Chapter 19
The Rise of the Knowledge Economy in the Megalopolis

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Abstract This chapter described the evolution of the *Megalopolis*, the region of continuous urban development that stretches along the US East Coast from Boston Metropolitan Region in the North to the Washington DC Metropolitan Region in the South and includes New York, Baltimore, and Philadelphia. Economic dynamism in the Megalopolis over recent decades has been propelled in part by new transport and communication systems which have facilitated the emergence of global economy and the arrival of dynamic new knowledge in the form of physical and institutional technologies in the manufacturing and service economies. The chapter reviews the literature on transition to knowledge economy, explores trends in the entire Megalopolis Region, and provides additional detail on the Boston region's evolutionary shift to the knowledge-intensive service economy. Finally, the chapter implements the Spence and Hlatshwayo (The evolving structure of the American economy and the employment challenge. Working paper, Council on Foreign Relations, Maurice R. Greenberg Center for Geoeconomic Studies, 2011) approach to study the evolution of tradable and non-tradable sectors and the progress of income distribution for one Megalopolis metro area, namely, Boston. In its conclusion, the chapter attributes the rise of knowledge economy in the Megalopolis to three kinds of *proximity* among economic agents: physical, relational, and institutional.

Keywords Income distribution · Knowledge economy · Megalopolis · Non-tradable sectors · Services

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19.1 Introduction and Overview

This chapter describes *the nature and scope of the economic structural evolution* toward a knowledge economy in the *Megalopolis*, which is the dynamic settlement corridor stretching from Boston to Washington, D.C., in the USA.

The Megalopolis, as christened by Jean Gottman, stretches between the Boston Metropolitan Region in the north and the Washington Metropolitan Region in the south and includes some of the country's oldest areas of industrialization and of urbanization. It had become the densest mega-urban region in the USA by the mid-twentieth century. In the quarter century following 1950, the metropolitan regions of the Megalopolis experienced industrial restructuring and decline as industrial enterprises began migrating to other regions in the USA and abroad. However, over the past 40–50 years, there has been a remarkable reversal of regional economic decline. There has occurred indeed a notable economic resurgence in the various metropolitan areas of the Megalopolis. A variety of knowledge-intensive production and service sector enterprises have arrived and continue to grow in the metro areas that comprise the Megalopolis. These revived metropolises represent today large concentrations of high-quality human, cultural, and organizational capital and some vibrant contemporary "knowledge metropolises" (Lakshmanan et al. 2016).

This chapter will argue that this economic dynamism in the Megalopolis over recent decades has been propelled in part by new transport and communication systems which have facilitated the emergence of global economy and the arrival of dynamic new knowledge in the form of physical and institutional technologies in the manufacturing and service economies.

The recent decades of *globalization* have yielded an explosive expansion of cross-country economic interactions, division of labor, complex webs of production chains, a globally distributed production system, and the emergence of corporate central organizational service functions (financial, legal, accounting, and other business and professional services) that support business operation. There is thus a twofold shift to a "knowledge economy," comprising of *first* a relative shift away from production that is dependent on material resources, physical capital, and low skill labor to one which increasingly exploits knowledge and knowledge workers as key ingredients of competitiveness and innovation and, *second, the emergence of* knowledge-intensive business services, which promote a growing shielding of manufacturing products in a "service sheath," which exploit the economies of scale in human capital and which promote knowledge dissemination and productivity effects in other parts of the economy. Thus economic evolutionary effects in the Megalopolis over recent decades are *joint consequences* of changes in transport systems, the emergence of global economy, and the onset of dynamic new knowledge in the form of physical and institutional technologies in the manufacturing and service economies.

Part II describes how the historically modally organized transport system in the Megalopolis has transformed itself into a *multivalent and multimodal transport*

system, which in turn unleashes various economic mechanisms and processes underlying the broader economic consequences of transport investments over time.

Part III highlights an analysis of urban development patterns in the I-95 Corridor over six decades and suggests *urban decline and resurgence.* This evolution ranges from the dense and compact *industrial era spatial pattern* (pre-1950s—manufacturing production and working class households concentrated in dense cities) to the *Decentralized Spread City* (1950s to the early 1980s) in an increasingly affluent economy, to the contemporary (post-1985) *trends toward agglomeration and metropolitan clustering of* "knowledge economy" *activities* along the metropolitan regions in the Megalopolis.

Part IV offers a brief survey of (a) the reinvention of major metro areas in the Megalopolis as knowledge economies. Such economic transformation processes are highlighted in terms of (1) current theoretical formulations of the rise of the "knowledge production economy" and (2) the contributions that the growing knowledge-intensive business services make in the form of positive knowledge and productivity spillovers to other industries in the broader economy. The scale and scope of the growth and evolution of such knowledge-intensive production sectors over recent decades in the Megalopolis and its component five large metro areas are presented. Next, the vibrant growth and evolution of knowledge-intensive business sectors and their functioning as knowledge, innovation, and expertise transfer agents in the Megalopolis are highlighted.

Part V highlights the rising income inequalities in the various metropolitan associated with the advent of the new knowledge economy.

Part VI concludes the chapter.[1]

19.2 Transport Networks in the Megalopolis: Their Evolution and Economic Contributions

19.2.1 Network Evolution

Over the last four to five decades, the highways, railroads, waterways, ports, and the aviation system in the Megalopolis have evolved from those serving the dense city-based transport networks of the immediate post-World War industrial era to the contemporary nationally integrated multimodal transport network enabling seamless transportation, serving a nationally integrated production system and more recently a globally distributed, increasingly knowledge-intensive production economy.

