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Range of Contemporary Urban Patterns and Processes

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Abstract

Urbanization has historically been characterized by population density, durable built environments, governance, specialized economic activities, urban infrastructures, and their rural spheres of influence. This chapter highlights major contemporary patterns, trends, processes, and theories related to these dimensions, with special attention to the relation of central places to surrounding rural areas. It begins with a discussion of definitional issues related to the different dimensions of urban settlements and contemporary urban patterns. Theories and policies corresponding to these major characteristics of urban patterns and urbanization processes are presented, beginning with a brief overview of economic spatial theories. Focus is given to central place theory, where cities are conceptualized as central market places providing goods and services to lower-order cities and their rural hinterlands in exchange for food and materials. The impact of advances in technology and infrastructures on global trade connections is discussed, and insights from Castells' network society are highlighted. Empirical evidence of two urban policies—the compact city model and urban growth management—are reviewed for their connections to central place theory.

Introduction

To provide a theoretical background to the issues of global land use, this chapter reviews and reflects on major contemporary urban patterns and processes. Historically, urbanization has been represented by six characteristics: density of population, durable built environments, governance, specialized economic activities, urban infrastructures, and their rural spheres of influence. Recognizing these different dimensions or enablers of urban settlements, the chapter first discusses definitional issues and contemporary urban patterns. It then proceeds to various theories and policies that correspond to these major characteristics, beginning with a brief overview of economic spatial theories. Special focus

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is given to central place theory, a theory that explained the spatial pattern of industrial economies in developed countries in the early part of the twentieth century. This influential theory conceptualized cities as central market places that provide goods and services to lower-order cities and their rural hinterlands in exchange for food and materials. Proximate connections between cities and their regional spheres of influence have increasingly given way to distal relations between international locations for materials, food, manufactured goods, and services, as a result of globalizing trends, which have accelerated since the 1990s.

Advances in technology and infrastructures, in particular, transportation infrastructures and information communications technology and logistics have shaped our global trade connections. In addition, changes in governance and economic structural issues have contributed to the globalization of production and consumption. Consideration is given to how these impact urbanization. Thereafter, a brief review follows of the main insights related to the major socio-political-economic theory of globalization that focuses on urbanization: Castells' network society (Castells 1996). Two major urban policies (the compact city model and urban growth management), empirical evidence supporting them, and their connections to central place theory are discussed. The final section summarizes and reflects on the findings.

Features of Urbanization

Urbanization can be traced back in history to about 10,000 years ago. Çatal Hüyük, often credited as the first city in what is now modern Turkey, dates back to 6,500 BCE (Mellaart 1965). Since the earliest records, several essential features of cities can be identified as shown in Figure 14.1.

The features of urbanization (Figure 14.1) most often noted are (a) higher densities and (b) compact, durable environments. Whether agriculture preceded cities and provided the agricultural surplus for urban dwellers or, as Jane Jacobs argued (1969; see also Soja 2010), cities and agriculture coevolved, cities (from early on) traded special goods or services for food and other materials with their hinterlands and other cities. Many large ancient cities, such as Uruk or Ancient Athens, were city-states, exerting secular or religious power over their rural peripheries. For internal purposes, large urban populations also required formal governance to establish social customs, settle conflicts among strangers, as well as manage urban growth and provide infrastructures. Early cities also relied on road and water infrastructures. Roads facilitated trade between rural areas and cities and between cities. Water infrastructures, such as aqueducts, wells, and public fountains, were necessary to make local water supplies available to city residents. Urban water supply infrastructure, drainage and even sewers as well as irrigation canals in rural peripheries date back to 7,000 BCE. Ancient Greek cities, for example, were laid out in block patterns

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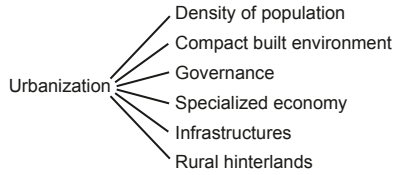

Figure 14.1 Six features of urbanization. Some are associated with the character of urban settlements (density, durable built environments, and urban infrastructures), others refer to processes that enable urbanization (specialized economies and governance), while rural hinterlands or spheres of influence provide goods or services not available in urbanized areas.

with roads, and public fountains provided a public water supply (Wycherly 1962). Greek city-states—the *poleis*—were composed of cities and their rural hinterlands and gave the Western world the word for politics. *Polis* meant both the city, as a place, and the people, as a political entity. Cities have always depended on rural areas for food, fuel, materials for construction, as well as water for drinking and as sinks for their wastewater and solid waste. The rural hinterlands of urban areas have traditionally provided many benefits that we now understand as ecosystem services (Daily 1997).

Review of New Urban Patterns

In 2007, for the first time in human history, half of the world's population lived in urban areas. In the United States, Western Europe, and South America, by 2010, over 80% of the population was urbanized. China is undergoing the most rapid rate of urbanization. In 1990, its urban population was 26.4%; by 2010, 49.2% of its population was urban; and, by 2050, China's urban population is projected to reach 77.3% (UN 2012b). But, how do we identify urban areas? There is no recognized, worldwide definition of urban land or urban areas. The United Nations, in their periodic reports on global urban and rural populations, use the statistics that countries report as their urban areas or cities, and definitions vary across countries. Urbanized land is mainly defined in the following ways:

- as land in state-recognized cities such as municipalities or local authorities, as in the Dominican Republic,
- as land in agglomerations with threshold populations ranging widely from 1,000 persons in Australia to 10,000 persons in Italy, and,
- in terms of density per unit area, ranging from 386 persons per square kilometers (in the United States), to 1,500 persons/ km^2 (in the People's Republic of China).

The extent of the durable built environment of urban settlements or contiguous built environment remains implicit in many definitions. Definitions of urban

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places in a few countries, such as Costa Rica or Panama, also include the availability of urban services, such as electricity, water and sewerage systems, and other municipal services (UN 2012b).

