Research on the Commercial House Price of Supply and Demand Elasticity Based on the Panel Data of China's Four Municipalities

Yanming Lyu[1(✉)] and Mengxue Chen[2]

[1] Department of Engineering Management, Sichuan Agricultural University, Ya'an, China
lvyanming0515@163.com
[2] School of Sichuan Agricultural University, Ya'an, China

Abstract. Based on the panel data from 2000 to 2016 of China's four municipalities, this paper constructs a dynamic cobweb model that includes the price of real estate, per capita disposable income, interest rate, and other variables. Then, an empirical analysis of the price elasticity of China's commercial housing supply and demand is conducted. The results show that for the supply side, the supply of residential real estate has a positive correlation with the real estate prices in the previous period and is insensitive to changes in the benchmark lending rates. For the demand side, the demand for residential real estate is positively correlated with the per capita disposable income of urban residents in the current period, and is negatively correlated with the real estate price in this period. However, the demand of residential real estate is not sensitive to price changes. This result may be due to the fact that the four municipalities are China's economic and cultural centers. There are a large number of people are flooding into these cities. The increase in demand brought by the population boom far exceeds the decline in demand caused by rising prices. At the same time, the purchase restriction policy has played a certain role in suppressing speculative demand arising from price increases.

Keywords: Commercial housing market · Price elasticity · Dynamic cobweb model · Supply and demand balance

1 Introduction

With the rapid development of China's economy, the real estate has become an important pillar industry for the development of China's national economy thanks to its high relevance and strong driving force [1]. The average price of commercial housing in China rose from 1948 yuan per square meter in 2000 to 7203 yuan per square meter in 2016 [2]. The irrational soaring of housing prices in recent years has posed a potential threat to the sustainable development of China's social economy [3]. The commercial house price elasticity not only can reflect the characteristics of supply and demand in the real estate market, but also can explain the change of commercial house

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price. It plays an important role in measuring whether the real estate market is healthy or not, and it also can help decision makers to identify the regular of commercial house market, so as to formulate relevant policies.

Muth R F's research on "non-agricultural housing needs" in the paper "The Stock Demand Elasticities of Non-Farm Housing: Comment" is considered as the beginning of studies on housing demand in Western economics [4]. Thanks to the convenience of data acquisition, scholars from other countries have studied the demand and supply elasticity of the real estate market on the micro level. They not only consider the impact of income and price on housing demand, but also consider the effects of other factors such as different skin color, age, family size and income stability on the price elasticity of real estate demand. Polinsky A M and Ellwood D T selected relative sustained income and relative value of housing as independent variables, and conducted weighted least-squares method for housing price elasticity in 31 major cities in the United States [5]. Tong H L and Chang M K investigated the actual consumption area of housing in the United States. And they used panel analysis to study factors such as total income, relative housing prices, and characteristics of residents [6]. Carliner adopted the least square method and conducted an empirical study on the real income, the relative price of the house, skin color, gender, age and other factors by collecting the micro data of 4,565 consumers in the United States [7]. In recent years, scholars' research on the real estate market is more and more novel. Liebersobn C J studied the regional changes in housing and consumption boom. The results show that the price effect of housing supply in non-elastic cities is stronger [8]. Based on theory and practice, Chen K S and Yang J J studied the relationship between housing price dynamics and demand for mortgages and reverse mortgages [9]. F Niu and W liu systematically discussed the spatial heterogeneity of urban housing price based on the interaction rules of urban activities [10]. The perspectives of Larson W D and Zhao W are novel. They studied the impact between oil prices and housing prices, and quantified the huge and differential risks of changes in oil prices between city and city [11].

China's real estate market started relatively late, and its development history is only a few decades. It is an immature and fast-growing market. Before 1998, housing was allocated in kind. In other words, housing was a ration, not a commodity. In 1998, the State Council issued the "Circular of the State Council Concerning Further Deepening the Reform of Urban Housing System to Accelerate the Construction of Housing", which unveiled the prelude of the reform of China's comprehensive housing system. The government began to implement commercial housing supply model. Since then, real estate has become a commodity into the market, and has a real price [12].

