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**The United States Urban System,
From colonial settlement to global urban center, an original trajectory**

Anne Bretagnolle¹, Fabien Paulus², Sukkoo Kim³, Céline Vacchiani-Marcuzzo^{4 5}

Abstract

This chapter documents the historical evolution of the US urban system. From a handful of port cities in the colonial period, there was a sustained urban growth from 1830 to the twentieth century. While the initial rise is associated with a transportation revolution and early industrialization, regional shocks associated with immigration, second industrial revolution, gold and oil discoveries, and land speculation give special character to US urban development. The rank-size analysis of city sizes shows that there were three periods of urban hierarchy, largely coinciding with functional evolutions of cities: first, as regional mercantile centers; second, as national, industrial-mercantile, densely built cities; and, third as post-industrial, service-oriented, metropolitan, suburban places. A more detailed analysis of post-industrial cities shows that innovations in services such as finance, insurance and real estate contribute significantly to the concentration of few large metropolitan areas whereas manufacturing and retail tend toward medium and smaller cities. The larger cities were considerably more economically diverse than smaller cities, and a spatial analysis indicates that cities tend to co-evolve as they compete to grow. The chapter concludes with an analysis of the impact of political institutions on urban development. In contrast to developments in Latin America and Canada, American federalism that grants significant political authority to state and localities has significantly impacted US urban and rural development.

Keywords : USA, urbanization concentration, post-industrial cities, political institutions, federalism

1. Introduction

Many large cities of the United States appear today at the top of world urban hierarchies in terms of wealth and power of influence in important world networks. This is paradoxical since

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<http://geodivercity.parisgeo.cnrs.fr/blog/>

urbanization is a very recent process in this country, compared to what happened in other parts of the world. Ancient urban civilizations left very little traces in North America, at latitudes where so many cities were created in Eurasia (Fagan, 1991). Urbanization in that region really started following the European immigration waves from seventeenth century on and followed a peculiar trajectory that explains many original features of this urban system.

That is why this chapter will develop the history of urban settlement from its origins to the present time, using reliable statistical sources. On a total surface around 7.8 million km² (9.6 including Alaska, Puerto-Rico and Hawaii), quite twice the European's, the United States urban system was unified lately. According to MacKenzie (1933 p. 6), it is only at the end of the 19th century that railways "brought the entire settlement of the United States into a single economic unity integrated through a system of gateway cities of varying importance". The opening of the Panama Canal in 1913 also played a major role by reducing the travel from New York to Los Angeles from 21 000 to 8 000 km (Rodrigue et al. 2013). Airplanes and automobiles finally achieved the integration of cities in a unified urban system at the level of the country, in the 1920-1930's (Pred 1977).

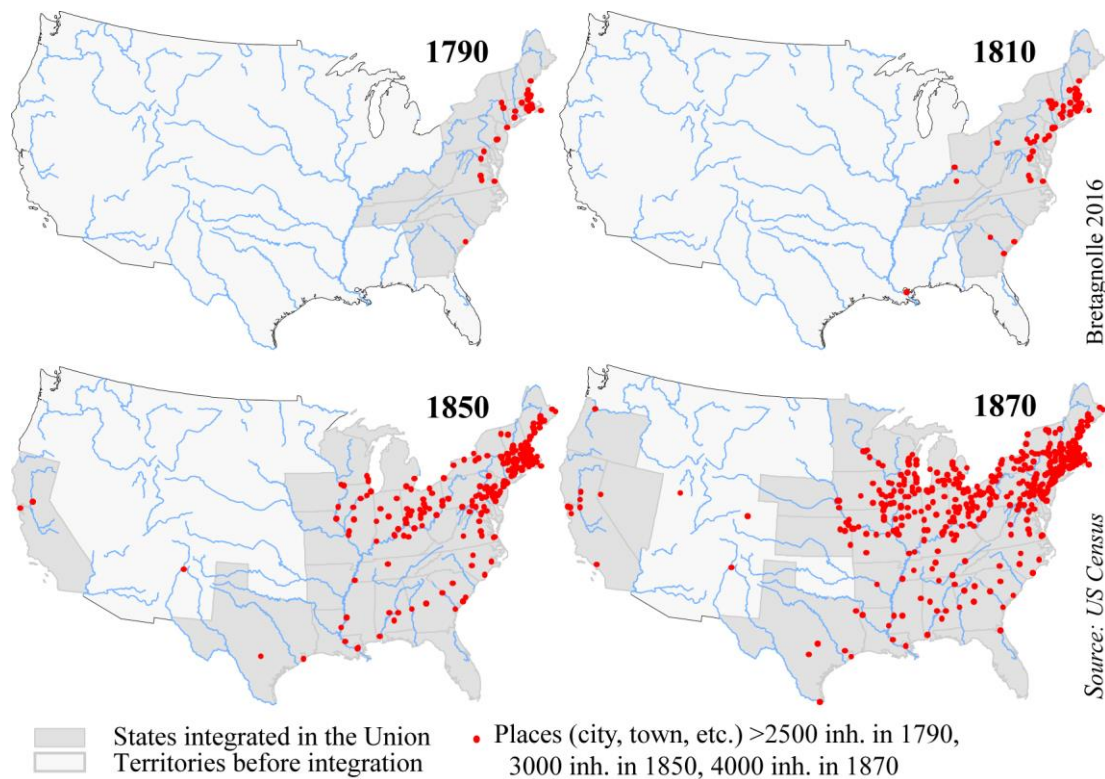
Even if formed recently, the United States urban system shares some features that are observable in long-standing urbanized countries: a very regular distribution of city sizes, corresponding to a hierarchy of urban functions and to more or less regular spatial patterns, a functional diversity and a co-evolution of socio-economic profiles (Bretagnolle et al. 2009). But it is also characterized by very specific features, such as the particularly sudden and marked growth of cities and towns, notable first by a genuine conquest of space and territory and then, once they become major nodes within their territories, by their influence over their immediate environment, reaching out over particularly large distances. In 150 years the United States moved from a status and lifestyle that were largely rural (urbanization rates of 15% in 1850) to a status of leader for various parameters linked to the city (urbanization rate of 94%, higher than in Europe and much the same as Japan, maximum city size of around 20 million, while London and Paris have 10-12 million only). Another specific feature is the relationship between political institutions and urban development, with a democratic federalist system that installed state capitals in many small and medium sized cities, while a hierarchical diffusion of innovations lead to the concentration of economic power in a few major metropolises.

2. Trends in urbanization since 19th century

City does appear in the United States very recently, in the 17th century. According to historian sources (Greene & Harrington 1932, Chudacoff 1981), 4 cities (defined as an area having a population larger than 2,000 inhabitants) were registered in 1690, i.e. (from the largest to the smallest) Boston, Philadelphia, New York and Newport. There were 32 cities according to the first census of 1790, all located along or close to the Eastern coast, whose activities were dominated by trade with Europe (Figure 1). Migrations westward and commercial exchanges with North-East ports and Europe were then helped by the construction of canals (1810-1830) and railroads (1830 and after). These transportation networks connected the Eastern places not only to the booming Ohio of the first industrial revolution, but also to the wheat producers who used the Mississippi river to export their harvest. A second "urban frontier" (Wade 1959) was

opened by the Spanish moving in from Mexico, but it was not until the gold rush of the middle 19th century that San Francisco and Sacramento exceeded 3,000 inhabitants.

Figure 1: United States spatial diffusion of urban areas from 1790 to 1870



2.1. Methodological considerations concerning the longitudinal approach of cities

Following urbanization levels through time requires to adopt a harmonized delineations of urban areas (Berry & Okulicz-Kozaryn 2012). From 1790 to 1870, we use cities and towns populations, as defined in censuses, with an increasing minimal threshold from 2,000 inhabitants in 1790 to 5,000 inhabitants in 1890 and 10,000 inhabitants from 1940 (Bretagnolle et al. 2015). From 1870, we consider the functional agglomerations. As commuting data do not exist at that time, we use a proxy based on the time-budget dedicated in average for commuting, by train or later by car and bus. As shown by Zahavi (1974) and more recently by Cervero (2011), this time-budget is very stable through time, around one hour. An automatic aggregation of outlying municipalities located at less than one hour from one or several central municipalities was processed and completed by historical expertise of transportation networks for some of the largest cities (Bretagnolle et al. 2015). From 1940, we also consider the remote suburbs formed by car and fast train commuting by using metropolitan and micropolitan areas as defined by the Census Board.

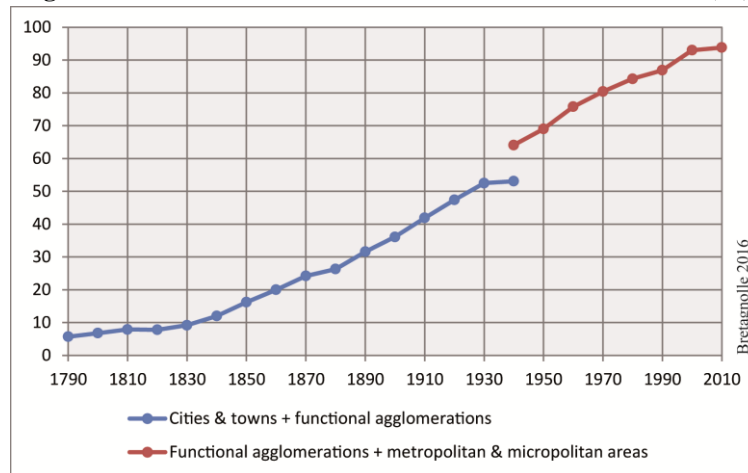
Thus the database comprises several types of urban entity and individual cities can evolve from one type to another in the course of their existence. For example, Boston is represented between

1790 and 1860 by the city of Boston, then up to 1940 by a functional agglomeration and finally from 1940 by a metropolitan area.

