-income ratio causes some troubles for people in Taipei, especially for young generation since they are no longer able to afford housing in Taipei. There is a significant consequence in Taipei with a high housing price-to-income ratio in that people in Taipei (and Taiwan) have to save more in order to buy a house in the future. Moreover, after one bought a house, he/she has to pay a good amount of monthly payment and then he/she has to reduce their consumption, and so it hurts Taiwan's aggregate demand and economic growth in the long run.[17]

In Table 7.13, one could see that Taipei has the second highest price-to-rent ratio, next to Shenzhen. The ratio in the city center for Taipei is 67.84 and it says that the average housing price is equal to 67.84 times of average yearly rental price. The result implies that the rate of return of owning a house and then renting it out will be only 1.47% per year. The results imply that it is much cheaper to rent a house instead of owning one in Taipei. In fact, in a long period of time, Taipei has experienced a very high price-to-rent ratio. For example, Lin (1993) has shown that the average price-to-rent ratio is around 25 times (or 300 times compared to monthly rent) in 1990.[18]

7.7.3 National Economy of Taiwan After 2000

As a member of four little dragons, Taiwan had enjoyed an annual economic growth rate as 7.1% from 1950 to 2000. However, the economic growth rate of Taiwan quickly dropped entering the new century.[19] Table 7.14 shows that the average GDP growth rate from 2000 to 2016 is only 3.70% per year.

Though GDP per capita in terms of US$ was still growing after 2000, the average household income was stagnated both for Taiwan and Taipei. For instance, the average annual household income for Taiwan was NT$1.14 million in 2000 and it increased to NT$1.25 million in 2016. The situation for Taipei was even worse. One could see that the average household income in Taipei was NT$1.53 million in 2000 and it increased to NT$1.57 million in 2016, almost no increase at all in sixteen years!

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[17]Someone called that large amount of monthly payment as a forced saving. About the estimation on forced saving behavior in Taiwan, one may refer to Lin et al. (2001) and Chen et al. (2007).

[18]There are several reasons to explain why the price-to-rent ratio keeps at so high level in a long period of time in Taipei. One of the reasons is that the effective property tax rate is as low as 0.1% in Taiwan. Therefore, the rich people in Taiwan tend to own multiple dwelling units as an investment. At the meantime, thought rental revenue is relatively low, the landlords (and investors) usually expect more on the capital gain (i.e. housing price).

[19]Among other reasons, one important reason is that a new party (DPP) won the presidential election at the year of 2000, which was the first time that the ruling party KMT lost the presidential election since 1950.

Table 7.13 Price-to-rent ratio: some major cities, 2017

Rank	City	Price to rent ratio city centre	Price to rent ratio outside of city centre
1	Shenzhen, China	79.35	77.44
2	Taipei, Taiwan	67.84	60.41
3	Beijing, China	62.81	52.32
4	Tokyo, Japan	52.58	43.64
5	Seoul, South Korea	51.57	50.62
6	Shanghai, China	50.05	52.31
7	Hong Kong, Hong Kong	47.52	47.14
8	Tel Aviv-Yafo, Israel	46.39	39.55
9	Mumbai, India	45.78	35.03
10	Jerusalem, Israel	45.29	27.71
11	Thane, India	44.37	42.21
12	Delhi, India	43.87	30.45
13	Guangzhou, China	43.68	35.10
14	Chennai, India	42.00	32.63
15	Singapore	40.87	31.39
16	Haifa, Israel	37.97	29.62
17	Stockholm, Sweden	37.54	34.22
18	Split, Croatia	37.26	33.58
19	London, United Kingdom	37.24	27.57
20	Paris, France	37.78	34.93

Source Numbeo (https://www.numbeo.com/property-investment/rankings.jsp)
Note The price-to-rent ratio is equal to housing price divided by yearly rental price

As a stagnated economy, the price indices were also stagnated in Taiwan, too. For instance, Table 7.14 shows that the CPI index increased from 100 in 2000 to 117.0 in 2016 and it was a very mild inflation rate at 1% per year. Meanwhile, the salary in Taiwan was stagnated at the same period of time, too. In Table 7.14, one could see that the average monthly salary for Taiwan increased from NT$33,953 to NT$39,238, and it equals an index as 115.57 if one use 2000 as the base year. Comparing to the CPI index (117.0) for the same period of time, the real growth rate of average salary was zero in Taiwan! The situation in Taipei is even worse. The average salary in 2001 was NT$44,720 and it dropped to NT$41,780 in 2016 in nominal term. Considering the CPI index grow up by 17%, it means that the real salary in Taipei has been dropped by 23% in the past sixteen years.

With a low economic growth rate after 2000, the economic structure in Taiwan was very stable, too. In Table 7.15, the GDP share of agriculture kept almost constant from 1.98% in 2000 to 1.82% in 2016. The share of secondary industry increased a little form 31.28% in 2000 to 35.06% in 2016. At the same time, the

Table 7.14 Major indicators of economic development of Taiwan

Year	GDP growth rate (%)	GDP per capita (US$)	CPI (2000 = 100)	Average annual household income		Average monthly earnings			
				Taiwan (NT$)	Taipei (NT$)	Taiwan		Taipei	
						Amount (NT$)	Index (2000 = 100)	Amount (NT$)	Index (2001 = 100)
2000	6.42	14,941	100.0	1,139,336	1,530,735	33,953	100.00	–	–
2001	−1.26	13,448	100.0	1,108,461	1,505,506	34,489	101.58	44,720	100.00
2002	5.57	13,750	99.8	1,111,550	1,514,440	34,746	102.34	46,016	102.90
2003	4.12	14,120	99.5	1,112,233	1,501,916	34,804	102.51	47,021	105.15
2004	6.51	15,388	101.1	1,122,966	1,488,180	35,096	103.37	46,181	103.27
2005	5.42	16,532	103.5	1,133,642	1,514,069	35,382	104.21	46,595	104.19
2006	5.62	17,026	104.1	1,151,338	1,526,228	35,724	105.22	45,585	101.94
2007	6.52	17,814	105.9	1,162,366	1,550,134	36,319	106.97	46,105	103.10
2008	0.70	18,131	109.7	1,150,912	1,538,257	36,387	107.17	45,685	102.16
2009	−1.57	16,988	107.7	1,128,201	1,515,793	35,629	104.94	43,585	97.46
2010	10.63	19,278	109.8	1,123,761	1,564,298	36,214	106.66	45,137	100.93
2011	3.80	20,939	111.3	1,157,895	1,537,890	36,689	107.06	45,604	101.98
2012	2.06	21,308	113.5	1,176,877	1,570,778	37,151	109.42	46,104	103.10
2013	2.20	21,916	114.4	1,195,566	1,545,415	37,527	110.53	44,288	99.03
2014	4.02	22,668	115.8	1,213,703	1,575,819	38,208	112.53	47,165	105.47
2015	0.72	22,384	115.4	1,224,600	1,581,899	38,716	114.03	44,379	99.24
2016	1.48	22,540	117.0	1,253,389	1,568,945	39,238	115.57	41,780	93.43

Source Directorate General of Budget, Accounting and Statistics, Executive Yuan, Taiwan

Table 7.15 GDP structure of Taiwan

Year	Primary industry (%)	Secondary industry (%)	Tertiary industry (%)
2000	1.98	31.28	66.74
2001	1.86	29.37	67.78
2002	1.77	31.12	67.11
2003	1.66	32.11	66.22
2004	1.63	32.73	65.64
2005	1.61	32.28	66.11
2006	1.56	32.38	66.06
2007	1.45	32.96	65.59
2008	1.55	31.30	67.15
2009	1.68	31.50	66.82
2010	1.60	33.78	64.63
2011	1.72	33.02	65.27
2012	1.67	32.75	65.58
2013	1.69	33.46	64.85
2014	1.80	34.79	63.41
2015	1.70	35.13	63.17
2016	1.82	35.06	63.13

Source Directorate General of Budget, Accounting and Statistics, Executive Yuan, Taiwan

share of service industry dropped a little from 66.74 to 63.13% at the same period of time.

Moreover, if one looks more details about the changes inside the manufacturing industry of Taiwan, he could see that, in Table 7.16, the production share of high-tech intensive industry slightly increased from 44.1 to 46.9% from 2000 to 2016, while the share of low-tech intensive industry dropped from 15.1 to 12.9%.

Furthermore, the changes inside the service industry were also very small. Table 7.17 shows that the share of financial industry dropped from 7.2 to 6.6% from 2000 to 2016. At the same period of time, the shares of real estate, professional and technological, and wholesale and retails all had a near constant share.

High tech industry might be the only industry with a significant improvement during the past sixteen years in Taiwan. In Table 7.18, one could see that the total government spending on R&D increased from NT$197.6 billion in 2000 to NT $483.5 billion in 2014, more than double in the time span. The share of R&D spending to GDP quickly increased from 1.94% in 2000 to 3.05% in 2015. Thanks for government spending in R&D, the number of full-time researchers per 1,000 employment increased sharply from 5.8 to 12.9 persons, and at the meantime, the number of R&D personal (in headcount) per 1,000 employment also increased from 7.3 to 16.4 persons.[20]

[20]Most squads of research personnel in Taiwan stay at the universities and government founded research institutes.

Table 7.16 Structure of manufacturing industry of Taiwan (unit: NT$ Million; Base: 2000 = 100)

Year	Manufacturing industry	By technology intensity					
		High tech intensity		Medium tech intensity		Low tech intensity	
		Percentage[a] (%)	Index[b]	Percentage (%)	Index	Percentage (%)	Index
2000	8,428,430	44.1	100.00	40.8	100.00	15.1	100.00
2001	7,366,350	42.3	86.84	41.9	91.29	15.9	102.49
2002	8,030047	43.6	100.53	41.0	93.77	15.5	109.77
2003	8,886,584	42.8	116.13	41.7	97.15	15.6	117.09
2004	10,529,274	41.1	132.24	42.6	102.10	16.3	129.52
2005	10,942,140	41.1	146.16	42.6	100.30	16.3	127.12
2006	11,965,822	41.7	157.92	41.7	102.13	16.6	126.77
2007	13,320,748	40.7	181.57	43.2	106.38	16.2	127.15
2008	13,263,670	37.5	190.06	44.5	100.10	17.0	119.42
2009	10,732,791	41.7	177.33	42.1	90.03	16.2	115.41
2010	14,048,343	42.8	243.24	42.2	106.66	15.0	126.32
2011	14,661,726	41.2	263.64	42.9	107.39	15.9	127.70
2012	14,102,967	41.0	265.94	42.8	105.94	16.1	123.51
2013	13,925,152	42.0	269.15	42.8	106.72	15.2	117.71
2014	14,425,538	43.4	297.57	41.9	109.09	14.7	117.63
2015	12,861,116	46.1	295.04	40.5	106.58	13.4	115.83
2016	12,313,235	46.9	304.85	40.2	106.85	12.9	116.14

Source Department of Statistic, Ministry of Economic Affair, Taiwan
[a]The percentage shows the percentage of total output in terms of money (value)
[b]The index is calculated by total amount of output (quantity) for each subindustry

7.7.4 Competitiveness of Taipei

Though Taiwan as a whole performed not that well after 2000, it does not imply that Taipei, as a capital, has lost her competitiveness, especially in attracting investment. First, though housing price is very high in Taipei, the rental price is still very reasonable. Actually, the rental price in Taipei is almost the same as sixteen years ago. It means that the housing cost for firms is not too high. In fact, it is not too costly to find a decent office space in Taipei, though it may be difficult to find a large land to build a factory or a warehouse in Taipei. Since the rental price for residential housing is reasonable in Taipei, it is comfortable for white-color workers to stay in Taipei, as long as they are willing to rent a dwelling unit instead of owning one. Therefore, Taipei is competitive in attracting skilled workers in this sense.

In Table 7.19, one may see that total number of firms in Taipei has increased from 193 thousands in 2000 to 224 thousands in 2016 and it shows that Taipei is still attractive for creating new businesses, where manufacturing, financial, real

Table 7.17 Structure of service industry of Taiwan. Unit: NT$ Million; %

Year	Service industry	By industries			
		Financial and insurance activities (%)	Real estate activities (%)	Professional, scientific and technical activities (%)	Wholesale and retail trade (%)
2000	10,351,260	7.2	7.4	1.9	16.9
2001	10,158,209	7.1	7.6	2.0	16.7
2002	10,680,883	7.8	7.0	2.0	16.3
2003	10,965,866	7.4	7.1	2.0	16.3
2004	11,649,645	7.4	7.9	2.0	16.7
2005	12,092,254	7.5	7.9	2.1	17.2
2006	12,640,803	7.1	7.2	2.2	17.4
2007	13,407,062	7.0	7.1	2.2	17.2
2008	13,150,950	6.9	7.4	2.2	17.6
2009	12,961,656	6.2	7.9	2.3	17.2
2010	14,119,213	6.2	7.4	2.2	16.8
2011	14,312,200	6.4	7.5	2.2	17.1
2012	14,686,917	6.4	7.5	2.2	16.7
2013	15,230,739	6.4	7.5	2.2	16.9
2014	16,111,867	6.5	7.2	2.1	16.4
2015	16,759,016	6.5	7.1	2.1	16.3
2016	17,118,694	6.6	7.1	2.1	16.1

Source Directorate General of Budget, Accounting and Statistics, Executive Yuan, Taiwan

estate relative and professional and technologic related firms are all increased. However, the trend is a little different by production share. Table 7.20 shows that the production share for manufacturing had increased from 13.0 to 16.3% in 2012, then dropped to 13.4% in 2016. At the same time, the financial sector also experienced a down trend from 24.5% in 2008 to 17.4% in 2016, while real estate related and professional and technologic related businesses were both increased. Finally, total number of workers increased from 1,137 thousands in 2000 to 1,280 thousands in 2016, see Table 7.21. While the labor share in manufacturing had decreased in the past sixteen years in Taipei, the labor shares for both real estate related sector and profession and technologic related sector both were increasing from 1.0 to 1.5% and from 7.6 to 9.0%, respectively. The result shows that Taipei is more suitable for financial industry, real estate industry, and professional and technologic industry.

Another important competitiveness for Taipei is that it has a good amount of universities and colleges with abundant inexpensive skilled workers. Though Taipei science park came late comparing to Shin-Chu science park, the total production and total employment in Taipei science park have gone up quickly in recent years,

Table 7.18 R&D expenditure of Taiwan

Year	R&D expenditure (NT$ million)	R&D expenditure as a percentage of GDP (%)	Researchers per 1000 employment	
			R&D personnel (FTE)	R&D personnel (headcount)
2000	197,631	1.94	5.8	7.3
2001	204,974	2.06	6.4	7.8
2002	224,428	2.16	7.4	9.9
2003	242,942	2.27	7.8	10.5
2004	263,271	2.32	7.3	11.1
2005	280,980	2.39	7.9	11.7
2006	307,037	2.43	9.4	12.5
2007	331,777	2.47	10.1	13.2
2008	351,911	2.68	10.6	13.9
2009	367,808	2.84	11.6	15.1
2010	395,835	2.80	12.2	15.8
2011	414,412	2.90	12.6	16.3
2012	433,502	2.95	12.9	16.6
2013	457,641	3.00	12.9	16.4
2014	483,493	3.00	12.9	16.4
2015	–	3.05	–	–

Source Indicators of Science and Technology, Ministry of Science and Technology, Taiwan

see Table 7.22.[21] In Table 7.22, one could see that the production share of Taipei science park increased from 59.5% in 2003 to 69.8% in 2015, while the production share from Shin-Chu science park dropped sharply from 34.3 to 14.4% at the same time span.[22]

As the production share increased, the share of total employment of Taipei science park also increased from 37.8 to 45.5% from 2006 to 2015, while the share of total employment at the Shin-Chu science park dropped from 39.8 to 31.3%. It means that Taipei science park has created 10,296 new jobs in ten years, which maybe the only place enjoyed significant growth in the past sixteen years in Taiwan.

[21]There are several industrial parks in Taipei, they all work well because most skilled workers prefer staying in Taipei, instead of going to other science parks in Taiwan.

[22]The total production share of Shin-Chu science park dropped from 87.2 to 34.3% in 2003 is because lots of firms shifted their main offices from Shin-Chu science park to Taipei science park at that year.

Table 7.19 Industrial structure of Taipei: by number of firms. Unit: number of firms, %

Year	Number of firms	Manufacturing (%)	Service (%)	By industries			
				Financial and insurance activities (%)	Real estate activities (%)	Professional, scientific and technical activities (%)	Business (%)
2000	193,039	3.3	92.4		14.1		73.2
2001	191,616	3.1	92.5		14.6		72.8
2002	191,867	3.0	92.6		14.9		72.8
2003	193,403	3.2	92.4		14.5		69.6
2004	195,325	3.2	92.2		15.1		70.6
2005	197,914	3.1	92.2		15.4		70.8
2006	197,754	3.1	92.2		15.8		70.6
2007	196,736	3.1	92.1		16.2		70.4
2008	194,788	3.2	91.7	5.3	2.7	6.4	74.0
2009	196,924	3.3	91.7	5.3	2.9	6.4	73.7
2010	201,154	3.3	91.7	5.3	3.2	6.5	73.2
2011	204,749	3.5	91.4	5.3	3.4	6.6	72.3
2012	208,310	3.5	91.2	5.5	3.6	6.8	71.7
2013	212,893	3.5	91.2	5.6	3.7	7.0	70.6
2014	216,839	3.5	91.1	5.8	3.9	7.2	70.1
2015	220,966	3.6	90.9	6.1	4.0	7.4	69.4
2016	224,499	3.6	90.9	6.2	4.0	7.5	67.7

Source Department of Budget, Accounting and Statistics, Taipei City Government, Taiwan
Note Business-related industries include Wholesale & Retail Trade, Transportation & Storage and Accommodation & Food Services

7.7.5 Conclusion

In general, the relationship of housing price and household income could be an-inverted U-shape in that housing price could be no good for a city's competitiveness if the housing price there is either too low or too high. Though housing price in Taipei is much higher than other cities in Taiwan, but it is still lower than other cities in this Asian region, therefore, Taipei is still competitive in abstract foreign investment. Moreover, though housing price is relatively high, the rental housing price is still very reasonable and it is comfortable if one chooses to stay at a rental house in Taipei. Furthermore, Taipei has abundant of high quality and inexpensive skilled workers, so Taipei is suitable for high tech companies to stay.

However, Taipei is also facing some serious problems mainly from national level, such as low GDP growth rate, low consumption rate, low investment rate, and so on. Furthermore, there are several important national economic policies which

Table 7.20 Industrial structure of Taipei: by total output. Unit: NT$ million, %

Year	Total sales	Manufacturing (%)	Service (%)	By industries			
				Finance and insurance (%)	Real estate (%)	Professional, scientific and technical (%)	Business (%)
2000	9,598,677	13.0	81.4		26.6		64.1
2001	8,749,928	11.8	82.2		27.8		62.9
2002	8,886,940	13.4	80.7		25.1		65.7
2003	10,015,849	13.5	81.0		27.1		54.5
2004	11,708,508	13.6	80.6		31.5		54.5
2005	13,126,304	12.2	83.0		42.0		46.7
2006	12,838,642	13.3	81.9		40.2		49.2
2007	12,694,160	14.2	80.6		37.6		52.1
2008	11,893,019	14.8	79.1	24.5	3.9	3.7	59.9
2009	10,230,308	13.6	79.9	21.6	4.7	4.0	60.7
2010	11,810,841	15.0	77.9	19.8	4.8	4.0	62.5
2011	12,283,808	16.2	77.9	20.7	4.0	4.0	61.6
2012	12,030,354	16.3	77.5	17.8	4.6	3.8	62.2
2013	12,152,565	16.0	77.9	17.6	5.3	3.8	62.1
2014	12,810,834	15.4	77.5	17.7	5.1	3.6	61.7
2015	12,589,228	14.7	79.0	19.0	4.9	3.7	60.7
2016	12,213,584	13.4	80.2	17.4	4.7	3.6	60.6

Source Department of Budget, Accounting and Statistics, Taipei City Government, Taiwan
Note Business-related industries include Wholesale & Retail Trade, Transportation & Storage and Accommodation & Food Services

have significant impact on the competitiveness of Taipei. For instance, the Legislative Yuan in Taiwan had just past such a severe national labor law last year, which will increase a significant amount of labor cost. The other example is the policy toward economic integration with other countries in this region, including signing FTAs, and so on. Taiwan is a typical small open economy and is highly relied on foreign trade, it is very crucial for Taiwan to sign FTAs with others. However, comparing to Singapore, Korea, Japan, Taiwan is far behind in signing FTAs, it hurts Taiwan's national competitiveness and so is for Taipei's competitiveness as well.

7.8 Foshan, China

Xiao Geng

University of Hong Kong, Hong Kong, China

Table 7.21 Industrial structure of Taipei: by number of employees. Unit: thousand Persons, %

Year	Number of employees	Manufacturing (%)	Service (%)	By industries			
				Financial and insurance (%)	Real estate (%)	Professional, scientific and technical (%)	Business (%)
2000	1137	14.9	77.9		30.2		47.5
2001	1110	14.8	79.4		31.6		44.8
2002	1116	14.6	79.8	10.5	1.0	7.6	45.9
2003	1119	13.8	80.2	10.1	1.2	7.2	46.9
2004	1134	13.8	80.4	10.4	1.3	9.3	45.8
2005	1135	13.4	80.5	10.9	1.4	9.8	44.2
2006	1143	13.4	80.3	10.9	1.2	10.3	45.0
2007	1165	13.0	80.7	10.2	1.3	7.4	42.2
2008	1182	12.9	81.0	10.3	1.3	7.4	41.8
2009	1168	13.1	80.6	10.9	1.1	7.3	41.1
2010	1174	12.8	80.5	11.4	1.2	7.5	40.3
2011	1207	12.6	80.5	11.0	1.2	7.0	40.7
2012	1224	13.0	80.8	10.8	1.3	7.6	40.8
2013	1243	13.4	80.5	10.9	1.4	7.9	39.7
2014	1262	13.1	81.1	10.9	1.5	7.5	37.6
2015	1275	13.1	80.9	10.4	1.4	9.0	37.5
2016	1280	13.1	80.8	10.5	1.5	9.0	37.3

Source Department of Budget, Accounting and Statistics, Taipei City Government, Taiwan
Note Business-related industry include Wholesale & Retail Trade, Transportation & Storage and Accommodation & Food Services

7.8.1 Introduction

In 2016 the total area of residential housing sales in Foshan surpassed each of the four first-tier cities (Beijing, Shanghai, Guangzhou and Shenzhen), accounting for 1/40 of the national total. Since 2016, 14 non-local real estate developers have come to Foshan, including nearly all of the key national-level developers.[23] The massive expansion in residential housing and new towns (*xin cheng*) generated concerns about overcapacity in housing and the possibility of creating ghost towns (*gui cheng*). Unlike Guangzhou and Shenzhen, which are recognized as “first-tier cities” in China, Foshan is merely the third largest prefecture-level cities by size of GDP within Guangdong province. However, Foshan ranked among China’s top 20 economically strong cities in 2016 with its GDP reaching RMB 863 billion. Its housing prices are much lower than in Shenzhen and Guangzhou, making it affordable for many migrants of skilled professionals working in Guangzhou. Based

[23]From Guangzhou Daily: http://gzdaily.dayoo.com/pc/html/2017-09/08/content_60_1.htm; Based on our interviews with local officials.

Table 7.22 The performance of science and technology parks in Taiwan. Unit: Person; NT$100 million; %

Year	Number of employees (persons)	Percentage (%)				Total sales (NT$100 million)	Percentage (%)			
		Taipei[a] Science Park	Hsinchu Science Park	Central[b] Taiwan Science Park	Southern[c] Taiwan Science Park		Taipei[a] Science Park	Hsinchu Science Park	Central[b] Taiwan Science Park	Southern[c] Taiwan Science Park
2000	96,677	–	100.0	–	–	9,540	–	97.4	–	2.6
2001	102,236	–	90.7	–	9.3	7,127	–	93.0	–	7.0
2002	109,007	–	86.6	–	13.4	8,086	–	87.2	–	12.8
2003	117,572	–	82.6	–	17.4	25,006	59.5	34.3	–	6.2
2004	145,953	–	73.0	4.6	22.5	–	–	–	–	–
2005	166,820	–	67.9	6.4	24.7	37,249	62.4	26.5	1.6	9.5
2006	305,057	37.8	39.8	5.9	15.5	44,606	60.7	25.1	4.0	10.1
2007	326,078	37.1	39.7	6.6	16.6	51,496	61.7	22.3	5.2	10.9
2008	326,345	37.8	40.0	6.4	14.8	49,559	62.8	20.3	5.8	11.0
2009	326,115	37.5	40.5	6.1	14.9	43,062	63.2	20.5	5.6	10.7
2010	355,886	37.4	39.2	6.6	15.8	63,249	65.9	17.8	5.7	9.6
2011	402,857	41.0	36.9	6.6	15.5	58,156	67.2	17.8	5.0	10.0
2012	–	–	–	–	–	–	–	–	–	–
2013	450,325	43.6	33.7	6.9	15.7	71,053	69.2	15.7	6.5	7.7
2014	–	–	–	–	–	–	–	–	–	–
2015	486,417	45.5	31.3	6.8	16.4	76,471	69.8	14.4	6.4	9.4
2016	–	–	–	–	–	–	–	–	–	–

Source Taipei City Government; Hsinchu Science Park; Central Taiwan Science Park; Southern Taiwan Science Park
[a]Taipei Science Park includes Neihu Technology Park, Da-wan industrial park, and Nankang Software Park
[b]Central Taiwan Science Park includes Taichung Park, Houli Park, Huwei Park, Erlin Park, and Advanced Research Park
[c]Southern Taiwan Science Park includes Tainan Science Park and Kaohsiung Science Park

on cross-city data and first-hand materials from field work in Foshan, this article illustrates the impacts of Foshan's housing market on Foshan's economic competitiveness as well as the challenge to the Foshan's local governments on developing affordable, resilient, and sustainable housing market.

7.8.2 Economic Growth and Competitiveness in Foshan

The diversity of China's economy across regions and sectors are well known. But the challenge of developing affordable, sustainable, and resilient housing market is particularly important for China's top 20 cities by GDP which together account for more than 35% of China's GDP since they signal the future of China's economy and society.

If we rank China's top 20 economically strong cities by their GDP per capita, an indicator of productivity and income, as shown in Table 7.23, 18 cities have passed the 12,236 USD threshold of high-income economies as defined by the World Bank for the 2018 fiscal year.[24]

In China's administrative hierarchy, some cities have been granted higher political and economic status to promote their development. For example, among the top 20, four cities, including Beijing, Shanghai, Tianjin, and Chongqing are designated as centrally-administered municipalities (*zhi xia shi*). Another five cities, including Guangzhou, Hangzhou, Nanjing, Wuhan, and Chengdu, are designated as deputy-provincial-level cities (*fu sheng ji cheng shi*). Shenzhen, Qingdao and Ningbo, have separate planning from their provinces with deputy-provincial rank (*jihua danlie shi*). Shenzhen is also a Special Economic Zone (*jingji tequ*). Apparently, the special political status of the 12 cities seems to have helped the expansion of their local economies.

However, among the top 20, there are 8 cities which have no special political status, including Suzhou, Wuxi, and Foshan. A lot of scholarly attentions have been given to Suzhou and Wuxi through the so-called "Sunan Model" in the past. But recently more and more scholars and policy-makers have started to appreciate the more market-oriented "Foshan Model".[25]

Among the top 20, Foshan only ranked 15th by size of GDP, but its GDP per capita at US$17,387.9 ranked 8th, higher than Beijing's US$17,097.6 and Shanghai's US$16,665.0, and is 220% of the national average of US$7923.5. Meanwhile, Foshan's financial leverage as measured by the ratio of loan over GDP was among the healthiest at 101%, ranked as the 3rd lowest, only higher than Dongguan and Yantai, and is significantly lower than the national average of 143.3%, indicating relatively healthy conditions with low financial leverage.

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[24]Retrieved from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

[25]See Xiao Geng, Zhang Yansheng, C. K. Law, and Dominic Meagher. The Future of China: The Foshan Model. The CITIC Press. 2017.

Table 7.23 Productivity, scale, and financial leverage of top Chinese cities: 2016

City	GDP per capita		GDP		Loan/GDP	
	USD per person	Rank	Billion USD	Rank	Percent	Rank
Shenzhen	25,365.3	1	293.5	4	207.9%	15
Suzhou	21,947.2	2	233.0	7	147.0%	8
Guangzhou	21,865.6	3	295.2	3	151.3%	10
Wuxi	21,022.7	4	137.7	14	114.2%	5
Nanjing	18,972.9	5	157.1	11	212.0%	16
Changsha	18,534.9	6	140.4	13	147.7%	9
Hangzhou	18,019.1	7	166.4	10	234.4%	18
Foshan	*17,387.9*	*8*	*129.9*	*15*	*101.0%*	*3*
Tianjin	17,333.5	9	269.3	5	160.8%	11
Beijing	17,097.6	10	374.9	2	256.0%	19
Wuhan	16,717.9	11	179.3	9	174.2%	12
Shanghai	16,665.0	12	413.5	1	217.4%	17
Qingdao	16,459.9	13	150.7	12	129.4%	6
Ningbo	16,436.6	14	127.6	16	194.2%	14
Yantai	14,767.7	15	104.3	18	67.4%	1
Nantong	13,524.5	16	101.9	20	101.9%	4
Zhengzhou	12,391.5	17	120.4	17	192.9%	13
Dongguan	12,140.5	18	102.8	19	95.9%	2
Chengdu	11,924.9	19	183.2	8	n/a	n/a
Chongqing	8,400.4	20	264.3	6	145.4%	7
National Level	7923.5		11202.9		143.3%	

Source CDMNext (CEIC) database, National Bureau of Statistics and various statistical bureau websites
Note (1) Suzhou, Wuxi and Nantong are not included in "35 Major Cities" when it comes to property price measured by NBS. Suzhou's data comes from SINA finance
(2) Numbers in "()" denote the ranks in each column

The outstanding performance in productivity and financial leverage of Foshan shows that its economic competitiveness is strong and solid. This competitive edge of Foshan is the driving force for the job opportunities there and attracts inflows of talents, capital, and firms, which all create housing demand in Foshan.

7.8.3 Housing Affordability in Foshan: Major Features of Foshan's Housing Market

Under strong, solid, and perhaps underestimated economic competitiveness, would Foshan's housing price keep growing just as what we are witnessing in metropolis like Shanghai, Shenzhen, Hong Kong? Let's look at the affordability-related characteristics of Foshan's housing market.

Table 7.24 Cost of 100 m^2 housing/GDP per capita of major Chinese cities: 2011 and 2015

City	2011[a]		2015	
	Years	Rank	Years	Rank
Changsha	6.1	1	4.8	1
Suzhou	7.9	2	9	5
Wuhan	7.5	3	7.1	3
Qingdao	7.7	4	7.2	4
Foshan	*9*	*5*	*7.8*	*2*
Tianjin	9.2	6	9.2	6
Nanjing	9.5	7	9.5	7
Ningbo	9.9	8	10.8	9
Guangzhou	10.3	9	10.3	8
Hangzhou	11.4	10	13.1	10
Shanghai	15.8	11	20.7	11
Shenzhen	17.1	12	21.3	13
Beijing	17.7	13	20.9	12
National	14.1		13.1	

Sources CDMNext (CEIC) database, National Bureau of Statistics and various statistical bureau websites
Notes Given data availability of both 2011 and 2015, here this table only includes 13 cities
[a]Denotes to how many years one could purchase 100 m^2 house measured by GDP per capita

Is Foshan's Housing Affordable?—When we started tracking cross-city indicators in 2011, we used the ratio of cost of 100-m^2 housing over GDP per capita as an indicator of housing affordability since the two variables can be easily obtained across many cities. In Table 7.24, we show the affordability index for 13 cities in both 2011 and 2015. Foshan's affordability for 100-m^2 housing improves from 9 years of average income (per capita GDP) in 2011 to 7.8 years in 2015. Foshan's affordability ranking also improved from 5th to 2nd. Foshan's effective cost of housing is 75% of Guangzhou's level, 60% of national average, and merely 36.6% of Shenzhen's level. Foshan witnesses the greatest drop in housing affordability other than Changsha, which is the provincial capital city of Hunan Province.

Is Foshan's Housing Market Resilient?—Figure 7.45 shows the trend of residential housing prices for Foshan and the four "first-tier cities" from 2005 to 2016. In contrary to the fluctuations witnessed in Beijing, Shanghai, and Shenzhen, the housing prices in Guangzhou and Foshan are very smooth. Comparing Guangzhou with Foshan, Guangzhou's housing prices also bounced higher than Foshan's in the wave of housing price surge in 2016. As of 2016, Guangzhou's housing price is nearly two times of Foshan's level. Normalized by productivity or income, Beijing, Shanghai and Shenzhen show apparent instability compared with Guangzhou and Foshan during 2005–2015. Facing various external economic shocks such as global financial crisis during 2008–2009 and nation-wide housing boom in 2015–2016,

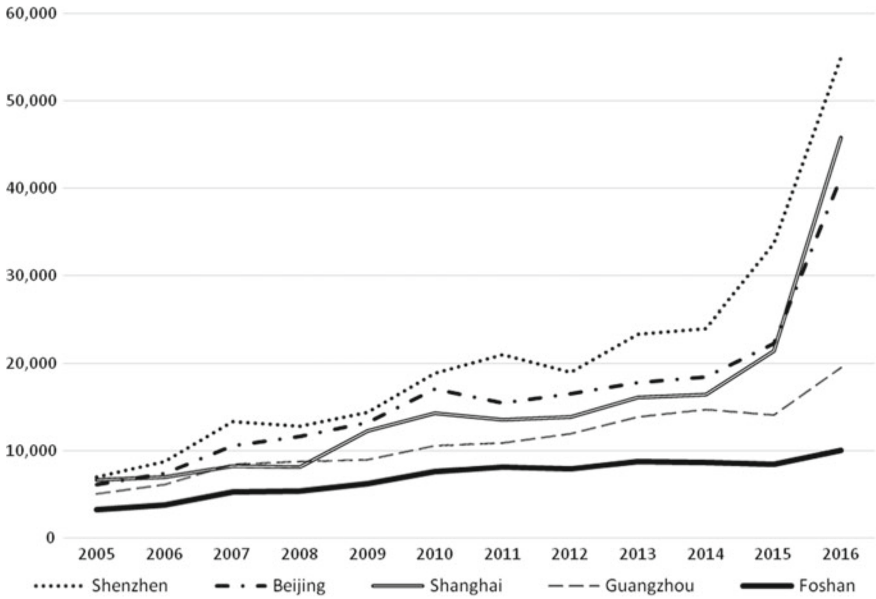

Fig. 7.45 Average housing price of selected cities: 2005–2016 unit: Yuan/m^2. *Notes* Due to data availability, Beijing, Shanghai, Guangzhou and Shenzhen's 2016 year-end data was replaced by data as of November 2016, which was retrieved from Fang.com by survey samples instead of NBS. Therefore, inconsistency of calibers exists between 2005–2015 data and 2016 data of each city. *Sources* CDMNext (CEIC) database, National Bureau of Statistics and various statistical bureau websites, Fang.com Index: http://fdc.fang.com/index/BaiChengIndex.html

Foshan's relatively stable housing prices show the resilience of Foshan's housing market and is a rare exception among China's cities.

Is Foshan's Housing Market Sustainable?—From a supply-demand perspective, the potential of population growth and migration would significantly contribute to the demand of housing. As shown in Table 7.25, during 2000–2010, Foshan witnessed 3.03% annual population growth rate, higher than Guangzhou's 2.48%, much higher than Guangdong's provincial average of 1.9% and the national

Table 7.25 Population growth during 2000–2010

	2000 (10 thousand)	2010 (10 thousand)	Growth during 2000–2010 (%)	Average annual growth rate (%)
Shenzhen	700.84	1,035.79	47.8	3.98
Guangzhou	994.3	1270.08	27.7	2.48
Foshan	533.79	719.43	34.8	3.03
Guangdong	8,642	10,430.31	20.7	1.9
National	126,582.50	133,972.49	5.8	0.57

Sources Various reports from the Sixth Population Census (2010) average of 0.57%. Foshan realized 34.8% population growth over the 10 years of 2000–2010. Such momentum was also pointed out by HSBC study, highlighting Foshan's expanding job opportunities as a key factor in driving housing demand (ranked 4th of all phoenix cities in China).[26]

The Impacts of Housing Price on the Economic Growth and Competitiveness in Foshan

Housing markets in China are under close watch by financial institutions, the governments, and the public. The HSBC Global Research published a report on catching "the phoenix cities" in China, which ranked Foshan the fourth highest in the attractiveness of housing investment.[27] However, investment value may not necessarily be consistent with other social objectives. Though grows at a slower pace compared with other major cities in Guangdong, Foshan's housing price still poses challenges on its traditional industrial model as well as opportunities.

Upgrading Original Industrial Model under the Pressure of Growing Housing Price

Higher housing prices not only contribute to the rising costs of labor but also reduce the living standard of low income households who would not be able to buy expensive housing. Also, rapid rise in housing prices may trigger speculative investment into real estate, thus hindering the sustainable development of housing market and the real economy.

Given the rising trend of residential property price, labor cost, and environmental expenditures, Foshan's traditional low value-added manufacturing model is under serious challenge. Foshan's overcapacity in traditional manufacturing needs to be cut and upgraded to higher value-added manufacturing and production services. Hence, Foshan's government proposed "Master Plan of Supply-side Reform 2016–2018", encouraging market-oriented industrial upgrading, such as promoting quality of the product, expending supply chains, improving efficiency of resources allocation etc. By adopting these measures, Foshan is moving towards intelligent manufacturing, technology-intensive industry, and producer services. As of 2016, Foshan's modern producer services accounted for 57.5% of its tertiary industry.[28]

Opportunities for Foshan: Price Advantages Compared with Neighboring Cities

Located at the geographic center of the economically vibrant Pearl River Delta, Foshan serves as the most important manufacturing base in the "Guangdong-Hong Kong-Macau Greater Bay Area (*Yue Gang Ao Da Wanqu*)", which is projected to be the fourth largest bay area economy in the world, following New York, San Francisco, and Tokyo. Such grand blueprint indicates expectation of massive

[26]Kwok. China Real Estate: Catching Phoenixes.

[27]Michelle Kwok. June 2017. China Real Estate: Catching Phoenixes. *HSBC Global Research*.

[28]From materials provided by Foshan Bureau of Housing and Urban-Rural Development.

inflows of people, business, and investment into "Greater Bay Area" over the next few decades.

Consistent with this expectation and as a pioneer of China's reform and opening up, Guangdong province has been developing many big cross-city infrastructures to promote better allocation of resources across cities and curb unhealthy local protectionism. Shenzhen-Zhongshan transportation corridor, which connects two shores of the Pearl River Delta is expected to be completed in 2020. Hong Kong-Zhuhai-Macau bridge-tunnel is expected to be in operation by the end of 2017. The high-speed rail linking Hong Kong and Shenzhen will be in operation in 2017. These public infrastructure projects will likely to improve significantly the connectivity in the greater bay area of the Pearl River Delta, benefiting particularly the regions with relatively low costs of housing.

Earlier in 2009, Guangzhou and Foshan officially initiated the cross-city integration and collaboration on transportation infrastructures. The metro line linking Foshan and Guangzhou was planned to break the administrative barriers between these two cities and further promote the cross-city economic integration. Foshan Metro Line One, which completed in 2010, was the first metro line in China's third-tier cities or the regular prefecture-level cities (*di ji shi*).

The growing proximity between Guangzhou and Foshan raise the possibility that enterprises/individuals may consider relocating to cities with cheaper cost of living that are in the vicinity of the headquarters, as predicted by HSBC.[29] The price advantages of Foshan generate opportunities for Foshan to attract large multinational and national corporations with headquarters in Guangzhou, Shenzhen and Hong Kong to move their services centers to Foshan, which is the major reason for the success of the Guangdong High Tech Service Zone for Financial Institutions created in Foshan, where HSBC, AIA, China Merchant Bank and many other financial institutions have their data centers.

7.8.4 Real Estate Related Policies in Foshan

Foshan's price advantages further raise the issue of how to maintain the balance of housing market demand and supply. The dynamics of housing demand and supply becomes the key for understanding the housing market. The role of local governments is also crucial in shaping the market dynamics.

External Sources of Demand for Foshan's Housing

Apart from robust economic competitiveness that would generate stable housing demand, Foshan also faces external demand shocks given its geographical position. As addressed by Foshan Bureau of Housing and Urban-Rural Development, the

[29]Kwok. China Real Estate: Catching Phoenixes.

tighter housing policies in Guangzhou and Shenzhen might increase housing demand in neighboring cities such as Foshan.[30]

The demand spill-over from Guangzhou could be seen clearly in Table 7.26, which shows Foshan's housing price and housing area sold by district over time. Evidently, other than Foshan's traditional urban and administrative center Chancheng District where the Foshan municipal government is located, Nanhai District is leading Foshan's housing price as well as housing area sold among its districts. Nanhai District is located next to Guangzhou, and a good part of the public infrastructures planned by Foshan for promoting Foshan-Guangzhou integration, such as the Financial Hi-Tech Zone and several metro stations, are located in Nanhai.

7.8.5 Understanding Housing Supply in Foshan

To curb the explosive increase in housing price in recent years, many cities have proposed "restrictions on housing-purchase (*xian gou ling*)" to reduce the demand pressure. Compared with neighboring cities like Guangzhou and Shenzhen, Foshan's housing policies are targeting more on relaxing supply than restricting demand. The growing economic competitiveness of Foshan and the spillover demand on housing from Guangzhou and greater Pearl River Delta bay area both help to sustain the demand on housing in Foshan. Facing with strong and rising demand on local housing, it is critically important for local governments to develop strategies that could increase supply of housing to a suitable level which could avoid both housing price bubble and housing overcapacity.

To appreciate Foshan's housing supply, Fig. 7.46 shows the ratio of housing area sold over population for Foshan and four first-tier cities and Fig. 7.47 shows the housing price of the same set of selected cities. It is clear that Foshan's housing area sold per capita increased sharply during 2011–2016 while its average housing prices have been very stable with a healthy upward trend. On the other hand, for the four first-tier cities, their housing area sold per capita has been very stable without much increases while their housing prices increased sharply since 2015.

In another word, the housing price bubble in the first-tier cities is most likely due to the limitation of their housing supply. On the other hand, the much smooth and gradual increase of housing prices in Foshan can be attributed to its aggressive increase in housing supply. While Shenzhen ranks the bottom in terms of housing area sold per capita its housing price surge in recent years was steepest among the five cities shown in above figures. Compared with Foshan's flexible land and housing supply, the four first-tier cities were not able to increase their land and

[30]Media describes Guangzhou citizens rushed to Foshan for purchasing properties after Guangzhou proposed restrictions: http://news.sina.com.cn/c/nd/2017-03-19/doc-ifycnpvh4944542.shtml.

Table 7.26 Total area and average price of housing sales in Foshan and its Districts. Units: 10 thousand m^2 for area and Yuan/m^2 for price

	2016.10		2016.11		2016.12		2017.01		2017.02	
	Total area	Average price	Total area	Average price	Total area	Average price	Total area	Average price	Total area	Average price
Overall	216.80	10049.00	143.80	10955.89	136.23	10067.56	117.67	9867.45	57.11	10142.10
Chancheng	25.41	11956.61	7.51	13042.43	17.12	12090.51	12.86	11985.92	6.59	12029.98
Nanhai	80.65	12292.26	70.13	13363.39	46.60	11599.44	43.93	11922.28	24.72	11801.55
Shunde	55.17	9671.31	31.92	9857.25	39.96	9992.33	27.56	9083.18	10.92	9747.56
Gaoming	21.26	5424.75	14.97	5287.34	13.12	6175.31	16.88	6794.71	6.69	6342.40
Sanshui	34.32	7030.75	17.28	7307.63	17.43	7146.64	17.44	7349.52	9.19	7555.21

Source Materials from Foshan Bureau of Housing and Urban-Rural Development

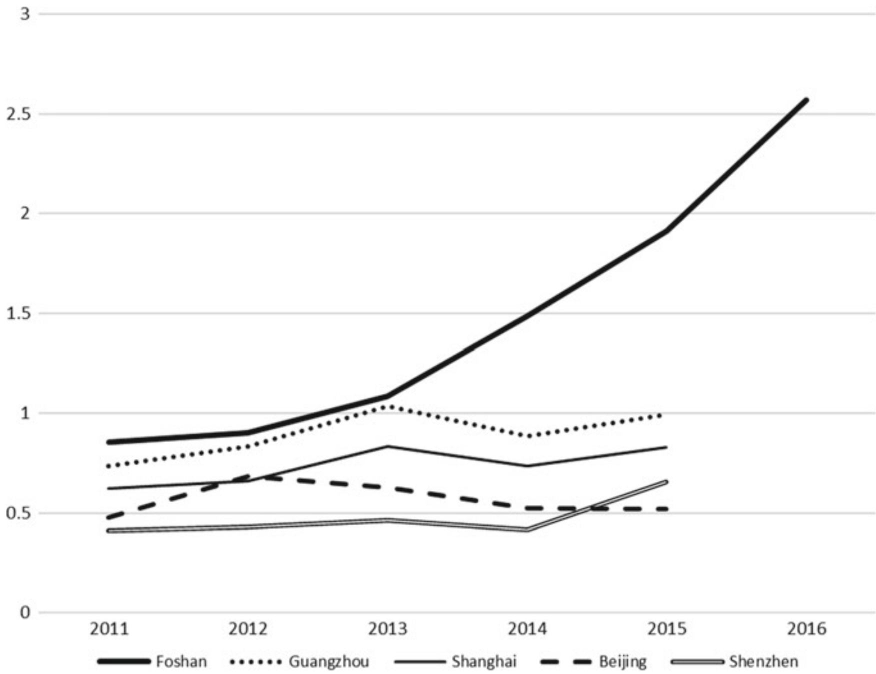

Fig. 7.46 Total area of housing sales/population unit: M^2/Person. *Notes* For calculation purpose, we simply adopt each city's 2015 sample survey population (based on 1% population) for each year. Given data availability, we only present Foshan's 2016 data here. *Source* Materials from Foshan Bureau of Housing and Urban-Rural Development, National Bureau of Statistics

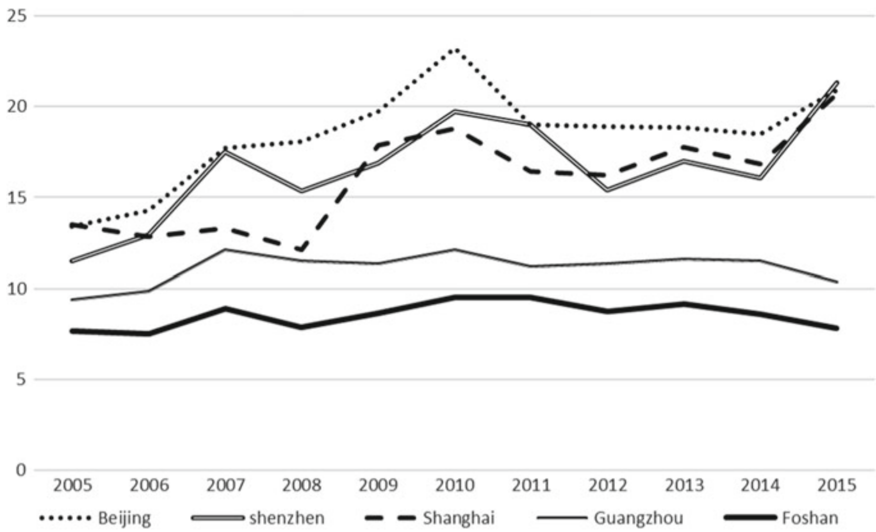

Fig. 7.47 Housing affordability of major Chinese cities: 2005–2015 (ratio of cost of 100 m^2 housing over GDP per capita) unit: Years. *Sources* CDMNext (CEIC) database, National Bureau of Statistics and various statistical bureau websites

housing supply effectively. This seems the key factor for the explosive increase in housing prices in the first-tier cities.

Local governments in Foshan has been very aggressive in pushing the increase of land supply through the city-upgrading program "Renovating Old Towns, Old Factory Buildings and Old Village Houses (*san jiu gai zao*)". Foshan was acknowledged by the Ministry of Land and Resources as the pioneer of "Decisions on Renovating Old Towns, Old Factory Buildings and Old Village Houses" in 2007, which led to the establishment of provincial guidelines in 2009.[31] Moreover, close monitoring and regulating real estate developers is another "supply-side" reform in housing market initiated by Foshan. Foshan government has issued "The Announcement of Further Promoting Healthy Development of Housing Market" in Oct 2016, proposing several key measures to stabilize the housing market, including:

Establish Mechanisms for coordinating and managing comprehensively the housing market;
Implementing purchasing limitations based on regional conditions and disparities;
Real time monitoring on abnormal price hike, as well as suspension on property projects that submit unreasonable prices;
Heavy punishment on illegal behaviors that try to push up the housing price;
Guiding and encouraging investment in real economy, accompanied with industrial upgrading reforms.

For residential housing, Foshan government has set a target to reduce inventory by 1.6 million m^2 during 2016–2017. However, due to nation-wide boom in housing market as well as effective implementation of various action plans, Foshan achieved reduction of housing inventory as much as 4.35 million m^2 in 2016 alone, which is 270% of total inventory reduction target for 2016–2017. Since Guangdong's provincial inventory reduction target for 2016–2018 was set at 10 million m^2, Foshan's inventory reduction in 2016 accounted for almost 50% of the provincial total for three years, which indicates Foshan's tremendous capacity in digesting the housing market expansion. As confirmed by local officials, Foshan has managed to stabilize its housing price after entering 2017.

7.8.6 Conclusion

Forced by growing housing price, Foshan's original developmental model needs to be reformed. Given the nature of Foshan's housing market, Foshan also faces with opportunities to utilize its advantages in light of the Guangdong-Hong Kong-Macau Bay Area development blueprint. Under such circumstances, Foshan's strong

[31]Various city-level land and resources bureau, for example, Ministry of Land and Resources of China: http://www.mlr.gov.cn/xwdt/jrxw/201205/t20120523_1101983.htm.

competitiveness creates job opportunities and sustainable demand for local housing. The timely and effective supply responses, facilitated by local governments, helped to maintain the stability of housing prices in Foshan, making housing much more affordable than most cities in China when productivity or income per capita are taken into account. The stable housing prices and flexible land supply also helped Foshan to develop a rapidly expanding and resilient housing market. Going forward, local governments in Foshan also started to focus on the "last miles" public infrastructure development with aim to improve the living standards of local residents, local environment, and industrial upgrading and innovation. The Foshan approach, with focus on the real economy and market forces, avoided excessive speculation in real estate market and achieved much bigger expansion in the housing area sold in recent years than each of the first-tier cities, benefiting both local and migrant people in Foshan. If the first-tier cities can learn from Foshan, the risks of China's housing bobble could be reduced significantly.

7.9 Spanish City: Madrid, Valencia and Bilbao

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7.9.1 Introduction

City competitiveness and the channels through which cities growth faster than others is a key issue in the developed countries. The role that the cities are playing on the global economy networks allows them to compete in better conditions generating economic benefits for the citizens in terms of skills, knowledge and better wages (Glaeser and Maré 2001) promoting relocation of household into cities and enlarging the potential of the city as a large and complete production system.

Several studies demonstrate how urban areas provide larger productivity in economic activities as they expand, what is known as the 'Urban Productivity Premium' (Maré 2016). It is far known that labour market shows those benefit with larger human capital associated to jobs and higher salaries which are product of the larger productivity as the cities concentrate more specialised activities, well explained by the agglomeration theories (Fujita). The empirical evidence support the idea of the existence of a relationship between city size and productivity, as in Sveikaukas (1975) who established that a doubling of city size is associated with a 6% increase in labour productivity.

The role of real estate is key to support economic activities and efficient labour markets as well as to offer a good environment to the citizens. In fact, real estate market is the city as such: a set of buildings whose space is used for economic, social or household purposes.

The efficiency of real estate markets and how flexible their mechanisms are, are also a key to understand the city dynamics. The economic activities require that real estate markets (both residential and non-residential sectors) respond quickly to their demands avoiding to create constrains or barriers for inputs and resources to move.

One of the more common examples of these barriers is how the housing market responding to labour mobility. When a city exhibits housing supply constraints, any increase on industrial or services activities (which has the effect of rise the number of jobs) results on both limiting its expansion due to the lack of decent houses available for rent or sell, or with available houses at expensive prices. There is a great paradox well reported by Gyourko et al. (2006) when define the 'superstar cities': the city success competing with others creates a very wealthy city for business which attracts wealthy people at large creating competition for the existing housing and increasing housing prices.

Large housing prices force workers in less-productivity sectors to move outside looking for affordable houses to live and increasing travels to work. Commuting is the result, as an increasing phenomenon associated to the city competition since three decades ago and rising as the city size does. But when commuting takes longer than a reasonable both time or cost due to the spatial diffusion of the housing market and prices, the excessive housing costs in the city could act as a barrier for firms or movers and would prevent the economic activity of growth because the lack of workers.

Housing provision (new supply) or supply mechanism is the transmission channel in which most of literature relates productivity and housing market. Blumenthal et al. (2016) suggests that a lack of housing (or a fail in the housing market mechanism) reduces productivity in cities as '*competition for limited housing units pushes job-seekers away from centers of economic activity*' (ibid. p. 2). The result is that the richest households gain in such competition, creating cities with large accumulation of rich and middle-rich citizens (Gyourko et al. 2006) affecting the income distribution and making other households to move towards more affordable areas (Furman 2015).

Some evidence of this phenomena has appeared recently in several researches. For instance, Glaeser (2006) demonstrates that housing costs has been associated with declines in employment and income, and a loss of population in metropolitan areas. There are insufficient supply of housing in high-cost cities in the US (Hsieh and Moretti 2015) and Ganong and Shoag (2017) empirically show that a flow of less-skilled workers to high-paying-job cities have declined as a result of expensive housing. Glaeser et al. (2005b) also sets that regulation that reduces housing supply have substantial impact on housing and labour market dynamics.

The solution for less-skilled workers (assuming lower salaries and productivity) is to commute to further areas, suggesting the key role played by transport infrastructures.

It can be said that housing prices constitute a ceiling for economic development unless the wealthy and smart city applies measures or establishes flexible systems to allow housing provision. The ability of housing markets in the city to respond by constructing new units to any increase in housing demand coming from both labour or income shocks, is important to its economic well-being (Glaeser et al. 2005).

7.9.2 Economy and Housing Prices' Links. Theoretical Base

"Fast productivity growth in three main American cities (New York, San Francisco and San José) increased local housing prices and local wages, but employment did not expand accordingly" (Hsieh and Moretti 2015).

The mechanism to which the economy and the housing market are related is well-known in housing economics. DiPasquale and Wheaton (1994, 1996) identified the channel to which an increase in economic activity results in a rise in housing prices, the direction and its effect on the real estate cycle. The sense of the effect is not, as believed, through firms' costs which do not directly increase due to housing prices (unless the firm would eventually cover its workers' housing costs). The effect is posterior, directly affecting housing purchase capacity through the increase in wages due to larger productivity or the increase of workers due to expansion of production.

Basically, what DPW model and other studies support is the fact that any increase in the basic housing demand affects the price level in the short run. Rising demand could come from the natural population growth (new household creation) and/or migration (new households appearing in the city). Every market has a stable population growth or migration rate to which the housing market mechanism is adjusted to; that is, the housing market holds a vacancy or unoccupied stock (or build a stable number of new units according to it) which is proportional to market size and results enough to attend the 'stable' demand in the long term. When the housing market absorption is enough to satisfy the amount of new demanders, housing prices are stable or growth at their long term rate.

In the short run, the housing market capacity (increasing the supply) to respond to new housing needs is limited as the stock is fixed (that is, the total units available to be habited cannot increase rapidly because development needs time to be completed and some regulatory limitations would make the new construction reacts slowly), and new-enters should meet the amount of houses already supplied (the vacant units). In the case that the increase in demand is larger than the existing vacancy in the market (or an unexpected shift in the demand happen) then the rent prices go up. This is the only reason, from the basic demand perspective, to justify the increase in prices.

DPW also explains the financial mechanism responsible to transmit the rent increases (resulting from a demand pressure) into housing prices (and in the real estate prices in general). Property prices (that is, the price of the real estate asset—a building or a house) maintain a relationship with rent prices associated with the benefits generated by the property as a capital good. The capitalization rate is the relationship itself and the variable making the developers to react starting construction. The capitalization rate is very stable in the long term so that when rents rise, housing prices also rise at a similar rate. Cap-rate can change exogenously depending on whether there are changes in the financial system or capital markets affecting the capital asset returns. For instance, when the interest rates rise *caeteris paribus*, the perception of the amount of capital associated with the property asset changes, and it could increase the demand of financial assets and reduce the one for real estate. The real estate value perceived is lower in that case and, then, the housing prices can fall, stop overpricing or reduce growth rate. It is considered that the housing price growth rate is in equilibrium when it is close to the economic growth (as real estate represents part of fixed capital in the economy and, then, represents part of the wealth).

The Cap-rate can be influenced by the expected return of other investment in the city (or other cities) and compete in attracting capital with them. When the cap-rate in real estate is sufficiently larger than in other investment assets, then capitals go to real estate markets, both through purchasing the existing buildings to manage their rents or building new ones. This situation normally happens in growing cities and make cities to expand the size.

Large cap rates are associated with large housing prices and diminishing house price growth rate, and the larger the housing price growth, the stronger the incentives to build. This is the market mechanism affecting new supply.

At a developer level, and focusing on new supply, the literature well supports that developer responds to market incentives, that is, he or she starts building when see housing prices going up and expectations of larger prices exist when the building is finished. That is why during periods of housing price revaluations, housing development also rises with some lags. When many developers are in the market housing supply industry works under perfect competition what determines markets with larger increases on new housing supply rather than on housing prices.

But it is also common to find the existence of barriers to development in several cities especially in the larger ones. The common barriers would take the form of scarce supply of land, land regulations, permission regulations, non-market interventions (like the one coming from housing policy) or market privileges or power. This type of problems is well summarized in Taltavull de La Paz (2014). When land regulations are flexible, they have weaker effects on new housing decisions to build and developments evolves accordingly with the demand until the land supply is scarce. In the absence of land supply and severe barriers to build, any demand pressure results in a growth of the house price. Some cities where housing prices grow quickly could have experienced such limitation. Those situations can be captured by the new supply elasticity in every city (See Taltavull de La Paz and Gabrielli (2015) for the supply elasticity classification).

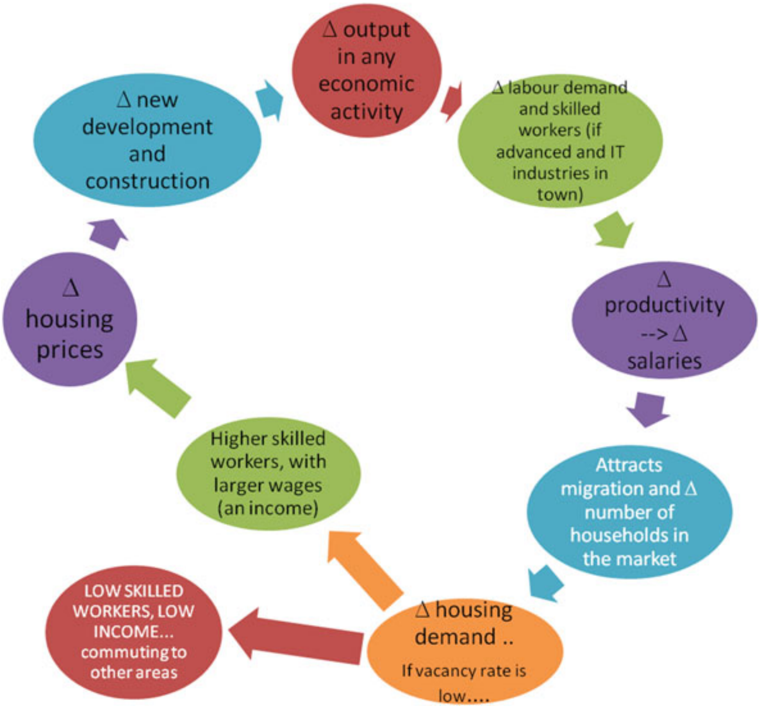

Fig. 7.48 Circle between economic activity and housing prices

Then, summarizing the literature, the process to which any change on economic productivity can affect housing prices can be defined as a 'virtual circle' which starts with an impulse coming from any economic sector in the city (Fig. 7.48).

The circle goes round until the housing prices become unaffordable for a part of the demand which should, then, look for a more affordable houses outside the city and commute towards other urban areas. When the prices reach a certain level to become unaffordable for the main households, then new houses remain in the market, increasing the vacancy rate, and stopping house price revaluation.

However, the impact of housing and real estate construction in the city is a controversy. In wealthy and smart cities, construction and building renovation are more intense due to those cities contribute to strongly human capital creation in sectors with larger and increasing wages (Glaeser and Maré 2001) and requires efficient, modern and advanced buildings. Larger quality construction is associated with longer building life that is a sign of sustainable construction and larger productivity of the real estate investment. A smart city requires innovative buildings promoting efficiency in the economic activities which also increases their productivity. Smart buildings reduce energy consumption, emissions and creates a better environment to work and live, contributing to increase the productivity. That is, high productivities' cities require 'modern buildings' that is, continuous housing quality renovation (investment) making the stock largely efficient and increasing the housing costs.

There is a paradox when modern cities promote building renovation, rises the productivity and increase housing costs which affects negatively to housing affordability. Housing prices acts as a limit of the inflow of the new workers into a city with large productivity gains reflected in larger wages and income gains.

7.9.3 Case Study

The aim of this paper is to test empirically whether some selected Spanish cities show relationships between productivity, efficiency and housing prices. To do that, three cities has been selected: Valencia, Bilbao and Madrid.

The three cities are very different in relation to their structure and organization as well as in their housing markets. Information about economic competitiveness, population mobility, housing densification, construction, prices and demographic indicators are collected in order to show how those variables could explain the differences on cities.

Variables are at the aggregate level for every city. There isn't available micro data for some of the key indicators which would allow to test at the individual level the relationships as Glaeser (2006) did. Some variables are in time series shape for a period from 2004 to 2016 while others only are available for a shorter period forcing to be analysed at the cross-section base.

III.1 Methodology

The case study methodology follows, as explained below, two main steps: the exploratory analysis and the empirical evidence about the relationship between productivity and housing prices. The main problem in this topic is the data availability and the shape of the data structure at city level. Main Spanish statistics are aggregate at the province level and only a few cities have got available long time series observation at the city level to be used in an empirical exercise. That's why this paper follows the two steps: Firstly, it uses the available data according to the literature to give a 'picture' of cities allowing to establish a hypothesis related to productivity and housing prices, and then using the variables with long time series to test the productivity-premium hypothesis.

The variable of interest is city productivity. In Spain there are no data measuring the total income produced in a city and some databases (micro-data) with evidence about productivity have the information at firm level, non-aggregated and mostly belong to restricted databases. This paper has reconstructed the city productivity based on the disposable income by household and using information from two sources: City audit (Eurostat) which publishes the disposable income by household (DIh) for some selected years, and the Spanish Regional Accounts (INE) which publishes the total GDP produced in provinces for a long period. Using the latter as a proxy, the former has been rebuilt from 2005 until 2014 estimating the missing years by every city. Once DIh has been obtained, the total city production is assumed to be the sum of the all households living in the city[32] times the average disposable income. Then, a proxy of the city's productivity of labour is calculated following the formulae (7.1):

$$ProdL_i = \left[\frac{(DIh_i * hh_i)}{Pocu_i}\right] \tag{7.1}$$

and the productivity by firm in the city follows the formulae (7.2):

$$ProdF_i = \left[\frac{(DIh_i * hh_i)}{firms_i}\right] \tag{7.2}$$

where 'i' refers to the city, DIh_i is the disposable income by household in the city 'i', hh_i is the number of households living in the city, $Pocu_i$ is the number of workers in the city 'i' and $firms_i$ is the number of firms located in the city.

Housing prices, starts and transactions comes from the Ministry of Fomento database, which is available on its website (http://www.mfom.es). Rest of information on prices and interest rates comes from the Spanish Institute of Statistics (INE) and Bank of Spain (BdE).

The rest of the indicators have been used for descriptive and exploratory analysis as the available time series is so short to allow them for sophisticated tests. They come from Eurostat, City Audit.

The analytical process followed in this paper has two steps.

1st. Exploratory analysis describing how extent the differences among the three cities relate to the three groups of indicators describing a smart city: productivity (economic growth, labour variables, income and population), city features (transport, firms, size and other characteristics) and housing market features (density, new construction, transaction, housing prices). The idea in this step is to use selected indicators in order to save a picture of how their characteristics could show them closer to what is known as a 'superstar city' in the sense of Gyourko et al. (2006: 26). The literature has given evidence of that the following relationships appears (Glaeser 2006; Hsieh and Moretti 2015):

Superstar cities exhibit larger price to rent ratios than others.

The demand is reflected more in house price growth rather than in housing new units' construction, that is, the superstar cities show low elasticity of supply.

Larger income comes from high productivity, high-income/skill workers shows a larger level of mobility, so as strong mobility is a signal of superstar cities.

As the superstar city is an expensive one, most middle-income workers commute – in the city from other closers urban areas.

[32]As the disposable income is the results (at aggregate level) of add all sources of income (salaries, transfer, capital returns, property returns …) less indirect taxes (see European System of National and Regional Accounts (SEC-2010)).

Changes on employments are negatively related to increase on housing prices.
Housing prices are related to the productivity level.
With the available data, evidences I to IV only can be empirically tested in a descriptive way. However, it is possible to test V and VI.

Albeit of lack of data, the analysis here does permit to identify strong signs of a superstar city in Bilbao and Madrid, but not in Valencia, and give some partial empirical evidence of the limits in the city expansion due to housing costs.

2nd. Step. To test V and VI relationships, a panel is built and regression model is used to give initial evidence of the relationships among productivity, housing prices and employment.

Using panel methods, the following relationships are explored

$$Ph_{it} = \alpha_t + \sum_{\mathrm{i=1...n}} (\beta_t \mathrm{z_{it}})_{\mathrm{t}} + \delta[\mathrm{P_{it}}] + \varepsilon_{it} \tag{7.3}$$

where P is the productivity of city 'I' in time 't'. Z_{it} is a matrix of control variables related to a smart city. Parameters to be estimated are α, β, and δ. The latter is the parameter of interest as it captures the sensibility between housing prices and city productivity. The model includes fixed effects by city and δ is allowed to vary on time as the theoretical relationship is not direct. Endogeneity will also controlled in Eq. (7.1). The relationship between employment and housing prices can be estimated simultaneously in the model by including the variable capturing number of effective works as part of the matrix Z.

III.2. Descriptive and exploratory analysis

The three selected cities are the Spanish capital, Madrid, located in the centre of the peninsula; Bilbao, in the north, and Valencia in the Eastern coast; they are identified on Map 7.2.

The selection of those three cities has been done due to their differences and relevance for the Spanish economy. Valencia is the third Spanish capital in size while Bilbao is ranged in the top ten with a lower size in population and area but strong advanced economy. While Madrid exert a relevant effect on its metropolitan area, Bilbao and Valencia show an influence in a shorter region. To approach the three cities, Table 7.27 contains some basic indicators which describe their position among the rest of Spanish provinces and cities.

Regarding the provinces, Table 7.27 shows how Madrid concentrates around 18–19% of the total Spanish GDP. It is the largest economy in the country followed by Barcelona (15–16% of GDP), Valencia (5.1% of GDP) and, in fifth place of the ranking (average of the last five years) by Vizcaya[33] with around 3% of the total National output. Two out of three are coastal cities and all show intense industrial activity located on their land, more technically advanced in Bilbao and traditional in Valencia while Madrid's economy is intensive in services. Those features are fully

[33]The capital city of Vizcaya province is Bilbao.

Map 7.2 Province capitals in Spain. *Source* https://mapasinteractivos.didactalia.net

reflected in the aggregate productivity, with values larger than the Spanish average in Madrid and Vizcaya (overpassing a 20% of the mean) and lower in Valencia (with a productivity being 93% of the Spanish average, a 7% less than the Spanish average) with around 25–27% of the productivity difference with the other two cities reflecting the relevance of worker-intensive activities. The three provinces are highly competitive having their economies fully open to abroad (see Table 7.27) concentrating around 20% of the total Spanish exports in these three cities. Other than the first province in the Spanish export ranking (which is Barcelona with around 20% of total Spanish exports on average alone), Madrid, Valencia and Vizcaya are in the second, the third and fifth position in the export ranking with more intensive export activities relative to their GDP in Valencia and less in Madrid.

Those features affect the city design and efficiency requirements to attend the economic activity needs. One of the signals disappointing of those apparent homogeneity in the province characteristics is the low relevance of house-building in Valencia province during last decade where the housing cycle (number of starts) falls to 10% of the one in Madrid far from the figures apparently from equilibrium of the other two provinces. As this is happening after the Global Financial Crisis effects, the reason supporting the housing construction weakness in Valencia is the extreme negative effect of the crisis in this territory and the flexibility (showed

Table 7.27 Main indicators

provinces													
	GDP			GDP/worker (productivity)			exports				Housing Starts		
in % of total in Spain	Madrid	Valencia	Vizcaya	Madrid	Valencia	Vizcaya	Madrid	Valencia	Vizcaya		Madrid	Valencia	Vizcaya
2005-2010	18,1	5,1	3,0	117,9	91,9	117,1	--	--	--	2005-2010	6,94	4,83	0,76
2010-2013	18,6	5,1	3,1	117,8	93,9	114,9	12,3	5,4	3,9	2010-2013	9,42	2,98	2,96
2014-2016	18,9	5,1	3,1	120,9	93,6	120,7	11,1	6,5	3,5	2014-2016	19,61	1,96	2,81
Cities													
	Population			Workers (num)			Number of firms				Income by household		
in % of total in Spain	Madrid	Valencia	Bilbao	Madrid	Valencia	Bilbao		Madrid	Valencia	Bilbao	Madrid	Valencia	Bilbao
2000-2004	7,19	1,82	0,84	8,71	2,01	0,99	2004	3,79	0,68	0,34	122,7	104,5	111,8
2005-2010	7,00	1,76	0,78	9,14	1,89	0,85	2011	8,55	1,78	0,85	113,1	92,0	102,3
2011-2017	6,80	1,69	0,74	10,78	1,81	0,79					137,1	107,6	125,3
pro-memoria:				*Number of workers by city in 2013:*			*Number of firms in 2013:*				*income by household, 2013 in euros/year*		
				1956639	*324783*	*139903*		*307608*	*64132*	*30558*	*36635,68*	*28833,70*	*32884,72*
	Num housing in the stocks				Housing transactions								
in % of total in Spain	Madrid	Valencia	Bilbao		Madrid	Valencia	Bilbao						
2004	6,50	1,74	0,68	2005-2010	5,4	1,3	0,5						
2011	6,07	1,67	0,64	2010-2013	6,4	1,5	0,6						
				2014-2016	8,2	1,9	0,8						
pro-memoria:	*Stock 2011, No of units:*			*No transactions (2008)*	*26992*	*6170*	*2468*						
	25208623	*811106*	*419929*	*id in 2013*	*22657*	*4922*	*1646*						
	Housing prices (€/m2)			Rent prices (€/m2/month)				Rent/price			Price/income		
	Madrid	Valencia	Bilbao		Madrid	Valencia	Bilbao	Madrid	Valencia	Bilbao	Madrid	Valencia	Bilbao
2000-2004	2776,53										10,99		
2005-2010	3789,85	2546,50	3792,61	2005-2010	13,10	7,66	--	4,25	3,74	3,92	12,27	10,37	12,99
2010-2013	3101,66	1849,29	3364,89	2010-2013	11,81	6,52	11,60	4,58	4,27	4,14	8,71	6,38	10,46
2014-2016	2863,50	1488,34	2792,42	2014-2016	12,90	6,77	10,63	5,39	5,45	4,57	7,66	5,13	8,13

Sources: Eurostat (City Audit), INE, MFOM, Idealista and author's calculation below) of its housing cycle. House-building in Vizcaya and Madrid recovered their equilibrium size during 2015–2016, and Madrid concentrates almost 20% of total Spanish house-building on average during last two years.

Regarding the city indicators, the available statistics reveal that almost a 10% of the Spanish population are resident in the three cities (7% in Madrid, 1.8% in Valencia and 0.8% in Bilbao). The number of workers is a bit large of their population weights showing also larger activity rate in the three cities. Nevertheless, the number of firms located in the cities shows less weight than their population size or workers, especially in Madrid and Bilbao, suggesting larger firm size or firms located outside for workers living in the city and addressing commuting as a common feature of these two capitals.

Income by household provided by the Eurostat statistics (relative to the Spanish average) reflects a predominance of higher income levels in Madrid and Bilbao, and lower in Valencia. In spite of the strong changes due to the analysed crisis period, the average suggests a difference in around 20% of income per household between Madrid and Bilbao (the richest cities) and Valencia (on the Spanish average), consistently with ratios suggesting lower firm size, more labour-intensive activities and, then, lower productivity in the latter. Note that the city income/household relative to the Spanish average is, just in the case of Valencia, larger than the productivity estimated for the province what suggests larger income in the city residents for Valencia than for the households living in the metropolitan area which is not the case in Madrid or Bilbao.