Research on China's real estate market can be roughly divided into empirical research and policy research. Empirical research: Jian Xiong and Chunyan Li studied the main influencing factors and characteristics of China's real estate market demand, pointing out that the demand of China's real estate market is mainly based on rigid demand [13]. Zan Yang, Huan Zhang and Siqi Zheng studied the demand elasticity of home housing in six provinces of China, and made qualitative and quantitative predictions about changes in the future demand and the trend of price [14]. Donghe Zhang and Wenwen Zhou estimated the overall and individual housing supply elasticity of 35 large and medium-sized cities in China, and considered that overall urban housing supply in China is inelastic [15]. From the perspective of population structure, Jianjun

Zhou et al. analyzed the impact of demographic changes on the demand of real estate market based on provincial panel data [16]. Li Wang constructed a modified cobweb model by using the state space model to construct a variable parameter model for the demand function and supply function of Beijing real estate market. The results of the research show that the solution of the cobweb model is divergent, reflecting that the real estate price in Beijing has increasingly deviated from the equilibrium price in recent years, which requires the government to make it converge through macro-control [17]. Shuai Zhai and Yufei Yin added interest rates, per capita disposable income of urban residents and policy variables on the basis of the classic cobweb model, analyzed the supply and demand mechanism and price fluctuation characteristics of commercial housing in 35 large and medium-sized cities [18].

Policy research: Guozhen Chang divided China's credit control policy into three phases and studied the cyclical impact of China's credit policy on commodity housing prices [19]. Xiaoyan Shen studied the impact of China's urban land supply policy on commodity residential stocks, theoretically analyzed the three channel effects of land supply policy on the real estate market, and tested the effectiveness of the three channels through empirical research [20]. Lu Li pointed out that "land finance" is closely related to housing prices. Through the analysis of the optimal model, it is concluded that the effective of controlling land supply to impact the housing price is far less than controlling land supply directly to impact the land revenues [21].

The existing literature has analyzed the fluctuation of house prices from the angles of real estate cycle, supply and demand mechanism, influencing factors, industrial linkage, and policy control. However, there are few studies on house price fluctuations in specific regions, and research based on the cobweb model is even less. The innovation of this paper lies in the fact that the per capita disposable income of urban residents and interest rates were added on the basis of the classic cobweb model, and the price elasticity of the real estate market of China's four municipalities was studied in terms of supply and demand. The paper fully considers the characteristics of the real estate construction cycle and the lagging effect of the real estate market. Through the empirical analysis of the panel data of China's four municipalities, it is of reference significance to measure the healthy development of the real estate market in China's municipalities directly under the Central Government.

2 Model Construction

2.1 Dynamic Cobweb Model

The cobweb model is a dynamic analysis theory that introduces time into equilibrium analysis and uses elasticity theory to explain the different fluctuations in the occurrence when commodities with longer production cycle lose balance. It's a classic model for analyzing dynamic equilibrium prices in microeconomics. The model is generally used to analyze the balance of products with long production cycles such as agricultural products, livestock products, and real estate [22].

Hypothesis 1: Current supply of commodities Q_t^s depends on the price of the previous period P_{t-1}, namely the supply function for $Q_t^s = f(P_{t-1})$. Hypothesis 2:

Current demand of commodities Q_t^d depends on the current price P_t, namely the supply function for $Q_t^d = f(P_t)$

Through a brief introduction to the common cobweb model, this paper constructs the following cobweb model for the real estate market of municipalities directly under the Central Government:

$$\text{Supply function: } Q_t^s = \alpha_0 + \alpha_1 P_{t-1} + \alpha_2 R_t + \varepsilon_1 \quad (1)$$

$$\text{Demand function: } Q_t^d = \beta_0 + \beta_1 P_t + \beta_2 S_t + \varepsilon_2 \quad (2)$$

When $Q_t^d = Q_t^s$, the spider model reaches equilibrium.