2.2. Urban growth in the 19th-20th centuries

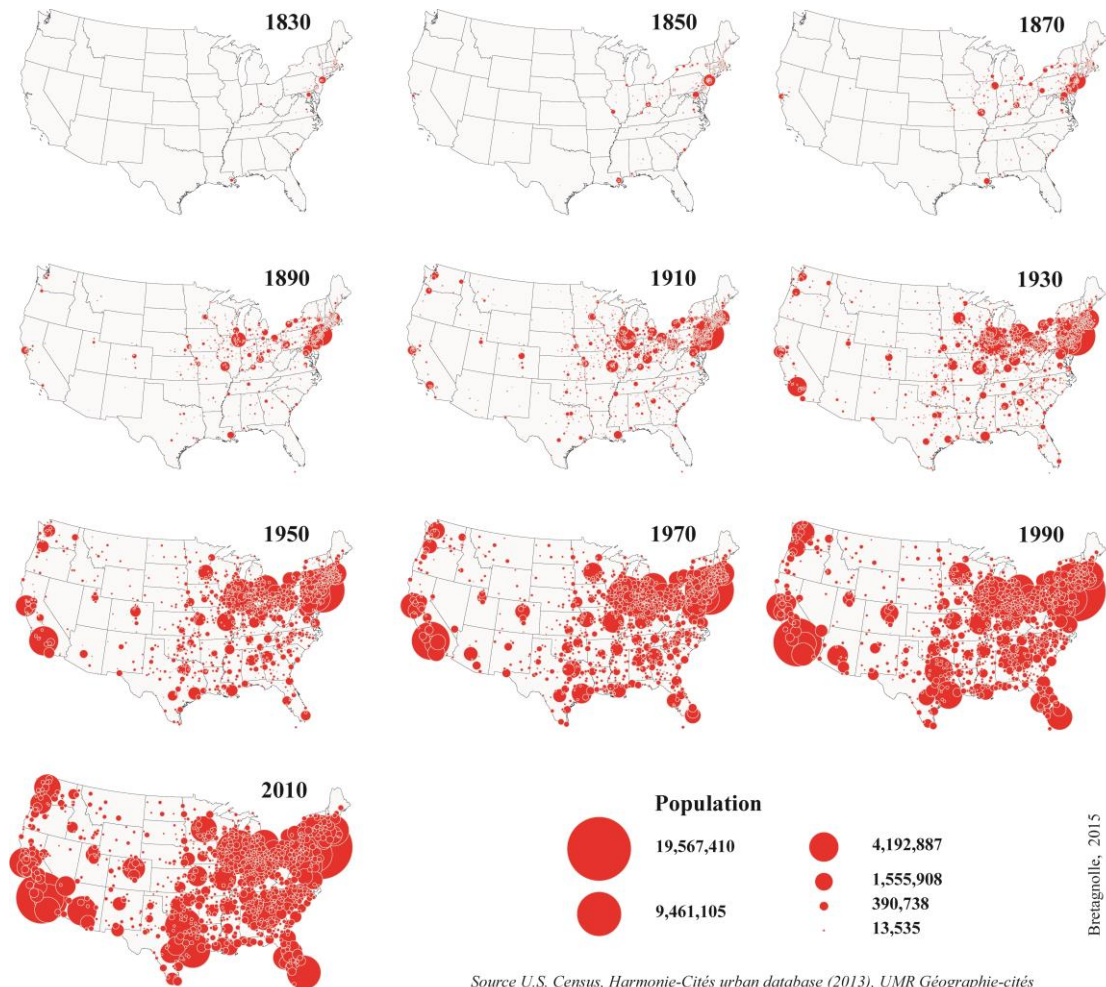
This longitudinal database allows demonstrating the particularly sudden and marked growth of urban areas in the United States in the 19th-20th centuries. The 1830–2000 period is an exponential phase of urban growth (with the exception of the 1929 crisis and the Great Depression), that stabilized in 2000–2010 after this transition (Fig. 2).

Figure 2: United States urbanization rate from 1790 to 2010 (%)



- The spatial distribution of urban growth (Fig.3) leads to a striking stability in the distribution of urban sizes, in particular at the top of the hierarchy (New York, Philadelphia, Boston, *etc.*). A high specificity of United States is however the strong correlation between the different innovation cycles, the associated resources, and the emergence of new regional metropolises. Indeed, most of the cities that suddenly emerge during an innovation cycle and remain sometimes specialised in the corresponding activities are concentrated in very specific regions:
 - the north Atlantic coast at the start of the 19th century (New York, Philadelphia and Boston),
 - the south Atlantic coast and the Mississippi system in the mid-19th century (Baltimore, Cincinnati, New Orleans, St. Louis, Chicago),
 - the cities of the industrial belt in the second half of the 19th century (Pittsburgh, Detroit, Cleveland, Buffalo, Chicago),
 - those of the gold rush at the end of the 19th century (San Francisco),
 - Texas and California for the oil boom (Dallas, San Antonio, Los Angeles, Oakland, even if at that time some cities of the first industrial revolution remain very dynamic with the automobile industry, such as Detroit or Akron),
 - Florida and California for the land speculation from 1900 to 1930 and the new information technologies, but also retirees and tourism economy in the years 1940 to 1980 (Miami, Tampa, Phoenix, San Diego, San Jose *etc.*).

Figure 3: United States evolution of urban patterns from 1830 to 2010



Source U.S. Census, Harmonie-Cités urban database (2013), UMR Géographie-cités

3. Formal description of urban hierarchy

Rank-size graphs may be used for measuring urban concentration. The slope of the adjusted line, in absolute value, is an indicator of the degree of inequality of size among urban areas. When this degree increases over time, it means that the larger cities have a higher growth than average, leading to an urban concentration (or hierarchization) (Fig.4 and 5).

Figure 4: United-States rank-size graphs, from 1790 to 2010

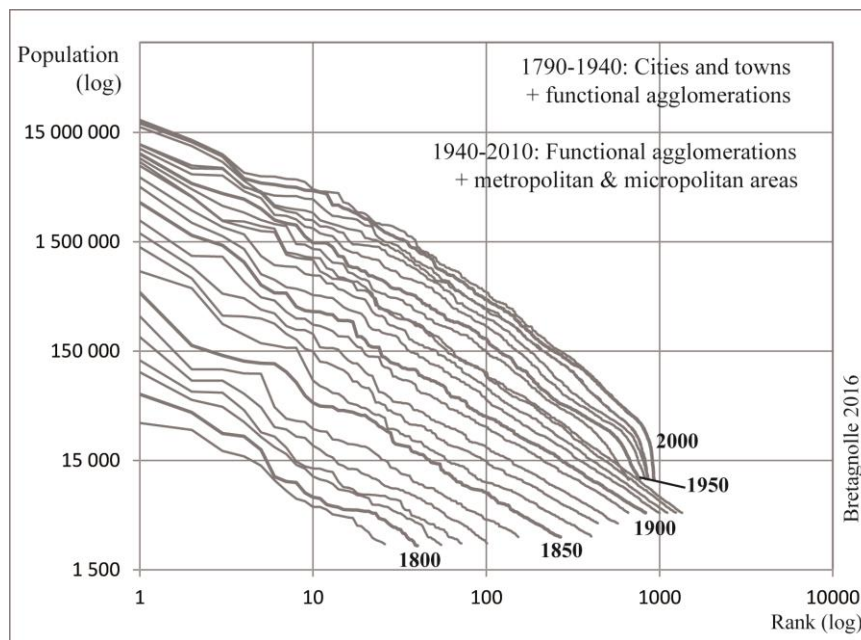
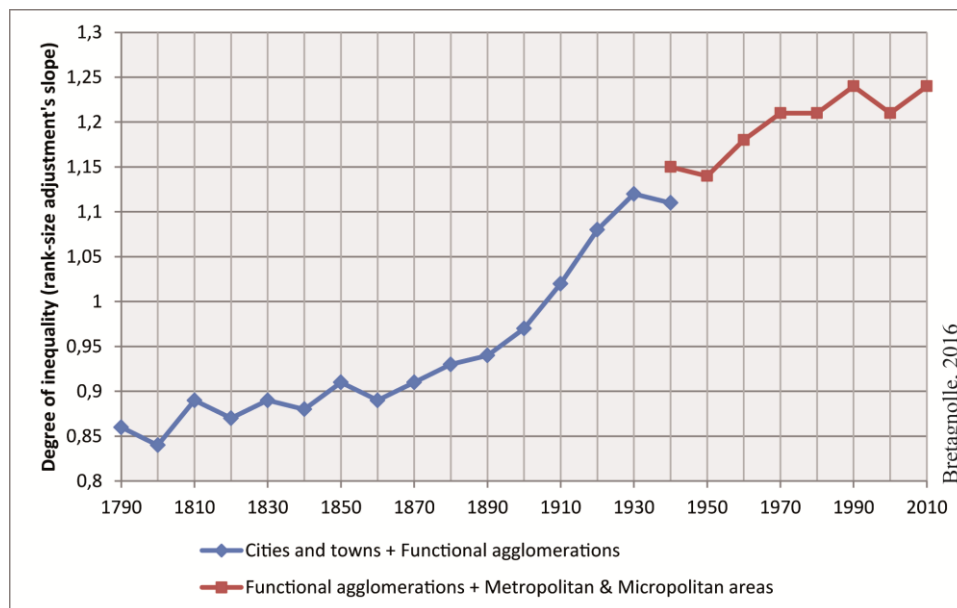