In the twentieth century, many urban areas exceeded their official political boundaries and became metropolitan areas. The U.S. concept of metropolitan areas, first identified for the 1950 census, defines areas that contain a large population nucleus and adjacent areas that have a high degree of integration, typically through an integrated labor market and travel patterns. Metropolitan areas typically include at least one central city, suburban areas, and other urban areas (such as towns or villages) as well as surrounding rural land. The concept of functional urban regions in Europe (Nordregio et al. 2005) is analogous to the concept of U.S. metropolitan areas. Beyond metropolitanization, two other interconnected urbanizing trends complicate the study of urbanization: the growth of mega-cities (i.e., cities over 10 million) and the convergence of metropolitan areas into mega-scale urban regions, referred to by various terms: *megalopolis* (Gottmann 1961), *megapolitan areas* (Lang and Dhavale 2005),[1] or more recently *mega-city regions* (Hall 2009). Gottmann (1961) used the merging of the metropolitan areas of Boston, New York, Philadelphia, Baltimore, and Washington, D.C., or the Boswash urban corridor as a first example. This type of convergence of metropolitan areas is now understood as a functional, rather than a physical, or administrative concept, drawing on Castells' concept of urban space as a "space of flows" of people (Castells 1996), goods and information. Mega-city regions are polycentric, incorporating multiple cities and towns and their surrounding rural areas.[2] The term mega-city region was first applied to urbanized regions of eastern Asia, areas with populations of ten million or more, such as the Pearl River Delta, the Yangtze River Delta, the Tokaido (Tokyo-Osaka) corridor, and Greater Jakarta (Hall 2009). These urban regions are currently found throughout most parts of the world. Some examples include the Greater La Plata-Buenos Aires Metropolitan Region in Argentina, Mumbai-Pune megaregion in India, and the Randstad in the western portion of the Netherlands (for European examples, see Hall and Pain 2006). In Europe, a mega-city region is made up of several functional urban regions (Hall and Green 2005). These new urban patterns are typically represented by multiple units of government. This mismatch between function and political jurisdiction complicates the planning and governance of these urban regions (McCarney and Stren 2008).

The traditional urban-rural distinction is often used to define urbanization. As the urban-rural distinction has blurred, a new concern with peri-urban areas

1 U.S. studies have identified ten megapolitan areas that house 197 million people (Lang and Knox 2009).

2 In the U.S. census, consolidated metropolitan statistical areas, composed of several metropolitan areas, are similar to the concept of mega-city regions.

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(transitional areas between rural and urban) has emerged in Europe over the past decade (Piorr et al. 2011; for European examples, see Hall and Pain 2006).[3] The physical expansion of urban areas at multiple times the rate of population growth fuels concern over peri-urban areas in Europe and urban sprawl in the United States. In Europe, for example, while population increased by approximately 7% from 1990–2006, urban areas grew by 37% during the same time period (Fertner 2012). In a meta-analysis of global urban land-conversion studies from 1970–2000, Seto et al. (2011:1) concluded that "across all regions and for all three decades, urban land expansion rates are higher than or equal to urban population growth rates, suggesting that urban growth is becoming more expansive than compact." According to another recent study of urban population and urban land-cover estimates that was based on the 1990–2000 growth rates of 160 cities around the world, the growth rates for urban land cover will more than double the rate of urban population growth (Angel et al. 2011). The ongoing expansion of urban areas diminishes the potential of rural areas to provide certain ecosystem services for urban agglomerations.

Understanding Urban Spatial Structures: Economic Spatial Theories

How do we make sense of the spatial configuration of urban areas? What factors or processes determine the size of cities with respect to each other and their spacing?

Economic theories concerned with spatial agglomeration focus on the role of economic agents and the factors that drive their decisions to concentrate or agglomerate in urban areas. These theories assume that economic agents agglomerate for two main reasons: (a) because a place provides a comparative advantage, such as proximity to a port or cheap labor or materials, and (b) because the concentration of activities in a place provides advantages for the producing or consuming agents. Several branches of economic theory have made contributions to spatial analysis: location theory with its focus on the location decisions of firms, urban economics with an emphasis on the location of households and firms within a city, and central place theory (Mulligan 1984).

Location and Spatial Equilibrium Theories

In the United States, Walter Isard's work was instrumental in the 1950s and 1960s in developing the fields of regional science and urban economics. His seminal work, *Location and Space Economy*, introduced the classic works of

[3] In the context of developing countries, the term peri-urban has been used to refer to informal settlements without adequate urban infrastructure that extend for miles beyond central cities (Adell 1999).

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J. H. von Thünen, Lösch, Weber, Christaller, and others, made a strong argument for the centrality of space as a factor in economic analysis, and demonstrated how production theory can incorporate location factors, in particular transport inputs and rates (Isard 1956). Later work provided the basic analytic methods in regional science, including regional and interregional input-output analysis, econometrics, and spatial interaction models, among others.

The historical roots of location theory can be traced to the work of von Thünen (1826) who sought to determine optimal agricultural land uses based on transport costs to a central market. Von Thünen assumed that production methods and costs for any crop were independent of location. Alonso, a student of Isard, developed von Thünen's theory of agricultural land use into an intracity theory of land uses. Alonso assumed a monocentric city as a featureless plain, with transport availability in all directions, and with employment and all goods and services available only in the central business district. In this model, households have to decide how much land and where to locate to maximize their utility, and firms decide their location to maximize their profits. Alonso extended the land price function from an agricultural to the urban context, in what is now the main feature of all formal residential location and urban housing market models, the "bid price curve" of a resident; that is, the "set of prices for land that the individual could pay at various distances" from the central business district that permits individuals to attain a constant level of satisfaction.

Going beyond the land models of von Thünen and Alonso, the work of Muth (1969) and Mills (1972) further developed a formal model of the housing market, in which producers combine land and capital to produce housing. The work of Mills (1967) focused on the question of why cities exist, and his response emphasized scale economies in production, people's utilities, and the cost of interregional trade. His work, more grounded on empirical research, also examined trends toward the decentralization of jobs and residences and foresaw the increasing importance of subcenters. Today, with increasing trends toward polycentricity, as evident in the discussion above on metropolitan and mega-city region urban patterns, the monocentric assumption underlying Alonso's urban location model have made the application of this theory less useful. However, recent research is beginning to explore how spatial agglomeration economic principles can be used to understand polycentric urban regions (Agarwal et al. 2012).

Spatial equilibrium theories focus on the issue of why cities exist, or as Glaeser and Gottlieb (2009:984) put it, "why dense areas are so much more productive." The theories get their name from the assumption that workers can migrate freely, which creates a spatial equilibrium where utility levels are equalized. This assumption is supported, at least for the United States,[4] by the

[4] Empirical evidence indicates that migration flows in Europe during the 1980s were not as large as in the United States (Decressin and Fatas 1995).