This transformation of the transport system in recent decades has been driven by *three* key transport *technological* innovations—*Interstate Highway System, containers, and jet aircraft—and two organizational reforms, pertaining to economic*

[1] Many of the issues addressed in this chapter are considered in more expanded form in Lakshmanan et al. (2016).

governance of transport, physical flows and border controls. The Interstate Highway System vastly enhanced interurban and intraurban mobility and led to steep drops in regional and national passenger and freight travel times and costs. Containers, first introduced in 1966 in the Megalopolis by US shipping lines on the North Atlantic routes, have greatly enhanced shipping efficiency and rapidly grown and spread worldwide, facilitating intermodal transport of freight. The technical evolution of jet aircraft and the aviation sector has led to sharp drops in travel times and air freight prices and to growing volumes of high value-added goods being shipped by air domestically and globally. The institutional innovations in the form of deregulation and privatization of transport have enabled a broad range of transport service and process innovations and logistical improvements. The reform of rules governing transport physical flows (e.g., vehicle size/wt. rules, reinvented inspection processes) has not only enlarged transport capacities on routes and terminals and logistical potential but has stimulated new "service opportunities," which are critical to the operation of a globalized economy (Lakshmanan et al. 2009).

19.2.2 Transport Improvements and Economic Evolution

As transport infrastructure and service improvements lower costs and increase accessibility to various market actors—input suppliers, labor, and customers—market expansion, increased integration, and mutually sustaining economic growth will ensue. The underlying economic mechanisms are:

1. *Gains from trade:* As transport improvements expand markets for firms, there is an increasing specialization and trade, a surge in productivity, and "Smithian" growth. Export expansion will lead to higher levels of output and efficiencies, and increasing imports lower local prices. Firms enjoy a broader labor pool, lower local prices, and improved land and other factor markets, thereby promoting a highly integrated national economy and over time a globalized economy.
2. *Technology diffusion:* Associated with the growth of interregional and cross-country trade, there has been an upsurge in intra-industry trade and the exchange of intermediate goods. Opportunities for adopting new technical knowledge associated with imports, as well the potential for knowledge and technology growth through "learning by doing" and "learning by using."
3. *Gains from agglomerations made possible by transport*: Some urban agglomerations enjoy *increasing returns* in the form of dynamic location advantages, enabling innovation and dynamic competitiveness of these cities. The three broad modeling approaches which try to capture these advantages are:

   (a) *Economic Geography and Location Economics Models*: e.g., Marshall's (1890) focus on agglomeration economies—(a) *input sharing* among firms, (b) *matchin*g in metro areas of workers' skills and requirements of employers,

and (c) *knowledge spillovers or learning* in these dense locations, with workers being the primary vehicles of these transfers—such ideas are further elaborated by Hoover (1948) and Isard (1956) and later by Haynes and Shibusawa (2005).

(b) *New Economic Geography Model*: Krugman (1991) applied a general equilibrium modeling framework to the geography of the economy under conditions of increasing returns to scale and labor mobility, reinterpreting the findings of Marshall on agglomerations. In the resulting "new economic geography" (NEG) model, spatial concentration and dispersion emerge. The NEG model, however, accounts for only pecuniary economies, makes no mention of either human capital or technological spillovers, and has no answers for the contemporary knowledge creation process and innovation-led growth in urban agglomerations.

(c) Innovation-Led Urban Centers: This class of models views the increasing returns associated with regional agglomerations as dynamic location advantages attributable to:

(i) Physical proximity among economic actors, promoting interactions and access to appropriation and sharing of tacit knowledge, thus promoting innovation
(ii) Relational proximity of economic agents, facilitating cooperative behavior, collective learning, and socialization of innovation risk
(iii) Institutional proximity among the firms in the urban agglomeration in terms of shared rules, codes, and norms of behavior which will promote cooperation in interactive learning processes
(iv) Lowering of adaptive costs among firms competing in an environment of rapid pace of change of knowledge infrastructures

As has been noted widely, a major consequence of such innovations in both transport and ICT infrastructures has been the economic structural change of globalization of the USA and the Megalopolis economies, namely, the ability to decompose and organize production into many value-adding components, many of which are fabricated in a variety of locations around the world.

While growth deriving from interregional and international trade is most associated with freight transportation, the effects of agglomeration and innovation are also driven by public transportation, including passenger rail within megaregions. Results from sophisticated empirical models indicate that this is especially true for the Megalopolis, as Chen and Haynes (2015) find that the economic contribution of public transit including passenger rail infrastructure tends to be much stronger at the US northeast metro level than the national level of analysis.

19.3 Demographic and Economic Evolution of the Megalopolis

The Megalopolis has witnessed a growth of urban population (approximately 75%) and of urbanized area (a 300% increase)—thereby dropping urban density and reflecting the growth of suburbs and exurbs. In the three decades, 1972–2002, the five major metro areas in the Megalopolis had a modest growth in population (Fig. 19.1). But this period actually comprised two different subperiods. The first half (1972–1987) was more or less a stationary period for the four metro areas and one of even population decline (Fig. 19.1). However, the manufacturing employment performance of this region relative to the nation drops sharply since 1990, indicating sharper regional decline of the manufacturing sector. The earnings shares in the manufacturing sector of the Megalopolis stay higher than the employment shares in the entire period (and more so in the last two decades). In the last two decades, the earnings per manufacturing worker in the Megalopolis are higher, suggesting a higher proportion of high value-adding sectors—deriving from the arrival of more knowledge-intensive sectors in the region.

The Megalopolis shares of national total (non-farm) earnings have dropped in the 1970–1990 period but have since held steady, reflecting the faster growth in the knowledge-intensive service sectors. However, the Megalopolis shares of total non-farm earnings remains high—5% higher than population shares in 2010, suggesting that earnings per employee are higher in the region than in the nation.