Figure 5: Evolution of the degree of inequality in city size in the United States (1790-2010)



Three main stages appear:

- First, from 1790 to 1860, the degree of inequality remains very stable despite the strong urban growth. Due to the immensity of the country and the recentness of railway diffusion, US cities do not yet form an integrated city-system at a national scale.
- The second period (1870-1970) is characterized by a market urban concentration, driven by industrialization and search for scale economies, particularly important after 1870 (Kim, 2000) – excepted of course during the 1929 crisis and the Great Depression. Using a time-scale reference for defining urban areas gives very different results from former studies (Bretagnolle et al. 2015). A large corpus of literature insists that the US would

be characterized by a non-hierarchical process of urbanization (Berry 1976) or a slightly increasing concentration (Dobkins & Ioannides 2000, Black & Henderson 2003) in contrast to what is observed in Europe. These authors suggest that this could be explained by a sort of wariness towards large cities and an inclination towards scattered, less dense settlements closer to nature. Indeed, urban concentration appears very slow when cities are defined as municipalities (for instance in Madden 1955, Batty 2006) or as metropolitan areas from 1900 (for instance in Dobkins & Ioannides 2000, Black & Henderson 2003). Our harmonized database demonstrates conversely that the urban concentration process was very strong during this period..

- A third period is characterized by a stabilization of the slope values around 1.2, from 1970 to 2010. The level of inequalities is much more important than in European countries (around 0.9) and similar to other “New World” countries, such as South Africa or Australia. Indeed, in these countries, towns and cities developed according to a pioneer logic, i.e. aiming to occupy the widest possible space, even if this was in an extensive manner, and they also developed with faster and more efficient means of communication (especially the railways).

This “New World” specificity results in systems where towns and cities are less numerous, particularly the smallest ones (Tab.1). The smallest cities are less dependent upon the initial sparse agricultural settlements. Railways and later the automobile enabled a small number of large urban centers to have an influence over very distant outer rings. Largest cities can reach sizes that are larger than those observed in the metropolises of the Old World (Moriconi-Ebrard 1993, Pumain 2000, Bretagnolle et al. 2009).

Table 1: Number of urban areas by size categories (1790-2010)

	1790	1820	1850	1880	1910	1940	1941	1970	2010
Min. threshold-5000	20	44	116	117					
5000-10 000	7	23	86	242	474	590			
10 000-25 000	3	8	38	140	310	422	223	162	64
25 000-50 000	2	2	18	42	110	154	200	324	260
50 000-100 000		2	4	15	50	89	101	145	212
100 000-250 000		1	5	16	35	52	84	109	190
250 000-500 000			1	2	12	21	32	60	80
500 000-1 million				1	5	11	14	29	52
> 1 m.					4	11	12	33	51

N-B: the minimal threshold is 2000 inhab. in 1790, 3000 in 1850, 4000 in 1880, 5000 in 1910 and 1940, 10 000 in 1941 and after. Sources: US Census, Harmonie-cités urban database (2013).

4. Functions and specializations of cities in the national and world division of labor

The economic urban dynamics is examined through the successive economic cycles that impacted American cities (part 4.1), which contributed to their specialization. This past leaves some footprints that cities integrate in their current and future trajectories. Since the 1970's, the

American cities, as well as all cities of mature industrialized countries, are going through a period of intense change, that is a transition from the industrial age to the age of a knowledge economy in the context of redrawing economic geography at a global scale.

4.1. Urban economy on the long term

US urban and economic development is divided in four distinct periods: mercantile (1690-1840), early industrial (1820-1860), industrial (1860-1940), and services (1940-). In mercantile era, even though only a quarter of the population was directly engaged in maritime transport and commercial exchange (rest composed of government, artisanal craft production and domestic services), all cities were seaports, created and supported by the overseas Atlantic trade between Europe, West Indies and the colonies. Yet, in Virginia, despite its sizeable population and exports, there were no cities. In Virginia, the trade in tobacco, its main exports, was controlled by merchants in Great Britain rather than by locals. Thus, the lack of cities in the American South comes from the early colonial era.

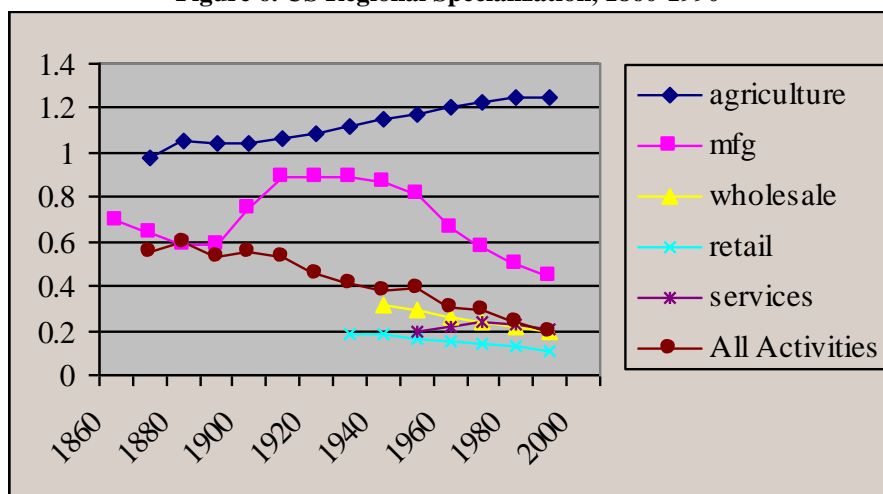
In the first few decades of nineteenth century, early industrialization began in rural rather than in urban places. It arose in rural New England, most likely because of its access to women and child labor from nearby farming communities (Goldin & Sokoloff, 1982) and the availability of inexpensive land for housing industrial workers. This transition from handcraft activities to factory manufacturing occurred in industries such as textiles, boots and shoes, hats, glass, paper and flour (Sokoloff, 1984). Sokoloff suggests that Smithian division of labor was a significant source of productivity growth of non-mechanized factories. Within a few decades, rural factory towns grew into highly specialized industrial cities throughout New England. During this period, the merchants in port cities continued to coordinate the Atlantic overseas trade but they also expanded their business into supplying raw material for industrial cities and selling their domestic manufactures. Thus, the port cities played an essential role in the rise of early industrial cities in New England. Surprisingly, no industrial center emerged near the major port city of New Orleans in the South even though it was the center of US cotton exchange and domestic trade.

The second industrial revolution of the late nineteenth and the early twentieth century is associated with the rise in scale and scope of production and the spread of factory organization to countless number of industries, often intensive in resources and energy. By 1920, US manufacturing production became more important than its agricultural production. The second industrial revolution, unlike its earlier counterpart, was concentrated in urban areas and was responsible for transforming America from a rural to an urban economy. Figure 6 shows that US regions became significantly more specialized in manufacturing between 1860 and 1920, especially as industrial revolution spread and became concentrated in the Northern region known as the manufacturing belt.

While many factors contributed to the urban concentration of manufacturing, an important one was the shift in the industrial workforce from unskilled women and children to unskilled male European immigrant workers (Kim, 2007). Many immigrants, pushed from overseas by famines and persecution, migrated with dreams of becoming independent farmers. Instead, they formed

immigrant enclaves in the Northern cities. The diversity in the skill sets and physical endowments of European immigrants may have played a role in contributing to the depth and breadth of US industrial revolution. Kim (2006) argues that the most likely cause of urban concentration of industrial workers during this period was labor market transactions cost. In an era when workers were hired on temporary basis and lived in walking distance to employment, the concentration of workers and firms in dense cities lowered the costs of matching workers and firms.

Figure 6. US Regional Specialization, 1860-1990*



Source: Kim (1995, 1998).

*Measure of regional specialization is based on Krugman's Index (Krugman (1991) using US census regions. Industries are defined at the 2-digit level excepted for agriculture which uses various crops. For all activities, 1-digit industries are used.

The industrial cities were highly specialized. During this period, a city's manufacturing structure reflected that of its Census region as shown in figure 6. In 1880, at the beginning of the second Industrial Revolution, the cities in New England were specialized in textile and leather; cities in Middle Atlantic were specialized in textile and apparel; cities in East North Central were specialized in food, lumber and wood; cities in West North Central were specialized in food, lumber and wood, apparel, and stone, clay and glass; in the Southern and Pacific regions, they were specialized in food, tobacco, apparel and lumber and wood (Kim (2000, 1995)).

Between 1880 and 1940, however, cities and regions became even more specialized. In 1940, cities in New England remained specialized in textile but also moved into apparel and machinery; cities in Middle Atlantic remained specialized in textile and apparel but also more so in food; cities in the East North Central continued to specialize in food but also moved significantly into the heavy industries of primary metal, machinery and transportation; cities in the Southern regions were specialized in food, textiles as well as furniture and primary metal; cities in the Mountain and Pacific regions were generally specialized in food and apparel. In general, majority of the cities were concentrated in the Northern region. The relative absence of cities in the South has often been attributed to slavery, but the role of its political institutions is likely to have been important as discussed in section 6.