Their impact on the housing market are reflected in the data about the number of units and housing transactions. The housing stock and housing transaction data[34] are fully consistent with the population in the cities: in Madrid, closer than 6.5% of total Spanish housing are located into the city, around 1.7% in Valencia and a 0.7% in Bilbao, similar share of the population one, suggesting that housing stock is mainly devoted to be principal home for households covering housing needs. Housing transaction in every city also reflects similar weights.

Finally, housing prices among the three cities represents two different levels. The upper housing-price level are in Madrid and Bilbao which are the most expensive markets in Spain (together with Barcelona and the Balearic Islands). On the contrary, Valencia shows lower housing prices which are around 60% of the level in the other two cities. That is, from the perspective of prices, the third Spanish city in economic relevance (Valencia) has the cheaper housing market. The prices of rental market exhibit similar proportion and levels than in the ownership markets in Madrid and Bilbao with an average of 11.8 euros by m^2 and month, while Valencia shows at half-price around 6.5 euros/m^2/month.

Such prices (both rental and ownership) seem to be in equilibrium as rent/price ratio exhibit very close figures among the three cities, with values around 4.3% until 2013 and increasing during the last period overpassing the seemly long term average until more than 5% in Madrid and Valencia. The increase on rent-to-price

[34]Source INE and Ministry of Fomento.

ratio are evidence of demand concentrating on the rental market (and pushing prices up) which are stronger in the two latter cities.

Price to income ratio reflects the affordability household effort in every city.[35] In general terms, the effort diminished after 2010 from more than 10 (years) to 7.6 and 5.13 in Madrid and Valencia in the latter period, reflecting a situation where households find more affordable to buy a house as it includes less risk due to the debt in the long term. Although the ratio dynamism is similar in Bilbao, this city still shows difficulties for increase the affordability. In terms of housing accessibility, the price information suggests the existence of stronger housing demand in Madrid and Valencia with better conditions in terms of risk perception and difficulties in Bilbao.

Table 7.28 contains the information which may identify the quality of existing resources in the city for the indirect contribution to productivity as the literature demonstrates. Variables as quality of human capital in the city, commuting, household features, quality of air and the age of housing stock, are able to capture differences in quality and city competitiveness, then affecting to differences in productivity.

As it can be seen, Madrid concentrates Spanish workers in new technology and specialised service sector jobs with more than 21% of those employees in research, finance and firm services and more than 36% in TIC activities. It also shows the larger proportion of qualified workers on its total working force: a 47.6% of the total, although in the other two cities such weight is close to this figure and the high-qualified workers percentage is a bit lower ranged by 44.6% (Bilbao) and 43.5% (Valencia). The number of students in higher education level seems to be consistent with the population distribution with larger figures in the three cities. However, Valencia shows stronger concentration (5.13% of total Spanish) than in the other cities (9.23% in Madrid and 1.91% in Bilbao) relative to their population which suggest the existence of human-capital-generation cluster in Valencia creating specialized workers.

The concentration of IT and high-qualified workers is not in equilibrium among Spain showing the existence of technological-high specialized services cluster in Madrid. Such concentration is not equivalent to the number of firms located in the city. Madrid locates a 7.5% of total firms as it is remarked by the Eurostat database while Valencia concentrates 1.8% and Bilbao 0.8% of the total. Such proportions are far from population and worker distribution indicating the out-of-city location of those companies and stressing the relevance on the firm specialization in Madrid city above comment.

A proxy of disposable income by the firm has been calculated in every city as explained in Eq. (7.2). The results give Bilbao as the city with larger firm productivity than the other three analysed with a 121.2% of the Spanish average while Madrid shows a 109.9% and Valencia's is close to the mean. This feature signs to

[35]The ratio account by the number of years a household should need to pay the house if it devotes the whole income to do it.

Table 7.28 Quality characteristics of the cities

(Year 2013)	Madrid	Valencia	Bilbao
Human capital quality and productivity			
No employees in TIC	141,564	8,471	4,681
% s/Spain	36.98	2.21	1.22
No employees in finance	96,076	14,144	6,598
% s/Spain	22.54	3.32	1.55
No employees in research	457,978	57,755	31,417
% s/Spain	21.11	2.66	1.45
% of population aged 25–64 qualified at level 5–8 ISCED (2011)	48.6	43.5	44.6
Students in higher education (ISCED level 5–8), 2009, % of total in Spain	9.23	5.13	1.91
Number of firms in city	307,608	64,132	30,558
% s/Spain	8.5	1.8	0.8
Estimated disposable income (DI) in the city by firm (2013, euros)[a]	130,200.5	118,411.3	143,588.1
% of total Spanish DI_Firm	109.93	99.97	121.23
Commuting			
Into the city (2008)	581,284	90,839	73,736
% of total population	18.1	11.5	9.4
Out of the city (2008)	246,471	91,140	70,813
% of total population	7.7	11.5	9.1
km (2008)	23.20	22.34	23.92
Time (minutes, 2011)	31.21	22.04	22.49
Cars per 1000 inhab.	454.3	449.3	385.3
Share of journeys to work by public transport—% (2008)	39.00	23.96	30.02
Number of days ozone O_3 concentrations exceed 120 µg/m130	38.27	0.50	19.00
Others			
Household (number)	1,239,702	311,029	142,847
households with children under 18 (%/total h)	26.42	27.74	23.85
Age of houses in years (Census 2011)			
Average age (Census 2011) in years	42.5	43.2	47.5
Houses in bad quality	67.0	67.5	73.7
Houses in good quality	41.1	39.9	46.0
% of houses in bad quality	5.4	11.5	5.3

Source Eurostat, City Audit, Census 2011, INE and author's calculations
[a]Estimated as DI by Household * number of households/number of firms

Bilbao as the most productive city. However, those results would be biased by the number of commuters moving in and out of the city (explained below) affecting the precision on the income by firm estimated.

The three capitals experiences large commuting figures equivalent to more than 9% of their population. Two out of three have equilibrate numbers of commuters in and out of the city, with Bilbao has workers entering in the city equivalent to 9.4% of its population and a similar figure (9.1%) of those moving to work in firms located out of the city. The average kilometres travelled (following the available statistics in Eurostat) is around 24 km which is a large distance for this province (which is small in size); commuting takes an average of 22.5 min and one third of commuters use public transport.

Valencia City shows larger number of workers moving in and out (11.5% of total population in every direction) and is equilibrated in the number of those moving in and out the city. Its workers use 22.04 min to reach the working place and move forward an average of 22.34 km, which is a distance according to most of industrial and service areas located in the smaller municipalities around the metropolitan region. Almost 24% of commuter use public transport in Valencia, with the lowest use among the three cases analysed here, suggesting the intensive use of private cars (449.3 units by 1000 inhabitants).

Madrid shows the larger share of the population commuting into the city, the equivalent to its 17.1% of total population, more than the double of out-commuters (people living in Madrid and working outside) whose are 7.7% of the population. Such disequilibrium would be a signal of that Madrid could be expelling population. The 39% of those workers uses public transport but the large ratio of private cars (454.3 by 1000 inhabitants) suggests that most of the in-city commuting would be done by car intensifying the traffic in the city during working days. Surprisingly, the distance commuted is quite similar to those in other two cities, of 23.2 km with longer transport time of 31.2 min, suggesting less efficiency in the transport system in Madrid possibly due to congestion[36] both in private and in public transport.

Data about the number of days with Ozone intensification in the air supports this hypothesis. As the statistics remark, Madrid is the city experiencing more days (37.27 a year) of O3 excess concentration in the city while Bilbao has also a relative high number of days (19 days/year) and mostly none in Valencia (0.5 days a year). The pollution indicated by those figures would reflect negative external effects resulting from the transportation system or its intense use and highlight a potential negative effect on the city productivity.

The age in both demographic structure and housing stock is also a key information to evaluate the future productivity evolution in the city. Valencia is the city with large concentration of households with children under 18 years with a 27.7% of those while Bilbao shows a 23.8%, the lower concentration. Regarding the housing stock, the three cities show similar figures regarding the housing stock age, between 42.5 years old (Madrid) and 47.5 years old (Bilbao). When the houses are broken down distinguishing by quality, the average age for the bad quality units is

[36]The transport system in Madrid has high quality and it is well managed by a combination of several modes. The amount of commuters and congestion seems to be the reason for this perception of lack on efficiency.

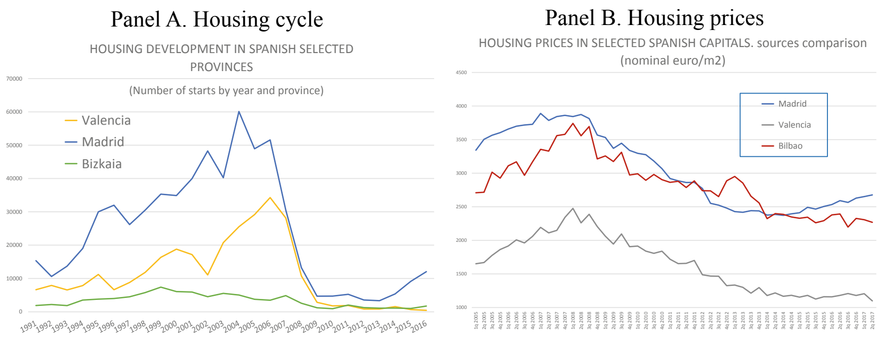

Fig. 7.49 Housing activity and prices in selected Spanish cities

ranged between 67 and 73.7 years old while those in good shape have got ages close to the average (39.9 years old in Valencia and 46 years old in Bilbao). The proportion of units in bad quality are small in Madrid and Bilbao (5.3–5.4% of total units) and large in Valencia (11.5%) suggesting the need to reinvest in renovation and planning in the latter to update the city.

Housing market and prices

Short description of the housing prices, building and affordability evolution by city are useful to frame the housing market situation during the last decade. The Spanish statistics do not identify the precise number of starts in every city as it does at provincial level. Regarding the latter, Madrid and Valencia (together with other main cities) experienced a long expansion period in building activity during the past two decades until 2007. The effect of the Global Financial Crisis hit housing construction down, making the building levels to go through the historical minimum since 2009. In the case of Bizkaia, the house-building expansion was far from dynamic during the expansion period with small activity which also was reduced after the crisis impact (suggesting a lack of supply in the market as a permanent situation). Since 2009, starts remained at the historical minimum activity in two out of three cities, with Madrid being recovered until 1/6 of the previous construction level in 2016 (see Fig. 7.49, panel A).

The long term period reflects a strong dynamism in the construction activity in Madrid and Valencia with quite less intensity in Bilbao (Bizkaia). On the contrary, prices are stronger in Madrid and Bilbao than in Valencia which shows half-price level relative to the other two cities as mentioned before. The larger price in Bilbao has been explained as the results of housing supply constraints (due to several reasons among that administrative controls or lack on land) combined with strong demand led by large income level as reflected by the differential productivity of its economy. The lower level of housing prices in Valencia is explained by similar reasons systematically different than those from the other two cities: supply of land has been enough in every cycle to attend construction requirements and lower income levels in this region related to their lower economic activities productivity

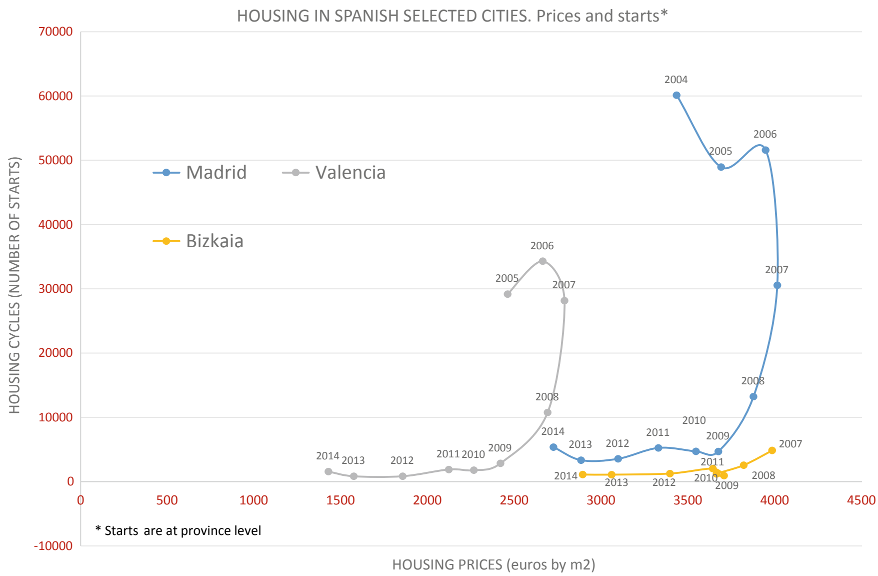

Fig. 7.50 Housing supply elasticity evidence by year in selected Spanish Cities

prevented housing prices to rise. As the empirical evidence supports, Madrid and Bizkaia shows small-inelastic-non significant elasticity of supply (see Taltavull de La Paz 2014: 17–18, Table V) suggesting that other reason than the market signal are driving the housing cycle (starts) in those territories. On the contrary, Valencia (and the whole region) shows elastic and significant new supply elasticities reaching values of 0.7–1.6 depending on the periods.

The starts reactions to price changes (elasticity of supply) can be approached by Fig. 7.50 where both variables are represented. After the hit of the GFC, the capacity to build following prices diminishes mainly in Valencia and Madrid, while the Bizkaia reaction was far different. The strong contraction in house-building determined the loss of market sensibility and the convergence on house price patterns in Madrid and Valencia to be closer to the one in Bilbao with no signs or recovery (Fig. 7.50).

In Fig. 7.50 every line represents the combination of level of housing prices with the number of starts in every city (although starts correspond to the province as the data is not available at city level). The points cloud determines a proxy of the new supply elasticity which changes with time, as the literature supports, that is, the speed at which developers react to changes on housing prices in the market, at any period of time.

During the latter period (since 2008), the demand sources maintained the pressure to the market, and started to become effective demand with the economic recovery since the end of 2013. As a consequence of affordability constraints in the

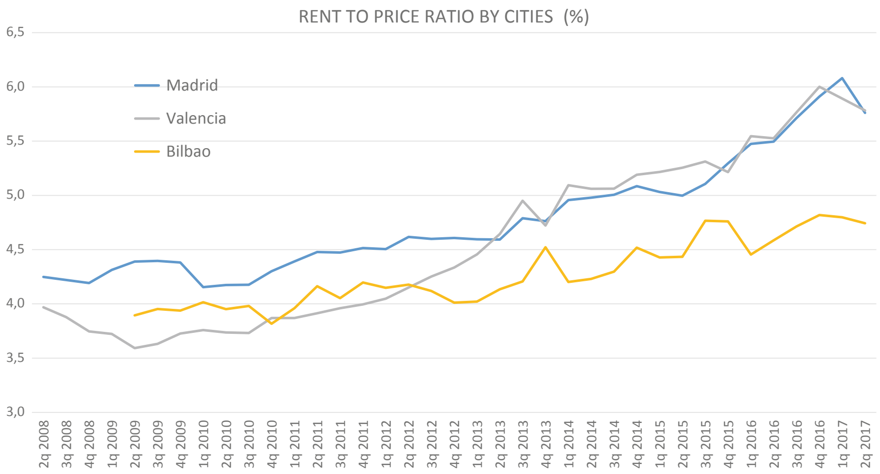

Fig. 7.51 Rent to price ratio by cities (%)

Spanish housing markets,[37] the demand faces the rent market mainly in those cities where the new jobs were created. The recovery of employment in Spain since 2014 were located in main cities of more advances regional economies: Vasc Country, Madrid, Barcelona and Valencia Community, with their cities experiencing a strong increase in rental demand, stressing rental prices up and increasing the rent to price ratio (Fig. 7.51). The ratio came out of the long term equilibrium level since 2014 in Madrid and Valencia rather than in Bilbao.

7.9.4 Evidence of the Effects Between Productivity and Housing Prices

In order to find evidence of the economic productivity and housing prices, this chapter follows the conceptual relationship explained in Fig. 7.48 and fitting Eq. (7.3). Due to the time-data constrains, the models cannot be estimated using commuting, that is, empirical evidence cannot be found between housing prices and increase on commuting and this exercise concentrates the attention to estimate the indirect link between housing prices and the proxy of city productivity calculated 'ad-hoc'.

To estimate the models, a panel data has been built using 99 main Spanish cities to which the data are available both from Eurostat and the Spanish sources, to test the productivity-premium hypothesis. The model is fitted letting the productivity

[37]See reports about the affordability in Spanish Economic and Financial Outlook, Funcas. Available at http://www.funcas.es.

parameter to vary across the cities and fixed effect at the city level are also included. Model (3) is estimated by including four control variables: housing transactions in the city, in order to take into account the differences in demand dynamics; number of households, in order to control by market size, and the number of workers in town also to control by the labour market size. The fourth control is the active population older than 55 years and it is introduced following the literature which suggests that the older the worker force, the lower the productivity.

The panel data built here is an endogenous system by nature and good technical framework to test the above mentioned model which exhibit endogenous relationships. Pooled EGLS with cross-section weights method is used to estimate the model (3) including an iterative estimation of the coefficient after one step weighting matrix. The crosssection standard errors and covariance are White corrected in all models,[38] and only the last model (VIII) which includes time effects is estimated by Pooled Least Squares.

Table 7.29 contains the results for the model testing the housing prices and city productivity in levels and Table 7.30 includes the results of testing both variables in differences. Several models have been estimated for robustness check. In Table 7.29, productivity parameter results (in bold) can be interpreted as the impact on the housing prices resulting from the level of productivity in the city. Results are consistent across the models systematically capturing a productivity effect on housing prices in Valencia and Bilbao, but not in Madrid. In all cases, the effect is positive, suggesting that gains in productivity has positive effect on housing prices increasing the price level. The effect is bit larger in Valencia than in Bilbao.

Estimated parameters for Valencia City suggest than an increase of one hundred euros in the city productivity results in an increase on 5.5–7 euros by m^2 in the city. The effect is a bit smaller for Bilbao, between 3.8 and 5.4 euros by m^2. None statistically significant result has been found for Madrid.

The models in differences (Table 7.30) capture the dynamics on both variables in the city. Table 7.30 presents five models where fixed effects and time effects have been introduced in order to support the robustness of the results.

Results in those models are consistent with the ones obtained before: There is no conclusive results for Madrid and the model finds empirical evidence of the existence of a productivity premium for Valencia and Bilbao. For Valencia, the premium is 4%, as estimated betas for the best-fitted models (the one with fixed effects by city) is 0.04. The premium for Bilbao is 2.6%. Having in mind the time (model VIII) the effects become 3.1 and 1.8% respectively.

[38]The previous test of stationarity and cointegration suggest the existence of individual unit root process but reject the null of existence of a common unit root. Testing for cointegration in the panel the results partially suggest the existence of autoregressive patterns in data. It was tested including AR processes which results in insignificant test and that worsen the model results when fixed effects by city were introduced.

Table 7.29 Evidence on the relationship between productivity and housing prices

Method:	Pooled EGLS (cross-section weights)								
Sample: 2005–2014 (yearly data)									
Model	I			II			III		
Dependent variable	Ph			Ph			Ph		
Cross-section No	99			99			99		
Total pool observations	625			625			625		
Variables	β	Std error		β	Std error		β	Std error	
C	4771.5	468.4	***	6393.7	982.8	***	6663.1	916.3	***
Transactions	0.048	0.016	***	0.014	0.022		−0.009	0.025	
Working population	0.007	0.004		0.007	0.004	*	0.006	0.004	*
No. of households				−0.017	0.007	**	−0.016	0.006	**
Active pop 55–65 old							−0.037	0.014	***
Productivity[a]									
Prod_MADRID	−0.19	0.23		−0.13	0.22		0.01	0.19	
Prod_VALENCIA	0.062	0.020	***	0.055	0.023	**	0.073	0.022	***
Prod_BILBAO	0.054	0.012	***	0.040	0.011	***	0.038	0.015	**
City fixed effects (cross)	Yes			Yes			Yes		
Weighted tests									
R^2	0.97			0.97			0.97		
Adjusted R-squared	0.96			0.95			0.96		
S.E. of regression	237.21			223.14			218.94		
F-statistic	67.80	***		64.83	***		68.49	***	
Durbin-Watson St	1.59			1.74			1.68		
Unweighted tests									
R^2	0.86			0.87			0.87		
Durbin-Watson St	1.16			1.44			1.21		

The models have been estimated including White cross-section standard errors and covariance correction

[a]Only the fixed effects for the selected cities are included in this table. Rest of results until 99 cities area available under request

Regarding the interpretation of the variable ‘number of workers’, it does not show any significant impact on housing prices (as some previous evidence did) when the model has fixed effects by city but it does when not. The interpretation is that, in the absence of city controls, the effect of the number of workers in housing prices is very small: an increase on 1000 workers results in prices rising 2 euros/m^2.

Table 7.30 Evidence of relationship between changes in productivity and changes in housing prices

Method:	Pooled EGLS (cross-section weights)												Pooled L squares		
Sample: 2006–2014 (yearly data)															
Model	IV			V			VI			VII			VIII		
Dependent variable	D(Ph)			D(Ph)			D(Ph)			D(Ph)			D(Ph)		
Cross-section No	99			99			99			99			99		
Total pool observ.	599			599			599			599			599		
Variable	β	Std error		β	Std error		β	Std error		β	Std error		β	Std error	
C							−394.4	108.6	***	−299.4	72.4	***	−172.9	116.6	***
Transactions	0.034	0.006	***	0.031	0.006	***	0.051	0.006	***	0.049	0.004	***	0.011	0.006	
Working population	0.002	0.000	***	0.002	0.000	***	0.001	0.001		0.001	0.001		0.000	0.000	
No. of households	−0.004	0.000	***	−0.003	0.000	***	0.001	0.001					0.000	0.001	
Active pop 55–65 old													0.004	0.003	
Productivity (differences)															
D(prod_MADRID)	0.03	0.19		0.03	0.14		−0.06	0.23		−0.08	0.23		−0.03	0.05	
D(prod_VALENCIA)	0.062	0.011	***	0.083	0.037	**	0.040	0.015	***	0.040	0.015	***	0.031	0.010	***
D(prod_BILBAO)	0.024	0.013	*	0.046	0.036		0.026	0.010	***	0.026	0.010	***	0.018	0.007	***
City fixed effects	No			No			Yes			Yes			Yes		
Time fixed effects	No			No			No			No			Yes		
Weighted tests															
R^2	0.43			0.41			0.71			0.71			0.75		
Adjusted R-squared	0.31			0.29			0.57			0.57			0.61		
S.E. of regression	134.04			137.72			120.33			120.38			88.51		
F-statistic							4.91	***		4.98	***		5.46	***	
Durbin-Watson St	1.60			1.63			2.02			2.02			2.24		
Unweighted statistics															
R-squared	0.23			0.22			0.50			0.50					
Durbin-Watson St	1.56			1.64			1.86			1.87					

White cross-section standard errors and covariance (d.f. corrected)
Linear estimation after one-step weighting matrix

7.9.5 Conclusions

This chapter has presented some evidence about the relationships between economic productivity and housing prices in three main Spanish cities: Madrid, Valencia and Bilbao. Find evidence of the effect of how productive and efficient is a city is not an easy task as the measure of such productivity is not clearly defined at the minute. The city productivity concept as several perspectives, not only the economic one (production per worker), but is a key issue for future analysis as it would explain the reasons to understand how cities compete in better conditions and highlight the ways to apply policy measures to improve the cities' quality.

An approach to those variables affecting the competitiveness and productivity is made here applied to Spanish cities. The chapter highlights the need of proper statistics which allow the researchers to use robust available techniques to solve the questions of what drives city housing prices, the impact of the economic growth on them and measure the impacts.

Two analytical approaches have been followed: An exploratory analysis with data identification, classification and description following the theoretical approach and an empirical analysis, finding evidence of the effect of city productivity on housing prices.

The previous evidence shows the ways to follow: Competitive cities increase wealth and affect to housing prices, making them to increase; Rising housing prices increase commuting by expelling medium-level income households from the city looking at more affordable housing market in the surroundings; An extreme increase on housing costs would break the virtual cycle of competitiveness—wealth—jobs–large salaries—rising housing prices by expelling workers from the city, and, then, reducing production resources (workers) and acting as barriers for firms preventing the economy to grow. Lastly, excessive housing costs expel basic demand and would reduce construction activity contributing to a further increase in housing prices in the metropolitan area. Lack of supply and rising prices is the final results of a distorted housing markets, but wealthy housing mechanism improves productivity and city wealth.

It is not possible to test the hypothesis above. This chapter has shown some of them through the available statistics. The exploratory analysis suggests that Bilbao and Madrid could be super-cities due to the lack in market reactions (as housing supply shows insensibility to the market signal), high technological cities, the excess of commuting in-city, the higher housing prices and an apparent lack of affordability, among other variables. The empirical section supplies an initial evidence about the effect of economic productivity on housing prices in two cities: Valencia and Bilbao, but fail to find it in Madrid.

The need to deep in more precise analysis is key to understand the city dynamics and the role of housing markets in the economic growth.

7.10 Lima, Peru

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7.10.1 Introduction

Lima is the capital of Peru, its largest city and the third in size in Latin America after Sao Paulo in Brazil and Mexico City. Lima's metropolitan area comprises more than 10 million inhabitants. This case study argues that Lima's present and future competitiveness depends on proper delivery of infrastructure and connections to national and global markets. All of this requires not only investment in hard infrastructure, but also in soft infrastructure, as well as adequate building codes and urban layout, in order to make an efficient real estate market possible.

7.10.2 Economic Growth and Competitiveness in Lima

7.10.2.1 Brief Economic History of Peru

Through the 1950s, 1960s and 1970s, Peru's economic program was mainly focused on import substitution policies; although no strong industrial sector emerged from as a result of these policies. In fact, economic growth was very slow during this period. In the 1980s, the country was affected by the regional debt crisis and the surge of violent leftist insurgent groups. In response, the government engaged in a heterodox economic program, which triggered a stage of hyperinflation and the country's isolation from international financial markets. By the end of the decade, GDP had dropped by 20%, GDP per capita was below 1960 levels and poverty rates had increased by more than 10% points.

Since 1990, the government took drastic measures to stop hyperinflation. During that decade, Peru underwent free-market reforms such as ending price controls and protectionism, the privatisation of most state companies, and the elimination of restrictions to foreign investment. The insurgency was almost defeated, and except for the economic consequences of the 1997 Asian financial crisis and the 1998 'El Niño' weather phenomenon, the country achieved economic stability and sustained growth. However, this decade was also marked by political problems, which led to an institutional crisis in the year 2000.

During the decade of the 2000s and the beginning of the 2010s, Peru managed to sustain economic growth and political stability. Through this period, Peru became one of the fastest-growing economies in the world, with an average growth rate slightly lower than 7% between 2010 and 2013. Growth was achieved mainly through the exports of commodities, which benefitted from a favourable international context. In fact, the value of exports rose markedly from $7 billion in 2001 to more than $46 billion in 2011, while the share of traditional exports grew from 67.4 to 77.4% during the same period. Particularly, metals and minerals' participation in the country's exports rose from 45.6% in 2001 to almost 60% in 2011.

Meanwhile, the poverty rate decreased from above 60% in 2004 to 25.8% in 2012, while increased public spending in water, sanitation and electricity and conditional cash transfer programs decreased inequality of opportunities (World Bank 2016). Although trade and industrial activities remain centralized in Lima, increased agricultural exports have fostered economic development in many regions, particularly in the coastlands. However, in spite of the country's impressive performance during the last decades, income inequality has barely decreased. Moreover, institutional transparency has not improved significantly and roughly 70% of the labour force remains in the informal sector, thus limiting productivity and tax collection while increasing the risk for environmental damage.

Economic diversification and technological development have also remained relatively low: the share of non-traditional exports was 29.1% in 2016, a lower level than in 2001. According to the World Bank, the share of high technology manufacture exports has only risen from 4.3% in 2001 to 4.7% in 2016. These trends have preserved the country's vulnerability to price volatility in international markets. In recent years, higher external uncertainty and the decrease in international growth have lowered the value of the country's exports by more than 20% between 2011 and 2016, and they now account for 21.3% of the GDP (down from 30.5% in 2011). As a result, Peru's economic growth has decelerated to rates below 4%.

Overall, Peru's economy reflects its varied geography that goes from the desert coastal zone in the west facing the ocean, the Andean range of mountain in the centre, and the jungle in the east. The abundance of natural resources is found mainly in mineral deposits in the Andes regions, while its extensive sea territory has traditionally yielded excellent fishing resources. In 2016, Agriculture and Fishing accounted 6% of the country's GDP, while the extraction of gas, petroleum and minerals contributed with 14.9%. Manufacture, Construction and Commerce are also dynamic sectors that contributed with 14.3, 6.3 and 11.7% respectively, while the tertiary sector (Services) accounted for more than 45% of the country's production.

7.10.2.2 Importance of Lima

Lima is the capital and the largest city of Peru, since it hosts nearly one third of the country's population. With an estimated population of over 10 million inhabitants, Lima is the third-largest city in the Americas, behind São Paulo and Mexico City. According to the Institute of National Statistics (INEI), Lima is a relatively young city. In 2014, the age distribution in Lima was: 24.3% between 0 and 14, 27.2% between 15 and 29, 22.5% between 30 and 44, 15.4% between 45 and 59 and

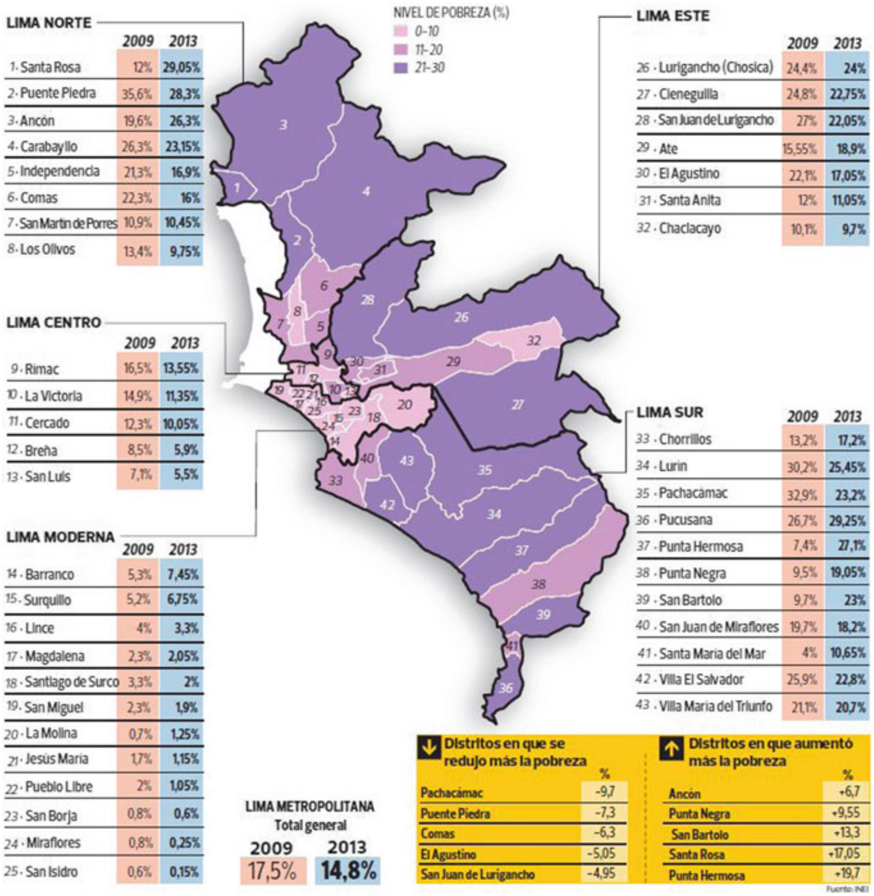


Fig. 7.52 Lima Poverty Map (2013). *Source* El Comercio (with data from INEI)

10.6% above 60. Migration to Lima from the rest of Peru is substantial. In 2013, 3,480,000 people reported arriving from other regions, which represents almost 36% of the entire population of Metropolitan Lima.

The city is located in the valleys of the Chillón, Rímac and Lurín rivers, in the central coastal part of the country, overlooking the Pacific Ocean. It consists of 43 districts covering an approximate area of 2,672.3 km^2 with a metropolitan density of 3,800 inhabitants/km^2. Together with the seaport of Callao, it forms a contiguous urban area known as the Lima Metropolitan Area, which is divided into six sectors (see Fig. 7.52 for a detailed map of the city):

The Northern Pole (red): groups 25.6% of the population in 2016, and is comprised by Ancón, Carabayllo, Comas, Independencia, Los Olivos, Puente Piedra, San Martín de Porres and Santa Rosa.

East Lima (green): groups 25% of the population in 2016, and is made up by Ate, Chaclacayo, Cieneguilla, El Agustino, Lurigancho-Chosica, San Juan de Lurigancho (the most populated district, with over one million inhabitants) and Santa Anita.
Constitutional Province of Callao (grey): groups 10.2% of the population in 2016, and is made up by Callao, Bellavista, Carmen de la Legua-Reynoso, La Perla, La Punta and Ventanilla.
Central Lima (yellow): groups 7.3% of the population in 2016, and comprises the districts in the inner city (Breña, La Victoria, Lima, Lince, Rímac).
Modern Lima (blue): groups 12.7% of the population in 2016, and is made up by Barranco, Jesús María, La Molina, Margdalena del Mar, Miraflores, Pueblo Libre, San Borja, San Isidro, San Luis, San Miguel, Santiago de Surco and Surquillo.
The Southern Pole (orange): groups 19.2% of the population in 2016, and is made up by Chorrillos, Lurín, Pachacámac, Pucusana, Punta Hermosa, Punta Negra, San Bartolo, San Juan de Miraflores, Santa María del Mar, Villa el Salvador and Villa María del Triunfo.

The Metropolitan Municipality of Lima has authority over the entire province of Lima (which comprises 43 of the 49 districts in the Metropolitan area). Although each district has its own local municipality, they must all coordinate with the metropolitan government. Unlike the rest of the country, the Metropolitan Municipality was endowed with a Special Regime that granted it the means and competencies of a regional government. This resulted in an integration of municipal (at the metropolitan and local government levels) and regional functions in one territorial entity, without itself being a region or belonging to one.

The incidence of poverty is relatively low in Metropolitan Lima and has decreased in recent years. According to the INEI Poverty Map (see Fig. 7.52), the percentage of the population in Metropolitan Lima living in households in poverty[39] was 14.8% in 2013, down from 17.5% in 2009. However, these figures hide important disparities between Lima's areas. The difference in poverty levels is most stark between Modern Lima, where poverty rates are below 3% in most districts, and Northern Lima and Southern Lima, where some districts are near 30%. Furthermore, many districts in the outskirts of the city (particularly in the South) displayed increasing poverty rates between 2009 and 2013, mainly due to new invasions in vulnerable areas.

INEI used the 2012 and 2013 household surveys and complementary administrative data sources to calculate the distribution of blocks in Metropolitan Lima according to their socioeconomic status. In Fig. 7.53, it can be seen that the higher income areas are concentrated in Modern Lima and some areas in Eastern Lima, while the poorest areas are located the furthest from the centre of the city (mostly in the Northern and Southern Poles, as well as the outskirts of Eastern Lima).

[39]The level of poverty is measured by households that are unable to access a basic food and other household goods and services, such as clothing, housing, education, transportation and health.

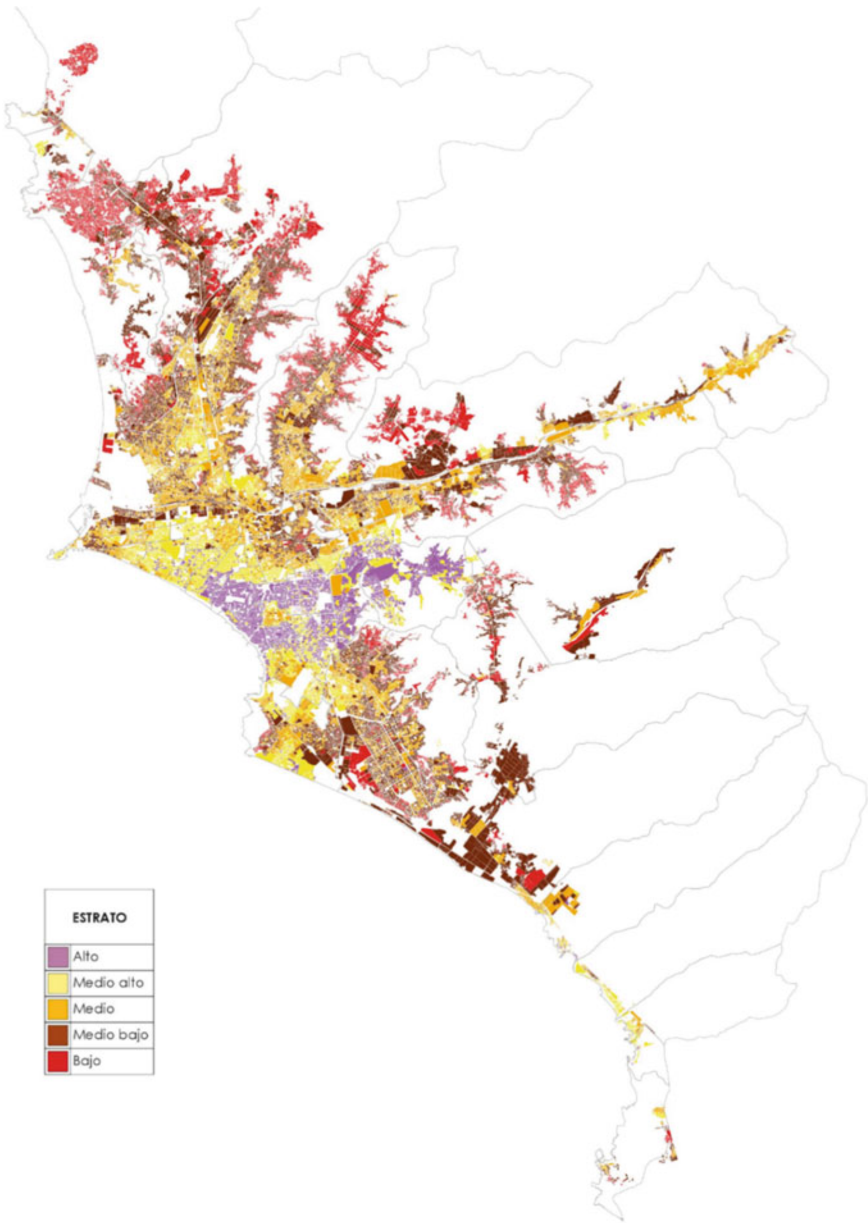


Fig. 7.53 Lima: socio-economic status distribution by block. *Source* INEI (with data from ENAHO 2012/2013 and other administrative sources)

7.10.2.3 Economic Activity in Lima

General Description

Lima is a Mega City, which has almost 30% of the country's population, slightly more than 50% of GDP (see Fig. 7.54) and almost 80% of tax revenue. It accounts for more than two thirds of Peru's industrial production and most of its tertiary sector. This level of economic spatial concentration is a common feature in Latin America. Due to historical and political factors, this city developed at a much faster pace than the rest of the country, increasingly diverging from other regions (Lazarte 2015). In Lima, the ratio of the percentage of the national GDP generated by the city and the proportion of the population is roughly 1.5, which provides evidence of a far higher level of per-capita productivity than in the rest of the country (UN-HABITAT 2015).

Lima's economic activities are mostly related to Services (e.g., Transport, ICTs, Lodging and Restaurants, among others). According to INEI, in 2016 these sectors accounted for almost 60% of the regional GDP and 55.29% of the city's employed population. Manufacture, Commerce and Construction are also important activities, since their contributions to the regional GDP and the city's employment are 17.16% (15.06%), 13.22% (20.81%) and 5.27% (7.76%) respectively. Unlike most other regions in the country, extractive activities (agriculture, fishing and mineral extraction) account for only 4% of the region's GDP and 1.39% of the city's employed population. However, the importance of Lima's mostly urban economic activities for the country is evidenced by the fact that these account for a larger share of Peru's value added than the sum of mining, hydrocarbons and fishing at a national scale (Ganoza 2017).

As a consequence of Peru's sustained growth, Lima has positioned itself as an attractive investment node in the LAC region. In recent years, the city's

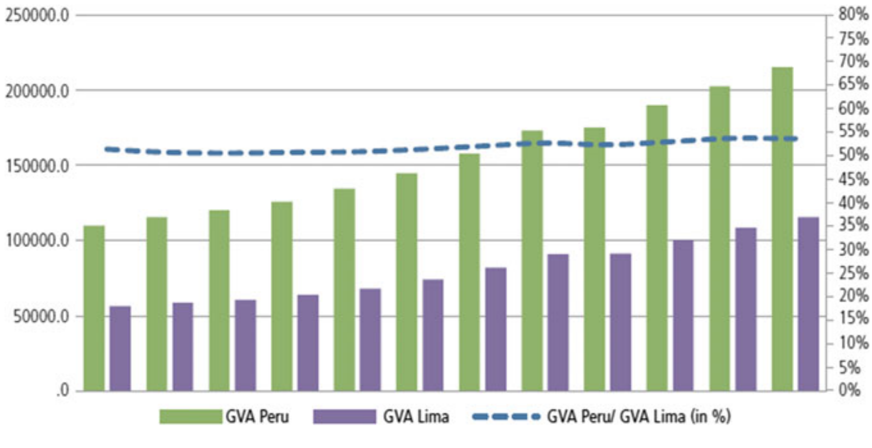


Fig. 7.54 GVA Peru versus GVA Lima. *Source* UN-Habitat (2015) with data from INEI

competitiveness and economic attractiveness shifted. The evidence for this statement can be found in the ranking provided by América Economía Magazine for the best cities in America to do business, where Lima passed from number 23th in 2006 to the 7th in 2009. In recent years, Lima has become one of Latin America's most important financial centres, home to many national companies and hotels. Furthermore, the city has hosted many important international events, such as the APEC meetings in 2008 and 2016, the ASPA meeting in 2012, the COP20 in 2014 and the IMF and World Bank annual meetings in 2015.

The Metropolitan area, with around 7,000 factories, leads the country's industrial development, thanks to the quantity and quality of the available workforce, transport and other infrastructure. Its main products include textiles, clothing and food. Chemicals, fish, leather and oil derivatives are also manufactured and/or processed. The financial district is in San Isidro, while much of the industrial activity takes place west of downtown, extending to the airport in Callao. Lima also has the largest export industry in South America and is a regional hub for the cargo industry. The Callao seaport is one of the main fishing and commerce ports in South America, covering over 47 ha (120 acres) and shipping 20.7 million metric tons of cargo in 2007.

Regarding its labour force, data from INEI show that Lima has seen an important decrease in unemployment in recent years. Specifically, the unemployment rate was 6.5% in 2016, almost 3% points lower than its 2004 level. Furthermore, underemployment (by income and hours) has decreased from 61.8% to 35.1% during the same period, and is now considerably lower than the national rate. Similar to the rest of the country, most workers are employed in small firms (10 workers or less). However, this figure has also decreased from 67.6 to 59.1% between 2004 and 2016, while the share of workers in firms with more than 50 workers has grown from 23.2 to 30.7%.

Geographical Distribution of Economic Activity

Historically, Lima developed around economic poles of activity. The dominant political and economic pole in the centre of Lima housed public institutions, commerce and finance, while the industrial pole in Callao was where industrial activities were centred. During the 1990s, this urbanization model was transformed as the city expanded. Although the institutional pole remained in Lima's centre, the industrial pole began to expand to other districts such as La Victoria (where the textile centre 'Gamarra' is located) and to other peripheral areas or poles of Lima, marking a trend towards the reformation of Lima's districts to small, independent cities.

Finally, financial and commercial activities moved to San Isidro-Miraflores in Modern Lima. This lead to the emergence of an East–West axis, which was developed through investments in road infrastructure and is bordered by the international airport at the extreme west and by a high-income suburban residential zone in the extreme east, with the financial district as a mid-point. At the same time, a variety of businesses and services gravitated to different parts of the east-west transport axis. Thus, in what was a segregated periphery of the city, market niches and areas of investment have emerged, consolidating new, specialized centres (UN-Habitat 2015).

However, the lack of urban planning in a period of fast horizontal growth has turned the city into an uncoordinated and poorly connected space. Through the last decades, increased immigration led to an informal expansion in the outskirts of the city, in many cases without access to proper households and public services. The lack of a proper transportation system that efficiently connects this area with the Poles of economic activity enhanced the surge of small-scale economic initiatives and self-employment (mainly in the Commerce and Services sectors, and more recently also in Manufacture), which in most cases also lack governmental support. As a result, many alternative economic poles have surged in the newer areas of Lima, though informality and linkages to more productive economic sectors remain low (Lazarte 2015; UN-Habitat forthcoming 2017). In fact, 95% of economic establishments in the city in 2007 had 10 workers or less, becoming microenterprises rather than SMEs.

A direct consequence of this process is low economic density, which measures value added per m^2. Lima has one of the lowest economic densities among the capitals of Latin American countries,[40] which indicates that spatial distribution of economic activity is inefficient. Furthermore, it is highly concentrated in the centre of the city. In this regard, the economic census (2008) revealed that although economic initiatives are increasing at an accelerating rate in all parts of the city, growth is not homogenous across the different zones in the city (see Fig. 7.55). A comparison of Southern Lima, Northern Lima, Eastern Lima and Centre Lima (the Central Business District, CBD, which also includes Modern Lima), reveals that the latter groups more than 40% of the city's economic initiatives and showed the largest increase between 1995 and 2008 in absolute terms (from 22,666 to 66,442).

In spite of the prevalent importance of Centre Lima, the three remaining zones have shown larger growth rates in economic activities throughout the same period. In fact, their contribution to the city's economic initiatives has grown from 46.5% before 1995 to almost 64% in 2007. Particularly, the number of new economic establishments in these districts tripled between the period 2000–2004 and 2005–2007. In this group, Northern Lima has shown the greatest surge of economic initiatives. This growth has been linked to the trends discussed in the previous paragraph, and has led to the development of new economic poles in the city with a growing local demand. The recent surge of large-scale malls and commercial agglomerations in these zones is a result of this process.

Centre Lima and Eastern Lima display the higher levels of concentration of economic activities. In the former, a little more than 30% of economic establishments are located in Lima Cercado and roughly 25% are in La Victoria, while San

[40]Sao Paulo and Bogotá score 30% and 100% higher, respectively (Ganoza 2017).

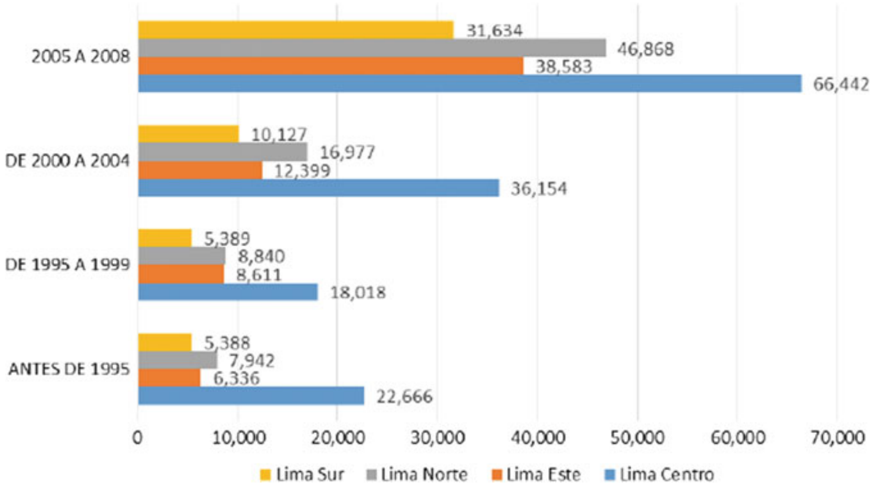


Fig. 7.55 Economic initiatives per homogenous area, per period, in Lima. *Source* Lazarte (2015), with data from the economic census 2008

Juan de Lurigancho and Ate concentrate 37.61 and 29.06% of economic initiatives in Eastern Lima, respectively. The conglomerates of Las Malvinas (Lima Cercado), Gamarra (La Victoria), San Juan (San Juan de Lurigancho) and Ceres (Ate) provide examples of this dynamic. In contrast, Northern and Southern Lima display a more homogeneous distribution of economic initiatives. In the former, the leading districts are San Martin de Porres (24.76%), Comas (20.51%), Los Olivos (16.79%) and Puente Piedra (10.96%), whereas Villa El Salvador, San Juan de Miraflores and Villa María del Triunfo group 29.16, 23.4 and 19.81% of economic establishments in Southern Lima, respectively.

In Fig. 7.56, the distribution of establishments, employed population and value of production for the year 2008 are shown. It can be seen that Centre Lima groups more than 40% of economic establishments in the city, but less than 30% of its employed population. However, this zone accounts for 71.82% of the city's production, which is probably related to the fact that most firm's headquarters are in

Zone	A. Establishments		B. Employed PEA		C. Value of Production		Firm Productivity	Labour Productivity
	#	%	#	%	S/. Million	%	C/A	C/B
Centre Lima	143,280	41.85%	896,266	27.37%	109,206	71.82%	**0.76**	**0.12**
Eastern Lima	65,929	19.26%	843,293	25.75%	23,637	15.55%	**0.36**	**0.03**
Northern Lima	80,627	23.55%	859,044	26.23%	9,370	6.16%	**0.12**	**0.01**
Southern Lima	52,538	15.35%	676,370	20.65%	9,835	6.47%	**0.19**	**0.01**
Total	342,374	100.00%	3,274,973	100.00%	152,048	100.00%	**0.44**	**0.05**

Fig. 7.56 Firm and labour productivity by zone. *Source* Own elaboration, with data from the economic census 2008 reported in Lazarte (2015)

this area. Therefore, firm productivity and particularly labour productivity are much higher than those of the rest of the city. Regarding Eastern Lima, the table shows that although it does not have as many firms as Northern Lima, these are larger and more productive. This relate to the recent development of an industrial cluster in this area. Finally, Northern and Southern Lima are generally less productive, which relates to the fact that most firms in these districts are small and informal.

Finally, Lazarte (2015) used the information from the 2008 economic census to analyse the predominant economic activities in Lima. Her findings show that **Wholesale and Retail Trade** is by far the largest economic activity in terms of economic establishments, which are distributed throughout the city. 39.42% of the economic initiatives in this sector are located in Centre Lima, mainly in the markets and galleries that are in the Malvinas, Plaza Union, Barrios Altos, Central Market, Blue Powder, Pink Powder, among others. Northern Lima groups 24.68% of these establishments, mainly due to large commercial centers such as Mega Plaza and Plaza Norte, and the dynamism of the agglomerations formed predominantly by small traders. Meanwhile, Eastern and Southern Lima house 19.73 and 16.17% of the economic initiatives in this group, respectively.

Manufacture is the second most dynamic activity in Metropolitan Lima. This sector is more concentrated in the centre, since it groups 50.77% of the economic initiatives of the Manufacturing Industry (mostly in the conglomerates of Gamarra, Malvinas among others). The remaining initiatives are distributed in a homogenous across the remaining three zones: 17.96% in Northern Lima, 16.90% in Eastern Lima and 13.37% in Southern Lima. This shows that manufacturing activities are dynamic in all the newer zones in Lima. On the other hand, **Accommodation and Food Services** are the third most dynamic activity in the city. Although it is also fairly concentrated in Centre Lima (36.55%), the other zones also group important shares of the sector's economic initiatives (25.87% in Northern Lima, 21.98% in Eastern Lima and 15.6% in Southern Lima).

Information and Communication it is the fourth most dynamic activity in Metropolitan Lima. However, the greatest dynamism is found in Northern Lima, which accounts for 29.71% of economic initiatives throughout Lima. This is explained in part by the number of radio and TV firms it hosts, as well as by the existence of the UNI conglomerate that has a set of services for dissemination and communication. The remaining initiatives in the sector are located in Eastern Lima (27.74%), Centre Lima (22.73%) and Southern Lima (19.83%). In contrast, **Transportation and Storage Services**, the fifth most dynamic economic activity in Lima in terms of economic establishments, is mostly concentrated in Centre Lima (73.26%). To a lesser degree they are developed in Northern Lima (11.85%).

Among the remaining activities, the degree of concentration in Centre Lima is highly variable. While some sectors such as **Professional, Scientific and Technical Activities**, **Construction** and **Real Estate** are predominantly located in Centre Lima (69.71, 67.22 and 62.5% respectively), others are more evenly distributed (i.e., **Private Education**, **Health Services**, **Entertainment**, **Finance and Insurance**, among others).

7.10.3 Housing Affordability and Impact on Competitiveness in Lima

The dynamics in Lima's housing markets are a good indicator of the trends that have been described in the previous sections. For instance, the housing supply has increased steadily from 6,468 units in 2002 to 29,156 in 2014 (see Fig. 7.57). The increasing offer in housing is a reflection of the significant national housing deficit —estimated at 1.86 million units and the low penetration of mortgage loans (Scotiabank 2015). However, recent economic deceleration has affected this market, since this indicator decreased by almost 20% in 2015 and only showed a slight recovery in 2016.

In Fig. 7.58, the supply and effective demand (houses sold) are compared for the period between 2007 and 2014. This figure shows that both increased notably after the sub-prime crisis in 2009, which is directly related to increasing income expectations and private investment during the period. However, the number of houses sold increased at a lower rate than housing supply, a signal that buyers still face economic constraints. Furthermore, house sales decreased notably from 2013 to 2014, which led to an increase in vacancy rates in the following years which might partly explain the recent decrease in housing supply.

According to BBVA Research (2016), the largest increase in housing supply from 2015 to 2016 was concentrated in the districts in Modern Lima, and to a lesser degree Central Lima. However, demand was higher for lower-price segments of the market (82% of total participation). This means that the current supply might not satisfy the increasing housing needs of the emerging neighbourhoods in the newer parts of the city (i.e., the Southern, Northern and Eastern Poles). Figure 7.59 displays a comparison of the apartment supply by district in 2016, compared to each district's population. It shows that the districts in the newer parts of the city (mostly the Northern and Southern Poles and Eastern Lima) have the lowest housing supply, despite their growing populations.

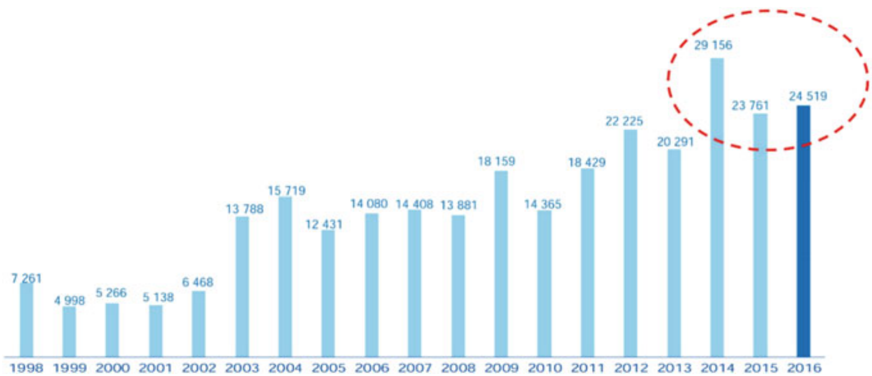


Fig. 7.57 Housing supply in Metropolitan Lima (total units). *Source* BBVA Research (2016)

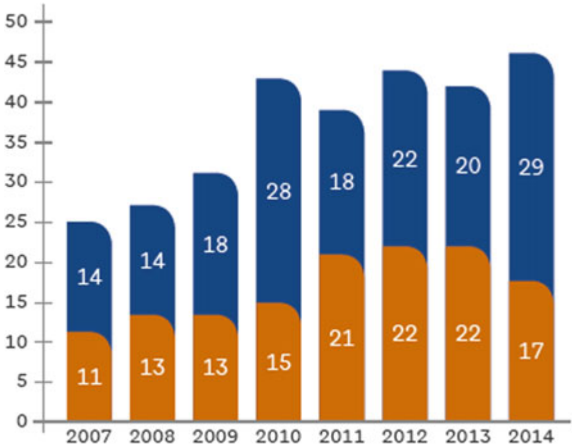


Fig. 7.58 Supply (blue) and sales (orange) of apartments 2007–2014 (in thousands). *Source* Scotiabank (2015) (with data from Capeco)

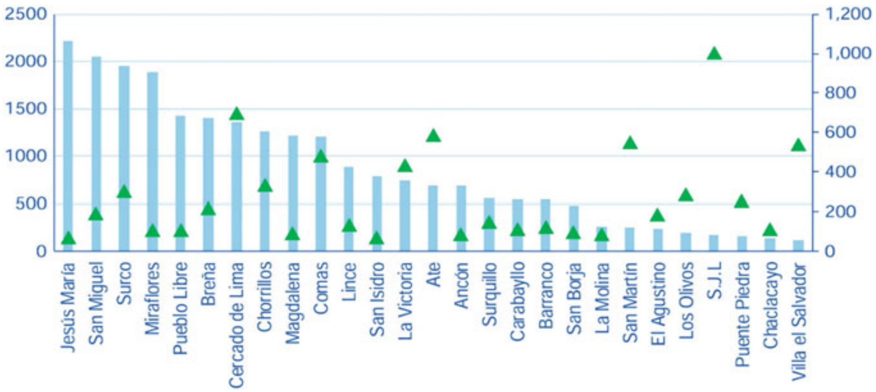


Fig. 7.59 Housing supply (blue, left axis) and population in thousands (green, right axis) by district in 2016. *Source* BBVA Research (2016)

Regarding house values, Fig. 7.60 shows the change of the average price per m^2 reported by the Central Bank of Peru (BCRP), between 2007 and 2016. This indicator is calculated with information from 10 districts, 9 of which are located in Modern Lima (Lince is in Central Lima). As the graph shows, house prices have increased at a steady rate throughout the whole period. This trend is related to the scarcity of land with installed basic services and property titles, coupled with the still significant demand for housing. However, growth in recent years made it possible to close the gap with the Latin American average and reach "normal" price ranges in the region by 2014 (Scotiabank 2015), which might partly explain the lower rates observed in the last two years.

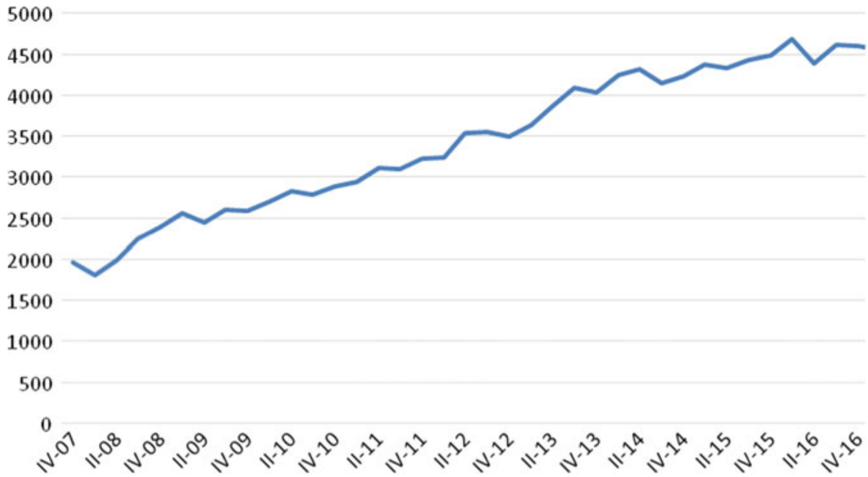


Fig. 7.60 Apartment prices by m^2 (2009 S/). *Source* Own elaboration with data from BCRP, calculated as the geometric average of the medians of prices of m^2 by district (Jesús María, La Molina, Lince, Magdalena, Miraflores, Pueblo Libre, San Borja, San Isidro, San Miguel, Surco), weighted by the total supply in m^2 of apartments in each district

Nevertheless, the BCRP started reporting house prices for a larger sample of districts in 2016, which also includes districts in the Northern and Eastern Poles, as well as two districts in Callao. In general, this Figure provides evidence of the heterogeneity in the city's housing market. For instance, average housing prices in wealthy districts such as Barranco, Miraflores, San Borja and San Isidro can be more than twice as high as those in Bellavista, Breña, Carabayllo, Lima, La Perla or Los Olivos (Fig. 7.61).

Unlike housing prices, annual rents have not changed substantially during the last decade. As a result, the house price-to-annual rent ratio has grown in recent years, despite an important decrease in the last trimesters of 2016. This indicator is important because it shows how long it would take to pay the price of a house through rents. When the ratio is above 25, properties might be overpriced. Although current levels are well below that threshold, in some areas of Lima this indicator is close to 20 (Fig. 7.62).

Despite the growth in housing supply during the last decade, the gap of unattended demand remains large. In fact, estimates of effective demand in the city (the amount of households that want to buy a house and can afford it) are above 400,000. However, supply growth remains constrained by factors such as the lack of urban land, an inefficient municipal bureaucracy (e.g., procedures to obtain permission to build, availability of proper land, plotting rules, among others) and low investment in water and sanitation. Furthermore, local regulations that restrict vertical growth impose an upper bound to housing supply, which leads to higher prices. In addition to these supply factors, recent years have seen an economic

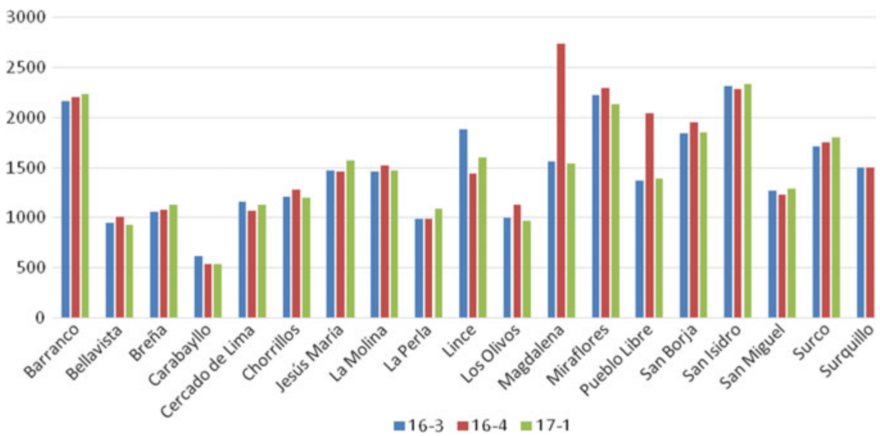
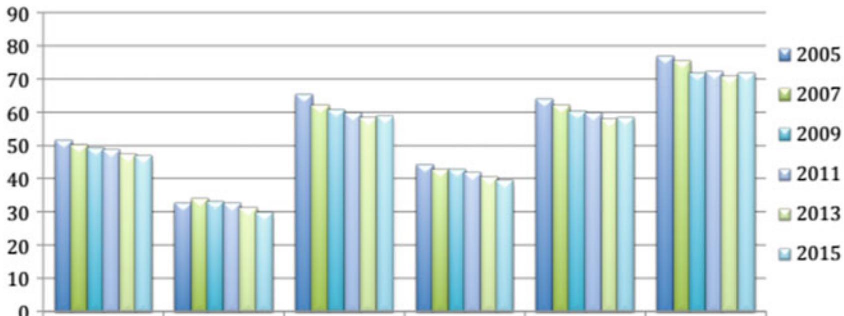


Fig. 7.61 Apartment prices by m^2 by district (current $). *Source* Own elaboration with data from BCRP, calculated as the simple average of prices by m^2 by district

Fig. 7.62 House price-to-annual rent ratio (current $ by m^2). *Source* Own elaboration with data from BCRP housing market reports

deceleration and an increase in credit constraints for the middle and lower-income sectors, which have led to a decrease in housing demand (Arnaiz 2016).

Partly due to the inability of housing supply to satisfy the increasing demand, a large portion of Lima's populations lives in marginal slums in the periphery of the city, facing low accessibility a lack of basic public services and severe vulnerability to natural disasters (UN-Habitat forthcoming 2017). Figure 7.63 shows the share of population living in inadequate houses, by region of Peru. Although these figures are the lowest in Metropolitan Lima, they still account for almost a third of the total population of the city. Moreover, this proportion has barely decreased from 2005 to



	Total	Lima Metropolitana	Resto país	Costa	Sierra	Selva
2005	51.2	32.4	65	44.1	63.5	76.8
2007	49.9	33.6	61.8	42.8	62	75.3
2009	48.9	32.9	60.5	42.4	60.1	71.7
2011	48.3	32.5	59.5	41.4	59.6	72.1
2013	47.1	31.3	58.3	40.4	57.7	70.6
2015	46.6	29.5	58.6	39.2	58.1	71.7

Fig. 7.63 Share of population living in inadequate houses. *Source* Ministerio de Vivienda, Construcción y Saneamiento (2017)

2015, which shows that policies have been ineffective in promoting better urban planning and access to proper housing.

In order to offset the recent decay in housing sales, the government has fostered the program *MiVivienda (My House)* in recent years, which provides subsidized credit to low-income families to access housing. However, the results from this initiative have been limited. Therefore, the government is currently developing a National Plan for Housing, which seeks to build more than 100,000 houses through large real estate projects. To accelerate this process, the Ministry of Housing and Sanitation has started a Program for the Generation of Urban Land. Furthermore, the Plan intends to provide diversified credit options to different economic segments of the population. Particularly, it seeks to redistribute housing supply towards the lower-income segments (mainly through the program *Techo Propio, Own Ceiling*), which currently cannot afford increasing housing prices and more conservative credit policies from banks (El Peruano 2017).

As housing affordability and access to jobs are concerned, Lima is planning to implement an ambitious mobility programme with multimodal stations (See Fig. 7.64) and including a metro network by 2035 (See Fig. 7.65), if those projects are implemented Lima will be able to connect population from all axis becoming a mega-region in Peru.

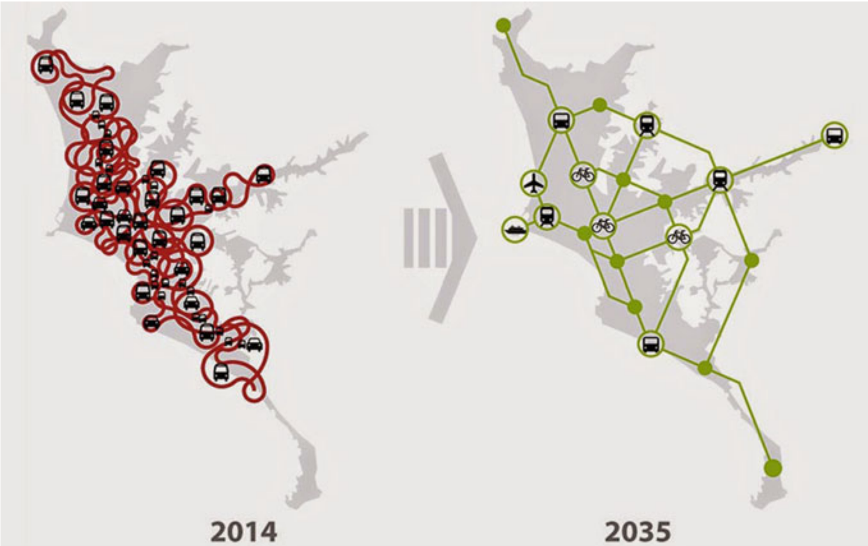


Fig. 7.64 Integration of modalities of mobility 2035. *Source* IMP 2015

7.10.4 Real Estate Related Policies in Lima

The economic literature on urban development predicts that inelastic housing supply may lead to increasing prices when the demand is high (Glaeser et al. 2006; Ryan-Collies et al. 2017; Salat et al. 2017), this appears to be the case in Lima, where the lack of space in the districts in the centre has caused the value of houses to rise, thus limiting the possibilities of the lower-income segments of the population to access proper housing. As a result, Lima is growing on the outskirts, which may carry important productivity losses due to low-quality public services and longer commuting time. This problem is aggravated by the lack of a proper public transportation system and the existence of numerous informal settlements. Therefore, urban planning is required to boost economic productivity in the newer zones of Lima, thus increasing wages and opportunities to access proper housing.

A competitive city is a city that successfully facilitates its firms and industries to create jobs, raise productivity, and increase the incomes of citizens over time (World Bank 2015). Cities facilitate increased productivity, job creation and surplus income through domestic public policies aimed at stimulating the referred economic areas. In the case of Peru, these transformations have covered fiscal, economic, financial, labour and private sector reforms. It is important to state that these reforms started when the political and economic situation of the country was in a shock (Klein 2007). Capitalism was imposed as the basis for the expansion of the economy: the effect was fast, and the capitals of the region were suddenly attractive in the eyes of international investors.

Fig. 7.65 Lima Metro Network Plan 2035. *Source* Lima Metro Blogspot (accessed 16 Oct 2017)

The current housing policy is characterized by the centralization of programs aimed at both the construction of new housing for middle sectors via the 'MiVivienda' fund, and the 'Programa de Mejoramiento Integral de Barrios', which allows the construction infrastructure in urban areas, and also provides work to those neighbours who are in an unoccupied condition.

The MiVivienda Fund, formed from resources of the National Housing Fund -from workers' contributions-, constitutes a credit fund that is used by commercial banks to offer mortgage loans mainly targeted at the middle-income sectors. Although it has boosted the construction sector, the magnitude of the built houses between 1999 and February 2005 is 6.6% of the quantitative housing deficit, which indicates severe inefficiencies in the programme. The financial scheme ensures the return on investment in the short term for the investor and sacrifices the borrower for long periods of repayment. The housing complexes are usually located at the margins of the development plans of each municipality. This has been associated with problems such as lack of services, lack of municipal equipment, and weak municipal assistance. With the objective of stimulating private investment in construction, building standard has decreased. Moreover, many constructions do not provide the minimum comfort stated by the law (e.g., minimum area of 35 m^2, which in many cases can be off by order of 10%) (Quispe Romero et al. 2005).

The Techo Propio Program has an important component: the "Bono Familiar Habitacional" (Housing family bond), financed by IDB (Inter-American Development Bank) with the aim to favour the lower-income groups so that they have access to housing. The average subsidy is a relatively high amount, which in turn limits the space of the programme given the scarcity of resources for this purpose. Another difficulty is that bank credits must be added to this bond in order to purchase housing, but bank credits are difficult to access for such groups. It is also a subsidy that is offered without specific guidance in the sense that it does not consider the particular characteristics of the location.

On another perspective, the labour market has had great influence in the purchasing power of Lima's inhabitants and in the layout of the city. From the market perspective, before economic reforms, labour legislation in Peru was characterised as overly rigid, dis-encouraging firms to innovate and compete. The referred reforms forced a generation of a labour market compatible with the new requirements of dynamism and flexibility, which enabled to reallocate resources and enable the respond quickly to new challenges raised by greater external competition with the 'Ley de fomento del empleo' [Employment Promotion Law] (Fuentes and Link 2014). The basic assumption was that this reform would stimulate employment and increases wages in the poorest segments of society. Nonetheless, this aperture towards a less regulated market unfolded into prevarication of the labour market. Informal, extremely short or contract-less jobs increased rapidly. High mobility between jobs was detrimental for firms but more harmful for the working class. The main consequences were the increased insecurity in income, the reduction of training opportunities within companies, intermittent contribution to pensions and exposure to lack of health coverage, among others. Despite significant economic growth in Peru during the 1990s and 2000's, informal employment has not been reduced and persists as the engine of Lima's economy.

High economic growth, the increase in education, the consolidation of democracy and political discourses, have fed expectations of increasing amounts of historically relegated populations, to improve and achieve a more egalitarian social position, with full access to well-being and proper quality of life. However, reality collides with the hope of exercising the full right of citizenship, given the growing weaknesses that occur in the link between the sectors of the social pyramid and the labour market, to which must be added relegation and spatial isolation. The restructuring process of the metropolitan economy of Lima has been the transfer of risks and liabilities on the well-being to individuals, the ones that precisely have established the weakest link with the labour market and those who are relegated to certain sectors of the city (Fuentes and Link 2014).

7.10.5 Conclusion and Experience Revelation

Peru has achieved important economic growth in recent years, and given its importance for the country's economic activities, Lima has been in the centre of this process. As a result of the country's recent economic development, Lima has grown notably during the last decades and its economic activity boomed, particularly in the Services, Commerce and Manufacture sectors. However, increasing uncertainty in international markets has slowed the country's growth in recent years. Particularly, excess reliance on exports of commodities has affected the local economy, with important implications for the development prospects of its capital.

During the last decades, explosive population growth mainly due to immigration led to an unprecedented urban expansion in Lima, with the surge of new large zones like the Southern and Northern Poles, and Eastern Lima. The districts in these sectors are typically less developed, with poor-quality public services and lower-income households. Due to a lack of proper urban planning, most of these areas are also badly connected to the traditional centre of economic activity. As a result, new poles of economic dynamism are surging in the outskirts of the city, although institutional conditions and productivity remain weak.

Furthermore, constraints in real estate supply have generated a large gap in the demand for proper housing. While housing prices in modern Lima keep growing, most families in the lower-income segment (a majority of the effective demand) lack opportunities to access proper housing. These dynamics contribute to the economic inequalities between the centre of the city and its outskirts.

The current constitution of Peru does not recognize housing as a basic need thus restringing public policies. Examples from the 'MiVivienda' fund targeting at the middle income sectors but resulting in decreasing building standard, to the "Techo Propio" Program aiming at improving the lower-income groups' access through Housing Family Bond but suffering from insufficient bank credits, to the 'Banco de Materiales' visualized as a State entity which leads to high delinquency, all proved ineffective and unsustainable. Meanwhile, the labour legislation lying under informal employment needs to be taken into consideration as well.