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high mobility of workers: 40% of Americans change homes and 20% change counties every five years (Glaeser and Gottlieb 2009). Rosen (1979), Roback (1982), and Blomquist et al. (1988) have applied spatial equilibrium models that incorporate labor, land factors, and amenities in determining urban location decisions. Their research has identified prices for amenities and disamenities that quantify the quality of life across cities in the United States. In highlighting the role of amenities in urban location choices, this work is directly relevant for the reconceptualization of urban phenomena envisioned by Boone et al. (this volume), which emphasizes livelihoods and lifestyles, since lifestyles are often associated with a bundle of amenities.

Renewed interest in spatial agglomerations has generated empirical research on agglomeration economies. In his recent review, Puga (2010) discusses the research challenges and empirical evidence on the clustering of production beyond what can be explained by chance or natural advantage, including research that compares wages and rents across spatial patterns, such as the work of Combes et al. (2010), which analyzes data on the wages of French workers; the work of Dekle and Eaton (1999), which examines data on rents; the earlier work of Rosen and Roback, which employed both wages and rents; and research that uses data on outputs and inputs to estimate how productivity varies across space (Rosenthal and Strange 2004).

In addition to access to markets, since the mid-1990s, spatial equilibrium theories have been focusing on the role that access to ideas or human capital play in agglomeration economies (Glaeser et al. 1992). Duranton and Puga (2001), for example, argue that cities are "nurseries" for new ideas. However, the great strides in information technology (IT) over the past few decades challenge the role that urban agglomeration plays in the exchange of ideas and innovation. Glaeser and Gottlieb (2009) dispute this, pointing out the example of Silicon Valley, both a geographic cluster and IT center. Glaeser and Ponzetto (2007) further argue that changes in IT over the past few decades provide increasing returns to new ideas and make cities even more important. This line of theory and research will be important to the reconceptualization of urban phenomena and suggests that while the urban-rural distinction may be blurring in polycentric mega-regions that are greatly aided by IT and transportation technology, the physical proximity of dense urban areas may still hold idea-generating and innovation advantages.

Central Place Theory

Central place theory (CPT), developed by Christaller (1933/1966) and Lösch (1940/1954), integrates three key concepts in regional studies: consumer choice, firm agglomeration, and functional hierarchy (Mulligan et al. 2012). It focuses on trade and service activities, how they are distributed among settlements or central places, and, most important for understanding the spatial patterns of urban agglomerations, how central places are located across the

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landscape. The theory assumes a flat landscape and that people will buy goods from the closest place. Cities are conceived as central market places that provide goods and services to a surrounding population. In addition, the concepts of threshold and range are central to Christaller's theory, threshold meaning the minimum number of customers needed for a business to remain viable, and range referring to the average maximum distance that people will travel to buy goods or services. In effect, according to CPT, centrally located settlements have more purchasing power and offer more goods and services. Each type of settlement has a particular location in the hierarchy, and relative centrality determines both the type and variety of goods. Applying the theory to urban settlements in Southern Germany, Christaller arrived at a hierarchical spatial arrangement (depicted in Figure 14.2), where large cities are at the core of constellations of smaller towns and villages, with each central place providing

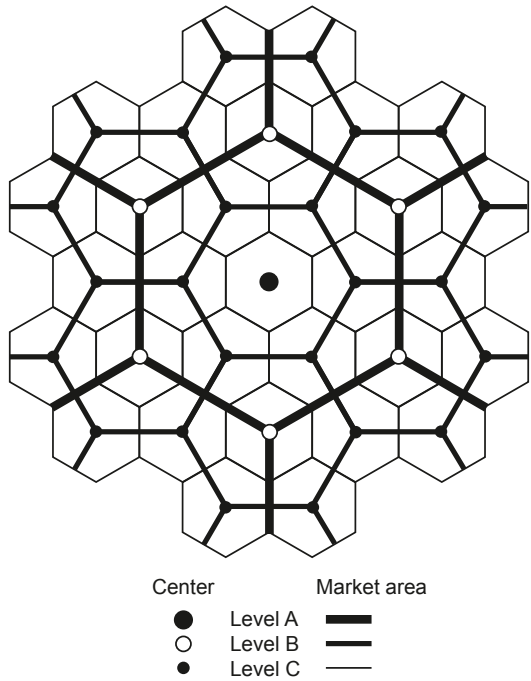

Figure 14.2 Hierarchy of hexagonal market areas after Christaller. Cities, towns, and villages are central places that provide goods and services to their residents, their rural hinterlands, and lower-order central places. At the center of this hierarchy are large cities, which serve as market places for their constellation of towns. Towns, in turn, provide goods and services to their constellation of villages and their rural hinterlands. Figure redrawn from Berry and Parr (1988).

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some goods and services to their residents and their rural hinterlands, and where the size, spacing of, and the goods provided by the central places are determined by the size of their populations or consumer markets. An important element of CPT is that central places provide goods and services to both their urban residents as well as their rural hinterlands.

In the early industrial urban-rural landscape that Christaller's model sought to explain, there were multiple links of influence and effects between central places and their hinterlands. Central places provided goods and services to their rural hinterlands, and the hinterlands provided food and materials to central places. Due to their proximity, we can hypothesize that central places provided employment opportunities for rural areas, leading to an ongoing influx from rural to central places. Rural lands often had urban landlords. Multiple ties of language, culture, and travel linked urban places and their rural hinterlands. Finally, both urban and rural areas were under the same regional or national governance. Underlying the central place model and the early twentieth century economic spatial structure was a set of reciprocal relations between urban and rural areas. The proximate connections between cities and their regional spheres of influence has given way today to distal relations with international locations for materials, food, manufactured goods, and services as a result of globalizing trends, which have accelerated since the 1990s (Seto et al. 2012b; Seto and Reenberg, this volume).

Central place theory was further developed and applied after Lösch's modifications (Mulligan 1984), although its lack of a microeconomics foundation left it outside the dominant economic paradigm. The new economic geography (NEG) developed by Krugman (1991) and others (Fujita et al. 1999) sought to legitimatize concern with space and location decisions in mainstream economic theory by providing a rational choice-general equilibrium model of urban agglomerations. Krugman's NEG model changed one of the assumptions of classic general equilibrium models: instead of decreasing returns, he posited increasing returns. In his model, spatial structure is determined by the costs of transactions (e.g., shipping costs, transport structure, and geography) and types of increasing returns to scale (e.g., dense labor markets providing much better matching for workers). The model focused on industrial production. The spatial structure that results from NEG models, however, has been criticized as simplistic and at best capturing the industrial urban landscape of the early twentieth century (Mulligan et al. 2012). Even in the mid-1990s, NEG could not account for deindustrialization trends (Martin and Sunley 1996), and it is not clear how such models would address the international urban landscape in the wake of global supply chains.