In the second half of the twentieth century, there were two important economic developments. In manufacturing, production shifted from factory production based on unskilled workers to a more automated factory system that utilized more skilled labor force. Decline of immigration and the rise of secondary education created a more educated workforce. In addition, there was an important structural shift in the economy from manufacturing to services. All of these factors played important roles in the transformation of US regional and urban economies. At the regional level, as seen in Figure 6, there was a remarkable convergence in industrial structures across the US accompanying the spread of cities in the Southern and Western regions (Kim (1995, 1998, 2000)). The growing attention to climate amenities may also explain the growth of these regions (Cragg and Kahn (1997)).

From the beginning, bigger cities provided transaction services to smaller cities and rural areas. Table 2 reports the 20 largest cities in any given year between 1800 and 1860. In the mercantile era, the main focus was lowering the transactions costs of international trade whereas in the industrial era, the focus was on domestic trade. Between 1820 and 1840, most of the port cities were concentrated in New England, Middle Atlantic and South Atlantic regions. With industrial revolution and the rise of domestic trade, the largest cities grew in the interior areas of Middle Atlantic and the Northwest regions. Kim (2000) finds that the activities of these larger cities were not correlated with share of manufacturing labor, but were highly correlated with shares in wholesale trade and financial services. In the twentieth century, as the share of international trade has risen, cities like Los Angeles is once again playing a vital part in coordinating both international and domestic movement of goods.

Table 2. Twenty Largest Cities in the US: 1800-1860

	1800	1810	1820	1830	1840	1850	1860
NEW ENGLAND							
Boston, MA	24.9	38.7	54.0	85.6	118.8	195.6	262.9
Gloucester, MA	5.3	5.9					
Lowell, MA					20.8	33.4	
Marblehead, MA	5.2	5.9					
Nantucket, MA	5.6	6.8	7.3				
New Haven, CT			7.1	10.2			
New London, CT	5.2						
Newport, RI	6.7	7.9	7.3				
Newburyport, MA	5.9	7.6					
Portland, ME		7.2	8.6	12.6	15.2		
Portsmouth, NH	5.3	6.9	7.3				
Providence, RI	7.6	10.1	11.8	16.8	23.1	41.5	50.7
Salem, MA	9.5	12.6	12.7	13.9			
MIDDLE ATLANTIC							
Albany, NY	5.3	10.7	12.6	24.2	33.7	50.8	62.4
Buffalo, NY					18.2	42.3	81.1
Newark, NJ				11.0	17.3	38.9	71.9
New York, NY	60.5	100.8	130.9	215.0	348.9	643.2	813.7
Philadelphia, PA	61.6	87.3	108.8	161.3	220.4	340.0	565.5
Pittsburgh, PA			7.2	12.6	21.1	46.6	49.2
Rochester, NY				9.2	20.2	36.4	48.2
Schenectady, NY	5.3	5.9					
Troy, NY			11.6	19.3	28.8		
SOUTH ATLANTIC							
Baltimore, MD	26.5	46.6	62.7	80.6	102.3	169.1	212.4
Charleston, SC	18.8	24.7	24.8	30.3	29.3	43.0	
Norfolk, VA	6.9	9.2	8.5	9.8			

Richmond, VA	5.7	9.7	12.1	16.1	20.2	27.6	
Savannah, GA	5.1		7.5				
Washington, DC	11.2	20.4	28.8	35.5	39.1	57.1	61.1
NORTHWEST							
Chicago, IL						30.0	112.2
Cincinnati, OH			9.6	24.8	46.3	115.4	161.0
Cleveland, OH							43.4
Detroit, MI							45.6
St. Louis, MO					16.5	77.9	160.8
Milwaukee, WI							45.2
SOUTHWEST							
Louisville, KY				10.3	21.2	43.2	68.0
New Orleans, LA	17.2	27.2	46.1	102.2	116.4	168.7	
WEST							
San Francisco, CA						56.8	

Populations are reported in thousands. Sources: Census of Population, 1800-1860

The rise of New York, Chicago, and Los Angeles demonstrates the importance of international and domestic trade as well as natural and man-made advantages. Despite the fact that Philadelphia was the most important city throughout the colonial period, New York became the dominant city by 1690. Its rise was aided by a natural harbor but also by the implementation of an auction system of disposing goods and regular packet ships. In the 1820s, New York's dominance was cemented with the opening of the Erie Canal that linked New York with the growing Midwest. The rise of Chicago occurred during the Second Industrial Revolution with the growing importance of railroads. While Chicago's location on the Great Lakes provided access to low cost transportation, its rise was aided by man-made innovations that lowered transactions costs (Cronon, 1991). The invention of the Chicago mercantile exchange significantly lowered long distance transactions costs for grain, wood, and all kinds of commodities where product quality was difficult to inspect from long distances. Finally, the rise of Los Angeles occurred in the second half of the twentieth century with the growing trade with Asia. Unlike San Diego, Los Angeles lay inland and possessed no natural harbors. Yet, Los Angeles was able to create a port infrastructure that handled more than seventy percent of all the Pacific Coast waterborne trade (Erie, 2004).

4.2. Functional structure and activities of US cities since the 1970's

The economic dynamic of cities has induced intense changes in the structure of US urban systems since the 1970s. Largest cities are privileged places for the location of economic activities that emerge or develop in this globalized post-Fordist context (financial intermediation, R&D, logistics, information and communication technologies, etc.). On the contrary, small and medium cities can be considered a step aside in this dynamics. Urban theory tends to consider that this link between city size and the ability to innovate is not new. At the beginning of a new economic cycle, the size and density of urban centres create the best opportunities for the development of inventions and innovations. Pumain et al. (2006) suggest an evolutionary interpretation of urban scaling laws that link diffusion of innovation, city sizes and urban functions. At a given moment, it can be expected that the most advanced technologies concentrate in the largest cities, while current technologies are ubiquitous, and outdated technologies remain only in small towns.

Indeed, the regularities observed in the structure of urban systems can be expressed in the form of nonlinear scaling laws that were recognised as specific of the dynamics of complex systems (West, 2009). Some researchers have investigated the relationship between innovation, as measured by patenting activity for example, and the population size of cities (Bettencourt et al., 2007). In the following, we use scaling laws for investigating how city size is linked with the distribution of employment in different economic activities⁶.

Scaling parameters are calculated on economic sectors employment and city size population in 2000⁷. A first test of the theory was made on a grouping of economic sectors mentioned in the US nomenclature according to their most probable stage of appearance in the current economic innovation cycle (Tab.3; Fig.7; Tab.4) illustrating the relevance of the theory for the aggregation of activities in three stages of economic cycle: innovative, common and mature. Of course, this is only approximate since activity nomenclatures are not established for this purpose.

Table 3. Economic sectors according their level of innovation

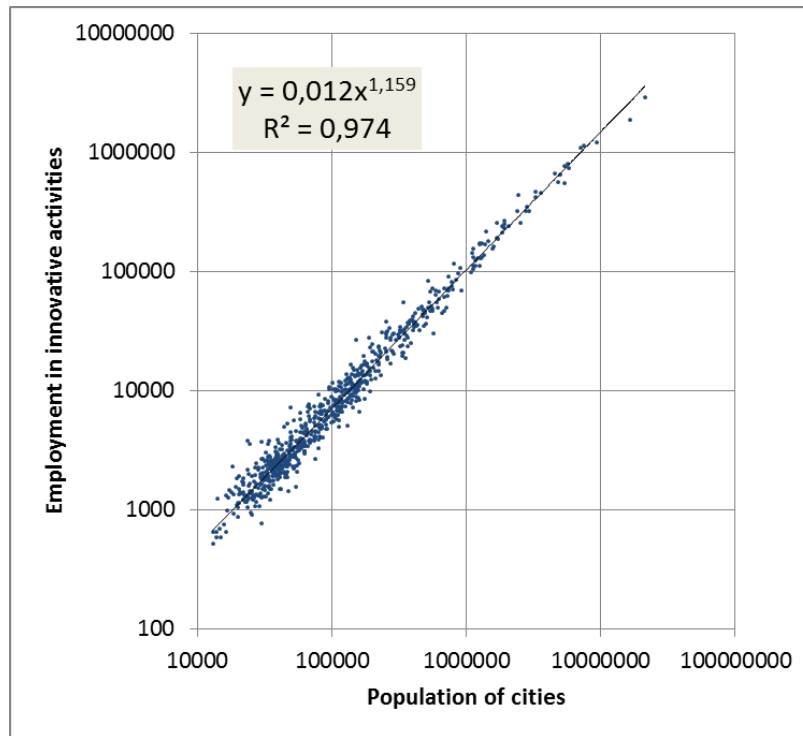
Stage innovation cycle	Economic Sector	Scaling parameter 2000 by economic sector	Scaling parameter 2000 by stage in innovation cycle
Innovative	Professional; scientific and technical services / Consultancy and assistance activities	1,21	1.16
	Finance and assurance / Financial activities	1,14	
	Wholesale trade	1,09	
	Administrative and support and waste management services / Renting and other business activities	1,11	
Common place	Construction	1,01	1.01
	Accommodation and food services	0,98	
Mature	Retail trade	0,98	0.96
	Health care and social assistance / Social work	0,96	
	Manufacturing	1	

Source: Author's calculations using US Census and NHGIS data

Figure 7. Scaling parameters of innovative activities in US urban system

⁶ The databases are built from population employed by industry (sources: US Census and NHGIS, Minnesota Population Center, www.nhgis.org)

⁷ $x = y^\beta$ (x is the number of employed in an urban industry and y is the size of the city). Leading technologies, which are at the top of current innovation cycle, have a $\beta > 1$. For commonplace, widespread technologies which corresponds to diffusion stage, $\beta = 1$ and in the case of mature technologies, decay or substitution stage, $\beta < 1$.