Therefore, it is crucial that the government engages in policies to foster access to housing through increased supply in areas where demand is high, subsidised credit and simplified procedures at the local level. At the same time, the transport and mobility projects have to be implemented to integrate populations from the suburbs to a larger pool of jobs and opportunities. All this will determine the competitiveness of Lima and Peru in the medium and long run.

7.11 Buenos Aires

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7.11.1 Introduction

This section aims to briefly introduce the city. Where is it located, which role does it play in the region and at national level.

Topics included

During the half of the 20th century South American cities like Buenos Aires, have experienced a tremendous growth being currently one of the regions with the highest levels of urbanization in the world. Rapid growth has created productivity and economic development. However, this combined with inadequate planning and public investment has created sprawl cities, having negative externalities within the city by, among others, worsening accessibility and reinforcing inequalities.

Argentina has one of the longest histories of urbanization among Latin American countries. Based on the official national definition of urbanization, Argentina is one of the most urbanized countries of Latin America. It has largely completed the spatial transformation associated with urbanization— with only 8.3% of gross domestic product (GDP) in agriculture in 2014 (World Bank 2015). In 1930, when Latin America was still largely a rural area, Buenos Aires was already a highly relevant urban center.

Argentina is also one of the countries with the highest demographic and economic concentrations in the world. Urban distribution of the population in asymmetric, in 35 cities live 61% of the argentine population. This is a very concentrated pattern for a country whose territorial extension is the 8th of the world. Its urban hierarchy is dominated by the weight of metropolitan Buenos Aires, which is nearly 11 times as large as the second largest agglomeration, Cordoba. The city population is around 3 million people (among the first 100 cities by population size of the world). However, when considering the Buenos Aires Metropolitan Area, the conurbation of BA, total population amounts to 13.6 million people. All over the years, the increase in the annual population growth has been accompanied by an unusual spurt of urban expansion.

The BA Metropolitan Area is the fourth by population size in Latin America and is among the first 30 metropolitan areas in the world ranking. The metropolis includes the city of Buenos Aires and departments, or partidos, from 32 municipalities that belong to the Buenos Aires province, referred to as peri-urban metropolitan Buenos Aires. Economic activity of the BA is around a quarter of the total economic activity of the country (24% of total GDP).

The city has a very rich history beginning in late XVI century when it was settled as a port in the new Spanish colonies of the Río de la Plata. Since then the city developed as a political and economic center. In 1880 BA became the capital city of the country and by the beginning of the 20th century the process of conurbation around the city was already in course.

- Contribution of the city to national GDP

The city economic primacy is higher than for cities at the same level of economic development. For example, in 2012, Mexico City contributed 21% of its country's national GDP, and Sao Paulo contributed 18%. In line with its demographic primacy, which has remained stable over time, Buenos Aires has consolidated its economic primacy over the past decades, with fluctuations following national macroeconomic trends.

- GDP and competitiveness in the city

From the very beginning BA city economic activity was characterized by a mix of manufactures and services (government, commerce and professional services). The importance of manufacturing activity declined over time along with the process of conurbation. BA importance as an international port for the country was shared by new utilities specialized by merchandise (ports for agribusiness near Rosario City, container ports in BA province). BA acquired the characteristics of a central city mainly devoted to providing high quality services to the neighboring urban area.

Argentina's economy, including that form Buenos Aires, has grown less than other highly urbanized Latin American countries in GDP per capita, with periods of reduction in GDP per capita in 1990 and 2002 (in correspondence with the financial crises) (World Bank 2016).

Macroeconomic stability holds the key for economic growth and it has dominated the debate in Argentina. However, as the country needs more than macroeconomic stability for economic growth, cities—and Buenos Aires are part of the solution, since they have the potential to become a magnet for economic growth.

7.11.2 Spatial Economic Structure

This section aims to introduce the spatial economic model of the city. It explains where economic activity is concentrated and where the main urban economic centers are located and why. It analyzes urban growth in the city in the last years and explores the causes and how this is linked to competitiveness. Finally, the land-value prices and changes over time are spatially analyzed.

Buenos Aires city exhibits a primacy roll in the urban system of Argentina. This is due to complex historical reasons such as: the Spanish organization of their American colonies around a few ports, the Latin-American choice for an import-substitution development strategy that reinforced the importance of big urban centers where manufacturing activities where near to consumers, the importance of the capital cities as locations for power negotiations, etc.

Since the 1930s, metropolitan Buenos Aires has been very slowly moving from a monocentric to a slightly polycentric agglomeration. The city of Buenos Aires started to change when manufacturing firms began to relocate from the center to periurban areas. Indeed, for decades, the working population's reliance on access to radial transportation lines ensured that Buenos Aires remained largely a monocentric city. However, from 1935 to 1994 the share of industrial jobs in the city of Buenos Aires decreased from 80 to 37%, and by 2010, Buenos Aires had become more polycentric, with manufacturing sector located in peri-urban areas, only keeping cleaner manufacturing firms, such as ITC, locating within the central city.

As result, BA city as the center of the metropolitan area kept a stable population while the suburbanization process developed. Between 2001 and 2010 the population growth rate was 0.45% annually, well behind from the national average (1.12%) and the average for the adjacent metropolitan urban area (1.33%).

As shown by data provided by the Atlas for Urban Expansion Database developed by UN-Habitat, the metropolitan area has been increasing at an annual rate of 1.5% since 2001, which has led to the region reaching a population of almost 14,000,000 by 2015. This contrasts to population growth in the metropolitan area before 2001 where annual growth rates barely reached 0.7%.

This increase has been accompanied by disproportionate urban expansion. Buenos Aires urban extent grows annually by 2% (Fig. 7.66).

The growth in the size of the city is nevertheless not only due to an increase in populations. Numbers showing where urban expansion is taking place are striking and show how urban developments are concentrated in the periphery. In fact, according to data from the Atlas for Urban Expansion, 50% of the developments are occurring in previously non-urbanized areas.

Some fluctuations are worth mentioning. In the 90s part of the rich population moved to the suburbs to new gated communities. At the same time, a complete new high income neighborhood was developed within the city center (Puerto Madero). The city was also a choice for immigrants from neighboring countries (Bolivia, Paraguay) that populated the city slums.

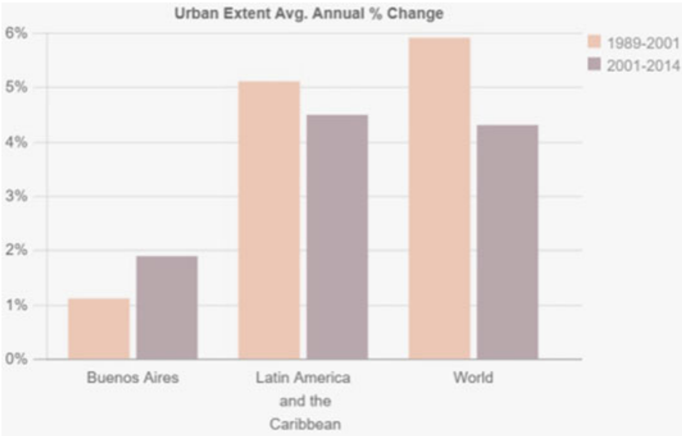

Fig. 7.66 Urban built up area growth. *Source* Atlas for Urban Expansion Database

BA per capita income more than doubles the per capita income of its surrounding conurbation. Considering personal income spatial distribution within the city, BA central city exhibits a very rich North area that continues towards the Northern part of the conurbation. The percentage of poor population grows towards the South and South-West. The percentage of the total population with Unsatisfied Basic Needs is around 8%, but this share almost doubles in the South of the city and is less than 4% in the Northern area. Slums are more frequent at the periphery of the city.

- Where are the main urban centers located?

Economic activities are geographically concentrated in Buenos Aires. Figure 7.67 shows the land use curves (panel A), employment access (panel B), population density (panel C), land price (panel D), and access to water and sewer services (panel E) from the CBD of Buenos Aires to the periphery of its metropolitan area. All the variables behave quite consistently with a monocentric city model, since near the CBD of Buenos Aires City, there is a greater proportion of the land devoted to business and commercial activities (panel A) which is consistent with the higher density of jobs observed in that area (panel B). In addition, given the transportation cost savings implied by proximity to labor sources and competition with commercial uses, the price of land for residential use has its maximum values in this central area (panel D), which is why supply of housing is given only in the modality of multifamily housing which implies high levels of population density (panel C). Meanwhile, as the distance to CBD increases, commercial and business use is reduced, while residential multifamily and then single-family residential use increase. The population density also reduces as well as the price of land when distance to CBD increases.

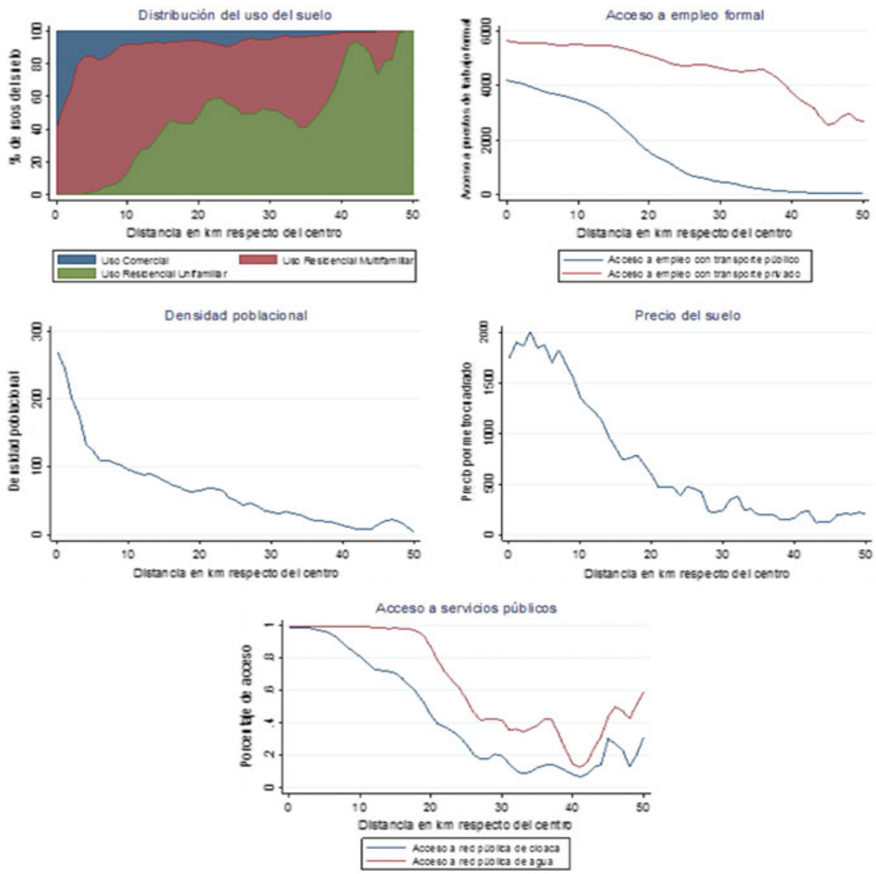

Fig. 7.67 Gradients on land use, access to employment, population density, land prices, and public services for the Metropolitan Area of Buenos Aires. *Source* Own elaboration for CAF (2017) based on data from the INDEC National Population, Households and Housing Census 2010, for land use gradients, population density and access to services; Quirós, T. P., & Mehndiratta, S. R. (2015), for the employment access gradient; and CIPUV Atlas of Land Prices in the Metropolitan Region of Buenos Aires (CIPUV-UTDT, 2016), the price gradients and land use

Beyond these general trends, the behavior of gradients does not always follow the same downward trend with the same fall (monotonic) rate. In other words, at some distances from the ACN, significant changes can be seen in slope curves, suggesting the existence of new sub-centers with a certain level of employment and population concentration. For example, 20–25 km from CBD, an increase in multi-family housing (panel A) explains in part the flattening of the population density curve from that distance (panel C).

On the other hand, an interesting fact that shows panel B on access to employment is that although the number of jobs that can be accessed by traveling an hour or less in both public and private transport decreases as the distance to CBD increases, most pronounced drop is observed for jobs that can be reached through public transportation. This shows the fact that in many Latin American cities public transport services are generally available in central areas and their coverage is substantially reduced in suburban and more peripheral areas. In the case of access to employment by private transport the gradient is quite flat up to almost 40 km from the center of the city. This suggests that, in Buenos Aires, the use of the car, combined with the supply of highways to the south, north and west, has improved access to jobs, which in part explains the great expansion of the metropolitan area of this city in the last years. Not only is access to public transport services significantly reduced in the extension areas of cities, it is also true of other network services such as water and sewage as documented in Chart D of Fig. 7.67.

The gradient analysis for metropolitan Buenos Aires indicates that city center have been adding population at slower rates than peri-urban areas. In metropolitan Buenos Aires, 85% of the total population growth (equivalent to the addition of around 900,000 people) over the period 2001–10 occurred in peri-urban areas, in the range of 15–30 km from the city center, with little growth in the areas closer to the city center. Only 3% of the population growth was within the range of 5 km from the city center.

- Urban economic density: How does urban economic density vary across space?

BA city exhibits the higher employment density of the BA Metropolitan Area. The economic activity centres that follow the central city in economic importance in this area (La Matanza-Morón al Oeste; San Martín-Tres de Febrero al Noroeste; Quilmes-Avellaneda al Sur; Vicente López-San Isidro al Norte) show a rather homogeneous distribution of employment with lower densities.

BA central city concentrates all kind of employment, but the largest share corresponds to public employment and employment in services (822,000 private employees in BA city as compared to 769,000 positions in the rest of the Metropolitan Area).

A key element to understanding the evolving structure of Buenos Aires urban economy is to identify in which sectors the employment growth drivers of the city lays. Such drivers are defined as sectors that have a higher-than-average share of employment and a higher-than-average growth in employment. The analysis of these facts from 2001 to 2010 confirms the important role of the city of Buenos Aires as a cultural and service center. High-end services and education are the main drivers of employment growth in the city of Buenos Aires. However, the limited number of employment growth drivers in tradable sectors in peri-urban metropolitan Buenos Aires raises concerns about the international competitiveness of the metropolitan area, which has a lower share of employment in tradable sectors than do comparator cities. Those facts indicate that peri-urban metropolitan Buenos Aires may not have harnessed the benefits of agglomeration economies to the extent that other cities around the world have (World Bank 2016).

While the location of jobs clearly plays an important role in residential location choices, many other factors also matter, including the quality of local schools, noise, crime, pollution, the type of neighbors, and the ease of conducting other daily errands. As already mentioned, Metropolitan Buenos Aires has decentralized into a low-density, fragmented, and spatially segregated polycentric city, characterized by isolated gated communities, social housing and low-income settlements marginalized to the city's peri-urban areas. The spatial inequality that arises is reinforced by failures in housing and transportation policies, with high socioeconomic costs, for example, a significant difference in access to water and sanitation between core and peri-urban areas of metropolitan Buenos Aires.

- How does land value change spatially?

Land and housing values tend to decline with distance from the city center—though with substantial variation within different geographic areas. Data from the CIPUV Land Price Atlas for the Metropolitan Region of Buenos Aires, provides the best available picture of land prices by geographic area in Buenos Aires. It includes land values for 15,500 parcels (each month) throughout Buenos Aires region, while only 967 are in the central city.

The average price of the square meter (m^2) for the entire Metropolitan Region, without considering the gated neighborhoods neither the lots for sale within the City, reaches US$381.3. Land values tend to differentiate within the city as a function of the distance to the CBD, transport costs and the presence of different levels of services and amenities. The disaggregation in those components shows an important disparity that reinforces the declining value trend, the further away from the City of Buenos Aires where the lots are located. Centrally located, Puerto Madero, a newly developed area, displays the higher land and housing prices per m^2.

The average price for a square meter in the City of Buenos Aires is US $1,766.9 m^2, the average value of lots in GBA1 (the nearest ring) is US$730.1, in GBA 2 (the second metropolitan ring) it is US$247.9 and in rest of the region is US $150.6. These price differences stand out when considering the maximum and minimum prices. As for the highest values, in the City is US$10,714.9 m^2, in GBA 1 the maximum reached US$6,799.3 m^2, while in GBA 2 was US$1,780.4 m^2, and in the gated neighborhoods closed the maximum came to US$900.0 per m^2. In the City of Buenos Aires, the minimum is US$173.6 m^2, while in the Metropolitan Region, without considering the City, the registered minimum value is US$0.6 per m^2.

This phenomenon coupled with the fact that families have different levels of income produces a process of segregation by income level. However, the specific form that urban segregation takes can be very varied. For example, depending on the circumstances, wealthier families tend to be in suburban areas or near the central areas of economic activity.

The spatial expansion of the city contributes to the segregation process if it is accompanied by a process of suburbanization of higher income households, motivated for example by the demand for more space or by fiscal incentives. This process encourages the creation of gated communities, with private security green spaces and sports. For example, in the Metropolitan Area of Buenos Aires, 10% of the land that is zoned for urban use is destined to this type of urbanization. The same happens with the location of informal settlements which can be in the urban periphery a type of residential segregation that is more problematic—because it reduces accessibility—when employment opportunities are concentrated in only one part of the city. The mean formal sales price is more than 4 times higher than the mean sales price for an informal parcel in the same area. This phenomenon could be complemented by the location of social housing projects in non-continuous peripheral areas of cities, where the cost of the land is lower and where the availability of infrastructure networks for services and transport is precarious. On the contrary, the growth by extension of the cities and by infill development on open space is associated with a lower segregation of the most vulnerable households, which are more homogeneously distribute.

Finally, lots in gated communities present a very different dynamic from the rest, accounting for characteristics related to their location inside or outside the urban area. The Northern zone presents the higher average value, which reaches US $594.8 m^2 at 30 km from the CBD, while in the west, and further out, land prices of US$16.0 m^2 are the lowest. Indeed, less than 10% of lots have lower values (less than US$100 per m^2), and only 3% of them have dimensions that are affordable for lower income households. The provision of basic services in those lower cost neighborhoods is very poor, since it reaches only 13% of households for sewage, and less than 30% have access to pipelined water service. That is, those who access these locations see their opportunities for access to employment, health, and services much more limited, thus restricting their possibilities of social mobility, generating and perpetuating the conditions of structural poverty from their location.

- Where is Real Estate Development concentrated?

The more developed areas with the highest average housing and office prices correspond to the Norther zone. However, territorial distribution of housing supply has been slowly changing from 2001 to 2017, correlated to several policies implemented by the city government intended to maintain the attraction of the central areas and reinforce the development of the southern area, which was characterized by vacant and underutilized plots and buildings. The interventions carried out in Puerto Madero (PM), the cluster incentives (ICT, Media, Design or Pharmaceutical), were all aimed to upgrade underutilized or vacant areas of the city that were in the process of degradation, with consequent negative externalities, for example, in terms of maintenance of public space, insecurity and incipient processes of informality in land occupation. All these interventions are targeted to areas of the city that have lost economic activity due to changes in the location of manufacture that relocates to suburban areas, leaving a vast number of vacant and underutilized buildings in areas closed to the center of the city.

Several neighborhoods of the Western and Southern areas, which in general terms, used to have a low proportion of supply—below 1.0% of total, have been slightly recovering due to new urban strategies developed by the city government.

The increase in weight may be noted from 2010 in neighborhoods where the ICT cluster is being developed, since it represents 1.6% of the supply in 2001 to 3.9% in the last measurement from 2016. Moreover, the location of the new administrative facilities for the City Government and a commitment to improve transportation—by new subway extensions and BRT, together with the upgrading of informal settlements while several urban cluster laws were enacted, all have provided a set of different incentives for households and firms to locate there.

The West zone of the City, shows lower values (US$1,839.8 m^2) and, with values very close to the latter, the Central area with US$1,437.0 per m^2. Finally, it is the southern zone that presents the lowest average price per m^2 (US$1,603.0), 42.2% below the average value of the Northern zone. Affordable (low) land values is available in areas where commuting costs are high (fringes), urban infrastructure and services are lacking; building is risky (due to legal or terrain conditions as flooding). Land values are cumulative with respect to these conditions.

7.11.3 Economic Competitiveness in the City and Real Estate

This section analyses the economic structure of the city. It provides an overview of the main economic sectors and the role that Real Estate plays in the city's economic structure. It analyses economic growth and competitiveness in the city and how this has changed over the years. It also draws on some of the causes for economic growth.

Though time, BA city has evolved from a central city devoted to a mix of activities to a service city. Manufacturing activities decentralized from the city to the suburbs in the 80s and 90s. Moreover, during the 90s and first part of the 2000s part of the manufacturing activity moved to other locations in the country abandoning the Metropolitan Area. In BA city, the manufacturing activity used to represent 17% of the total economic activity and reduced this share moderately by the end of the 2000s (around 16%). In 2011 BA city was the home to 13,246 manufacturing companies producing pharmaceuticals, food, leather manufactures, publishing, electric machinery and chemicals.

The increase of service activities in BA city grew steadily since mid 80s. Currently, more than 40% of GDP corresponds to Transport, storage and communication services, Financial intermediation and Business services (Fig. 7.68).

One indicator of the relative importance of service activities in BA city as compared to other urban centres in Argentina is the share of professionals (tertiary and university degrees) on total employment. This share amounts to 27% in BA city against 12% on average for the main 31 urban centres of Argentina. The agglomeration of human capital at the city level provides knowledge spillovers to the whole production system that can be measured by the wage premium accrued to non-professional workers. This premium was estimated in 8–9% of the average

Gross Geographic Product (Millions of pesos at 2004 prices) by activity. 2004 - 2015
Source: GCABA. Dirección General de Estadística y Censos

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture, livestock, fishing and mines and quarries	1,1	1,0	0,8	0,8	0,9	1,1	1,0	1,0	1,1	1,1	1,2	1,2
Manufacturing	16,2	16,1	16,6	15,4	15,4	15,2	15,7	15,4	14,8	14,6	14,5	14,8
Electricity, gas and water	1,3	1,2	1,2	1,1	1,2	1,1	1,0	1,0	1,0	0,9	0,9	0,9
Building	4,0	4,8	5,5	5,7	5,8	5,4	5,3	5,3	4,8	4,8	4,7	4,6
Commerce	15,4	15,2	14,7	14,9	14,9	14,9	15,4	15,5	15,3	15,6	15,6	15,5
Hotel and restaurant services	2,9	3,0	2,9	3,1	3,2	3,3	3,2	3,2	3,2	3,2	3,1	3,1
Transport, storage and communications services	10,4	10,2	10,1	10,6	10,3	10,4	9,9	10,0	10,2	10,3	10,3	10,4
Financial intermediation and other financial services	8,0	8,4	9,5	10,1	9,6	9,7	9,6	9,9	10,4	10,9	10,7	10,7
Real estate, business and rental services	21,0	21,0	20,5	20,4	20,7	19,9	20,4	20,4	20,4	19,4	19,2	19,0
Public administration, defense and compulsory social security	5,9	5,9	5,3	5,4	5,4	5,3	5,4	5,3	5,3	5,6	5,6	5,7
Teaching	3,2	3,0	2,9	2,8	2,7	3,0	2,8	2,7	2,8	2,7	2,7	2,7
social and Health Services	4,2	4,1	4,0	4,0	4,2	4,6	4,7	4,9	5,2	5,4	5,9	6,1
Community, social and personal services n.c.p.	5,0	4,9	4,7	4,7	4,8	4,8	4,6	4,4	4,5	4,5	4,6	4,6
Services of private households hiring domestic services	1,2	1,2	1,2	1,1	1,0	1,1	1,0	1,0	1,0	0,9	0,9	0,8

Fig. 7.68 Gross domestic product for Buenos Aires city

national wage for non-professional workers in the country. This estimation points to the higher productivity of BA city as compared to the rest of the urban areas in Argentina. Other interesting piece of information refers to the Public Investment in Research and Development: 26% of the National Total is performed in BA city. Can we consider BA city as a “skilled city”? Even though the high share of human capital is a distinctive feature of BA city in Argentina, it is lower than the observed in other cities in USA or Europe where the presence of professionals varies between 36 and 53%.

- How has the city improved urban productivity and economic competitiveness in the last years?

Despite the macroeconomic constraints, the city of Buenos Aires stands out because of its proactive policies to increase its economic competitiveness. An example is its policy for economic development districts to promote growth in strategic sectors such as technology, audiovisual, design, and arts. Its policy is now shifting toward the promotion of innovation to move up the value chain. However, the city needs to further leverage its human capital to strengthen its global competitiveness. At the same time, while the city of Buenos Aires has the strongest performance of all the cities in Argentina in generating prosperity and livability, its peri-urban areas lag significantly behind. Municipalities in peri-urban metropolitan Buenos Aires face the challenge of transforming their economy toward higher value-added products and services. One of the main constraints is the absence of a mechanism for core-periphery coordination that will promote an integrated economic development strategy for the entire metropolitan area.

When two complementary metrics of city performance—prosperity and livability—are estimated to compare prosperity, and living conditions the city of Buenos Aires is not only the most prosperous but also the most livable city within the country. However, in metropolitan Buenos Aires, core-periphery disparities in quality of life are even more pronounced than disparities in prosperity. Indeed, the international comparison of metropolitan areas -based on The Economist Intelligence Unit (EIU) Livability Index -shows that the city is overall more livable than are direct comparator cities, but it lags in several areas, including stability, infrastructure, culture and environment, sprawl, connectivity, and natural assets. In 2015, metropolitan Buenos Aires ranked 62 of the 140 cities surveyed, ahead of Istanbul (113), Bangkok (102), and São Paulo (92), but behind Seoul (58), London (53), and Paris (29).

- How has land value changed over the past years?

Land prices are increasing every year. As for the variation of land values with respect to the year 2002, for the total of the city it raised to 590.6%. In part, some of this variation can be directly attributed to urban interventions—such as the upgrading of the south area of the city. However, the scarcity of well-located parcels is extending the real estate market to other less developed areas. Furthermore, the extension of the metropolitan area allows for the continue valorization of lots inside the city, offsetting transportation and congestion costs. That's why accessibility is considered as one of the most relevant characteristics that determines land prices. The city is still a very attractive place to live, for the young and middle age families, who value time and proximity to work, and are willing to pay a premium for that. At the same time, the city population includes a great share of older residents (over 65 years of age) who also highly value proximity to public services—and medical ones.

The area with the highest growth is the Southern zone, whose percentage variation within the period analyzed (2002–2016) is 725.6%. In this area, several urban programs were implemented, including the ICT District and more recently, the relocation of all city government offices, coupled with public investments in transportation and public space. On the other hand, the area with the lowest percentage change in the average value per m^2 compared to 2002 is the Central area, whose difference amounts to 286.8%. In fact, the highest values are still generally found in the Central Zone (CBD) with average prices per m^2 of US$4,475.7, showing the relevance of the CBD in the city's economic structure. This is a very important matter when many cities all over the world are struggling to maintain the attraction of firms and population to their city centers.

When comparing the territorial distribution of land prices between December 2015 and December 2016, there is a very marked difference between the prices of the Center and the south of the City. In the South, average prices are much lower (US$3,767.6 per m^2). In the West, a case to be highlighted is the highest percentage increase in the series surveyed (2002–2016), with a positive variation of 988.5% compared to 2002, in part explained with increases in density allowance turning from low to high density.

7.11.4 Real Estate Development and Competitiveness

This section analyses in detail Real Estate development in the city and its positive as well as negative effects. It goes into depth on what is driving Real Estate development and property markets investments. It also analyses how Real Estate is contributing to competitiveness in the city. Additionally, it draws on the negative effects of Real Estate Development that can include unplanned urban growth, housing unaffordability, segregation, etc.

After the severe banking, monetary and government debt crisis of 2001—in which many contracts were rewritten and dollar-peg clauses were abrogated—Argentines massively channeled their savings towards real estate investments. While this was especially favored by the low exchange rate during 2002–2005, the inflow of funds into the sector continued for several years after this initial head start. Buenos Aires city was the main epicenter of such investment flow.

When it comes to saving, Argentines buy U.S. dollars and store them at home—and far away from banks. When they have piled up enough dollars, they swap them for an apartment and offer it in the rental market. Residential real estate has been the most trustworthy and generalized investment vehicle used by middle and upper-middle class families over the last 40 years. In fact, families make lifelong consumption plans relying on future rental income—something that they do not normally do based on coupon payments of government bonds or equity dividend streams.

It is noteworthy that, since the macroeconomic crisis—end of Convertibility in 2001—new buildings have acquired some store of value characteristics that are typical of money; new houses are now smaller and more luxurious. These are akin to the divisibility and the low risk properties of money. The lack of a mortgage market has strongly affected affordability for median and lower income households.

However, when the flow of funds into the real estate sector for the city of Buenos Aires since 1992 is compared to traditional savings instruments, it provides very relevant evidence of the great flows into real estate as a savings instrument from 2003 to 2012. For each dollar that went into the city's real estate from 1992 until 2000, about six dollars went into deposits in the national banking system. Conversely, from 2003 until 2012, for each dollar that went into real estate, only 99 cents went to bank deposits. Furthermore, it is noteworthy that flows into real estate only pertain to the City of Buenos Aires (CABA), while the increase in time deposits represents the whole banking sector of the country (Cruces 2016). Thus, according to national accounts, from 1992 until 2001 money flows into CABA real estate were about 8.4% of CABA private sector savings, while they rose to 13.3% in the 2003–2013 period, a 57% increase in the ratio. The following figures contribute to illustrate and describe this situation.

First, Fig. 7.69 shows the volume of new residential construction that was authorized by the City of Buenos Aires each year, the volume that was put on the market as finished construction each year and the average price per m^2 of finished dwellings. During 1992–2001, new construction averaged 1.12 million m^2 per year. During 2003–2012 that figure was 27% higher, 1.42 million. The increase in simple average price was slightly more important: $1,139 per m^2 during the first period, compared to $1,483 during the second period, or a 30% increase. Prices are expressed in constant 2014 dollars. Second, Fig. 7.70 shows the volume of new money channeled to the real estate sector each year, from 1992 until 2014 in the city

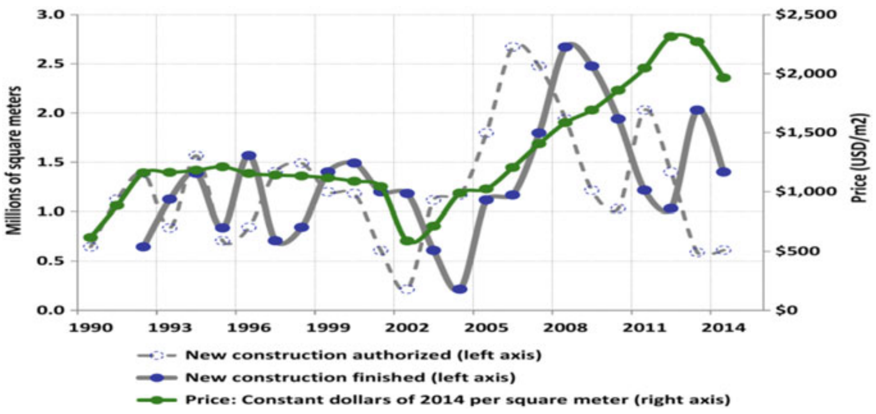

Fig. 7.69 New construction and price of real estate

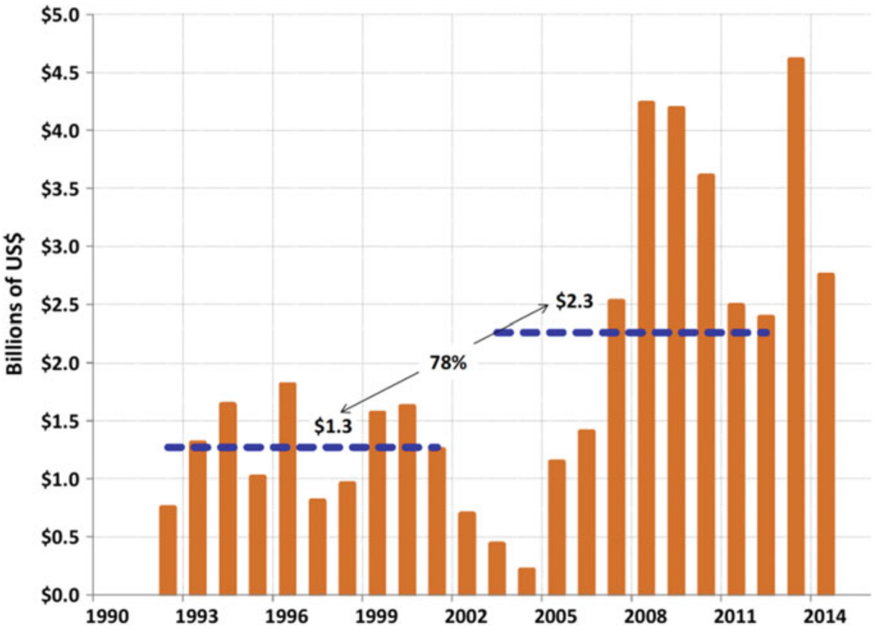

Fig. 7.70 Money flows into the real estate sector

of Buenos Aires. During 1992–2001, the average was $1.3 billion per year, while it was $2.3 during 2003–2012, an increase of 78%. Figures are in constant 2014 dollars.

The next figure (Fig. 7.71) compares the flow of new savings channeled to real estate with that invested in banks' time deposits. From 1992 until 2000, new time

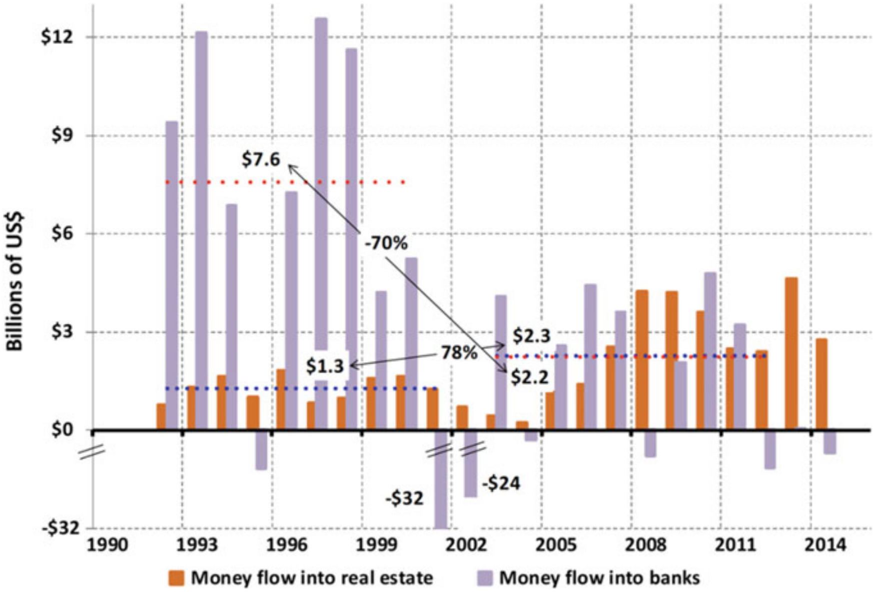

Fig. 7.71 Allocation of new savings: real estate versus banks

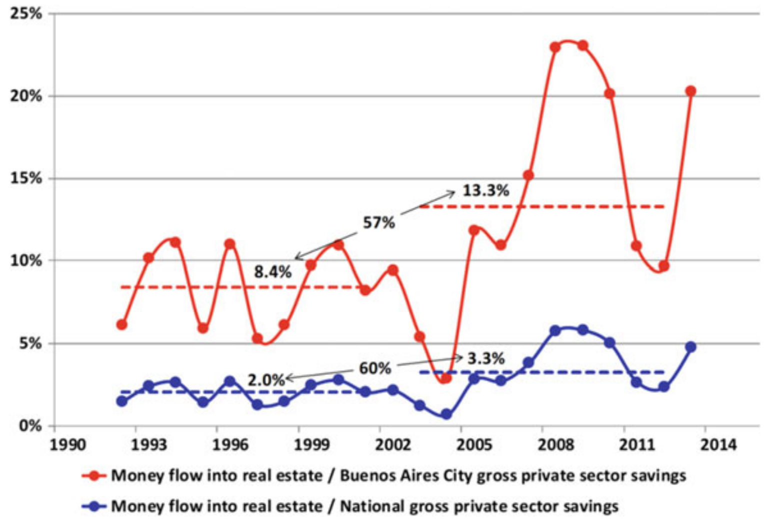

Fig. 7.72 Savings channeled to real estate as a share of city and national savings

deposits at banks totaled $7.6 billion per year on average, while from 2003 until 2012 they were $2.2 billion per year, a 70% reduction. These figures compare with an increase of 78% in new savings channeled to real estate across the two periods.

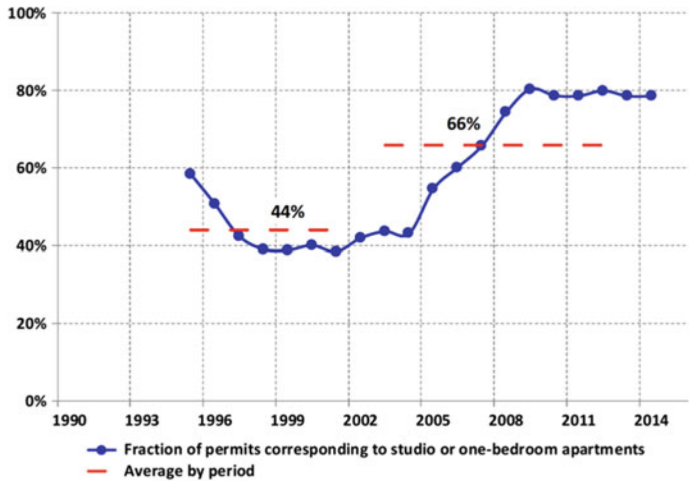

Fig. 7.73 Construction permits for studio or one-bedroom apartments

During the first period, for each dollar that went to real estate, about six dollars went to new time deposits. During the second period, for each dollar that went to real estate, only 99 cents went to new time deposits. Furthermore, it is noteworthy that flows into real estate only pertain to the City of Buenos Aires, while the increase in time deposits represents the whole country's banking sector.

Figure 7.72 shows the ratio of savings channeled to the real estate sector in the City of Buenos Aires to National private sector savings (from the national accounts) and to City private sector savings (adjusting National savings by the fraction of National GDP generated in the City). In both cases, the money flow into the real estate sector rises by about 60%, when comparing the period 1992–2001 with 2003–2012. Savings channeled to real estate amounted to $12.7 billion during the first decade and to $22.6 billion during the second decade (all amounts are in constant 2014 dollars). The 78% increase results from a combination of a 27% rise in physical construction and a 40% increase in real price.

One key characteristic of money is divisibility. In this case, since 2003 investors demanded smaller houses, which require lower minimum investment. This is consistent with the use of real estate as a store of value, a classic characteristic of money. To illustrate this fact, Fig. 7.73 shows the percentage of new home construction permits for studio or one-bedroom apartments is shown. From 1995 until 2001, these units amounted to an average 44% of permits, while from 2003 until 2012 they accounted for 66% of permits, meaning that demand for such units rose by 50% across the two periods.

Complementing the analysis, Fig. 7.74 shows the percentage of new home construction permits for luxurious houses. From 1995 until 2001, such houses amounted to an average of 27% of permits, while from 2003 until 2012 they accounted for 41% of permits. This is consistent with real estate being used as an

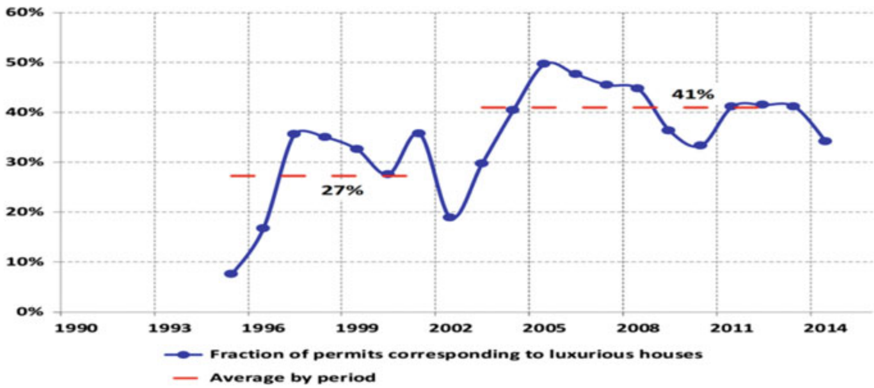

Fig. 7.74 Construction permits for luxurious houses

investment vehicle for three reasons: (i) anecdotal evidence indicates that the prices of more luxurious houses better resisted the 2001 crisis than those of lower-quality houses, (ii) renting a more luxurious house targets a customer base that presumably has lower credit risk than houses of lower quality, and (iii) as a last resort, investors could bequeath such houses to their heirs and thus would prefer higher-quality houses for that purpose as well. These data are consistent with the demand of new construction being dominated by investors as opposed to the future inhabitants of the houses whose construction permits were submitted to the City of Buenos Aires.

- Investment in real estate and rental markets laws

In the decade from 2003 to 2012 the CABA real estate market had to absorb 27% more m^2 than in the decade from 1992 to 2001 (14.2 million m^2 compared to 11.2. How did the market react? When landlords are fearful of future unfavorable changes in rental laws it is usual to choose to leave their newly acquired houses vacant. The data in the 2010 census shows an alarming 24% of vacant houses in CABA, which contrasts with an average vacancy rate of about 7% for major cities worldwide, and it is much higher than the 15% vacancy rate for Buenos Aires in the 2001 census. The vacancy rate around 6% is an average of the large stock of old houses that are mostly occupied, and the relatively small stock (of new houses that are largely vacant and used as a store of value by investors.

Respecting investor property rights in the real estate market has not been the historical norm. The period from 1942 to 1976 was plagued by laws and regulations that severely affect the real estate market and rental market in particular. However, since the reform of the rental law in 1976, and the amendments to it after the return of democracy in 1983, the rights of owners have been largely respected, regardless of the political or ideological affiliation of the administration in office. In a country like Argentina, where there is generalized mistrust given historically recurrent episodes of minority investor confiscation in different asset classes—including, of course, real estate during a large part of the twentieth century, when institutions care for investor rights, capital is abundant.

At present, besides increases in housing prices, the real cost of renting a house is much lower than it used to be in Buenos Aires: rents have fallen by about 40% in real terms compared to their average value during 1992–2001. The net rental yield is 1.5% per annum. It means that net rental rates fell from an average of 7.1% from 1992 to 2001 to an average of 2.9% from 2003 to 2012. And much more in recent times. It is noteworthy that this fall in yield is not exclusive to the Buenos Aires market, and it has also taken place in major cities worldwide, in part because of the abnormally low interest rates of the major reserve currencies. Thus, be that as it may, the bottom line is that the market has reacted to the increase in supply by lowering rental rates and maintaining vacancy rates that are close to their worldwide averages.

During the period from 2003 until 2012, a total of $22.6 billion flowed to the Buenos Aires real estate sector. The estimated current annual opportunity cost of these funds earning is about 1.5% per annum. In a country in which savings are badly needed, both to finance the government and for investments in infrastructure and in plant and equipment, it would seem paradoxical to find a flight to quality effect through which substantial amounts of capital found refuge in the real estate sector and are parked at a yield lower than that of the 10-year U.S. Treasury Bond. Optimal from the investor's standpoint, the market failure that gives rise to this externality is mistrust in traditional investment vehicles—due to macroeconomic crisis—compared to the security afforded to investors by the real estate sector. Neither of these investments has reached the most in need.

- Is housing affordable?

Urban households devote considerable time, money, and effort to housing. Besides the supply of luxury apartments, Buenos Aires has experienced a rise in its quantitative housing deficit. The rise has led to an increase in informal housing and low affordability. Indeed, the metropolitan area region is the most populated, and also concentrates 58% of the total quantitative and qualitative housing deficit.

Figure 7.74 presents the evolution of alternative affordability indicators for BA City. On the one hand the ratios of formal wages to construction direct costs are calculated for multifamily residential and detached houses. In cost terms affordability showed an increasing trend since 2008 and has remained stable between 2015 and the beginning of 2017. The affordability indicator shows that, on average, a household can "built" at least 3 m^2 per month.

On the other hand, we present a more standard affordability indicator measured by the ratio of the final price of a new apartment to the average formal wage. Now, the story is completely different. Land value, taxes, developer's costs and benefits, and financial expenses determine a big gap in affordability between construction costs and the housing final price. Households are restricted to buy only 0.8 m^2 per month considering the final housing price. Since 2015, an increase in housing prices in relation to wages evolution determined a reduction in affordability of around 15% (Fig. 7.75).

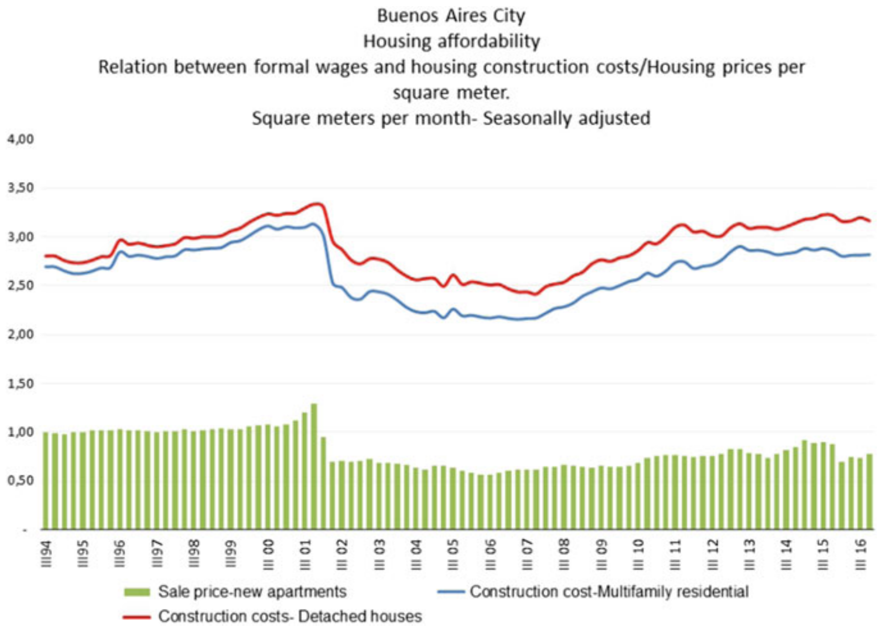

Fig. 7.75 Buenos Aires housing affordability

Considering that the average worker can afford 0.8 m^2 per month, the typical household would buy around 1.6 m^2 per month (two workers per household). Considering savings by households around 25% of their monthly income, they could buy a home of 60 m^2 in 12.5 years. This latter figure is a reasonable period when the mortgage market is well developed. Unfortunately, this was not the case of BA City and Argentina in general since the 2001 macroeconomic crisis of our country.

From 1998 to 2015 the mortgage market decreased from representing 4.5% of GDP to only 0.6%. Credit constraint and high macro instability including inflation determined the preference of investors for foreign currency and real estate, as already explained. This fact along with the lack of affordability and access to housing by medium income households created a real estate market specialized in costly dwellings in selected neighborhoods of the city. This evolution of the real estate market resulted in higher land prices and a larger incidence of plots in housing price formation in BA city as compared to the city surroundings. Increase in land valuation is an observed result for central cities over time due to the concentration of highly productive activities and skilled workers, but in the case of BA city the main reason of a rapid increase in land prices was the fact than real estate was being used as a hedge against financial risks.

Over more of 15 years the average household in BA city faced the problem of accessing to housing so that tenure through renting increased from less than 16% to more than 30%. This dramatic change in tenure features was even more visible in the rest of the country where affordability is even lower.

When new national authorities came into office at the end of 2015, the financial market was normalized and a new model for housing policy was put in place following a Savings-Voucher and Loan system like the Chilean one (the PROCREAR). For the first time in the development of the housing and housing financing policies, a system of direct subsidy to the demand was implemented.

To this aim, important changes have been introduced in the whole system. Firstly, private commercial banks will lend inflation-adjustable mortgage loans to median income households, using the new mechanism introduced by the Central Bank, the Unidades de Valor Adquisitivo (UVA), and at market interest rates. Currently, most banks, both private and publicly owned, offer mortgage loans denominated in UVAs. Real interest rates for these loans are close to 5% and the longest term is 20 years.

Complementing the mortgage, a direct subsidy for purchasing the housing units was introduced for lower income households, those between 1 and 3 average minimum salaries. The purchase of the house must be completed with the household's savings. Loans can be used to acquire a new or used finished housing unit while loans for construction have been recently introduced. The implementation of this program will have effects on the wellbeing of the families that are becoming homeowners. This effect will be positive, as evidenced by the available literature on the externalities of homeownership.

- Is real Estate development happening in a planned manner? Is it creating urban sprawl?

In the past decade, metropolitan Buenos Aires experienced a marked change in its pattern of territorial expansion, with a significant increase in suburbanization and sprawl. Urban expansion in Argentine cities accelerated from 2001–2010 compared to 1990–2001, and Buenos Aires has not been an exception. Municipal land use practices have fostered unsustainable patterns of urban development by extension. Instead of decentralizing into a dense polycentric form, metropolitan Buenos Aires is expanding into low-density, fragmented, and spatially segregated forms, which are characterized by isolated gated communities and low-income settlements marginalized to the city's peri-urban areas. Most development has occurred in peri-urban areas of metropolitan Buenos Aires, where there is poor public transport access for workers.

Moreover, Buenos Aires it is characterized by significant institutional fragmentation, which—in the absence of effective metropolitan coordination in planning and land use regulation—encourages sprawl. This highly fragmented metropolitan area comprises the city government, the federal government, the provincial government, and departments, or partidos, from 32 municipalities. Thus, territorial development is challenged when urban development crosses administrative boundaries, and the lack of instruments for horizontal coordination is a constraint for metropolitan planning. The population density of the built-up area has decreased by 2.2% annually from 2001 through 2010, compared to a decrease of 0.8% annually from 1991 through 2000.

These developments have very detrimental effects in the well-functioning of the city. It has led to decreasing densities posing challenges for accessibility and social inclusion. While Buenos Aires was traditionally planned following European block-type layouts and had considerable high density of 106.7 persons per ha, this density, according to data of the Atlas for Urban Expansion, is decreasing at a pace of 0.6% annually.

Several policy factors could explain the patterns of sprawl characterizing territorial expansion of Buenos Aires, including urban transport policies, land use and housing policies, and institutional fragmentation of metropolitan areas.

First, Improvements in the suburban highways in metropolitan Buenos Aires after 1980 increased accessibility but also promoted sprawl. The period after 2001 also corresponds with the freeze of public transport tariffs. A national system of transport subsidies in the aftermath of the financial crisis of 2001/02 made transportation in metropolitan Buenos Aires very affordable and decreased commuting time and costs. The subsidies made living outside the city in lower density suburbs more affordable than within the central city, leading to an increase in land consumption per housing unit of the median and higher income households.

Comparing to other Latin American cities, Buenos Aires has a comparatively high use of motorize transport and specifically of private car use. According to data collected by LSE Cities (2010), private car use in Buenos Aires represents 36% of used transport modes as opposed to 11% in Lima or 14% in Bogota. Besides, being one of the only cities that have a metro system, the use of public transport is comparatively lower to other cities in Latin America having a public transport use of 43% as opposed to 57% in Bogota and 51% in Lima (LSE Cities, 2010). This trend has obviously considerable consequences on the accessibility to jobs and socio-economic opportunities, especially for the most impoverished population (Fig. 7.76).

Instead, for the lower income households who depend on public transportation, the low-density expansion in areas where transportation accessibility is very low, it decreases employment opportunities, and access to social services, reinforcing social and economic fragmentation and segregation. Sprawl also occurs when informal low-density settlements are the only mechanism for providing housing to low-income populations who lack access to formal land and housing markets.

Sprawl is also encouraged by a lack of flexibility in land use regulation and a lack of incentives to developers to increase density. Furthermore, additional negative externalities can be observed in the increasing levels of segregation within the city. While the old planned city core still preserves a high level of diversity, the trend of city expansion in the periphery is creating segregating patterns. According to a study of LSE Cities, the most educated people are increasingly living in wealthy pockets along the coastline as well as along main transportation corridors outside of the city. On the other hand, the underprivileged and least educated areas show increasing levels of impoverishment. Being situated in the western and

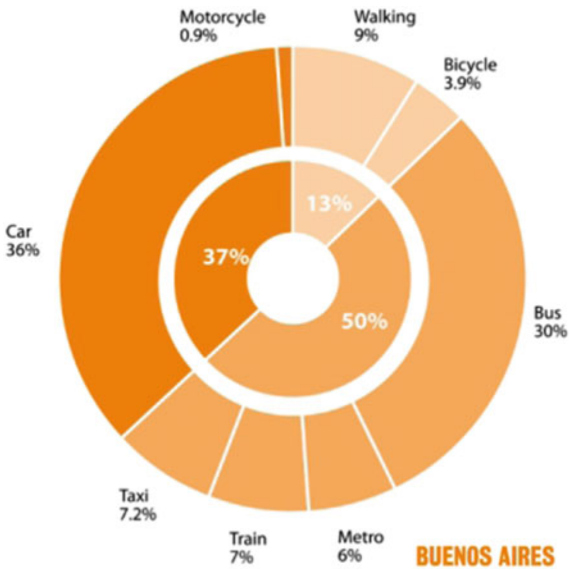

Fig. 7.76 Transport modal split. *Source* LSE Cities (2010)

southern parts of the city's periphery, these areas are isolated and removed from the main transport infrastructure corridors.

At the metropolitan scale, there are negative consequences of unplanned city expansion. Most of the new developments are discontinuous and occurring in peripheral areas. The growth of gated communities, has also been accompanied by growth in informal settlements which have exacerbated the fragmentation and dispersal of urban areas in metropolitan Buenos Aires in the 1990–2010 period. This trend is reflected on an increase of the population living in slums from 6.8% of the population in 2001 to 10.4% in 2006.

The observed pattern of urban expansion in metropolitan Buenos Aires has a direct effect on the efficiency of public infrastructure and public service provision, environmental sustainability, mobility, and housing supply. With weak planning instruments, and a gap in technical and implementation capacity within the central city and its region, scarce fiscal resources, and no mechanisms for institutional coordination, the span of interventions is restricted to piecemeal and reactive planning for urban growth. Furthermore, strict land use regulations contribute to constrain access to formal land and housing, thus promoting the growth of informal settlements. For example, use of land value capture instruments for planning is not yet common practice, although innovative initiatives are emerging.

7.11.5 City Policies and Regulations for Real Estate Development

This section analyses the role of regulation, planning and policy in increasing competitiveness of the city through Real Estate Development. Concretely, this section aims to draw on regulations that the city is implementing to encourage Real Estate Development as well as to address the negative effects of Real Estate Development.

City growth and population growth represent an opportunity for the economic development of cities. However, city expansion must be accompanied by good planning and design to maximize the city's potential. Contrasting the unplanned development of the metropolitan area, the city of Buenos Aires stands out because of its proactive policies to increase its economic competitiveness by urban polices that seek to foster real estate development.

One example is Buenos Aires cluster policy for developing districts that to promote economic growth in strategic sectors such as technology, audiovisual, design, pharmaceutical, and arts. They look for high value added firms to concentrate in the central-southern areas, improving agglomeration economies that increase productivity and innovation while providing benefits to their workers for working locally. What is most important, is that all these new initiatives are intended to restructure, densify and renovate several areas of the city by providing either fiscal or land use incentives for firms and households. Although partially degraded and underutilized, all those areas are equipped with excellent accessibility and full coverage of infrastructure services.

One of them, the Technological District created a cluster of ICT activities and provide fiscal and land use incentives for firms and workers to locate in the southern area of the city. During some decades, by moving away from central the center to the periphery, firms lower their land costs but also lose some agglomeration benefits, the more so the steeper the spatial decay of interactions. Since this new ICT cluster creation, other urban clusters are supporting the urban transformation process within Buenos Aires city. There has been an economic and real estate transformation not only by the arrival of new firms but also commercial activities and related services for new residential projects.

- What is the city doing to address the negative effects of Real Estate Development?

The urban literature has stressed the importance of land regulation on housing supply and costs. In developing countries, more stringent regulations not only increase the costs of providing additional supply of houses, given that they reduce the amount of land available, but also, generate a substitution effect towards a demand for untitled-informal lots. Therefore, standards setting a minimum quantity of land can exclude the lowest segment of the market. Some experts estimate that an increase in one standard deviation in the indicator of land regulations reduces the chances of being formal by 13% and by 9% when the approval cost indicator rises in the same magnitude.

Furthermore, conventional land use policies largely neglect the fact that the changes in administrative norms and regulations raise property values but the benefits are still privately owned. Value ‘recapture’ and value ‘sharing’ on ‘betterments’ are starting to be pursued with different intensities in time and space within the municipalities of the metropolitan area (not within the city), due to the enactment of a new Buenos Aires Provincial law, in 2013. The aim of the law, is to mobilize, for the benefit of the community at large, some or all the windfall income that landowners gain from public investments and by land use regulation. In the short term, the distribution between the private and the public spheres of surplus values generated by urban transformation has implied a difficult process, where information asymmetries, lack of sufficient incentives for public officials, lack of the requisite skills in public administrations in many jurisdictions, has been restricting its implementation.

At the same time, the city government is currently analyzing a new urban code, which will increase the built-up area in 3 million m^2, by allowing greater densities and mixed uses in many city neighborhoods, including rezoning of areas for commercial use. Its preliminary presentation raises the discussion about the need for capturing the value generated by urban land transformations where landowners will reap increases in land and property value from the easing of zoning and other restrictions. Therefore, the new urban code provides an opportunity to tap this fundamental resource using a variety of land-based financing tools (LBFTs). In that way, value capture can turn land into a major potential revenue source for the city, improving its ability to meet public expenditures as well as manage urban growth and promote greater social integration.

The city has several previous successful experiences for collecting contributions and other types of charges which enable further public investments. Among them, taxes on land value are also a form of value capture insofar as much of that value results from accumulated public actions and investments. To pay for the new 40-km subway line that doubles the existing capacity, Law 23.514 of 1987 created a special fund financed with a 5% increase in property taxes for all city residents, plus another 2.4% surcharge for residents living within 400 meters of the stations.

Land banking and land leasing are two instruments already used. Under land banking, the city holds tracts of land to control their use and prevent speculation. Upon sale or lease of land, the municipality captures the land value increment resulting from public investments or market forces. Several new investments are now financed by this scheme. However, there were many missed opportunities for implementing value capture in large urban regeneration projects, such as Puerto Madero waterfront.

Finally, transfers of development rights (TDRs) allow compensation to owners for constraints on building rights on historic preservation buildings. These rights can be sold to third parties or used directly in developments in predefined areas. The city is now willing to use such rights to compensate owners’ maintenance of old real estate assets.

7.11.6 Lessons Learnt

This section aims to highlight some concrete examples of regulations that are have worked effectively, and commenting on some recommendations for improvements. The aim is that, In the long term, the game could turn into a positive-win-win one, if the share of recaptured land rents is channeled towards urban infrastructure improvement and enhanced livability services triggering a virtuous cycle of continuous urban wellbeing, competitiveness and growth.

The most recent urban interventions followed a pioneer one, developed in Puerto Madero (PM). A great urban project covering the waterfront area adjacent to the city center, PM intervention has regenerated the port area into higher-added value real estate. It was conceived as a catalytic project that was key to overcame years of disinvestment in the Buenos Aires CBD and change the public's perception of the downtown area.

The image of Puerto Madero has become an icon that represents the city, mainly in the perception of tourists and visitors and in some service activities, rather than as a central reference for all the inhabitants of the city. Today this is the area of the city with greater locative value and leads the market of products of high category with prices of buildings much higher than the average of the city and other residential areas of high valuation.

The renovation plan pursued more intensive uses of the area, in 170 ha adjacent to the commercial, administrative and political center of the city, which makes the scale of the intervention very significant, for the real estate market of the city and even of the region. It increases the supply of high income housing, office and services. It encompasses 3.03 million m^2 of buildings introduced into the real estate market, an amount equivalent to all those currently available in the CBD.

Project was self-financed by proceeds of land sales by a quasi-private corporation (CAPMSA) which gained ownership of the port lands through government decree. During the life of the project, CAPMSA recorded sales amounting to US $300 million. By selling the plots, the main infrastructure—highway and public services and public space were financed.

The intervention has generated positive externalities in neighboring areas. As an example, San Telmo is indicated—south of the center of the city and bounded by PM—that reverses its previous characteristics of deteriorated central and historic area, with a process of gentrification (especially young households) that, unlike other gentrified neighborhoods (like Palermo), for the moment coexists with the original population.

While the consensus is that the Puerto Madero Project was a success, a current discussion is the one associated with its social impact. Some criticisms point to the fact that land sales could have been paced more strategically. If less land had been released between 1997 and 1999, the project could have yielded much greater profit for the corporation and the city, capturing—in some proportion—some of the increases in land value promoted by public and private actions throughout the intervention. Instead, most profits went to private developers.

The scope of the Puerto Madero regeneration project went beyond the transformation of the formerly industrial port area. From the project's conceptualization, the goal of political leaders and city planners was the revitalization of Buenos Aires' southern area, which includes the some of the oldest neighborhoods of the city. After that, the consolidation of the Central Area, as a center of local and metropolitan gravitation, and the promotion of opening and expansion towards the south, propitiates a new transformation of the urban structure, balancing the asymmetries between the North and South sectors of the city and revitalizing the value of the central location. Considering the stagnation, and even the decrease in the population levels of the City of Buenos Aires during the last three decades, it is interesting to note that the changes introduced—the PM area and the economic Districts-, giving new uses to underutilized areas, strongly contribute to retain and reinforce residential and business real estate development in the central area of the city.

Following Puerto Madero, several new interventions, like the new city government location and economic clusters are promoting urban development and real estate investments in underused areas of the city. It will be important to evaluate the impact of those urban interventions to learn from such experiences.

7.11.7 Conclusions

This chapter has reviewed major strands of the relationship between real estate development and competitiveness in Buenos Aires, focusing on three elements. The initial focus is on real estate development, a main driver of city growth in any city. The discussion summarizes the state of the relationship between land and house prices and city competitiveness which depicts the new equilibrium generated after the macroeconomic crisis. The chapter then turns to the issue of the transformation undergone from a manufacturing oriented economy to a service sector based economy. Like many other modern cities, Buenos Aires city serves as hub of the service sector and industry for its economic region and linked it to global markets. Following a comparison of the central city and its metro area that shows the disparities in economic and urban development, the discussion argues that misguided metropolitan land-management and governance-that increase urban sprawl-had not weaken the importance of agglomeration effects due to economic and urban development policies implemented by the city government that were aimed to maintain agglomeration by promoting the spatial concentration of firms. It is, however, a remarkable fact that the most famous urban and real estate interventions —such as Puerto Madero—was a key step towards increasing city competitiveness by reinforcing the importance of central city as business and residential location.

Turning finally to the issue of redevelopment, the clusters and upgrading projects implemented have enhanced housing development and positive externalities, mitigating the location and costs advantage of greenfield development in the peripheries. The point that must be made is that while the cluster can be a powerful urban strategic economic intervention, caution must be taken to ensure that all the different clusters pursued are as promising for the city, since there is a fiscal cost associated to them.

By all those interventions, redevelopment of abandoned industrial sites in residential neighborhoods is positively affecting the price of all the surrounding properties. But, at the same time, it limits housing affordability and might influence economic competitiveness in the medium and long run, in two different ways. One, by affecting the costs of labor, housing prices may increase enterprise costs as well, and the availability of human capital. This in turn will increase the set-up costs of new firms and their ability to attract labor from elsewhere. In a world where knowledge is freely mobile, high local set-up costs for new firms and the development of new ideas would only lead entrepreneurs to locate in cheaper areas. Thus, very high rent levels may discourage many new firms from being created and new innovations from being made. The social and economic cost of this may be quite high since innovation arguably generates large positive external impacts. The second possible inefficiency is that it may lead to more informal housing development and more inefficient residential sorting.

Finally, to complement city analysis, we need more empirical evidence that can provide important clues of "what works" for city competitiveness. For doing that, we need good grounded data, as the one provided by the Atlas for Urban Expansion Database or the Atlas of Buenos Aires Metropolitan Land Prices which can help identifying the trends and can contribute to inform policy makers and city governments to create well-functioning and value-creating cities for all.

Appendix on Econometrics Analysis

Linear Regression Analysis

We conduct regression analysis to see how urban competitiveness affects housing price. We include various measures of competitiveness. Instead of using the original series, we first detrend the data by transforming them into the growth rates. We apply the linear regression model to each MSA separately.

Data are collected from multiple sources. HPI is the seasonally adjusted housing price index from FHFA, deflated by consumer price index of all urban consumers (housing in San Francisco-Oakland-San Jose, CA). Data on population is from US Census Bureau. Productivity is measured by annual percent change in real gross product per worker from Bureau of Labor Statistics, Bureau of Economic Analysis and Moody's Analytics. Employment data comes from Bureau of Labor Statistics. Start-up growth relies on the data from Kauffman Foundation and Business Dynamics Statistics.

Two MSAs exhibit different pattern of the housing price and competitiveness. We didn't find significant correlation between GMP growth and HPI growth, nor is the relation between productivity growth and housing price growth statistically

Table 7.31 Linear model

	San Jose		San Francisco	
g.HPI	b	t	b	t
g.GMP	13.228	0.306	−1.443	−1.465
g.Population	−10.141**	−3.116	−4.822*	−2.662
g.Productivity	−0.117	−0.28	0.025*	2.193
g.Employment	−11.202	−0.26	3.466*	2.907
g.startup	0.008	0.195	0.115*	2.61
Constant	0.053	0.833	−0.073	−1.777
Adjusted R-squared	0.555		0.676	
Observations	22		22	

Note *if p-value < 10%, **if p-value < 5%, ***if p-value < 1%. "g. x" is the growth operator, defined as log(x) − L.log(x)

significant. In both MSAs, population growth does exert a negative impact on the housing price growth. The response to employment growth and start-up growth are different across two MSAs. In San Francisco, we find the effect of both factors positive and significant on housing price growth, while in San Jose, there is no convincing evidence in favor of the claim. Although our time series are short, more than 50% of the variation in housing price growth can be explained in our model (Table 7.31).

Availability of data at MSA level does restrict our regression results. To augment our analysis, we look at the correlation matrices. In the matrix, we include HPI growth, GMP growth, personal income growth, population growth, patent growth, productivity growth, start-up growth, employment growth, growth of employment in technology sector and unemployment rate. We didn't find strong evidence that higher patent growth will be associated with housing price growth. The correlation between HPI growth and productivity growth in San Jose is positive and significant with 95% confidence, while such correlation in San Francisco is only significant at 90% confidence. Start-up growth is not so correlated with housing price growth in San Jose, but the effect is significant in San Francisco. Though employment share of technology sector is extremely high in those two MSAs, we don't find strong evidence that higher employment growth in technology sector is associated with higher housing price growth in two MSAs (Tables 7.32 and 7.33).

Vector Autoregression Analysis

Variable Choice

To explore the relation between urban competitiveness and local housing prices, we look at the interaction and dynamics of the following three variables in the benchmark analysis: the seasonally adjusted housing price index from FHFA deflated by

Table 7.32 Correlation matrix, San Jose

	g_hpi	g_gmp	g_inc	g_pop	g_patent	g_prod	g_startup	g_emp	g_emp_tech	unemp_rate
g_hpi	1.00									
g_gmp	0.54	1.00								
	(0.00)									
g_inc	0.54	0.91	1.00							
	(0.01)	(0.00)								
g_pop	−0.18	0.52	0.45	1.00						
	(0.40)	(0.01)	(0.02)							
g_patent	0.17	−0.04	0.09	0.15	1.00					
	(0.54)	(0.89)	(0.75)	(0.59)						
g_prod	0.47	0.55	0.43	−0.11	−0.64	1.00				
	(0.02)	(0.00)	(0.03)	(0.61)	(0.01)					
g_startup	0.21	0.17	0.11	−0.06	0.04	0.53	1.00			
	(0.34)	(0.44)	(0.63)	(0.80)	(0.89)	(0.01)				
g_emp	0.37	0.83	0.77	0.71	0.06	0.30	0.13	1.00		
	(0.07)	(0.00)	(0.00)	(0.00)	(0.82)	(0.15)	(0.55)			
g_emp_tech	0.27	0.79	0.76	0.71	0.09	0.34	0.11	0.95	1.00	
	(0.19)	(0.00)	(0.00)	(0.00)	(0.74)	(0.10)	(0.61)	(0.00)		
unemp_rate	−0.40	−0.61	−0.49	−0.16	0.30	−0.64	−0.45	−0.63	−0.54	1.00
	(0.05)	(0.00)	(0.01)	(0.45)	(0.28)	(0.00)	(0.03)	(0.00)	(0.01)	

Note *p*-values in parentheses. "g. x" is the growth operator, defined as log(x) − L.log(x)

Table 7.33 Correlation matrix, San Francisco

	g_hpi	g_gmp	g_inc	g_pop	g_patent	g_prod	g_startup	g_emp	g_emp_tech	unemp_rate
g_hpi	1.00									
g_gmp	0.53	1.00								
	(0.01)									
g_inc	0.31	0.80	1.00							
	(0.13)	(0.00)								
g_pop	−0.34	0.22	0.20	1.00						
	(0.10)	(0.29)	(0.33)							
g_patent	−0.05	−0.13	0.00	0.17	1.00					
	(0.85)	(0.64)	(0.99)	(0.55)						
g_prod	0.38	0.51	0.16	−0.22	−0.58	1.00				
	(0.06)	(0.01)	(0.44)	(0.28)	(0.02)					
g_startup	0.61	0.27	0.19	−0.37	−0.31	0.40	1.00			
	(0.00)	(0.22)	(0.39)	(0.09)	(0.30)	(0.06)				
g_emp	0.41	0.87	0.77	0.48	0.06	0.29	0.06	1.00		
	(0.04)	(0.00)	(0.00)	(0.02)	(0.84)	(0.16)	(0.80)			
g_emp_tech	0.32	0.78	0.73	0.51	0.12	0.18	0.09	0.80	1.00	
	(0.12)	(0.00)	(0.00)	(0.01)	(0.68)	(0.40)	(0.69)	(0.00)		
unemp_rate	−0.46	−0.76	−0.56	−0.00	0.35	−0.66	−0.36	−0.67	−0.51	1.00
	(0.02)	(0.00)	(0.00)	(0.99)	(0.20)	(0.00)	(0.10)	(0.00)	(0.01)	

Note p-values in parentheses. "g. x" is the growth operator, defined as log(x) − L.log(x) consumer price index of housing, the start-up density, and real gross metropolitan product. We use the log variables, instead of the originals, to map those variables from the positive domains to a comparable range defined on the real line.

Start-up density is a proxy of innovative potential and vibrancy of local industries, driving the future growth of a city. The indicator reflects the state of both the demand and the supply side of the local labor market, in terms of business and job creation activities. Housing price index summarizes the sales and refinancing of the local housing market, which is the key statistic of the report. Real gross metropolitan product is defined as the market value of final goods and services created for a given period, which indicates economic performance as well as labor productivity of the local market.

We focus our attention on those three variables for two reasons. First, as the frequency of the time series is annual and the length of the data is short due to data availability, we try to work on a simple model with fewer but necessary variables to understand the relationship between competitiveness and housing prices. Second, those three time series seem to describe the economic dynamics well. Our post-estimation tests and robustness check show that the qualitative features over time as well as across MSAs can be captured by the simple dynamics of the benchmark model.

Model Choice

We consider applying vector autoregression (VAR) or vector error correction (VECM) model to our analysis. Instead of taking a stand on the dependency or linkage between competitiveness and housing prices, we attempt to treat them equally by including all contemporaneous variables as dependent and their lags as explanatory variables. We estimate the system as a whole.

Before going to regression analysis, we conduct Dicky-Fuller test on each series to test whether the processes are unit-root, and confirm that they are not covariance stationary, but integrated series of order 1. Hence, it is improper to apply the VAR model directly to the level variables. We further test whether the series are cointegrated, Johansen's trace statistics show that we cannot reject the existence of 1 cointegrating relationship between our time series. It is improper to apply the first differences of the series to a VAR model which assumes no cointegrating relationship. A VECM model will correct the problem by introducing an error correction term in each first-difference VAR regression equation.

Model Specification

We consider the following Vector Error Correction model (VECM) that describes the evolution of k variables over the sample period from 1991 to 2014 on the annual basis

$$\Delta \mathbf{y}_{\mathrm{t}}^{i} = \mathbf{\Pi}^{i} \boldsymbol{y}_{t}^{i} + \sum_{j=1}^{J-1} \mathbf{\Gamma}_{j}^{i} \Delta \mathbf{y}_{t-j}^{i} + \epsilon_{\mathrm{t}}^{i}$$

where $\mathbf{y}_t^i = \left(y_{1t}^i, y_{2t}^i, \ldots, y_{kt}^i\right)'$ and $\epsilon_t^i = \left(\epsilon_{1t}^i, \ldots, \epsilon_{kt}^i\right)'$ are column vectors of length k = 3, and $\mathbf{\Gamma}_j^i$ is a k × k matrix. In our setting,

$$\mathbf{y}_t^i = \left(\log\left(HPI_t^i\right), \log\left(GMP_t^i\right), \log\left(Startup_t^i\right)\right)'$$

Superscript *i* stands for San Jose or San Francisco Metropolitan Statistical Area, while subscript indicates the lag of the year. $\mathbf{\Pi}^i \equiv \boldsymbol{\alpha}^i \boldsymbol{\beta}^{i\prime}$ is the k × k error correction matrix, made up of a k × r matrix $\boldsymbol{\alpha}^i$ and an r × k matrix $\boldsymbol{\beta}^{i\prime}$. Both $\boldsymbol{\alpha}^i$ and $\boldsymbol{\beta}^{i\prime}$ have full rank r = 1. By Granger Representation Theorem, the cointegrating relationship is a linear combination of all variables

$$z^i = \boldsymbol{\beta}^{i\prime} \boldsymbol{y}^i$$

J = 2 the order of the VECM model, or the maximum lags to be included. It is chosen based on minimizing Schwarz Bayesian information criterion (SBIC).