In the formula, α_0 and β_0 are constant terms, α_n and β_n are regression coefficients. Among them, Q_t^s and Q_t^d represent the supply amount and demand amount in the t-th period, respectively. P_t is the current price, R_t express the current interest rate, and S_t represents disposable income of urban residents in the current period. Formula (1) means that the housing supply in this period depends on the price of the previous period P_{t-1} and the current interest rate R_t. Formula (2) shows that the demand for housing in this period depends on the current housing price P_t and disposable income of urban residents in the current period S_t.

2.2 Variable Description

2.2.1 Supply Variable Description

Floor space completed refers to the completed commercial housing area that developers can directly input the market as supply. Floor space completed can intuitively reflect the change of supply, so this paper selects it to represent supply.

Real estate price is the primary factor that affects the supply of real estate. In the case of constant construction cost, the higher the real estate price, the greater the profitability of real estate developers, and the more real estate supply. In the hypothesis of dynamic model, the real estate developers decide the supply quantity of real estate according to the real estate price of the last period. Due to the particularity of the real estate industry, the construction period is long, and this paper selects the completed area to represent supply, so the current price is not added into the model.

The real estate industry is characterized by a long cycle and high investment. The developer's funds are generally composed of its own funds and bank loans. The level of interest affects the profitability of developers in real estate development. Therefore, this paper adds the interest rate indicator to the supply model. In the model, interest rates are selected from the benchmark RMB interest rate (one-year period) of financial institutions issued by the People's Bank of China. Because of the frequent changes in benchmark interest rates for several years, the author adopts weighted average method in data collection. In fact, the level of interest rate affects both the supply and the demand of real estate. This paper focus mainly on its impact on supply.

2.2.2 Demand Variable Description

The level of sales can most intuitively reflect the people's demand for real estate, so this paper selects residential commercial housing sales area to represent demand. And the

real estate price is an important factor that people consider whether to buy property. In general, prices and demand change in the opposite direction. In the dynamic model assumptions, the demand for real estate in this period will be determined by the real estate price in this period.

Disposable income is the decisive factor for people to consider whether to buy a house. It represents people's purchasing ability. The per capita disposable income reflects the development level of the national economy. With the growth of economy, people's income levels continue to increase. People's demands for living environment and housing condition are getting higher and higher, and the demand for real estate increases accordingly. Therefore, the urban residents' per capita disposable income index is added to the demand model in this paper.

3 Data Description

3.1 Sources of Data

This paper selects annual data for the period from 2000 to 2016. The average sales price of residential real estate in the country is taken from the "China Statistical Yearbook". The floor space completed, sales area, annual average selling price, and per capita disposable income of urban residents in each municipality were taken from statistical yearbooks of municipalities directly under the Central Government. The benchmark interest rate for RMB loans of financial institutions (one year) comes from the official website of the People's Bank of China.

See the attached table for details:

Table 1. Municipality panel data sheet

City	Years	Sales area (Ten thousand square meters)	Selling price (yuan)	Per capita disposable income (yuan)	Floor space completed (Ten thousand square meters)	Last year sales price (yuan)	Interest rate (%)
Beijing	2000	898.22	4557.00	10349.70	1365.60	4787.00	5.94
Beijing	2001	1127.50	4716.00	11577.80	1707.35	4557.00	5.94
Beijing	2002	1604.40	4467.00	12463.90	1926.20	4716.00	5.60
Beijing	2003	1771.10	4456.00	13882.60	2080.75	4467.00	5.49
Beijing	2004	2285.82	4747.14	15637.80	2343.95	4456.00	5.51
Beijing	2005	2823.65	6162.13	17653.00	2841.42	4747.14	5.76
Beijing	2006	2205.03	7375.41	19977.50	2193.32	6162.13	6.00
Beijing	2007	1731.48	10661.24	21988.70	1853.95	7375.41	6.32
Beijing	2008	1031.43	11648.00	24724.90	1399.30	10661.24	7.31
Beijing	2009	1880.45	13224.00	26738.50	1613.23	11648.00	5.40
Beijing	2010	1201.39	17151.00	29072.90	1498.48	13224.00	5.42
Beijing	2011	1034.96	15517.90	32903.00	1316.13	17151.00	6.36