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

Table 4. Calculations of β value for all urban economics sectors (2000)

Type of employment ⁸	Power law exponent β (R^2)
Mature	0,96 (0,96)
Common place	1,01 (0,98)
Innovative	1,16 (0,97)

Source: Author's calculations ((Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

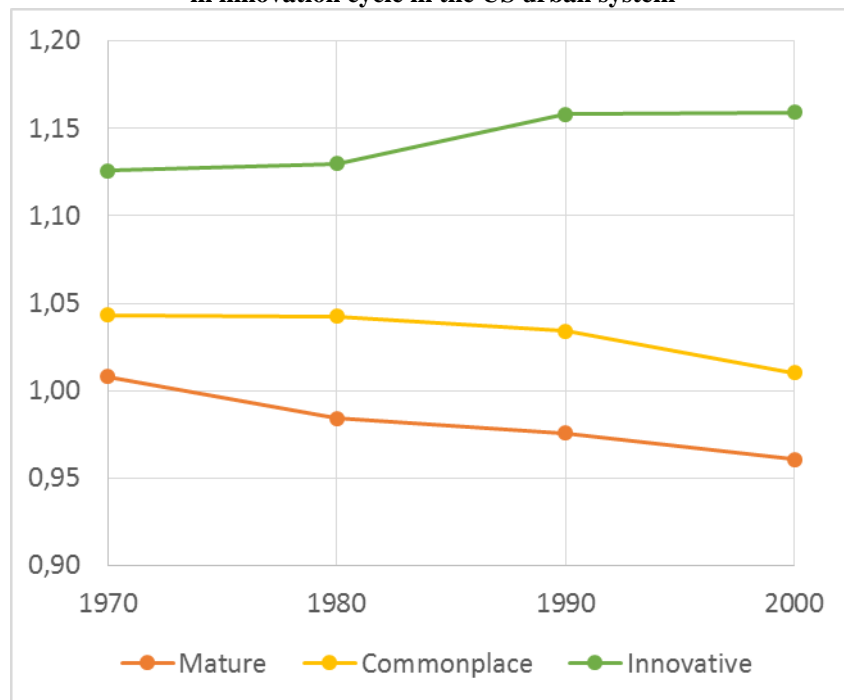
The results reveal that innovative activities, like Finance, Insurance and real Estate, exhibit exponents well above 1. An activity whose participation to the current innovation cycle is large scales super-linearly with city size. In other words, these kinds of economic activities tend to highly concentrate in few large metropolitan areas whereas they are under-represented in medium and small cities. Therefore, the repartition of employment among cities is not simply a proportional process. At the opposite, mature activities, like manufacturing (textile, wood and paper, etc.) or retail trade scale sub-linearly. If at a given moment, they were localised in large cities and then were disseminated throughout the urban system, nowadays, those activities remain mostly in small and medium cities. In between, diffusing activities (like construction) scale linearly, and follow the size of the urban units.

⁸ This classification is built by the authors according to the stage of economic cycles and could be linked to the NAICS:

- Mature activities: Mining, Food Products, Textile, Wood and Paper, Metal industry, Other industries.
- Common activities: Construction, Printing, Chemistry, Machinery, Transportation equipment, Utilities, Food and accommodation, personal services, Education, Health, social services, public administration.
- Innovative activities: Communication, FIRE, Wholesale trade, Entertainment, Business and Professional services.

This interpretation can be checked because the data we use are built for a rather long time period and enable observing the evolution of scaling parameters over time. An historical database has been built on economic employment in US cities from 1970, for testing this hypothesis. One can expect that the now leading and innovative technologies can still increase their parameter value, while activities of older cycles may have decreasing parameters as they become mature. In USA, the main changes in the scaling parameter values occur because of the moderate decay of mature activities in the economic portfolio of cities, while leading activities show different steps of evolution. Some specificities are noticed in the leading sector, for example the entertainment sector, which is increasing very fast (Fig.8).

Figure 8: Evolution of β exponents of economic activities according to the stages in innovation cycle in the US urban system



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

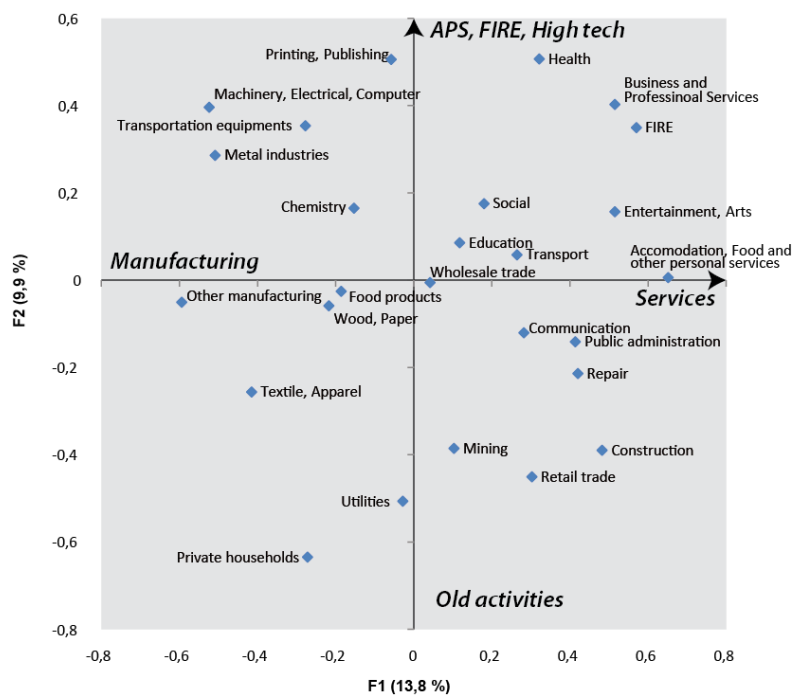
A good example of this increase of the scaling parameter is communication sector. It can be surprising that β exponent is around 1 in 1970 and gets the highest value in 2000 (1,22), when this sector starts taking a crucial role in the productive system. It can be understood if we keep in mind that, at that time, 90% of cities have no employees at all in this economic sector, and employees are overall very few. In this context, a few small towns hosting a research centre may count as many researchers as biggest cities. But rapidly, as this research activity is taking a growing importance in the economy with a high rate of employment growth, the leading position of biggest cities is emerging as translated by increasing scaling parameter values. In the context of the information society, all related communication activities become more and more concentrated in largest cities. At the same time, education and retail trade have β exponents close to 1 at each date, which correspond well to their constantly renewed function, but always spatially ubiquitous repartition. There are decreasing values of β exponents for some economic sectors over time. Most of them are manufacturing industries. But it is important to keep in mind that industries are not all mature. Diversity inside those manufacturing industries is large, including some offices that are at the cutting edge of the technology and some others

that are in an older stage. This first analysis that focused on hierarchical structure of the system of cities is thus completed with a focus on the nature and diversity of urban functions.

4.3. Diversity of urban functions and relative positions of cities

The nature of economic activities that specialize more or less cities can be synthesized with a principal component Analysis (PCA) on a table describing cities according to the share of their employment in the various economic sectors (NAICS, year). In US, as in other urban systems, the main differentiation factor opposes manufacturing cities and others where services and retail trade are much more present (Fig.9 and Fig.10). This opposition corresponds to the well-known regional pattern of manufacturing activities, especially the contrast between the Great Lakes and Midwest Region and the rest of the country.

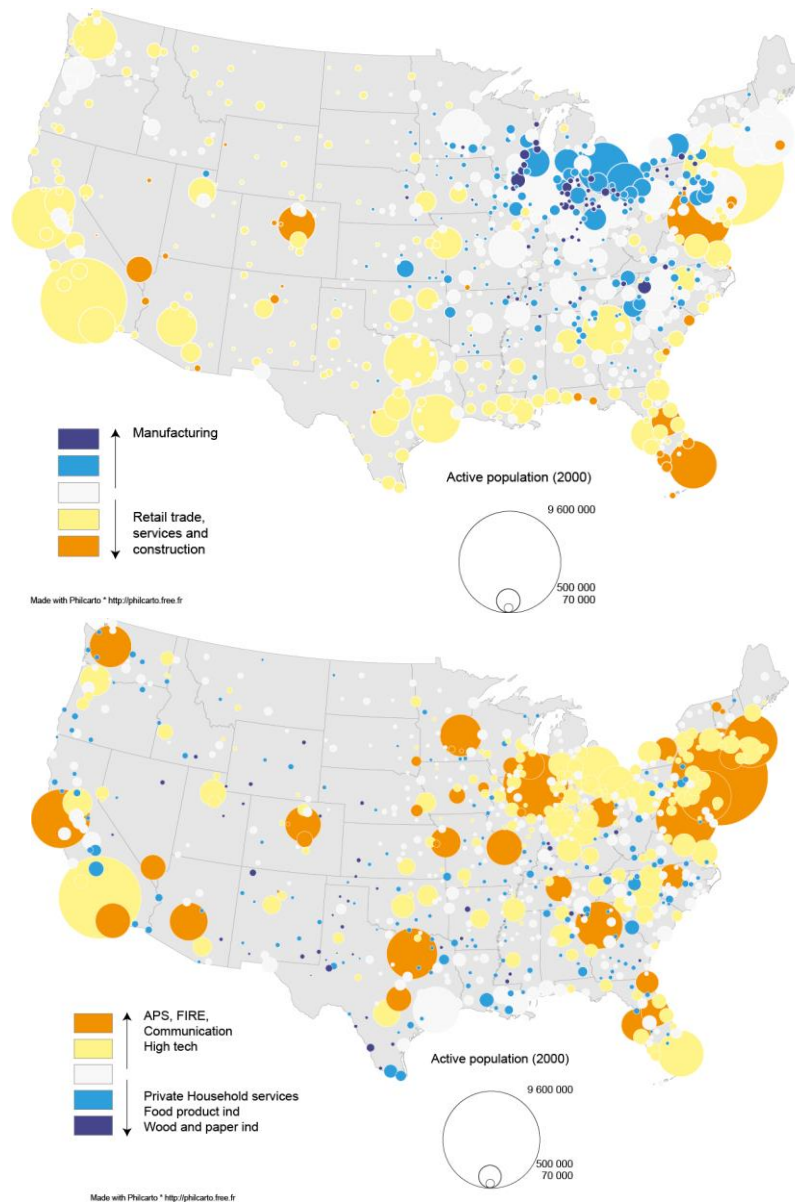
Figure 9. Main features of the economic differentiation of US cities in 2000