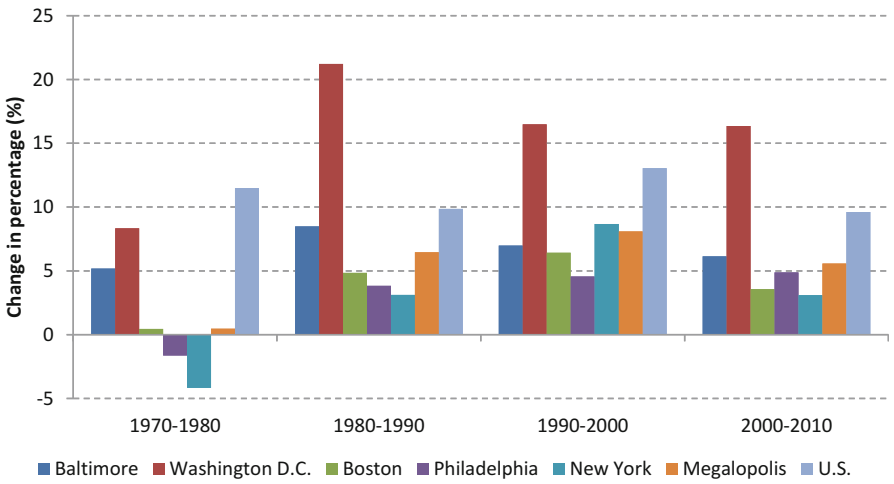

Fig. 19.1 Population growth in Megalopolis metro areas. (Source: Lakshmanan et al. 2016)

19.4 The Transition to Knowledge Economies in the Megalopolis

The major metropolitan areas in the Megalopolis have experienced in the recent past economic decline, as their manufacturing sectors lost their competitive edge in the two decades after World War II. They had to confront the malaise of postindustrial society, unraveling the complexities and dead ends of economic decline.

Yet some of these same urban regions in the Megalopolis have, in the last quarter century, reinvented themselves as hubs of creativity and development, creating jobs utilizing knowledge in technical, economic, social, and cultural fields.[2] These are the "creative regions" or the "knowledge economies." The old industrial metros of Boston and New York are well advanced in this transition to knowledge economies, and Washington, D.C. (with a large public sector), is emerging as a vibrant creative region with economic sectors based on scientific, technical, and cultural knowledge.

How did these metro areas make this transition from a trajectory of decline to "creative regions"? To make such a transition successful, key economic, political, and social actors in the metropolitan region have had to unravel the complexity of change. Such actors should be able to engage in shifting mindsets, changing behavior of various urban agents, evolving and sustaining innovation, and maintaining the dynamics of change. This is a tall order of evolutionary change in the creation of a "creative region." What sorts of processes are at play, and how do they interact in the birth of a "knowledge economy" and its continuing evolution?

Such questions have predictably attracted theoretical interest from a broad range of disciplines: economic geography, business economics, innovation studies, growth theory, evolutionary economics, and urban studies. Two theoretical streams of inquiry on "creative regions" have emerged:

- Models of Nurture and Commercialization of Innovation and Regional Industrial Adaptation
- Evolutionary Processes towards a Knowledge-Intensive Service Economy

This chapter can only highlight the key concepts and the evolutionary processes emphasized in these two classes of models of the rise of knowledge-intensive production and services, in order to set the stage for an empirical review of the economic resurgence of the Megalopolis metros. Further, the empirical part of the analysis is largely limited in this chapter to the Boston metro region, supplemented by some tabular data with reference to other Megalopolis metropolitan areas.

[2]Other examples of such creative regions or knowledge economies are Bay Area and Silicon Valley, Los Angeles, Seattle, London, Tokyo, Milan, Sydney, etc.

19.4.1 The Rise and Evolution of Knowledge-Intensive Production

Most of the literature on the emergence of knowledge-intensive production focuses largely on what may be described as innovation networks which nurture and commercialize innovation and industrial adaptation in various regions (Bathelt 2001; Scott 1998; Best 2000; Cooke et al. 2011). The key idea in this vast literature that has burgeoned over the last two decades or more is that innovation or the creation and commercialization of new knowledge in a dynamic region is based on *multidimensional interactions* among autonomous but interdependent economic agents (Capello 2011).

Such models of innovation-led agglomerations attribute knowledge generation, spillovers, and accumulation in "creative regions" to:

1. *Physical proximity* among economic actors, facilitating interactions and enabling access to appropriation and sharing of tacit knowledge, thus promoting innovation
2. *Relational Proximity* of economic agents, facilitating cooperative behavior, collective learning, and socialization of innovation risk
3. *Institutional Proximit*y among the firms in the urban agglomeration in terms of shared rules, codes, and norms of behavior which will promote cooperation in interactive learning processes

These linkages and interactions allow firms and other economic agents to complement their core competencies with requisite knowledge and capacities creatively, speedily, and flexibly. Such linkages are really "embedded in the social network."[3] Firms (often small- and medium-sized) in such regions develop flexible and interdependent relationships with suppliers and competitors and increasingly depend on intangibles, like know-how, synergies, and untraded knowledge (Von Hippel 1988; Storper 1995).

Further, dynamic metro regions also exhibit, from *political and institutional perspectives*, the attributes of "learning systems," such as entrepreneurial ability and relational skills. Such attributes of learning systems reflect the cultures of local entrepreneurial social, economic, and political agents, stimulating them to innovate *institutionally and organizationally* (Lakshmanan and Button 2009). Further, the creation of new "governance systems" in metro regions (e.g., inclusive stakeholder policy decision and implementation processes as in Boston) facilitates, among metropolitan private, public, and civil society actors, new modes of interaction,

[3]Indeed, even the ("autonomous") market relations emphasized by the neoclassical economists' world are socially embedded in the sense that they depend upon assumptions, norms, and institutions shared by the actors and do not themselves derive from economic decisions (Polyanyi 1944; Granovetter 1985). The recent interest in social capital as key supporting asset of productivity has been inspired by the spatial clustering and dynamism in places such as Italy's Emilia-Romagna and California's Santa Clara Region.

decision-making, and implementation of projects and programs. Such governance changes speed up the physical adaptation of the metro region—in the form of rapid generation of new urban infrastructures and land uses appropriate to a knowledge region (Chatterjee and Lakshmanan 2005; Lakshmanan and Chatterjee 2006).