Glaeser and Kohlhase (2004) pose more fundamental objections to both economic geography and urban economic models, including NEG models. They point out that such models are driven by transportation costs and that with the decline of transportation costs for goods movement, the models may provide good accounts of Western industrial cities in the 1900s but fail to

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capture the dynamics of urban patterns in the twenty-first century. They point out that in 1890, the average cost of moving a ton of goods one mile in U.S. cities was 18.5 cents (in 2001 USD), and that in 2004, the price dropped to 2.3 cents, arguing that theories of spatial development could almost assume that the transportation cost of goods movement is costless (Glaeser and Kohlhase 2004:199). Instead, they argue that agglomeration effects come from access to other people and not from transportation savings, that "natural resources in production are becoming increasingly irrelevant," and that factors that determine agglomeration are consumption-related natural amenities (such as warmth/climate) and regulatory policies of states or cities (Glaeser and Kohlhase 2004:200).[5]

Central place theory is garnering renewed interest today for several major reasons. First, empirical studies are providing evidence of the hierarchy of central places and its relation to the power law (Chen and Zhou 2006; Hsu 2012). This makes CPT an early precursor of scale-free network theory (Barabasi and Albert 1999), a branch of complexity theory, providing CPT with new theoretical pedigree and a claim to "feasible optimality" (Chen and Zhou 2006). Second, CPT is being recognized for its policy value in regional economic development and planning strategies (Mulligan et al. 2012). In addition, a recent study of the hinterlands and small urban centers in metropolitan areas in the United States (Partridge et al. 2008) finds that distance from higher-tiered urban areas was associated with lower population growth during the 1950–2000 period. The study concludes that given this result, the NEG model needs to take into account that distance has discontinuous effects, as well as the market pull of hierarchical central places. Furthermore, the study indicates that the costs of distance appear to be increasing more rapidly over the past few decades, despite the advances in IT and decline in transportation costs during this period. This research has important implications for the development of a new concept of urbanity envisioned by Boone et al. (this volume), since it suggests that distance is not a uniform measure, but rather weighted by the urban node's location in the urban hierarchy.

Motivated by interest in the environmental footprint or imprint of cities, recent scholarship is turning attention to rural hinterlands, a crucial aspect of CPT. In particular, recent empirical work provides evidence of the relationships between several Western cities and their hinterlands (Billen et al. 2012b). For example, Keene (2012) examines the food, drink, and fuel demands of Medieval London in 1300 and shows how the city drew supplies from its hinterland. Other studies focus on the actual extent of the hinterlands; for example,

[5] Responding to these criticisms, Krugman (2011) admits that since NEG was mainly focused on manufacturing, it really was designed to explain the 1900 spatial economic landscape in the United States. He argues, however, that while the theory may not be adequate to explain the current urbanization patterns in advanced economies, it can explain the spatial geography of emerging manufacturing powers, especially China.

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New York City's food came from distant places as early as 1800s (Swaney et al. 2012), but 70% of Paris's food supply is still local (Billen et al. 2012a).

Contemporary Urban Patterns, Infrastructures, and Globalization

This section reviews the role that transportation and other infrastructures played in metropolitanization, before turning to a discussion of factors that led to globalization. Most important for understanding urban agglomerations and the distal supply hinterlands that have replaced local hinterlands are advances in technology, logistics, and the removal of financial barriers to trade.

Technology and Infrastructures Enabling Metropolitanization

The transportation infrastructures that facilitated the dense and compact early industrial city in the United States and other Western countries in the twentieth century were railroad and water transportation. Through these infrastructures, cities obtained food and raw materials from the countryside, and manufactured goods were transported from cities to other settlements and rural areas. The efficiency of these infrastructures depended on few hubs for shipping and, thus, railroad stations and ports reinforced central places, both in cities as well as in rural towns and villages. According to the 1952 U.S. Bureau of the Census, the mass production of automobiles (which began in the 1910s and made automobiles widely affordable) led to widespread car ownership after WWII, with the rate of car registrations per person surpassing 26% by 1950. Cheap automobiles, extensive road building by states and local governments, and the Federal Interstate Highway System of the 1950s were major factors contributing to the decentralization of the U.S. population into suburbs, leading to the first phase of metropolitanization. Communications media, such as the telephone and television, were well-established in the United States by the end of the 1940s and facilitated suburbanization. Rural electrification, which began during the New Deal of the 1930s, also contributed to opening up rural areas to suburbanization. In the 1960s and 1970s, retail in the form of shopping malls followed housing to the suburbs. With the shift in the U.S. economy from manufacturing to services in the 1960s and 1970s, office stock doubled, and then doubled again from 1970–1990. By 1986, over 57% of the U.S. office stock was located in suburban locations (Pivo 1990). Lang (2003) noted that by the late 1990s, more than 40% of total office space was located in outer suburban and exurban areas, in office clusters referred to as "edgeless cities." In the early 1990s, Garreau (1991) had identified "edge cities" as a new urban phenomenon in suburban America. Edge cities were primarily new office and retail centers, typically located at or near highway intersections. Tysons Corner, Virginia, was an early example of an edge city. A new metropolitan spatial model developed by Lang and Knox (2009) depicts metropolitan areas as polycentric with

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two or more central cities and their suburban areas, several edge cities near highway intersections, and isolated office clusters or the edgeless cities within the urban centers' spheres of influence, and micropolitan areas (self-standing towns of from 10,000 up to 50,000 people) outside the sphere of influence of the major urban centers.

Widespread automobile ownership and ubiquitous road networks in developed countries have facilitated the deconcentration of population in urban regions. The clear spillover of population, built environment, and economic activities into what used to be the rural hinterlands of central cities have either reduced the role of rural hinterlands in providing food and materials to their traditional central places or extended these areas much farther.

Technology and Infrastructures Enabling Globalization

The reshaping of the United States and European landscapes into polynucleated metropolitan areas occurring over the past twenty years encroached into the traditional rural hinterlands of central cities. At the same time, the globalization of production and services and international trade was accelerating. These complementary economic-spatial patterns led to both the diminishing importance of rural hinterlands for supplying food and raw materials to their central cities, and of central cities for the production of goods and services for their spheres of influence. We now turn to a discussion of how freight movement transportation advances, information communications technology, and logistics have been major factors in the quickening of the global trade experienced in the last few decades.