Source: Author's calculations ((Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

The second component reveals a more recent process of differentiation among cities, corresponding to the emergence and diffusion of FIRE, APS and High Tech industries. These newly developed activities concentrate in largest cities. They are the more rapidly growing economic sectors since the 1970's, in terms of employment. The cross-sectional distributions revealed by the multivariate analysis actually reflect the unequal diffusion of past innovation waves, since cities and the associated activities that specialize them are grouped (correlated) according to their stage of major emergence in time (fig. 10).

Figure 10. Economic differentiation of US cities (1st and 2nd components of a PCA)



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

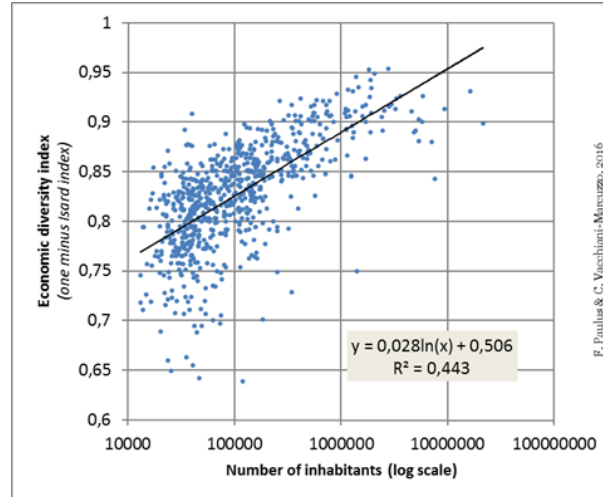
To complete this demonstration, it will be observed how the structure defined by the variety of economic profiles was evolving during the last forty years. As innovation cycles appear in large cities, they leave footprints of past cycles, so larger cities should be more diverse and more complex in terms of economic portfolio. The hypothesis is that economic diversity of largest cities promotes innovation and reflects the accumulation process resulting of their abilities to do so in the past (Feldman, Audretsch, 1999). In order to test this hypothesis, a diversity index has been calculated, which is derived from Isard's coefficient of specialization (one minus the Isard's index) (Fig.11). This index is used because of its simplicity and its property to be bounded between 0 (extreme specialization) and 1 (diversity as in the whole urban system⁹). This diversity index is expressed as follow:

⁹ Other tests with other indices (Location quotient, Herfindahl index or Krugman index) have been made and the results lead to the same conclusions.

$$D_i = 1 - \left[\frac{1}{2} \sum_j |x_{ij} - \bar{x}_j| \right]$$

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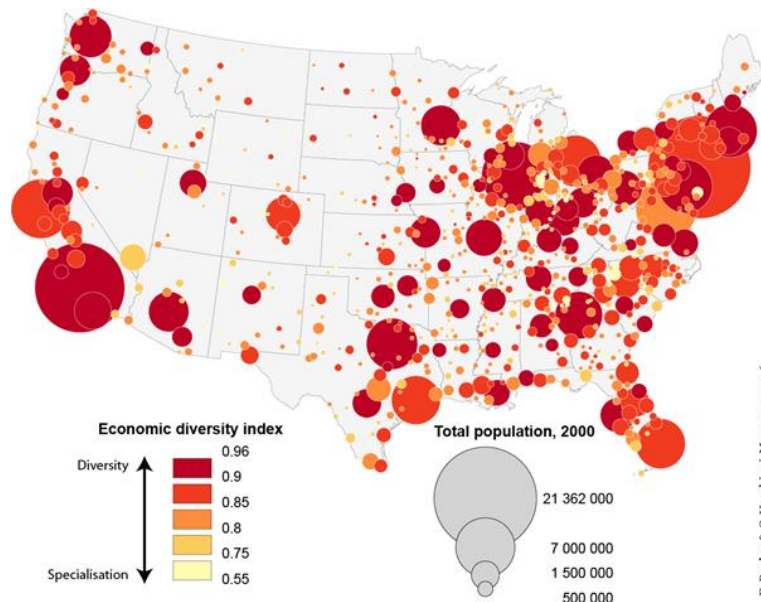
Figure 11. City size and economic diversity



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

The relationship is quite strong and significant for US cities, despite rather large variations ($R^2=0,44$). The largest US cities are a little below the regression line, probably because of the specificities of their economic profiles (Fig.11).

Figure 12. Economic diversity and city size in the US urban system in 2000



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

Middle-size and large cities are globally less specialized than smaller ones, and this is independent of any regional effect (Fig.12). The smallest cities in Midwest appear very specialized. Largest ones are more diverse.

5. General and specific trajectories of cities since the 1970s

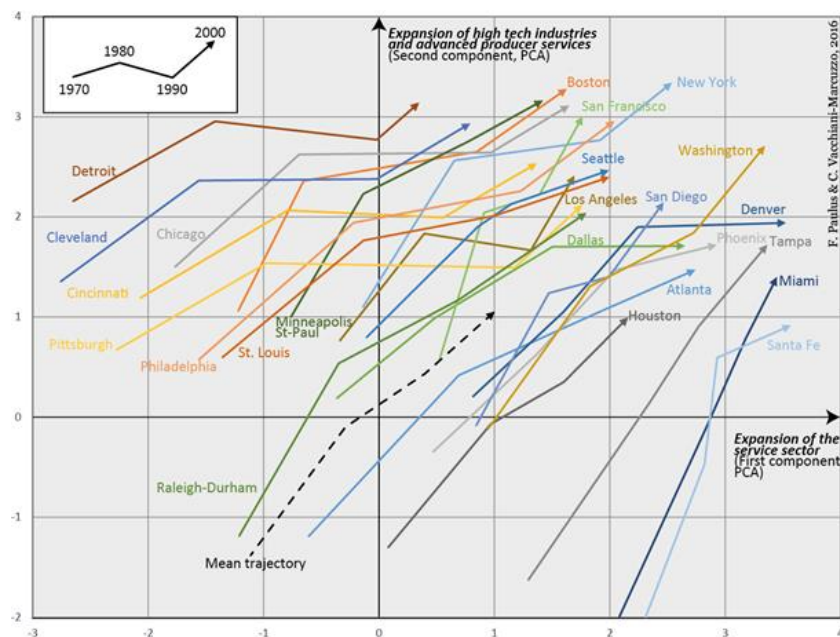
How does each city catch up the new innovative activities and integrate the decline of mature industries, especially in manufacturing?

5.1. Trajectories of cities in economic space

The evolution of economic basis of cities can be observed by drawing their trajectories in a graph of the first two factors of a principal component analysis (PCA) representing the main features of the economic differentiation in the whole urban system. This can be done because the main pattern of association and exclusion of urban locations of economic activities did not change much over the period, the first two axis of the PCA keep roughly the same interpretation.

The striking result is that all those cities evolve in the same direction, exhibiting an expansion of services sector and high tech industries linked to business services and a retraction of manufacturing employment (Fig.13). This coherent dynamics is called “co-evolution” that means all cities compete with each other to catch the new economic activities (Paulus, 2004).

Figure 13: Co-evolution of major US cities between 1970 and 2000



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

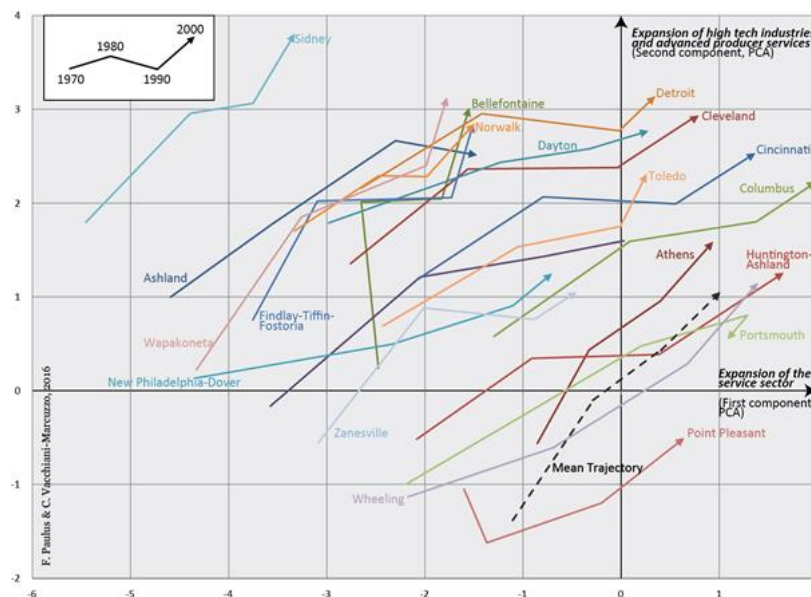
A slight deviation is observed in this main trend for the old industrial cities like Detroit, Cleveland or Pittsburgh (Fig.14), that belongs to the innovation cycle of 1st and 2nd industrial revolution, while in the South, Miami, Phoenix or Houston, are more attained by the contemporary innovation cycle. Even if it is possible that urban growth and attractiveness of southern cities have little to do with the sun and the warmest weather (Glaeser and Tobio, 2007), it is necessary to add other relevant factors, linked with the rise of new technologies and also thanks to states laws (Markusen, 2006).