(*continued*)

Table 1. (*continued*)

City	Years	Sales area (Ten thousand square meters)	Selling price (yuan)	Per capita disposable income (yuan)	Floor space completed (Ten thousand square meters)	Last year sales price (yuan)	Interest rate (%)
Beijing	2012	1483.37	16553.48	36468.80	1522.72	15517.90	6.42
Beijing	2013	1363.67	17854.00	40321.00	1692.04	16553.48	6.15
Beijing	2014	1136.53	18499.00	43910.00	1804.34	17854.00	6.14
Beijing	2015	1126.84	22300.00	52859.00	1378.22	18499.00	5.31
Beijing	2016	981.37	28489.00	57275.00	1267.06	22300.00	4.75
Shanghai	2000	1445.87	3326.00	11718.00	1643.62	3102.00	5.94
Shanghai	2001	1681.48	3658.00	12883.00	1791.36	3326.00	5.94
Shanghai	2002	1846.40	4007.00	13249.80	1708.10	3658.00	5.60
Shanghai	2003	2224.50	4989.00	14867.50	2139.99	4007.00	5.49
Shanghai	2004	3059.53	5761.21	16682.80	3076.19	4989.00	5.51
Shanghai	2005	2845.70	6698.00	18645.00	2739.91	5761.21	5.76
Shanghai	2006	2615.49	7039.00	20667.90	2699.11	6698.00	6.00
Shanghai	2007	3279.17	8253.00	23622.70	2752.45	7039.00	6.32
Shanghai	2008	2007.48	8115.00	26674.90	1801.45	8253.00	7.31
Shanghai	2009	2928.04	12364.00	28837.80	1508.81	8115.00	5.40
Shanghai	2010	1690.82	14290.00	31838.10	1396.05	12364.00	5.42
Shanghai	2011	1500.00	13565.83	36230.50	1645.47	14290.00	6.36
Shanghai	2012	1592.63	13869.88	40188.30	1609.13	13565.83	6.42
Shanghai	2013	2015.81	16192.00	43851.00	1417.41	13869.88	6.15
Shanghai	2014	1780.91	16415.00	47710.00	1535.55	16192.00	6.14
Shanghai	2015	2009.17	21501.00	52926.00	1588.95	16415.00	5.31
Shanghai	2016	2019.80	25910.00	57692.00	1532.88	21501.00	4.75
Tianjin	2000	378.34	2274.00	8140.55	583.51	2157.00	5.94
Tianjin	2001	514.59	2308.00	8959.70	690.48	2274.00	5.94
Tianjin	2002	538.30	2414.00	9337.60	673.00	2308.00	5.60
Tianjin	2003	720.60	2393.00	10312.90	750.67	2414.00	5.49
Tianjin	2004	796.09	2950.34	11467.20	1014.46	2393.00	5.51
Tianjin	2005	1264.38	3987.22	12638.60	1270.96	2950.34	5.76
Tianjin	2006	1332.49	4649.25	14283.10	1308.95	3987.22	6.00
Tianjin	2007	1401.85	5575.72	16357.40	1398.61	4649.25	6.32
Tianjin	2008	1135.35	5598.00	19422.50	1492.54	5575.72	7.31
Tianjin	2009	1461.47	6605.00	21402.00	1580.82	5598.00	5.40
Tianjin	2010	1302.61	7940.00	24292.60	1603.65	6605.00	5.42
Tianjin	2011	1365.71	8547.64	26920.90	1645.10	7940.00	6.36
Tianjin	2012	1511.40	8009.58	29626.40	1913.97	8547.64	6.42
Tianjin	2013	1720.34	8390.00	28980.00	2117.66	8009.58	6.15
Tianjin	2014	1483.64	8828.00	31506.00	2130.25	8390.00	6.14

(*continued*)

Table 1. (*continued*)