19.4.2 The Rise and Evolution of Knowledge-Intensive Production in Boston Metro Region

Boston, with its near four-century run of impressive innovations—technological, human capital, social, institutional, and financial capital—has a long history of economic growth, decline, resilience, and reinvention at various times.

The two key determinants of the recent upsurge of Boston region as a vibrant knowledge-intensive economy are:

A. *The large and diverse stocks of Human Capital*, derived from its early and continuing large investments on education and public schools[4] and in higher education. This higher education sector is a large regional economic contributor and provides a basis for large stocks of regional human capital in fields as diverse as professional, scientific, technical, computer, legal, financial, and health services.[5]

Table 19.1 sheds light on the high levels of human capital in Boston region. The proportion of knowledge workers in the Boston region's 2011 labor force (as measured by persons over 25 with a Bachelor's degree or higher) is 43.1%—51% higher than the national average and is higher than in other Megalopolis major metros—all of which, in turn, outrank the nation in this measure.

The proportion of labor force in Management in Business, Science and Arts is another measure of knowledge workers (in occupational terms) and is presented in Table 19.1. By this measure also, Boston, Washington, D.C., and other Megalopolis metros evidence richer stocks of human capital.

B. *Tradition of Diverse Innovation Networks*

There has been a tradition of *innovation networks and knowledge creation* in *New England*: This tradition was to set up venues where information about work

[4]Since the nineteenth century, Boston has led globally in its proportion of literate population. Boston created the first school (Latin School in 1635) and the first college (Harvard College in 1636 with a large dose of public funds). Indeed, the states in New England achieved in mid- to late nineteenth century highest levels of education anywhere in the world—followed by Meiji Japan, Scandinavia, Holland, and Prussia.

[5]The scores of colleges and eight major universities in Boston function as major economic engine, enrolling in 2000 over 120,000 students, conducting over $1.5 billion of external research, and reporting total revenues of $5.8 billion.

Table 19.1 Educational attainment and occupation by class of worker in Megalopolis in 2011 (%)

		New York	Philadelphia	Boston	D.C.	Baltimore	Megalopolis	USA
Educational attainment (aged 25 or above)	Less than high school	15.2	11.3	9.4	11.1	11.1	12.7	14.1
	High school graduate	26.5	31.1	24.5	28.3	26.6	27.1	28.4
	Some college/associate	22	24.7	23	27.3	26.6	23.8	29
	Bachelor's degree or higher	36.3	32.9	43.1	33.4	35.8	36.4	28.5
Occupational classes of workers	Management, business, science, arts	39.6	40.9	46.4	50.7	44.6	41.4	36
	Service	19.7	16.9	16.3	16.2	16.1	18.1	18.3
	Sales and office	24.7	25.4	22.9	20.8	23.8	24.1	24.5
	Natural resources, construction, maintenance	6.9	7.3	6.4	6.8	7.5	7.3	9.1
	Production, transportation, material moving	9	9.6	8	5.5	8	9.2	12.1

Source: 2011 American Community Survey, US Census Bureau

techniques can be exchanged among farm workers[6] in the eighteenth century. In the nineteenth century, various firms (e.g., Pratt and Whitney, Browne and Sharpe) created fellowships and networks of skilled machinists, who visited one another, engaged in technical talks and demonstrations (Temin 1999). Such networks and variations thereof have been a potent force in creating and disseminating knowledge-generating high-technology networks in contemporary Boston region, particularly in the generation and commercialization of biotechnology, with the multiplicity of requisite skills—scientific, clinical, manufacturing, legal, financial, legal, sales, regulatory, distribution, etc.—and or to some degree in other creative Megalopolis.

The initial boom in high-technology industries in the Boston region was punctured in the late 1980s by the decline of the minicomputer industry and the falloff in military research budgets. High-technology industries in the Boston region have been, however, able to readjust and rejuvenate their product and process structures in order to sustain further innovation and growth, through *a network model of complementary, vertically disintegrated, open system firms* (Bathelt 1999; Best 2000). Further, Boston's revitalization is based on its technological diversification rather than in an existing trajectory (Best 2000), given its rich and diverse human capital and its dynamic labor markets.[7]

The biotech industry, based on genetic engineering technology, comprises small- and medium-sized research firms and recently multinational pharmaceutical firms, in an ambience of close interactions among small and large firms, university researchers, and public research centers.

The majority of the studies of resurgent regions such as Boston often limit themselves to a discussion of the performance of mostly fabrication sectors, such as military electronics, microcomputer industry, electronic components, instruments, and the biotechnology industry (Bathelt 2001), ignoring the larger knowledge-intensive services.

19.4.3 Evolutionary Shift to the Knowledge-Intensive Service Economy

In the USA where the transition to the service economy is advanced, the share of service employment has progressed from a little over 50% in 1950 to over 75% by year 2000.This long-term evolution toward a service economy—if observed over a century—reflects the drop of consumption on low-income elasticity *goods* (food and

[6]In Connecticut, Massachusetts, and New Hampshire, farmers often shared knowledge about farming techniques and household practices in Unitarian and other churches after Sunday Service in the eighteenth and nineteenth centuries.

[7]Heurmann (2009) suggests that human capital externalities accrue predominantly to growing firms, which benefit from sharing, matching, and learning externalities arising from a large supply of highly qualified workers in skilled labor markets.

clothing—from 75% to 21% of total consumption expenditures) and growing expenditure shares of high-income elastic *services* (health and education) from 3.2% to 42% of total consumption.