Estimation Results

The estimation results of VECM for each MSA are summarized in the table. The first term in each regression, L.ce1, denotes the error correction, or α^i In terms of notation above. We observe a significant coefficient of error correction term in the regression of the start-up density, confirming our finding that the time series are cointegrated. All the coefficients in Γ^i are smaller than unity. The stability of the system is thus guaranteed.

By comparing the estimated coefficients between San Jose and San Francisco, we notice most of the coefficients carry the same sign or are qualitatively the same. But two MSAs do differ in several aspects. Besides, we observe the effect of last year's GMP growth on today's housing price growth is negative in both San Jose and San Francisco. The reaction to GMP is not statistically significant, so it may stem from the length of the data we work with.

Another noticeable difference is the effect of last year's start-up density growth on today's GMP growth. The coefficient in San Jose is negative and that in San Francisco is positive, though both are not statistically significant.

We also observe significantly positive effect of housing price growth and GMP growth on the start-up density growth. 1% increase in the housing price growth will boost start-up density growth by 0.37% in San Jose and 0.38% in San Francisco, almost identical across two MSAs. 1% increase in GMP growth will boost start-up density growth by 0.49% in San Jose and 0.37% in San Francisco (the latter is not significant).

The coefficients in Γ capture the short-run dependence of the lag variables. As to the long run, the cointegration equation is informative. Our model implies the following cointegrating relationship in the long run (Table 7.34):

Table 7.34 VECM model

	San Jose		San Francisco	
	Γ	t	Γ	t
D_log_hpi				
L._ce1	−0.01	−0.205	−0.059	−0.683
LD.log_hpi	0.630*	2.57	0.474*	2.038
LD.log_gmp	−0.608	−1.18	−0.352	−0.414
LD. log_sta_density	0.155	0.445	0.196	0.559
Constant	0.034	1.342	0.018	0.809
D_log_gmp_pc				
L._ce1	0.034	1.146	0.024	0.699
LD.log_hpi	0.113	0.793	0.101	1.102
LD.log_gmp	0.457	1.525	0.367	1.093
LD. log_sta_density	−0.038	−0.19	0.102	0.737
Constant	0.029	1.943	0.019*	2.186
D_log_sta_density				
L._ce1	0.135***	6.685	0.183***	4.946
LD.log_hpi	0.366***	3.788	0.379***	3.825
LD.log_gmp	0.485*	2.383	0.366	1.009
LD. log_sta_density	0.058	0.42	0.17	1.137
Constant	−0.005	−0.457	0.003	0.351
Observations	22		22	

Note *if *p*-value < 10%, **if *p*-value < 5%, ***if *p*-value < 1%. "L" and "D" are the lag and the difference operator

$$z^{SJ} \equiv \log\left(HPI^{SJ}\right) - 2.311\log\left(GMP^{SJ}\right) - 5.105\log\left(Startup^{SJ}\right) \sim I(0)$$
$$z^{SF} \equiv \log\left(HPI^{SF}\right) - 2.839\log\left(GMP^{SF}\right) - 3.353\log\left(Startup^{SF}\right) \sim I(0)$$

where both z^{SJ} and z^{SF} are covariance stationary series, or I(0). In both MSA, GMP and the start-up density are positively correlated with local housing prices in the long run. In San Jose, 1% increase in GMP (or start-up density) is associated with 2.3% increase (or 5.1%) in the housing price, *ceteris paribus*. In San Francisco, 1% increase in GMP (start-up density) is associated with 2.8% increase (3.4%) in the housing price, *ceteris paribus*. All the coefficients are highly statistically significant at 99% confidence.

If both GMP and start-up density increase by 1%, we will witness roughly the same percentage increase (6–8%) in the housing price across MSAs. Nevertheless, the elasticity of the housing price with respect to GMP and start-up density are different across MSAs. The housing price in San Jose is more responsive to the change of start-up density, while the housing price in San Francisco responds more to GMP (Table 7.35).

Table 7.35 Cointegration equation

β	ef.	Std. Err	z	P > |z|	[95% Conf. Interval]	
San Jose						
log_hpi	1.000					
log_gmp	−2.311***	0.216	−10.710	0.000	−2.734	−1.888
log_sta_density	−5.105***	0.590	−7.650	0.000	−6.262	−3.948
_cons	27.681					
San Francisco						
log_hpi	1.000					
log_gmp	−2.839***	0.281	−10.100	0.000	−3.390	−2.288
log_sta_density	−3.353***	0.549	−6.100	0.000	−4.430	−2.276
_cons	25.395					

Note *if *p*-value < 10%, **if *p*-value < 5%, ***if *p*-value < 1%

Impulse Response Functions (IRF)

To explore the dynamics of the system, we simulate the model by hitting each variable with a one-time one-standard-deviation shock to see how each variable will react to the unexpected impulse over time. The figures show the panels of impulse response functions for each MSA. The length of each step is by year. The vertical axis shows the change of the response variable. Due to the cointegrating relationship, the effect of a shock in most cases are permanent, though it will gradually settle down to the new level in 3–5 years.

Panel (row 1, col 3) tracks the response of the start-up density to an impulse of GMP. We can see the response variable decreases. The initial increase is driven by the short-run positive relationship shown in the start-up regression equation. But the long-run negative response is mainly driven by the cointegrating relation.

Panel (row 3, col 1) plots the response of GMP to a start-up density shock. IRF implies a negative response, but the estimated coefficient of the start-up density in GMP regression is insignificant for both MSAs, leading to a wide confidence interval. We cannot conclusively say that the response is negative and significant.

Panel (row 2, col 1) and Panel (row 2, col 3) show the response to the unexpected shock of the housing price. Higher housing prices boosts both GMP and start-up density. The effect is more pronounced in San Jose than in San Francisco.

Panel (row 3, col 2) show that a one-standard deviation shock to the start-up density results in 2% increase in housing price in both MSAs.

Panel (row 1, col 2) shows the reaction of the housing price to a GMP shock. The effect is predicted to be negative in San Jose, while the effect in San Francisco, is initially positive. As the estimated coefficient of GMP in HPI regression is insignificant, the confidence interval will be fat, so that the difference in IRF across MSAs is inconclusive of the different reaction to a GMP shock across MSAs (Figs. 7.77 and 7.78).

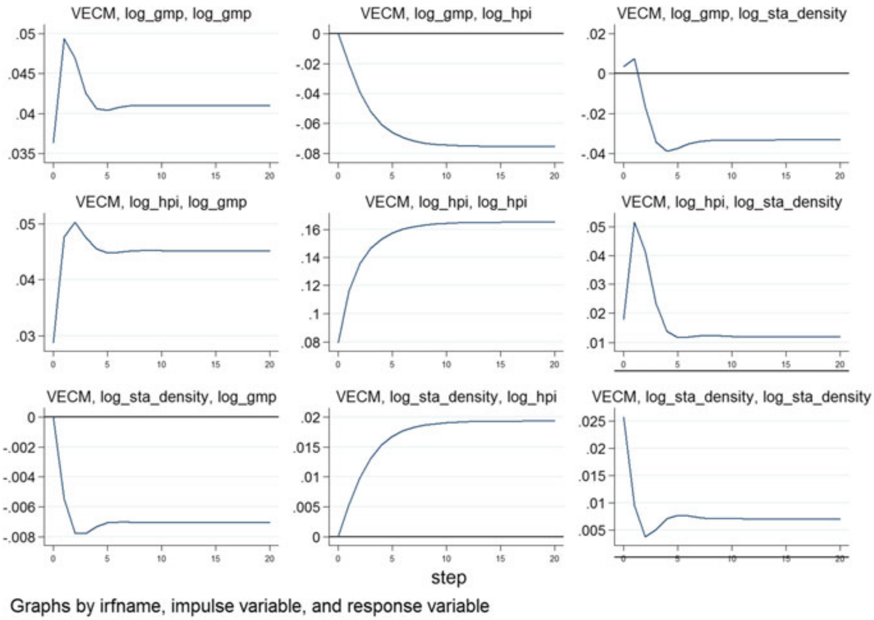

Fig. 7.77 Impulse response function—San Jose

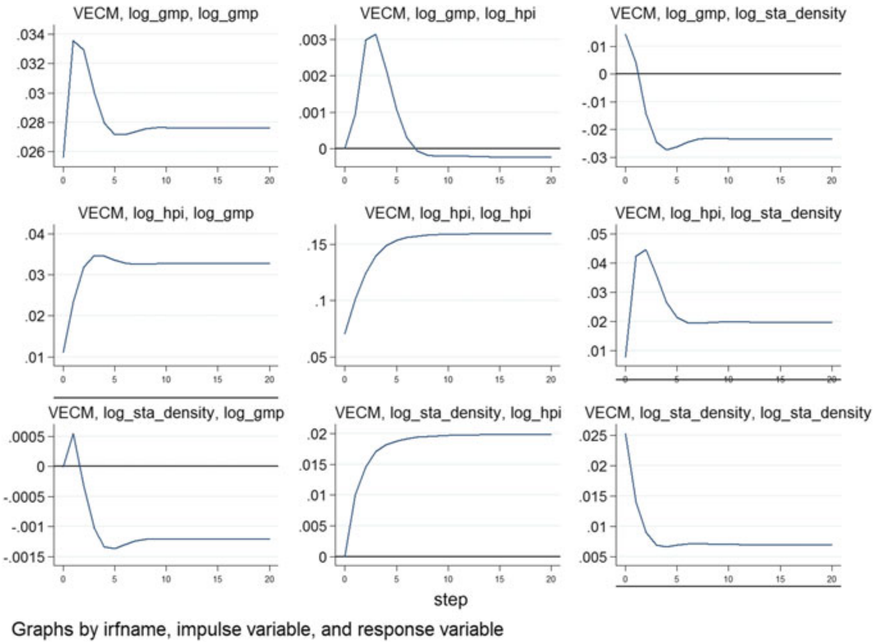

Fig. 7.78 Impulse response function—San Francisco

Appendix: The Calculation of Two Indexes Measuring the Housing Affordability in Tokyo

Year	Income	Size	Pincome	Price	Fspace	Price30	Index 1	Index 2
	Average household income (10,000 Yen)	Average household size (person)	Per capita income (10,000 Yen)	Average dwelling price (10,000 Yen)	Average floor space (m^2)	Price for 30 m^3 (10,000 Yen)	Price30 to Pincome	Price to income
1975	327	3.1	104.1	1530	56.8	808.1	7.8	4.7
1976	361	3.1	115.3	1630	56.6	864.0	7.5	4.5
1977	400	3.1	128.2	1646	56.4	875.5	6.8	4.1
1978	412	3.1	132.5	1711	56.1	915.0	6.9	4.2
1979	445	3.1	143.1	1992	59.5	1004.4	7.0	4.5
1980	493	3.1	159.0	2477	63.1	1177.7	7.4	5.0
1981	516	3.1	167.5	2616	61.0	1286.6	7.7	5.1
1982	534	3.1	174.5	2578	60.2	1284.7	7.4	4.8
1983	557	3.1	182.6	2557	59.8	1282.8	7.0	4.6
1984	594	3.0	195.4	2562	61.1	1257.9	6.4	4.3
1985	634	3.0	209.2	2683	62.8	1281.7	6.1	4.2
1986	663	3.0	221.0	2758	65.0	1272.9	5.8	4.2
1987	660	3.0	222.2	3579	65.2	1646.8	7.4	5.4
1988	682	2.9	232.0	4753	68.0	2096.9	9.0	7.0
1989	730	2.9	250.0	5411	67.9	2390.7	9.6	7.4
1990	767	2.9	264.5	6123	65.6	2800.2	10.6	8.0
1991	828	2.9	287.5	5900	64.9	2727.3	9.5	7.1
1992	875	2.8	308.1	5066	63.3	2400.9	7.8	5.8
1993	854	2.8	303.9	4488	63.8	2110.3	6.9	5.3
1994	854	2.8	309.4	4409	64.6	2047.5	6.6	5.2
1995	856	2.7	315.9	4148	66.7	1865.7	5.9	4.8
1996	842	2.7	314.2	4238	69.5	1829.4	5.8	5.0
1997	853	2.7	321.9	4374	70.3	1866.6	5.8	5.1
1998	896	2.6	342.0	4168	71.0	1761.1	5.1	4.7
1999	859	2.6	330.4	4138	71.8	1728.0	5.2	4.8
2000	815	2.6	317.1	4034	74.7	1620.0	5.1	4.9
2001	813	2.6	318.8	4026	77.0	1569.0	4.9	5.0
2002	823	2.5	326.6	4003	78.0	1539.0	4.7	4.9
2003	783	2.5	313.2	4069	74.7	1634.1	5.2	5.2
2004	796	2.5	321.0	4104	74.6	1650.0	5.1	5.2
2005	790	2.5	321.1	4107	75.4	1635.0	5.1	5.2
2006	794	2.4	325.4	4200	75.7	1664.5	5.1	5.3
2007	798	2.4	331.1	4644	75.6	1842.9	5.6	5.8
2008	791	2.4	332.4	4775	73.5	1949.0	5.9	6.0
2009	804	2.3	343.6	4535	70.6	1927.1	5.6	5.6

(continued)

(continued)

Year	Income	Size	Pincome	Price	Fspace	Price30	Index 1	Index 2
	Average household income (10,000 Yen)	Average household size (person)	Per capita income (10,000 Yen)	Average dwelling price (10,000 Yen)	Average floor space (m^2)	Price for 30 m^3 (10,000 Yen)	Price30 to Pincome	Price to income
2010	762	2.3	331.3	4716	71.0	1992.7	6.0	6.2
2011	742	2.3	325.4	4578	70.5	1949.2	6.0	6.2
2012	759	2.3	335.8	4540	70.4	1933.8	5.8	6.0
2013	782	2.2	349.1	4929	70.8	2089.4	6.0	6.3
2014	775	2.2	349.1	5060	71.2	2133.2	6.1	6.5
2015	786	2.2	357.3	5518	70.8	2337.8	6.5	7.0

Source Calculated by the author based on the statistical data of MILT (2016)

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Chapter 8
Economic Foundations for Sustainable Urbanization: The Link with Competitiveness

Marco Kamiya and Loeiz Bourdic

UN-Habitat's priority is to support city leaders to achieve sustainable urbanisation by providing urban planning methods and systems to address current urbanization challenges such as population growth, urban sprawl, poverty, inequality, pollution, congestion, as well as urban biodiversity, urban mobility, and energy.

This work is done with cities, as urban economies generate more than 90% of global gross value added (Gutman 2007). This chapter explains what are the fundamentals needed to design urbanisation policies and what is the link with competitiveness. We sustain that competitiveness is an expression of productivity, and from a city approach, both are strongly linked to the spatial dimension and urban layout.[1] In this chapter we explain urban productivity and competitiveness; the components of the integrated approach to urbanization (Three-Pronged Approach); the layers of government that govern cities, and finally provide thoughts on competitiveness and cities.

8.1 Urban Productivity and Competitiveness

Productivity is traditionally defined as the best use of labour and capital given a state of technology, it is usually measured as a rate of output by units of inputs, where the main inputs are labour and capital. Then urban productivity is labour and

[1]This chapter incorporates recent developments from UN-Habitat operational and normative work, and relies on UN-Habitat and Morphologie Institute Paris (2017), Salat, Serge; Bourdic Loeiz & Marco Kamiya. "Economic Foundations for Sustainable Urbanization: The Three-Pronged Approach, Urban Planning, Legal Framework, and Municipal Finance", 2nd Edition, March 2017. Nairobi, Kenya.

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capital, plus land, material, energy and information, all the spatial features that bring in higher the value-added output of a city. One of the criticism of the concept of productivity is that it does not properly include land as a major component (Ryan-Collies et al. 2017) and so it is difficult to model the urban economy when a spatial analysis that comes with land and properties are needed.

Productivity is the base for competitiveness, as higher productivity means that a nation or city can produce goods that are demanded by global markets. Competitiveness is ultimately a revealed productivity of the city. Cities are the result of multivariable and integrated factors working together and impacting on productivity and competitiveness.[2]

Different theories try to explain why and under which conditions urban development is accompanied by rising productivity levels. The theory of agglomeration economies, economies of scale and scope and different variations of both.

The theory on economies of scale states that the greater the quantity of a good produced, the lower are the average costs per product unit. Economies of scale may also lead to a reduction of the variable costs per product unit due to operational efficiencies and synergies. Producing a high volume of one product type allows firms and workers to specialize in specific tasks and thereby achieve a high productivity level.[3] This concept can be transferred on the relationship between city size and productivity level, however, for cities this link is not mechanical since there are also diseconomies of scale due to governance and planning of large cities or metropolises that must be considered.

The theory on economies of scope states that production costs can be reduced by producing a range of goods of a similar type together instead of producing each one of them on its own. Transferred to the macro level this theory explains the existence and growth of urban agglomerations with the opportunities they offer for businesses to utilize the interrelations between the production processes of their goods with those of other business. Cities enable business to share centralized functions in procurement, production and sale processes.

Urbanization economies seek to explain the relationship between city size and productivity level. It suggests that urban diversity and large city sizes generate productivity advantages for any business locating in an urban agglomeration. As it argues that the urban environment creates positive externalities which benefit different industries. This theory is especially suitable for explaining high and growing productivity levels in cities with no single dominant industry. Firms locating in a large city can benefit from the common physical resources, such as roads, buildings, and power supply, and from the access to a large, diverse labour pool, regardless of their industry.

Localization economies, on the other hand, discusses how the size of an industry in a city affects the productivity level of a particular activity. The productivity

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[2]See the Global Competitiveness Report [http://www.weforum.org/], on urban competitiveness (Ni et al. 2013), and the analytical chapter of the Global Urban Competitiveness Report 2017 (Ni, Kamiya Ding).

[3]Lobo et al. (2011) from the Santa Fe Institute demonstrate empirically that in a typical city in the US Total Factor Productivity in 11% with each doubling in population.

advantages of cities are seen to relate primarily to higher levels of activity in an industry, with the benefits accruing to that industry (Jofre-Monseny et al. 2012).

Agglomeration economies unify ideas from the theories presented above. It states that urban economies offer a diversified and extended market for the purchase of inputs on the one hand and for selling final goods on the other. In the literature on economies of agglomeration, different factors are argued to cause productivity advantages in urban agglomerations. Higher concentration and scale of people, activities, and resources in urban areas foster economic growth (Duranton & Puga, 2004; Fujita & Thisse, 1996; Henderson, Kuncoro & Turner, 1995; Puga, 2010), innovation (Arbesman et al. 2009; Bettencourt et al. 2007; Feldman abd Audretsch 1999), and increase efficiencies (Kahn 2009). The agglomeration economies made possible by the concentration of individuals and firms make cities ideal settings for innovation, job and wealth creation (Carlino et al. 2007; Brian et al. 2008; Puga 2010; Rosenthal and Strange 2004).

Larger urban areas are the most productive since they allow for greater specialization in labour use, better matching of skills and jobs, and a wider array of consumption choices for workers and ancillary services for producers. It is also in large cities where the vast majority of substantial innovations emerge. As long as this greater productivity outweighs higher costs for land, labour, housing, and other necessities, the city can thrive. (World Bank 2003, 2009).

An emerging approach linking urbanization and productivity comes by linking value chain and supply chains. The urban setting is the place where goods are produced and those goods are results of several inputs, goods, and services, then the urban forms and the infrastructure that offers highways, roads, and information technology are as important as human capital in the production of final goods. Then supply chains which determine the channels through which inputs are delivered to a production hub impact in efficiency, competitiveness and ultimately in productivity.[4]

But, cities not only have the potential to provide productivity advantages, there are also negative externalities being generated in urban agglomerations, and the most relevant is related with land. Land in urban areas is scarce; this leads to higher land prices in urban compared to rural areas and leaves room to speculation. Especially in case of lacking public and private transport networks, urbanization is accompanied by rising congestion, security, noise, pollution levels and environmental effects.

A city has to generate more positive than negative externalities, meaning the factors causing productivity advantages have to be supported to create positive effects on the local economy; the negative externalities of urban agglomerations, on the other hand, have to be rooted out to the greatest extent possible.

[4]Roads and productivity is a potential link (see Fernald 1999). Another is proximity and access to jobs (see Bertaud 2002).

8.2 Productivity and Land

The standard model of land prices in mono-centric cities is originally designated to make theoretical predictions on how far a city will extend. The theory is based on how much the urban population is willing to pay for piece of land depending on the accessibility to the urban centre. The willingness to pay increases with accessibility to the centre, since people and companies prefer locations with better access to the economic opportunities in the centres and are willing to pay more for them (Alonso 1964; Ottensmann 1977; Salat 2014a, b). As shown in the following chart, this translates into a decreasing gradient of land value as the distance from the city centre rises (Fig. 8.1).

The price of agricultural land, on the other hand, is assumed to be constant in this model. The outer radius R of potential built-up urban area is then defined as the intersection between the two curves. The theoretical city limit is thus the result of a trade-off between urban land price and agricultural land price.

This concept can not only be used to make theoretical predictions on the spatial limits of urban extension; the decreasing gradient of land value with increasing distance to the city centre also offers an indicator for the quality of urban development as well as of the density at certain distance from the center. It reflects the desirability and feasibility of a city on the one hand and the quality of its infrastructure on the other. The desirability and profitability of a city are reflected in the prices people and businesses are willing to pay, displaying the economic and commercial benefits of settling close to the urban centre. The difference between

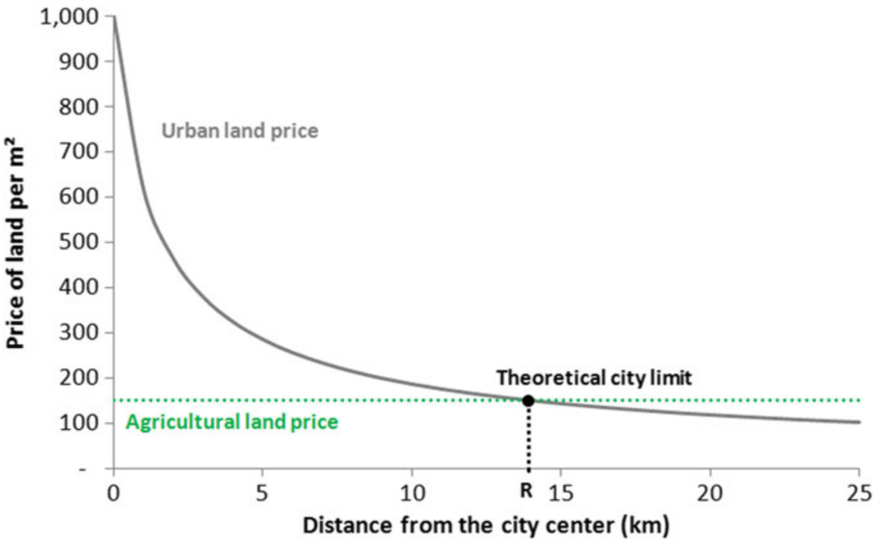

Fig. 8.1 Urban land price and agricultural land price define the city size *Source* Urban Morphology Institute

land value in the city centre and in the surrounding rural areas gives an idea of the economic opportunities, the liveability and attractiveness of the city compared to rural areas: The more economic advantages a city promises for workers and businesses and the more liveable it is, the higher is the willingness to pay for land in the urban area. This gives an indication of the opportunity costs of living in the city. By also integrating the regional agricultural land price this indicator becomes comparable among different regions of different economic development levels.

The gradient of decreasing land value reflects how fast the accessibility decreases with distance to the urban centre: The better developed the public transport and street network in a city, the slower the accessibility of the urban centre degrades with increasing distance.

Besides analysing the decrease of land value with rising inaccessibility to the urban centre, the productivity per km^2 can be examined, depending on the distance to the city center. Urban productivity per km^2 can be defined as the Gross Value Added (GVA) per km^2 less the infrastructure costs per km^2. Beyond a certain distance from the city centre (or the centre were production is mostly concentrated), this indicator for urban productivity becomes negative. The indicator reflects how fast the urban productivity advantages decrease with distance to the centre. Again, the value of the gradient indicates the quality of the urban infrastructure. For example, as certain activities require proximity, agglomeration of activities provide higher productive areas, and in those areas, better and more sophisticated infrastructure is located.

8.3 The Three-Pronged Approach

Many of the factors leading to productivity advantages in urban agglomerations, discussed above are generated by the proximity and density of workers and businesses in urban agglomeration. Proximity, density, integrity and accessibility, however, are not necessarily given in every urban agglomeration and not automatically maintained during the urban extension process. There are rather planning and regulatory activities, as well as strategically sound public investments necessary to ensure the establishment or preservation of density of residential housing and businesses.

UN-Habitat promotes three fundamental components that must be considered by local authorities in the process of planning and implementing urban extension programmes in order to achieve sustainable urbanization. Sound performance in these three areas is essential to exploit the potential of a city to generate wealth, employment, coexistence and cultural interchange as discussed in the presented theories and avoid the pitfalls of a spontaneous development.

The essential components for successful Planned City Extension (PCE), are Urban Design, Financial Management, and Regulations. For a PCE to succeed, UN-Habitat advises local authorities to balance actions on the three components putting similar effort in good performance in the three areas, so that action in one can support the performance in the others. The three essential components of successful PCE are the foundation for further action. To tackle central issues, like urban youth issues, housing scarcity etc. successfully in urban extension programmes, it is essential to create an appropriate framework through good performance on the three components of the Three-Pronged Approach (3PA).

For the 3PA most of the indices that would measure it are correlated. As an example, cities with high residential and job density often display at the same time higher walkability and transit accessibility. Those cites also have high technical capacity for planning and design, possess sustainable municipal finance, and a stable set of rules and regulations.

The Three-Pronged Approach Model[5]

As this study aims at better understanding the benefits of the 3PA on urban productivity, a framework is provided to understand the importance of the three prongs that result on a necessary trinity for urban planning.

The urban productivity is measured as the gross value added per km^2 in the area that has been subject to the 3PA programme less the capital and operational expenditures per km^2 and less the total overcost per km^2 occurring in this area. The strength of this approach is that urban productivity is decomposed into four components, on which the impact of each urban planning characteristic can be assessed. The decomposition of urban productivity comes as follows, with GVA being the Gross Value Added, CapEx the Capital Expenditure, OpEx the Operational Expenditures and TotOve the Total Overcost.

$$\frac{Urbanproductivity}{Km^2} = \frac{GVA}{Km^2} - \frac{CapEx}{Km^2} - \frac{OpEx}{Km^2} - \frac{TotOve}{Km^2}$$

It is assumed that production (GVA), CapEx, OpEx and TotOve occur according to augmented Cobb-Douglas functions.

8.4 Urban Planning

UN-Habitat promotes five key principles for urban design,[6] as concepts for urban planning rather than economics. These principles are empirical and pragmatic advice to “good” urbanization and provided to policymakers when urban expansion

[5] UN-Habitat (2017) “Economic Foundations for Sustainable Urbanization.”

[6] UN-HABITAT (2014) “A New Strategy of Sustainable Neighbourhood Planning: Five principles” Urban Planning Discussion Note 3. Nairobi, Kenya.

plans are designed, so they are not derived from an abstract model and each principle should be applying considering the geographic, social and political context.[7] These five principles are:

Adequate space for streets and an efficient street network. A street network that not only serves private and public transport vehicles but also specifically aims to attract pedestrians and cyclists. The street network should occupy at least 30% of the land and at least 18 km of street length per km^2.

High density. High concentration of people and their activities. At least 15,000 people per km^2, that is 150 people/ha or 61 people/acre.

Mixed land-use. Combination of different residential, commercial, industrial, office or other land use in one neighbourhood. At least 40% of floor space should be allocated for economic use in any neighbourhood.

Social mix. The availability of houses in different price ranges and tenure types in any neighbourhood to accommodate residents from different backgrounds and with different income level. 20 to 50% of the residential floor area should be for low cost housing; and each tenure type should be not more than 50% of the total.

Limited land-use specialization. Reduced amount of single function blocks or neighbourhoods. Single function blocks should cover less than 10% of any neighbourhood.

The proportion of urban space dedicated to public use and the features of the network of streets, commercial corridors and sidewalks determine the walkability of a city; they thereby determine a city's quality and intensity of street life and interaction between the citizens. The amount of space dedicated to streets and transport infrastructure also shapes the city regarding connectivity and accessibility, thereby affecting the level of congestion and the air quality. A city's street network, moreover, functions as the layout for the provision of urban basic services. Its quality determines the affordability of these urban services. The positive effect of sufficiently high quality public space on a city's liveability, moreover, causes potential buyers to be willing to pay more for urban land, and also allows local authorities to plan for future cities by making easier reordering and reorganization of the plotting areas and roads. To ensure a development of quality street patterns and public space, spontaneous growth must be prevented through urban planning from the initial stage of urban expansion.

To prevent urban sprawl and promote sustainable urban extension, it is necessary to achieve high density of residents as well as economic activity. Compared with low density, high density has economic, social and environmental benefits as follows. Efficient land use slows down urban sprawl because high density neighbourhoods can accommodate more people per area. Through high density development costs for public services, such as police and emergency response,

[7]For example, public space of 50% is not to be intended for slums where slum upgrading must be incremental but for established cities or cities are being planned.

school transport, roads, water and sewage, can be reduced. High density development leads to high walkability and accessibility, thereby reducing car dependency and parking demand, and facilitating the provision of an efficient public transport network. This increases energy efficiency and decreases pollution.

In the planning process, it is crucial to match efforts to increase urban density with the needs for public space discussed above. Therefore, the general plan on the urban layout has to integrate considerations on the present and future transportation and street infrastructure needs. Urban density must not overwhelm infrastructure at risk of congestion. Reciprocally, under-using infrastructure because of low-density levels is not economically efficient. Public transport hubs should be located in an advantageous place for capturing the peaks of urban density, services and urban amenities. It is therefore important that densities be articulated across the metropolitan area and strategically increased along key infrastructure (i.e., transit) corridors.

Recent literature on urban planning proposes a general plan combined with rules and regulations rather than a detailed master plan that is conceptualized in the early stage of a development programme. A PCE based on a general plan with supplementing rules and regulations allows for evolution and adaption to changes in economic or environmental circumstances. The definition of the street network is the key element of a general plan as the street network, as the backbone of a city, determines the layout of a city.

The development of productive urban extensions relies on the capacity of stakeholders to integrate spatial planning and all essential urban infrastructure policies on different levels, from those conceptualized on a metropolitan scale to neighbourhood-scaled development policies. Very often in fast urbanizing countries, master plans focus on the large scale but lack the fine grain level of detail that is essential to urban productivity. The diversity of land plot sizes is essential to support a vibrant and sustainable land market. Plots are constitutive of land sale processes and structure land property. As such, they are one of the basic bricks on which urban economic markets rely. Because of the lack of human and technical resources, or due to different artistic and design concepts, most of the current urbanization in developing countries and emerging economies are based on massive plots: the superblocks which result in an urban fabric lacking density and diversity.

To avoid these problems, new urbanism theories promote the core concept of mixed land-use. Mixed land-use requires some combination of residential, commercial, industrial, office, or other land-use. To mix different economic and residential activities in one neighbourhood, they have to be made compatible and be integrated in a well-balanced manner by careful design and management.

8.5 Financial Framework and Governance

The second essential pillar for successful PCE is a sound financial plan, meaning proper budgeting, revenue generation and expenditure management. Municipal finance authorities must be able to translate urban development policies into a sound financial plan and to generate the income required for their implementation. Careful budgeting is essential to guarantee the maintenance and development of public institutions programmes and infrastructure. Municipal finance activities should aim at preventing liquidity risks and reducing the dependency on transfers from the central government.[8]

For the successful implementation of a PCE programme, adequate financial frameworks and governance schemes must be in place, including:

The financial capacity of the municipality to finance and deliver infrastructures and plans
The financial know-how of the municipality to implement and monitor infrastructure delivery and plans
Effective institutions with clear roles and adequate human and financial capacity to perform them
Fiscal capacity of the municipality to raise revenues, e.g., through land and property taxes
High degree of freedom of municipalities with regard to central governments.

Along with history the role of the governments has been highly discussed, how much responsibilities they have to take is the big question, and it is a question that has not been solved yet, and that probably will never get solved because is a matter of preferences. However, in terms of local government responsibilities the path has been narrowed, the major role assigned to local governments is to provide goods and services within a geographic area to residents who are willing to pay for them. They should not do stabilization policy because they do not have access to monetary instruments and they should not do redistribution as a primary focus because it will result in a non-general equilibrium policy, with people moving from one place to another.

There are two useful principles that have to be taken into consideration for municipal finance. The subsidiarity principle (Barnett 1996), states that the efficient provision of services requires that decision making be carried out by the level of government that is closest to the individual citizen. The second has to do with the fiscal decentralization; it is a concept developed for transferring the financial responsibility from central governments to local authorities forcing local governments to deliver and fund an increasing number of services.

[8]See UN-Habitat (2009) and (2017) Finance for City Leaders Handbook.

8.6 The Legal Framework

Rules and regulations have the power to shape the form and character of the city by playing an essential role in the implementation of urban plans. Depending on the quality of rules and regulations supporting the general plan of a PCE and the quality of the local legal framework, the rules and regulation accompanying an urban plan can either support or hinder its implementation and evolution. A design following all the best practice of urban planning cannot be implemented if it does not comply with the local legal framework. First and foremost, particular attention must thus be given to legal feasibility and implementation of all components of an urban plan. Possible rules and regulation to support the implementation of an urban plan are: Floor Area Ratio regulations, setback rules, mixed use regulations, as well as regulations on plot sizes, the maximum distance between intersections, street design, etc.

The different areas of knowledge consider diverse elements by the time they are determining if a law is a good law or if it is not. But there are values that characterize a good law or a good legal framework, those elements according to Mousmouti and Crispi (2015) are: efficacy, effectiveness, efficiency and simplicity. Even though different views try to prevail one over another of the characteristics mentioned before, there is one at which everyone agrees and it is: effectiveness. In the particular case in which the legislation regards urbanization, eight pillars have to be achieved for a law to be effective. Those pillars according to the authors mentioned before are:

Law has to be attached to the urban realities
Law has to be developed according to evidence
Affected people should have a voice to express their position
Legislation has to be simple and easy to comply with
Legislation has to be easily accessible
The law has to be coherent and consistent
Legislation must have a capacity to deliver results
Make legislative quality a guiding value in the process of developing and implementing legislation.

Even though is desirable that the laws are established at the most immediate territorial level, and that the norms could be easily modified according to the context, this could not always happen. Is inevitable to consider factors that could allocate some particular norms at a level that do not fulfil the expectations established by the subsidiarity principle, those factors could be: economies of scale, development of the local institutions in comparison to the national institutions, desirable level of flexibility for the norms, among others (Berrisford 2017). To give a practical example, the establishment of a physical and fiscal cadastre, with an efficient, up-to date and publicly available information system, should be desirable at a local level, but the technological and physical infrastructure to fulfil this objective could be costly if each local government acquire it individually, that is why usually this is held at a national level, because it represents efficiencies in terms of specialization for the country and savings.

8.7 Scales of Urban Assessment

When dealing with urban parameters, the scale of observation and of analysis is essential. Cities and urban environments are by nature highly heterogeneous areas, with intense concentrations and peaks of activities, and a long tail of sectors with a medium to low intensity. Average figures have thus to be handled with care, as they can hide very complex patterns of urban development. This study differentiates three scales on which a city can be assessed:

On the metropolitan scale, urban assessment addresses the spatial extension of the city. Analyses on this scale give an indication of the spatial layout of a city (by differentiating rural and urban land use) and of human activities (industries, offices, housing) and the way they are organized and distributed on the territory.
On the district scale, urban assessment addresses how streets and transportation networks are organized, as well as how urban amenities such as parks, hospitals or schools are distributed within the city.
On the neighbourhood scale, urban assessment considers the form and the size of urban blocks and the way they are divided into plots.

The metrics and indexes proposed in this study aim at being implemented at the very local scale: For measuring urban design matters, this is the neighbourhood scale and the block scale. Thereby the issue of city- or district-wide average values obscuring trends and the existence of spatial mismatch can be circumvented.

A systematic approach for assessing a government's performance with regard to urban design should be based on data with all parameters being measured on the same scale; therefore, the urban area could for example be gridded to cells of 500 m by 500 m which can be considered as the neighbourhood scale. In the case studies provided in this report, the layout used is either based on a 500 × 500 m gridding (Johannesburg), or using a more detailed gridding (200 × 200 m gridding in Paris, Census Output Areas in London).

To assess a government's performance about financial management and the efficiency of the legal framework, acquiring data on neighbourhood scale is not always possible or useful. Rules and regulations normally do not differ among neighbourhoods; there might, however, be differences between city districts. Municipal finance activities are also often undergone on a higher than neighbourhood level. The guiding principle, therefore, should be to acquire data for the lowest possible and sensible scale. The indicators provided seek to assess how well a PCE is funded. Therefore, they do not only capture characteristics of the conceptualization and implementation of a PCE, but also those components which constitute

Table 8.1 Investment and Responsibilities according to Layers of Government

Investment	Central Government	Metropolitan/ Regional Government	Municipal Government
Large-Scale transport infrastructure			
National road network (outside city)	▲	△	
National road network (crossing city)	△		△
Local road networks			▲
Airport	△	△	
Fluids protection			
Potable water		▲	△
Electricity		▲	△
Sanitation			
Solid waste landfill		△	△
Purification station		△	△
Smaller-scale infrastructure networks			
Roadways			▲
Electricity, drainage, swerage, and water distribution		△	△
Public lighting			△
Public facilities			
Major facility (for example, hospital)		▲	△
Commercial facility (for example, market)			▲
Social services facility (for example, school			▲
Development			
Industrial and commercial zones		△	△
Housing extension		▲	▲
Neighbourhood development			▲

Source Adapted and expanded from Paulais (2012)
▲ = majority of cases
△ = depending on the case or a shared responsibility

the framework for the PCE; this again explains why some concepts of the areas of financial management and legal framework are measured on higher than neighbourhood scale.

The different roles of governments are shown in Table 8.1, with investments that correspond to central or federal government, metropolitan or regional government, and municipal governments. Planned City Extensions and Planned City Infills correspond to a neighbourhood level whereas airports, basic infrastructure for water, electricity, energy, and national highways networks belong to the central government.

8.8 Competitiveness and Implications for Policy

The concept of productivity is the basis for competitiveness. Competitiveness is a country or city to achieve a higher level of productivity, and that is reflected in higher income. But productivity is the optimal combination of labour and capital, and therefore to make the concept operational, it should incorporate land and real estate markets. Land is already present in spatial and urban economics as there is literature on agglomerations, urban layout and value chains/supply chains, that is incorporated in productivity analysis.

Land and real estate markets have two dimensions, the central government is in charge of large macro planning of economic poles and large-scale infrastructure, but it is at a provincial and municipal level that the decisions on planned city extension and planned city infills are done. So, land and local properties also become the largest source of 'endogenous' finance for local governments.

For policy, cities need to build and strengthen the core conditions for sustainable urbanization, and those are the rules and regulations, municipal finance, and urban planning and design. Planning, Finance, and Regulations are the base for the Three-Pronged Approach.

Once this is present as technical resources and city assets, local government can build stronger urban systems and provide basic services, water, energy, electricity, at a local level, and eventually take care of more complex tasks such as job creation by linking urban layout making it friendlier for productive activity and enhancing mobility of people and goods.

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Part III
Classified Report

Chapter 9
Global Urban Comprehensive Economic Competitiveness Report 2017–2018

Bo Li and Xiaonan Liu

9.1 Patterns and Discoveries of Global Urban Economic Competitiveness

Driven by the emerging market countries, the global economic and trade situation has improved in a good way, and the environment of world economic development has also improved; however, trade protectionism, anti-globalization trend, geopolitical issues are still stirring on the fragile Global economic environment stability from time to time. In the context of the increasingly complex global development, to ensure the stability and sustainability of economic development has become the first priority of the development for every nation. Therefore, acting as the major carrier of the global economy, the economic development and economic competitiveness of each city has become the focus of competition all over the world. The Global Urban Competitiveness Project Team (GUCP) has been closely tracking the frontier of global urban development since 2005 and has continued to study and publish the Report on the Global Urban Economic Competitiveness (Biennial) (hereinafter referred to as the "Report"), in order to provide useful references for the healthy development of the city globally.

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Compared to “Report (2011–2012)” and “Report (2013–2014)”, In “Report (2017–2018)”, the research team has enlarged the observatory city database from 500 cities to 1007 cities, which covers almost all major cities with population of more than 500,000. Furthermore, “Report (2017–2018)” has divided the previous Global City Competitiveness Index into Global Urban Economic Competitiveness Index and Global Urban Sustainable Competitiveness Index, and has modified the evaluation indicator system accordingly.

In order to highlight the feasibility of index and indicator system, the global urban economic competitiveness index in “Report (2017–2018)” adopts the economic density and increment as the two only indicators to construct a relatively simplified and representative index system for economic competitiveness. Furthermore, “Report (2017–2018)” catches the fundamental core of urban economic competitiveness by implement the assessment from the perspective of realized output instead of potential output capacity. Besides that, “Report (2017–2018)” adopts the other dimensions of indicators in the previous reports as the explanatory variables for urban economic competitiveness and further uses the spatial scale of metropolitan area (Metro) in the analysis and assessment. The This research approach is obviously different from the approaches of other domestic and foreign research institutions in the evaluation and measurement of urban competitiveness, thus refreshing the current information and knowledge of relative position of global cities.

9.1.1 The Imbalanced Global Urban Economic Competitiveness

(1) **Overall Pattern of Global Urban Economic Competitiveness**

The overall global urban economic competitiveness index is low and economy is highly concentrated in a small number of cities. The global urban economic competitiveness index is produced through the weighted average calculation and standardization of three secondary indexes including the five-year growth of global urban GDP, the urban GDP per capita, and the urban connection to multinational corporations. The higher the index value is, the stronger the urban economic competitiveness is. Findings show that the total GDP of the 1007 sample cities around the world was about 47 trillion dollars in 2015, accounting for 63.5% of the total global GDP of 74 trillion USD. The mean and median of the economic competitiveness index of all sample cities were 0.338 and 0.294 respectively. The index of 593 cities, or 58.9% of all sample cities, was lower than the average, indicating that the overall global urban economic competitiveness index is low and the world economy is highly concentrated in cities of a small number of countries. Further studies of the statistical indexes of the differences in global urban economic competitiveness show that the standard deviation of global urban economic competitiveness is 0.193, the coefficient of variation is 0.571, the Gini coefficient is

Table 9.1 Global urban economic competitiveness index: global cities

Area	Sample size	Mean	Median	Standard deviation	Coefficient of variation	Gini coefficient	Theil index
World cities	1007	0.338	0.294	0.193	0.571	0.317	0.158

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

0.317, and the Theil index is 0.158, showing that considerable difference exist among cities in terms of economic competitiveness (Table 9.1).

A clearer picture of the distribution of the global urban economic competitiveness index can be developed through the histogram and kernel density estimation. The distribution is uneven and has a certain right skew, indicating the low economic competitiveness of quite a number of cities. It further proves our conclusion that the overall urban economic competitiveness is low and considerable differences exist among cities (Fig. 9.1).

Among the top 10 cities, the United States has an obvious edge while China catches our eyes with the rapid rise of its cities. Our findings show that New York, Los Angeles, Singapore, London, and San Francisco rank top 5 in terms of the global urban economic competitiveness index. Of the top 10 cities, five are from North America, accounting for 50%, three are from Asia, and two are from Europe. No cities from the other three continents enter the top 10 list. Of the top 20 cities, nine are from North America, eight are from Asia, and three are from Europe. On the national level, the United States has the most top 20 cities. A total of nine cities are listed, showing a robust economy of this traditional power despite its subprime mortgage crisis, industrial hollow, trade deficit, and other problems. Right after the United States is China, an emerging power with five cities listed, whose rise can be attributed to its economic restructuring and upgrading, macroeconomic policy coordination, and integration of Internet and other new technologies into economic development (Table 9.2).

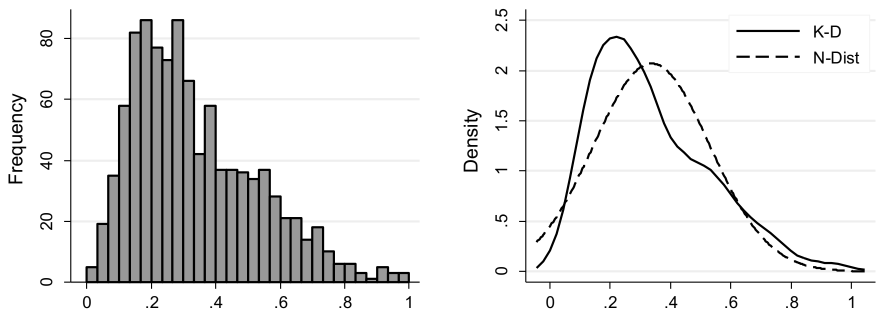


Fig. 9.1 Global urban economic competitiveness index: histogram and kernel density estimation. *Source* Urban and competitiveness index database of Chinese Academy of Social Sciences

Table 9.2 Top 20 cities in global urban economic competitiveness ranking

Rank	City	Economic competitiveness	Country	Continent	Rank	City	Economic competitiveness	Country	Continent
1	New York	1.000	United States	North America	11	Houston	0.900	United States	North America
2	Los Angeles	0.999	United States	North America	12	Hong Kong	0.887	China	Asia
3	Singapore	0.971	Singapore	Asia	13	Seoul	0.848	Korea	Asia
4	London	0.958	United Kingdom	Europe	14	Shanghai	0.837	China	Asia
5	San Francisco	0.941	United States	North America	15	Guangzhou	0.835	China	Asia
6	Shenzhen	0.934	China	Asia	16	Miami	0.816	United States	North
7	Tokyo	0.920	Japan	Asia	17	Chicago	0.815	United States	North
8	San Jose	0.916	United States	North America	18	Boston	0.812	United States	North
9	Munich	0.905	Germany	Europe	19	Dublin	0.811	Ireland	Europe
10	Dallas	0.903	United States	North America	20	Beijing	0.810	China	Asia

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

From the continental level, Europe and North America are in the lead while North-South difference is significant. Looking at the urban economic competitiveness index by continent, we will find that Oceania, North America, and Europe rank the highest, with both the mean and median of their overall economic competitiveness higher than the world average. South America has a mean value slightly lower than the world average and a median value slightly higher than the world average. As for Asia and Africa, both their mean and median are below the world average. In terms of the distribution of top 100 cities by continent, North America, Asia, and Europe are winners, having 39, 32, and 26 cities from their respective continent and accounting for 29.55%, 5.68% and 20.47% of the sample cities of their own group. However, since Asia contributes more than half of the total samples, its 32 cities on the top 100 list is hardly a large enough number. It is worth noting that none of the cities from South America and Africa are listed. Therefore, it is safe to say that the northern hemisphere surpasses the southern hemisphere by far in terms of both the most competitive cities and the largest number on the top 100 list. Although it registers the highest percentage of top 100 cities, only three cities from Oceania actually enter the list, a fact that can be explained by the small sample size of the continent (Table 9.3).

There are significant differences within Asia. Nor can we overlook the differences among continents. Most of the indicators reflecting the differences in the global urban economic competitiveness index show that Oceania and South American have relatively less differences while differences among African and Asian cities are more significant (Table 9.4).

We further divide the 1007 cities around the world into six continent groups and carry out **Theil Index** decomposition in order to better understand the pattern of the overall difference in urban economic competitiveness. Findings show that within Asia, Europe, and North America, the difference in urban economic competitiveness takes a larger portion of the overall difference (46.31%, 11.68% and 9.61% respectively), while that within Oceania and South America accounts for a

Table 9.3 Global urban economic competitiveness index by continent and percentage of top 100 cities

Area	Sample size	Mean	Median	No. of top 100 cities	Percentage of top 100 cities (%)	Maximum		
						City	Index	Global rank
Asia	563	0.303	0.277	32	5.68	Singapore	0.971	3
Europe	127	0.438	0.455	26	20.47	London	0.958	4
Africa	104	0.178	0.169	0	0.00	Tripoli	0.452	262
Oceania	7	0.606	0.603	3	42.86	Perth	0.733	39
North America	132	0.509	0.533	39	29.55	New York	1.000	1
South America	74	0.322	0.310	0	0.00	Buenos Aires	0.577	131

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

Table 9.4 Global urban economic competitiveness index: the world and its six continents

Area	Coefficient of variation	Gini coefficient
World	0.571	0.317
Asia	0.560	0.304
Europe	0.460	0.262
Africa	0.595	0.333
Oceania	0.127	0.066
North America	0.387	0.220
South America	0.324	0.183

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

Table 9.5 Decomposition of Theil index of global urban economic competitiveness difference by six continents

Group	Intraregional							Inter-regional
	Asia	Europe	North America	Africa	South America	Oceania	Total	
% of difference	46.31	11.68	9.61	6.03	2.29	0.00	75.97	24.03

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

relatively smaller part. The differences within all the continents combined contribute to 75.97% of the overall difference while the differences among all the continents account for a significant 24.03% (Table 9.5).

Europe and North America have well balanced city clusters while economic competitiveness in developing countries is concentrated in central cities. A comparison of major city clusters shows that those in the United States, Germany, and the United Kingdom show prominent economic competitiveness with the mean value of their respective index uniformly above 0.32. It points to the still robust economic strength of traditional developed countries. In China, India, and other emerging economies, economic competitiveness is mainly concentrated in central cities despite the large scale and size of their city clusters. Most other cities in such clusters show low urban economic competitiveness and high coefficient of variation. In contrast, cities in Northeastern United States enjoy relatively balanced development. While New York the central city has the highest economic competitiveness in the world, there is not an insurmountable gap with other cities. In China and India, an obvious center-periphery pattern can be discerned in the economic competitiveness index of city clusters, with a prominent central city, a significant gap between this city and other cities on the periphery, and a quite unbalanced group development (Table 9.6).

Table 9.6 Statistical comparison of economic competitiveness index of major global city clusters

City cluster	Country	No. of cities	Mean	Coefficient of variation	No. of top 100 cities	Percentage of top 100 cities (%)	Top city	Index of top city	Ranking of top city	Index of last city	Ranking of last city	Index mean excl. top city
Northeastern United States	United States	11	0.703	0.193	8	72.73	New York	1.000	1	0.546	157	0.674
Midwestern United States	United States	13	0.647	0.133	7	53.85	Chicago	0.815	17	0.529	178	0.633
London-Liverpool	United Kingdom	8	0.620	0.242	3	37.50	London	0.958	4	0.500	212	0.572
Yangtze River Delta	China	26	0.504	0.312	5	19.23	Shanghai	0.837	14	0.234	644	0.491
Pearl River Delta	China	13	0.468	0.504	3	23.08	Shenzhen	0.934	6	0.211	702	0.429
Beijing-Tianjin-Hebei	China	10	0.438	0.482	2	20.00	Beijing	0.810	20	0.216	682	0.397
Bangalore	India	5	0.324	0.167	0	0.00	Bangalore	0.404	319	0.280	547	0.304
Rhine-Ruhr	Germany	4	0.703	0.056	4	100.00	Dsseldorf	0.733	38	0.645	87	0.693

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

9.1.2 Changing Pattern of Top 10 Cities in Global Urban Economic Competitiveness

Due to some subjective and objective reasons, the Urban economic competitiveness assessment system and measurement methods in "Report (2017–2018)" has been adjusted, thus making them different and not directly comparable with previous versions of reports. However, the comparison of TOP 10 cities in recent versions of report could shed some light on the change of pattern of global urban competitiveness.

According to the results in the following table, only New York, Singapore, London, Tokyo are the cities remain in the TOP 10 cities of all three versions of reports. Among these four cities, only the rank of New York fluctuates, the ranks of rest three cities all rank down in varying degrees. In "Report (2017–2018)", there are six new cities in the Top 10, among which Los Angeles and San Francisco ranked Top 10 in "Report (2011–2012)", while the rest cities including Shenzhen, San Jose, Munich, and Dallas are the new Top 10 cities in the newest version of the report (Table 9.7).

Table 9.7 Top 10 cities in the recent three versions of reports

Global urban competitiveness (2011–2012)	Rank	Global urban competitiveness (2013–2014)	Rank	Global urban competitiveness (2017–2018)	Rank
New York	1	London	1	New York	1
London	2	New York	2	Los Angeles	2
Tokyo	3	Tokyo	3	Singapore	3
Paris	4	Paris	4	London	4
San Francisco	5	Singapore	5	San Francisco	5
Chicago	6	Hongkong	6	Shenzhen	6
Los Angeles	7	Shanghai	7	Tokyo	7
Singapore	8	Beijing	8	San Jose	8
Hongkong	9	Sydney	9	Munich	9
Seoul	10	Frankfurt	10	Dallas	10

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

9.1.3 Greater Pressure on Emerging Market Cities Calls for the Forces of Urban Agglomeration and Driving Factors

(1) **Major Findings of Global Urban Economic Competitiveness**

Coastal cities show higher competitiveness and emerging market cities face significant pressure for catching up. In order to have a clearer picture of the global distribution pattern of urban economic competitiveness, we use different color dots to represent the 1007 cities according to their competitiveness and put these dots on a world map. On the one hand, the economic competitiveness of coastal cities is generally higher than that of inland cities. In North America, Europe, Asia, Oceania, and even Africa and Oceania, color dots that represent higher economic competitiveness (such as red and green) are often seen in the vicinity of the sea, while those representing lower competitiveness (such as blue and white) are usually found in inland areas. It shows that the international network of trade and the global network of the division of labor, traditionally promoted by ocean shipping, has determined the current world economic structure and is still playing an important role. Cities at important network junctions are often able to develop higher economic competitiveness than inland cities. On the other hand, it should be noted that the rise of emerging market economies has brought with it many cities whose economic competitiveness is impressive as well. Take China for example. The implementation of major regional economic strategies has contributed to the spread of high economic competitiveness from coastal to inland cities. However, there remains a significant gap between inland cities and cities in emerging economies on the one hand and traditional coastal cities on the other hand in terms of their economic competitiveness. Great catch-up efforts are still needed (Fig. 9.2).

Fig. 9.2 Global urban economic competitiveness distribution map. *Source* Urban and competitiveness index database of Chinese Academy of Social Sciences

Cities of similar economic competitiveness tend to form clusters, indicating the importance of their development. Analysis shows that Morans I Index is 0.657 and the p value is less than 0.0001, which is significantly positive. It shows that there is a significant positive spatial correlation among the economic competitiveness of the 1007 cities around the world. In other words, there is a positive spillover effect on the economic competitiveness of neighboring cities. The higher a city's economic competitiveness is, the higher economic competitiveness cities in its vicinity enjoy. This rule can also be verified by the Moran scatter chart below. Most cities are found in Quadrant 1 and 3 which shows positive autocorrelation and points to the positive spatial autocorrelation of urban competitiveness. Due to the existence of the spatial spillover effect between neighboring cities, economic development by city clusters can better improve overall urban economic competitiveness and avoid the negative impact of neighboring cities on the development of any individual city (Fig. 9.3).

Significant echelon effect is observed in urban economic competitiveness and differentiation exists among group differences. The 1007 cities can be divided into 10 groups or 10 levels (see Chap. 1). A study of the statistical indicators of economic competitiveness on different levels shows that most cities are on lower levels. For example, we have 99 cities on Level 8, 400 cities on Level 9, and 397 cities on Level 10. Differences in the mean and median value of economic competitiveness between neighboring groups are quite even and there is no abrupt gap, pointing to the existence of a quite obvious echelon effect. Further studies show that most indicators reflect a wider gap between cities on lower levels and a narrower gap between cities on higher levels. It indicates a certain level of differentiation in terms of the difference in economic competitiveness among groups (Table 9.8).

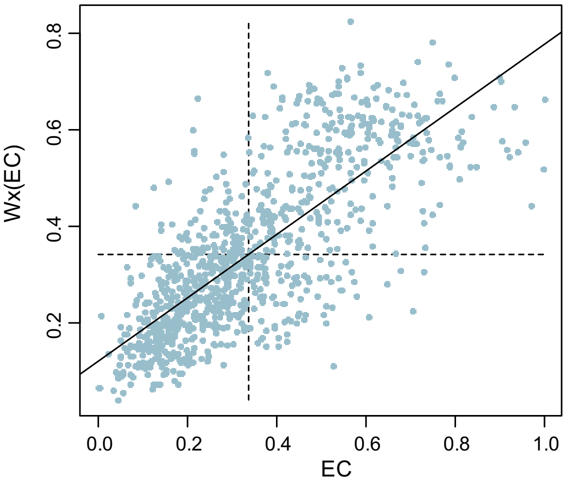


Fig. 9.3 Global urban economic competitiveness index: Moran scatter chart. *Source* Urban and competitiveness index database of Chinese Academy of Social Sciences

Table 9.8 Economic competitiveness statistical index of cities of different ranks

New rank	Sample size	Mean	Median	Standard deviation	Coefficient of variation	Gini coefficient
1	2	0.979	0.979	0.030	0.030	0.011
2	5	0.943	0.941	0.044	0.047	0.024
3	16	0.790	0.811	0.090	0.114	0.061
4	11	0.762	0.781	0.078	0.102	0.055
5	11	0.731	0.729	0.080	0.109	0.051
6	36	0.659	0.661	0.083	0.125	0.069
7	55	0.596	0.593	0.078	0.131	0.073
8	96	0.499	0.515	0.091	0.182	0.103
9	388	0.341	0.332	0.103	0.304	0.172
10	387	0.175	0.170	0.071	0.406	0.230

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

A key measure for BRICS countries to catch up with developed countries is to improve the economic competitiveness of their cities and narrow existing gaps. Studies of major statistical indicators of sample cities from BRICS countries and countries in the Group of Seven show that both the mean and median value of economic competitiveness of BRICS cities are far below those of G7 cities, showing that although emerging market economies as represented by BRICS are playing an increasingly important role in expanding the world economic scale and promoting the global economic growth, their urban economic competitiveness still lags behind that of traditional economic powers and developed countries. As we all know, cities are the main playfield for modern civilization and play a vital role in technological innovation, industrial upgrading, and wealth creation. In a sense, the gap in urban economic competitiveness well captures the weakness and shortcomings of BRICS countries in terms of the quality of current economic development as well as areas where urgent future improvements are needed (Table 9.9).

Local demand index, infrastructure index, and science and technology innovation index are driving forces that have a relatively greater influence on improving global urban economic competitiveness. In order to better understand factors that influence global urban economic competitiveness and their respective impact, we apply the regression method to the 1007 sample cities around the world and analyze the relationship between their economic competitiveness and major

Table 9.9 Global urban economic competitiveness index: intergovernmental organizations

Area	Sample size	Mean	Median	Standard deviation	Coefficient of variation	Gini coefficient	Theil index
BRICS	463	0.296	0.276	0.150	0.508	0.272	0.119
G7	141	0.602	0.584	0.143	0.237	0.132	0.027

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

explanatory factors including the financial service index, science and technology innovation index, industrial system index, human resources index, local demand index, business cost index, business environment index, infrastructure index, and cost of living index.

Findings of the regression study show that except for the financial service index which has a positive U-shaped effect on a city's economic competitiveness, all other indexes demonstrate a significant positive effect. Let us put the financial service index aside and rank other indexes according to the connection between explanatory variables and explained variables. From highly connected to barely connected, we have on our list the local demand index, infrastructure index, science and technology innovation index, industrial system index, business cost index, cost of living index, business environment index, and human resource index. It can be seen that local demand, infrastructure, and science and technology innovation are the most important factors that affect urban economic competitiveness. The positive U-shaped impact of the financial service index shows that only when a city's financial services reach a certain threshold level can they have a significantly positive impact on its economic competitiveness.

The aforementioned findings point out the direction for our future studies on how to improve global urban economic competitiveness. We should carefully analyze how such explanatory factors are distributed for cities around the world, what laws govern their distribution, as well as their respective role and importance and apply our findings to improving global urban economic competitiveness in a speedy and targeted manner. Therefore, the present report will devote separate sections in the following chapters for detailed analysis of the explanatory indexes. Since the science and technology innovation index is already covered in the **Report on Sustainable Competitiveness**, it will not be repeated here in this report (Table 9.10).

Table 9.10 Regression analysis results of global economic competitiveness and explanatory indexes

Explanatory index	Coefficient	t value
Financial service index	−0.603***	−5.645
Financial service index (quadratic)	0.350***	2.638
Science and technology innovation index	0.158***	6.854
Industrial system index	0.142***	3.919
Human resources index	0.048*	1.906
Local demand index	0.709***	20.152
Business cost index	0.134***	6.858
Business environment index	0.065***	2.667
Infrastructure index	0.267***	8.744
Cost of living index	**0.080***	3.968
Constant term	−**0.227***	−12.355
Sample size	1007	–

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Source Urban and competitiveness index database of Chinese Academy of Social Sciences

9.2 Analysis of Global Urban Financial Service Index

9.2.1 The Lagging Financial Service of Asian Cities Has Become a Constraint to Development

i. **The overall pattern of global urban financial services index**

Global financial activities are concentrated in a small number of cities, and the overall level is low. The global urban financial services index is obtained through the weighted calculating and standardized processing of such secondary indicators as the global distribution of top 50 banks, the number of bank branches, and the indexes of exchanges. The higher the index value is, the higher the level of urban financial services is. According to the calculation, the mean value of financial services indexes of all sample cities is 0.166, and the median is 0.151. The number of cities with the index lower than the mean value has reached 590, accounting for more than 58.6% of the sample cities, reflecting that the world's financial services activities are highly concentrated in cities of a few countries, thus resulting in an overall low-level index. When further examining the statistical indicators that measure the degree of global urban financial services differences, we find that, the standard deviation of global urban financial services is 0.081, the coefficient of variation is 0.490, the Gini coefficient is 0.243, and the Theil index is 0.104, showing that the financial services between cities have certain differences (Table 9.11).

The histogram and the kernel density distribution can show more clearly the distribution characteristics of global urban financial services index, which shows an obvious right-skewed distribution. At the same time, the low mean value indicates that most cities have a low level of financial services, which further verifies that the overall urban financial services level is low (Fig. 9.4).

Among the top ten cities, New York ranks the first, and China's cities are upgrading rapidly. According to calculation, in the global urban financial services index ranking, the top five cities were New York, London, Tokyo, Hong Kong, and Shanghai. New York ranked the first among the top 10 cities and was the only city from North America. Seven cities were from Asia, constituting an absolute majority, and two cities—London and Paris—were from Europe. The remaining continents had no city on the list. The results show that, despite the considerable financial strength of cities in North American and European power nations, the urban financial services of Asian countries are developing rapidly, ranking the

Table 9.11 The financial services index of global cities

Scope	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Global cities	1007	0.166	0.151	0.081	0.490	0.243	0.104

Source City and competitiveness index database, CASS

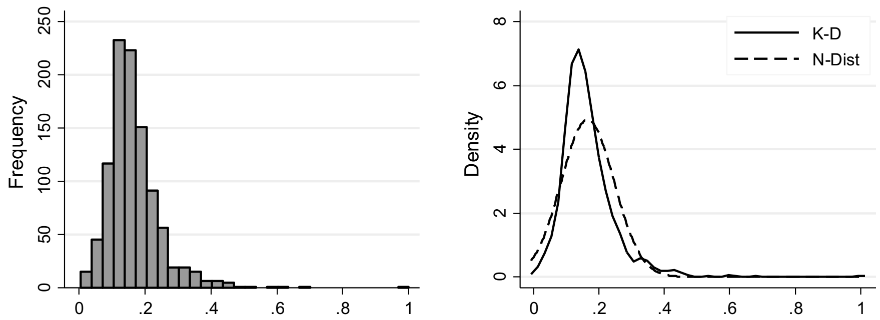


Fig. 9.4 Global urban financial services index: histogram and kernel density. *Source* City and competitiveness index database, CASS

worlds front row both in quantity and quality. At the national level, although the United States and the UK each has only one city—New York and London respectively on the list of top 10 global cities in financial services index, they are the top two cities. Particularly, the financial services index of New York is much higher than that of London, far higher than that of other cities. It shows that, the United States as the world's economic hegemon is out of reach by other countries in the urban financial sector, and the UK, as the former worlds economic hegemon, also has enormous advantages in financial services. But meanwhile, we should see that, the world's largest developing country China have three cities—Hong Kong, Shanghai, Beijing—on the list of top ten global financial cities, indicating that the financial services levels of core cities in China are increasing rapidly, gradually matching its economic strength and status in the world (Table 9.12).

At the continental level, the financial services of Asian cities fall behind, becoming a constraint factor in development. Oceania, North America, Europe and South America are leading continents in the world's financial services ranking, with the mean value and median of financial services higher than the world average

Table 9.12 Top 10 global cities in financial services index

No.	City	Financial services index	Country	Continent
1	New York	1.000	USA	North America
2	London	0.679	UK	Europe
3	Tokyo	0.603	Japan	Asia
4	Hong Kong	0.600	China	Asia
5	Shanghai	0.534	China	Asia
6	Mumbai	0.474	India	Asia
7	Beijing	0.449	China	Asia
8	Singapore	0.447	Singapore	Asia
9	Paris	0.445	France	Europe
10	Seoul	0.444	ROK	Asia

Source City and competitiveness index database, CASS

level. But the mean value and median of financial services in Asia and Africa are slightly lower than the world average. Especially for Asia, the overall level of its financial services is not matched with the development of its industrial economy. But due to historical and realistic factors, the financial coordination levels between Asian cities are not high. As a result, their capability of resisting financial risks is not strong, the financing needs of economic entities are inhibited, and the overall economic development of Asian cities is restricted.

From the continental distribution of top 100 global cities in financial services index, 34 of the Asian cities have entered the global 100 cities list. However, Asia has the most sample cities, accounting for more than half of all sample cities. Therefore, the 34 top 100 cities only account for 6.04% of the Asian sample cities. North America and Europe have the best results, with 26 and 22 cities entering the list respectively, accounting for 19.70% and 17.32% of their corresponding sample cities. Therefore, from the perspective of the number of cities entering the list of top 100 cities, the important nodes of the worlds financial services are concentrated in the northern hemisphere. In contrast, the southern hemisphere is relatively backward. South America is doing okay, with 14 cities entering the list of top 100 cities, accounting for 18.92% of its sample cities. However, in Africa, only two cities have entered the list of top 100 cities in financial services. Although Oceania has a high proportion of cities on the list of top 100 global cities, the sample cities are relatively few, with two cities entering the list but ranking backward (Table 9.13).

Because of the weak driving capability of financial services in central cities, the financial services levels of China's urban agglomerations are not high. Based on the size of urban agglomeration, the research group has selected several important urban agglomerations of the United States, China, India, the UK, and Germany. The financial services levels of urban agglomerations of the United States and the UK are significantly prominent, with the mean value of urban financial services index above 0.240, indicating that the urban agglomerations of traditional developed countries are still leading in the financial sector. By contrast, the financial services of urban agglomerations in emerging economies have diverged. The financial services of Indian urban agglomerations are higher, while the financial services of three urban agglomerations in China are not high. From the perspective of coefficient of variation that reflects the difference levels, in both developed countries and emerging economies, the financial services levels between cities in the urban agglomerations have great differences, showing a central-periphery mode and reflecting the spatial characteristics of financial services. Meanwhile, it shows the promotion and drive effect of cities with high financial service levels on the development of the whole urban agglomerations. In comparison, the financial services levels of German urban agglomerations are balanced (Table 9.14).

Table 9.13 The continental situation of financial services index and the proportion of top 100 cities

Scope	Number of samples	Mean value	Median	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	Maximum value		
							City	Index	World ranking
Asia	582	0.147	0.134	0.468	34	5.84	Tokyo	0.603	3
Europe	131	0.202	0.188	0.432	22	16.79	London	0.679	2
Africa	105	0.116	0.056	0.484	2	1.90	Johannesburg	0.340	36
Oceania	7	0.262	0.239	0.318	2	28.57	Sydney	0.416	15
North America	136	0.215	0.196	0.449	26	19.12	New York	1.000	1
South America	74	0.197	0.177	0.314	14	18.92	Bogota	0.400	18

Source City and competitiveness index database, CASS

Table 9.14 Statistical comparison of the financial services index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Mean value	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	No. 1 city	Index of no. 1 city	Ranking of no. 1 city	Index of last city	Ranking of last city	Mean value deducting the index of no. 1 city
Northeast U.S.	USA	11	0.326	0.711	5	45.45		1.000	1	0.195	253	0.259
Midwest U.S.	USA	13	0.248	0.281	3	23.08		0.410	17	0.164	424	0.234
London-Liverpool	UK	8	0.275	0.622	2	25.00		0.679	2	0.164	422	0.217
Yangtze River Delta	China	26	0.164	0.543	1	3.85		0.534	5	0.091	929	0.149
Pearl River Delta	China	13	0.180	0.478	2	15.38		0.343	32	0.061	989	0.166
Beijing-Tianjin-Hebei	China	10	0.185	0.583	2	20.00		0.449	7	0.109	828	0.156
Bangalore	India	5	0.231	0.279	2	40.00		0.309	55	0.158	455	0.211
Rhine-Ruhr	Germany	4	0.217	0.156	1	25.00		0.262	91	0.188	289	0.202

Source City and competitiveness index database, CASS

9.2.2 Global Urban Financial Service and Economic Competitiveness Are Imbalanced

ii. **Important patterns and discoveries of global urban financial services**

The level of financial services plays a significant role in boosting the economic competitiveness of global cities. The distribution pattern of global urban financial services is highly coincident and consistent with that of global urban economic competitiveness; in other words, the financial services level of coastal cities is generally higher than that of inland cities. Moreover, the financial services levels of areas such as North America and Europe with strong economic competitiveness are high. On the one hand, it reflects the support of financial services to urban economic competitiveness; on the other hand, it reflects the distribution of global financial centers corresponds with the traditional world economic labor division pattern (Fig. 9.5).

There are problems of imbalanced development between the financial service and economic competitiveness in the world's cities. According to relevant statistics on the coupling coordination of the economic competitiveness and the business cost of the primate cities of 138 countries, the coupling coordination mean value and median of the economic competitiveness and the business cost of the cities are 0.435 and 0.441 respectively, on the verge of overall imbalance. As for the top ten cities in economic competitiveness, the mean value and median of the coupling coordination degree are 0.617 and 0.609 respectively; they have achieved the primary level coordination of economic competitiveness and business environment, while they are in the primary level of coordination in the other nine cities. For cities ranking from 11 to 20 and the cities ranking from 21 to 50, the mean

Fig. 9.5 Global urban financial services distribution. *Source* City and competitiveness index database, CASS

Table 9.15 Financial service index statistical index of cities of different ranks

With financial service	Mean value	Median	Standard deviation	Variation coefficient
1–10	0.563	0.555	0.075	0.133
11–20	0.541	0.535	0.031	0.057
21–50	0.477	0.470	0.030	0.064
51–100	0.450	0.448	0.028	0.062
101–200	0.412	0.408	0.030	0.073
201–300	0.382	0.381	0.028	0.074
301–500	0.340	0.338	0.030	0.087
501–1007	0.270	0.276	0.047	0.175
1–1007	0.330	0.318	0.082	0.248

Source City and competitiveness index database, CASS

value and median of urban coupling coordination degree are barely coordinated. For the ranking from 21 to 50, cities are on the verge of imbalance. For the ranking from 51 to 100, cities are on the verge of imbalance. For the ranking from 101 to 138, cities are in a moderately imbalanced state. On the whole, the economic competitiveness index and business cost index of the primate cities of 138 countries appear to be on the verge of imbalance. With the decline of economic competitiveness, the maladjustment will grow severe, which evidently impedes the improvement of most cities especially economically backward cities. Therefore, only by vigorously reducing the business cost of global cities can it play a positive role in enhancing the economic competitiveness and realizing the overall coordinated development of global urban competitiveness (Table 9.15).

9.3 Analysis of Global Urban Industrial System Index

9.3.1 The Industrial System of Urban Agglomeration Is Stronger in City of Developed Countries

The global urban industrial system levels vary greatly, with industrial systems concentrated in a few cities. The index of global urban industrial systems is concluded through the weighted calculation and standardized processing of the two secondary indicators—the distribution of transnational productive services companies in global cities and the distribution of the world's top 50 technology enterprises. The higher the indicator value is, the higher the urban industrial system level is. According to the calculation, the mean value of industrial system indexes of all sample cities is 0.063, and the median is 0.016. The number of cities with the index lower than the mean value has reached 766, accounting for more than 76.1% of the sample cities, reflecting that the world's industrial systems are highly

Table 9.16 The industrial system indexes: global cities

Scope	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Global cities	1007	0.063	0.016	0.120	1.905	0.704	0.910

Source City and competitiveness index database, CASS

concentrated in cities of a few countries, thus resulting in an overall low-level index. Through further examining the statistical indicators that measure the degree of global urban industrial system differences, we find that, the standard deviation of global urban industrial system is 0.120, the coefficient of variation is 1.905, the Gini coefficient is 0.704, and the Theil index is 0.910, showing that the industrial systems between cities have certain differences (Table 9.16).

From the histogram and the kernel density distribution, we can see more clearly the distribution characteristics of global urban industrial system indexes: the distribution of industrial system indexes of global cities shows conspicuous right-skewed trend. It indicates that many cities are in areas with a lower level of industrial system indexes and are generally not subject to normal distribution, showing that the overall urban industrial system index is extremely low and the differences between cities are great (Fig. 9.6).