City	Years	Sales area (Ten thousand square meters)	Selling price (yuan)	Per capita disposable income (yuan)	Floor space completed (Ten thousand square meters)	Last year sales price (yuan)	Interest rate (%)
Tianjin	2015	1674.78	9931.00	34101.00	2182.99	8828.00	5.31
Tianjin	2016	2521.87	12870.00	37110.00	2189.14	9931.00	4.75
Chongqing	2000	491.09	1077.00	6276.00	849.42	1080.00	5.94
Chongqing	2001	635.04	1133.00	6721.00	1020.63	1077.00	5.94
Chongqing	2002	870.40	1277.00	7238.00	1033.60	1133.00	5.60
Chongqing	2003	1133.00	1324.00	8093.70	1231.75	1277.00	5.49
Chongqing	2004	1138.26	1572.56	9221.00	1187.23	1324.00	5.51
Chongqing	2005	1792.41	1900.66	10243.50	1713.55	1572.56	5.76
Chongqing	2006	2011.70	2081.31	11569.70	1700.05	1900.66	6.00
Chongqing	2007	3310.13	2588.22	12590.80	1769.19	2081.31	6.32
Chongqing	2008	2669.93	2640.00	14367.60	1951.35	2588.22	7.31
Chongqing	2009	3771.22	3266.00	15748.70	2384.51	2640.00	5.40
Chongqing	2010	3986.31	4040.00	17532.40	2179.81	3266.00	5.42
Chongqing	2011	4063.42	4492.30	20249.70	2826.78	4040.00	6.36
Chongqing	2012	4105.11	4804.80	22968.10	3386.35	4492.30	6.42
Chongqing	2013	4359.19	5239.00	25216.00	2867.45	4804.80	6.15
Chongqing	2014	4423.68	5094.00	25147.00	2771.55	5239.00	6.14
Chongqing	2015	4477.71	5012.00	27239.00	3185.90	5094.00	5.31
Chongqing	2016	5105.46	5162.00	29610.00	3084.00	5012.00	4.75

3.2 Data Processing

In the context of panel data, there are fixed effect model and random effect model for common models. The biggest difference between the fixed effect model and the random effect model lies in its basic assumption, that is, whether the individual variables do not change over time is related to the predicted or independent variable. The HAUSMAN test value ($p > 0.05$) was obtained through data analysis. Therefore, the random effect model was chosen to perform regression analysis on the supply function and the demand function. In order to eliminate the influence of heteroscedasticity on the statistical results, the data has been processed logarithmically.

4 Regression Analysis

This paper adopts stata12.0 software to perform regression analysis on supply and demand variables in the cobweb model (1) and (2). The stata12.0 software running results are shown in the following table.

Table 2. Supply function regression results

Variable	Coefficient	P > |z|
P_{t-1}	3.06	0.002***
R_t	0.19	0.851
_cons	5.67	0.000***
R-sq	0.6475	
Prob > chi2	0.0092	
Number of samples	68	

Note: ***, **, and * indicate significance levels of 99%, 95%, and 90%, respectively.

Table 3. Demand function regression results

Variable	Coefficient	P > |z|
P_{t1}	−1.40	0.161
S_t	2.40	0.016**
_cons	0.84	0.403
R-sq	0.7217	
Prob > chi2	0.0000	
Number of samples	68	

Note: ***, **, and * indicate significance levels of 99%, 95%, and 90%, respectively.

Supply function and demand function are:

$$\ln Q_t^s = 5.5510 + 0.2015 \ln P_{t-1} + 0.0812 \ln R_t \tag{4}$$

$$\ln Q_t^d = 1.2577 - 0.5242 \ln P_t + 1.0826 \ln S_t \tag{5}$$

5 Conclusions and Discussion

5.1 Conclusion

Based on the panel data of 2000–2016 in four municipalities directly under the Central Government of China, the paper constructs a dynamic cobweb model that includes the price of commodity housing, disposable income per capita, and interest rate, etc. On this basis, the paper conducted an empirical analysis of the price elasticity of supply and demand in commercial housing in China.