A less observed characteristic, over the past two to three decades of the US transition to a service economy, is that the share in the economy of business services has grown monotonically, as the share of the manufacturing sector has been dropping. The share of knowledge-intensive services and products in total output and demand in the USA has steadily increased over time. This "quarternization" of the economies not only points toward the rising shares of services but also stresses the role of knowledge-intensive services and their growing importance as sources of innovation and technology and as inputs into the manufacturing process (Kox and Rubalcaba 2007) and the growing encapsulation of manufacturing products in a "service jacket" (Bryson and Daniels 2007).

This continuing growth of business services reflects a qualitatively new stage in the structure of production and an increasingly complex division of labor between economic sectors (Kox and Rubalcaba 2007). The structure of inter-industry relations is being recast in a new way by the growth and increasing specialization in knowledge-intensive business services (KIBS). KIBS, which include computer and software services, have lowered costs of outsourcing in-house services in firms. A major characteristic of this structural change is that firm-level positive scale economies can occur with regard to knowledge and skill inputs by external deliveries of such inputs. Many knowledge-intensive and nonroutine services in a manufacturing or service enterprise become eligible to outsourcing to independent service firms. Professional specialization in the latter firms can lead to innovations and changes, even in the nature of the service product and potentially toward further innovations.

The argument here is that in recent decades business services (particularly KIBS) have contributed heavily to the US and Megalopolis economic growth, in terms of employment, productivity, and innovation. A direct growth contribution stems from the business services sector's own remarkably fast growth, while an indirect growth contribution was caused by positive knowledge and productivity spillovers from business services to other industries. The spillovers come in three forms: from original innovations, from speeding up knowledge diffusion, and from the reduction of human capital indivisibilities at firm level. The external supply of knowledge and skill inputs exploits positive external scale economies and reduces the role of internal (firm-level)-scale (dis)economies associated with these inputs.

Further, the KIBS sector includes the major corporate central organizational services, such as financial, legal, accounting, and many professional services. Such services permit corporations with headquarters in New York or Boston to coordinate their various value-adding production chains spread across the globe. Thus KIBS sectors play a crucial role in the operation of the global economy and in the American economic structural evolution.

This brief review of the development of knowledge-intensive business services and their role in the generation and evolution of knowledge-intensive components of the US service economy supplements the review (in the earlier section) of various

Table 19.2 Knowledge intensive services, 1997 and 2007

	1997		2007	
	Number of employees (%[a])	Average wage (2007 US dollars)	Number of employees (%[a])	Average wage (2007 US dollars)
New York	381,722 (4.06)	70,141	478,409 (4.37)	82,363
Philadelphia	137,730 (4.50)	66,167	142,742 (4.11)	71,689
Boston	106,292 (3.78)	74,977	163,071 (4.60)	87,860
D.C.	241,800 (7.85)	69,414	374,383 (9.73)	84,319
Baltimore	49,021 (3.41)	57,911	80,521 (4.75)	76,012
Megalopolis	1,091,625 (4.15)	67,921	1,441,850 (4.73)	80,641
USA	4,092,136 (2.65)	57,436	5,696,838 (3.17)	64,675

[a]% of total regional/national employees in the specified sector

models which attempt to explain the rise and evolution of knowledge-intensive production sectors.

The levels of employment and average wages in KIBS sectors in 1995 and 2005 in the nation, Megalopolis, and its five major metros are presented in Table 19.2. While the Megalopolis had 17% of the national employment in 1997 and 2005, it was overrepresented in employment in those years in the knowledge-intensive KIBS sectors, garnering, respectively, 26.7% and 25.3% of the national totals (Table 19.2). Further, the average wages/worker are higher in the Megalopolis and component metros in 1997—with this gap widening in 2007. As noted earlier, these KIBS sectors support the arrival and evolution of knowledge-intensive service economy—by positive knowledge and productivity spillovers to other industries through original innovations and the speedup of knowledge diffusion.

The knowledge-intensive services in the Boston region are financial services, professional services, health-care services, and educational services.

The financial services sector is a large sector that is growing in the region, utilizing highly skilled personnel and offering high wages. New York is a globally dominant region with over 420,800 workers (13% of the national total) with an average wage of $168,800, an average annual wage growth rate of 7.7% in 2004 (Table 19.3). The Boston metro area has the fourth largest employment, the third highest average wage, and the second highest wage growth rate (1990–2004) among US metros in the financial sector in 2004. In Massachusetts, this sector accounts for 10.8% of the gross state product, 5.5% of employment, and 65% of the workers with a postsecondary degree and has a significant multiplier effect on professional and technical services. The annual growth rate of average wage in this sector over a 15-year period in Boston was 7.83, with other Megalopolis metros not far behind. The magnitude and importance of the financial services sector in the Boston region are not surprising given its past history of merchant and industrial capital in earlier times and the region's many *financial innovations* over time (e.g., merchant banking, marine insurance, "Suffolk Bank" notes, venture capital, trust

Table 19.3 Financial services—Megalopolis metropolitan areas by employment, 2004

Metropolitan area (national rank in employment)	Total employment	Share of national employment	CAGR of employment 1990–2004	Average wages	CAGR of average wages 1990–2004
New York-Northern New Jersey-Long Island **(1)**	427,296	13.0	0.44	$168,802	7.66
Boston-Cambridge-Quincy **(4)**	**133,342**	**4.0**	**3.48**	**$114,696**	**7.83**
Philadelphia-Camden-Wilmington **(5)**	113,112	3.4	2.21	$73,158	6.12
Hartford-West Hartford-East Hartford **(9)**	65,219	2.0	1.38	$86,851	6.52
Washington, D.C. **(12)**	58,098	1.8	1.99	$76,880	5.64

The expanded review of the Boston's recent economic evolution in this chapter suggests a robust economic recovery and export capacity across a broad range of knowledge-intensive goods and services. The five key determinants of the Boston region's reinvention as a vibrant knowledge economy are (1) large and diverse human capital, (2) open innovation networks, (3) local entrepreneurship, (4) financial innovations, and (5) innovative models of urban governance to facilitate rapid urban spatial reinvention

bank, mutual funds, etc.).[8] The Megalopolis metro areas of Philadelphia, Hartford, and Washington, D.C., draw respectively, 5th, 9th, and 12th national ranks in employment levels in this sector.