Containerization of Maritime Shipping

The containerization of cargo, its standardization, and the development of container ships and container port facilities were design innovations that revolutionized maritime shipping. It has made possible the globalization of trade that we are experiencing today. Before containerization, specialized goods, such as oil, were carried across the oceans in bulk, in ships designed to transport such goods, referred to as break-bulk shipping. Break-bulk ships carried goods in boxes, bags, barrels, or loose. Such shipping required individual handling and the potential for damage and theft was high. Before containerization of break-bulk cargo, longshoremen could spend as much time loading and unloading ships as the vessels spent in transit. Containerization, in effect, automated the handling of freight in port facilities. Malcom McLean developed the first commercial containers and container ship in 1956 (Cudahy 2006), but the widespread adoption of this innovation was slow. It was not until the late 1970s that container shipping reached developing countries (Hummels 2007). The container revolution included standardization of truckbeds and railcars for

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transporting containers over land. This enabled the secure transshipment of goods from the producer to its final destination.

By cutting out a large part of the labor costs to move cargo from port to vessel, increasing the speed of loading and unloading cargo (reported to have dropped from weeks to hours; Levinson 2008), and increasing the capacity of container vessels[6] and their speed, containerization reduced total time in transit, and shipping costs. The World Trade Organization estimates that maritime freight rates decreased by 65% between the 1950s and 1990s (WTO 2011); however, in a study of cargo and air shipping, Hummels (2007) concludes that containerization reduced transportation costs at best by 3–13%. The shortening of total time spent in transit and reduced transport costs enabled factories in emerging and developing countries and, given their lower labor costs, to compete with United States and European factories. As a result, United States and European imports diversified. According to Levinson, for example, the United States imported four times as many types of goods in 2002 as it did in 1972. In developed countries, this diminished the importance of urban centers as sources of manufactured products for their urban regions.

Growth in Air Freight

The widespread adoption of jet engines between 1957–1972, which were "faster, more fuel-efficient, and reliable and required much less maintenance compared to the piston engines they replaced" (Hummels 2007:137), was instrumental in lowering the price of aircraft and opening up opportunities for air freight. By the mid-2000s, air shipments represented less than 1% of total tons and ton-miles shipped, but were growing rapidly. A good illustration of the increasing importance of air shipping is the growth in the value of air imports and exports in the United States. Over the period 1965–2004, the share of trade value of air imports more than tripled, and the share of trade value of exports more than quadrupled. The total amount of air freight carried increased from 20 billion freight tons/km in 1975 to 160 billion freight tons/km in 2007 (Kupfer et al. 2011). This rapid growth of air imports occurred because of the sharp drop in the relative cost of air shipping: from 1955 to 2004, worldwide air revenue per ton-kilometer fell more than ten times (Hummels 2007).

Both maritime and air freight are urban-serving infrastructures. They are network infrastructures in which metropolitan ports and airports are nodes in global supply chains increasingly dominated by powerful shipping alliances and large carriers (Ducruet and Notteboom 2012). However, ports and airports are typically financed and maintained by local or regional governments.

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[6] At the beginning, 20-ft containers (twenty feet long and eight feet wide) were the norm. Today the capacity of container ships and trade from container ports is measured in trailer-equivalent units (TEUs) or 20-ft equivalent units. A 2,000 TEU container ship can accommodate 2,000 20-ft containers or 1,000 40-ft containers. By 2010, new vessels could handle over 10,000 TEUs.

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Information Technology, Logistics, and Supply Chains

The transformation of global trade was brought about by both advances in transportation and information technology as well as by techniques that optimized their use in global trade (i.e., logistics and supply and demand chain management). Logistics and supply chain management (often used interchangeably) refer to the planning and control of the flow of materials, supplies, and finished products for a firm (Stenger 2011). Logistics services, a growing subsector in the advanced services sector, rely on computing and digital communication technology to utilize programming and scheduling algorithms, spreadsheets, inventory optimization, electronic data interchange among businesses, on-line shipment, billing and payment, etc. (Schwarz 2006). The increasing speed of IT technology and sophistication of logistics services have made possible process innovations such as lean production and just-in-time manufacturing.

Governance and Economic Factors Enabling Globalization

Reductions in trade barriers among nations, the export-oriented growth strategies of emerging markets and other developing countries, and the increasing dominance of international financial institutions and multinational corporations were essential conditions for the globalization of trade. This has also contributed to the erosion in importance of the rural hinterlands of cities.

Reductions in Trade Barriers

Reductions in trade barriers in emerging markets,[7] especially in China and India—outcomes of either unilateral or multilateral agreements—have increased the opportunities for trade. For example, according to the World Trade Organization, by 2009 "China, India and Vietnam, countries which lowered overall tariffs the most, relative to 2001, had also seen the highest annual rates of trade growth" (WTO 2011:40). Another indicator of the decline of trade barriers over the past twenty years is the change in the trade openness ratio (i.e., ratio of total trade to gross domestic product) of these emerging economies. A Brookings Study (Kose and Prasad 2010:43) estimates that from 1985 to 2010, the trade openness ratio of emerging economies increased from less than 30% to around 80%, while advanced countries saw an increase from 26% to 46%. Moreover, the average growth rate of exports from emerging markets during this period was two times the rate than for advanced economies (Ahearn 2011:13).

[7] Emerging markets include China, India, Brazil, Indonesia, Mexico, Russia, Turkey, and Vietnam, of which China, India, and Brazil are the most dynamic.

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Financial Flows and Foreign Direct Investment

As a result of the privatization of state-owned banks and removal of restrictions on the acquisition of assets by foreigners, private capital flows to developing countries have substantially increased over the past 25 years almost quadrupling their share of GDP, a much faster rate of growth than that of trade flows. During this period, foreign direct investment has been instrumental in incorporating developing countries into the global economy. By 2009, China was the second largest recipient of foreign direct investment, behind only the United States (Ahearn 2011:20–21).