The results of the supply function regression are shown in Table 1. For the supply side, the supply of residential real estate is positively correlated with the price of real estate in the previous period, and it is significant at the 99% confidence level. For every 1 percentage point increase in housing prices, real estate supply rose by 3.62

percentage points. With rising house prices, developers will find it profitable to increase supply. The central bank's RMB-based benchmark lending rate is not significant for real estate, indicating that real estate supply is insensitive to changes in the benchmark lending rate. Interest rate adjustment may curb property supply in the short term, resulting in insufficient supply. However, in the long run it does not mean that interest rates can effectively curb property supply.

The results of the demand function regression are shown in Table 2. For the demand side, the demand for residential real estate is negatively correlated with the real estate price in the current period. As the price increases, the demand declines. For every 1 percentage point increase in housing prices, real estate demand fell by 1.4 percentage points. However, the regression results are not significant. This may due to the fact that China's four municipalities are the economic and cultural centers of China and a large number of people are flooding into these cities. The increase in demand brought by the population boom far exceeds the decline in demand caused by rising prices. Furthermore, real estate has its own characteristics as a commodity, which itself can also be used as an investment. In recent years, Beijing, Shanghai, and other economically developed cities have adopted a purchase restriction policy, so the speculative demand brought about by price increases has also been somewhat suppressed. In addition, the demand for residential real estate is positively correlated with the per capita disposable income of urban residents during the current period, and it is significant at the 95% confidence level. Per capita disposable income rose by 1 percentage point, and real estate demand rose by 2.4 percentage points. With the rapid economic growth, people's income levels have continued to increase, their living standards have gradually increased, and people's desire to improve their living environment has also increased. Thus, this has increased the demand for residential real estate (Table 3).

Make $Q_t^d = Q_t^s$, the following conclusion can be drawn:

$$\ln Q_t^d = 5.5510 + 0.2015 \ln P_{t-1} + 0.0812 \ln R_t \tag{6}$$

It can be seen that under the equilibrium conditions, the real estate market demand is positively correlated with the housing price in the previous period, indicating that the cobweb model of the real estate market in the four municipalities is divergent. There are many factors that make the cobweb model out of equilibrium. It is necessary for the government to introduce macro-control policies to rationally intervene in the real estate market.

5.2 Discussion

At present, China's economy has entered a new normal and its economic growth has slowed down. Based on the study of the price elasticity of demand and supply in the municipalities directly under the Central Government, the following suggestions are proposed for China's commercial housing.

1) Supply-side regulation should still be centered on increasing land supply.

The lack of flexibility in the supply side of commercial housing in China's municipalities directly under the Central Government is a major reason for land supply.

Land control policies have a huge impact on housing prices. For municipalities with skyrocketing housing prices, such as Beijing and Shanghai, it is could be better to limit housing price, bids for land prices, and promulgate corresponding land control policies.

2) Supply-side regulation should vigorously promote the construction of affordable housing.

China's affordable housing has been relatively lacking. At present, housing prices have soared. Many low- and middle-income families cannot afford housing. The government should vigorously promote the construction of affordable housing. When necessary, the implementation of the public housing security system can be included in the performance evaluation system of local governments.

3) The demand-side regulation: The "restricted purchase" and "limited loan" policies are short-term effective tools for curbing housing prices.

The "restricted purchase" and "limited loan" policies are major measures for China's current adjustment of real estate demand. The result proves that these policies have also played a certain role, especially in suppressing real estate investment demand.

4) Improve the land market information release system and guide people's reasonable expectations.

A large part of China's housing demand consists of speculative demand for investment. When people expect a higher level of real estate prices, they will increase investment and cause high prices. The government should promote the establishment of a land market information release system and guide people's reasonable expectations.

5) Vigorously promote the concept of renting is as well as buying a house, and guide people to solve housing problems in multiple ways.

Affected by traditional concepts, Chinese people are more inclined to buy a house when they choose a basic solution to solve the housing problem, leading to strong demand in China's real estate market and high housing prices. The government should vigorously promote the concept of renting is as well as buying a house, guide people to solve the housing problem in a diversified way, and ease the pressure on housing demand in China.