The health services sector is a larger sector in the Boston region, about 2.5 times as large as the financial sector in employment. Table 19.4 offers an employment comparison of the Megalopolis metro areas in 2004. With many major university hospitals and research institutes, Boston region is not only the fifth largest national employer but has registered a 4% annual rate of growth over a recent 15-year period. The elite hospitals and public research institutes in this region also provide a key component of the biotechnology innovation networks.

Higher education plays a major role in the Boston region than in most others. In 2000, Boston metro ranked first in college and university enrollment and first in degrees granted and in per capita spending, per 100,000 people. The eight universities in the metro area, attracting research funds, partnering with firms, generating patents, starting companies, and training large numbers of students are major regional economic contributors.

[8]The "Suffolk system" was developed in Boston by the Suffolk Bank before the Civil War (by the investors who founded the textile industry). This bank issued its own notes which were redeemable at par (along with those issued by any New England bank, provided those banks maintained deposits at the Suffolk Bank—thus rapidly expanding industrial capital in New England).

Table 19.4 Local health services: Megalopolis metropolitan areas by employment, 2004

Metropolitan area (national rank in employment)	Total employment	Share of national employment	CAGR of employment 1990–2004	Average wages	CAGR of average wages 1990–2004
New York-Northern New Jersey-Long Island **(1)**	1,113,374	7.6	1.91	$42,631	3.64
Philadelphia-Camden-Wilmington **(4)**	373,167	2.5	1.71	$38,436	3.17
Boston-Cambridge-Quincy **(5)**	**310,759**	**2.1**	**1.45**	**$42,180**	**3.95**
Washington-Arlington-Alexandria **(9)**	221,485	1.5	2.29	$43,770	3.35
Baltimore-Towson **(16)**	150,055	1.0	1.86	$40,832	3.90

Source: Prof. Michael E. Porter, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Richard Bryden, Project Direct *Boston Region's Reinvention*

19.5 Rise of "Tradable" and "Non-tradable" Sectors and Income Inequalities in the Megalopolis

Globalization, made possible in recent decades by lowered international trade barriers and technical improvements in transport and information technologies, has restructured the functional and spatial organization of the economy in the Megalopolis and the USA. The production and delivery of goods and services are decomposed into increasing number of value-adding components, and the relevant supply chains of economic activities have been increasingly organized on a global basis. At the same time, innovations in information technologies have created many knowledge-intensive business services (KIBS). KIBS (comprising of financial, legal, accounting, information, and other professional services) enable global corporations, as noted earlier, to develop and support management innovations that make possible the smooth operation of global supply chains and the integration of global corporate operations. Further, KIBS also have become tradable.

In the Megalopolis, as in many highly developed regions, early globalization was marked by corporations moving the lower-wage, lower value-adding components of production to low-income industrializing countries while retaining the more knowledge-intensive components domestically. Thus the activities remaining in the Megalopolis comprise the upstream knowledge-intensive activities (e.g., R&D, product design) and downstream knowledge-intensive activities (e.g., marketing, brand exploitation), while tasks of fabrication of many components (except the more knowledge-intensive components) are outsourced to the newly industrializing countries. At this stage, there is a decline in low- to medium-wage jobs and a growth in higher wage knowledge-intensive jobs in the manufacturing and other tradable sectors in the Megalopolis. Those jobs in manufacturing and other tradable components are relatively devalued and only survive if wages are suppressed. The twofold

result of job loss and wage stagnation in manufacturing and other tradable sectors and a rise in value added per job in the more knowledge-intensive value chains of production which remain in the Megalopolis in turn yields *rising income inequality* in the Megalopolis.

The nature of global supply chains is evolving away from this simple low-wage/high-wage dichotomy in recent years, however, due to the rapid pace of economic development in the rapidly industrializing economies of the world. Rapidly industrializing countries (such as China) are accumulating in recent years significant levels of physical, human, and organizational capital, which permit an increasing incorporation of higher value-adding components of global chains into their manufacturing and other tradable sectors, thereby displacing such components of manufacturing and other tradable sectors in the Megalopolis. In this context of globally linked production, the corresponding production chains disappear in the Megalopolis, which increasingly plays host largely to the high value-adding components such as R&D, design, fabrication of some knowledge-intensive components, marketing, and a few post-sales services in such sectors. While overall value added per employee rises in these sectors retained in the Megalopolis, two adverse consequences follow. Powerful market forces operate directly on the tradable sector. More medium wage jobs in these sectors disappear from the Megalopolis locations. There are indirect effects on the non-tradable economic sectors of the Megalopolis and the national economy through wage and price effects and shifting opportunities in labor markets. Income inequalities, as a consequence, widen further in the last two decades in the Megalopolis centers of economic activity.

Spence and Hlatshwayo (2011) have carried out an analysis of the evolution of tradable and non-tradable sectors in the US economy and the progress of income inequalities in the nation during 1990–2007. This part of the chapter implements the Spence-Hlatshwayo approach to study the evolution of tradable and non-tradable sectors and the progress of income distribution in the Megalopolis and component major metros (for a slightly longer period) during 1990–2011.[9] This chapter illustrates this analysis for one Megalopolis metro area, namely, Boston.