Among the top ten cities, Asian cities, especially Chinese cities, are emerging rapidly. According to calculation, in the global urban industrial system index ranking, the top five cities were New York, Beijing, London, Singapore, and Tokyo. New York ranked the first among the top 10 cities and was the only city from North America. Six cities were from Asia, constituting an absolute majority, two cities—London and Moscow—were from Europe, and one city—Sydney—was from Oceania. The remaining continents had no city on the list. The results show that, although cities of North American and European power nations have considerable strength in the high-tech industry and the productive services industry,

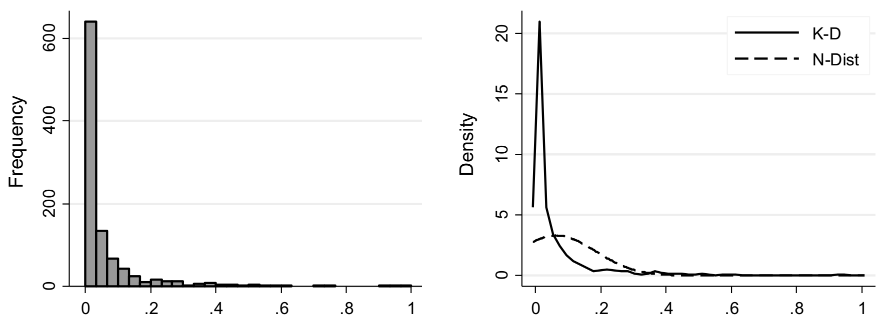


Fig. 9.6 Global urban industrial system index: histogram and kernel density. *Source* City and competitiveness index database, CASS

Asian urban industrial system is undergoing rapid transformation and upgrading and ranks the worlds top in both quantity and quality with tremendous strength. At the national level, although the United States and the UK each had only one city entering the list of global top 10 cities in industrial system index, the two listed cities—New York and London- ranked the first and the third place respectively. This reveals that, as traditional global industrial power, the United States and the UK still have certain advantages in the high-end industries. But meanwhile, we should see that China's urban industrial development has made considerable progress, with a total of three cities—Beijing, Shanghai, Hong Kong—on the list of top 10 global cities, ranking the second, sixth and seventh respectively. It shows that the above Chinese cities have achieved remarkable effects in the convergence of the secondary industry and the tertiary industry and realized the overwhelming emergence of industrial systems (Table 9.17).

At the continental level, Europe and North America lead the world, while Asia and Africa are intensifying efforts to catch up. In the world's urban industrial system ranking, North America, Europe, and Oceania are in the lead, with the mean value and the median higher than the world average level. The mean value and median of industrial system in Asia and Africa are slightly lower than the world average.

From the continental distribution of top 100 global cities, 33 European cities enter the list, accounting for 25.98% of the corresponding sample cities. Twenty-seven Asian cities entered the top 100 global cities list, accounting for 4.80%. 22 North American enter the list, accounting for 16.67% of the corresponding sample cities. Therefore, from the number of cities on the top 100 cities list, we can see that, cities with higher industrial system levels are mainly concentrated in the northern hemisphere. In contrast, the southern hemisphere falls behind. South America and Africa each had seven cities entering the list of top 100 global cities, accounting for 9.46% and 6.73% of its corresponding sample cities. Oceania had a backward ranking with three cities on the list (Table 9.18).

Table 9.17 Top 10 global cities in the industrial system index

No.	City	Industrial system index	Country	Continent
1	New York	1.000	USA	North America
2	Beijing	0.943	China	Asia
3	London	0.935	UK	Europe
4	Singapore	0.933	Singapore	Asia
5	Tokyo	0.918	Japan	Asia
6	Shanghai	0.751	China	Asia
7	Hong Kong	0.707	China	Asia
8	Moscow	0.631	Russia	Europe
9	Seoul	0.610	ROK	Asia
10	Sydney	0.605	Australia	Oceania

Source City and competitiveness index database, CASS

Table 9.18 The continental situation of industrial system index and the proportion of top 100 cities

Scope	Number of samples	Mean value	Median	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	Maximum value		
							City	Index	World ranking
Asia	563	0.042	0.014	2.537	27	4.80	Beijing	0.943	2
Europe	127	0.126	0.054	1.307	33	25.98	London	0.935	3
Africa	104	0.042	0.012	1.702	7	6.73	Johannesburg	0.373	35
Oceania	7	0.234	0.093	0.953	3	42.86	Sydney	0.605	10
North America	132	0.103	0.062	1.228	22	16.67	New York	1.000	1
South America	74	0.061	0.027	1.595	7	9.46	Buenos Aires	0.446	24

Source City and competitiveness index database, CASS

The industrial systems of urban agglomerations in developed countries are more vigorous, and the urban agglomeration effects of global industrial systems are remarkable. Based on the size of urban agglomeration, the research group has selected several important urban agglomerations of the United States, China, India, the UK, and Germany. The industrial system levels of urban agglomerations of the United States, the UK and Germany are significantly higher, with the mean value of urban industrial system indexes above 0.18, indicating that the industrial systems of urban agglomerations of traditional developed countries are upgrading smoothly and vigorously. Regarding the emerging economies such as China and India, there has been certain differentiation among the urban agglomerations in the development of industrial systems. China's urban agglomerations have a big coefficient of variation, and show the central—peripheral mode, i.e., industrial systems are concentrated in central cities and the industrial system levels of other cities are low. Indian urban agglomerations lack high-level industrial system cities and the overall industrial system level is low. By contrast, Germany's urban agglomerations have higher industrial system levels and balanced urban strength (Table 9.19).

9.3.2 The Global Urban Industrial System Shows the Phenomenon of "Tier-Based Jump"

ii. **Important patterns and discoveries of global urban industrial system**

The global urban industrial system shows the phenomenon of "tier-based jump", with the industrial system concentrated in cities with stronger economic competitiveness. Through examining the statistical indicators of the industrial system indexes of 1007 sample cities which are divided into ten tiers, we find the industrial system of tier-one cities is at the highest level with a mean value of 0.968, far higher than that of tier-two cities' industrial system which is 0.546. In the meantime, the industrial system mean value of tier-eight cities is 0.092, more than 2 times the mean value of tier-nine cities, while the industrial system mean value of tier-nine cities is 3 times that of tier-ten cities. The results reveal that there exists obvious industrial system index jumping between different tiers of cities and the industrial system of global cities shows polarization. That is, the activities of major multinational corporations and technology enterprises of productive services are concentrated in a few cities with strong economic competitiveness, but many cities with poor competitiveness fall behind in the industrial system (Table 9.20).

Further examining the statistical indicators which reflect the differences, we find that, most of the indicators reflect that cities of lower tiers have greater differences in the industrial system levels, which further highlights the outdated industries and uneven development of cities with weak economic competitiveness. In addition, it is found that, the mean value of industrial system index of cities in BRICS is significantly lower than that of G7. The differential index shows that the industrial

Table 9.19 Statistical comparison of the industrial system index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Mean value	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	No. 1 city	Index of no. 1 city	Ranking of no. 1 city	Index of last city	Ranking of last city	Mean value deducting the index of no. 1 city
Northeast U.S.	USA	11	0.203	1.397	4	36.36		1.000	1	0.027	403	0.124
Midwest U.S.	USA	13	0.137	0.849	3	23.08		0.396	31	0.012	724	0.115
London-Liverpool	UK	8	0.203	1.489	2	25.00		0.935	3	0.012	724	0.098
Yangtze River Delta	China	26	0.062	2.362	2	7.69		0.751	6	0.014	538	0.035
Pearl River Delta	China	13	0.066	1.776	2	15.38		0.362	41	0.000	966	0.041
Beijing-Tianjin-Hebei	China	10	0.123	2.379	1	10.00		0.943	2	0.014	538	0.032
Bangalore	India	5	0.130	1.216	2	40.00		0.383	32	0.018	467	0.067
Rhine-Ruhr	Germany	4	0.181	0.435	2	50.00		0.280	54	0.099	169	0.148

Source City and competitiveness index database, CASS

Table 9.20 Statistical indicators of the industrial system index for different tiers of cities

New tier	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient
1	2	0.968	0.968	0.046	0.047	0.017
2	5	0.546	0.580	0.305	0.559	0.282
3	16	0.477	0.410	0.243	0.510	0.275
4	11	0.305	0.292	0.115	0.378	0.193
5	11	0.283	0.321	0.191	0.675	0.364
6	36	0.233	0.174	0.146	0.627	0.333
7	55	0.159	0.107	0.121	0.760	0.380
8	96	0.092	0.061	0.082	0.897	0.434
9	388	0.037	0.016	0.049	1.345	0.530
10	387	0.012	0.007	0.016	1.324	0.569

Source City and competitiveness index database, CASS

Table 9.21 Global urban industry system index: international organizations

Scope	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
BRICS	463	0.033	0.014	0.089	2.712	0.689	1.116
G7	141	0.132	0.078	0.167	1.264	0.533	0.512

Source City and competitiveness index database, CASS

system difference of BRICS is distinctly higher than that of cities of G7 members. This indicates that although the city status of emerging market countries in the global value chain is gradually changing, there remain many challenges in the process of restructuring the global value chain, and they have a long way to go in catching up with the traditional developed countries (Tables 9.21 and 9.22).

Urban development calls for the reconstruction of value chain of global industrial system. The industrial system index has a significant positive effect on economic competitiveness. The regression method is adopted to test the support of the global urban industrial system index to economic competitiveness. It is found that, there is significant linear positive correlation between the industrial system index level and the economic competitiveness of main cities in the world, which shows the significant positive effect of the industrial system level on economic competitiveness. This finding provides a supportive basis for the value chain reconstruction of the global urban industrial system. Because of the generally higher industrial system development level of developed countries where the economic competitiveness is strong, it will have limited promoting effect on their economic competitiveness when further enhancing the aggregation of productive services multinational corporations and technology enterprises. In comparison, in cities of emerging markets represented by BRICS, due to their increasingly important role in the sluggish global economy, coupled with their generally low

Table 9.22 Comparison of industrial system indexes between cities of BRICS and G7

	Country	Sample	Number of top 100 cities	The proportion of top 100 cities (%)	Mean value	Variation coefficient	Maximum value		
							City	Index	World ranking
BRICS	China	292	7	2.40	0.032	2.848	Beijing	0.943	2
	Russia	33	1	3.03	0.034	3.227	Moscow	0.631	8
	India	100	4	4.00	0.025	2.807	Mumbai	0.500	18
	Brazil	32	1	3.13	0.044	1.719	Sao Paulo	0.420	28
	South Africa	6	2	33.33	0.127	1.159	Johannesburg	0.373	35
G7	UK	12	2	16.67	0.155	1.624	London	0.935	3
	France	9	1	11.11	0.100	1.820	Paris	0.581	12
	USA	75	17	22.67	0.124	1.183	New York	1.000	1
	Germany	13	6	46.15	0.166	0.724	Frankfurt	0.423	27
	Italy	13	2	15.38	0.102	1.569	Milan	0.600	11
	Japan	10	1	10.00	0.162	1.671	Tokyo	0.918	5
	Canada	9	3	33.33	0.161	0.821	Toronto	0.463	22

Source City and competitiveness index database, CASS

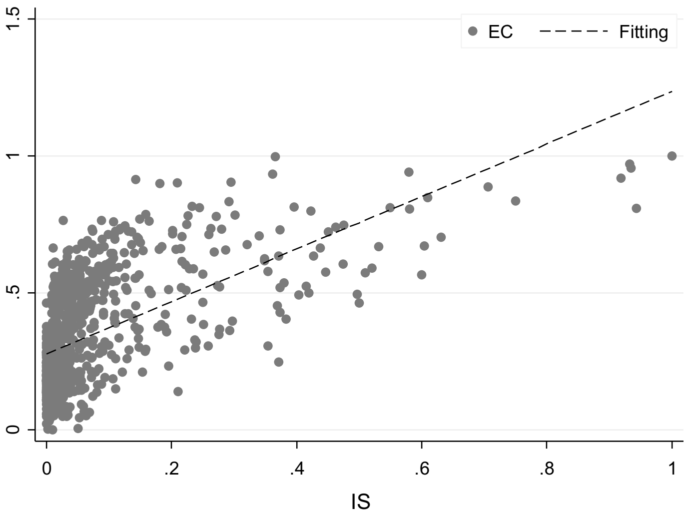


Fig. 9.7 The scatterplot and fitting of global urban economic competitiveness and industrial system index. *Source* City and competitiveness index database, CASS

industrial system index level, there is great space for them to upgrade the industrial system. Through the reconstruction of the global industrial system value chain, more and more multinational corporations and technology companies in the productive services sector are gathering in cities of emerging markets and will have greater effects on enhancing the economic competitiveness, thus boosting global economic growth and balanced development (Fig. 9.7).

9.4 Analysis of Global Urban Human Resource Index

9.4.1 Uneven Distribution of Global Urban Human Resources V. S. Competitive Advantage of Human Resource in Emerging Market

i. **The overall pattern of global urban human resources index**

The problem of uneven distribution of urban human resources in the world is prominent. The global urban human resources index is concluded by the weighted calculation and standardized processing of such three secondary indicators as the population of global urban labor force, the proportion of young population, and the university index ranking. The higher the indicator value is, the higher the urban human resources index is. According to the calculation, the mean value of human resources index of all sample cities is 0.293 and the median is 0.268, and there are

Table 9.23 Global urban human resources index: global cities

Scope	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Global cities	1007	0.293	0.268	0.129	0.440	0.223	0.086

Source City and competitiveness index database, CASS

632 cities with the index lower than the mean value, exceeding 62.8% of the sample cities. This reflects that the human resource distribution in global cities is unbalanced, which further exacerbates the overall low-level index. Further examining the statistical indicators of the degree of global urban human resource differences, we find that, the standard deviation of global urban human resource is 0.129, the coefficient of variation is 0.440, the Gini coefficient is 0.223, the Theil index is 0.086, showing that the human resources between cities have certain differences (Table 9.23).

Among the top ten cities, Tokyo ranks the first, and the human resource advantages of BRICS show up. According to calculation, in the ranking of global urban human resources index in 2016, the top five cities were Tokyo, New York, Sao Paulo, Seoul, and Beijing. Tokyo ranked first in the top 10 cities. A total of six cities in Asia were shortlisted, constituting an absolute majority. Two cities in North America entered the list of top ten cities, and South America and Europe each had one city on the list, while the remaining continents had no listed city. The results show that Asia has distinct advantages in human resources. From the national perspective, among the top 10 global cities in human resources index, three cities are from G7 member countries, namely, Tokyo (No. 1), New York (No. 2), and London (No. 9). Although traditional economic power faces the challenge of aging population, their cities remain world-leading in human resources because of the unique advantages in education and training as well as their appeal to global talents. Besides, we can see that among the world's top ten cities, five cities are from members of BRICS, including Sao Paulo of Brazil (No. 3) and Beijing (No. 5), Shenzhen (No. 7), Dongguan (No. 8) and Shanghai (No. 9) of China. The results show that the cities of emerging market countries represented by BRICS not only have advantages in labor force and population structure, but also see rapid development in education and talent policies, thus accumulating great human resources to support their economic competitiveness (Table 9.24).

At the continental level, the top 100 global cities in human resources index are mainly in Asia and North America. North America, Oceania, South America, and Asia are leading in the world's human resources, with the mean value and median of human resources higher than the world average level. The mean value and median of human resources in Europe and Africa are slightly lower than the world average. Viewed from the continental distribution of human resources index of top 100 global cities, Asia and North America have the best results, with 59 and 25 cities shortlisted respectively, accounting for 10.48% and 18.94% of their

Table 9.24 Top 10 global cities in human resources index

No.	City	Human resource index	Country	Continent
1	Tokyo	1.000	Japan	Asia
2	New York	0.977	USA	North America
3	Sao Paulo	0.915	Brazil	South America
4	Seoul	0.912	ROK	Asia
5	Beijing	0.858	China	Asia
6	Mexico City	0.846	Mexico	North America
7	Shenzhen	0.795	China	Asia
8	Dongguan	0.792	China	Asia
9	London	0.791	UK	Europe
10	Shanghai	0.779	China	Asia

Source City and competitiveness index database, CASS

corresponding sample cities, highlighting the urban development vitality of the two continents and the importance attached to the accumulation and cultivation of human resources. Other continents have fewer shortlisted cities. Specifically, Europe and South America each has five cities shortlisted, accounting for three. 94% and 6.76% of their corresponding sample cities. Africa and Oceania have three and two cities respectively entering the list of top 100 cities, accounting for 2.88% and 28.57% of their corresponding samples (Table 9.25).

The urban agglomerations of emerging economies have comparative advantages in human resources. Based on the scale of urban agglomerations, the research group has selected several important urban agglomerations of the United States, China, India, the UK, and Germany. The Northeast U.S., Bangalore of India, and China's Beijing-Tianjin-Hebei and Pearl River Delta urban agglomerations have outstanding advantages in human resources, with the human resources index of all above 0.41. But the human resources level of German urban agglomerations is low, with the index mean value of only 0.256. It reveals that in terms of human resources, cities of emerging economies have formed relative advantages both in the quantity and quality of labor force (Table 9.26).

9.4.2 The Distribution Pattern of Global Urban Human Resources Shows a Situation of China–U.S. Confrontation

The distribution pattern of global urban human resources shows a situation of China–U.S. confrontation. The distribution pattern of global urban human resources index level is greatly different from that of global urban economic competitiveness. A great number of cities with high human resources index are distributed not only in North America and Europe, but also in Asia and South

Table 9.25 The continental situation of human resources index and the proportion of top 100 cities

Scope	Number of samples	Mean value	Median	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	Maximum value		
							City	Index	World ranking
Asia	563	0.299	0.282	0.434	59	10.48	Tokyo	1.000	1
Europe	127	0.259	0.232	0.381	5	3.94	London	0.791	9
Africa	104	0.238	0.218	0.369	3	2.88	Cairo	0.586	39
Oceania	7	0.403	0.414	0.291	2	28.57	Sydney	0.531	67
North America	132	0.332	0.274	0.500	25	18.94	New York	0.977	2
South America	74	0.313	0.280	0.337	5	6.76	Sao Paulo	0.915	3

Source City and competitiveness index database, CASS

Table 9.26 Statistical comparison of human resources index between major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Mean value	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	No. 1 city	Index of no. 1 city	Ranking of no. 1 city	Index of last city	Ranking of last city	Mean value deducting the index of no. 1 city
Northeast U.S.	USA	11	0.516	0.542	7	63.64	New York	0.977	2	0.150	957	0.470
Midwest U.S.	USA	13	0.347	0.467	2	15.38	Chicago	0.731	16	0.189	869	0.315
London-Liverpool	UK	8	0.400	0.437	2	25.00	London	0.791	9	0.226	716	0.344
Yangtze River Delta	China	26	0.334	0.494	5	19.23	Shanghai	0.779	10	0.129	990	0.317
Pearl River Delta	China	13	0.464	0.400	6	46.15	Shenzhen	0.795	7	0.228	708	0.436
Beijing-Tianjin-Hebei	China	10	0.417	0.476	3	30.00	Beijing	0.858	5	0.221	751	0.368
Bangalore	India	5	0.477	0.249	3	60.00	Bangalore	0.628	27	0.328	257	0.439
Rhine-Ruhr	Germany	4	0.256	0.361	0	0.00	Hamburg	0.367	199	0.155	948	0.219

Source City and competitiveness index database, CASS

Fig. 9.8 Global urban human resources distribution. *Source* City and competitiveness index database, CASS

America. The results show that, the 4th industrial revolution featuring internet-based industry, industrial intelligence, and industrial integration is sweeping across the world. Cities of emerging market countries represented by China are gradually becoming the gathering place of global human resources, breaking the monopoly of traditional developed countries in high-quality human resources, which makes their cities more powerful in the international competition. But it is noteworthy that the human resources mentioned herein refer to human resources in the general sense rather than high-end talents. It should be noted that the competition for high-end talents by cities of developed countries is becoming a new trend, and the emerging market countries should take the initiative to address it to avoid a disadvantageous position in the competition (Fig. 9.8).

The human resources level has a significant positive effect on economic competitiveness. Through further examining the support of global cities' human resources to their economic competitiveness with the regression method, we find that, there exists significant linear positive correlation between the human resources index level and the economic competitiveness in main cities of the world, which shows that the level of human resources has significant positive effect on economic competitiveness of major cities of the world (Fig. 9.9).

The urban human resources level of member countries of BRICS and Asian Infrastructure Investment Bank (AIIB) is not inferior to that of G7. Further examining the human resources index statistics of global representative cities of international organizations, we find that, the mean value of urban human resources index of BRICS is slightly lower than the average level of G7 countries, and the gap between AIIB and G7 in the mean value of urban human resources index is even smaller. From the perspective of difference indicators, the cities' human resources differences of both BRICS and AIIB are significantly lower than those of G7,

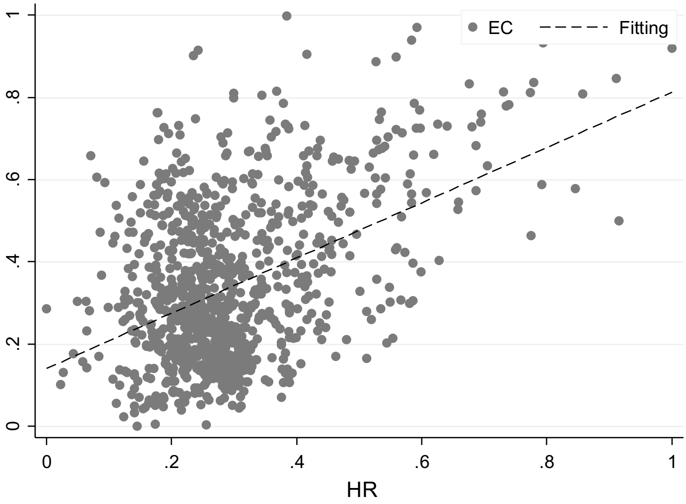


Fig. 9.9 The scatterplot and fitting of global urban economic competitiveness and human resources index

further verifying that the pattern of human resource allocation of global cities is undergoing great changes. It can be expected that against the background of floundering global economy, the uplift of human resources quantity and quality is playing an increasingly important role in promoting the economic competitiveness and the global industrial transformation. In a new era of innovative technology boosting the industrial revolution, cities of emerging economies represented by China, with the typical business mode of "Internet +", will bring new opportunities and momentum for the release of human resources (Tables 9.27 and 9.28).

Table 9.27 Global urban human resources index: international organizations

Scope	Sample size	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
BRICS	463	0.294	0.280	0.124	0.422	0.217	0.084
G7	141	0.318	0.252	0.186	0.585	0.304	0.150
AIIB	730	0.301	0.279	0.125	0.415	0.215	0.080

Source City and competitiveness index database, CASS

Table 9.28 Comparison between urban human resources indexes of BRICS and G7

	Country	Sample	Number of top 100 cities	The proportion of top 100 cities (%)	Mean value	Variation coefficient	Maximum value		
							City	Index	World ranking
BRICS	China	292	33	11.30	0.284	0.478	Beijing	0.858	5
	Russia	33	1	3.03	0.244	0.248	Moscow	0.546	57
	India	100	7	7.00	0.317	0.269	Mumbai	0.776	11
	Brazil	32	2	6.25	0.331	0.390	Sao Paulo	0.915	3
	South Africa	6	2	33.33	0.433	0.210	Johannesburg	0.559	53
G7	UK	12	2	16.67	0.354	0.478	London	0.791	9
	France	9	0	0.00	0.202	0.314	Paris	0.345	222
	USA	75	18	24.00	0.344	0.563	New York	0.977	2
	Germany	13	0	0.00	0.261	0.355	Munich	0.417	134
	Italy	13	0	0.00	0.205	0.359	Rome	0.329	252
	Japan	10	2	20.00	0.272	1.094	Tokyo	1.000	1
	Canada	9	5	55.56	0.473	0.285	Toronto	0.695	19

Source City and competitiveness index database, CASS

9.5 Analysis of Global Urban Local Demand Index

9.5.1 The Local Demand Gap Between Cities in the Northern and Southern Hemispheres Is Prominent

i. **The overall pattern of local demand index of global cities**

The local demand levels of cities in the world are uneven, with a small number of cities occupying a huge share of demand. The local demand index of global cities is obtained through calculating the total amount of urban disposable income of global cities and the standardized processing, which shows the scale of urban demand. The higher the index value, the higher local demand level of the city. According to the calculation, the mean value of local demand indexes of all sample cities is 0.427, and the median is 0.393. The number of cities with the index lower than the mean value has reached 572, accounting for more than 56.8% of the sample cities, reflecting that the world's local demand is highly concentrated in cities of a few countries, thus resulting in an overall low-level index. Through further examining the statistical indicators of the degree of global cities' local demand differences, we find that, the standard deviation of global cities' local demand is 0.167, the coefficient of variation is 0.391, the Gini coefficient is 0.220, the Theil index is 0.076, showing that the local demand between cities have certain differences (Table 9.29).

Of the top ten cities, half of them are from North America, followed by Asia and Europe. According to calculation, in the global cities' local demand index ranking, the top five cities were New York, Tokyo, Los Angeles, London, and Osaka. New York ranked first in the top 10 cities. Five cities were from North America, accounting for half of the top ten cities. Three cities were from Asia, constituting a large proportion. Two cities from Europe—London and Paris—were shortlisted, and the remaining continents had no city on the list. The results show that the economic base of North American cities is still strong, and the accumulation of wealth over the years has created huge market demand of local areas, so they have occupied the largest share of the world market. European cities, due to the over-burden of welfare in recent years, the sluggish economic growth and other institutional and structural factors, have seen a decline in local market demand. With the development in recent years, Asian cities have achieved accelerated development and rapid catch-up, and the local demand is gaining a more and more

Table 9.29 The local demand index of global cities: global cities

Scope	Sample size	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Global cities	1007	0.427	0.393	0.167	0.391	0.220	0.076

Source City and competitiveness index database, CASS

Table 9.30 Top 10 global cities in local demand index

No.	City	Local demand index	Country	Continent
1	New York	1.000	USA	North America
2	Tokyo	0.958	Japan	Asia
3	Los Angeles	0.935	USA	North America
4	London	0.918	UK	Europe
5	Osaka	0.907	Japan	Asia
6	Chicago	0.896	USA	North America
7	Paris	0.888	France	Europe
8	Seoul	0.879	ROK	Asia
9	Washington DC	0.868	USA	North America
10	Houston	0.861	USA	North America

Source City and competitiveness index database, CASS

important position in the world's market. From the national perspective, the United States had five cities entering the list of top ten global cities in local demand, two cities of Japan were shortlisted, and the UK, France and the Republic of Korea each had one city selected. New York and Tokyo were the top two cities: particularly, the local demand index of New York was higher than that of Tokyo which ranked second, far higher than that of other cities. This indicates that, as the world's economic hegemon, the United States is far ahead of other countries in the market and local demand of cities. The former world economic hegemon—the UK—has already fallen behind Japan in local demand. But meanwhile, we should see that, the world's largest continent Asia has such three cities as Tokyo, Osaka, and Seoul entering the list of top ten global cities, indicating that the local demand of some cities in Asia is increasing rapidly, gradually matching its economic strength and status in the world (Table 9.30).

At the continental level, the local demand gap between cities in the northern and southern hemispheres is prominent. Europe, North America, Oceania, and South America are leading in the world's local demand ranking, with the mean value and median of local demand higher than the world average level. The mean value and median of local demand in Asia and Africa are slightly lower than the world average. From the continental distribution of top 100 global cities in local demand index, North America and Europe have the best results, with 43 and 23 cities entering the list respectively, accounting for 32.58% and 18.11% of their corresponding sample cities. Asia has the most sample cities, accounting for more than half of all sample cities. However, only 20 Asian cities have entered the global 100 cities list, with a proportion of 3.55%. Therefore, from the number of cities entering the list of top 100 cities, the important nodes of local demand in the world are concentrated in the northern hemisphere. By contrast, the southern hemisphere is relatively backward. South America, Oceania and Africa have seven cities, four cities and two cities on the list respectively, accounting for 9.46%, 57.14% and 1.92% of their corresponding samples, falling behind in the ranking of quantities (Table 9.31).

Table 9.31 The continental situation of local demand index and the proportion of top 100 cities

Scope	Sample size	Mean value	Median	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	Maximum value		
							City	Index	World ranking
Asia	563	0.372	0.338	0.375	20	3.55	Tokyo	0.958	2
Europe	127	0.530	0.537	0.260	23	18.11	London	0.918	4
Africa	104	0.325	0.312	0.430	2	1.92	Cairo	0.716	57
Oceania	7	0.669	0.682	0.130	4	57.14	Sydney	0.783	28
North America	132	0.603	0.608	0.246	43	32.58	New York	1.000	1
South America	74	0.478	0.463	0.247	7	9.46	Buenos Aires	0.805	19

Source City and competitiveness index database, CASS

The urban agglomerations in developed economies have strong demand, while the concentrated demand in urban agglomerations of emerging economies is prominent. Based on the size of urban agglomeration, the research group has selected several important urban agglomerations of the China, United States, India, UK, and Germany. The local demand levels of urban agglomerations of the United States, Germany and the UK are significantly higher, with the mean value of urban local demand indexes above 0.6 and at an even level, indicating that the urban agglomerations of traditional developed countries still have huge local demand. Although the urban agglomerations of emerging economies such as China and India are large in scale and contain a great number of cities, the local demand is mainly concentrated in central cities, while the demand level is low in many other cities, so the coefficient of variation is large. In contrast, the city development of two major urban agglomerations in the United States is relatively balanced. The central cities Chicago and New York have the leading global demand, compared with which, the local demand indexes of other cities have not seen great difference. The local demand indexes of urban agglomerations of China and India show an obvious central—periphery mode: central cities have remarkable local demand, the gap between central cities and other cities is very large, and there is a certain degree of imbalance in local demand of urban agglomerations (Table 9.32).

9.5.2 The Spatial Agglomeration Effect of Local Demand in Global Cities Is Obvious, Highlighting the Importance of the Development of Urban Agglomerations

ii. **Important patterns and discoveries of global cities' local demand**

The spatial agglomeration effect of local demand in global cities is obvious, highlighting the importance of the development of urban agglomerations. According to analysis, the Moran's I index is 0.5569, and the P value is smaller than 0.0001, which is significantly positive, indicating remarkable positive spatial autocorrelation between the local demand of 1007 global cities: the local demand of adjacent cities shows positive spillover effect. The higher the local demand of a city, the higher the local demand of its surrounding cities, and the spatial agglomeration effect of urban demand is conspicuous. The above pattern is also verified in the Moran scatter diagram: most cities are clustered in the first and three quadrants, showing a positive spatial autocorrelation of urban competitiveness. Because of the spillover effect of adjacent cities, it can better raise the overall local demand level of cities when developing the economy with urban agglomeration as a unit, thus avoiding the negative effects of a single city on its surrounding ones in the development (Figs. 9.10 and 9.11).

The echelon effect of local demand index of global cities is obvious, with differentiation existing in cities of some tiers. Based on the city tiers, 1007 cities

Table 9.32 Statistical comparison of local demand index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Mean value	Variation coefficient	Number of top 100 cities	No. 1 city (%)	Index of No. 1 city	Ranking of No. 1 city	Index of last city	Ranking of last city	Mean value deducting the index of No. 1 city
Northeast U.S.	USA	11	0.763	0.149	9	81.82	New York	1.000	1	0.636	135
Midwest U.S.	USA	13	0.708	0.122	9	69.23	Chicago	0.896	6	0.585	202
London-Liverpool	UK	8	0.655	0.180	3	37.50	London	0.918	4	0.565	224
Yangtze River Delta	China	26	0.442	0.303	1	3.85	Shanghai	0.798	23	0.245	916
Pearl River Delta	China	13	0.462	0.391	2	15.38	Shenzhen	0.712	63	0.196	984
Beijing-Tianjin-Hebei	China	10	0.448	0.353	1	10.00	Beijing	0.771	32	0.303	761
Bangalore	India	5	0.460	0.133	0	0.00	Bangalore	0.521	292	0.380	552
Rhine-Ruhr	Germany	4	0.643	0.120	2	50.00	Hamburg	0.715	58	0.535	275

Source City and competitiveness index database, CASS

Fig. 9.10 Moran

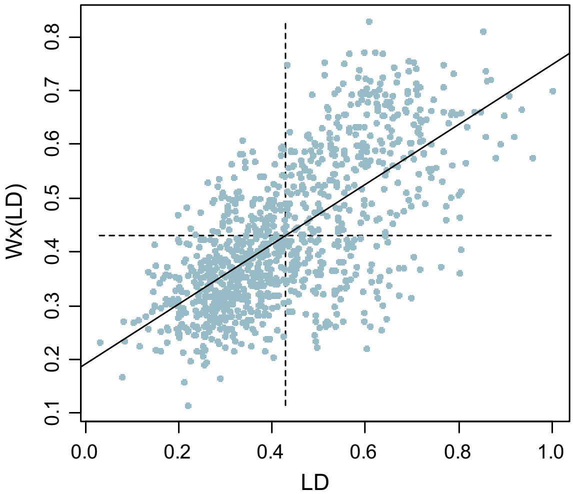
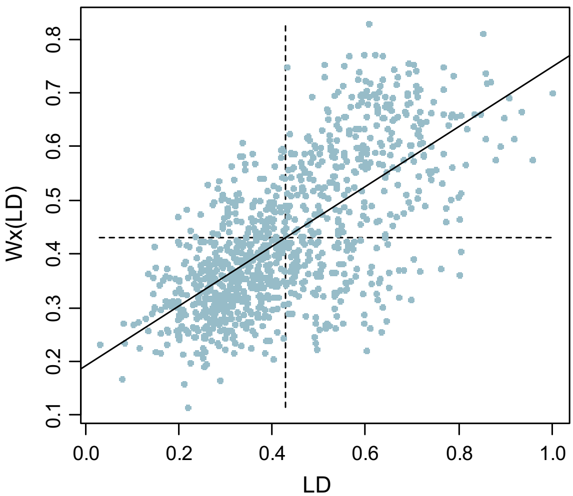


Fig. 9.11 Global cities' local demand index: Moran scatter diagram. *Source* City and competitiveness index database, CASS



are divided into 10 groups. It is found through examining the statistical indicators of local demand indexes of each group of cities that, the local demand of tier-one cities is the highest with the mean value of 0.959, 20% higher than the mean value of tier-two cities which is 0.784, while the mean value of tier-three cities is slightly higher than that of tier-two cities. Further examining the statistical indicators which

Table 9.33 Statistical indicators of local demand index for different tiers of cities

New tier	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
1	2	0.959	0.959	0.058	0.061	0.021	0.001
2	5	0.784	0.815	0.152	0.194	0.090	0.016
3	16	0.805	0.822	0.094	0.117	0.063	0.007
4	11	0.746	0.739	0.079	0.105	0.057	0.005
5	11	0.720	0.712	0.064	0.088	0.046	0.004
6	36	0.702	0.707	0.067	0.095	0.050	0.004
7	55	0.654	0.652	0.056	0.086	0.048	0.004
8	96	0.587	0.587	0.062	0.105	0.059	0.005
9	388	0.425	0.424	0.096	0.226	0.128	0.026
10	387	0.292	0.290	0.086	0.294	0.161	0.044

Source City and competitiveness index database, CASS

reflect differences, we find that the difference between the local demand indexes of lower-tier cities is larger, while the difference in the local demand indexes of higher-tier cities is smaller. The results show there exists certain differentiation in the local demand index differences of different tiers of cities (Table 9.33).

The pattern of local demand driving up economic competitiveness in the global cities begins to show up. Examining the effect of global cities' local demand on their economic competitiveness through the regression method, we find that, there exists significant linear positive correlation between the local demand index level and the economic competitiveness in main cities of the world, which shows that the level of local demand has significant positive effect on economic competitiveness in major cities of the world. The results show that the market demand is an important factor driving the economic competitiveness, but also reflect the new trend of global economic development, which is, more and more high-end industries are making use of technology including intelligent manufacturing and digital simulation brought by the 4th industrial revolution to select areas closer to the local demand of consumer market. The interaction between the market and industry leads to that cities with higher levels of local demand have greater economic competitiveness. This trend brings remarkable opportunities and challenges to cities of emerging economies. On the one hand, it is hard for the cities to sustain the traditional mode of promoting economy through low labor cost and export growth; on the other hand, the cities of emerging economies will have new opportunities for economic growth by making good use of the huge domestic consumer market to promote industrial upgrading and economic transformation (Fig. 9.12).

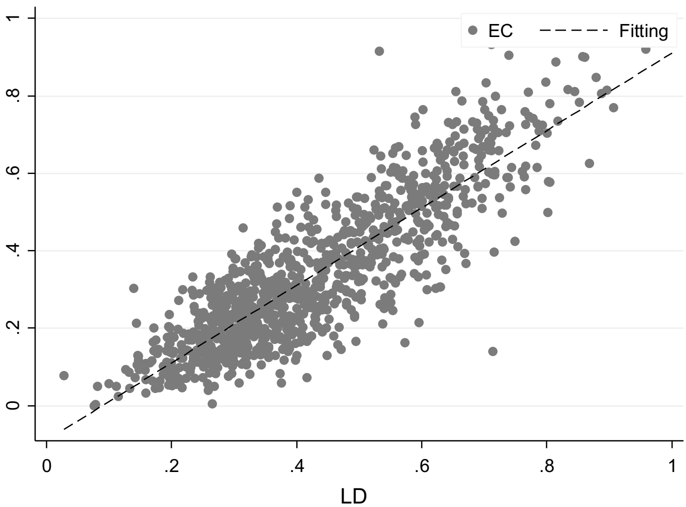


Fig. 9.12 The scatterplot and fitting of global urban economic competitiveness and local demand index

9.6 Analysis of Global Urban Business Cost Index

9.6.1 European and North American Cities Are Leading in Business Cost, While Cities of Asia and South America Are Relatively Backward

i. **The overall pattern of business cost indexes of primate cities of countries in the world**

The overall business cost level of primate cities in the world needs to be improved, and the cost of a small number of cities is low. The global urban business cost index is formed through direction adjustment, weighted calculation and standardized processing of such three secondary indexes as the global urban loan interest rate, the proportion of tax revenue in GDP, the ratio of per capita income to standard hotel rate. The larger the index value, the lower the urban business cost. As the index data adopted follows the national standard, this article mainly probes the statistics of business costs of the primate cities of 138 representative countries. According to the calculation, the mean value of business cost indexes of the primate cities of global representative countries is 0.462 and the median is 0.443, reflecting the cost of business activities in the world is highly concentrated in cities of some countries, thus resulting in that the overall index level is not high. Further examining the statistical indicators of the degree of global urban business cost differences, we find that, the standard deviation of global urban business cost is 0.162, the coefficient of variation is 0.351, the Gini coefficient is

Table 9.34 The business cost index of the primate cities in the world's representative countries: global cities

Scope	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Primate cities	138	0.462	0.443	0.162	0.351	0.193	0.058

Source City and competitiveness index database, CASS

0.193, and the Theil index is 0.058, showing that the business cost between cities have certain differences (Table 9.34).

Among the top 10 cities, Abu Dhabi ranks first and five European cities are shortlisted. According to calculation, the top five global cities in business cost index in 2016 were Abu Dhabi, Berlin, Guatemala City, Amman, and Moscow. In the top 10 cities, Abu Dhabi ranked first, five European cities were shortlisted, occupying half of the cities, three Asian cities entered the list, North America and Oceania each had one city on the list, and other continent had no city listed. The results show that as traditional economic developed areas, European cities have always attached importance to the construction and improvement of the business environment, so many cities are forefront in the ranking. Meanwhile, Asian cities, especially those in Central Asia and West Asia, are actively seeking innovation and breakthrough in aspects of loan, tax, the business cost, etc. to gradually build a world-leading business environment, and this is what should be learned by emerging economies represented by BRICS (Table 9.35).

Table 9.35 The top 10 primate cities in the world's representative countries in business cost index

No.	City	Business cost index	Country	Continent
1	Abu Dhabi	0.918	The United Arab Emirates	Asia
2	Berlin	0.917	Germany	Europe
3	Guatemala City	0.857	Guatemala	North America
4	Amman	0.829	Jordan	Asia
5	Moscow	0.805	Russia	Europe
6	Budapest	0.778	Hungary	Europe
7	Sydney	0.768	Australia	Oceania
8	Ashkhabad	0.762	Turkmenistan	Asia
9	Zurich	0.749	Switzerland	Europe
10	Vienna	0.713	Austria	Europe

Source City and competitiveness index database, CASS

At the continental level, European and North American cities are leading in business cost, while cities of Asia and South America are relatively backward. Continental comparison shows that the urban business costs of Europe, Oceania, and North America are leading, with the median of business cost slightly higher than the world average. However, the mean value and median of business cost in Asia, South America, and Africa are slightly lower than the world average. From the continental distribution of top 50 global cities in the business cost index, Europe and Asia have the best results, with 19 and 18 cities respectively entering the world's top 50 cities list, accounting for 67.86% and 41.86% of their corresponding sample cities. Other continents have fewer shortlisted cities. Specifically, South America and North America have six and four cities shortlisted respectively, accounting for 42.86% and 40.00% of their corresponding sample cities. Africa and Oceania have two cities and one city respectively entering the list of top 50 cities, accounting for 4.88% and 50.00% of their corresponding samples (Table 9.36).

9.6.2 Reducing the Business Cost Is an Important Way for Cities in Emerging Economies to Catch up

ii. **Important patterns and discoveries of global urban business cost**

Reducing the business cost is an important way for cities in emerging economies to catch up. Through the business environment index statistics of global representative cities of international organizations, it is found that, the mean value of urban business environment index of BRICS and AIIB member countries is obviously lower than the average level of G7 countries, and the gap between AIIB member countries and G7 in the mean value of urban business environment index is even smaller. From the perspective of differential indicators, the cities' business environment differences of both BRICS and AIIB are significantly higher than those of G7. This indicates that cities of emerging economies represented by BRICS need to improve the business environment and innovation environment through accelerating institutional and legal guarantees, so as to effectively reduce the market operation cost and the burden of enterprises, and improve operational efficiency and international competitiveness, which is an important way for cities of emerging economies to attain their own development and catch up with and surpass developed countries (Table 9.37).

Making efforts to reduce the business cost and improve its coordination with economic competitiveness (measured by per capita GDP) is important to promote the economic development of backward cities. From the correlation between the business cost index and economic competitiveness of the primate cities of 138 representative countries, it is found that, there exists significant linear positive correlation between the two, showing that the business cost level of major cities in the world has a linear positive stimulating effect on their economic competitiveness (Figure 9.13).

Table 9.36 The continental business cost index of the primate cities in the world's representative countries and the proportion of top 50 global cities

Scope	Sample size	Mean value	Median	Variation coefficient	Number of top 50 cities	The proportion of top 50 cities (%)	Maximum value		
							City	Index	World ranking
Asia	43	0.486	0.461	0.323	18	41.86	Abu Dhabi	0.918	1
Europe	28	0.576	0.591	0.266	19	67.86	Berlin	0.917	2
Africa	41	0.351	0.370	0.301	2	4.88	Lagos	0.527	42
Oceania	2	0.620	0.620	0.338	1	50.00	Sydney	0.768	7
North America	14	0.489	0.434	0.332	6	42.86	Guatemala City	0.857	3
South America	10	0.424	0.454	0.280	4	40.00	Santa Cruz	0.566	35

Source City and competitiveness index database, CASS

Table 9.37 The business cost index of the primate cities in global representative countries: international organizations

Scope	Sample size	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
BRICS	7	0.487	0.553	0.218	0.447	0.228	0.094
G7	7	0.635	0.651	0.149	0.235	0.116	0.023
AIIB	35	0.499	0.461	0.171	0.342	0.188	0.056

Source City and competitiveness index database, CASS

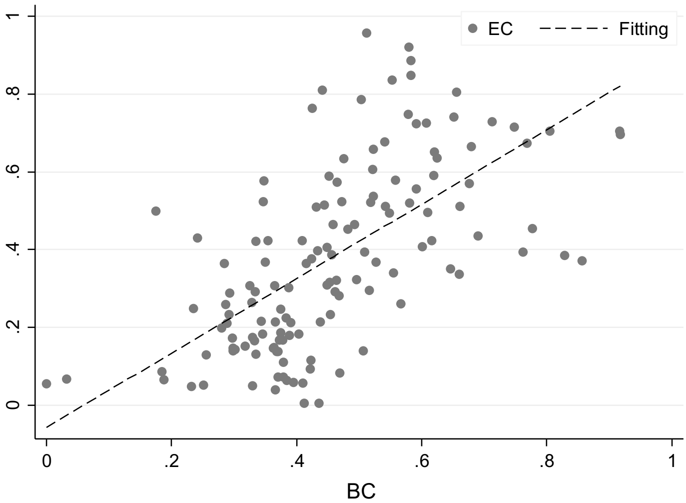


Fig. 9.13 The scatterplot and fitting of economic competitiveness and business cost index of global representative cities. *Source* City and competitiveness index database, CASS

There are problems of imbalanced development between the financial service and economic competitiveness in the world's cities. According to relevant statistics on the coupling coordination of the economic competitiveness and the business cost of the 1007 sample cities globally, the coupling coordination mean value and median of the economic competitiveness and the business cost of the cities are 0.330 and 0.318 respectively, indicating a slightly imbalanced state. As for the top ten cities in economic competitiveness, the mean value and median of the coupling coordination degree are 0.563 and 0.555 respectively, indicating that they are in a barely coordinated state of economic competitiveness and business environment.

As for the cities ranking from 11 to 20 in economic competitiveness, the mean value and median of the coupling coordination degree are 0.541 and 0.535 respectively, also indicating that they are in a barely coordinated state.

Table 9.38 The coupling coordination degree of the primate cities of global representative countries: economic competitiveness and business cost index

With Business cost ranking	Mean value	Median	Standard deviation	Variation coefficient	Interpretation
1–10	0.617	0.609	0.017	0.027	Primary level coordination
11–20	0.582	0.582	0.011	0.019	Barely coordinated
21–50	0.527	0.527	0.019	0.037	Barely coordinated
51–100	0.424	0.430	0.041	0.096	On the verge of imbalance
101–138	0.289	0.320	0.075	0.259	Moderate imbalance
1–138	0.435	0.441	0.118	0.273	On the verge of imbalance

Source City and competitiveness index database, CASS

As for the cities ranking from 21 to 200, the cities ranking from 201 to 300, and the cities ranking from 501 to 1007 in economic competitiveness, there are in the states of on the verge of imbalance, slight imbalance and moderate imbalance respectively.

Generally speaking, the economic competitiveness index and financial service index of the 1007 sample cities appear to be slightly imbalanced, and as the level of economic competitiveness decreases, the imbalance states of the cities are more severe. Therefore, in order to make the financial service more positively effectively, improvements should be made in the aspect of financial service for cities all over the world (Table 9.38).

9.7 Analysis of Global Urban Business Environment Index

9.7.1 The Overall Business Environment of Global Primate Cities Is Good, but There Are Big Differences Between Cities

i. **The overall pattern of global urban business environment index**

The overall business environment of global primate cities is good, but there are big differences between cities. The global urban business environment index is formed through weighted calculation and standardized processing of such secondary indicators as the ease of doing business and market liberalization. The higher the index value, the higher the urban business environment level. Since the

Table 9.39 The business environment index of the primate cities in the world's representative countries: global cities

Scope	Sample size	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Primate cities	138	0.596	0.640	0.203	0.340	0.191	0.059

Source City and competitiveness index database, CASS

index data adopted follows the national standard, this article mainly probes the statistics of business environment in the primate cities of 138 representative countries. According to the calculation, the mean value of business environment index of the primate cities of global representative countries is 0.596 and the median is 0.640. The overall urban business environment index is at the medium-low level. Through further examining the statistical indicators of the degree of global urban business environment differences, we find that, the standard deviation of global urban business environment is 0.203, the coefficient of variation is 0.340, the Gini coefficient is 0.191, and the Theil index is 0.059, showing that the business environment between cities has great differences (Table 9.39).

Among the top 10 cities, Hong Kong ranked first and five European cities were shortlisted. According to calculation, in 2016, in the world's ranking of business environment index of the primate cities of 138 representative countries, Hong Kong, Singapore, Oakland ranked the top three respectively. In the top 10 cities, five European cities were shortlisted, occupying half of the cities, Asia and Oceania each had two cities on the list, North America had one city shortlisted, and the other continent had no city entering the list. The results show that although the traditional developed cities in North America and Europe have considerable experience in the construction of business environment, but some cities in Asia, Oceania and other late-developing areas are gradually catching up or becoming leading in the business environment. They have made great progress in both the ease of doing business and market liberalization and are taking a world leading position, thus providing good support for the economic competitiveness. But at the same time, we should see that the construction of business environment is of long-term and cumulative nature, which should be paid attention to by cities of emerging economies and is proven by that many cities of Europe have entered the list of top ten cities (Table 9.40).

At the continental level, the urban business environment of the northern hemisphere is superior, while Asia is at a middle level. Europe, North America and Oceania are leading in the world's business environment ranking, with the mean value and median of business environment higher than the world average level. The mean value of business environment of Asia and Africa is slightly lower than the world average, and the median of Asian business environment is on a par with that of the world level. As to the continental distribution of top 50 global cities in the business environment index, Europe and Asia have the best results, with 24 and 14 cities entering the world's top 50 cities list respectively, accounting for

Table 9.40 The top 10 of the primate cities in global representative countries in business environment index

No.	City	Business environment index	Country	Continent
1	Hong Kong	1.000	China	Asia
2	Singapore	0.991	Singapore	Asia
3	Auckland	0.966	New Zealand	Oceania
4	Sydney	0.899	Australia	Oceania
5	London	0.880	UK	Europe
6	Copenhagen	0.878	Denmark	Europe
7	Zurich	0.877	Switzerland	Europe
8	New York	0.870	USA	North America
9	Helsinki	0.863	Finland	Europe
10	Oslo	0.858	Norway	Europe

Source City and competitiveness index database, CASS

85.71% and 32.56% of their corresponding sample cities. A total of seven cities in North America are shortlisted, accounting for 50% of the samples, which is a good result. It can be seen that, cities with a better business environment are mainly concentrated in the northern hemisphere, while cities in the southern hemisphere are relatively backward. Specifically, Oceania and South America each has two shortlisted cities, accounting for 100% and 20% of their corresponding samples respectively (the number of Oceanian sample cities is small), and only 1 African city has entered the list of top 50 cities, with a proportion of 2.44%, which is relatively low (Table 9.41).

9.7.2 The Key for Emerging Economies to Catch up and Take the Lead Is to Play the Positive Stimulating Role of Business Environment in Economic Competitiveness

ii. **Important patterns and discoveries of global urban business environment**

The key for emerging economies to catch up and take the lead is to play the positive stimulating role of business environment in economic competitiveness. Examining the correlation between the business environment index and economic competitiveness of the primate cities of 138 representative countries, we find that, there exists significant linear positive correlation between the two, showing that the business environment level of major cities in the world has linear positive promotion effect on their economic competitiveness (Fig. 9.14).

Further examining the urban business environment differences of G7, BRICS and AIIB, we find that, the mean value and median of urban business environment

Table 9.41 The continental business environment index of the primate cities in global representative countries and the proportion of top 50 global cities

Scope	Sample size	Mean value	Median	Variation coefficient	Number of top 50 cities	The proportion of top 50 cities (%)	Maximum value		
							City	Index	World ranking
Asia	43	0.605	0.639	0.318	14	32.56	Hong Kong	1.000	1
Europe	28	0.766	0.776	0.129	24	85.71	London	0.880	5
Africa	41	0.442	0.470	0.347	1	2.44	Kigali	0.710	42
Oceania	2	0.933	0.933	0.051	2	100.00	Auckland	0.966	3
North America	14	0.634	0.686	0.340	7	50.00	New York	0.870	8
South America	10	0.586	0.587	0.281	2	20.00	San Diego	0.802	22

Source City and competitiveness index database, CASS

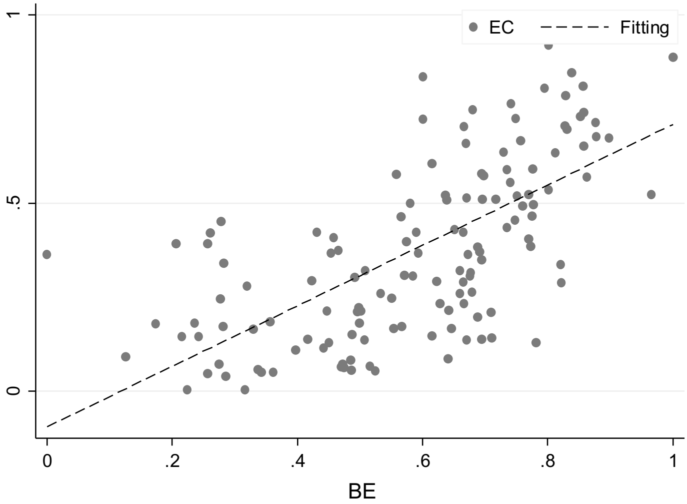


Fig. 9.14 The scatterplot and fitting of economic competitiveness and business environment index of the primate cities of representative countries. *Source* City and competitiveness index database, CASS

index of BRICS and AIIB are significantly lower than those of G7, indicating that cities of developed countries are generally ahead of emerging economies in business environment. From the perspective of indicators which reflect the differences between the cities' business environment, the difference between the BRICS cities is slightly smaller than that between G7 cities, showing the ease of doing business and market liberalization of BRICS and developed countries have no obvious difference. But it is noteworthy that the difference between AIIB cities is obviously higher than that between G7 cities, which indicates that during the implementation of the Belt and Road Initiative, we should pay attention to institutional differences of cities, start from urban agglomerations with similar business environment to improve the business environment as well as economic competitiveness of surrounding cities with large differences (Table 9.42).

Table 9.42 The business environment index of the primate cities in global representative countries: international organizations

Scope	Sample size	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
BRICS	7	0.667	0.601	0.151	0.227	0.093	0.020
G7	7	0.824	0.828	0.051	0.062	0.032	0.002
AIIB	35	0.661	0.666	0.176	0.266	0.144	0.037

Source City and competitiveness index database, CASS

9.8 Analysis of Global Urban Infrastructure Index

9.8.1 Top 100 Global Cities in Infrastructure Are Concentrated in Asia, Europe and North America

i. **The overall pattern of global urban infrastructure index**

The infrastructure is highly concentrated in cities in a few countries, and there are some differences between the cities. The global urban infrastructure index is concluded through the direction adjustment, weighted calculation and standardized processing of such three secondary indicators as shipping convenience, aviation convenience, and the number of broadband users. The higher the indicator value, the higher the urban infrastructure level. According to the calculation, the mean value of infrastructure indexes of all sample cities is 0.493, and the median is 0.491. The number of cities with the index lower than the mean value has reached 512, accounting for more than 50.8% of the sample cities, reflecting that the world's infrastructure is highly concentrated in cities of a few countries and the overall level needs to be improved. Further examining the statistical indicators of the degree of global urban infrastructure differences, it is found that, the standard deviation of global urban infrastructure is 0.129, the coefficient of variation is 0.262, the Gini coefficient is 0.141, and the Theil index is 0.035, showing that the infrastructure between cities has certain difference (Table 9.43).

From the histogram and kernel density distribution, we can see more clearly the distribution characteristics of infrastructure index of global cities: the overall infrastructure index of global cities is approximately following normal distribution. But meanwhile, the mean value is at a medium level, which indicates that the infrastructure construction of many cities needs to be enhanced (Fig. 9.15).

Among the top ten cities, European cities ranked the first, followed by Asian and North American cities. According to calculation, in the global urban infrastructure index ranking in 2016, the top three were Paris, Istanbul, and Beijing. In the top 10 cities, five cities were from Europe, including Paris (No. 1), London (No. 5), Frankfurt (No. 7), Amsterdam (No. 8), and Moscow (No. 9), three cities were from Asia, two cities were from North America, and the other continents had no city shortlisted. At the national level, the United States and China had two cities shortlisted respectively, i.e., Beijing (No. 3), Shanghai (No. 6), New York (No. 4), and Atlanta (No. 10), and other countries each had one city shortlisted for the top

Table 9.43 Global urban infrastructure index: global cities

Scope	Sample size	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Global cities	1007	0.493	0.491	0.129	0.262	0.141	0.035

Source City and competitiveness index database, CASS

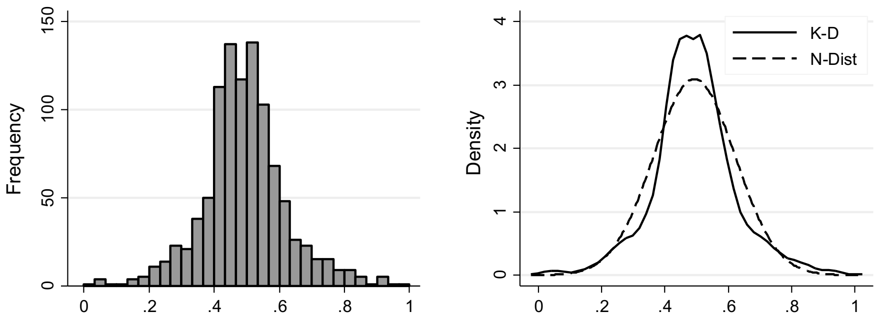


Fig. 9.15 Global urban infrastructure index: histogram and kernel density. *Source* City and competitiveness index database, CASS

ten. The results show that in terms of transportation and communication infrastructure, Europe and North America have had huge construction, with many cities at the world-leading position. At the same time, cities of emerging economies represented by China are attaching great importance to shipping, aviation, communications, and other infrastructure construction in the process of economic development, and therefore, more and more cities are surpassing traditional economic powers in infrastructure construction and becoming world leaders (Table 9.44).

At the continental level, the top 100 global cities in infrastructure are concentrated in Asia, Europe and North America. In the continental urban infrastructure ranking, Asia, Europe, and North America are in the lead, with both the mean value and the median higher than the world average level. The mean value and median of infrastructure in Africa and South America are slightly lower than the world average level. In the continental distribution of top 100 cities in infrastructure index, Asia, Europe and North America have the best results, with 32, 33

Table 9.44 Top 10 global cities in infrastructure index

No.	City	Infrastructure index	Country	Continent
1	Paris	1.000	France	Europe
2	Istanbul	0.945	Turkey	Asia
3	Beijing	0.924	China	Asia
4	New York	0.919	USA	North America
5	London	0.915	UK	Europe
6	Shanghai	0.906	China	Asia
7	Frankfurt	0.902	Germany	Europe
8	Amsterdam	0.869	Netherlands	Europe
9	Moscow	0.860	Russia	Europe
10	Atlanta	0.857	USA	North America

Source City and competitiveness index database, CASS

and 22 cities on the list respectively, accounting for 5.68%, 25.98% and 16.67% of their corresponding sample cities. Therefore, the number of cities on the top 100 cities list shows that cities with higher infrastructure levels are mainly concentrated in the northern hemisphere. In contrast, the southern hemisphere is relatively backward. Oceania had two cities shortlisted, with a proportion of 28.57%. South America and Africa each had only one city shortlisted, accounting for 1.35% and 0.96% respectively of their corresponding samples, and the ranking was relatively backward (Table 9.45).

Both developed countries and emerging economies have attached great importance to infrastructure construction. According to the urban agglomeration scale, the research group has selected several important urban agglomerations of the United States, China, India, UK, Germany, and through calculation, it is found that the infrastructure level of urban agglomerations of both developed countries and emerging economies is generally high, with the highest mean value in Rhine-Ruhr urban agglomeration which is 0.701, and the lowest mean value in Indian Bangalore urban agglomeration which is 0.517. Viewed from the coefficient of variation, the differences of the above urban agglomerations is not big. Specifically, China's Beijing-Tianjin-Hebei urban agglomeration has the largest variation coefficient, while Bangalore urban agglomeration of India has the smallest variation coefficient. Obviously, increasing investment in infrastructure construction has become the consensus of the world's major urban agglomerations. Meanwhile, the urban agglomerations of emerging economies, compared with those of developed countries, have no disadvantages in infrastructure (Table 9.46).

9.8.2 There Exists Spatial Agglomeration of Infrastructure for Global Cities

Moran's I Moran's I 0.6713p0.00011007

ii. **Important patterns and discoveries of global urban infrastructure**

The characteristics of infrastructure lead to that the infrastructure levels of adjacent cities are close. According to the analysis results, the index of Moran's I is 0.6713, and the P value is smaller than 0.0001, which is significantly positive. It indicates that the infrastructure of 1007 cities has significant positive spatial autocorrelation. Around a city with higher level of infrastructure, the levels of other cities are also high: there exists positive spillover effect between infrastructure levels of adjacent cities. First, it can be seen from the diagram that most cities are clustered in the first and three quadrants featuring positive auto-correlation, and the positive correlation is significant. This phenomenon is of great significance in guiding the improvement of urban economic competitiveness. Attention should be paid to the spatial spillover effect and the mutual interaction of adjacent cities. Especially for infrastructure represented by shipping, air transportation and

Table 9.45 The continental urban infrastructure index and the proportion of top 100 cities

Scope	Sample size	Mean value	Median	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	Maximum value		
							City	Index	World ranking
Asia	563	0.499	0.491	0.190	32	5.68	Istanbul	0.945	2
Europe	127	0.579	0.587	0.253	33	25.98	Paris	1.000	1
Africa	104	0.326	0.314	0.416	1	0.96	Cairo	0.666	95
Oceania	7	0.567	0.581	0.206	2	28.57	Sydney	0.703	64
North America	132	0.548	0.526	0.206	22	16.67	New York	0.919	4
South America	74	0.431	0.440	0.238	1	1.35	Buenos Aires	0.702	66

Source City and competitiveness index database, CASS

Table 9.46 Statistical comparison of infrastructure index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Mean value	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	No. 1 city	Index of no. 1 city	Ranking of no. 1 city	Index of last city	Ranking of last city	Mean value deducting the index of no. 1 city
Northeast U.S.	USA	11	0.653	0.184	4	36.36	New York	0.919	4	0.539	323	0.626
Midwest U.S.	USA	13	0.560	0.157	2	15.38	Chicago	0.788	25	0.480	571	0.541
London-Liverpool	UK	8	0.688	0.155	4	50.00	London	0.915	5	0.596	174	0.655
Yangtze River Delta	China	26	0.580	0.144	3	11.54	Shanghai	0.906	6	0.496	501	0.567
Pearl River Delta	China	13	0.597	0.157	2	15.38	Guangzhou	0.817	19	0.491	523	0.579
Beijing-Tianjin-Hebei	China	10	0.617	0.210	3	30.00	Beijing	0.924	3	0.513	422	0.583
Bangalore	India	5	0.517	0.105	0	0.00	Chennai	0.579	216	0.460	630	0.501
Rhine-Ruhr	Germany	4	0.701	0.129	3	75.00	Dusseldorf	0.784	26	0.572	225	0.673

Source City and competitiveness index database, CASS

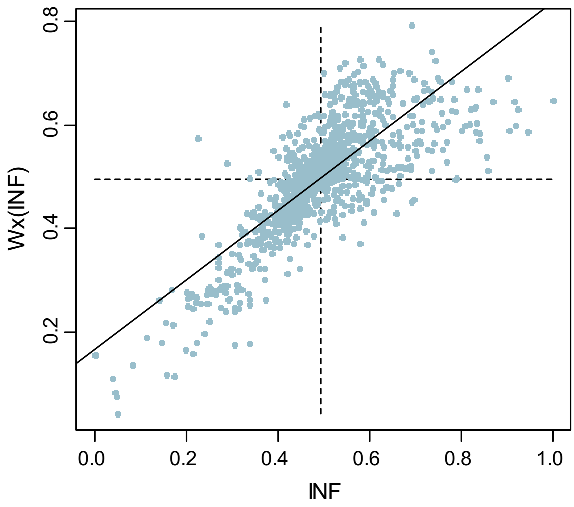


Fig. 9.16 Global urban infrastructure index: Moran scatter diagram. *Source* City and competitiveness index database, CASS

communications, the connectivity of adjacent cities will better exert the effects of network economy and mobilize the nodes of the network on a wider scale (Fig. 9.16).

The above patterns can also be found in the distribution of global urban infrastructure index. The high-level connectivity of urban agglomeration infrastructure of West Europe and North America has effectively supported the development of regional economy. However, emerging economies failed to achieve such connectivity, so they have not developed a high-level interconnected spatial network pattern in the infrastructure (Fig. 9.17).

Fig. 9.17 The distribution of global urban infrastructure index. *Source* City and competitiveness index database, CASS

The key for emerging economies to catch up and take the lead is to play the positive stimulating role of infrastructure in economic competitiveness. Through examining the support of global cities' infrastructure to their economic competitiveness, we find that, there exists significant linear positive correlation between the infrastructure index level and the economic competitiveness of main cities of the world, which shows that the infrastructure level of major cities in the world exerts significant linear positive promotion effect on their economic competitiveness (Fig. 9.18).

Further examining the infrastructure differences of cities of G7, BRICS and AIIB, we find that, the mean value of urban infrastructure index of BRICS and AIIB is significantly lower than that of G7, while the indicators that reflect the difference between cities are all higher than those of G7. The above results imply that, on the one hand, the infrastructure level differences are restrictive factors affecting emerging economies to catch up with developed economies, and on the other hand, the regional infrastructure development strategies represented by China's Belt and Road Initiative will have greater space for development, and the idea of promoting development with infrastructure will benefit many countries with relatively backward economic competitiveness (Tables 9.47 and 9.48).

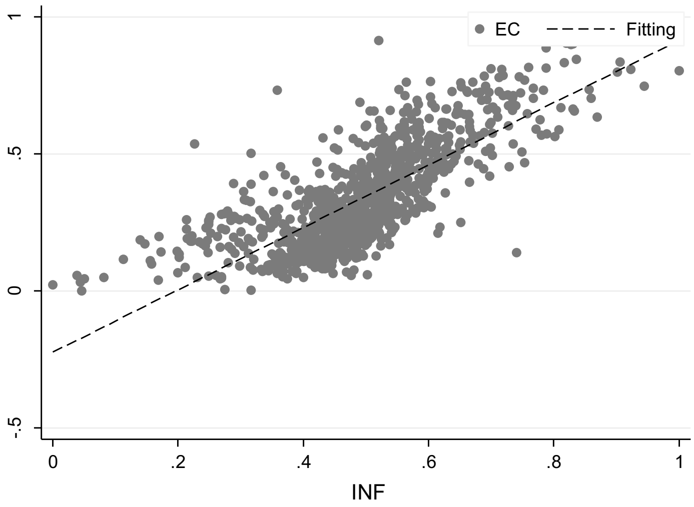


Fig. 9.18 The scatterplot and fitting of economic competitiveness and infrastructure index of global representative cities. *Source* City and competitiveness index database, CASS

Table 9.47 Global urban infrastructure index: international organizations

Scope	Sample size	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
BRICS	463	0.482	0.481	0.096	0.198	0.107	0.019
G7	141	0.614	0.584	0.116	0.189	0.101	0.017
AIIB	730	0.506	0.496	0.115	0.227	0.123	0.025

Source City and competitiveness index database, CASS

Table 9.48 Comparison between urban infrastructure indexes of BRICS and G7

	Country	Sample	Number of top 100 cities	The proportion of top 100 cities (%)	Mean value	Variation coefficient	Maximum value		
							City	Index	World ranking
BRICS	China	292	14	4.79	0.520	0.156	Beijing	0.924	3
	Russia	33	2	6.06	0.426	0.296	Moscow	0.860	9
	India	100	0	0.00	0.428	0.123	Mumbai	0.636	119
	Brazil	32	0	0.00	0.360	0.241	Sao Paulo	0.588	189
	South Africa	6	0	0.00	0.494	0.143	Johannesburg	0.608	153
G7	UK	12	4	33.33	0.660	0.145	London	0.915	5
	France	9	3	33.33	0.666	0.198	Paris	1.000	1
	USA	75	18	24.00	0.587	0.198	New York	0.919	4
	Germany	13	8	61.54	0.699	0.152	Frankfurt	0.902	7
	Italy	13	2	15.38	0.620	0.141	Rome	0.809	21
	Japan	10	2	20.00	0.609	0.175	Tokyo	0.839	11
	Canada	9	3	33.33	0.595	0.191	Toronto	0.768	30

Source City and competitiveness index database, CASS

9.9 Analysis of Global Urban Living Environment Index

9.9.1 More Than Half of the Top 100 Cities in Living Environment Are Concentrated in Asia

i. **The overall pattern of global urban living environment index**

The overall living environment of global cities is at a medium level, with differences between cities. The global urban living environment index is obtained through direction adjustment, weighted calculation and standardized processing of such secondary indicators as PM2.5 emission and crime rate. The higher the indicator value is, the better the urban living environment is. According to the calculation, the mean value of living environment indexes of all sample cities is 0.607 and the median is 0.635. The number of cities with the index lower than the mean value has reached 409, accounting for more than 40.6% of the sample cities, reflecting that the world's living environment is highly concentrated in cities of a few countries, thus resulting in an overall low-level index. Through further examining the statistical indicators of the global urban living environment differences, we find that, the standard deviation of global urban living environment is 0.144, the coefficient of variation is 0.237, the Gini coefficient is 0.129, and the Theil index is 0.030, showing that the living environment between cities has great differences (Table 9.49).

Among the top 20 cities, Sapporo ranks first and many Asian cities are at the forefront. According to calculation, in the global urban living environment index ranking for 2016, the top five were Sapporo, Nagoya, Osaka, Sendai and Kitakyushu–Fukuoka. Among the top 20 cities, 13 cities were from Asia, constituting an absolute majority, 5 cities including Munich were from Europe, and North America and Africa each had 1 city shortlisted, i.e., Quebec from Canada and Libreville from Gabon. No city of other continents entered the list of top 20 cities. The results show that, from the perspective of air quality and social security which reflect the social environment, East Asian countries, especially Japan, have distinct advantages globally, while cities of Germany also have a superior living environment, thus providing great support for the gathering of talents and the forming of innovation environment, which promotes the enhancement of economic competitiveness. It is noteworthy that, no city of emerging market countries represented by BRICS has entered the list of top ten. Obviously, the construction of living environment has yet to be strengthened (Table 9.50).

Table 9.49 Global urban living environment index: global cities

Scope	Sample size	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Global cities	1007	0.607	0.635	0.144	0.237	0.129	0.030

Source City and competitiveness index database, CASS

Table 9.50 Top ten global cities in living environment index

No.	City	Living Environment Index	Country	Continent	No.	City	Living Environment Index	Country	Continent
1	Sapporo	1.000	Japan	Asia	11	Shizuoka-Hamamatsu metropolitan area	0.889	Japan	Asia
2	Nagoya	0.974	Japan	Asia	12	Zurich	0.889	Switzerland	Europe
3	Osaka	0.933	Japan	Asia	13	Kwangju	0.885	ROK	Asia
4	Sendai	0.921	Japan	Asia	14	Niigata	0.883	Japan	Asia
5	Kitakyushu-Fukuoka metropolitan area	0.917	Japan	Asia	15	Stuttgart	0.882	Germany	Europe
6	Kumamoto	0.917	Japan	Asia	16	Omsk	0.880	Russia	Europe
7	Munich	0.910	Germany	Europe	17	Libreville	0.879	Gabon	Africa
8	Tokyo	0.899	Japan	Asia	18	Daegu	0.875	ROK	Asia
9	Dresden	0.894	Germany	Europe	19	Cheongju	0.873	ROK	Asia
10	Quebec	0.892	Canada	North America	20	Singapore	0.873	Singapore	Asia

Source City and competitiveness index database, CASS

At the continental level, more than half of the top 100 cities in living environment are concentrated in Asia. Oceania, Europe, and Asia are the top three in the ranking of urban living environment index, with the mean value and median of living environment higher than the world average level. The mean value and median of living environment of South America and Africa are slightly lower than the world average. The mean value of living environment of North America is higher than the world average level, but the median value of living environment of North America is slightly lower than the world average level.

In the continental distribution of living environment index of top 100 global cities, Asia had the best result, with a total of 55 cities shortlisted, accounting for 8.35% (the number of Asian sample cities was large), followed by Europe and North America which had 23 and 15 cities on the list, accounting for 18.11% and 11.36% respectively. Therefore, according to the number of cities on the top 100 cities list, cities with higher living environment levels are mainly in the northern hemisphere. In contrast, the southern hemisphere is relatively backward. Four cities from Africa were shortlisted, with a proportion of 3.85%. Oceania had one cities shortlisted, accounting for 14.29%. South America fell behind with no city shortlisted (Table 9.51).

The living environment is evenly developed in European and North American urban agglomerations, but is concentrated in central cities of developing countries. According to the size of urban agglomerations, the research group has selected several important urban agglomerations of the United States, China, India, the UK, and Germany. According to calculation, the mean value of living environment index of urban agglomerations of these countries is generally not high, and the top three are Rhine-Ruhr urban agglomeration of Germany, Pearl River Delta urban agglomeration of China, London-Liverpool urban agglomeration of the UK; none of their mean value has exceeded 0.8. It reveals that the living environment level of urban agglomerations with strong economic competitiveness is generally not high, except for European cities which are doing okay. Therefore, in the future development course, urban agglomerations of both developed countries and emerging economies should not only make efforts to improve economic competitiveness but also strengthen their living environment construction (Table 9.52).