The Transformation of the Industrial Production Model and the Rise of Multinational Enterprises

The industrial production model for most of the twentieth century revolved around the breakdown and automation of tasks on the factory floor or assembly line, *and* the vertical integration of production under one company beginning with the acquisition or processing of raw materials, design of products, to the manufacture of parts, their assembly, and, in some cases, even the delivery and marketing of the finished product. In the United States, this model of vertical integration was eroding by the 1980s, with outsourcing of parts, even in the automobile industry, becoming common. With advances in freight transportation and information communications technology, firms in emerging economies, and developing countries in general, sought opportunities to export goods and services to developed and other countries. In a similar way, companies in developed countries saw opportunities for foreign direct investment by offshoring segments of their production or by investing in new factories offshore, where the entire production process could take place to reduce overall cost (WTO 2011). Vertical fragmentation of production, or "slicing and dicing" the production process and distributing the segments around the world, enabled firms to seek out the cheapest and most appropriate labor for different aspects of production; it also provided the opportunity to open up multiple markets for their merchandise. In effect, the new model of vertical fragmentation internationalizes the assembly line. An example of a distributed global production chain is found in Table 14.1, which lists the distribution of production for Boeing's 787 Dreamliner. The new wave of multinational enterprises ushered in a network model of global production and distribution managed by IT-enabled logistics and global freight shipping infrastructures. In the early stages of globalization, multinational enterprises were typically large corporations from advanced economies that belonged to oligopolistic industries (Kogut 2001). Today, emerging economies are the source of an increasing number of multinational enterprises. By 2010, almost one-fifth of

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Table 14.1 Fragmentation of production for Boeing's 787 Dreamliner: components are listed by country in which they were produced. Data from WTO (2011:95).

Components	Countries
Doors and windows	United States
Forward fuselage	Japan, United States
Escape slides	United States
Flight deck seats	United Kingdom
Flight deck controls	United States
Engines	United States, United Kingdom
Engine nacelles	United States
Center wing box	Japan
Landing gear	France
Electric brakes	France
Tires	Japan
Prepreg composites	Japan
Cargo doors	Sweden
Passenger doors	France
Auxiliary power unit	United States
Horizontal stabilizer	Italy
Raked wing tips	Korea
Vertical stabilizer	United States
Wing box	Japan
Wing ice protection	United Kingdom
Rear fuselage	United States
Lavatories	Japan
Center fuselage	Italy
Tools and software	France
Navigation	United States
Pilot control system	United States
Wiring	France
Final assembly of the airplane	United States

the Fortune Global 500 companies were emerging market multinational enterprises (Ahearn 2011:23).

Trade globalization has resulted in a multiplicity of urban global linkages over which cities have little direct control or influence. As a result, urban places have no meaningful links to or influence over the global location of their suppliers (their global hinterlands). In addition, because of the globalization of production and services, urban places have fewer ties with their traditional, surrounding hinterlands.

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Castells' Theory of the Network Society

Castells, who recognized early the new social reality made possible by information communications technology and transportation advances, argues that our current stage of world development is not properly characterized as the information society, but rather as the network society (Castells 1989, 1996). As he explains, network organizations, such as families or friends, are not new, but before digital IT, communication and coordination across a network was slow and difficult, and so major social processes were carried out by hierarchical organizations (e.g., government, military, vertically integrated business firms, religions). In contrast, digital information and communication technologies enable networks that make possible communication and coordination among large numbers of people in real time across the world, diminishing the importance of space (Castells 2010). Networks are multiple, fluid, and are characterized by different nodes and linkages of shifting strengths. What others call global cities, due to their prominence in financial services or technological innovation, Castells insists are nodes in networks of global finance or technological innovation. It is the networks and not the places which are formative, and networks are always in flux. In his conception of the network society, Castells conceives urban space as a space of flows of people, communication, and goods, and, as noted above, he provides the rationale for the definitions of metropolitan and mega-city regions. He recognizes the role of transportation and communication in urban agglomerations and the lack of government or institutional cohesion in these vast regions.

Castells' insistence on the importance of networks, and not places, raises the question of why the hubs of global networks are located in metropolitan regions. In an age of instantaneous and multiple means of communication, why do networks still concentrate in urban regions? Part of his answer is that urban agglomerations of "services, finance, technology, markets, and people" generate economies of scale. More intriguingly, he points to another type of economy that drives urbanization: spatial economies of synergy. By this, he means that sharing a space with a valuable partner in a particular network increases the "possibility of adding value as a result of the innovation generated by this interaction" (Castells 1996). The network society still requires metropolitan spaces where interpersonal interaction can occur "because communication operates on a much broader bandwidth than digital communication at a distance" (Castells 1996). From his perspective, these vast metropolitan areas are likely nodes for various networks, which act as attractors for capital, talent, or other valued things. However they lack, except in a few cases, such as Toronto, the type of government or institutions that match their vast territories, and thus remain powerless to plan or govern these vast regions. As a result, Castells concludes, these new urban patterns display both dynamism and marginality, and face a fundamental contradiction between the wealth and power attached to network flows and the meaning that places hold for people.

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Changing Urban Values and Urban Policy: The Compact City Model

While urban development has become increasingly decentralized into vast metropolitan regions, the worldwide social movement toward sustainable development has embraced a compact city strategy as key to sustainability and revived the concept of place-based communities. The compact city model has become a near-paradigm for urban design and planning (Kenworthy 2006; OECD 2012). At its theoretical core, the compact city approach argues for higher densities, clear boundaries between urban and nonurban places, a mix of land uses, transit accessibility, as well as a pedestrian- and bicycle-friendly street environment. The central values that underlie the contemporary compact city model are related to transit accessibility, to the reduction of the number and length of household automobile trips, their associated energy savings, and the consequent reduction of air pollution and greenhouse gases. In Europe, the United States, and other countries around the world, the exemplars for the compact city model are the older, compact, pedestrian-oriented, and transit-accessible European cities such as Paris, London, or Barcelona. In the United States, prompted by and reacting to ongoing suburbanization, the compact city model is aligned with urban growth management efforts and the New Urbanism, especially transit-oriented development (TOD).

The early phases of urban growth management policies were primarily concerned with protecting rural and resource areas from urban encroachment, in effect from suburbanization, which led to various urban containment mechanisms, in particular, the urban growth boundary pioneered by the state of Oregon. New Jersey, which was the most suburbanized state in the country in the 1980s, used the central place concept as the major regional organizing concept for managing growth in its first state-wide urban growth management plan (New Jersey State Planning Commission 1991). The plan's general strategy was to guide future growth into compact forms of development and redevelopment. The plan identified compact forms of development as "centers," ranging from urban areas to towns, villages, and hamlets, and emphasized the market function of these centers and their potential for public transit and walkability.