Manufacturing was the largest tradable sector in the Boston metropolitan area until fairly recently (Fig. 19.2a). Over a period of 22 years (1999–2011), this sector lost about 150,000 employees (close to 45% of its total). The average earnings per worker in this sector, however, climbed up from $80,000 to over $90,000 (in chained dollars) in that period (Fig. 19.3a). A significant loss of employment accompanied by an upward shift of average wage in that sector in Boston over two decades replicates the pattern of increasing income inequalities predicted earlier for regions engaged in globally organized production and trade. However, two tradable sectors—professional services and finance and insurance—increased in employment

[9]Spence and Hlatshwayo used a methodology developed by Bradford Jensen and Lori Kletzer. Their approach determined the tradability of an industry based on its geographic concentration—the more concentrated the industry, the higher its tradability (and vice versa). For example, take retail trade: its ubiquitous geographic presence implies that it is highly non-tradable.

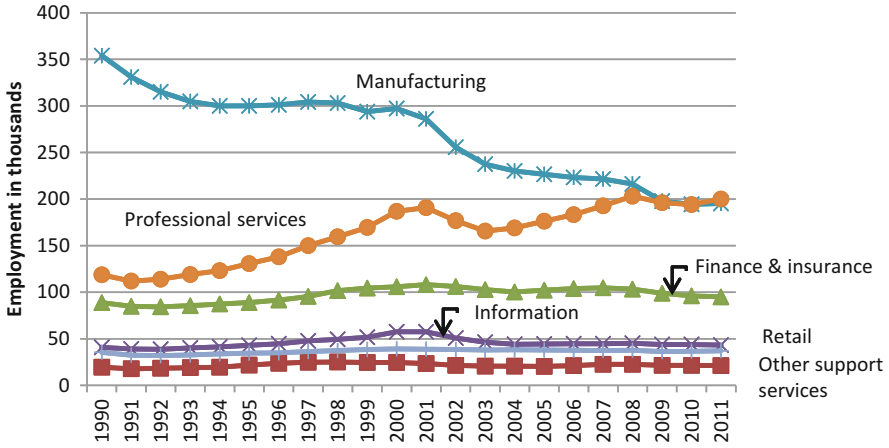

Fig. 19.2a Tradable industrial employment (major sectors) in Boston metro

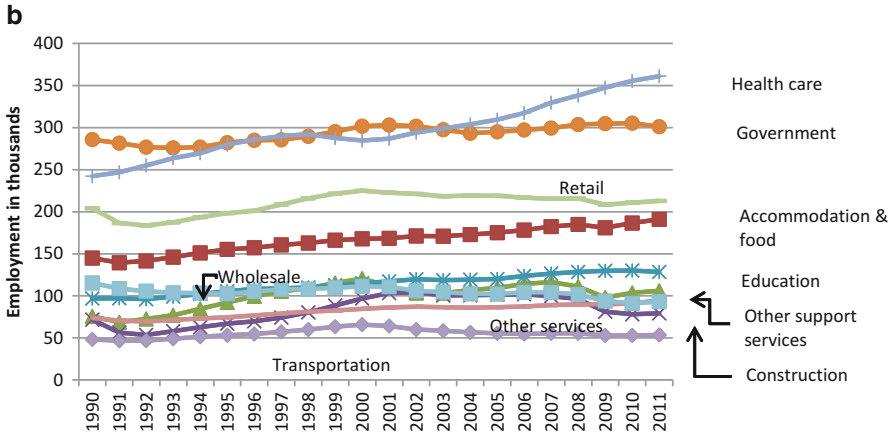

Fig. 19.2b Non-tradable industrial employment (major sectors) in Boston metro. (Source: Lakshmanan et al. 2016)

(about 80,000), and the high average wage per employee, over $140,000 in 2001, climbed up (in chained dollars) 20% and 15%, respectively, in that decade. The overall result is a drop in tradable sector employment and increasing income inequalities in the Boston region.

In contrast to traditional models of regional growth that emphasize the "basic" sector or exported goods and services as driving growth, much of the growth in employment in Boston Metro in these two decades derives from the non-tradable sectors (Fig. 19.2b). Health services sector is the largest contributor to growth. Indeed, the greater part of the employment growth in the Boston metro region by year 2011 derives from the three non-tradable sectors of health services,

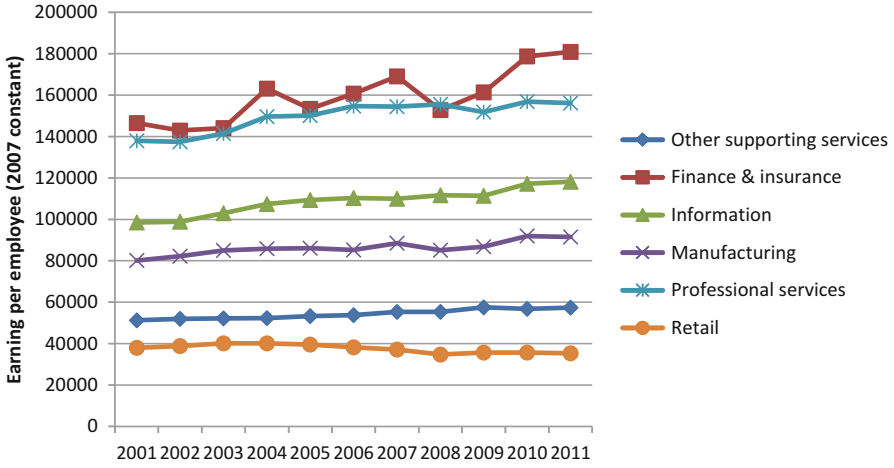

Fig. 19.3a Tradable sectors: earning per employee (in 2007 dollars) in Boston metro. (Source: Lakshmanan et al. 2016)