Some specialized cities where the industrial history is older (Detroit or cities in Ohio state for example), have trajectories showing that the most industrial cities remain more industrial

despite of their deindustrialization. Furthermore, at that time, they seem less engaged in the expansion of high-tech industries and business and professional services. Few others cities, smaller ones or more specialized, demonstrate a strongly accelerated modernisation of their economic profiles, as for example Santa Fe and Raleigh-Durham, well known for their successful trajectory during the last decades. Nevertheless, in this analysis, New York or Boston appears to be the major leaders in the general economic transformation.

But this general similar evolution over three decades cannot hide some individual specificity and differentiation in the ability to capture innovation. For example, the two majors cities in California, Los Angeles and San Francisco, are in a parallel situation in 1970 but they have divergent trajectories (Storper, 2015), especially during the 1980's because of their different investigations in new economic and innovative cycles.

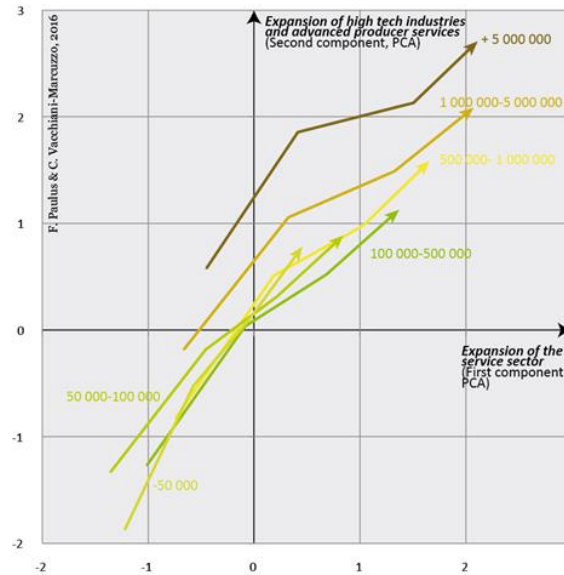
Figure 14 Trajectories of a selection of industrial cities



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

In order to provide a synthetic view of those trajectories according to the size of the cities, the mean trajectories of cities by size classes are drawn (Fig.15). The major process remains the coevolution of cities, since all trajectories are parallel. In this process of common adaptation of each city to economic development, time lags are noticed. Largest cities are, in average, at the leading edge in this process of innovation and adaptation to economic change. Medium and small towns appear to be lagging behind in this dynamics.

Figure 15. Co-evolution of US cities by classes of size



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census and NHGIS data

At this step, the main conclusion is that there are two processes linking urban dynamics and economic activities: a hierarchical diffusion of new activities and a co-evolution of cities in economic space on the long run. The current innovation cycle has the specificity to heavily rely on highly skilled jobs. So, we examine in a final step the level of skill in urban population, by analysing occupational groups in cities.

5.2. Scaling parameters and hierarchy among occupational groups

The same methodology is applied to another distinction among population status, using Occupational groups or Professions as they are given by the American census. Following the nomenclature, it is rather easy to distinguish population according to its average skill (Tab.5).

Table 5. Scaling parameters among Occupational Groups in US cities in 2000

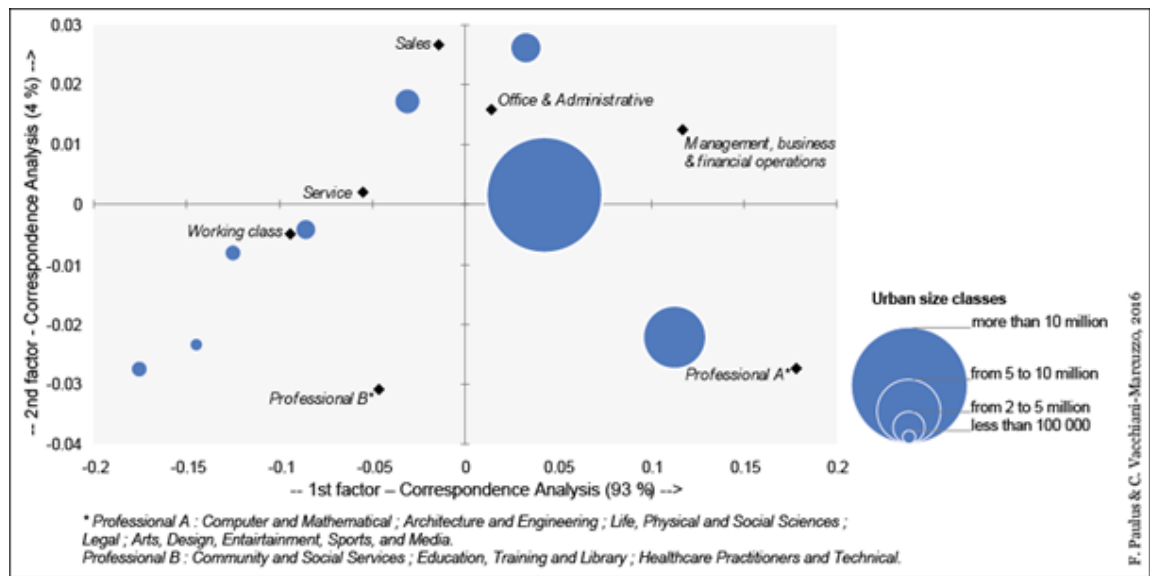
Main US Occupational Groups	Power-law exponent (β)	95% Confidence limits	R ²
Management, business and financial	1.11	1.09-1.14	0.97
Professional A (1)	1.16	1.12-1.20	0.92
Professional B (2)	0.96	0.94-0.98	0.97
Service (3)	0.97	0.96-0.98	0.99
Sales	1.01	1.00-1.02	0.99
Office and Administrative	1.04	1.02-1.06	0.98
Working-class (4)	0.96	0.94-0.98	0.97

Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census 2000

- (1) Computer and mathematical - Architecture and engineering - Life; physical; and social sciences - Legal - Arts; design; entertainment; sports; and media.
- (2) Community and social services - Education; training; and library - Healthcare practitioners and technical.
- (3) Healthcare support - Protective service - Food preparation and serving - Building and grounds cleaning and maintenance - Personal care and service.
- (4) Construction and extraction - Installation; maintenance; and repair - Production - Transportation and material moving.

All “creative” occupational groups named Professional A as researchers, artists, architects or journalists scale superlinearly with city size, with a β exponent at 1.16, followed by Management, business and financial groups. Teachers, although another example of skilled people, scale linearly with city size with a β exponent of 0.96. Finally, “working class”, who can be considered, now as unskilled people relatively to the current innovation cycle, scale lightly sublinearly with a β exponent at 0.96. These results reveal the link between the levels of skill and the stage in the innovation cycle. To improve the demonstration, a synthetic view of the strong relation between professions and city size using factor analysis is proposed (Fig.16).

Figure 16. Another view of scaling between occupational group and city size



Source: Author's calculations (Paulus, Vacchiani-Marcuzzo) using US Census 2000

The society of small towns concentrates many unskilled workers according to current technological stage, medium size towns concentrate relatively much more skilled employees, as technicians, clerks and salesmen but also more highly skilled people and biggest cities count a larger proportion of skilled people. This cross-sectional view corresponds to the historical process of emergence of more and more skilled activities that relatively concentrate in the largest cities. The analysis demonstrates the robustness of the linkage between skill level of urban employment and city-size. On the whole, occupational groups could be a better indicator than economic sectors for interpreting scaling laws and confirm that skilled urban societies concentrate in larger cities in a systematic way. Furthermore, more complex and skilled urban societies make these cities the more innovative and creative ones.

6. Political Institutions and US Urban Development

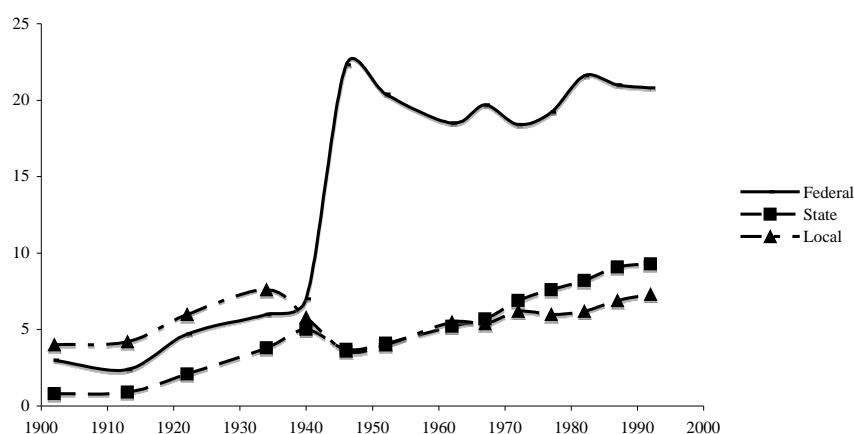
Because national or state governments can limit political and fiscal autonomy of cities and local governments, there is strong *a priori* reason to believe that institutions affect urban and local development. In Latin America, where institutions were historically autocratic and unitary, urban development has been characterized by urban primacy that favored the growth of capital

cities. By contrast, in the US, as well as in Canada, the democratic federalist system has led to a more balanced urban development. Particularly for the US, political decentralization has historically favored rural rather than urban areas especially in states whose legislatures are captured by their rural constituents.