The New Urbanism: Transit-Oriented Development

The New Urbanism is an influential urban design movement that emerged in the United States in the mid-1980s focused mainly on reforming suburban development (Duany et al. 2001). It sought to replace suburban subdivisions with more traditional town plans incorporating interconnected street grids, better defined lot/block and block/street patterns, and higher densities than existing suburbs. In addition, many new urbanist designers emphasize vernacular architectural styles. Peter Calthorpe, an urban designer, initiated the concept of TOD in the late 1980s. This concept has been incorporated into the new

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urbanism agenda and is a major tenet of the compact city approach. As with New Urbanism in general, the concept was very much aimed at new suburban development, but it is also applicable to the redevelopment of existing neighborhoods. Calthorpe (1993) argues that reduction in automobile use and increase in public transit should be pursued as a regional urban form strategy that links TODs. The TOD hierarchy is similar to the central place hierarchy. The TOD strategy,[8] however, is part of a broader sustainability agenda that includes the following elements (Dittmarr and Ohland 2004):

- organizing growth at a regional scale to be compact and transit supportive,
- locating retail, jobs, housing, parks, and civic uses within walking distance of transit stops (mixture of land uses),
- creating pedestrian-friendly street networks that connect local destinations,
- providing a mix of housing types at different densities and prices,
- preserving sensitive habitat, riparian zones, and high-quality open space, and
- making public spaces the focus of building orientation and neighborhood activity.

A variation of the TOD concept is Seattle's urban village strategy,[9] which has been used to densify existing low-density residential neighborhoods in Seattle. The organizing concept of urban villages (also similar to the central place concept) was applied within the city itself to develop hubs of neighborhood-oriented commercial areas mixed with higher-density residential uses. While the compact city model is a general internal urban form model that specifies broad features of a city, such as a mix of uses or density, the urban village concept and TODs are hierarchical organizing concepts for the internal structure of cities or urban regions.

More recently, sustainable urbanism has promoted local food and materials, in effect, calling for greater reliance on local food suppliers. This is an understandable attempt to bring back Christaller's world. Reviving a city's connection to its rural hinterland would provide greater ties of influence between urban consumers and proximate hinterland producers and avoid the unknown and hard to influence multinational supply chains. These calls for "buying local" are often motivated by concern for a city's ecological footprint, and, more specifically, for the reduction of energy used in transporting food from distant regions and the resultant emission of greenhouse gases. However, life-cycle analyses draw a more complex account of the energy and greenhouse gas costs

8 To view the "Urban Strategy: A New Framework for Growth" see http://www.calthorpe.com/files/Urban%20Network%20Paper.pdf

9 For more information, see http://www.seattle.gov/dpd/static/Urban%20Village%20Element_LatestReleased_DPDP_021118.pdf

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of distal versus local food production (Sim et al. 2007), and theorists warn against assuming that local supplies are more just or sustainable than nonlocal ones (Born and Purcell 2006).

Empirical Research on Compact Cities

Is the compact city model supported by the findings of empirical research? Much research has been conducted on this topic. A recent meta-analysis of research on travel and the built environment (Ewing and Cervero 2001) gives a good indication of the amount of research on the topic. Ewing and Cervero reviewed 200 studies that quantified the relation between travel and the built environment and included fifty of these in their meta-analysis. In addition, a comprehensive study conducted by the U.S. National Research Council examined the empirical evidence on the effects of compact development on motorized travel, energy use, and CO_2 emissions (NRC 2009). Based on the few studies that used data from individual households and applied the best available statistical methods, the National Research Council found that doubling residential density across a metropolitan area might lower the number of vehicle miles traveled (VMT) per household by about 5–12%, and perhaps as much as 25%, if coupled with higher employment concentrations, significant public transit improvements, mixed uses, and other supportive demand management measures. This means that the elasticity of VMT, with respect to density, ranged from –0.05 to –0.12.[10] Ewing and Cervero's meta-analysis of research on travel and the built environment analyzed, for the most part, studies that used aggregate data. Using aggregate data rather than individual household data makes it difficult to claim causality. However, the meta-analysis untangled the effects of different aspects of the compact city model and found that the elasticities of VMT, with respect to different aspects of the built environment, varied from land-use mix at –0.09, intensity/street density at –0.12, destination accessibility –0.20, distance to downtown –0.22, and density –0.04. Density in the meta-analysis had a very weak correlation with automobile travel, at the low range of the National Research Council results. Both of these major research syntheses conclude that combining several compact city strategies (e.g., density, land-use mix, and roadway connectivity) can have a synergistic effect and significantly reduce VMT. In effect, these studies support a mix of compact city strategies, such as increasing density and mixing appropriate land uses around areas of high public transit accessibility, centralizing jobs in city centers and surrounding transit nodes or TODs, as well as urban containment strategies. Research also indicates that higher densities than typical suburban densities are more cost-effective from the perspective of infrastructure and public facilities provision (Burchell et al. 2005).

[10] Elasticity is a measure of the change in density to the associated change in VMT. In this case, as the density increased 100% or doubled, VMT decreased from about 5% to 12%.

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Summary and Conclusion

Defining the Urban

When we turn to definitions of urbanization, it is clear that what we mean by urban settlements varies around the world. Traditional definitions revolve around total population, population density, and authorized local units of national or state governments. More recently, some advanced nations have shifted their definitions from state-authorized units (such as municipalities or contiguous dense physical development) to flows of population (as in commuting patterns) and flows of goods, services, and communication. This has led to definitions of new urban patterns, such as metropolitan areas or mega-city regions that incorporate some rural lands. It also reflects the blurring of the traditional urban-rural dichotomy. Around the world, urban regions have outgrown the local government jurisdictions of the past century, and most urban agglomerations today are faced with the lack of adequate government power to manage their growth, raise revenue, and provide public goods and services. This makes the urban governance issue a crucial challenge for the urbanizing world.