9.9.2 High-Tier Cities Have No Advantage in Living Environment

ii. **Important patterns and discoveries of global urban living environment**

Japan and Europe are leading in the living environment, and there is little difference between the living environment of China and the United States. From the distribution pattern of living environment of 1007 global cities, it is found that, on the one hand, cities with higher living environment indexes are mainly

Table 9.51 The continental situation of urban living environment index and the proportion of top 100 cities

Scope	Sample size	Mean value	Median	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	Maximum value		
							City	Index	World ranking
Asia	563	0.622	0.649	0.224	47	8.35	Sapporo	1.000	1
Europe	127	0.680	0.679	0.138	23	18.11	Munich	0.910	8
Africa	104	0.486	0.488	0.345	4	3.85	Libreville	0.879	18
Oceania	7	0.715	0.709	0.049	1	14.29	Sydney	0.770	83
North America	132	0.618	0.633	0.200	15	11.36	Quebec	0.892	11
South America	74	0.507	0.531	0.186	0	0.00	Maturin	0.684	337

Source City and competitiveness index database, CASS

Table 9.52 Statistical comparison of living environment index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Mean value	Variation coefficient	Number of top 100 cities	Proportion of top 100 cities (%)	No. 1 city	Index of no. 1 city	Ranking of no. 1 city	Index of last city	Ranking of last city	Mean value deducting the index of no. 1 city
Northeast U.S.	USA	11	0.643	0.126	0	0.00	Providence	0.723	198	0.522	793	0.635
Midwest U.S.	USA	13	0.638	0.129	0	0.00	Grand Rapids	0.758	105	0.457	877	0.628
London-Liverpool	UK	8	0.659	0.052	0	0.00	Liverpool	0.707	243	0.614	590	0.652
Yangtze River Delta	China	26	0.650	0.079	0	0.00	Anqing	0.752	121	0.545	748	0.646
Pearl River Delta	China	13	0.671	0.138	1	7.69	Yunfu	0.777	76	0.435	901	0.662
Beijing-Tianjin-Hebei	China	10	0.580	0.166	1	10.00	Zhangjiakou	0.761	97	0.459	875	0.560
Bangalore	India	5	0.605	0.150	0	0.00	Cochin	0.712	230	0.465	858	0.579
Rhine-Ruhr	Germany	4	0.776	0.020	3	75.00	Dortmund	0.793	66	0.758	103	0.770

Source City and competitiveness index database, CASS

Fig. 9.19 Global urban living environment index distribution. *Source* City and competitiveness index database, CASS

distributed in Japan and Europe, indicating that both the natural environment and the social environment of the above areas are world-leading; on the other hand, China's overall urban living environment has no obvious disadvantage compared with that of the United States, but cities of a high living environment index are lacking (Fig. 9.19).

High-tier cities have no advantage in living environment. The 1007 sample cities are divided into ten tiers, and it is found through the statistical indicators of living environment index of each tier that, the mean value of living environment index of tier-one cities is merely 0.665, or even slightly lower than that of many cities of other tiers. In general, the echelon pattern of urban living environment index level is inconspicuous. Higher tiers of cities have no advantage in the living environment, and tier-four cities have the highest mean value, which indicates that there exists certain mismatch between the living environment and economic competitiveness in global cities (Table 9.53).

Further examining the statistical indicators which reflect the differences, we find that, most of the indicators reflect that cities of lower tiers have greater differences in the living environment levels. Viewed from the international organizations, it can be found that the mean value of urban living environment index of BRICS and AIIB member countries has no obvious disadvantage compared with that of G7. But from the differential indicators, we can see that the urban living environment difference of BRICS is slightly greater than that of G7, and the living environment index difference between AIIB member countries is relatively large (Tables 9.54 and 9.55).

Table 9.53 Statistical indicators of living environment index for different tiers of cities

New tier	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
1	2	0.665	0.665	0.037	0.056	0.020	0.001
2	5	0.687	0.707	0.133	0.193	0.096	0.015
3	16	0.699	0.673	0.118	0.168	0.092	0.013
4	11	0.711	0.715	0.118	0.166	0.089	0.013
5	11	0.680	0.684	0.059	0.087	0.047	0.003
6	36	0.665	0.694	0.126	0.190	0.104	0.018
7	55	0.662	0.648	0.129	0.195	0.101	0.020
8	96	0.672	0.673	0.125	0.185	0.102	0.018
9	388	0.613	0.640	0.125	0.204	0.110	0.023
10	387	0.561	0.596	0.156	0.279	0.156	0.042

Source City and competitiveness index database, CASS

Table 9.54 Global urban living environment index: international organizations

Scope	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
BRICS	463	0.621	0.650	0.119	0.192	0.101	0.021
G7	141	0.695	0.690	0.108	0.156	0.087	0.012
AIIB	730	0.620	0.645	0.135	0.217	0.117	0.025

Source City and competitiveness index database, CASS

9.10 Analysis of Global Urban Economic Competitiveness for Top 100 Cities

9.10.1 Comparative Analysis of Global Urban Economic Competitiveness for Top 100 Cities

i. **The overall situation of top 100 global cities in economic competitiveness**

The total GDP of top 100 global cities in economic competitiveness is USD24.5 trillion, accounting for about 52.15% of the total GDP of 1007 sample cities, and for about one third of the world's GDP. It shows that the top 100 cities have a crucial position and influence in global economic activities. From the perspective of population, the top 100 economically competitive cities have a total of about 600 million people, accounting for about one fifth of all the population of 1007 sample cities, and accounting for about 5% of the total population of the world.

Table 9.55 Comparison between living environment indexes of BRICS and G7

	Country	Sample	Number of top 100 cities	The proportion of top 100 cities (%)	Mean value	Variation coefficient	Maximum value		
							City	Index	World ranking
BRICS	China	292	12	4.11	0.669	0.105	Zhanjiang	0.811	54
	Russia	33	1	3.03	0.634	0.149	Omsk	0.880	17
	India	100	3	3.00	0.533	0.283	Warangal	0.837	42
	Brazil	32	0	0.00	0.499	0.165	Juiz de Fora	0.639	499
	South Africa	6	0	0.00	0.341	0.144	Capetown	0.408	930
G7	UK	12	0	0.00	0.661	0.048	Liverpool	0.707	243
	France	9	0	0.00	0.643	0.083	Lyons	0.716	212
	USA	75	7	9.33	0.659	0.127	Rochester	0.848	38
	Germany	13	10	76.92	0.808	0.070	Munich	0.910	8
	Italy	13	0	0.00	0.629	0.121	Bologna	0.732	168
	Japan	10	10	100.00	0.912	0.062	Sapporo	1.000	1
	Canada	9	6	66.67	0.784	0.097	Quebec	0.892	11

Source City and competitiveness index database, CASS

Among the top 100 cities in comprehensive economic competitiveness, 39 cities are distributed in North America, 32 cities are from Asia (24 in East Asia, 6 in West Asia, 2 in Southeast Asia), 26 cities are from Europe (13 in Central Europe, 8 in West Europe), three cities are from Oceania. But there are none cities in Africa and South American cities. The 100 cities are mainly distributed in developed countries, and few are in developing countries. Specifically, most cities are from the United States (36 cities), China (21 cities), Germany (7 cities), Canada (5 cities), and Australia (three cities), and the UK, Japan, Switzerland, the United Arab Emirates, Spain and India each has two cities shortlisted. From the perspective of international organizations, among the top 100 cities in economic competitiveness, 75 cities are from countries of OECD, 22 cities are in member countries of the European Union, 19 cities are from BRICS countries, and 57 cities are from countries of G7. In addition, 59 cities are from AIIB member countries (31 cities are in regional members, 21 in non-regional members, and 7 in prospective members). In addition, among the top 100 cities in economic competitiveness, 58 cities are from the world's top 10 GDP countries in 2016 (Table 9.56).

9.10.2 Analysis of Driving Forces for Top 100 Cities in Global Urban Economic Competitiveness for

ii. **Important patterns and discoveries of top 100 global cities in economic competitiveness**

The advantages of top 100 cities are mainly in the industrial system, financial services, local demand and human resources. From the perspective of economic competitiveness, the mean value of top 100 cities is 0.733 and the median is 0.714, which is 3.3 times of the mean value and 4.8 times of the median of the world's 1035 sample cities, further indicating that the top 100 economically competitive cities are the most advanced and dynamic representative cities in economy. According to the statistical indicators reflecting the difference, the coefficient of variation of economic competitiveness of top 100 cities is 0.131, the Gini coefficient is 0.07, and the Theil index is 0.008. The coefficient of variation in economic competitiveness of all sample cities is 0.913, the Gini coefficient is 0.431, and the Theil index is 0.318. The variation coefficient, Gini coefficient and Theil index of the former are respectively equivalent to 28.26%, 31.58%, and 9.43% of those of the latter.

From the perspective of industrial system, the mean value of top 100 economically competitive cities is 0.263 and the median is 0.183, which are 5 times the mean value and 16.9 times of the median of 1035 sample cities, **showing that the great advantages of industrial system is an important driving force of the leading economic competitiveness of top 100 cities**. Viewed from the statistical indicators that reflect the difference, the coefficient of variation of industrial system index of top 100 cities is 0.878, the Gini coefficient is 0.447, and the Theil index

Table 9.56 List of top 100 global cities in economic competitiveness

No.	City	Economic competitiveness	No.	City	Economic competitiveness	No.	City	Economic competitiveness	No.	City	Economic competitiveness
1	New York	1	26	Seattle	0.781	51	Nashville-Davidson	0.713	76	Columbus	0.66
2	Los Angeles	0.999	27	Osaka	0.77	52	Minneapolis-Saint Paul	0.709	77	Riyadh	0.659
3	Singapore	0.971	28	Suzhou	0.765	53	Berlin	0.706	78	Baton Rouge	0.659
4	London	0.958	29	Bridgeport-Stamford	0.764	54	Charlotte	0.705	79	Louisville	0.658
5	San Francisco	0.941	30	Tel Aviv-Yafo	0.764	55	Moscow	0.704	80	Barcelona	0.658
6	Shenzhen	0.934	31	Baltimore	0.76	56	Las Vegas	0.699	81	Calgary	0.656
7	Tokyo	0.92	32	Stuttgart	0.75	57	Raleigh	0.697	82	Ulsan	0.653
8	San Jose	0.916	33	Istanbul	0.748	58	Abu Dhabi	0.696	83	Oslo	0.651
9	Munich	0.905	34	Geneva	0.745	59	Milwaukee	0.691	84	Manchester	0.647
10	Dallas	0.903	35	Toronto	0.741	60	Austin	0.683	85	Qingdao	0.646
11	Houston	0.9	36	Cleveland	0.737	61	Salt Lake City	0.682	86	Chongqing	0.646
12	Hong Kong	0.887	37	Atlanta	0.735	62	Chengdu	0.678	87	Dortmund	0.645
13	Seoul	0.848	38	Dusseldorf	0.733	63	Copenhagen	0.677	88	Nagoya	0.645
14	Shanghai	0.837	39	Perth	0.733	64	Orlando	0.677	89	Kuala Lumpur	0.635
15	Guangzhou	0.835	40	Wuhan	0.731	65	Sydney	0.673	90	Amsterdam	0.635
16	Miami	0.816	41	Vienna	0.73	66	Richmond	0.67	91	Foshan	0.632
17	Chicago	0.815	42	San Diego(US)	0.729	67	Dubai	0.67	92	Antwerp	0.628
18	Boston	0.812	43	Denver-Aurora	0.727	68	Wuxi	0.67	93	Washington, D.C.	0.626
19	Dublin	0.811	44	Nanjing	0.726	69	Birmingham	0.669	94	Oklahoma City	0.623
20	Beijing	0.81	45	Doha	0.726	70	Brussels	0.666	95	Sendai	0.619

(continued)

Table 9.56 (continued)

No.	City	Economic competitiveness	No.	City	Economic competitiveness	No.	City	Economic competitiveness	No.	City	Economic competitiveness
21	Paris	0.806	46	Detroit	0.725	71	Changsha	0.666	96	Melbourne	0.618
22	Frankfurt	0.799	47	Taipei	0.723	72	Hannover	0.665	97	Virginia Beach	0.616
23	Tianjin	0.787	48	Hamburg	0.717	73	Vancouver	0.662	98	Phoenix-Mesa	0.616
24	Stockholm	0.786	49	Cologne	0.715	74	Hangzhou	0.66	99	Zhengzhou	0.615
25	Philadelphia	0.784	50	Zurich	0.715	75	Essen	0.66	100	Tampa-St. Petersburg	0.615

Source City and competitiveness index database, CASS

was 0.328, respectively equivalent to 37.06%, 53.27%, and 24.75% of those of all global sample cities.

In aspect of financial services index, the mean value of top 100 cities in economic competitiveness is 0.299 and the median is 0.266 which are both 1.9 times of the mean value and the median of global sample cities, **revealing that the leading advantages in financial services is another impetus driving the rapid enhancement of economic competitiveness of top 100 cities**. Viewed from the statistical indicators that reflect the difference, the coefficient of variation of financial services index of top 100 cities is 0.404, the Gini coefficient is 0.192, and the Theil index was 0.067, respectively equivalent to 76.67%, 75.10% and 57.14% of those of all global sample cities.

With respect to local demand index, the mean value of economic competitiveness of top 100 cities is 0.717 and the median is 0.703, which are 1.7 times of the mean value and 1.8 times of the median of global sample cities, **indicating that the huge local market demand is an important factor in activating the rapid development of economic competitiveness of the 100 cities**. Viewed from the statistical indicators that reflect the difference, the coefficient of variation of local demand index of top 100 cities is 0.14, the Gini coefficient is 0.078, and the Theil index was 0.01, respectively equivalent to 5.86%, 34.53% and 12.82% of those of global sample cities, which indicates that the local demand difference of the top 100 cities is significantly lower than the overall difference of global cities.

From the perspective of human resources index, the mean value of top 100 economically competitive cities is 0.454 and the median is 0.427, which are 1.6 times both the mean value and the median of global sample cities, **indicating that the large base of high-quality human resources is an important factor of the leading economic competitiveness of the top 100 cities**. Viewed from the statistical indicators that reflect the difference, the coefficient of variation of human resources index of top 100 cities is 0.445, the Gini coefficient is 0.25, and the Theil index was 0.099, respectively equivalent to 96.42%, 107.49% and 104.49% of those of global sample cities. It indicates that despite the average level is world leading, the human resources difference of top 100 cities is significantly close to or even higher than the world's overall difference.

In terms of indexes of business cost, business environment, infrastructure, living environment, the mean value and median of top 100 economically competitive cities are both above the world's overall level, but the difference is small, so no clear advantages are formed (Table 9.57).

Local demand, industrial system, Business environment, Human resources are the driving factors of strong correlation with economic competitiveness of the top 100 cities. To examine the relative effect of each index on economic competitiveness, we further calculate the grey correlation degree between economic competitiveness and explanatory indicators. From the relative importance of the effect of explanatory factors on the economic competitiveness of the top 100 cities, it is found that, according to the strong to weak correlation between explanatory

Table 9.57 The comprehensive statistics of indicators of top 100 global cities in economic competitiveness

Top 100 cities	Number of samples	Mean value	Median	Standard deviation	Variation coefficient	Gini coefficient	Theil index
Economic competitiveness	100	0.733	0.714	0.096	0.131	0.07	0.008
Financial services	100	0.299	0.266	0.121	0.404	0.192	0.067
Industrial system	100	0.263	0.183	0.23	0.878	0.447	0.328
Human resources	100	0.454	0.427	0.202	0.445	0.25	0.099
Local demand	100	0.717	0.703	0.1	0.14	0.078	0.01
Business cost	100	0.723	0.692	0.15	0.208	0.118	0.022
Business environment	100	0.803	0.857	0.105	0.13	0.065	0.009
Infrastructure	100	0.7	0.698	0.115	0.164	0.092	0.013
Living environment	100	0.687	0.683	0.114	0.165	0.092	0.014

Source City and competitiveness index database, CASS

variables and explained variables, the order from high to low is: human resources, financial index, industrial system, local demand, infrastructure, Business environment, living environment, and business cost. In the nine explanatory indicators, local demand and economic competitiveness have the strongest correlation which is 0.9962. The correlation degree of industrial system and economic competitiveness is 0.9949, ranking the second. The correlation degree of business environment, and economic competitiveness is 0.9879, ranking the third. The correlation degree of human resources and economic competitiveness is 0.9843. ranking the fourth. Therefore, the correlation between the 9 explanatory indicators and urban competitiveness is relatively significant, and local demand, industrial system, Business environment, Human resources are the key factors in explaining the urban economic competitiveness. The above results not only verify the previous judgments, but also show the direction of further development for the top 100 global cities: all cities should consolidate their existing advantages while intensifying efforts to enhance the human resources level, narrow the gap, and more effectively promote the rapid enhancement of economic competitiveness (Fig. 9.20 and Table 9.58).

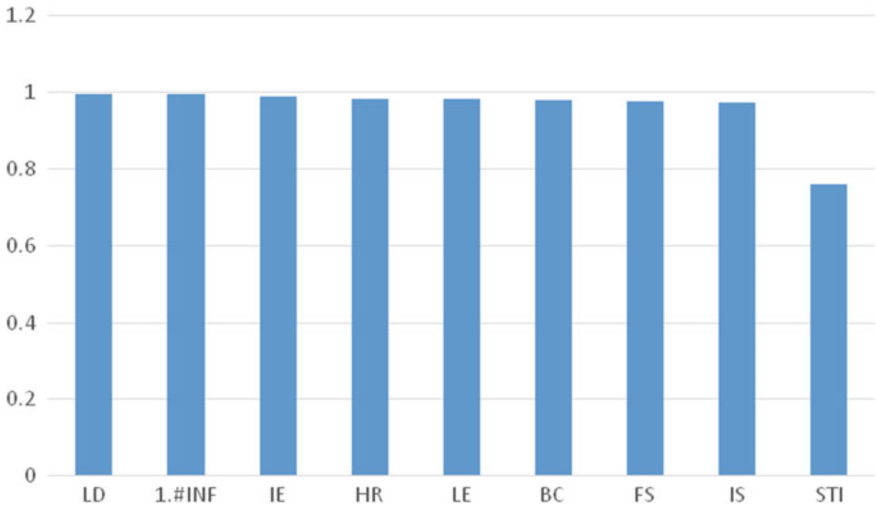


Fig. 9.20 The calculation of grey correlation degree of top 100 global cities in economic competitiveness

Table 9.58 The calculation of grey correlation degree of top 100 global cities in economic competitiveness

Explanatory indicators	Relational degree	No.
Human resources	0.7739	1
Financial services	0.7564	2
Industrial system	0.7274	3
Local demand	0.6944	4
Infrastructure	0.6646	5
Business environment	0.5571	6
Living environment	0.5386	7
Business cost	0.5141	8

Source City and competitiveness index database, CASS

9.11 The Stories of Economic Competitiveness for Top 10 Cities

9.11.1 Analysis of Economic Competitiveness for Top 10 Cities

New York: World Capital Supported by High-Level Financial Service

New York's economic competitiveness ranks first in the world, with the highest financial service index, industrial system index, local demand index, and global connectivity index. New York has an area of about 34,490 km^2 and a population of about 20.1905 million. Its per capita GDP is about 79886.98 USD. Its general economic competitiveness index is 1, ranking the first among the 1007 sample cities around the world. A Northern American city in North America, New York belongs to the city cluster along the northeastern Atlantic Ocean and is the no. 1 city in the northeastern United States city cluster. The United States is an important OECD member state and its GDP ranks no. 1 of all the countries in the sample.

New York's economic development benefits from its financial and technological strength, its robust industrial system, and its rich human resources. The fact that the US dollar has become the world currency provides an important foundation for New York to develop into a global city. New York's financial service index is 0.421, much higher than that of Los Angeles. New York's living environment index is 0.691 and the government plans to make it the country's cleanest city in 2030. It is also planned that 10 min of walk will bring any citizen to a park, where they can enjoy clean air in an open environment. With Broadway and other cultural facilities, New York has a rich modern culture. If New York could effectively utilize its brown field land, or previously developed land, it would be able to generate greater economic value (Fig. 9.21).

Los Angeles: City of Angel with Business Cost Advantage and multi-center layout

Los Angeles' business cost index is relatively high and it is more like a central city. It has an area of about 12,562 km^2 and a population of about 13.3527 million. Its per capita GDP is about 70223.21 USD. Its general economic competitiveness

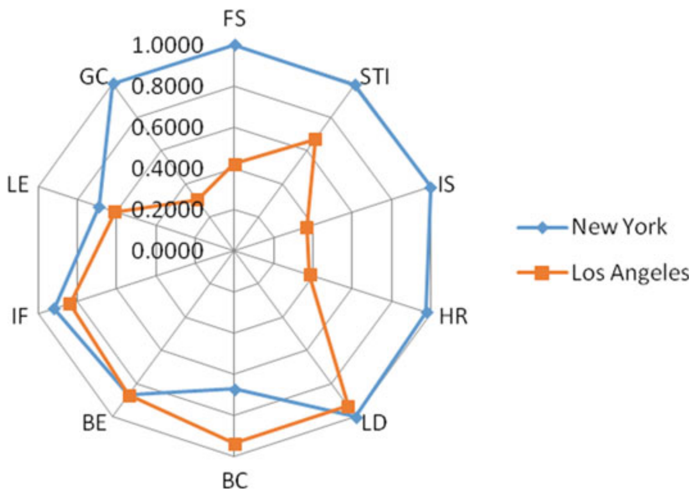


Fig. 9.21 Radar map of the top ten cities with economic competitiveness: New York and Los Angeles

index is 0.9992, ranking the second among the 1007 sample cities around the world. A Northern American city in North America, Los Angeles belongs to the San Francisco-San Diego city cluster along the west coast of the United States. The United States is an important OECD member state and its GDP ranks no. 1 of all the countries in the sample.

Let us look at the economic development of the city. Although its performance in the ten individual indexes is not as good as that of New York and it fails to invest as much as New York, Los Angeles follows New York closely in the comprehensive economic ranking, thanks to its overall economic efficiency. Los Angeles's business cost index was 0.939, much higher than New York's 0.675. As a port city, Los Angeles has a well-developed transportation network that ensures convenient transportation by sea and air. Los Angeles's infrastructure index is 0.838, still lower than New York's 0.919. While primary coordination is reached between its comprehensive economic competitiveness and technological innovation, business cost, local demand, infrastructure, institutional environment, and living environment, we find its financial service, industrial system, and human resources barely coordinated.

Singapore: City of Garden with balanced development

Singapore is a small city whose development surpasses most other cities in the world. It has an area of about 716 km^2 and a population of about 5.5792 million. Its per capita GDP is about 53204.72 USD. Its general economic competitiveness index is 0.9708, ranking the third among the 1007 sample cities around the world. A city state in Southeast Asia, Singapore is a regional member of the Asian Development Bank.

Singapore's living environment index is 0.873, much higher than London's 0.638. The city strictly follows the path of green development and strives to build an international garden city. Its development is ecologically friendly, low-carbon, and happiness-oriented. Singapore has a relatively sound industrial system, developed under the guidance of government policies. Singapore's industrial system index is 0.933, close to London's 0.935. Singapore's industrial structure is quite balanced and its manufacturing sector takes a larger part in the economy than that of London. The relatively solid manufacturing base and its contribution to net exports have become important forces for Singapore's robust economic growth in recent years.

Medium coordination is achieved between the city's comprehensive economic competitiveness and its institutional environment index while primary coordination is observed with the living environment index. Of all the top 10 cities, Singapore registers the highest level of coordination between comprehensive economic competitiveness and the institutional environmental index and the living environment index. Singapore realizes primary coordination when it comes to science and technology innovation, industrial system, human resources, local demand, business cost, and infrastructure. Singapore's economic competitiveness and financial

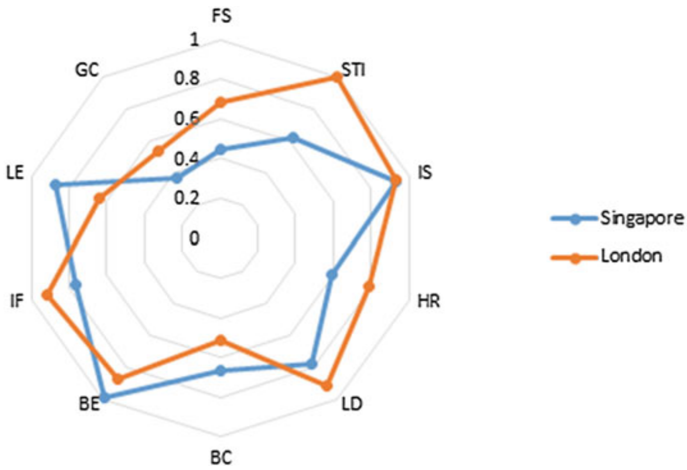


Fig. 9.22 Radar map of the top ten cities with economic competitiveness: Singapore and London

service are barely coordinated. There is still much room for the future improvement of Singapore's comprehensive economic competitiveness (Fig. 9.22).

London: Senior World Capital with High Levels of both Scientific & Technological Innovation and Finance

London ranks no. 1 in science and technology innovation and its performance in infrastructure, human resources, and local demand is also impressive. It has an area of about 8382 km^2 and a population of about 12.8908 million. Its per capita GDP is about 65154.68 USD. Its general economic competitiveness index is 0.9578, ranking the fourth among the 1007 sample cities around the world. A city in West Europe, London belongs to the United Kingdom city cluster and is the no. 1 city in the country's London-Liverpool city cluster. The United Kingdom is an OECD member state and an important EU country. The country's GDP ranks no. 5 of all the countries in the sample.

San Francisco: City by the bay suitable for both commerce and living

San Francisco ranks high in living environment and business convenience and is a city suitable for both living and business. It has an area of about 9128 km^2 and a population of about 4.6199 million. Its per capita GDP is about 94132.37 USD. Its general economic competitiveness index is 0.9408, ranking the fifth among the 1007 sample cities around the world. San Francisco is a Northern American city in North America and is located in the United States, an important OECD member state whose GDP ranks no. 1 of all the countries in the sample.

Let us look at the economic development of the city. San Francisco belongs to the San Francisco-San Diego city cluster along the west coast of the United States.

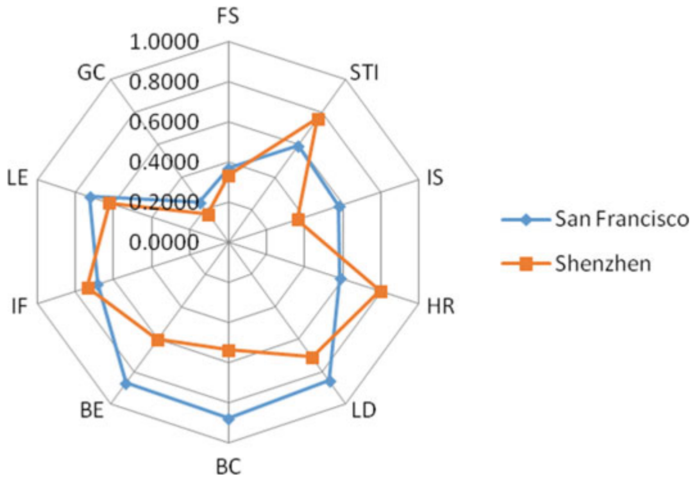


Fig. 9.23 Radar map of the top ten cities with economic competitiveness: San Francisco and Shenzhen

Its industrial system index is 0.5796, much higher than Shenzhen's 0.3666. San Francisco benefits from the sound development and continuous growth of its electronic information industry, biotechnology industry, light industry, and Hollywood-led entertainment industry, but suffers from a seriously shrinking aviation and defense industry. San Francisco's living environment index is 0.7252, slightly higher than Shenzhen's 0.622. San Francisco ranks quite high in local demand, business cost and institutional cost and the city' economic competitiveness is coordinated with its local demand, business cost, and institutional cost but barely coordinated with its financial service, industrial system, and human resources. There is still much room for future improvement (Fig. 9.23).

Shenzhen: Newborn beloved city of Global-level Scientific & Technological Innovation

Shenzhen ranks quite high in terms of science and technology innovation, human resources and infrastructure. It has an area of about 1997 km^2 and a population of about 11.38 million. Its per capita GDP is about 24,696.76 USD. Its general economic competitiveness index is 0.9337, ranking the sixth among the 1007 sample cities around the world. Located in East Asia, Shenzhen is a Chinese city. China is an important BRICS country and member of ADB. Its GDP ranks no. 2 of all the countries in the sample.

Let us look at the economic development of the city. As the first special economic zone since China's reform and opening up, Shenzhen has a superior geographical location, a beautiful environment, and a diverse and inclusive culture, all contributing to its development potential as a global city. Thanks to the efforts of the municipal government to establish platforms and incentives, Shenzhen impresses the world with its strength in science and technology innovation. The city science and technology innovation index is 0.759, much higher than San Francisco's 0.592. A young city, Shenzhen attracts outstanding young talents from around the world. The city's human resources index is 0.7949, much higher than San Francisco's 0.5844. Shenzhen's infrastructure index is 0.7376, higher than San Francisco's 0.6838. Shenzhen's comprehensive economic competitiveness has realized primary coordination with its human resources, science and technology innovation, industrial system, institutional environment, living environment, and local demand. Of all the top 10 cities, Shenzhen registers a quite high level of coordination between comprehensive economic competitiveness and human resources and science and technology innovation. The city's comprehensive economic competitiveness is barely coordinated with its financial service, industrial system, and business cost, thus not a very high level of coupling coordination among the ten cities. Despite the gap in local demand, business cost, institutional environment, and living environment, Shenzhen is quite close to San Francisco in terms of comprehensive economic competitiveness and the city still has great potential for future growth.

Tokyo: A Industrially Integrated and comfortable Canal City

Tokyo has a sound industrial system and a favorable living environment. It has an area of about 13,572 km^2 and a population of about 35.9189 million. Its per capita GDP is about 41123.07 USD. Its general economic competitiveness index is 0.9205, ranking the seventh among the 1007 sample cities around the world. Located in East Asia, **Tokyo** is a city of Japan, which is an important OECD country and its GDP ranks no. 3 of all the countries in the sample.

Let us look at the economic development of the city. Tokyo belongs to the Japanese city cluster along the Pacific Coast. Close to the natural harbor of Tokyo Bay, Tokyo enjoys all the advantages of a port city. Its urban economic development is mostly driven by maritime transportation. Tokyo's human resources index, industrial system index, and living environment index are 1, 0.9184, and 0.8994 respectively, all much higher than San Jose's 0.7399, 0.0826, and 0.6139. Tokyo is a hub of academic research and science and technology innovation. Tokyo's economic competitiveness has reached primary coordination with its science and technology innovation, industrial systems, human resources, local demand, cost of living, institutional cost and infrastructure but is barely coordinated with its financial service and business cost. There is much room for future improvement (Fig. 9.24).

San Jose: A Scientific and Technological City with extraordinary Business Environment

San Jose has a favorable business environment and a high degree of business convenience. It has an area of about 6979 km^2 and a population of about

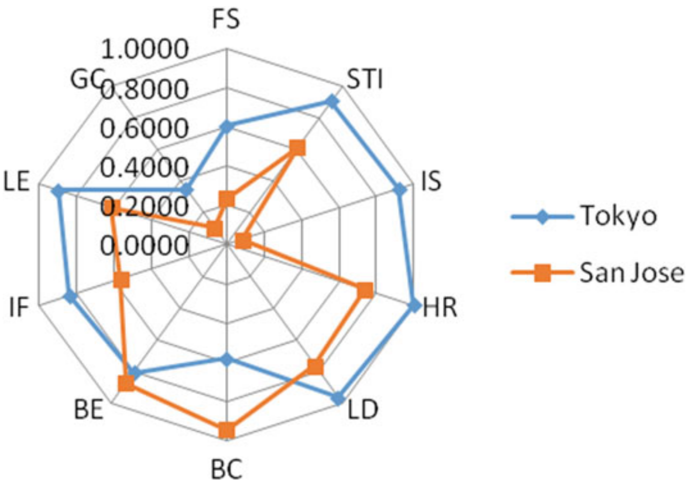


Fig. 9.24 Radar map of the top ten cities with economic competitiveness: Tokyo and San Jose

1.9736 million. Its per capita GDP is about 120061.64 USD. Its general economic competitiveness index is 0.9158, ranking the eighth among the 1007 sample cities around the world. A Northern American city in North America, San Jose belongs to the San Francisco-San Diego city cluster along the west coast of the United States. The United States is an important OECD member state and its GDP ranks no. 1 of all the countries in the sample.

Let us look at the economic development of the city. Although its investment and performance in the ten individual indexes is not as good as Tokyo's, San Jose follows Tokyo closely in the comprehensive economic ranking, thanks to its overall economic efficiency. San Jose's business cost index is 0.9392, much higher than Tokyo's 0.580. Its institutional cost index is 0.870, still higher than Tokyo's 0.802. Therefore, San Jose has a better institutional and business environment than Tokyo. Tokyo surpasses San Jose in human resources, but San Jose attaches greater importance to the education and training of professionals in science and technology and vigorously develops the information technology industry. As the central city of Silicon Valley, San Jose is committed to developing its high-end technology services industry and its strength in science and technology innovation has contributed to its leading position as a global city. Its economic competitiveness is primarily coordinated with its institutional cost, barely coordinated with its local demand, infrastructure, and business cost, almost uncoordinated with its financial service and human resources, and lightly uncoordinated with its industrial system. There is still much space for its future economic development.

Munich: Capital of Bavaria with full-fledged industry and livable ecological environment

Munich has a favorable ecological environment and enjoys a high level of industrialization. It has an area of about 611 km^2 and a population of about 2.87 million. Its per capita GDP is about 69,104.25 USD. Its general economic competitiveness index is 0.9053, ranking the ninth among the 1007 sample cities around the world. Munich is a German city located in Central Europe. An important member state of OECD and EU, Germany has a GDP that ranks no. 4 of all the countries in the sample.

Let us look at the economic development of the city. Located in the Frankfurt am Main Metropolitan Area in Germany, Munich is a city that emphasizes ecological conservation and cultural inheritance. Munich's living environment index is 0.9099, much higher than Dallas-Fort Worth's 0.6729. Munich has reached an advanced level of industrialization and established a sound industrial structure. Its industrial system index is 0.2948, higher than Dallas-Fort Worth's 0.2092. It values education and its human resources index is 0.4166, higher than Dallas-Fort Worth's 0.2351. However, its index is relatively low in terms of the size of the labor force and the proportion of the young population. The almost uncoordinated development of its comprehensive economic competitiveness with its financial service points to the urgency for further improvement. Its comprehensive economic competitiveness is primarily coordinated with its local demand, business cost, institutional environment, infrastructure, and living environment and barely coordinated with its science and technology innovation, and industrial system. Of all the top 10 cities, Munich registers a relatively higher level of coordination between comprehensive economic competitiveness on the one hand and living environment and business cost on the other hand. There is still much space for its future economic development (Fig. 9.25).

Dallas: Cowboy City with high-level financial service and cutting-edge scientific innovation and technology

Dallas benefits from its science and technology innovation, advanced financial service, and low business cost. It has an area of about 24,059 km^2 and a population of about 7.09 million. Its per capita GDP is about 68,904.71 USD. Its general economic competitiveness index is 0.9026, ranking the tenth among the 1007 sample cities around the world. It is a Northern American city located in the United States, an important OECD member whose GDP ranks no. 1 of all the countries in the sample.

Let us look at the economic development of the city. Although its investment and performance in the ten individual indexes is not as good as Munich's, Dallas-Fort Worth follows Munich closely in the comprehensive economic ranking, thanks to its overall economic efficiency. Dallas-Fort Worth's science and

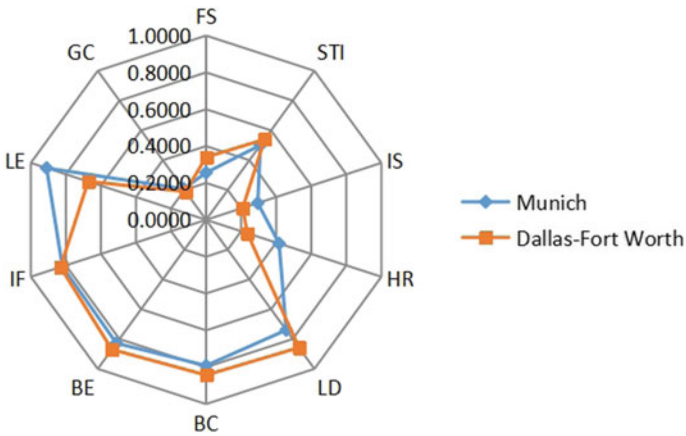


Fig. 9.25 Radar map of the top ten cities with economic competitiveness: Munich and Dallas-Fort Worth

technology index is 0.5395, higher than Munich's 0.5008. Its financial service index and business index are 0.3402 and 0.8428 respectively, higher than Munich's 0.2562 and 0.7915. Its comprehensive economic competitiveness is barely coordinated with its science and technological innovation, financial service, and business cost. Of all the top 10 cities, Dallas-Fort Worth registers a relatively higher level of coordination between comprehensive economic competitiveness and business cost. Its global connectivity is slightly lower than Munich's. Compared with Munich, Dallas-Fort Worth has a less close connection with multinationals, but a better international reputation. Therefore, Dallas-Fort Worth needs to further improve its connection with multinationals and thus increase its global connectivity. The city's comprehensive economic competitiveness is almost uncoordinated with its human resources and industrial system and therefore, requires further investment in human resources and adjustment of the industrial system.

9.11.2 Cities of China and U.S.: Situation Analysis of Chaser and Front-Runner

While the United States is the largest developed country, China is the largest emerging market economy. Cities of the two countries are at different development stages and the gap is inevitable. Generally, American cities are more advanced than Chinese cities. From Table 9.59, we can see that 292 Chinese

Table 9.59 All Chinese and American cities

Index	Country	No. of Samples	Mean	Median	Standard deviation	Coefficient of variation	Gini coefficient	Theil index
Economic competitiveness	United States	75	0.625	0.598	0.147	0.236	0.131	0.027
	China	292	0.343	0.305	0.153	0.445	0.238	0.091
Financial service index	United States	75	0.248	0.219	0.108	0.436	0.170	0.066
	China	292	0.132	0.120	0.065	0.490	0.225	0.096
Industrial system index	United States	75	0.124	0.076	0.147	1.183	0.499	0.452
	China	292	0.032	0.014	0.090	2.848	0.622	1.022
Human resources index	United States	75	0.344	0.270	0.193	0.563	0.294	0.139
	China	292	0.284	0.253	0.136	0.478	0.255	0.109
Local demand index	United States	75	0.692	0.685	0.102	0.148	0.082	0.010
	China	292	0.362	0.334	0.126	0.347	0.187	0.057
Business cost	United States	75	0.806	0.842	0.118	0.146	0.082	0.011
	China	292	0.594	0.576	0.077	0.129	0.057	0.008
Business environment index	United States	75	0.868	0.870	0.015	0.017	0.002	0.000
	China	292	0.603	0.601	0.023	0.039	0.002	0.001

(continued)

Table 9.59 (continued)

Index	Country	No. of Samples	Mean	Median	Standard deviation	Coefficient of variation	Gini coefficient	Theil index
Infrastructure index	United States	75	0.587	0.554	0.116	0.198	0.104	0.019
	China	292	0.520	0.511	0.081	0.156	0.081	0.012
Cost of living index	United States	75	0.659	0.659	0.084	0.127	0.071	0.008
	China	292	0.669	0.681	0.070	0.105	0.056	0.006

Table 9.60 Top 100 Chinese and American cities according to economic competitiveness

Index	Country	No. of samples	Mean	Median	standard deviation	Coefficient of variation	Gini coefficient	Theil index
Economic competitiveness	United States	36	0.746	0.719	0.106	0.143	0.076	0.010
	China	18	0.736	0.725	0.094	0.128	0.070	0.008
Financial service index	United States	36	0.296	0.262	0.138	0.467	0.187	0.077
	China	18	0.306	0.267	0.114	0.371	0.181	0.058
Industrial system index	United States	36	0.196	0.144	0.183	0.936	0.422	0.314
	China	18	0.265	0.134	0.273	1.031	0.500	0.422
Human resources index	United States	36	0.428	0.375	0.218	0.511	0.281	0.123
	China	18	0.589	0.571	0.125	0.212	0.111	0.021
Local demand index	United States	36	0.759	0.755	0.099	0.130	0.072	0.008
	China	18	0.662	0.647	0.081	0.122	0.067	0.007
Business cost index	United States	36	0.809	0.845	0.119	0.147	0.081	0.011
	China	18	0.574	0.579	0.021	0.037	0.020	0.001
Business environment index	United States	36	0.866	0.870	0.022	0.025	0.004	0.000
	China	18	0.624	0.601	0.094	0.151	0.034	0.009

(continued)

Table 9.60 (continued)

Index	Country	No. of samples	Mean	Median	standard deviation	Coefficient of variation	Gini coefficient	Theil index
Infrastructure index	United States	36	0.663	0.657	0.114	0.172	0.097	0.014
	China	18	0.707	0.674	0.098	0.138	0.073	0.009
Cost of living index	United States	36	0.645	0.645	0.083	0.129	0.072	0.008
	China	18	0.618	0.622	0.049	0.080	0.043	0.003

cities and 75 American cities have been chosen as samples. For Chinese cities, the mean value of economic competitiveness is 0.343, lower than American cities' 0.625. The standard deviation, coefficient of variation, Gini coefficient, and Theil index of Chinese cities are 0.153, 0.445, 0.238, and 0.091, all higher than American cities' 0.147, 0.236, 0.131, and 0.027. **Except for the living environment index, American cities surpass Chinese cities in all the individual indexes**.

In the top 100 cities, the number of Chinese cities is only half of that of American cities. However, these Chinese cities outperform their American counterparts in terms of the coefficient of variation, Gini coefficient, and Theil index. From Table 9.60, we can see that 292 Chinese cities have been chosen as samples but only 18 enter the top 100 list while in the United States, 36 cities out of the 75 samples are listed. The mean value of economic competitiveness of Chinese cities on the top 100 list is 0.736, lower than America's 0.746. The coefficient of variation, Gini coefficient, and Theil index of top 100 Chinese cities are 0.128, 0.070, and 0.008, all higher than their American counterparts' 0.143, 0.076, and 0.010. In terms of individual indexes, the coefficient of variation, Gini coefficient, and Theil index of the financial service index, human resources index, and infrastructure index of top 100 Chinese cities are all higher than those of American cities on the list.

Although Chinese cities generally lag behind American cities, their individual indexes performances vary. Take top 20 cities for example. Thanks to its obvious advantage in the size of the labor force and the proportion of the young population, Chinese cities slightly outperform their American counterparts in the human resources index. As to infrastructure, technology innovation, financial service, and living environment, there is no significant different. However, when it comes to business environment, business cost, and local demand, China still has to catch up with the United States. China, as an emerging power with five cities listed, whose rise can be attributed to its economic restructuring and upgrading, macroeconomic policy coordination, and integration of Internet and other new technologies into economic development (Table 9.61 and Fig. 9.26).

In terms of economic competiveness, the top 5 Chinese cities are Shenzhen, Hong Kong, Shanghai, Guangzhou, and Beijing and the top 5 American cities are New York, Los Angeles, San Francisco, San Jose, and Dallas-Fort Worth. Despite the significant gap between China's and America's top 20 cities, **China is a match for the United States in terms of the development potential of top 5 cities, with New York as an exception**, whose financial service, industrial system, and local demand are unmatchable. For Chinese cities, they can strive to catch up with other American cities first. Thanks to its supply-side reform and efforts to improve financial service, China has made considerable progress in improving its financial service and industrial system and expanding its local demand. Moreover, China is

Table 9.61 Top 20 cities according to economic competitiveness: China vs. U.S.

Top 20 Chinese cities	Master index	Overall rank	Top 20 U.S. cities	Master index	Overall rank
Shenzhen	0.934	6	New York	1	1
Hong Kong	0.887	12	Los Angeles	0.999	2
Shanghai	0.837	14	San Francisco	0.941	5
Guangzhou	0.835	15	San Jose	0.916	8
Beijing	0.81	20	Dallas-Fort Worth	0.903	10
Tianjin	0.787	23	Houston	0.9	11
Suzhou	0.765	28	Miami	0.816	16
Wuhan	0.731	40	Chicago	0.815	17
Nanjing	0.726	44	Boston	0.812	18
Taipei	0.723	47	Philadelphia	0.784	25
Chengdu	0.678	62	Seattle	0.781	26
Wuxi	0.67	68	Bridgeport-Stamford	0.764	29
Changsha	0.666	71	Baltimore	0.76	31
Hangzhou	0.66	74	Cleveland	0.737	36
Qingdao	0.646	85	Atlanta	0.735	37
Chongqing	0.646	86	Santiago	0.729	42
Foshan	0.632	91	Denver	0.727	43
Zhengzhou	0.615	99	Detroit	0.725	46
Ningbo	0.614	101	Nashville-Davidson	0.713	51
Changzhou	0.613	102	Minneapolis	0.709	52
Mean	0.724		Mean	0.793	
Standard deviation	0.097		Standard Deviation	0.076	
Variance	0.009		Variance	0.006	
Coefficient of deviation	0.134		Coefficient of Deviation	0.095	

Source City and competitiveness index database, CASS

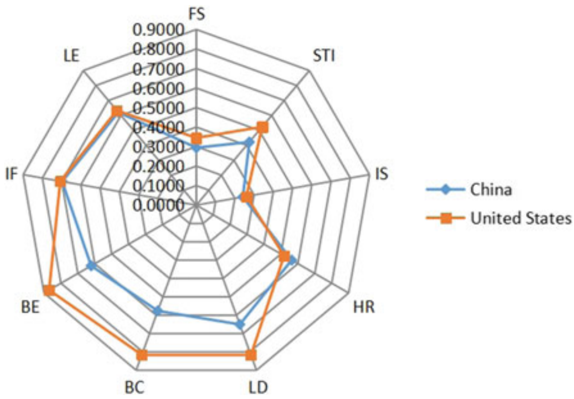


Fig. 9.26 Radar map of individual indexes of top 20 Chinese and U.S. cities. *Source* City and competitiveness index database, CASS

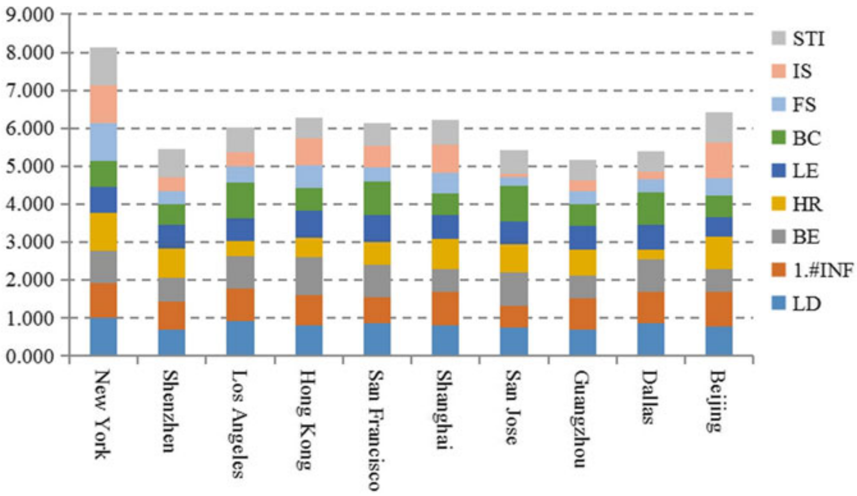


Fig. 9.27 Histogram of individual indexes of top 5 Chinese and U.S. cities. *Source* City and competitiveness index database, CASS

also taking proactive measures to increase its business convenience, market freedom, and social environment, thus narrowing the gap with American cities. Based on our comparative study of Chinese and American cities, we believe that China should consider the United States as a model and draw upon its advanced experience to facilitate the development of new-type intelligent cities (Fig. 9.27).

Chapter 10
Global Urban Sustainable Competitiveness Report 2017–2018

Xiaobo Zhou, Yufei Wang and Jie Wei

10.1 Global Urban Sustainable Competitiveness Pattern

10.1.1 None of the Emerging Economies Is on the List of Top Ten Global Cities with Sustainable Competitiveness

Urban sustainable competitiveness is a composite index of economic vitality, environmental quality, social inclusion, scientific and technological innovation, global connection, government management, human capital, and infrastructure. In 2014–2015, among 1035 sample cities, the top ten global cities with sustainable competitiveness are: New York, London, Tokyo, Boston, Singapore, Zurich, Seoul, Houston, Paris, and Chicago. Among them, European cities and Asian cities took 3 seats respectively, and North American cities occupied 4 seats. The number of Asian cities on the list is close to that of European cities and North American cities, showing the rapid rise of advanced cities in Asia which are at the same sustainable competitive level as European and North American cities. In the pattern of global urban sustainable competitiveness, advanced cities in Europe, North America, and Asia have formed a troika. In this regard, 3 of the top 5 global cities with sustainable competitiveness are in Europe and North America. Moreover, the world's

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P. Ni et al. (eds.), *House Prices: Changing the City World*,
https://doi.org/10.1007/978-981-32-9111-9_10

top 2 sustainable competitive cities are also in Europe and North America. It shows that, despite the constant change in the global urban competitiveness pattern with the rapid development of Asian cities, the sustainable competitiveness of European and American cities still takes the leading position. However, with the rapid development of Chinese cities, the advantage of European and American cities will weaken. In particular, Beijing and Hong Kong are on the heels of the world's top ten cities, and with the further development of China, their sustainable competitiveness will be further enhanced to be hopeful to challenge the leading position of European and American cities (Table 10.1).

Globally, with the decline in ranking of the city's sustainable competitiveness, the falling range of the index grows from small to large, which shows the gap between sustainable competitiveness of cities. With the drop of the ranking of sustainable competitiveness, the falling range of the index first shrinks and then becomes large. Specifically, within the ranking of city competitiveness from 1 to 100, the city competitiveness index fell by 0.533. Within the ranking of 100–200, the index decreased by 0.074. Within the ranking of 200–300, the index decreased by 0.056. Within the ranking of 700–800, the index fell by 0.016. Within the ranking of 800–900, the index fell by 0.034. Within the ranking of 900–1000, the index fell by 0.07. It shows that, the competitiveness gap between cities with good sustainable competitiveness and cities with poor sustainable competitiveness is relatively large, while the gap between cities with moderate competitiveness is relatively small (Figs. 10.2 and 10.3).

10.1.2 The Sustainable Competitiveness Gap Between African Cities Is the Largest

From the global perspective, among the top 100 cities with sustainable competitiveness, 36 cities are from Europe and 36 cities from North America. Compared with other continents, they have an absolute quantitative advantage. The variation coefficient of sustainable competitiveness index in Africa is 0.456 which is the highest, higher than the world's overall level of 0.398. The sustainable competitiveness index variation coefficient of the rest regions is lower than the overall level of the world. It reflects that, across the world, the sustainable competitiveness gap between African cities is the largest. The mean value of sustainable competitiveness index of both South American and Oceania cities is smaller than the median. The urban competitiveness index mean value of Asia, Europe and North America and Africa is greater than the median. This shows that in South America and Oceania, the cities with sustainable competitiveness above the regional average level are more than those below the average level; for Asia, Europe and North America and Africa, the situation is on the contrary. The levels of the most sustainable competitive cities in Asia, Europe and North America are close, while the most sustainable competitive cities in South America and Africa are laggard (Table 10.2).

Table 10.1 Top ten global cities with sustainable competitiveness

City	New York	London	Tokyo	Boston	Singapore	Zurich	Seoul	Houston	Paris	Chicago
Continent	North America	Europe	Asia	North America	Asia	Europe	Asia	North America	Europe	North America
Index	1	0.876	0.737	0.717	0.708	0.706	0.702	0.679	0.677	0.671
World ranking	1	2	3	4	5	6	7	8	9	10

Source City and Competitiveness Index Database, CASS

Table 10.2 Continental distribution of global urban competitiveness

Region	Sample	Number of top 100 cities	Mean Value	Variation coefficient	Number of cities below the mean value	Median	Maximum value		
							City	Index	World ranking
Asia	585	25	0.287	0.299	383	0.269	Tokyo	0.74	4
Europe	130	36	0.398	0.321	67	0.392	London	0.88	2
North America	135	36	0.397	0.348	73	0.381	New York	1	1
South America	75	0	0.227	0.271	35	0.229	Buenos Aires	0.426	211
Oceania	7	4	0.494	0.151	3	0.517	Sydney	0.607	21
Africa	103	0	0.172	0.456	57	0.156	Cairo	0.382	261

Source City and Competitiveness Index Database, CASS

10.1.3 The Sustainable Competitiveness Difference of German Cities Is the Smallest, While the Difference of Brazilian Cities Is the Biggest

The report selects BRICS and G7 members as representative countries to analyze the country pattern of sustainable competitiveness index. From the mean value and variation coefficient in Table 10.3, it can be seen that the overall strength of BRICS is significantly weaker than that of G7. On the whole, the sustainable competitiveness index mean value of BRICS is low, the difference between cities is large, and the coefficient of variation is relatively high. By contrast, the mean value of G7 is all around 0.5, the coefficient of variation is low, the cities' sustainable competitiveness is relatively balanced, and the national strength is strong. According to Fig. 10.1 Urban distribution of sustainable competitiveness index, European countries and the United States have most sample cities in the top 100 cities, with more concentrated city distribution in Europe. In the United States, the cities mainly concentrate in the northeast area and the western coast, and the cities in the central region are relatively few. In China, the cities are mainly distributed in the eastern coastal areas, and the cities in the central and western areas are relatively few. In Russia, the cities are mainly in the European area, with almost none in the vast land of Siberia, Asia. The overall distribution in India, Brazil, and South Africa is relatively sporadic.

10.1.4 The Urban Agglomerations of European and American Countries Have High Proportion of Top 100 Cities, While in Developing Countries Top Cities Are Mainly Economic Centers

According to the city number of urban agglomerations, the research group selects urban agglomerations of developed countries represented by the United States, the

Table 10.3 Comparison of sustainable competitiveness index between BRICS and G7 countries

	Country	Sample	Number of top 100 cities	Mean value	Variation coefficient
BRICS	China	292	6	0.305	0.228
	Russia	33	1	0.287	0.193
	India	102	0	0.253	0.159
	Brazil	32	0	0.227	0.241
	South Africa	6	0	0.261	0.175
G7	UK	13	6	0.537	0.208
	France	9	2	0.484	0.182
	USA	79	34	0.515	0.209
	Germany	13	10	0.549	0.116
	Italy	16	2	0.425	0.117
	Japan	10	4	0.512	0.186
	Canada	9	7	0.551	0.123

Source City and Competitiveness Index Database, CASS

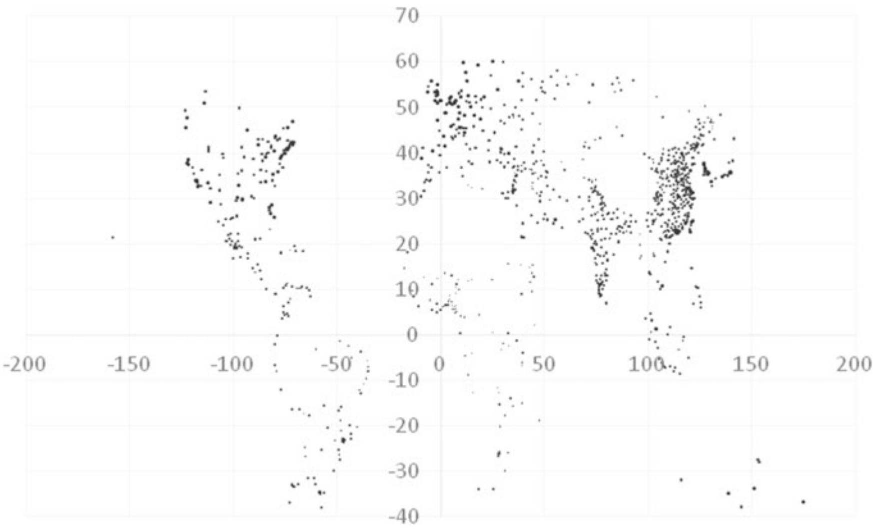


Fig. 10.1 Distribution of sustainable competitiveness of global cities

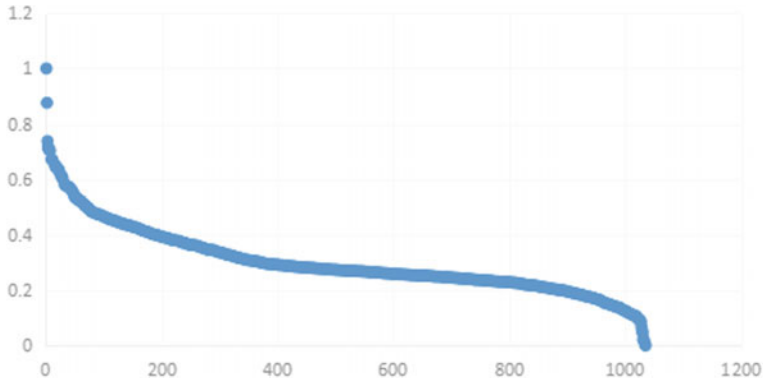


Fig. 10.2 Ranking distribution of sustainable competitiveness of global cities

UK, Germany, and South Korea, and major urban agglomerations of developing countries represented by China, India, Brazil, and Indonesia. In comparison, the urban agglomeration strength of the former is obviously stronger, with a higher proportion of top 100 cities and the sustainable competitiveness index mean value of all cities above 0.5 basically and the competitiveness level is even. By contrast, although the urban agglomeration of such developing countries as China, India, Brazil and Indonesia is large in scale, the number of cities on the list of top 100 cities is small, with the sustainable competitiveness mean value of all cities below 0.4. From the perspective of the coefficient of variation, the sustainable

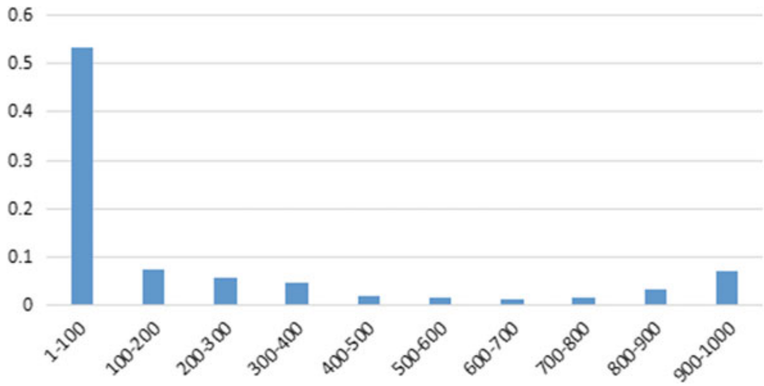


Fig. 10.3 The gap of urban sustainable competitiveness. *Source* City and Competitiveness Index Database, CASS

competitiveness difference of cities in Beijing-Tianjin-Hebei urban agglomeration of China is the largest, while the sustainable competitiveness difference of cities in Rhine-Ruhr urban agglomeration of Germany is the least. On the whole, compared to the urban agglomeration of developed countries, the cities in the urban agglomeration of developing countries have greater sustainable competitiveness difference (Table 10.4).

10.1.5 The Increase of High-Income Population Has Greater Influence on the Sustainable Competitiveness of Cities with a Low Proportion of High-Income Population

Through analyzing the revealed competitiveness index (as shown in Fig. 10.4 abscissa) with the sustainable competitiveness index (as shown in Fig. 10.4 ordinate) formed by integrating the population size with the annual income of more than USD15,000 with the incremental population with an annual income of more than USD15,000 in recent five years in the sample cities, and classifying the 1035 global cities into Category A, B, C, and D based on their revealed competitiveness indexes, it is found that, the revealed competitiveness index and the sustainable competitiveness are highly positively correlated. That is, the larger the city's high-income population, the greater the city's sustainable competitiveness. Specifically, according to the gradient of the fitted lines, the high-income population size has greater impact on the sustainable competitiveness of cities with lower overall revealed competitiveness index (Fig. 10.4).

Table 10.4 Comparison of sustainable competitiveness of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Central city	Number of top 100 cities	Index mean value	Variation coefficient
Yangtze River Delta urban agglomeration	China	26	Shanghai	2	0.334	0.255
Midwest urban agglomeration of America	USA	13	Chicago	6	0.462	0.182
Pearl River Delta urban agglomeration	China	13	Shenzhen	2	0.372	0.272
London-Liverpool urban agglomeration	UK	10	London	5	0.530	0.259
Beijing-Tianjin-Hebei urban agglomeration	China	10	Beijing	2	0.348	0.372
Northeast urban agglomeration	USA	12	New York	8	0.556	0.316
Bangalore urban agglomeration	India	6	Bangalore	0	0.358	0.231
Rhine-Ruhr urban agglomeration	Germany	4	Hamburg	4	0.508	0.079
Piedmont urban agglomeration	USA	6	Atlanta	3	0.480	0.169
Texas Delta urban agglomeration	USA	7	Houston	3	0.495	0.232
Holland-Belgium urban agglomeration	Europe	6	Amsterdam	2	0.477	0.199
Mumbai metropolitan area	India	4	Mumbai	0	0.328	0.307
Sao Paulo metropolitan area	Brazil	7	Sao Paulo	0	0.260	0.201
Southern Florida urban agglomeration	USA	4	Miami	2	0.440	0.200
Southern California urban agglomeration	USA	4	Los Angeles	2	0.494	0.328
State capital region of Seoul	The Republic of Korea	6	Seoul	4	0.505	0.197
Jakarta metropolitan area	Indonesia	4	Jakarta	0	0.315	0.266

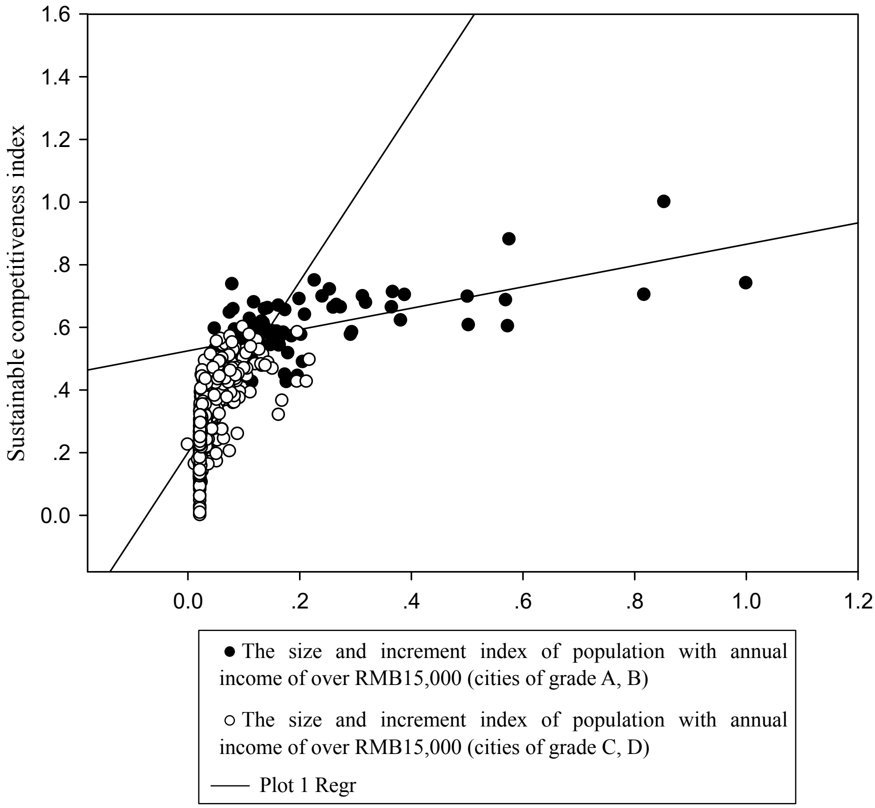


Fig. 10.4 Correlation between the revealed competitiveness index and the sustainable competitiveness index

10.2 The Economic Vitality Pattern of Global Cities

10.2.1 Urban Economy Vitality Remains Tremendous and China's Urban Economy Vitality Is Growing Rapidly

Economic vitality is a composite index of per capita GDP (USD/person) and the average GDP increment in recent five years. The top ten cities all have excellent performance in science & technology or finance, which indirectly indicates that science & technology and finance can lead and support the sustainable development of cities. The number of Asian cities entering the list of top ten cities has exceeded that of European cities, showing the rapid rise of advanced cities in Asia. In the pattern of global urban economic vitality, the vitality of U.S. urban economy is strong, and the vitality of Chinese urban economy grows rapidly. In this regard, all of the top six global cities are from the United States. It indicates that, although the pattern of world urban competitiveness is changing constantly with the rapid rise of Asian cities, the economic vitality of U.S. cities is still in a leading position. However, with the rapid development of Asian cities, the advantage of U.S. cities will weaken in the future. Particularly, with the further development of China's cities, their economic vitality will be further enhanced to be hopeful to challenge the leading position of U.S. cities (Table 10.5; Fig. 10.5).

10.2.2 The Economic Vitality of African Cities Is the Worst, and the Economic Vitality Difference of Asian Cities Is the Largest

From the global perspective, among the top 100 cities in economic vitality, 55 cities are from North America. Compared with other continents, it has an absolute quantitative advantage. The region with the highest mean value of urban economic vitality index is Oceania, which is 0.363, followed by North America and Europe. It can be seen that, in terms of the average level, European and American cities still have an absolute advantage. The variation coefficient of economic vitality index in Asia is the highest, which is 1.223. This shows that the economic vitality difference between Asian cities is the largest compared with other regions of the world. The mean value of urban economic vitality index of South America, Oceania, Asia, Europe, North America and Africa is all larger than the median. It shows that in all these regions, the number of cities with economic vitality above the regional average level is less than that below the average level. The levels of cities with the greatest economic vitality in Asia, Europe and North America are close, while cities with the greatest economic vitality in South America and Africa are relatively laggard (Table 10.6).

10.2.3 The United States and China Have the Largest Number of Cities Entering the List of Top 100 Cities in Economic Vitality

From the mean value in Table 10.7, it can be seen that except for China and the United States, the city economic activity in other countries of BRICSs and G7 is poor. On the whole, the mean value of economic vitality index of BRICS is low, the difference between cities is large, and the coefficient of variation is high. For G7, the overall mean value is between 0.3 and 0.4, the variation coefficient is low, the economic vitality of cities is even, and the national strength is strong. According to

Table 10.5 Top ten global cities in economic vitality

City	New York	San Jose	Los Angeles	Houston	San Francisco	Dallas	London	Shenzhen	Guangzhou	Beijing
Continent	North America	North America	North America	North America	North America	North America	Europe	Asia	Asia	Asia
Index	1	0.963	0.895	0.876	0.872	0.860	0.730	0.715	0.711	0.705
World ranking	1	2	3	4	5	6	7	8	9	10

Source City and Competitiveness Index Database, CASS

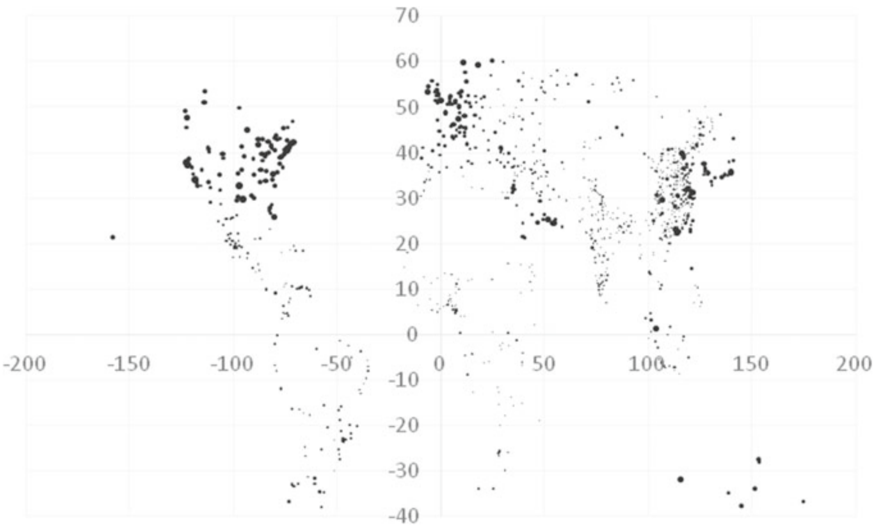


Fig. 10.5 Distribution of global urban economic vitality

Table 10.6 Continental distribution of global urban economic vitality

Region	Number of top 100 cities	Mean value	Variation coefficient	Median	City with maximum value	Index	World ranking
Asia	25	0.087	1.223	0.047	Shenzhen	0.715	8
Europe	16	0.207	0.692	0.199	London	0.73	7
North America	55	0.304	0.687	0.301	New York	1	1
South America	0	0.091	0.429	0.088	Santiago	0.197	222
Oceania	4	0.363	0.268	0.350	Perth	0.545	29
Africa	0	0.045	0.534	0.039	Pretoria	0.12	313

Source City and Competitiveness Index Database, CASS

Fig. 10.1 City distribution of economic vitality index, except for Germany, the city samples in all other European countries are few. In the United States, the cities with good economic vitality mainly concentrate in the northeast area and the western coast, with few in the central region. In China, the cities with good economic vitality are mainly in the eastern coastal areas, with few in the central and western areas. The overall economic vitality of Russia, India, Brazil, Italy, and South Africa is weak, without any city entering the list of global top 100 cities.

Table 10.7 Comparison of economic vitality index between BRICS and G7

	Country	Sample	Number of top 100 cities	Mean value	Variation coefficient
BRICS	China	292	13	0.087	1.269
	Russia	33	0	0.091	0.467
	India	102	0	0.044	0.537
	Brazil	32	0	0.081	0.339
	South Africa	6	0	0.078	0.348
G7	UK	13	1	0.291	0.467
	France	9	1	0.278	0.364
	USA	79	50	0.423	0.424
	Germany	13	5	0.336	0.258
	Italy	16	0	0.211	0.220
	Japan	10	2	0.289	0.469
	Canada	9	5	0.347	0.217

Source City and Competitiveness Index Database, CASS

10.2.4 The Economic Vitality of Urban Agglomerations in the United States Outshines the Rest and the Differences Within the Urban Agglomerations of Developing Countries Are Huge

Viewing from the mean value of economic vitality, the top three urban agglomerations are from the United States, which are Texas Delta, the northeastern urban agglomeration, and Southern California urban agglomeration. The last three urban agglomerations are Sao Paulo metropolitan area, Mumbai metropolitan area, and Bangalore urban agglomeration. From the perspective of the number and proportion of cities entering the top 100 global cities list, U.S. urban agglomerations are far ahead, while the quantities and proportions of listed urban agglomerations of other countries are small. Viewing from the variation coefficient of economic vitality, except for Sao Paulo urban agglomeration, the city economic vitality difference of urban agglomerations of developing countries is huge, and among them, the variation coefficient of Bangalore urban agglomeration and Beijing-Tianjin-Hebei urban agglomeration is the largest. By contrast, the economic vitality difference in urban agglomerations of developed countries is little, with the least variation coefficient in Holland-Belgium urban agglomeration and Rhine-Ruhr urban agglomeration (Table 10.8).