Due to the availability of data, the variables and parameters considered in this paper are incomplete. In general, there are many factors that affect the supply of real estate, such as: real estate prices, industry profitability, construction cost, land prices, interest rates, and national policies and so on. The more variable parameters, the more consistent the analysis results with the actual situation, and the more directivity will be. In future studies, it may be considered that adding construction cost and land prices as variables to the model. The price elasticity also can be explored in more depth.

There are also many factors that affect real estate demand, such as real estate prices, per capita disposable income, population growth rates, people's expectations of house prices, preferences for geographic locations, and so on. Similarly, in the later in-depth study, the rate of population increase can be added to make the analysis of price elasticity of demand more convincing.

References

1. Xu, X., Jia, H., Li, Y., et al.: The role of real estate economy in China's national economic growth. Chin. Soc. Sci. **1**, 84–101 (2015)
2. China Statistical Yearbook 2017. China Statistics Press (2017)
3. Zhang, Z., Zhang, Y.: Current situation and sustainable development of China's real estate market. Explor. Econ. Issues **8**, 1–6 (2011)
4. Muth, R.F.: The stock demand elasticities of non-farm housing: comment. Rev. Econ. Stat. **47**(4), 447–449 (1965)
5. Polinsky, A.M., Ellwood, D.T.: An empirical reconciliation of micro and grouped estimates of the demand for housing. Rev. Econ. Stat. **61**(2), 199–205 (1979)
6. Tong, H.L., Chang, M.K.: Elasticities of housing demand. South. Econ. J. **44**(2), 298–305 (1977)
7. Carliner, G.: Income elasticity of housing demand. Rev. Econ. Stat. **55**(4), 528–532 (1973)
8. Liebersohn, C.J.: Housing Demand, Regional House Prices and Consumption (2017)
9. Chen, K.S., Yang, J.J.: Housing Price Dynamics, Mortgage Credit, and Reverse Mortgage Demand: Theory and Empirical Evidence. Real Estate Economics (2017)
10. Niu, F., Liu, W.: Modeling urban housing price: the perspective of household activity demand. J. Geogr. Sci. **27**(5), 619–630 (2017). (in Chinese)
11. Larson, W.D., Zhao, W.: Oil Prices and Urban Housing Demand. Real Estate Economics (2017)
12. Department of Housing and Real Estate, Ministry of Construction: Question and Answer on the Current Housing System Reform Policy: "The State Council's Policy on Further Deepening the Urban Housing System Reform to Accelerate Housing Construction" Policy Q&A. China Price Press (1998)
13. Xiong, J., Li, C.: Analysis of factors and characteristics of real estate demand in China. Stat. Decis. **12**, 127–130 (2015)
14. Yang, Z., Zhang, H., Zheng, S.: Elasticity of housing demand for self-contained families. Stat. Decis. **14**, 60–63 (2015)
15. Zhang, D., Zhou, W.: Calculation of housing supply elasticity in China and analysis of influencing factors. Stat. Decis. **7**, 125–128 (2017)
16. Zhou, J., Dai, W., Yu, F., et al.: An analysis of the influencing factors of real estate prices based on spatial measurement. Take Hunan Province as an example. Theor. Pract. Finan. Econ. **2015**(6), 114–119 (2015)
17. Wang, L.: An empirical study on the relationship between supply and demand in Beijing real estate market and the role of price mechanism. Econ. Manage. Res. **5**, 61–66 (2008)
18. Zhai, S., Yin, Y.: Cobweb model analysis of real estate market price influencing factors——based on central 6 provinces data. Res. World **05**, 11–17 (2017)
19. Chang, G.: The periodical impact of domestic credit policy on prices of commercial housing. Price Month. **1**, 51–56 (2017)
20. Shen, X.: Research on the Impact of China's Urban Land Supply Policy on Commercial Residential Inventory. Nanjing University (2017)
21. Li, Y.: Housing prices, fiscal revenue stability, and optimal real estate regulatory policies. Stud. Finan. Econ. **02**, 43–51 (2017)
22. Gao, H.: Western Economics, 3rd edn. Renmin University of China Press, Beijing (2005)