Urban Economic Dynamics and Spatial Form

Economic geography theories attempt to explain urban spatial patterns through the interaction of economic drivers; as such, they are the main way through which we make sense of the economic aspects of urbanization. Urban spatial theories offer insights on why firms and people aggregate in cities, and on the location of firms and households within cities. Central place theory, drawn from observations of the pattern of urban settlements in Germany's industrial economy in the early twentieth century, developed a hierarchical scheme of central market places serving lower-order central places and their hinterlands, with hinterlands providing food and materials to their central places. The 1990s brought a new interest in the theory from mainstream economics and the NEG approach provided a microeconomic foundation for it, although the spatial result of NEG was simplistic. Renewed interest in CPT from regional scientists has been fueled by confirmation that in Japan and the United States, settlement size and numbers follow a power law, analogous to the hierarchical network of central places posited by Christaller and Lösch. Central place theory has also become particularly relevant in urban policy, since compact city strategies at the regional and intracity scales incorporate policies to develop hierarchies of central places. In addition, recent research finds that not all central places have the same centripetal pull on their rural spheres of influence, providing evidence of a hierarchy of urban places. Most recently, empirical studies of rural hinterlands, which are of theoretical interest because of the increasing substitution of the economic exchanges involved in central places and rural hinterlands with global, distal exchanges, are beginning to be published. To a

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large extent, these studies are motivated by the policy interest in more sustainable urban footprints.

Globalization Theory

Castells' influential theory of the network society incorporates a sophisticated understanding of our global economy and has special relevance to urban areas. Important insights include: the role of information communications technology in making possible global networks of production; the transformation of hierarchical, vertically integrated production processes to networked distributed global production; how economic networks as formative drivers are changing patterns of urbanization from contiguous urban places to the fluid spaces of mega-city regions; the continuing importance of urban agglomerations and their central places as attractors of capital, innovation, research, etc.; the evident contradictions in urban regions between wealth and marginality; and the fundamental contradiction for urbanism between the flows associated with the wealth and power of networks, and the meaning and attachment people have for places. Both Castells and Glaeser see the potential for human interaction in shared places as a major driver for urban agglomerations in our increasingly placeless global societies—the city as a setting for encounters. Both underestimate the value of infrastructure systems and built environment as economic attractors in themselves.

The Role of Infrastructures

Reflecting on the features of urbanization discussed at the beginning, definitions have emphasized density and, more recently, flows of population, goods, and information. Our review of factors and features of global trade highlighted the formative role of transportation infrastructures, information communications technology, and logistics (which essentially refers to strategic and implementation planning) in transforming the world economy into a global economy. The brief review of U.S. metropolitanization also emphasized the role of transportation and other infrastructures. In both cases, of course, other factors (e.g., government actions) were also necessary. For example, as discussed above, in the case of globalization, trade liberalization served as an essential driver; in the case of suburbanization, the role of government in insuring home mortgages, which led to the 30-year mortgage, opened up home ownership to millions. Infrastructures make possible the functioning of an urban region: they are the road and rail networks that channel the flows of people, the communication infrastructure that facilitates communication, water infrastructures which are essential for life and health, etc. Infrastructures are sources of continuing value for urban agglomerations. Unlike the assumption of CPT, the urban landscape is not a featureless plain; it is endowed with durable infrastructure networks that make urban life possible in vast urban agglomerations, and on which both

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people's lives and economic activities depend. Economic activities, especially in network societies, are fluid. An urban region's fortunes may ebb or flow, but infrastructures are long-lived endowments of urban civilizations. The persistence of primate cities in the world have much to do with the increasing returns of their urban infrastructures. Infrastructures represent the shared durable capital of urban regions and require government institutions, commensurate with their scale, to plan, establish, maintain, and upgrade them.

Urban Policy: The Compact City Model

While the economic and political-economic theories reviewed here seek to explain the economic aspects of urbanization, urban policy reflects normative values as well as an understanding of explanatory theories and relevant empirical research. The compact city model, although it flies in the face of trends toward deconcentration, has become a normative model for sustainable urbanism with its goals of reducing automobile travel, energy use, and greenhouse gas emissions. Within a regional or even within the city context, CPT can offer an organizing framework for mega-city regions. The NEG and complexity theory provide frameworks and models that support CPT as an organizing schema. Economic geography, on the basis of rational choice theory and general equilibrium models, and complexity theory, on the basis of self-organizing complexity models, provide theoretical support for CPT-based regional policies. Also, the hierarchy of central places aspect of CPT, with its focus on trade or retail centers, retains more relevance in the face of global production chains than NEG models, with their focus on industrial production. One of the major motivations behind support for the compact city model is to reduce automobile travel, although other motivations are also at work, such as providing a more livable built environment and reducing land conversion to urban uses. Reducing automobile travel has become very important because of the high energy consumption of automobile travel when compared to other modes of travel, and the associated air pollution, especially, greenhouse gas emissions and their impact on climate change. Empirical research supports a mix of compact city strategies for reducing vehicle miles traveled, although density alone is weakly correlated with travel behavior.

Rural Hinterlands and Ecosystem Services

Both economic geography, based on microeconomic theory, and Castells' sweeping account of the network society within a global economy fail to incorporate the reliance of cities on ecosystem services, what CPT partially captured through its recognition of the rural hinterlands of central places. Neither confronts the ecological challenges that we face (in particular, the challenge of climate change), which have significant implications for the future of urban agglomerations. For example, urban regions in many parts of the world

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already face water scarcity, a problem which will be compounded in this century under climate change. Doubtless, many of these metropolitan regions will have the institutional and financial means to forge sustainable solutions, but in other cases, water supply issues may reduce the growth and viability of urban regions.

The Governance Challenge of Metropolitan Regions

Around the world, urban regions have outgrown the local government jurisdictions of the past century, and most urban agglomerations today are faced with the lack of adequate government power to manage their growth, raise revenue, and provide public goods and services. This makes urban governance a crucial issue.

The concept of the ecological footprint has emphasized the extent of goods and services that urban areas consume. In a roundabout way, it has focused attention on the extent to which many of the ecosystem services, which local hinterlands provided to cities in an earlier age, are now being provided through the distal connections of our global economy. Correspondingly, the clients of the specialized goods or services that urban regions provide are not necessarily regional but global networks. An element in the movement toward sustainable urbanism is the "buy local" program, intended to reduce our ecological footprint. Assessing the value of the policy of buying local can be determined on the basis of transportation costs, energy savings, reduction of greenhouse gas emissions, or alternatively on the basis of supporting sustainable livelihoods in the local or in a distant region. Multiple criteria can and should be applied in this calculus. A neglected criterion that should be included is a concern for the future governance of urban regions. In a world where national governments over the past quarter century have increasingly ceded power over finance and economic activities to international financial institutions and multinational enterprises, fostering a common regional identity and solidarity may be important first steps in developing effective metropolitan governance regimes to confront climate change and other environmental challenges, as well as to temper the volatility of financial and trade markets in the twenty-first century.

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