Table 10.8 Comparison of economic vitality of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	No. 1 city	Number of top 100 cities	Mean value of economic vitality	Variation coefficient of economic vitality
Yangtze River Delta urban agglomeration	China	26	Shanghai	4	0.152	1.005
Midwest urban agglomeration	USA	13	Chicago	11	0.429	0.220
Pearl River Delta urban agglomeration	China	13	Shenzhen	2	0.204	1.176
London-Liverpool urban agglomeration	UK	10	London	1	0.310	0.523
Beijing-Tianjin-Hebei urban agglomeration	China	10	Beijing	2	0.167	1.492
Northeast urban agglomeration	USA	12	New York	10	0.503	0.395
Bangalore urban agglomeration	India	6	Bangalore		0.076	6.193
Rhine-Ruhr urban agglomeration	Germany	4	Dusseldorf	3	0.351	0.090
Piedmont urban agglomeration	USA	6	Atlanta	5	0.407	0.234
Texas Delta	USA	7	Houston	6	0.536	0.431
Holland-Belgium urban agglomeration	Europe	6	Amsterdam	1	0.319	0.205
Mumbai metropolitan area	India	4	Mumbai	0	0.080	0.732
Sao Paulo metropolitan area	Brazil	7	Jundiaí	0	0.116	0.203
Southern Florida urban agglomeration	USA	4	Miami	2	0.365	0.312
Southern California urban agglomeration	USA	4	Los Angeles	2	0.487	0.620
State capital region of Seoul	The Republic of Korea	6	Seoul	1	0.216	0.829
Jakarta metropolitan area	Indonesia	4	Jakarta	0	0.126	1.050

Source City and Competitiveness Index Database, CASS

10.2.5 *The Increase of High-Income Population Has Greater Influence on the Economic Vitality of Cities with a Low Proportion of High-Income Population*

Through analyzing the revealed competitiveness index (as shown in Fig. 10.6 abscissa) with the sustainable competitiveness index (as shown in Fig. 10.6 ordinate) formed by integrating the population size with an annual income of more than USD15,000 with the incremental population with an annual income of more than USD15,000 in recent five years in the sample cities, and classifying the 1035 global cities into Category A, B, C, and D based on their revealed competitiveness indexes, it is found that, the revealed competitiveness index and the economic vitality index are highly positively correlated. That is, the larger the city's high-income population and the increment, the greater the city's economic vitality. Specifically, according to the gradient of the fitted lines, the high-income

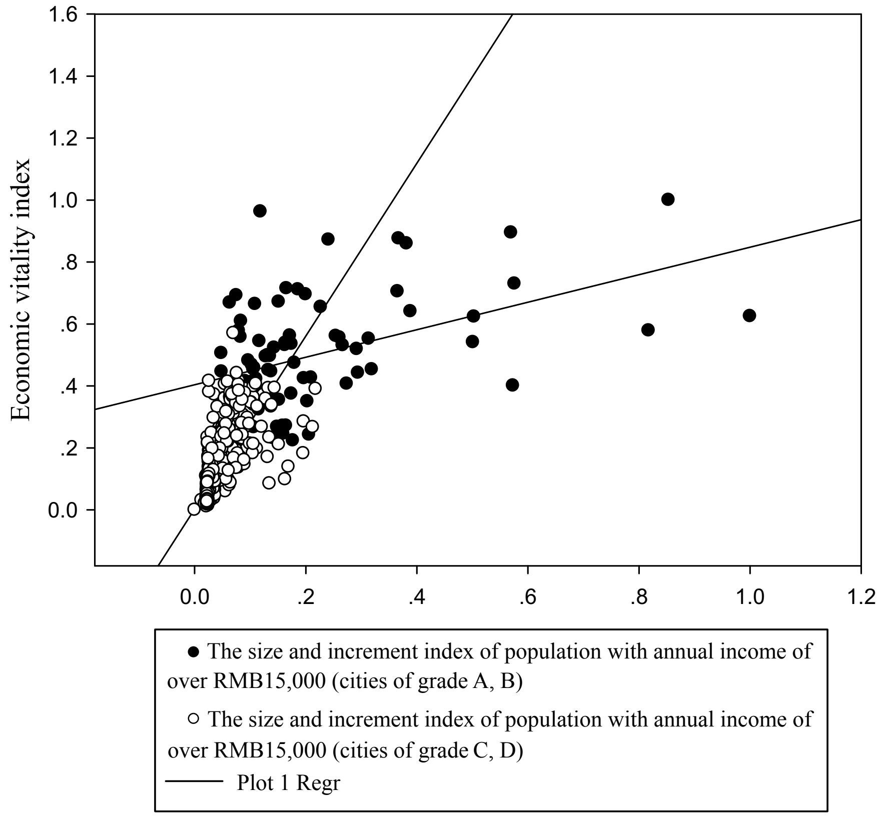


Fig. 10.6 Correlation between the revealed competitiveness index and the sustainable competitiveness index

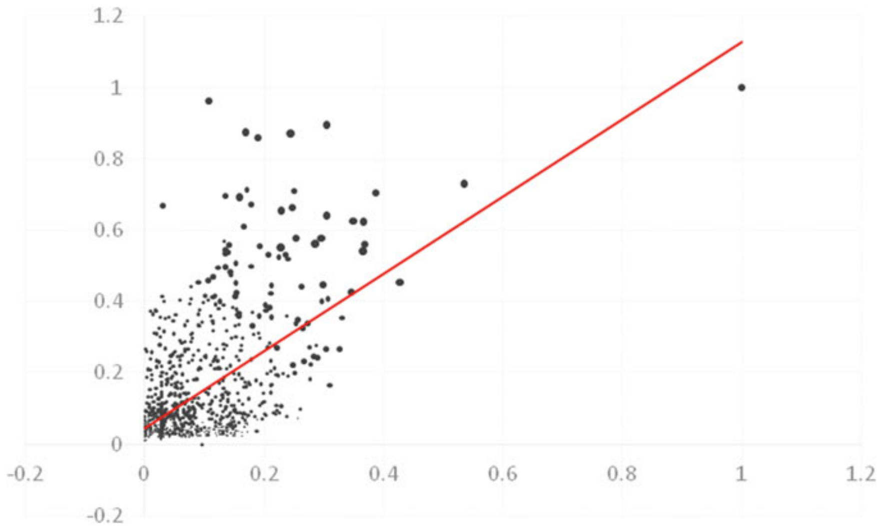


Fig. 10.7 Correlation between global connection and economic vitality

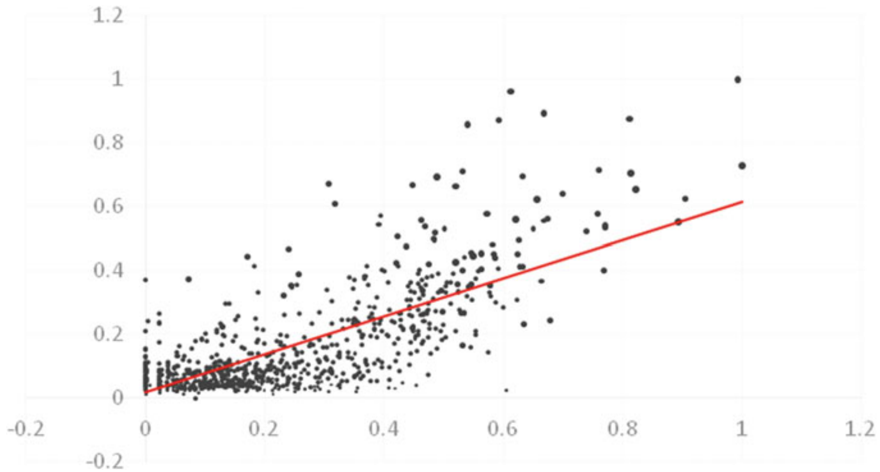


Fig. 10.8 Correlation between technological innovation and economic vitality

population size and the increment have greater impact on the economic vitality of cities with lower overall revealed competitiveness index (Fig. 10.6).

In addition, it is found that technological innovation and economic vitality are positively correlated, so are global connection and economic vitality, government management and economic vitality, and infrastructure and economic vitality (Figs. 10.7, 10.8, 10.9 and 10.10).

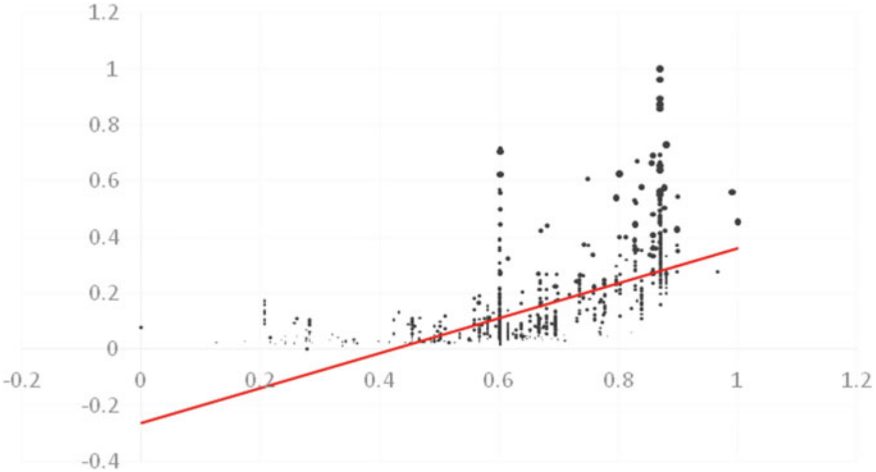


Fig. 10.9 Correlation between government management and economic vitality

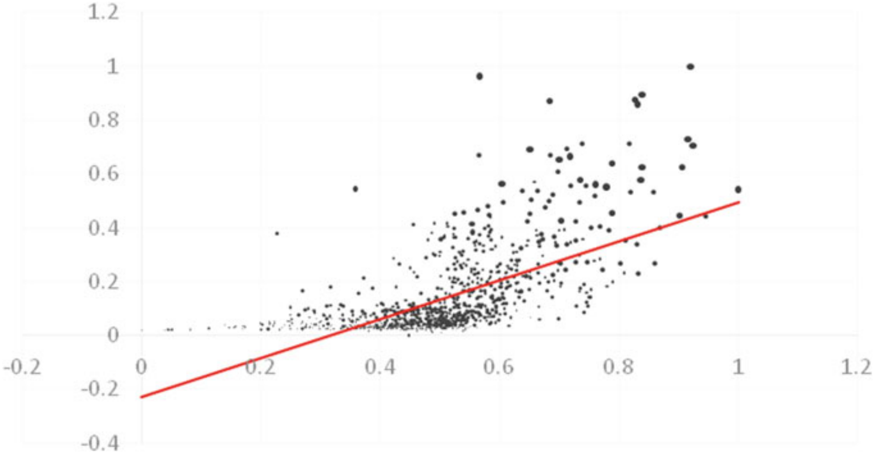


Fig. 10.10 Correlation between infrastructure and economic vitality

10.3 Global Urban Human Capital Potential Pattern

10.3.1 The Human Capital Potential of U.S. Cities Outshines that of Other Top Cities in the World

The human capital potential is a composite index combining the university index with the proportion of people aged 20–29. In 2014–2015, of the 1035 sample cities across the world, the top ten cities in human capital potential were: San Jose, Boston, Seattle, Austin, Baltimore, New Haven, Philadelphia, New York, San Diego, and Toronto. The top ten cities are all in North America, nine of which are from the USA and one is from Canada. It indicates that the human capital potential of American cities surpasses that of other cities in the world which is still weak. However, with the rapid development of Asian cities, the advantage of American cities will weaken in the future. Particularly, with the further development of China's cities, their human capital potential will be further enhanced to be hopeful to challenge the leading position of American cities (Table 10.9).

From the global perspective, with the decline in ranking of urban human capital potential, the index sees a constant decrease, and meanwhile, the human capital potential gap between cities shows a reduction to increase trend with the fall of the ranking of human capital potential. Specifically, within the ranking of human capital potential from 1 to 100, the city competitiveness index fell by 0.446. Within the ranking of 100–200, the index decreased by 0.103. Within the ranking of 200–300, the index decreased by 0.049. Within the ranking of 700–800, the index fell by 0.028. Within the ranking of 800–900, the index fell by 0.04. Within the ranking of 900–1000, the index fell by 0.072. This shows that the human capital potential index gap of cities with good human capital potential and poor human capital potential is huge, while the human capital potential gap of cities with medium human capital potential is small (Figs. 10.11, 10.12 and 10.13).

10.3.2 Asia Has the Largest Number of Cities Entering the List of Top 100 Human Capital Cities, and the Human Capital Difference of Cities in North America Is the Biggest

From the global perspective, among the top 100 cities in human capital potential, 54 cities are from Asia. Compared with other continents, it has an absolute quantitative advantage. In addition, North America also has many cities entering the list, the number of which is 28. The region with the highest average urban human capital potential index is Oceania, which is 0.518, followed by North America. It finds that, in terms of the average level, North American cities still have an absolute advantage. The variation coefficient of human capital potential index in North America is the highest, which is 0.207. This shows that the human capital potential difference between North American cities is the largest compared with other regions of the world. Except Oceania and Asia, the mean value of urban human capital potential index of South America, Europe, North America and Africa is all larger than the median, which shows that in all these areas, the number of cities with human capital potential above the regional average level is less than that below the average level.

Table 10.9 Top ten global cities in human capital potential

City	San Jose	Boston	Seattle	Austin	Baltimore	New Haven	Philadelphia	New York	San Diego	Toronto
Continent	North America	North America	North America	North America	North America	North America	North America	North America	North America	North America
Index	1	0.981	0.953	0.926	0.918	0.912	0.902	0.900	0.885	0.839
World ranking	1	2	3	4	5	6	7	8	9	10

Source City and Competitiveness Index Database, CASS

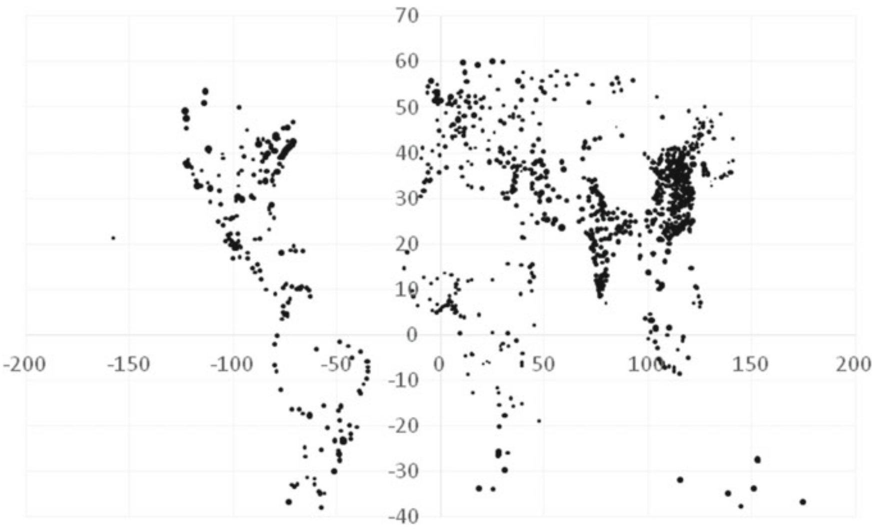


Fig. 10.11 Distribution of human capital potential of global cities

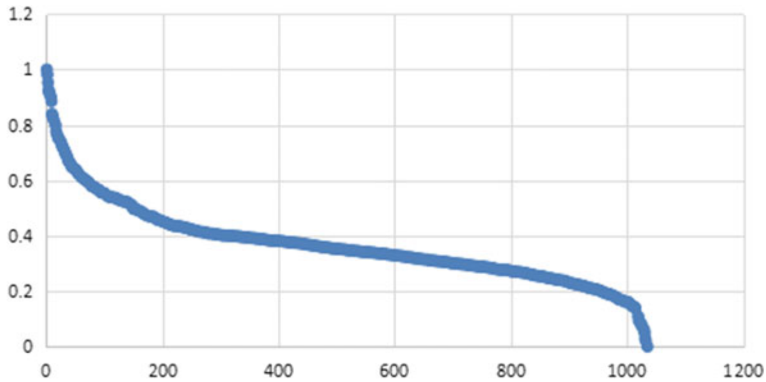


Fig. 10.12 Ranking distribution of global urban human capital potential

The levels of cities with the highest human capital potential in Asia, Europe and North America are close, while cities with the highest human capital potential in South America, Oceania and Africa are laggard (Table 10.10).

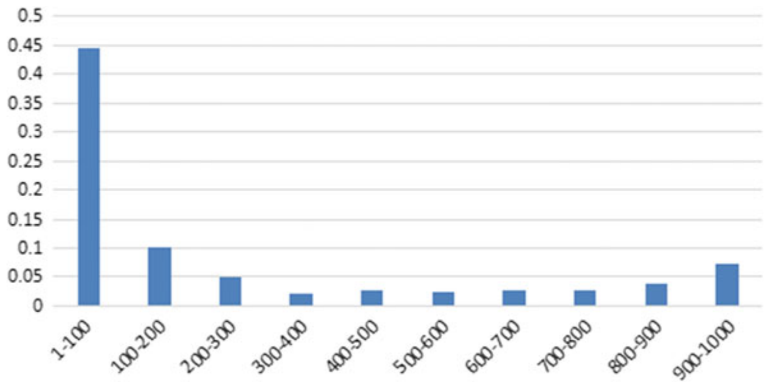


Fig. 10.13 Gap of global urban human capital potential index. *Source* City and Competitiveness Index Database, CASS

Table 10.10 Continental distribution of global urban human capital potential

Region	Number of top 100 cities	Mean value	Variation coefficient	Median	City with maximum value	Index	World ranking
Asia	54	0.373	0.131	0.373	Dongguan	0.83	11
Europe	9	0.323	0.126	0.301	London	0.82	12
North America	28	0.418	0.207	0.353	San Jose	1	1
South America	4	0.386	0.081	0.368	Sao Paulo	0.747	23
Oceania	2	0.518	0.144	0.522	Brisbane	0.69	33
Africa	3	0.299	0.089	0.282	Capetown	0.633	53

Source City and Competitiveness Index Database, CASS

10.3.3 The United States and China Have the Largest Number of Cities Entering the List of Top 100 Cities in Human Capital

Through the mean value in Table 10.11, we can see that except for China and the United States, other countries of BRICS and G7 have very few cities on the list of the top 100 global cities in human capital. Overall, the human capital index mean value of BRICS is about the same as that of G7, while the difference between cities is smaller than that of G7. According to Fig. 10.11 City distribution of human capital index, except for the UK, other European countries have no sample city. In the United States, the cities with good human capital mainly concentrate in the northeast area and the western coast, with few in the central region. In China, the

Table 10.11 Comparison of human capital potential index between BRICS and G7

	Country	Sample	Number of top 100 cities	Mean value	Variation coefficient
BRICS	China	292	37	0.365	0.405
	Russia	33	0	0.317	0.122
	India	102	2	0.401	0.120
	Brazil	32	2	0.401	0.217
	South Africa	6	3	0.531	0.144
G7	UK	13	3	0.448	0.386
	France	9	0	0.236	0.188
	America	79	20	0.425	0.583
	Germany	13	0	0.326	0.335
	Italy	16	0	0.215	0.578
	Japan	10	1	0.220	0.731
	Canada	9	6	0.622	0.250

Source City and Competitiveness Index Database, CASS

cities with good human capital are mainly in the eastern coastal areas, with few in the central and western areas. The overall human capital of Russia, Germany, France, and Italy is weak, with no city entering the list of global top 100 cities.

10.3.4 The Human Capital Potential of American and Chinese Urban Agglomeration Is Stronger, While the Human Capital of German and Korean Urban Agglomerations Is Weaker

Viewing from the mean value of human capital potential, the top three urban agglomerations are from the United States and China, which are the Northeast urban agglomeration, Pearl River Delta urban agglomeration, and Piedmont urban agglomeration. The last three urban agglomerations are Rhine-Ruhr urban agglomeration, Southern Florida urban agglomeration, and Seoul state capital region. Viewing from the number of human capital cities entering the list of global top 100 cities, America and Chinese urban agglomerations have the most listed cities, while only few cities of urban agglomerations in other countries have entered the list. Viewing from the variation coefficient of economic vitality, except for Sao Paulo urban agglomeration, the city human capital difference in urban agglomerations of developing countries is small, with the smallest variation coefficients in Jakarta metropolitan area and Mumbai metropolitan area. By contrast, the

Table 10.12 Comparison of human capital potential between major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Best city of human capital	Number of top 100 cities	Mean value of human capital	Variation coefficient of human capital
Yangtze River Delta urban agglomeration	China	26	Hefei	6	0.405	0.380
Midwest urban agglomeration	USA	13	Chicago	2	0.434	0.437
Pearl River Delta urban agglomeration	China	13	Dongguan	5	0.538	0.263
London-Liverpool urban agglomeration	UK	10	London	2	0.495	0.310
Beijing-Tianjin-Hebei urban agglomeration	China	10	Beijing	4	0.480	0.298
Northeast urban agglomeration	USA	12	Boston	6	0.594	0.548
Bangalore urban agglomeration	India	6	Bangalore	1	0.509	0.288
Rhine-Ruhr urban agglomeration	Germany	4	Hamburg	0	0.323	0.321
Piedmont urban agglomeration	USA	6	Atlanta	4	0.520	0.365
Texas Delta	USA	7	Austin	2	0.465	0.539
Holland-Belgium urban agglomeration	Europe	6	Amsterdam	1	0.327	0.437
Mumbai metropolitan area	India	4	Mumbai	1	0.452	0.174
Sao Paulo metropolitan area	Brazil	7	Sao Paulo	2	0.449	0.349
Southern Florida urban agglomeration	USA	4	Miami	0	0.316	0.360
Southern California urban agglomeration	USA	4	San Diego	1	0.393	0.835
State capital region of Seoul	The Republic of Korea	6	Seoul	1	0.268	0.659
Jakarta metropolitan area	Indonesia	4	Jakarta	0	0.367	0.214

Source City and Competitiveness Index Database, CASS

differences of human capital in urban agglomerations of developed countries are large, with the largest variation coefficients in Southern California urban agglomeration and the state capital region of Seoul (Table 10.12).

10.3.5 *The Higher the Level of Urban Human Capital Potential, the Greater the Internal City Differences*

Global cities are divided into such four grades as A, B, C, D based on their ranking. As is shown in the figure below, with the decline of the city grade, the mean value of human capital potential shows a gradient decrease trend, meanwhile, the coefficient of variation also shows a downward trend. This indicates that the higher the city grade, the greater the difference of internal cities (Fig. 10.14).

10.4 Technology Innovation Index

10.4.1 *Overall Pattern: The Global Focus Is in North America, and the Development of Global Cities Is Extremely Unbalanced*

Global technology innovation is highly concentrated, which is mainly in a few cities. The technology innovation index is composed of the patent application index and the paper index. According to calculation, in the 2016 global technology innovation index ranking, London, New York, and Tokyo are the top three. Among the top 20 cities, 9 cities are from North America, 6 are from Asia, 5 are from Europe, and no city of South America, Oceania and Africa is on the list. From the national perspective, the United States has the largest number of cities entering the list of top 20 cities, and all listed North American cities in technology innovation are from the United States and in the front rank (see Table 10.13). The focus of

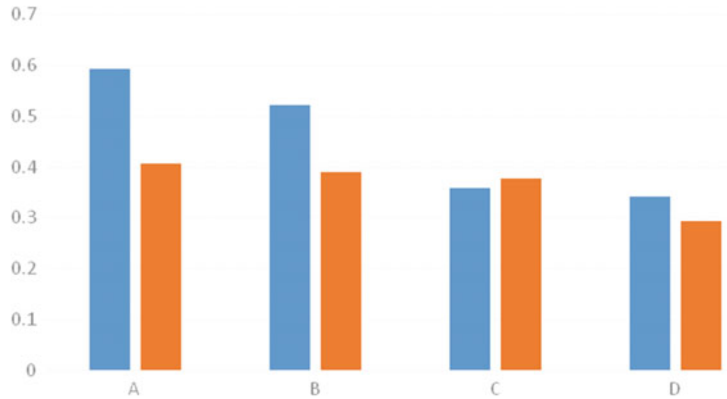


Fig. 10.14 The mean value and variation coefficient of human capital potential at different city grades

Table 10.13 Top 20 global cities in technology innovation index

Continent	Country	City	Index	Ranking	Continent	Country	City	Index	Ranking
Europe	UK	London	1.000	1	Asia	China	Shenzhen	0.759	11
North America	USA	New York	0.993	2	Asia	ROK	Seoul	0.758	12
Asia	Japan	Tokyo	0.904	3	Europe	Sweden	Stockholm	0.738	13
North America	USA	Washington DC	0.893	4	North America	USA	Chicago	0.699	14
North America	USA	Boston	0.822	5	Europe	Spain	Madrid	0.678	15
Asia	China	Beijing	0.813	6	North America	USA	Minneapolis	0.674	16
North America	USA	Houston	0.812	7	North America	USA	Los Angeles	0.668	17
North America	USA	San Diego	0.771	8	North America	USA	Philadelphia	0.668	18
Europe	France	Paris	0.770	9	Europe	Germany	Stuttgart	0.663	19
Asia	Japan	Osaka	0.769	10	Asia	China	Shanghai	0.656	20

Source City and Competitiveness Index Database, CASS

global scientific and technology innovation is still in North America. The U.S. history of economic development in the past 200 years since the founding of the United States is a history of innovation and entrepreneurship. The continual great invention and innovation makes new industries emerge one after another, which has constantly improved American productivity and greatly enhanced its economic strength and comprehensive national strength, pushing this young country to an unprecedented peak in the world's economic development. American cities such as New York, Washington, and Boston have become centers of global scientific and technology innovation. With the rise of China, Chinese cities such as Beijing, Shenzhen, and Shanghai become the technology innovation centers in East Asia, in addition to Tokyo, Osaka, and Seoul, making East Asia one of the world's most active regions in economic growth. Europe remains a world leader in scientific and technology innovation, and London and Paris still maintain strong scientific research strength.

In 2016, the mean value of technology innovation index of 1035 sample cities was 0.187 and the median was 0.131. The number of cities with index lower than the mean value reached 634, exceeding 60% of the sample cities, which revealed the overall low technology innovation index of the world. The R&D center has higher requirements for urban infrastructure, living environment, institutional environment and social culture, which forces out most of the cities. The coefficient of variation is the statistical magnitude measuring the variation of observed values of the sample data, the variation coefficient of global technology innovation index was 1.02, and the standard deviation was 0.191, indicating the great difference in global urban technology innovation index and the high degree of dispersion. According to the kernel density distribution (Fig. 10.15), the distribution pattern of global technology innovation index is: the peak of frequency distribution significant turns to the left, suggesting that cities are concentrated in low-value regions of technology innovation, while the long tail of distribution extends to the right. Compared with the normal distribution, the technology innovation index concentrates on the left and the peak is higher. It again verifies the conclusion that, the

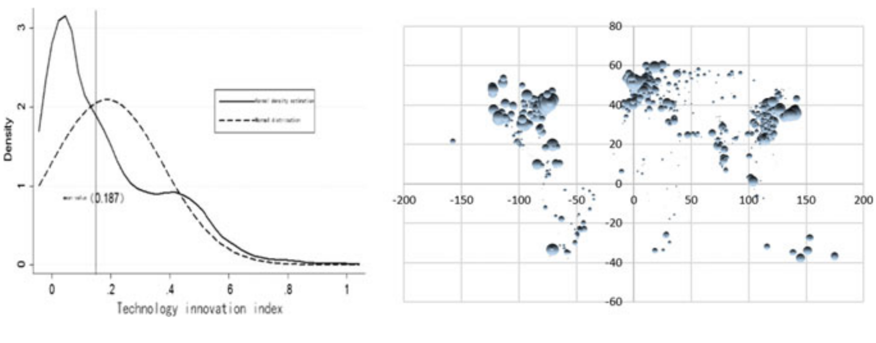


Fig. 10.15 The kernel density distribution of technology innovation index and urban distribution. *Source* City and Competitiveness Index Database, CASS

world's urban technology innovation index is in a general status, and the gap between indexes of different cities is large.

10.4.2 Regional Pattern: The National Gap Between North and South Is Wide, and the Difference Within Asia Is Large

From continental distribution of top 100 global cities in technology innovation index (see Table 10.14), North America and Europe have the best performance, with 40 and 27 cities entering the list respectively, accounting for 30.53 and 20.45% of their corresponding city sample. Asia has the most sample cities, accounting for more than half of all sample cities. 30 of the Asian cities have entered the top 100 cities list, accounting for 5.12%. From the perspective of the number of top 100 cities, the world's pioneers and centers of technology innovation are concentrated in the Northern Hemisphere, and in contrast, the Southern Hemisphere lags far behind—especially in Africa and South America, the technology innovation of many cities remains blank. Although Oceania has the highest proportion of cities on the list of top 100 global cities, the sample cities are relatively few, with 3 cities entering the list of top 100 cities and ranking at the bottom.

Table 10.15 also provides the mean value and coefficient of variation of all continents' R&D index. Oceania, Europe, and North America ranked the top three of the enterprise ontology index in 2013. It is notable that the mean value of Asian technology innovation index is quite high, ranking only second to that Oceania and being far ahead of Europe and North America as well as the world in the mean value. And the coefficient of variability is the lowest among all continents,

Table 10.14 The continental situation of technology innovation index and the proportion of top 100 cities

Region	Sample size	Number of top 100 cities and the proportion	Mean value	Variation coefficient	Maximum value		
					City	Index	World ranking
Asia	585	30 (5.12%)	0.406	0.302	Tokyo	0.904	3
Europe	132	27 (20.45%)	0.321	0.572	London	1	1
North America	131	40 (30.53%)	0.351	0.638	New York	0.993	2
South America	77	0 (0%)	0.128	0.906	Barcelona	0.771	163
Oceania	7	3 (42.86%)	0.420	0.323	Melbourne	0.541	55
Africa	103	0 (0%)	0.058	1.657	Johannesburg	0.397	175
World average	1035	100 (100%)	0.187	1.02	London	1	1

Source City and Competitiveness Index Database, CASS

indicating that between Asian countries and cities, the gap of technology innovation index is narrowing and the city innovation vitality is uplifting.

10.4.3 National Pattern: The Strength of G7 Is Strong, but the Distribution Within Major Countries Is Uneven

The report selects BRICS and G7 members as representative countries to analyze the country pattern in technology innovation index. Through the mean value and variation coefficient in Table 10.15, it can be seen that the overall strength of BRICS is significantly weaker than that of G7. On the whole, the mean value of technology innovation index of BRICS is low, the difference between cities is large, and the coefficient of variation is relatively high. By contrast, the mean value of G7 is all around 0.5, the coefficient of variation is very low, the cities' technology innovation capability is relatively balanced, and the national strength is strong. According to Fig. 10.15 (right) Urban distribution of technology innovation index, European countries have few sample cities, with concentrated distribution of technology innovation cities. In the United States, the technology innovation cities mainly concentrate in the northeast area and the western coast, and the cities in the central region are relatively few. In China, the technology innovation cities are mainly in the eastern coastal areas, with the largest number and proportion of cities entering the list of top 100 global cities among BRICS, but cities in the central and western areas are relatively few. In Russia, the cities are mainly in the European

Table 10.15 Comparison of technology innovation index between BRICS and G7

	Country	Sample size	Number of top 100 cities and the proportion	Mean value	Variation coefficient
BRICS	China	292	13 (4%)	0.184	0.798
	Russia	33	1 (3%)	0.151	0.671
	India	102	2 (2%)	0.081	1.532
	Brazil	32	0 (0%)	0.137	0.905
	South Africa	6	0 (0%)	0.281	0.423
G7	UK	13	4 (31%)	0.481	0.344
	France	9	1 (11%)	0.405	0.426
	USA	79	34 (43%)	0.467	0.376
	Germany	13	7 (54%)	0.471	0.270
	Italy	16	0 (0%)	0.321	0.333
	Japan	10	6 (60%)	0.554	0.296
	Canada	9	7 (78%)	0.493	0.133

Source City and Competitiveness Index Database, CASS

area, with almost none in the vast land of Siberia, Asia. The overall distribution in India, Brazil, and South Africa is relatively sporadic.

10.4.4 The Pattern of Urban Agglomerations: The Urban Agglomerations of European and American Countries Are Evenly Developed, While in Developing Countries, They Are Concentrated in the Central Cities

Based on the size of urban agglomeration, the research group selects several important urban agglomerations of the United States, China, India, UK, and Germany. The strength of urban agglomerations of the United States and the UK is prominent and great, with the mean value of urban technology innovation index above 0.5 and the level being even and remarkable. Although the scale of urban agglomerations in developing countries such as China and India is large, technology innovation only concentrates in central cities and most cities are lagging behind in technology innovation, so the coefficient of variation becomes larger. The urban development of the two largest urban agglomerations in the United States is balanced and the mean value is high. The central cities Chicago and New York are world-leading in technology innovation, and other cities also have good technology innovation index. The technology innovation indexes of urban agglomerations of China and India show an obvious central-periphery mode, that is, central cities are outstanding in technology innovation, the gap between central cities and other cities is very large, and the development of urban agglomerations is extremely uneven (Table 10.16).

10.4.5 The Main Findings Are: There Is Significant Positive Correlation Between the Technology Innovation Index and the Size of High-Income Population

Through analyzing the size of population with annual income of more than USD15,000 in the sample cities and the urban technology innovation index, it is found that the larger the higher-income population, the greater the scientific and technological innovation strength. Compared with cities having less than 10,000 people with the income above USD15,000, the fitted values of the technology innovation index of cities having more than 10,000 people with the income above USD15,000 are more steep, indicating that the higher the urban income level is, the more helpful it is to improve the city's scientific and technological innovation

Table 10.16 Comparison of the mean value of technology innovation index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Number of top 100 cities	No. 1 city	Index of No. 1 city (ranking)	Index of last city (ranking)	Mean value deducting the index of No. 1 city	Variation coefficient of technology innovation
Yangtze River Delta	China	26	4	Shanghai	0.656 (20)	0.023 (763)	0.194	0.477
Midwest	USA	13	7	Chicago	0.699 (14)	0.356 (215)	0.441	0.205
Pearl River Delta	China	13	3	Shenzhen	0.759 (11)	0.065 (663)	0.273	0.549
London-Liverpool	UK	10	5	London	1 (1)	0.375 (197)	0.382	0.368
Beijing-Tianjin-Hebei	China	10	1	Beijing	0.813 (6)	0.060 (670)	0.195	0.746
Northeast	USA	12	8	New York	0.993 (2)	0.254 (314)	0.565	0.353
Bangalore	India	6	0	Hyderabad	0.474 (101)	0.174 (425)	0.269	0.343
Rhine-Ruhr	Germany	4	1	Hamburg	0.577 (40)	0.244 (324)	0.269	0.421

Source City and Competitiveness Index Database, CASS

capability for technology innovation needs strong financial support. In reverse, the urban scientific and technological innovation capability will help raise the city's income level.

10.5 Social Index

10.5.1 Overall Pattern: The Global Social Index Is Leading and Cities of Japan and the Republic of Korea Are Outstanding on the Whole

In 2016, the top three of the global social index ranking were Jeonju, Zurich and Sapporo. The top ten cities in the social index ranking were all in Asia and Europe, of which 8 were from the Republic of Korea and Japan in Asia. The social index is composed of such two indicators as the Gini coefficient and the crime rate, the cities of the Republic of Korea and Japan are world-leading mainly thanks to the low crime rate. And the Gini coefficient is around 0.3, which is low from a global perspective, indicating that the social development is balanced and the gap between the rich and the poor is not large. Specifically, the gap between the social indices of the first ten cities is not large, with all the indexes above 0.9, which shows that the social development of cities in Japan and the Republic of Korea are basically at the same level (Table 10.17).

In 2016, the mean value of technological innovation index of 1035 sample cities was 0.612 and the median was 0.651. The mean value was lower than the median. The number of cities with index lower than the mean value was only 376, accounting for about 1/3 of the total sample cities, which indicated an overall high social index in the world. The global social index had a coefficient of variation of 0.262 and a standard deviation of 0.160. But from the kernel density estimation for European and American countries and African and South American countries respectively (Fig. 10.16), it can be viewed that the peak value of European and American countries was around 0.7, while the peak value for the backward African and South American countries was around 0.3, showing that social instability mainly exists in Africa and South America (Fig. 10.17).

10.5.2 Regional Pattern: East Asia and Europe Are in the Lead While South America and Africa Are Lagging Behind

Judging from the distribution of social index, Europe and East Asia have higher and even social index, followed by North America, and the status in Latin America is the worst. The social index of European and Asian regions is generally better,

Table 10.17 Top ten global cities in social index

City	Jeonju	Zurich	Sapporo	Nagoya	Munich	Kwangju	Daejeon	Daegu	Cheongju	Osaka
Country	ROK	Switzerland	Japan	Japan	Germany	ROK	ROK	ROK	ROK	Japan
Continent	Asia	Europe	Asia	Asia	Europe	Asia	Asia	Asia	Asia	Asia
Index	1	0.976	0.971	0.962	0.962	0.937	0.935	0.935	0.934	0.933
Ranking	1	2	3	4	5	6	7	8	9	10

Source City and Competitiveness Index Database, CASS

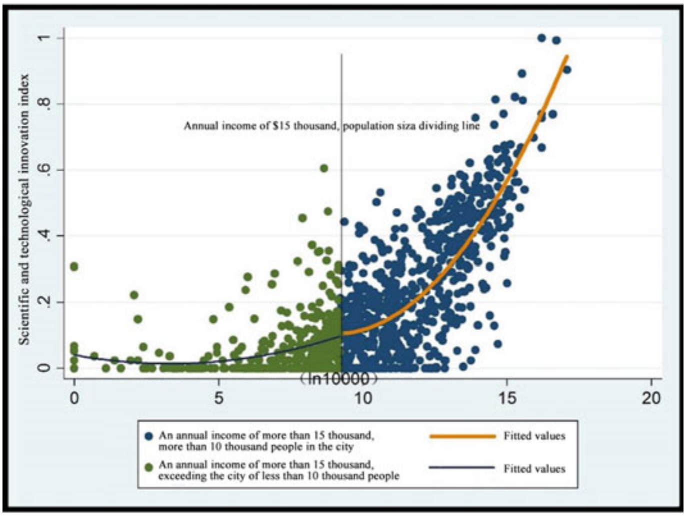


Fig. 10.16 Correlation between the size of population with annual income of more than USD15,000 and the urban technology innovation index.

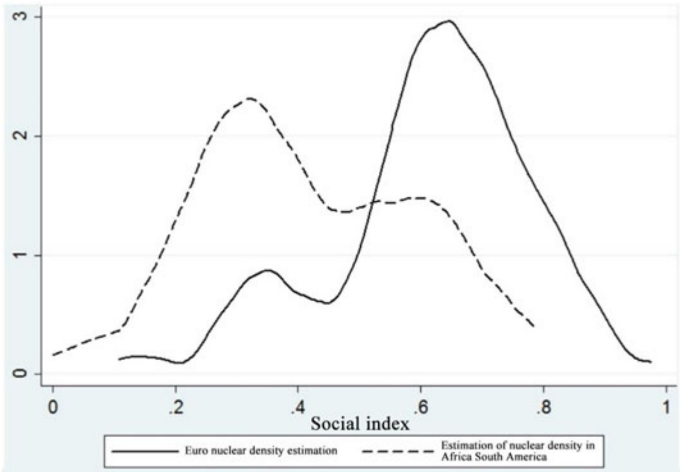


Fig. 10.17 The kernel density distribution of social index. *Source* City and Competitiveness Index Database, CASS

especially in Japan and the Republic of Korea of East Asia and Western European countries, where the crime rate is low and the Gini coefficient shows a smaller gap between the rich and the poor and the social development is healthy and stable. But in Central Asia the social problems are prominent. In contrast, the crime rate of

Table 10.18 The continental situation of social index and the proportion of top 100 cities

Region	Sample	Number of top 100 cities and the proportion	Mean value	Variation coefficient	Maximum value		
					City	Index	World ranking
Asia	585	58 (9.91%)	0.671	0.137	Jeonju	1	1
Europe	132	33 (25%)	0.681	0.184	Zurich	0.976	2
North America	131	7 (5.34%)	0.546	0.311	Quebec	0.861	43
South America	77	0 (0%)	0.321	0.308	Managua	0.543	816
Oceania	7	0 (0%)	0.698	0.066	Sydney	0.765	115
Africa	103	2 (1.94%)	0.480	0.397	Tanzania	0.784	87
World average	1035	100 (100%)	0.187	1.02	Jeonju	1	1

Source City and Competitiveness Index Database, CASS

cities in North America is generally higher, and especially the large gap between the rich and the poor and the poor social structure lead to a low social index in developed countries such as the United states. In Africa and South America, the society is turbulent featuring huge social safety hazards and frequent conflicts, so the social indexes are very low (Table 10.18).

10.5.3 National Pattern: The Difference Between G7 Countries Is Large, While Brazil and South Africa of BRICS Are Weak

As shown in Fig. 10.18 Global distribution of social index, both ends of Eurasia are prominent but the central region is downward. The social index of Western European countries and Japan and the Republic of Korea are high on the whole, while the social index of Central Asia is low because of social instability. The northeastern and western coastal cities of the United States have higher social indexes, while the central areas have lower ones, such as Bermingham, Baton Rouge. There are lots of cities in India, but the average social index is 0.705. The social development between cities is balanced, without great difference. The mean value of China's social index is 0.653, but the social index of economically developed cities such as Guangzhou, Shenzhen, Dongguan, and Taiyuan is lower, mainly because that the income difference of urban residents is big and the Gini coefficient is high despite the low crime rate and good social security. The social indexes of Brazil and South Africa are low, with social unrest and the big income gap as the main bottleneck of urban development. The social indexes of Sao Paulo and Rio de Janeiro of Brazil rank around the 1000th among cities worldwide.

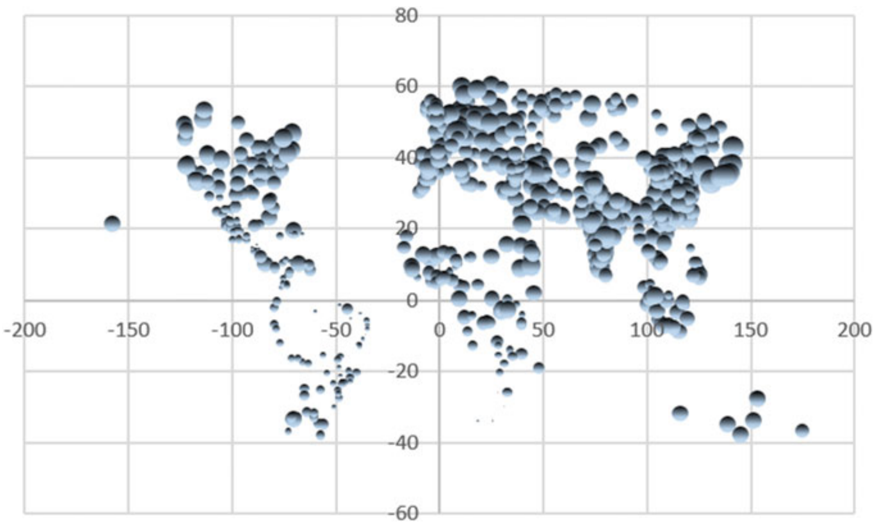


Fig. 10.18 The social index distribution of global cities. *Source* City and Competitiveness Index Database, CASS

10.5.4 The Urban Agglomeration Pattern of Social Index

The social index of central cities in urban agglomerations is not dominant, and the Rhine-Ruhr urban agglomeration in Germany is outstanding. Take typical urban agglomerations as examples. The social indexes of the urban agglomerations are basically the same as the national level. The social indexes of big countries such as China, the United States and India have no advantage. In addition, in urban agglomerations such as China's three urban agglomerations, American midwestern and northeastern urban agglomerations, the UK's London-Liverpool urban agglomeration, and Indian Bangalore urban agglomeration, the city with the highest social index is not the central city. Four cities in Rhine-Ruhr urban agglomeration of Germany have seen balanced social development and all entered the list of top 100 global cities with little gap (Table 10.19).

10.5.5 The Relation Between the Social Index and the Urban Income Level

At different per capita income levels, the correlation between the social index and the city is different. The per capita GDP is divided into two groups with USD10,000 as the boundary line. Figure 10.19 shows that the social index is positively correlated with cities with per capita GDP higher than USD10,000, and

Table 10.19 Comparison of the mean value of social index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Number of top 100 cities	No. 1 city	Index of No. 1 city (Ranking)	Index of last city (Ranking)	Mean value deducting the index of No. 1 city	Variation coefficient of technology innovation
Yangtze River Delta	China	26	0	Yancheng	0.697 (243)	0.551 (804)	0.641	0.056
Midwestern America	USA	13	0	Pittsburgh	0.706 (220)	0.443 (870)	0.602	0.117
Pearl River Delta	China	13	0	Yunfu	0.698 (237)	0.392 (906)	0.606	0.135
London-Liverpool	UK	10	0	Bristol	0.681 (308)	0.549 (808)	0.624	0.064
Beijing-Tianjin-Hebei	China	10	0	Zhangjiakou	0.679 (324)	0.604 (683)	0.656	0.033
Northeastern America	USA	12	1	Bridgeport-Stamford	0.811 (68)	0.544 (814)	0.645	0.116
Bangalore	India	6	0	Cochin	0.781 (89)	0.596 (702)	0.686	0.097
Rhine-Ruhr	Germany	4	4	Dusseldorf	0.847 (49)	0.804 (74)	0.825	0.024

Source City and Competitiveness Index Database, CASS

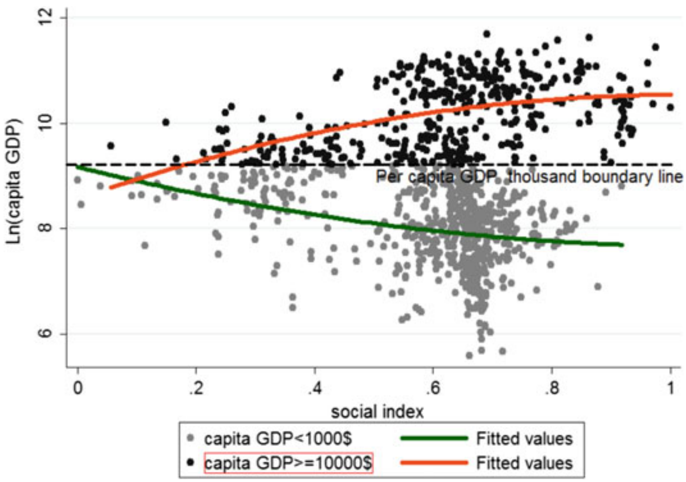


Fig. 10.19 The relationship between per capita GDP and urban social index. *Source* City and Competitiveness Index Database, CASS

negatively correlated with cities with per capita GDP below USD10,000. For cities with per capita GDP of more than USD10,000, the higher the per capita income, the higher the urban social index; for cities with per capita GDP of less than USD10,000, the lower the per capita income, the higher the urban social index. It is because that, the economic development level of low-income cities is low, the gap between the rich and the poor is little, and the Gini coefficient is small.

10.6 Ecological Environment Index Analysis

10.6.1 The Overall Pattern of Ecological Environment Index

The environmental quality of Asia, Africa and Latin America is leading, and North and South countries show polarization. In the ranking of global ecological environment index in 2016, the top three were Monrovia, General Santos and Cagayan de Oro, all of which are Asian or African cities. The top ten cities in the ecological environment index are all located in Africa, Asia and Latin America; the environmental quality index of European and North American countries falls behind, with obvious gap between North and South countries.

In 2016, the mean value of ecological environment index of 1035 sample cities in the world was 0.538, the coefficient of variation was 0.328, and the standard deviation was 0.176. The kernel density distribution of ecological environment index shows that, there are two peaks in the ecological environment index of global

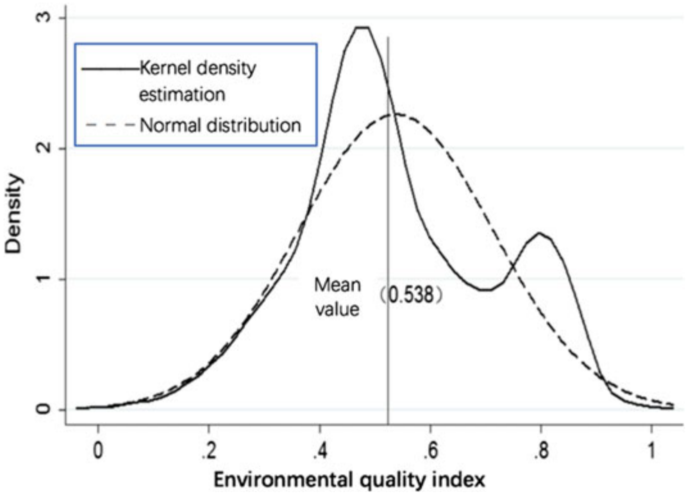


Fig. 10.20 The kernel density distribution of ecological environment index. *Source* The city and competitiveness index database of Chinese Academy of Social Sciences

sample cities, with one at around 0.8, mainly concentrated in Asian, African and Latin American countries, and the other at around 0.45, showing a normal distribution on the whole. The overall environmental quality of African countries is good. In Asia, except for a few Japanese cities in East Asia, the environmental quality is good. As a whole, the environmental quality of developing countries in Africa is significantly better than that of developed countries (Fig. 10.20).

10.6.2 The Regional Pattern of Ecological Environment Index

The ecological environment foundation of African cities is relatively good. Viewing from the distribution, the ecological environment indexes of Europe and North America are lower and even, followed by Asia, and the indexes of South America and Africa are the highest. European countries, especially northern European countries, have completed industrialization earlier and entered the post industrialization era, with the industrial structure becoming more rational and the urban environment getting good, which will become one of the world's ideal places to live in. In contrast, Asian, South American and African countries are mostly developing countries which show low economic vitality. Environmental problems in economic development have not fully shown up, and the environmental quality is relatively good currently (Table 10.20).

Table 10.20 The continental situation of ecological environment index and the proportion of top 100 cities

Region	Sample	Number of top 100 cities and the proportion	Mean value	Coefficient of variation	Maximum value		
					Urban area	Index	World ranking
Asia	585	38 (6.50%)	0.500	0.196	Istanbul	0.945	2
Europe	132	36 (27.28%)	0.581	0.249	Paris	1	1
North America	131	22 (16.79%)	0.549	0.204	New York	0.919	4
South America	77	1 (1.30%)	0.440	0.244	Buenos Aires	0.702	66
Oceania	7	2 (28.57%)	0.567	0.206	Sydney	0.703	64
Africa	103	1 (0.97%)	0.325	0.419	Cairo	0.666	96
World average	1035	100 (100%)	0.187	1.02	Paris	1	1

Source The city and competitiveness index database of Chinese Academy of Social Sciences

10.6.3 The National Pattern of Ecological Environment Index

G7 will be ahead of the world and BRICS are falling behind in environment. From the global distribution of ecological environment index in Fig. 10.21, it can be seen that the environmental quality of Europe and North America where G7 are located is getting better, while that of BRICS is becoming worse. The overall urban environmental quality of India is poor, with all cities at an even level. China's sample cities are mainly in the central and eastern areas. In recent years, affected by the haze, China's urban environmental quality is obviously worsening. The environment quality of South Africa and Brazil is also getting worse, and on the whole, the gap between them and European and North American countries in environment will narrow in the future.

10.6.4 The Urban Agglomeration Pattern of Ecological Environment Index

The environmental quality of European and North American urban agglomerations is very even, while that in urban agglomerations of India and China will obviously fall behind with remarkable internal differences. Take typical urban agglomerations as examples, the ecological environment indexes of urban agglomerations are basically the same as the national pattern. The environment in Europe and North America is optimizing while that in India and China are falling back. The urban agglomerations in European and North American countries have

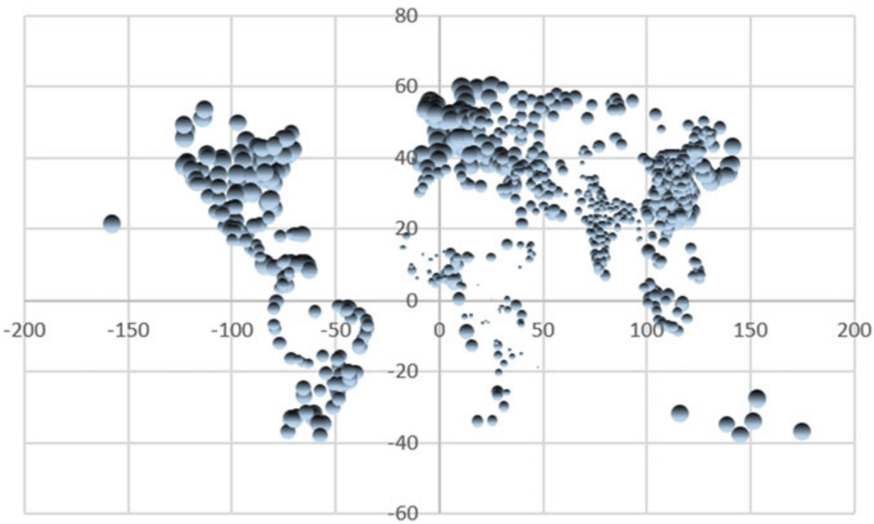


Fig. 10.21 City distribution of ecological environment index. *Source* The city and competitiveness index database of Chinese Academy of Social Sciences

high environmental quality, moreover, within the urban agglomeration, there is little difference between central cities and peripheral cities. On the contrary, the environmental quality of Chinese and Indian urban agglomerations is low, and the differences between cities are obvious (Table 10.21).

10.6.5 The Relationship Between Ecological Environment Index and Urban Per Capita GDP

If the index is revised by the development level, the ecological environment index and the city per capita GDP will show a significant positive correlation. After fitting the per capita GDP logarithm of different tiers of cities with the city ecological environment index, it is found that despite the city tier differences, the per capita GDP logarithm and the ecological environment index maintain an obvious positive correlation. The higher the urban tier is, the higher the per capita GDP logarithm and the environmental index are. As shown in Fig. 10.22, the correlation between the ecological environment index and per capita GDP of some tier-three or tier-four cities is inapparent, and these cities are mainly in central and western China, the per capita GDP and economic development level of which are low. Geographically, these sample cities are located in mountain areas where the environmental quality is relatively good, so there appears abnormal phenomenon as in Fig. 10.22.

Table 10.21 Comparison of the mean value of ecological environment index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Number of top 100 cities	No. 1 city	Index of No. 1 city (ranking)	Index of last city (ranking)	Mean value deducting the index of No. 1 city	Variation coefficient of environmental quality
Yangtze River Delta	China	26	0	Zhoushan	0.597 (339)	0.448 (730)	0.518	0.073
Midwestern America	America	13	6	Minneapolis	0.838 (42)	0.791 (137)	0.809	0.017
Pearl River Delta	China	13	0	Shenzhen	0.588 (349)	0.453 (706)	0.509	0.099
London-Liverpool	UK	10	9	London	0.922 (4)	0.810 (104)	0.848	0.040
Beijing-Tianjin-Hebei	China	10	0	Beijing	0.515 (483)	0.360 (888)	0.435	0.103
Northeastern America	America	12	11	Bridgeport-Stamford	0.918 (5)	0.809 (107)	0.837	0.036
Bangalore	India	6	0	Cochin	0.436 (763)	0.309 (950)	0.344	0.163
Rhine-Ruhr	Germany	4	4	Dusseldorf	0.849 (30)	0.817 (85)	0.824	0.016

Source The city and competitiveness index database of Chinese Academy of Social Sciences

10.7 System Management Index

10.7.1 The Overall Pattern of System Management Index

The system management of Oceania and Europe is in the lead, and the system management of developed countries is relatively perfect. Given the little difference in the system management indexes within the country, we choose the primate cities of the top ten countries in system management for analysis. In 2016, the top three global cities in system management were Hong Kong, Singapore, and Auckland. The excellent urban system management index of Asian countries is prominent, but most cities lag behind. The institutional indexes of European and North American countries show an overall advantage, while the system management indexes of Asian, African and South American countries are relatively backward. The index gap between northern and southern countries is obvious. It is noteworthy that the two countries of Oceania-New Zealand and Australia are world-leading in urban system management (Table 10.22).

In 2016, the mean value of system management index of 1035 sample cities in the world was 0.627, the coefficient of variation was 0.234, and the standard deviation was 0.147. The figure of the kernel density distribution of system management index shows that there are two peaks in the system management index of global sample cities, with one between the index of 0.8–0.9, mainly in Australia and the UK, and the other at around 0.6, showing an overall normal distribution. The overall system management of African and South American countries is poor. In

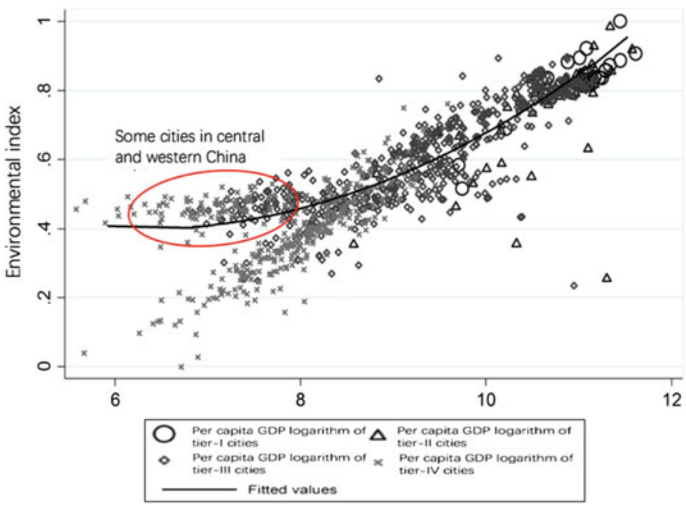


Fig. 10.22 The correlation between ecological environment index and urban per capita GDP. *Source* The city and competitiveness index database of Chinese Academy of Social Sciences

Table 10.22 The system management indexes of primate cities among the top ten global countries

City	Hong Kong	Singapore	Auckland	Sydney	London	Copenhagen	Zurich	New York	Helsinki	Oslo
Country	China	Singapore	New Zealand	Australia	UK	Denmark	Switzerland	USA	Finland	Norway
Continent	Asia	Asia	Oceania	Oceania	Europe	Europe	Europe	North America	Europe	Europe
Index	1	0.991	0.966	0.899	0.880	0.878	0.870	0.870	0.863	0.858
Ranking	1	2	3	4	5	6	7	8	9	10

Source City and Competitiveness Index Database, CASS

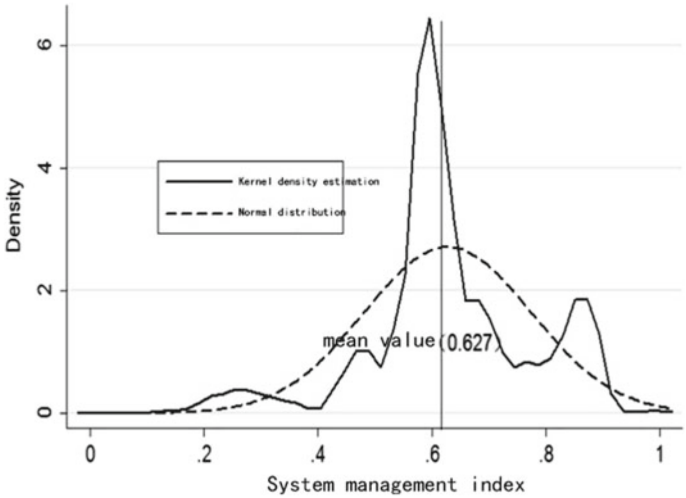


Fig. 10.23 The kernel density distribution of system management index. *Source* City and Competitiveness Index Database, CASS

Asia, except for Hong Kong, Singapore, and cities of the Republic of Korea and Japan, the system management index is not good (Fig. 10.23).

10.7.2 The Regional Pattern of System Management Index

The system management of European and American countries is advanced, while that of Asian, African and Latin American countries lags behind. Viewing from the distribution of the system management index, the indexes of Oceania, Europe and North America are higher and even, followed by Asia, and the indexes of South America and Africa are the lowest. In Asia, only Hong Kong and Singapore enter the list of top 100 global cities, followed by Japan and the Republic of Korea with the city ranking of 100–200, and the urban system management indexes of the rest cities are low. The gap between the system management in Africa and South America and that of western developed countries is huge. The system management index of Europe and North America where G7 countries are located is the best, while the indexes of BRICS generally fall behind. In various countries, the ranking from high to low of the system management indexes of G7 is the UK, the United States, Canada, Germany, Japan, France and Italy, with a mean value of 0.843. The ranking from high to low of the system management indexes of BRICS is Russia, South Africa, China, Brazil, and India, with a mean value of 0.558 (Table 10.23).

Table 10.23 The continental situation of system management index and the proportion of top 100 cities

Region	Sample size	Number of top 100 cities and the proportion	Mean value	Variation coefficient	Maximum value		
					City	Index	World ranking
Asia	585	2 (0.34%)	0.594	0.172	Hong Kong	1	1
Europe	132	17 (12.88%)	0.745	0.135	London	0.880	10
North America	131	78 (59.54%)	0.800	0.144	Bridgeport-Stamford	0.870	26
South America	77	0 (1.30%)	0.570	0.236	Valparaiso	0.802	168
Oceania	7	7 (100%)	0.908	0.028	Auckland	0.966	3
Africa	103	0 (0%)	0.467	0.293	Kigali	0.710	237
World average	1035	100 (100%)	0.187	1.02	Hong Kong	1	1

Source City and Competitiveness Index Database, CASS

10.7.3 The Urban Agglomeration Pattern of System Management Index

European and American urban agglomerations are way ahead, while those in India and China lag far behind. Take typical urban agglomerations as examples. The system management indexes of urban agglomerations are basically the same as the national level. Europe and North America are dominant while India and China lag behind. In Europe and North America, except for the Rhine-Ruhr urban agglomeration, all cities in major urban agglomerations have entered the list of top 100 global cities. In contrast, in developing countries represented by China and India, no city of their urban agglomerations is on the list of top 100, and they also rank backward (Table 10.24).

10.7.4 The Relationship Between the System Management Index and the Urban High-Income Population

The higher the city tier is, the stronger the positive correlation between the system management index and the urban high-income population is. After fitting the logarithmic population with annual income above USD15,000 against the system management index of cities of the corresponding tier, it is found that with the rise of the city tiers, the positive correlation of the system management index and the urban high-income population becomes stronger. The size of urban high-income

Table 10.24 Comparison of the mean value of system management index of major urban agglomerations in the world

Urban agglomeration	Country	Number of cities	Number of top 100 cities	Primate city	Index mean value
Yangtze River Delta	China	26	0	Shanghai (418)	0.601
Midwestern America	America	13	13	Chicago (26)	0.870
Pearl River Delta	China	13	0	Guangzhou (418)	0.601
London-Liverpool	UK	10	10	London (10)	0.880
Beijing-Tianjin-Hebei	China	10	0	Beijing (418)	0.601
Northeastern America	America	12	12	New York (26)	0.870
Bangalore	India	6	0	Chennai (566)	0.757
Rhine-Ruhr	Germany	4	0	Dusseldorf (140)	0.828

Source City and Competitiveness Index Database, CASS

population can reflect the city's economic development level, so the system management index has a significant relationship with the city economic level. Advanced system management and perfect laws and regulations are the basic guarantee for national and urban economic development (Fig. 10.24).

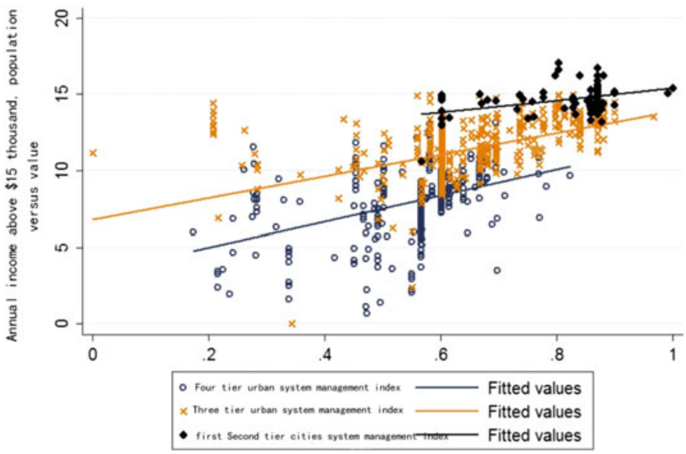


Fig. 10.24 The relationship between the system management index and the urban high-income population. *Source* City and Competitiveness Index Database, CASS

10.8 Global Connectivity Index: Cities in Europe and the United States Still Dominate Global Connection; the Asian Cities Are Catching up in High Speed

In terms of global connectivity, high-income developed countries still dominate global connectivity and exchanges, but the emerging-market countries as represented by China are experiencing rapid urban growth and are starting to lead the world and become an important part of global communications.

10.8.1 The Global Connectivity of Asian Cities Increased Significantly Among the World's Top Cities

As shown in Table 10.25, the top ten cities in terms of global connectivity are: New York, London, Hong Kong, Beijing, Singapore, Shanghai, Paris, Tokyo, Sydney, and Dubai. They are distributed in East Asia, Middle East, West Europe, North America, and Oceania. They are all economic and cultural centers on their continent, and are evenly distributed around the globe. Among these cities, 6 cities are Asian and only 1 is North American, but the latter is the No. 1 in global connectivity, indicating that the United States still occupies an important position in world economy. Among the Asian cities, 3 cities are in China, indicating that in recent years, Asian countries as represented by China are constantly strengthening their global connectivity and are chasing after European and American developed countries (Fig. 10.25).

Generally speaking, with the decline of the global connectivity ranking of a city, the index tends to decline all along; meanwhile, the gap of global connectivity between cities tends to decline first in a decelerated manner and then in an accelerated manner. Specifically, as a city's global connectivity ranking decreases from No. 1 to No. 100, its competitiveness index would decrease by 0.823; from No. 100 to No. 200, the index would decrease by 0.039; from No. 200 to No. 300, the index would decrease by 0.0324; from No. 300 to No. 400, the index would decrease by 0.029; from No. 700 to No. 800, the index would decrease by 0.0002; from No. 800 to No. 900, the index would decrease by 0.006; from No. 900 to No. 1000, the index would decrease by 0.018. This indicates that among the cities with good global connectivity and among the cities with poor global connectivity, there is a rather large gap in global potential, but among the cities with medium global connectivity, the gap in global potential is relatively small (Figs. 10.26 and 10.27).

Table 10.25 Top 10 cities regarding global connectivity

Cities	New York	London	Hong Kong	Beijing	Singapore	Shanghai	Paris	Tokyo	Sydney	Dubai
Continent	North America	Europe	Asia	Asia	Asia	Asia	Europe	Asia	Oceania	Asia
Global connectivity index	1	0.535	0.427	0.387	0.368	0.366	0.365	0.349	0.345	0.331
Global connectivity ranking	1	2	3	4	5	6	7	8	9	10

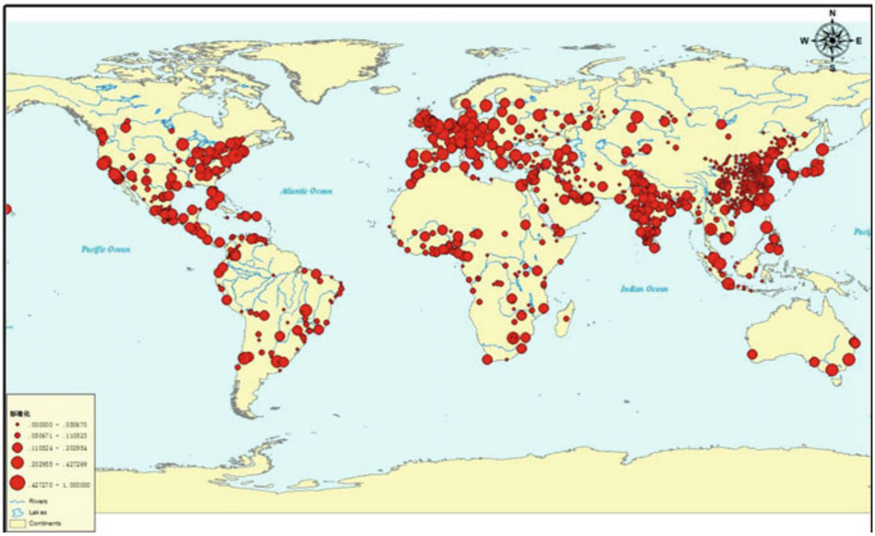
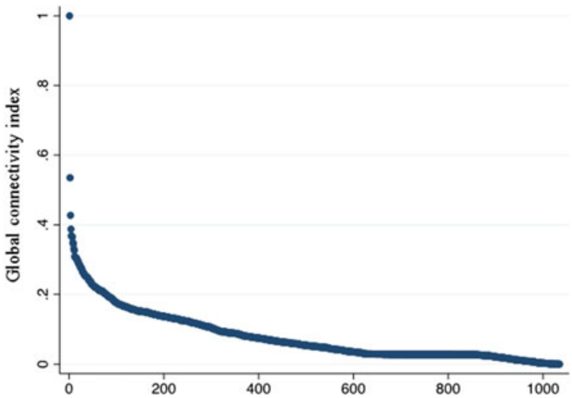


Fig. 10.25 Distribution of global cities with global connectivity

Fig. 10.26 Interval distribution of global connectivity rankings of global cities



10.8.2 *Regional Distribution of Global Connectivity: Asian and European Cities Running Neck to Neck Among the Top 100 Cities*

In terms of regional distribution, among the top 100 cities for global connectivity, there are 32 Asian cities and 31 European cities. These two continents have absolute superiority in numbers over other continents. They are followed by North America, with 23 of the top-100 cities for global connectivity. North America has

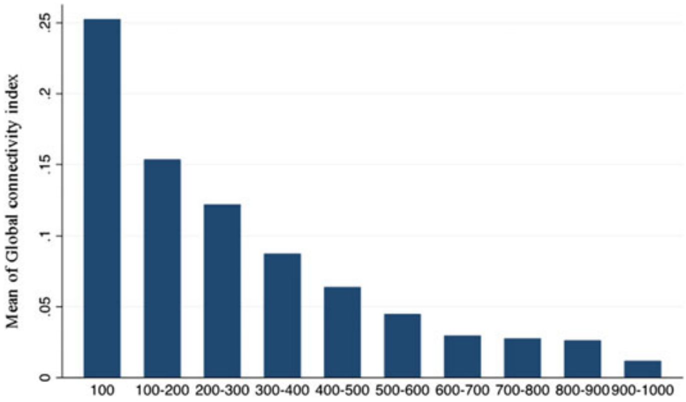


Fig. 10.27 Gap between global cities in terms of global connectivity index

the highest mean value of global connectivity of cities, that is, 0.265. The mean of global connectivity of cities on each continent varies between 0.21 and 0.26 and does not show much difference. The highest coefficient of variation of cities' global connectivity is in North America, reaching 0.611. The coefficients of variation in other regions are all below 0.25. This shows that among all the regions in the world, North America has the largest inter-city gap in global connectivity. As shown in Table 10.26, the mean of global connectivity of cities on each continent is higher than the median value. This indicates that in every region of the world, the number of cities with above-average global connectivity is smaller than the number of cities with below-average global connectivity. The city with the highest global connectivity in North America is also the No. 1 in the world. The cities with the highest global connectivity in Asia, Europe, and Oceania are at similar levels. However, the cities with the highest global connectivity in South America and Africa are at a relatively low level. The city with the highest global connectivity in South America is Buenos Aires, whose world ranking is the 25th. The city with the highest global connectivity in Africa is Johannesburg, whose world ranking is the 31st. This shows that the advanced cities on these two continents are still far behind the advanced cities in other regions.

10.8.3 Distribution by Country: Chinese and American Cities Dominate Global Connectivity

The United States and China have the largest number of top-100 cities for global connectivity. As shown in Table 10.27, except for China and the United States, the BRICS and G7 countries have very few top-100 cities for global

Table 10.26 Intercontinental distribution of cities with global connectivity

Region	Number of top 100 cities	Mean value	Coefficient of variation	Median	Maximum-value city	Index	World ranking
Asia	32	0.254	0.265	0.234	Hong Kong	0.427	3
Europe	31	0.252	0.269	0.225	London	0.535	2
North America	23	0.265	0.611	0.228	New York	1	1
South America	6	0.224	0.120	0.219	Buenos Aires	0.276	25
Oceania	4	0.250	0.246	0.237	Sydney	0.345	9
Africa	4	0.216	0.130	0.208	Johannesburg	0.261	31

Table 10.27 Comparison of economic dynamism index across BRICS and G7 countries

	Country	Samples	Number of top 100 cities	Mean value	Coefficient of variation
BRICS	China	292	13	0.045	1.207
	Russia	33	2	0.074	1.002
	India	102	3	0.066	0.899
	Brazil	32	0	0.065	0.784
	South Africa	6	2	0.131	0.588
G7	UK	13	4	0.158	0.839
	France	9	1	0.109	0.949
	USA	79	14	0.122	1.003
	Germany	13	6	0.148	0.541
	Italy	16	2	0.111	0.644
	Japan	10	2	0.130	0.694
	Canada	9	4	0.158	0.440

connectivity. In general, the mean of global connectivity index of the G7 countries is significantly higher than that of the BRICS countries. Among the G7 countries, Germany, Italy, Japan, and Canada have smaller inter-city differences. China, Russia, and the United States have relatively large inter-city differences in global connectivity.

10.8.4 Urban Agglomeration Comparison in Global Connectivity: The US, UK, and German Agglomerations Are in the Lead While Chinese and Brazilian Agglomerations Are Lagging Behind

The global connectivity of the urban agglomerations in the US, China, and the UK are relatively strong, while that of agglomerations in Brazil, Indonesia, and Republic of Korea are relatively weak. In terms of the mean of global connectivity, the top three urban agglomerations are from the US, UK, and Germany: the northeastern US urban agglomeration, the London-Liverpool agglomeration, and the Rhein-Ruhr agglomeration. The bottom three agglomerations are the Pearl River Delta agglomeration in China, the São Paulo agglomeration in Brazil, and the Yangtze River Delta agglomeration in China. In terms of the number of top-100 cities for global connectivity, the urban agglomerations in the US, China, and the UK have a larger number of top-100 cities, whereas those in other countries have fewer top-100 cities. In terms of the coefficient of variation of global connectivity, the urban agglomerations in developing countries such as China, India, and Indonesia have rather large inter-city differences in global connectivity. Especially the Beijing-Tianjin-Hebei agglomeration in China has the largest coefficient of variation. The urban agglomerations in developed countries such as Germany, European and American countries, and the Republic of Korea have relatively small inter-city differences in global connectivity. Especially the Netherlands-Belgium urban agglomeration and Rhein-Ruhr urban agglomeration have the smallest coefficient of variation (Table 10.28).

10.8.5 Originalfindings

The economic and population scale of a city is the foundation of global connectivity. The countries with the highest overall city global connectivity are the leading countries of their own continent. The global connectivity index of a city is closely associated with its GDP and population size (Fig. 10.28), and there are positive correlations among them. This again proves that as a city's economic development level improves and population grows, the city will enter into benign development, and slowly grow into a core city of the area, and thus serve as the central hub in the region for communications and exchanges with other regions.