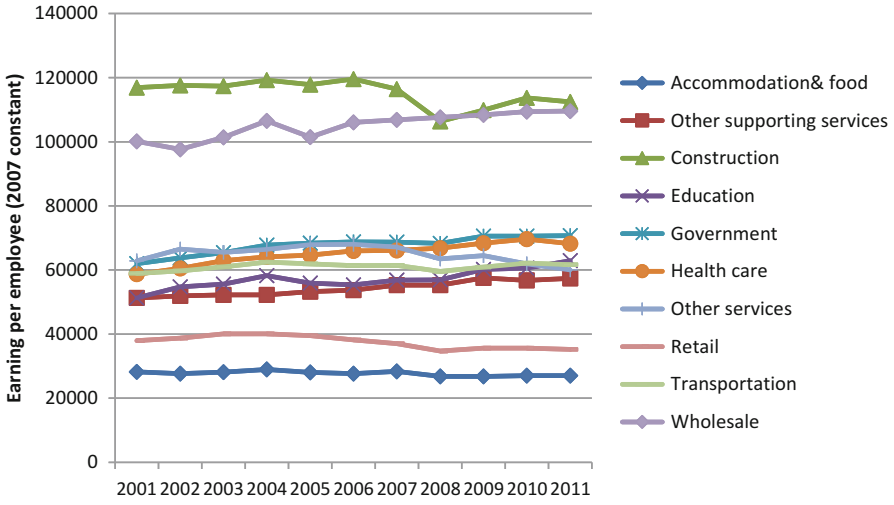

Fig. 19.3b Non-tradable sectors: earnings per employee (in 2007 dollars)in Boston metro. (Source: Lakshmanan et al. 2016)

government, and retail. Health and the government sectors have average earnings per employee of about $70,000, while the earnings per employee in the third employment growth sector of retail are low—less than $40,000 (Fig. 19.3b).

It appears that over the last decade of the twentieth century and the first decade of the twenty-first, employment in the Boston metro region declined in the tradable

Table 19.5 Gini index of household income inequality in the USA and for metropolitan areas of over 1 million population in the Megalopolis

Metropolitan area	1979	1989	1999	2006	2011
New York	0.353	0.385	0.475	0.499	0.507
Boston	0.399	0.449	0.413	0.461	0.477
Philadelphia	0.327	0.341	0.419	0.461	0.472
Providence	0.394	0.427	0.424	0.440	0.463
Baltimore	0.391	0.412	0.405	0.437	0.452
Hartford	0.355	0.421	0.399	0.438	0.456
Washington	0.367	0.380	0.379	0.434	0.438
USA	0.404	0.431	0.458	0.470	0.475

Source: 1979 and 1989 metropolitan Gini indices from Madden, 2000, 1999 metropolitan Gini indices from Lopez, 2004 (data published online, www.diversitydata.org) and 2006 and 2011 metropolitan Gini indices and U.S.'s indices in Table ∗ from US Census Bureau

sectors exposed to global competition. This development combined with a rise in average earnings per remaining employee in those tradable sectors leads to rising income inequalities. Further, the dominant (non-tradable) employment growth sectors of health care, government, and retail evidence moderate to low earnings per employee. Clearly, evolving trends in employment levels and earnings per employee in the globalizing knowledge economy of the Boston region over those two decades led to increasing income inequalities.

We have conducted similar empirical analyses for New York; Washington, D.C.; and other Megalopolis knowledge economies that yield comparable results of recently widening income disparities (Lakshmanan et al. 2016).

19.5.1 Income Inequality in the Megalopolis

Over the same late twentieth-century to early twenty-first-century period, income distribution in the Megalopolis shifted from being more equal than in the USA as a whole to in some cases being more unequal. Table 19.5 shows the progress of the Gini index in the USA and in selected metropolitan areas of the Megalopolis over three decades from 1979 to 2011. In 1979, income inequalities are more pronounced in the nation than in the metro areas of the Megalopolis. By 1989, when globalization has entered a rapid phase, the Gini indices (income inequalities) are climbing in the nation and in the metropolitan areas of the Megalopolis. As global organization of business and a finer differentiation of tradable and non-tradable sectors gather speed in the 1990s and in the decade of 2000s, income inequalities widen faster in the rising knowledge economies of New York and Boston than in the nation.

19.6 Conclusion

This chapter has two major objectives:

First, it offers an understanding of the ongoing structural change and socioeconomic transition underway in the last three decades and more in the Megalopolis, from a mature and declining industrial structure to that of a vibrant "knowledge economy." How has this come to pass? The chapter attributes the rise of knowledge economy to three kinds of *proximity* among economic agents:

Physical proximity promoting appropriation and sharing of tacit knowledge, thus promoting innovation

Relational proximity promoting among economic agents cooperative behavior, collective learning, and socialization of innovation risk

*Institutional proximit*y among the firms in the urban agglomeration in terms of shared rules, codes, and norms of behavior which will promote cooperation in interactive learning processes

These linkages and interactions allow firms and other economic agents to complement their core competencies with requisite knowledge and capacities creatively, speedily, and flexibly.

Second, this chapter applied the above model to the rise and evolution of the knowledge economy in the Megalopolis urban region stretching along the Eastern seaboard in the USA from the Southern New Hampshire to Northern Virginia, including the metropolitan areas of Boston, New York, Philadelphia, Baltimore, and Washington, D.C. Thus, the chapter addresses the evolution of a huge manufacturing and trading economy of the mid-twentieth century—one based on the movement and transformation of materials—to a large, vibrant, and new knowledge economy based on the transformation of new scientific and engineering knowledge into technical innovations, which merged with organizational and institutional innovations generate highly valued novel goods and services for the global market.

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