In addition, considering the economic development level of each country in the world, we define the cities with per-capita GDP below 1000 US dollars, between 1000 and 4000 US dollars, between 4000 and 12,000 US dollars, and above 12,000 US dollars respectively as low-income cities, lower middle-income cities, upper

Table 10.28 Comparison among main urban agglomerations in global connectivity

Urban agglomeration	Country	Number of cities	City with the best global connectivity	Number of top-100 cities	Mean of global connectivity	Coefficient of variation of global connectivity
Yangtze River Delta agglomeration	China	26	Shanghai	2	0.058	1.213
Mid-west US agglomeration	USA	13	Chicago	2	0.122	0.710
Pearl River Delta agglomeration	China	13	Guangzhou	1	0.073	0.923
London-Liverpool agglomeration	UK	10	London	4	0.189	0.774
Beijing-Tianjin-Hebei agglomeration	China	10	Beijing	1	0.076	1.424
Northeastern US agglomeration	USA	12	New York	4	0.191	1.326
Bangalore agglomeration	India	6	Bangalore	1	0.111	0.788
Rhein-Ruhr agglomeration	Germany	4	Hamburg	3	0.179	0.217
Piedmont agglomeration	USA	6	Atlanta	1	0.118	0.523
Texas Delta agglomeration	USA	7	Dallas-Fort Worth	1	0.099	0.613
Netherlands-Belgium agglomeration	Europe	6	Amsterdam	2	0.172	0.505
Mumbai metropolitan area	India	4	Mumbai	1	0.106	1.194

(continued)

Table 10.28 (continued)

Urban agglomeration	Country	Number of cities	City with the best global connectivity	Number of top-100 cities	Mean of global connectivity	Coefficient of variation of global connectivity
São Paulo metropolitan area	Brazil	7	Rio de Janeiro	0	0.059	0.705
South Florida agglomeration	USA	4	Miami	1	0.130	0.522
South California agglomeration	USA	4	Los Angeles	1	0.144	0.674
Seoul state capital area	ROK	6	Seoul	1	0.134	0.608
Jakarta metropolitan area	Indonesia	4	Jakarta	1	0.089	1.151

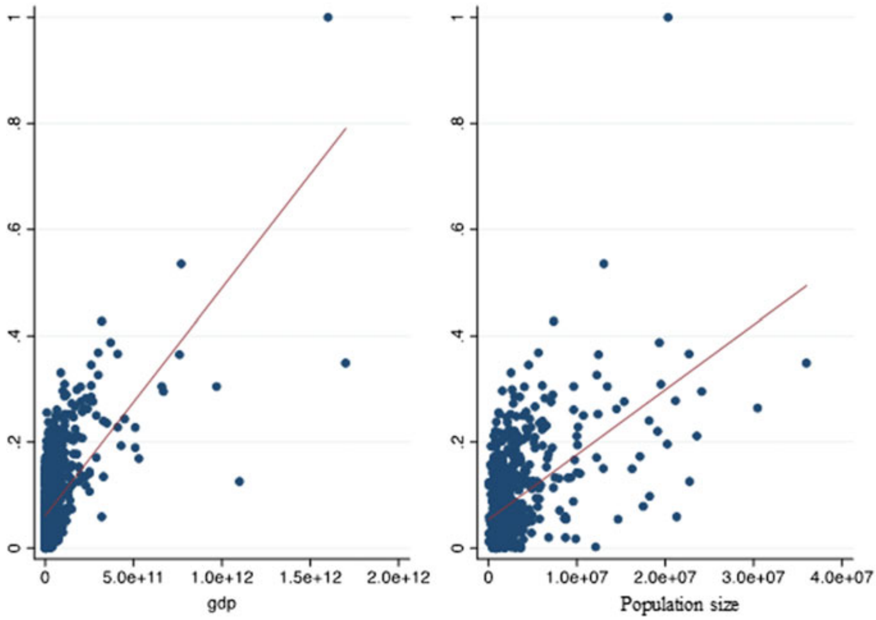


Fig. 10.28 Scatter diagrams of a city's GDP and population size versus its global connectivity

middle-income cities, and high-income cities. Meanwhile, we draw the mean global connectivity index of different income levels (Fig. 10.29), and find that the income level and global connectivity are not linearly correlated. The global connectivity of low-income cities and medium-income cities are not significantly different, but the

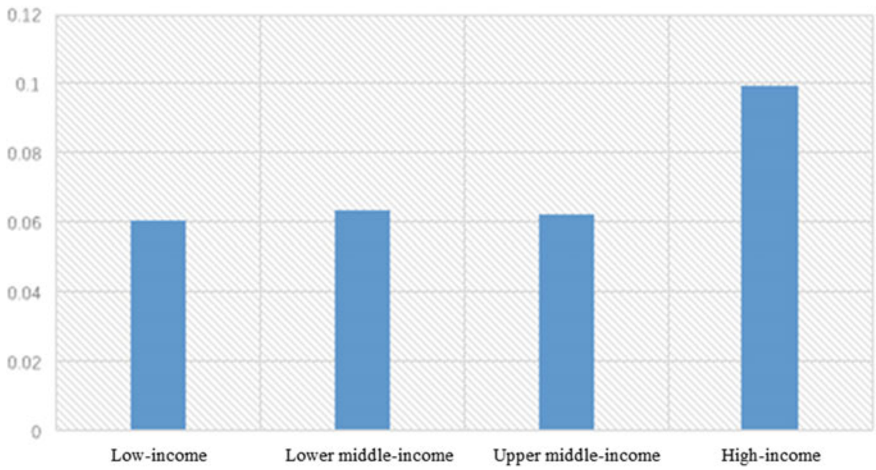


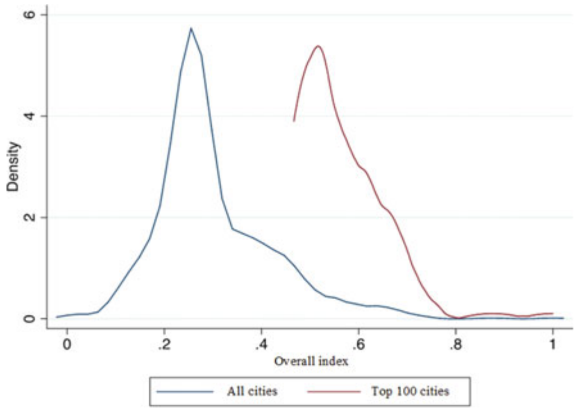
Fig. 10.29 Mean global connectivity index of different income levels

global connectivity of high-income cities is obviously higher than that of other cities. This again proves that the economic development level is the foundation of a city's global connectivity.

10.9 Top 100 Cities in the World

According to the sustainable competitiveness data of cities worldwide in 2017, we mainly analyze the top 100 cities. Generally speaking, the top 100 cities show the following characteristics.

The top 100 cities for sustainable competitiveness represent the blueprint of the topmost urban development in the world. Our calculations show that the mean value of the overall sustainable competitiveness index of 1035 cities around the world is 0.301, the standard deviation is 0.120, and the coefficient of variation is 0.398. The mean value of the overall sustainable competitiveness index of the top 100 cities in the world is 0.562, which is 1.87 times that of the global sample. The standard deviation and the coefficient of variation of the top 100 cities are 0.090 and 0.160 respectively, both of which are smaller than those of the whole sample, indicating that the differences among the top 100 cities are relatively small, and the competition among them is respectively fierce.



We also draw a kernel density diagram of the overall sustainable competitiveness indexes of the 1035 cities and the top 100 cities. It can be clearly seen that the overall index of the top 100 cities is more right-skewed than that of the whole sample. This indicates that the top 100 cities represent the highest level of sustainable competitiveness in the world, and are the blueprint and references for the future development of other cities.

The cities with the highest sustainable competitiveness are clearly concentrated spatially in certain regions, mostly in the United States and Germany. The world's top 100 cities for sustainable competitiveness are concentrated in 29 countries. The United States has the largest number of these cities, which amount to

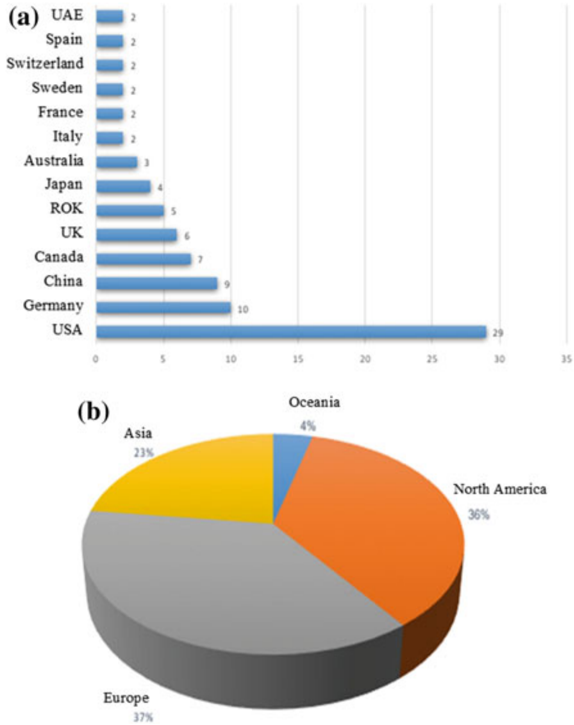


Fig. 10.30 **a** Top 100 cities for sustainable competitiveness by country. **b** Top 100 cities for sustainable competitiveness by continent

29 cities, accounting for nearly 30%. Besides, 13 countries such as Germany, China, and Canada each have two or more such cities (as shown in Fig. 10.30a); 15 countries such as New Zealand, Denmark, Russia, Turkey, Austria, Norway, Czech Republic, Belgium, Poland, Ireland, Finland, the Netherlands, Singapore, Thailand, and Malaysia each have one such city.

Continent-wise, the top 100 cities for sustainable competitiveness are distributed in Europe, North America, Asia, and Oceania. Africa and South America do not have any top-100 cities. Besides, in terms of continental distribution, more than 70% of the top 100 cities are distributed in Europe and North America (Fig. 10.30b), mostly in mature developed countries. Thus it can be seen that no matter at the state level or continental level, the cities with the highest sustainable competitiveness are clearly concentrated in certain regions.

The GDP growth has a greater boosting effect on sustainable competitiveness in the top 100 cities for sustainable competitiveness than in other cities. We draw a comparison chart of the GDP and population between the top 100 cities for sustainable competitiveness and all the 1035 cities (Fig. 10.31). We find that the population of the top 100 cities accounts for 24% of that of all cities, and the GDP accounts for as high as 55%. This indicates that the world's top 100 cities for sustainable competitiveness clearly feature population gathering (the number of cities accounts for 8.9% of the total while the population accounts for 20% of the

Fig. 10.31 **a** GDP ratio of top 100 cities. **b** Population ratio of top 100 cities

total). Besides, these cities have the topmost production capacity and wealth creation capacity, and contribute to half of the output value of worldwide cities. It can be seen that these cities are clearly "large and strong".

In addition, we analyze the relationship between the GDP and sustainable competitiveness index of the top 100 cities for sustainable competitiveness and all cities (Fig. 10.32). We find that the correlation between GDP and sustainable competitiveness index is stronger for the top 100 cities (0.734, greater than the 0.645 of all the cities). This again proves that the economic strength is the key to sustainable development of a city. If a city wants long-term healthy development, economic growth is still the priority.

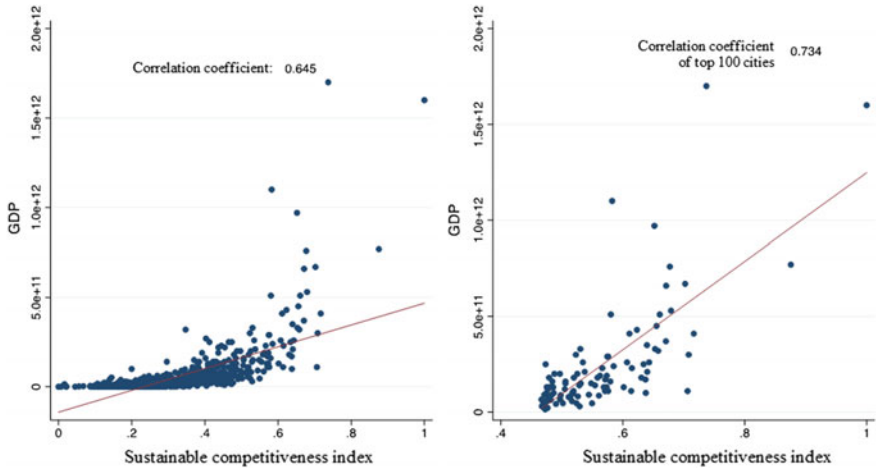


Fig. 10.32 Correlation between GDP and sustainable competitiveness index of top 100 cities and all cities

Technological innovation and strong global connectivity are the basic characteristics of the top 100 cities for sustainable competitiveness. The cities from emerging-market countries as represented by China, the Republic of Korea and Singapore are performing increasingly well. By observing the correlation coefficients between the overall index of the top 100 cities for sustainable competitiveness and the indexes of the sub-items (Table 10.29), we find that the highest correlation is with technological innovation and global connectivity. This indicates that a city's sustainable competitiveness mainly relies on its innovation drive and rich global connectivity.

Here we mainly analyze the technological innovation and global connectivity of the top 100 cities. We draw the world rankings of the top 100 cities for sustainable competitiveness in terms of these two sub-items (Fig. 10.33). The top 100 cities are mainly ranked within the top 200 places for technological innovation, accounting for 93% of the total. The top 100 cities are mainly ranked within the top 400 places for global connectivity, accounting for 88%.

At the country level, in terms of the national mean of cities' technological innovation index, the top ten countries are Japan, Spain, France, Singapore, the United States, Turkey, China, the United Kingdom, Republic of Korea, and Finland. It can be seen that the old developed cities from the US, Japan, the UK, and France and the emerging cities from China, Republic of Korea, and Singapore are at the forefront of innovation drive of the world.

In terms of global connectivity, the top ten cities are New York, London, Hong Kong, Beijing, Singapore, Shanghai, Paris, Tokyo, Sydney, and Dubai. All of them are the core cities of their own continent and region. These cities build the bridge for global communications and exchanges.

North American cities are the best in technological innovation but have poor environmental quality; whereas European cities are doing well in both innovation drive and environment. By drawing out the mean values of technological innovation index and environmental quality index of the top 100 cities for sustainable competitiveness on each continent, we have the following findings. North America has the strongest technological innovation but relatively poor urban environmental quality on the whole. There is an obvious divorce between economic development and ecological environment. Europe is the second best in technological innovation after North America, but it is doing well in environment. It has achieved a win-win situation of both innovation drive and environmental quality. Asia is inferior to North America and Europe in technological innovation, and inferior to Europe and Oceania in environment. Its performance is average, indicating that Asia as home to many emerging-market countries still has much room for improvement in innovation drive and environmental quality (Fig. 10.34).

The world's top 10 cities: cities from old developed countries are still as fine as ever, but the cities as represented by Chicago have alarming social and environmental problems. The world's top 10 cities for sustainable competitiveness are New York, London, Tokyo, Boston, Singapore, Zurich, Seoul, Houston, Paris, and Chicago. Four of them are in the US, and the rest are respectively in the UK, France, Switzerland, Japan, Republic of Korea, and Singapore. It can be seen

Table 10.29 Correlation coefficients between the overall sustainable competitiveness index of the top 100 cities and the indexes of the sub-items

Overall index	Technological innovation	Global connectivity	Economic dynamism	Infrastructure	Human capital	Social development	Environmental quality	Government management
	0.7607	0.7223	0.6705	0.5541	0.4455	0.0269	0.0229	0.1783

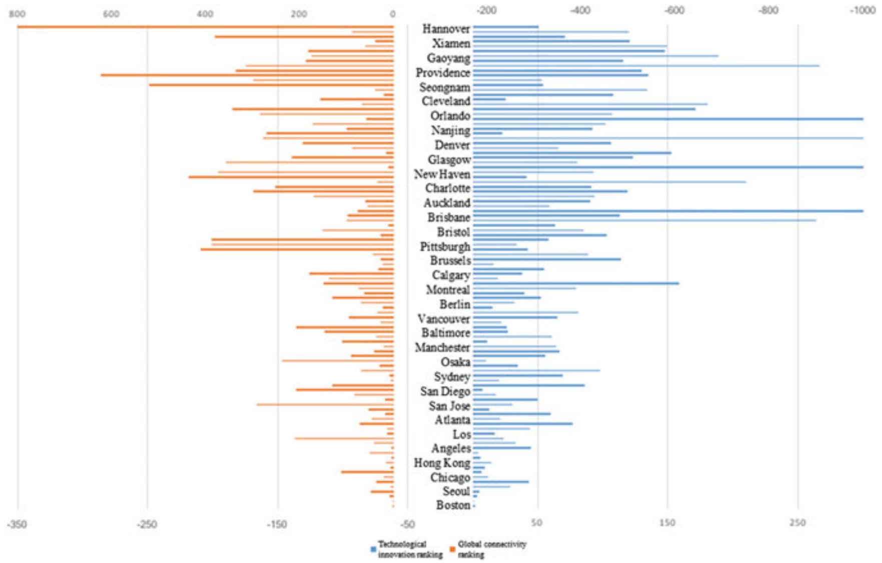


Fig. 10.33 Rankings of the top 100 cities for sustainable competitiveness in terms of technological innovation and global connectivity

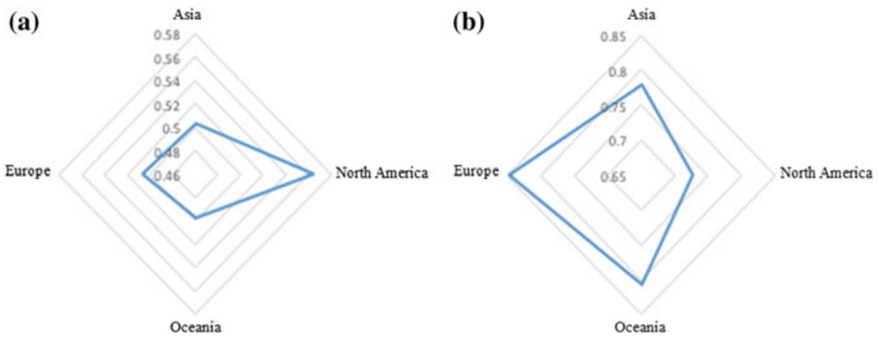


Fig. 10.34 **a** Mean of technological innovation index on each continent. **b** Mean of environmental quality index on each continent

that all of them except Seoul and Singapore are from old developed countries. These cities all have a long history of development, sound infrastructure and hardware facilities, and a pool of high-end talents. They are driven primarily by technological innovation, full of economic dynamism, and are the central cities of their own region and country, serving as a bridge to the outside world. Their governments also have rich experience and nice performance in governing the city.

But the world's top ten cities have common disadvantages, that is, deteriorating environment and increasingly serious social problems. Figure 10.35 presents the

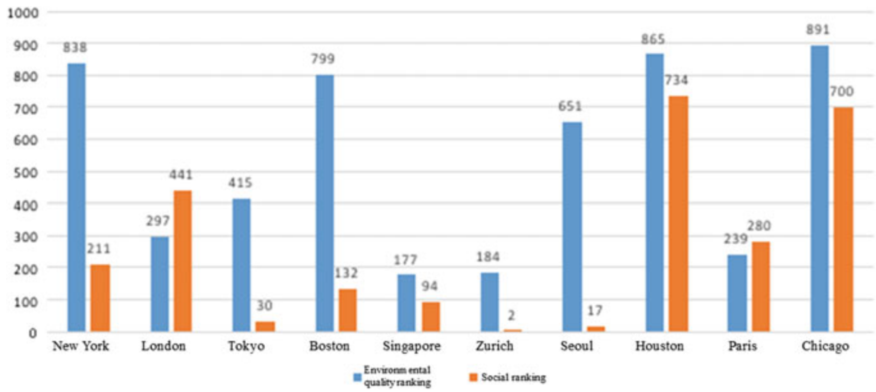


Fig. 10.35 World rankings of the top 10 cities for sustainable competitiveness in terms of environmental quality and social condition

environmental quality and social condition rankings of the top 10 cities for sustainable competitiveness. Regarding environmental quality, none of them is among the world's top 100. The best of them is Singapore at the 177th place, while the worst is Chicago at the 891st place. Regarding social condition, UK and U.S. cities are also lagging behind, with Chicago as the worst at the 700th place. It can be seen that the top ten cities for sustainable competitiveness are still the models of the world's future development in the long term, but the increasingly serious environmental and social problems are also alarming for these cities.

The top 10 cities for sustainable competitiveness in North America are New York, Boston, Houston, and Chicago. In terms of per-capita disposable income, these four cities are the top 4 of the 10 cities; they have the highest living standards of the world. New York is the world's No. 1 in global connectivity and economic dynamism. Boston is doing well in human capital potential and technological innovation, ranking 2nd and 5th in the world in terms of these two aspects. Houston has relatively good economic dynamism, ranking 4th in the world. Chicago has balanced development in all these aspects. It ranks around 20th in the world in all these aspects except for environmental quality and social development. It can be seen that the main cities throughout the US all perform well in sustainable competitiveness, but these cities all have outstanding environmental and social problems.

In Europe, there are London, Zurich and Paris. London has the strongest technological innovation strength of the world, and is second only to New York in terms of global connectivity. It is still glamorous as a strong city. Zurich has the best social development, ranking 2nd in the world, which is the highest place among the top 10 cities. Paris has the best infrastructure, ranking 1st in the world. Meanwhile, its global connectivity and technological innovation respectively rank 7th and 9th in the world. Generally speaking, European cities as represented by those of the UK and France have relatively balanced development in all the aspects of sustainable competitiveness, and excel as much as North American cities, only in different ways.

Asia only has two top-10 cities for sustainable competitiveness, which are Tokyo and Singapore. Tokyo has the largest population and the largest GDP. It also has rather strong technological innovation strength, ranking 3rd in the world. Tokyo is a representative of Asia that connects with the world, raking 8th in terms of global connectivity. Compared to other developed cities, Tokyo handles social development well, ranking 30th in the world. Singapore as a city of the emerging market has obvious late-mover advantages. It has relatively successful government management, ranking 2nd in this aspect; meanwhile it ranks 5th in terms of global connectivity. More importantly, Singapore ranks the highest among the top 10 cities in terms of environmental quality, indicating that it handles well the relationship between city development and environmental protection.

10.10 Comparison of Major Countries

For a better understanding of the basic facts of the urban sustainable competitiveness in major countries, we select traditional old developed capitalist countries including the G7 countries and emerging-market countries including the BRICS countries as the focus of our study. The G7 countries include the US, UK, Germany, France, Japan, Italy, and Canada. The BRICS countries include Russia, China, India, Brazil, and South Africa.

The cities of the G7 generally have top-ranking sustainable competitiveness, with obvious leading superiority. The mean of overall urban sustainable competitiveness index of major developed countries (Table 10.30) is obviously above

Table 10.30 Mean and SD of urban sustainable competitiveness of major countries

	Number of cities	Mean value	Ranking	Standard deviation	Ranking
USA	79	0.463	5th	0.118	2nd
UK	13	0.502	3rd	0.122	1st
Germany	13	0.515	1st	0.068	7th
France	9	0.446	6th	0.095	4th
Japan	10	0.484	4th	0.105	3rd
Italy	16	0.384	7th	0.051	10th
Canada	9	0.515	2nd	0.076	5th
Russia	33	0.260	10th	0.058	8th
China	292	0.289	8th	0.072	6th
India	102	0.262	9th	0.048	11th
Brazil	32	0.203	12th	0.054	9th
South Africa	6	0.235	11th	0.047	12th

that of emerging-market countries. Among the developed countries, Germany has the highest overall urban sustainable competitiveness, while Italy has the lowest; but Italy has relatively small inter-city difference in terms of sustainable competitiveness. This indicates that among the developed countries, Italy is, on the whole, relatively backward in the construction of urban sustainable competitiveness. On the contrary, the UK cities show the largest difference in terms of sustainable competitiveness (largest standard deviation), showing a tendency of polarization.

Regarding the rankings of urban sustainable competitiveness (Table 10.31), the G7 cities are mainly ranked among the top 300, accounting for 47% of the total 300 cities. A more noticeable feature is that the G7 cities account for 60% of the top 100 cities for sustainable competitiveness. It can be seen that the cities with the highest or high sustainable competitiveness are those in these mature developed countries.

The BRICS cities have great development potential, and Chinese and Russian cities have relatively small differences in sustainable competitiveness. In terms of the mean of overall urban sustainable competitiveness (Table 10.30), the BRICS countries as emerging markets have obviously weaker overall urban sustainable competitiveness than those mature developed countries. Among the BRICS countries, China and Russia have relatively small inter-city standard deviations. They are the two countries among BRICS with the smallest inter-city gap in terms of sustainable competitiveness. Meanwhile, the BRICS cities are mainly ranked among the 300th–800th in terms of sustainable competitiveness, accounting for 65% of the 500 cities in this range. This indicates that the BRICS countries are at the medium level in terms of overall urban sustainable competitiveness. Encouragingly, China has 48 cities ranking among the top 300 of the

Table 10.31 Rankings of major countries in terms of urban sustainable competitiveness

	Top 100 cities	Cities ranked 100th–300th	Cities ranked 300th–500th	Cities ranked 500th–800th	Cities ranked 800th–1000th	Cities ranked after 1000th
USA	29	45	5	0	0	0
UK	6	7	0	0	0	0
Germany	10	3	0	0	0	0
France	2	6	1	0	0	0
Japan	4	6	0	0	0	0
Italy	2	12	2	0	0	0
Canada	7	2	0	0	0	0
Russia	1	1	6	16	9	0
China	9	39	96	120	28	0
India	0	7	25	48	22	0
Brazil	0	1	2	7	20	2
South Africa	0	0	1	3	2	0

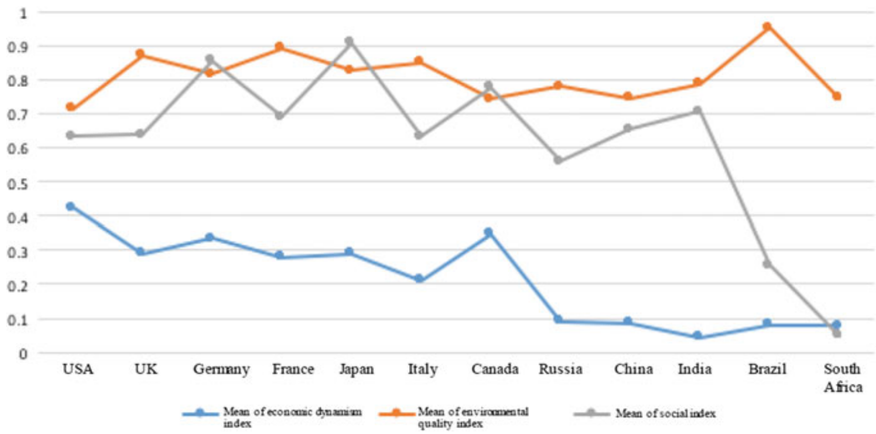


Fig. 10.36 Diagram of the mean values of cities' economic dynamism, environmental quality, and social competitiveness indexes of major countries

world, that is, among those with the highest sustainable competitiveness, accounting for 16% of the total.

The cities of mature developed countries as represented by the US are the most vigorous but have outstanding environmental quality and social problems. As shown in Fig. 10.36 and Table 10.32, in terms of economic dynamism,

Table 10.32 Distribution of top-ranking cities in terms of economic dynamism, environmental quality, and social competitiveness

	Economic dynamism ranking		Environmental quality ranking		Social ranking	
	Top 100 cities	Top 500 cities	Top 100 cities	Top 500 cities	Top 100 cities	Top 500 cities
USA	50	79	0	0	3	33
UK	1	13	0	13	0	4
Germany	6	13	0	13	13	13
France	1	9	0	9	0	8
Japan	2	10	0	10	10	10
Italy	0	16	0	16	0	5
Canada	5	9	0	0	4	8
Russia	0	25	0	0	0	1
China	13	95	0	57	0	181
India	0	8	5	62	19	77
Brazil	0	18	31	32	0	0
South Africa	0	3	0	0	0	0
Total	78	298	36	212	49	340

the cities of mature developed countries are generally stronger than those of emerging-market countries. The country with the highest mean of city Economic dynamism is the US. In addition, the US has 50 cities ranking among the top 100 in the world, accounting for 50% of the total 100 cities. Among the BRICS countries, Russia and China have the highest urban vitality (the mean of cities' economic dynamism index of Russia is the highest among the BRICS countries; China has 13 cities ranking among the top 100 cities for economic dynamism in the world).

Different from the case of economic dynamism, in terms of environmental quality, the cities of emerging-market countries as represented by the BRICS are generally better than those of the mature developed countries. The environmental quality is worrying in North American cities as represented by those in the US and Canada. In addition, none of the cities from the G7 countries are ranked among the top 100 for environmental quality. The US does not even have any city ranking among the top 500 for environmental quality. By contrast, the BRICS countries such as Brazil are doing well in environmental quality. Brazil has 31 cities ranking among the top 100 for environmental quality. Similarly, in the social aspect, Japan is the best among the developed countries for overall performance of the cities (with the highest mean of social index). However, none of the cities in the UK, France, and Italy are ranked among the top 100 for social development. Even the US has only three cities ranking among the top 100. Thus it can be seen that after a long period of development, the cities of mature old developed countries are doing quite well in economy, but are falling short in environmental and social aspects. This rings alarm bells for the cities' long-term sustainable development.

The BRICS countries are becoming an important part of global connectivity, but their innovation capacity and government management capacity still needs improvement. In terms of the mean of cities' global connectivity in different countries, the mature developed countries are not much different from the emerging-market countries (Fig. 10.37). According to the distribution of the top 100 cities for global connectivity (Table 10.33), 33 cities are in the G7 countries, and 22 cities are in the BRICS countries, which is on average 4.5 cities per country for both mature developed countries and emerging-market countries (33/7:22/5). Thus it can be seen that the core cities of emerging-market countries as represented by BRICS countries are becoming an important part of the world and a hub for connection and communication with the world.

Regarding the mean value of urban technological innovation and government management indexes, the BRICS countries are evidently inferior to the developed countries (Fig. 10.37), indicating that the BRICS countries are still far behind the developed countries in terms of these two spheres of soft power. Similarly, regarding technological innovation and government management (Table 10.33), none of the cities in Brazil and South Africa is among the top 100 cities for technological innovation, and only 16 cities in China, Russia, and India are among the top 100; by contrast, 59 cities in the G7 countries are among the top 100,

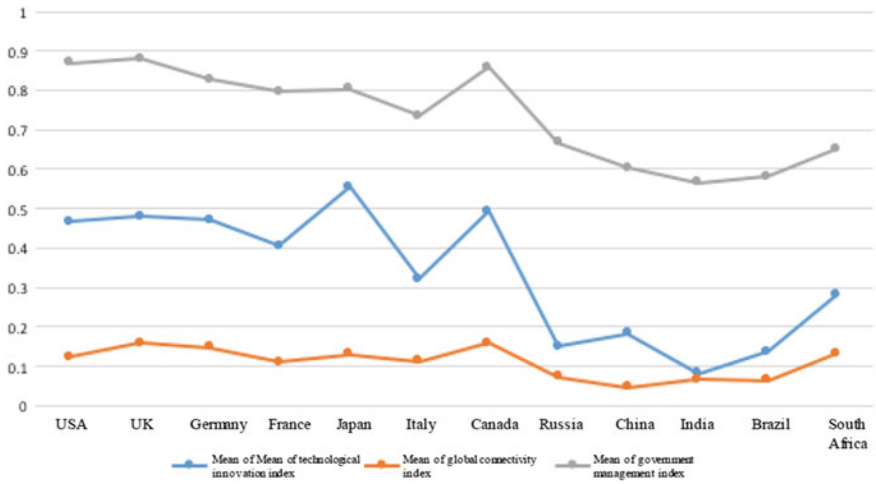


Fig. 10.37 Diagram of the mean value of urban technological innovation, global connectivity, and government management competitiveness indexes of major countries

Table 10.33 Distribution of top-ranking cities in terms of technological innovation, global connectivity, and government management competitiveness

	Technological innovation ranking		Global connectivity ranking		Government management ranking	
	Top 100 cities	Top 500 cities	Top 100 cities	Top 500 cities	Top 100 cities	Top 500 cities
USA	34	78	14	61	79	79
UK	4	13	4	10	13	13
Germany	7	13	6	11	0	13
France	1	8	1	6	0	9
Japan	6	10	2	8	0	10
Italy	0	15	2	12	0	16
Canada	7	9	4	9	0	9
Russia	1	15	2	17	0	33
China	13	163	13	38	1	292
India	2	19	3	52	0	0
Brazil	0	14	2	16	0	0
South Africa	0	5	2	5	0	6
Total	75	362	55	245	93	480

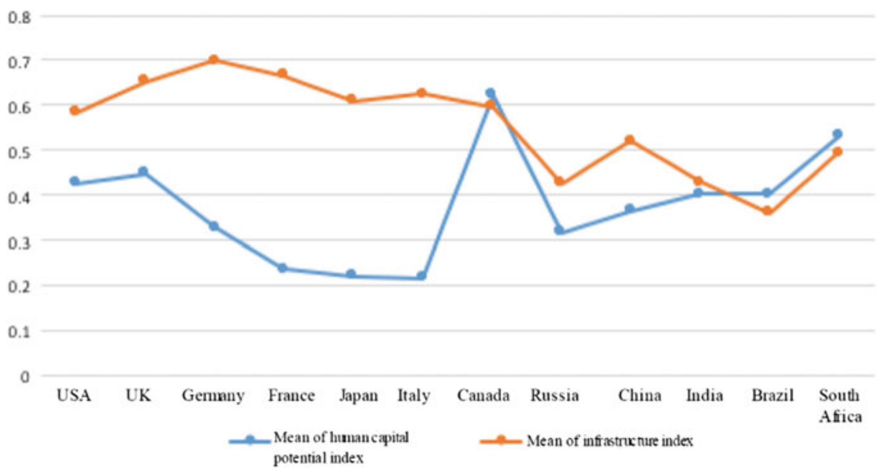


Fig. 10.38 Diagram of the mean value of urban human capital potential and infrastructure competitiveness indexes of major countries

accounting for nearly 60%. In terms of government management, all the G7 countries have cities among the top 500, whereas among the BRICS, only China and Russia do. This indicates that the cities of emerging countries as represented by the BRICS still need to accelerate their steps in innovation drive, and they need to reach for new higher standards in city governance.

The cities of emerging-market countries as represented by the BRICS are developing fast in infrastructure and have great human capital potential. Figure 10.38 and Table 10.34 show two sub-items. In terms of the mean value of cities' infrastructure index, the BRICS countries are not much different from the G7. In particular, the infrastructure of Chinese cities has generally caught up with that of developed countries. Among the world's top 500 cities for infrastructure, 180 cities are in China, indicating that more than half of the cities in China have above-the-average-level infrastructure in the world. However, except China, other countries such as India, Brazil, and South Africa still need much improvement in hard environment.

In terms of human capital potential, as the emerging countries as represented by the BRICS have a relatively good population age structure and a large proportion of working population, their cities show great vitality in population and human capital as compared to the cities of developed countries. In terms of human capital potential index, the cities' mean values of the BRICS are higher than the cities' mean values of developed countries. Regarding the rankings of human capital potential, a total of 45 cities in the BRICS are among the top 100 of the world, accounting for nearly half of the total. It can be seen that the population edge and human capital reserve

Table 10.34 Distribution of top-ranking cities in terms of human capital potential and infrastructure competitiveness indexes

	Human capital potential ranking		Infrastructure ranking	
	Top 100 cities	Top 500 cities	Top 100 cities	Top 500 cities
USA	20	35	18	67
UK	3	10	4	13
Germany	0	6	8	13
France	0	0	3	9
Japan	1	1	2	10
Italy	0	3	4	16
Canada	6	9	3	8
Russia	0	4	2	3
China	37	141	14	180
India	3	90	0	9
Brazil	2	20	0	2
South Africa	3	6	0	3
Total	75	325	58	333

will become important factors in the takeoff and sustainable development of cities in emerging-market countries.

Comparison among cities within major countries: The US urban agglomerations each have their own characteristics and generally have high global connectivity. The "three urban agglomerations" of China take the lead in development and generally have good infrastructure conditions. The Delhi urban agglomeration of India occupies the only strongest position, and the cities generally have great differences. The US urban agglomerations as a whole still show disadvantages in environmental quality and social development. The North California urban agglomeration with San Francisco and Silicon Valley as central cities has the strongesteconomic dynamism. The northeast urban agglomeration extending from Washington DC to Boston has the strongest technological innovation capacity among the urban agglomerations of the US. The US urban agglomerations generally have rather strong connections with the world, and are not much different from one another in terms of global connectivity. Still, the northeast urban agglomeration in Washington DC has the highest global connectivity. In terms of social development, the worst-performing urban agglomeration is the South Florida urban agglomeration with Miami as the core city. In terms of infrastructure, the Colorado urban agglomeration in the mid-west is not doing so well (Fig. 10.39).

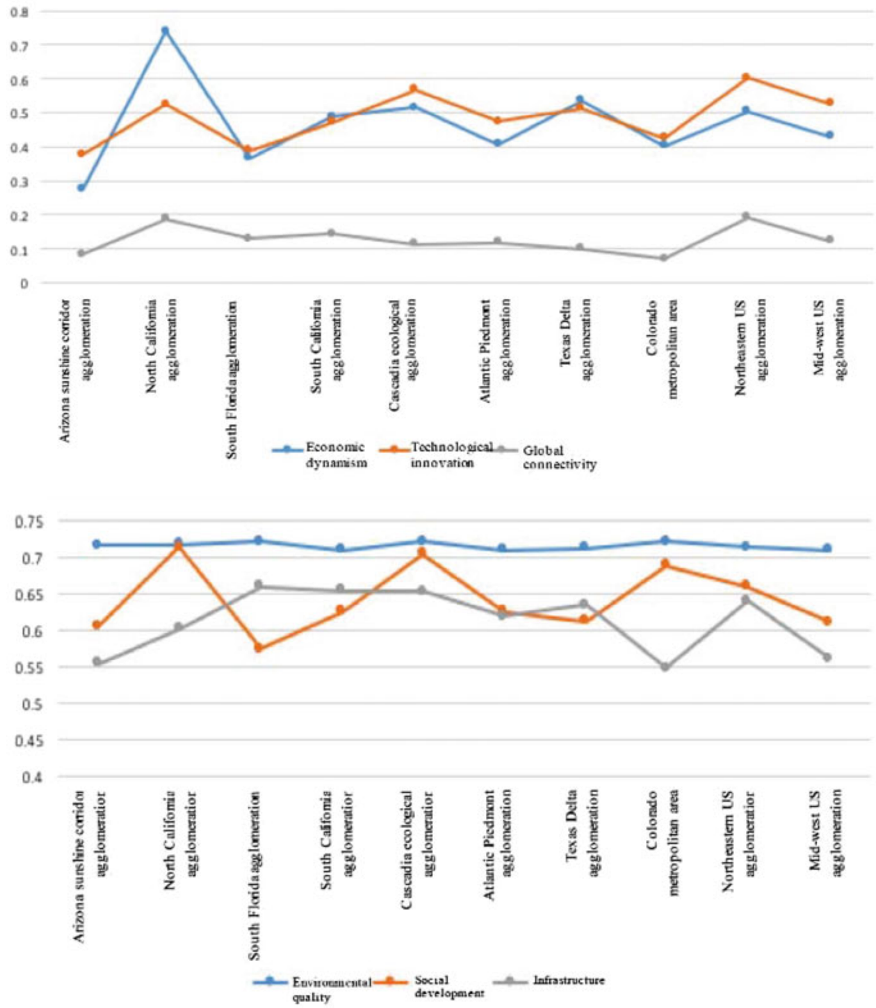


Fig. 10.39 Differences among the US urban agglomerations in terms of each sub-item index

China as an emerging market country currently has 12 relatively mature urban agglomerations. They are generally doing well in infrastructure. The environmental quality and social development show similar common characteristics. Generally speaking, China faces disadvantages in ecological protection and social development. In addition, in terms of economic dynamism, technological innovation, and global connectivity, the Yangtze River Delta urban agglomeration, Pearl River Delta urban agglomeration, and Beijing-Tianjin-Hebei urban agglomeration are obviously in the lead across China. In particular, the Pearl River Delta has the

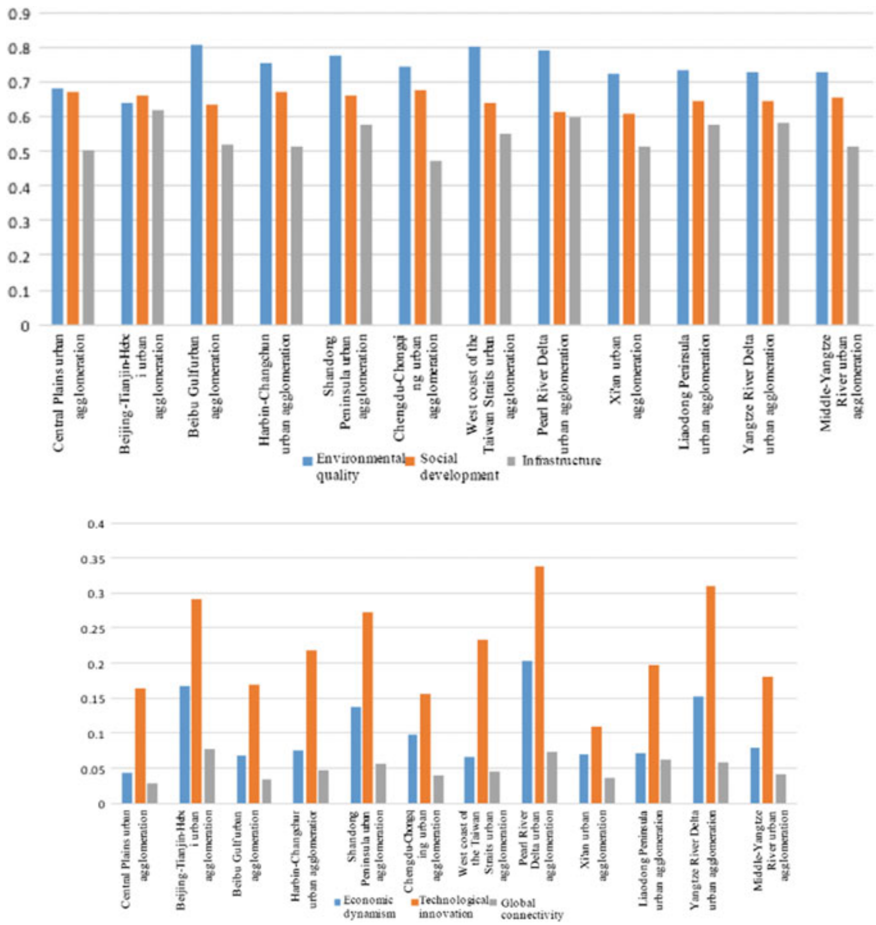


Fig. 10.40 Differences among the Chinese urban agglomerations in terms of each sub-item index

strongest technological innovation strength and Economic dynamism. Other cities in China obviously fall behind these three leading urban agglomerations (Fig. 10.40).

India, as a representative of the emerging market countries, also shows a tendency to pursue and catch up with the forefront. Among the four mature urban agglomerations of India, the Delhi metropolitan area with the capital Delhi as the central city is the best in every aspect, with the most complete infrastructure,

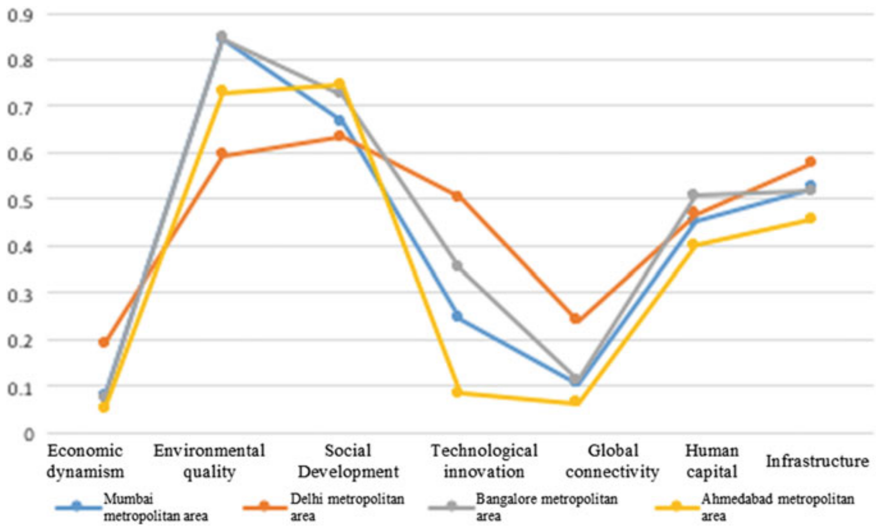


Fig. 10.41 Differences among the Indian urban agglomerations in terms of each sub-item index

strongesteconomic dynamism and S&T capacity, and widest global connectivity. Other urban agglomerations are obviously behind the Delhi urban agglomeration. But the Delhi urban agglomeration also faces disadvantages in environmental quality and social development. Compared to the other urban agglomerations, it is lagging behind in environmental quality and social development. Besides, the Bangalore urban agglomeration has the best human capital potential; its future development is promising. The Ahmedabad metropolitan area is doing well in social development, ranking the first in India, and is worth learning from by the other urban agglomerations (Fig. 10.41).

The largest developed country vs the largest emerging-market country: The top 20 cities in China are still at a distance behind the top 20 cities in the US in terms of economic dynamism and technological innovation. But China is already showing a tendency to surpass the US in infrastructure construction, human capital potential development, and social governance. Comparing the top 20 cities in China and the US in terms of sustainable competitiveness rankings, we find that the mean value of sustainable competitiveness index of the top 20 cities in the US is 0.678, which is significantly higher than the mean of the top 20 cities in China, which is 0.488. The top 20 cities in the US are all among the top 100 in the world, whereas only the top 9 cities in China are among the world’s top 100. The lowest world ranking of the top 20 cities in the US is the 66th place, whereas the lowest world ranking of the top 20 cities in China is the 187th place. It can be seen

Table 10.35 Comparison among the top 20 cities in China and in the US in terms of sustainable competitiveness

Top 20 in China	Overall index	Overall ranking	Top 20 in the US	Overall index	Overall ranking
Beijing	0.671	11	New York	1	1
Hong Kong	0.658	13	Boston	0.717	4
Shanghai	0.611	27	Houston	0.679	8
Shenzhen	0.576	35	Chicago	0.671	10
Guangzhou	0.575	36	Washington DC	0.661	12
Taipei	0.526	57	San Francisco	0.655	14
Nanjing	0.484	79	Seattle	0.653	15
Tianjin	0.474	93	Los Angeles	0.652	16
Xiamen	0.469	97	Atlanta	0.640	19
Hangzhou	0.466	101	San Jose	0.634	22
Chongqing	0.455	114	Philadelphia	0.623	24
Wuhan	0.453	116	San Diego	0.615	25
Chengdu	0.431	148	Dallas-Fort Worth	0.580	32
Dongguan	0.426	157	Baltimore	0.574	37
Suzhou	0.423	160	Austin	0.574	38
Qingdao	0.420	164	Minneapolis	0.535	51
Hsinchu	0.416	167	Miami	0.530	53
Changsha	0.413	173	Pittsburgh	0.529	55
Xi'an	0.404	182	Salt Lake City	0.526	56
Hefei	0.403	187	Raleigh	0.511	66
Mean value	0.488	–	Mean value	0.678	–

that China and the US are still obviously different in terms of the urban sustainable competitiveness (Table 10.35).

Generally speaking, the top 20 cities in China and those the US have obvious differences. Specifically, in terms of each sub-item index, first of all, China as an emerging market country is no different from the US in terms of the speed and quality of infrastructure construction. In terms of human capital potential, although their mean values are slightly different, yet ranking-wise, the Chinese cities are generally ahead of the US cities. The US cities have great differences among themselves, with a few cities ranking rather low in the world. This indicates that China as an emerging market country still has obvious late-mover advantage in human capital potential. In addition, in terms of social development and global connectivity, the top 20 cities in China and the US are barely different from one another. This shows that the Chinese cities are growing rapidly and are already neck to neck with the US in terms of global connectivity.

Table 10.36 Comparison between China and the US in terms of sub-item indexes

	Economic dynamism	Environmental quality	Society	Technological innovation	Global connectivity	Government management	Human capital potential	Infrastructure
China	0.404	0.734	0.634	0.509	0.184	0.621	0.625	0.703
USA	0.646	0.713	0.660	0.667	0.227	0.870	0.708	0.713

It is noteworthy that as compared to the cases of other sub-item indexes, in terms of economic dynamism and technological innovation, Chinese cities are obviously behind the top 20 cities in the US. It can be seen that the best-developing cities in China should learn from the experience of the US in building an innovative and vigorous city, explore their own potential, improve their own weak links, and speed up their growth (Table 10.36).

Appendix

A.1 Theoretical Framework

City competitiveness is a city's capacity of constantly attracting, controlling and transforming resources, occupying and controlling the market, creating more value in a more efficient and faster manner, obtaining economic rent, thus continuously providing benefits for their residents by virtue of the external economic advantages and internal organizational efficiency developed based on its own elements and environment in the process of competition and development. Therefore, urban competitiveness is the city's ability of creating value currently and in the future. The current size, speed and efficiency of the city's value creation is the short-term reflection of its capacity, i.e., the output of urban competitiveness, which is urban economic competitiveness. The urban competitiveness is based on the elements and environment. The agglomeration of economic entities such as talents and enterprises constitutes the absolute advantage, comparative advantage and competitive advantage of the industrial system. The process of competing with other cities' industries and enterprises in obtaining the economic rent is the explanatory variable of urban competitiveness. The city's elements and environmental conditions determine the sustainability and long-term performance of the city's capacity which is the input of urban competitiveness, i.e., the sustainable competitiveness. Thus, we can construct the urban competitiveness model as follows: the sustainable competitiveness determines the urban economic competitiveness via the explanatory variable of economic competitiveness; in turn, the urban economic competitiveness affects the sustainable competitiveness via the explanatory variable of economic competitiveness.

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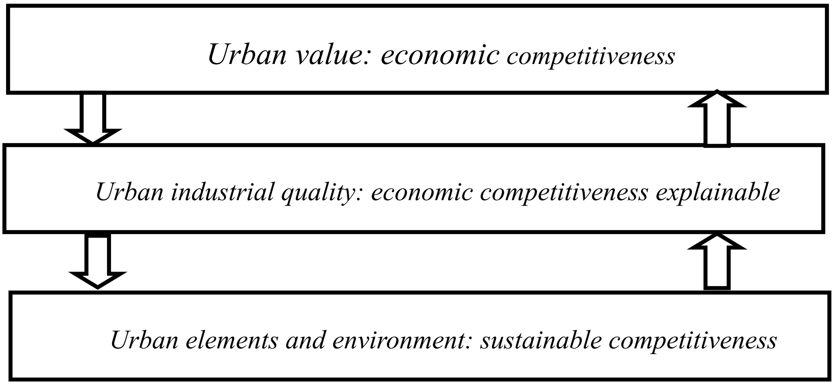


i. Economic competitiveness and its explanatory variable

Economic competitiveness is essentially the city's ability to create value and obtain economic rent. The capacity level is reflected by the city's competitive results in the current period, which is the output, current and short-term reflection of urban competitiveness. Economic competitiveness is mainly manifested as the comprehensive long-term growth of urban economy and the comprehensive economic efficiency, which are measured by the average increment of GDP for 5 consecutive years and the GDP per square kilometer of land. The urban economic competitiveness model is as follows:

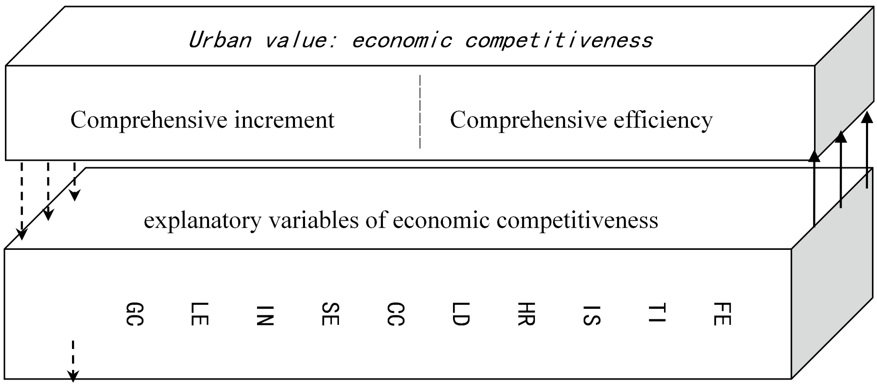
$$\mathbf{EC} = \mathbf{F}(\mathbf{LI}, \mathbf{EE})$$

EC is the economic competitiveness. LI, comprehensive long-term increase: The ability, potentiality and sustainability of a city's attraction, occupation, competition, control of resources and market value creation are determined by the long-term growth of GDP. The average annual increment of GDP in 5 consecutive years is used as an indicator measuring the comprehensive long-term growth. EE, the comprehensive economic efficiency: The GDP per square kilometer land modified by per capita GDP is used as an indicator to measure the comprehensive economic efficiency. The GDP per square kilometer land reflects the city's capacity of wealth creation per unit space, and efficiency in obtaining economic rent and economic benefit as well as utilizing the land which is an important resource. The per capita GDP reflects the urban development level.

The process is that, the urban industrial system is turned into economic competitiveness, and in turn, the urban economic competitiveness affects the sustainable competitiveness through explanatory variables of economic competitiveness. The urban industrial system is the sum of industries, and the industry is the sum of enterprise entities. The economic activities of enterprises are ultimately carried out through labor and creation, so people and enterprises are the behavioral subjects in urban industrial system. Based on the above theoretical analysis, this paper constructs the following explanatory model of economic competitiveness:

$$EEC = F(FE, TI, IS, HR, LD, CC, SE, IN, LE, GC)$$

EEC is the explanatory variable result of economic competitiveness. FE, financial services: A city or area's capability and efficiency of mobilizing storage, absorbing and allocating capital is an important decisive variable for a new global city. TI, technology innovation: Technology innovation is an inexhaustible and ultimate motive force of the sustainable development of urban economy and society, and the basic decisive variable of new global city. IS, industrial system: The industrial quality and modernization of a city. HR, human resources: Human resources are the main body of wealth and value creation in a city. LD, local demand: It is the local market demand. CC, commercial cost: The time and cost and so forth required in the setting up, operation, trading activities, taxes paying, contracts closing and executing of an enterprise pursuant to policies and regulations. SE, system environment: The institutional rules and environment. IN, infrastructure: The status of local infrastructure. LE, living environment: Local living environment and safety situation. GC, global connection: It is the position and visibility of urban subjects in the global industrial system.



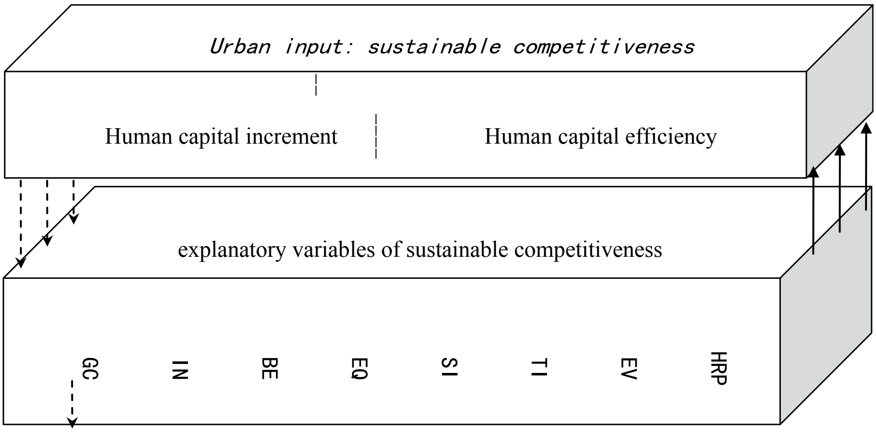
ii. Sustainable competitiveness

Urban sustainable competitiveness is essentially the conditions of a city's elements and environment. As the decisive factors in the process of urban development, the situation of a city's elements and environment has a decisive impact on the current and future development of the city. Thereby, urban sustainable competitiveness is the input, sustainable and long-term city competitiveness. According to the definition, economic competitiveness emphasizes the output while sustainable competitiveness emphasizes the input. Human capital, as the basic variable input in the city production, is a basic indicator measuring the sustainable competitiveness of the city, so we should use human capital density and increment to measure the sustainable competitiveness. Subject to the availability of international urban human capital data and the timeliness of the project, this report does not adopt human capital as a measure of sustainable competitiveness, but continues to use explanatory variables of sustainable competitiveness for analysis. In the future, it is considered to make further analysis based on the size and increment of urban high-income population.

Based on previous studies, this paper builds a model of urban sustainable competitiveness with 8 explanatory variables:

$$SC = F(HRP, EV, TI, SI, EQ, CE, IN, GC)$$

SC is urban sustainable competitiveness. HRP, human capital potential: Different from human resources, the human capital potential represents the future situation of the city's human capital. EV, economic vitality: Economic vitality is the level and speed of local economic development, and it is an important manifestation of urban sustainable development capacity. TI, technology innovation: Technology innovation is an inexhaustible and ultimate motive force of the sustainable development of urban economy and society. SI, social inclusion: It reflects the city's social mobilization and integration capabilities. EQ, environmental quality: It is the result of the combined impact of local natural environment and social and economic development, reflecting the capacity and level of local sustainable development. BE, Business environment: Local institutions and policies have important influence on urban competitiveness and its supply of elements. IN, infrastructure: The condition of local infrastructure is the material base of urban sustainable development. GC, global connection: It is the position and visibility of a city in the global industrial system and reflects the city's status in the global urban system.



The above model takes the subject's quality as the center, internal and external links as the main line, the counterparty's institutions as the baisis and the subject's supply and demand as the content, and integrates multidimensional factors affecting the competitiveness: the subject and the environment, supply and demand, stock and increment, short term and long term, static and dynamic, software and hardware, internal and external.

A.2 Indicator System

i. The result-oriental index estimating system of global urban comprehensive economic competitiveness

Sub index	Index name	Data source
Revealed economic competitiveness	1.1 The five-year GDP increment	The Economist EIU database, 2016 base period
	1.2 GDP per square kilometer land	The data of urban area is collected by the research group, and the urban GDP data is from the Economist EIU database and modified by per capita GDP

ii. The result-oriental index estimating system of global urban comprehensive economic competitiveness

Sub index	Index name	Data source and calculation method
1. Financial services	1.1 Bank index	The data is from Forbes 2000 indexes and processed by weighted calculation
	1.2 Bank branch index	The data is from the World Bank WDI database and converted proportionally based on the urban population
	1.3 Index at the exchange	The distribution of global stock exchanges adopts weighted transaction size
2. Technological innovation	2.1 Patent index	The data is from the World Intellectual Property Organization (WIPO), which is the synthesis of the total number of historical patents and the number of patents in the year
	2.2 Paper index	The data is from Web of Science
3. Industry system	3.1 Index of productive services enterprise	The data is from Forbes 2000 indexes and processed by empowerment calculation
	3.2 Technology enterprise index	The data is from Forbes 2000 indexes and processed by empowerment calculation
4. Human capital	4.1 The population of labor force (15–59)	The Economist EIU database
	4.2 The proportion of young people	The proportion of the population aged 20–29 years to the total population, and the data is from the Economist EIU database
	4.3 University index	The data of the ranking of world universities is from Ranking Web of Universities

(continued)

(continued)

Sub index	Index name	Data source and calculation method
5. Local demand	5.1 Total disposable income	The Economist EIU database
6. Business cost	6.1 Loan interest rate	The data is from the World Bank WDI database
	6.2 The proportion of tax revenue to GDP	The data is from the World Bank WDI database
	6.3 Per capita income/base price of hotel	The data of per capita income is from the Economist EIU database, and the data of basic hotel prices is from web crawler.
7. Institutional cost	7.1 Business facilitation	The data is from the World Bank's annual *Business Environment Report*
	7.2 Economic liberation degree	The economic liberation index released by the Wall Street Journal and The Heritage Foundation
8. Infrastructure	8.1 Convenience of shipping	The shortest earth surface distance from the city to the top 100 global ports
	8.2 Broadband subscriber volume	The data is from the World Bank WDI database and converted proportionally based on the population size
	8.3 The number of air routes and the distance from airports	The data is from the city airport websites, Wikipedia and the International Air Transport Association (IATA) (2016)
9. Living environment	9.1 PM2.5	The data is from WHO and the World Bank
	9.2 Crime rate	The data is from NUMBEO, and some Chinese urban data is the result of the regressive calculation of China's crime rate

iii. The index system of global urban sustainable competitiveness

Sub index	Index name	Data source and calculation method
1. Human capital	1.1 University index	The data is from Ranking Web of Universities, with the calculation method of adopting the ranking of the city's best university
	1.2 The proportion of young people aged 20–29	The Economist EIU database
2. Economic vitality	2.1 Per capita GDP (USD/person)	The Economist EIU database
	2.2 The average annual GDP increment of five years	The Economist EIU database
3. Technological innovation	3.1 Patent index	The data is from the World Intellectual Property Organization (WIPO), which is the synthesis of the total number of historical patents and the number of patents in the year
	3.2 Number of papers published	The data is from Web of Science

(continued)

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Sub index	Index name	Data source and calculation method
4. Social inclusion	4.1 Crime rate	The data is from NUMBEO, and some Chinese urban data is the proportional conversion result
	4.2 Gini coefficient	The data is from the Economist EIU database, which is calculated
5. Environmental quality	5.1 Per capita CO_2 emission	The data is from the World Bank WDI database and converted proportionally based on the urban population
	5.2 PM2.5	The data is from WHO and the World Bank
6. Business environment	6.1 Business environment index	The data is from the World Bank's annual *Business Environment Report*
	6.2 Economic liberation degree	The economic liberation index released by the Wall Street Journal and The Heritage Foundation
7. Infrastructure	7.1 Convenience of shipping	The shortest earth surface distance from the city to the top 100 global ports
	7.2 Broadband subscriber volume	The data is from the World Bank WDI database and converted proportionally based on the urban population
	7.3 The number of air routes	The data is from the city airport websites, Wikipedia and the International Air Transport Association (IATA) (2016)
8. Global connection	8.1 The connection degree of transnational corporations	The data is from Forbes 2000 companies, and the calculation method is in *WORLD CITY NETWORK*
	8.2 Global visibility	The number of searches of the city in GOOGLE is obtained through web crawler

A.3 Sample Selection and Stratification

i. **Definition of city**

A city is usually a residential area with a high degree of urbanization. However, there are different definitions and scopes for city in different countries. The "city" in the report refers to the aggregation region with the central city as the core which radiates to the surrounding area. It is clear from this definition that the cities herein are cities in the sense of metropolis rather than administration. It should be noted that, in the research process, for some cities, only statistics at the administrative level are available (such as most sample cities in China). We have made special notes for the related cities, but the other cities are ones in the sense of metropolis.

ii. **City samples**

Secondly, we should select cities for urban competitiveness assessment. The universality and typicality of the samples are related to the accuracy and value of the research conclusions. This report, according to the *World Urbanization Prospects* released by Department of Economic and Social Affairs of the United Nations in 2015, selects global cities with the population above 500,000 as samples, and based on China's urban situation, a total of 1035 sample cities around the world have been selected. From the view of spatial distribution, the 1035 cities are from 136 countries or regions of 6 continents, specifically, including 585 Asian cities, 130 European cities, 135 North American cities, 103 African cities, 75 South American cities, and 7 Oceanian cities. The 1035 cities basically represent the status of cities in different regions and at different levels. For the specific 1035 sample cities, see Chapter One. It is noteworthy that, GDP per square kilometer is adopted in measuring economic competitiveness, the selection criteria of which are more stringent, and due to its availability and accuracy, only 1007 cities are selected for the economic competitiveness model and ranking.

iii. **Sample stratification**

Global city, also known as the world-class city, refers to the city that directly affects global affairs at the social, economic, cultural or political levels and is the center of global economic system or the organizational node of global urban network. These nodes of different grades, capacities and connection degrees are aggregated into a multi-polarization and multi-level global urban network system. The existing researches generally classify the world cities through a single indicator from the perspective of urban function and value system. However, it is not comprehensive to analyze global cities through a single indicator, instead, we should proceed from the dimensions of population, space, network, etc. to identify the accurate position of a city in the global urban network. According to study, the competitiveness consists of such four aspects as elements, industries, functions, and value, among which, the value is a more general standard. Therefore, this study proceeds from the perspective of value, based on the revealed comprehensive economic competitiveness index, includes elements of urban agglomeration degree and connection degree, adopts the method of cluster analysis, preliminarily classifies global cities into the four levels of A, B, C and D. Furthermore, the levels of A, B and C are divided into three sections respectively. In total, there are ten sections at four levels. The specific division can be found in global urban comprehensive competitiveness index table in Chapter One.

iv. **Data source**

The study of global urban competitiveness is a research project which requires high quality and quantity of data. The data collection team of the research group has started work from last July, organized the translation of data in English, French, German, Spanish, Portuguese, Italian, Arabic, Russian, Japanese, Korean, etc., and established the collection team to collect data from official statistical publications, official network, academic researches and other channels. In this process, many foreign scholars and research institutions, as well as students studying abroad have offered great help. After nearly half a year of repeated searches and sorting, a fairly ideal index coverage is achieved. In view of countries' difference in data standards, we first study the statistics projects and standards of the United Nations Statistical Distribution (UNSD), the World Development Indicators of the World Bank, the OECD database and others, in combination with the actual situation of the countries, establish appropriate statistical standards with the strongest comparability and the widest coverage to apply in data collection and data processing, eventually forming a unified database covering 1035 global cities. The index data used in this international urban competitiveness index system mainly has four sources, i.e., the governmental statistical institutes of various countries; international statistical institutes; thematic reports and survey data of international research institutions or companies; big data obtained through web crawlers. For specific data sources and index interpretation, please refer to the GUCP database.

Nevertheless, due to subjective and objective restrictions, some exceptional cities are cast aside and some important indicators are adjusted or removed, which has left regret to this research and is hoped to be resolved in the future.

A.4 Calculation Method

i. Standardization method of index data

The dimension of the index data of urban competitiveness is different. First, we should conduct dimensionless processing of all index data. Objective indicators can be divided into single objective index and comprehensive objective index. For the dimensionless processing of single objective index data, this paper mainly adopts four methods: standardization, indexation, thresholding, and percentage ranking.

The standardization formula is: $X_i = \frac{(x_i - \bar{x})}{Q^2}$, X_i is the converted value of x_i, x_i is the original data, $\bar{x}$ is the average value, Q^2 is the square deviation, X_i is the data after standardization.

The indexation formula is: $X_i = \frac{x_i}{x_{0i}}$, X_i is the converted value of x_i, x_i is the original value, x_{0i} is the maximum value, X_i is the index.

The thresholding formula is: $X_i = \frac{(x_i - x_{Min})}{(x_{Max} - x_{Min})}$, X_i is the converted value of x_i, x_i is the original value, x_{Max} the maximum sample value, x_{Min} is the minimum sample value.

The percentage ranking formula is: $X_i = \frac{n_i}{(n_i + N_i)}$, X_i is the converted value of x_i, x_i is the original value, n_i is the number of samples with value smaller than x_i, N_i is the number of samples with value larger than or equal to x_i excluding x_i.

To sum up, the dimensionless processing of original data of objective index is: First quantize each component indicator, then take equal weight method to conclude the comprehensive index value through weighting.

ii. The method of measuring urban competitiveness

1. Comprehensive economic efficiency

The calculation method of comprehensive economic efficiency (GDP per square kilometer land weighted by per capita GDP) is a nonlinear weighted synthesis method. The so-called nonlinear weighted synthesis method (or multiplicative synthesis) refers to the application of the nonlinear model $g = \prod x_j^{w_j}$ for comprehensive evaluation. In the formula, w_i is the weight coefficient, and $x_i \geq 1$. For nonlinear models, when one indicator value is very small, the final value will be approaching zero. In other words, the evaluation model is sensitive to indicators with small value but unresponsive to indicators with large value. When measuring urban competitiveness with the nonlinear weighted synthesis method, it can reflect the overall index value more comprehensively and scientifically.

2. The calculation methods for economic competitiveness, explanatory variables of economic competitiveness, and sustainable competitiveness

Although the explanatory urban competitiveness index is designed as a grade-two index in the report, in fact, both the original index and the explanatory urban competitiveness index are at grade three. When synthesizing grade-three index into grade-two index and grade-two index into grade-one index, the method of standardization followed by equal weight addition is adopted. The standardization method is as mentioned before. The formula is:

$$z_{il} = \sum_j z_{ilj}$$

Specifically, z_{il} represents the grade-two index and z_{ilj} represents the grade-two index.

$$Z_i = \sum_l z_{il}$$

Specifically, Z_i represents the grade-one index and z_{il} represents the grade-two index.

A.5 Special Explanation

Urban competitiveness is a profound and complicated theme, and different nichetargeting conclusions can be drawn on different research objects through different methods and from different perspectives. The global urban competitiveness assessment system is developed based on the research model of Dr. Ni Pengfei's *Report on China's Urban Competitiveness*, in combination with the latest trend of global city development and multiple factors affecting urban competitiveness as well as the research on national competitiveness and urban competitiveness by other organizations in the world, and integrating urbanization, urban economics, spatial economics and other theories. The analysis framework and main thinking of competitiveness in this book are in line with the ideas in the *Report on China's Urban Competitiveness*, and there are also many references in the setting of index system. However, because of the change in research object, research theme and targeted readers, as well as various subjective and objective restrictions in the process of data collection, some updating and adjustment are made in the book's competitiveness assessment system and measurement methods compared with the *Report on China's Urban Competitiveness*. For academic prudence, the results of the index system and main conclusions in this book is not directly comparable with Report on China's Urban Competitiveness, and we suggest that readers will regard the two as the measure of urban competitiveness from different perspectives and levels.

A.6 1007 cities more than 10 competitive explanations variable index and ranking

Detailed data information found in http://www.gucp.org and https://cn.unhabitat.org.

Postscript

"Global Urban Competitiveness Report 2017–2018" by Professor Ni Pengfei (**National Academy of Economic Strategy, CASS**) and Marco Kamiya (UN-HABITAT), dozens of international and domestic well-known universities, authoritative statistical departments, corporate R&D institutions of nearly 100 experts to participate, After more than a year, the theory and investigation, measurement and case studies and other empirical research results. The basic theory, index system, research framework and important conclusions of the Global Urban Competitiveness Report 2017–2018 are mainly made by Dr. Ni Pengfei and Marco Kamiya. Deputy editor Wang Haibo (**National Academy of Economic Strategy**, Chinese Academy of Social Sciences) is responsible for reporting data collection, specific calculation, data collection, coordination and scheduling work.

With regard to urban competitiveness, this report divides it into two parts: economic competitiveness and sustainable competitiveness, and designs the index system respectively. The economic competitiveness of 1007 cities in the world and the sustainable competitiveness of 1035 cities are carried out and measured. This report, based on the relationship between global urban competitiveness and house prices, has written a thematic report named by "house prices, changing the city world". The manuscript of the report is written by the author after the theory of tempering, collecting the data, measuring and drawing the basic conclusion.

The contribution of each chapter is: Chapter 1: Annual ranking of general global urban competitiveness in 2017–2018, The whole group; Chapter 2: Global Urban Competitiveness of the overall report, Pengfei Ni, Marco Kamiya, Li Shen (Graduate School of the CASS), Weijing Gong (CASS) , Haidong Xu (Graduate School of the CASS); Chapter 3: City housing prices and competitiveness: Research Background and Literature Review, Pengfei Ni, Yangzi Zhang (Graduate School of the CASS); Chapter 4: The Relationship between Housing Prices and Urban Competitiveness: A Theoretical Framework, Qingfeng Cao (Tianjin University of Finance and Economics); Chapter 5: Global Urban Real Estate Market Status, Hongyu Guo (China Foreign Affairs University); Chapter 6: Relationship between the Housing Price and Competitiveness :Empirical analysis,

P. Ni et al. (eds.), *House Prices: Changing the City World*,
https://doi.org/10.1007/978-981-32-9111-9

Haidong Xu, HaiboWang; Chapter 7: City story: House Prices and Competitiveness, 7.1 Silicon Valley: Desen Lin (University of Pennsylvania), Andrew Renninger (University of Pennsylvania), Aidan T. Thornton (Ernst & Young U.S., LLP), Susan M. Wachter (University of Pennsylvania), Zhihua Zeng (World Bank), 7.2 Pittsburgh: Peter Karl Kresh (Bucknell University), 7.3 Singapore: Yangzi Zhang (China Everbright Group Postdoctoral Workstation), 7.4 Melbourne: SunSheng Han (University of Melbourne), 7.5 Tokyo: Erbiao Dai (Asian Economic Growth Research Institute, Japan), 7.6 Guangzhou: Jian Qin (Guangzhou Academy of Social Sciences), 7.7 Taipei: Chu-Chia Lin (National Chengchi University), 7.8 Foshan: Geng Xiao (University of Hongkong), Wenzhi LU (Hong Kong University of Science and Technology), 7.9 Madrdi: Paloma Taltavull de La Paz (University of Alicante, Spain), 7.10 Lima: Marco Kamiya, Oswaldo Molina (Universidad del Pacífico, Lima), 7.11 Buenos Aires: Cynthia Goythia (Torcuato Di Tella University); Chapter 8: Economic Foundations for Sustainable Urbanization: The link with Competitiveness, Marco Kamiya, Loeiz Bourdic (UN-Habitat); Chapter 9: Global urban comprehensive economic competitiveness report 2017–2018, Bo Li (Tianjin University of Technology), Xiaonan Liu (Graduate School of the CASS); Chapter 10: Global urban Sustainable Competitiveness report 2017–2018, Yufei Wang (Beijing University of Posts and Telecommunications), Xiaobo Zhou (China Everbright Group Postdoctoral Workstation), Jie Wei (China Northwest University); Appendix: Pengfei Ni, Haibo Wang.

"Global Urban Competitiveness Report 2017–2018" and the study of global urban competitiveness have been reported by consultants and many institutions and individuals with sincere and unselfish support. We express our admiration, respect and thanks for all the support and care of this research unit and person.

Ni Pengfei, Marco Kamiya
October 24, 2017