In America, the *Constitution* defines the powers of the national government, but the residual powers, those not specified, are granted to the states. On the other hand, the legal relationship between state and local governments is unitary as the latter are "creatures" of the former. While the law evolved over time, it became generally accepted after the 1868 Iowa Supreme Court decision known as Dillon's rule. Despite their legal status, American cities and local governments nevertheless possess considerable autonomy (see Aronson and Hilley (1986)). First, most state constitutions define local county government duties and boundaries that are difficult to revise. Second, since the early twentieth century, home rule legislations granted various local powers. Third, until quite recently, state governments did not have the revenues or the bureaucracy to monitor and oversee local governments.

The balance of power between the federal, state and local governments has not remained static, however (Fig. 17). The distribution of government revenues between the federal, state and local government provides some evidence of the changes. In the early years, the national government revenues and expenditures were quite limited. While state governments were actively involved in economic affairs in the early nineteenth century, the graph shows that the most significant government activities occurred at the local level until the turn of the twentieth century. Since the second half of the twentieth century, the federal government has become much more significant. However, a large share of federal government expenditure is composed of military, international relations, and interest on the public debt. If measured in terms of civilian functions, federal revenues and expenditures equal that of state and local governments (Dahl, 1981).

Figure 17. Own source revenue as a share of GNP by level of government, USA



Since institutions are not static but evolve and adapt to changing economic and political conditions, it is challenging to estimate the impact of institutions on geography and development. Recently, scholars have used the quasi-experimental nature of European colonization of the Americas to identify the impact of institutions on economic development

(Engerman and Sokoloff (1997), Acemoglu et. al (2001)). These scholars argue that exogenous factors, such as variations in factor endowments or settler mortality, contributed to diverging initial conditions that affected institutional development. In US and Canada, early egalitarian conditions from small scale farming led to the rise of democratic institutions whereas, in Latin and South America, the exploitation of mines or plantations using slave labor by few elites led to the rise of undemocratic ones.

Early historical conditions and other exogenous factors also likely contributed to the rise of federalism and political decentralization in the US. Even though the American colonies belonged to a centralized British empire with a unitary form of government, distance and the absence of British military contributed to colonial legal and political local autonomy of numerous, small colonies. Not surprisingly, with independence, these relatively autonomous colonies created an innovative constitutional, federalist form of government that allocated significant political rights to states and local governments. Just as important, the American nation achieved a continental size at a time when the federal government lacked powers for centralization, leading to *de facto* decentralization. Finally, while not completely exogenous, the creation of numerous small rather than a few large states further hindered political centralization.

Political decentralization can contribute to understanding the divergence and convergence of US Northern and Southern economies. While the lack of industrialization and urban development of the American South between the nineteenth and the turn of the twentieth century is often attributed to slavery, Kim (2009) argues that divergence in institutions also played an important role. In the South, the plutocratic, plantation elites had little incentive to extend the franchise or education to the slaves and the poor. The elites had firm control on state elections. At the more important local level, the elites were appointed as county justices and officials and ruled on matters of taxes, crime, and local expenditures. Indeed, political decentralization and sectional divisions led to Civil War that threatened the viability of the union. Throughout most of American history, political decentralization has contributed to the decentralized provision of public goods such as communication, transportation and education. From the early federal period, the postal delivery system subsidized communication and transportation to rural areas. Generally, the direct role of the federal government until the second half of the twentieth century was limited to granting of public lands or funds for transportation and education to state governments or to private corporations. Thus, major decisions on the provision of roads, railways, and schools were left to states, localities and private firms and individuals. By contrast, in Latin America, these decisions until recently were made unitarily by those who controlled the federal government.

How did differences in institutions impact urban development in the Americas? *First*, Galiani and Kim (2011) show that urban primacy in Latin America as compared to US was likely caused by political centralization that favored capital cities through political favoritism. In many nations in Latin America, population was highly concentrated in political capitals. In the US by contrast, political capitals, both national and state, were often located in remote, rural places. In a related, earlier work, Ades and Glaeser (1995) show that urban primacy was correlated with autocracy. Thus, in the US, political decentralization favored the development of small

and medium sized cities. *Second*, political decentralization in the US has led to greater variety and diversity of local governments (Ostrom, Bish and Ostrom (1988)). One of the main functions of local governments is to provide public services such as water, gas, electricity, mass transit, sewerage, libraries, hospitals, police, fire protection and education. In most nations, municipalities or cities provide these services. Since the 1940s, local public services in the US have been increasingly provided by special purpose districts rather than by municipalities (see Burns (1994)). Because political power is decentralized, local citizens, often in concert with developers, are able to create special purpose districts to acquire functions of governments such as eminent domain and taxes.

Because institutions diverged somewhat between US and Canada, it is possible to examine how political decentralization affects the number and diversity of local governments. While both nations adopted a federalist system, political power is much more centralized at the provincial level as compared to those of US states. Kim and Law (2012, 2016) find that political decentralization leads to greater use of special-purpose local governments (school districts, water districts, sewage districts, etc.) as compared to general-purpose local governments (municipalities, counties, towns) (Table 6). Political decentralization also leads to greater number, density and variety of local governments.

Table 6. Number of Local Governments in the US (in thousands), 1942-2012

Type	1942	1952	1962	1972	1982	1992	2002	2012
Municipalities	16,2	16,8	18,0	18,5	19,1	19,3	19,4	19,6
Special Districts	8,3	12,3	18,3	23,9	28,1	31,6	35,1	38,3
School Districts	108,6	67,4	34,7	15,8	14,9	14,4	13,5	12,9
Counties	3,1	3,1	3,0	3,0	3,0	3,0	3,0	3,0
Townships	18,9	17,2	17,1	17,0	16,7	16,7	16,5	16,4

Sources: Census of Governments, 1942-2012

Many scholars believe that the great variety of local governments has led to increased inefficiencies in the delivery of public services (Burns, 1994) while others believe that the arrangement is likely to be efficiency enhancing (Ostrom, Bish and Ostrom, 1998). Unfortunately, it has been extremely difficult to estimate the impact of political fragmentation on urban and local economic development as outputs of local public services are difficult to measure. Yet, the institutional impact on local economic development is likely to be significant as it affects the provision of all types of local public services.

7. Conclusion

The United States urban system is a fascinating case study to illustrate a trajectory of a “new” country in terms of settlement became one of major urban and economic centers in the global world. One of the main characteristics is certainly its great ability and permanent adaptation to change and to adapt itself to new socio-economic contexts. Thanks to natural and historical assets as natural resources and mostly migration attractiveness, the US urban system is increasing and developing on demographic and economic sides. The emergence of innovation

in urban centers is a relevant example to understand the functional aspects of cities. The role of urban governance and more generally, the effects of political and administrative organization on urban development are complex and the comparative approach can be a relevant way to explore them.

References

- Audretsch D.B, 2002, “The innovative advantage of US cities” *European Planning Studies* 10 (2) 165-176.
- Batty, M., 2006. Rank Clocks. *Nature*, vol. 444/30, November, 592-596.
- Berry, B. and Okulicz-Kozaryn, A., 2012. The city-size distribution debate: resolution for US urban regions and megalopolitan areas. *Cities*, vol. 29, 17-23.
- Berry, B., 1976. The Counter-Urbanization Process: Urban America Since 1970. In: Berry ed. *Urbanization and Counter-Urbanization*. Beverly Hills, London, Sage Publications, vol. 11, Urban affairs annual review.
- Bettencourt L, Lobo J, West G, 2009, “The Self Similarity of Human Social Organization and Dynamics of cities”, in Complexity perspectives on innovation and social change Eds D Lane, D Pumain, S Van der Leeuw, G West (ISCOM, Springer, Dordrecht) pp. 221-236.
- Black, D. and Henderson, V., 2003. Urban evolution in the USA. *Journal of Economic Geography*, vol. 3, 343-372.
- Bretagnolle A., Delisle F., Mathian H., Vatin G. 2015. Urbanization of the United States over two centuries: an approach based on a long-term database (1790-2010)”. *International Journal of Geographical Information Science*, 29(15): 850-857.
- Bretagnolle A., Giraud T. and Mathian H., 2008. La mesure de l’urbanisation des Etats-Unis, des premiers comptoirs coloniaux aux *metropolitan Statistical Areas* (1790-2000). *Cybergeo*, 427: 1-40.
- Bretagnolle A., Pumain D., Vacchiani-Marcuzzo C., 2009, The organisation of urban systems. In Lane, D, Pumain, D., Van der Leeuw, S. & West G. (Eds.), Complexity perspective in innovation and social change. Springer (Methodos Series 7), pp. 197-220
- Cervero, R., 2011. *Beyond travel time savings*. The International Bank for Reconstruction and Development/The World Bank [Accessed online 10 Sept. 2014]
- Chudacoff H. (1981), *The evolution of American Urban Society*, Englewood Cliffs, NJ, Prentice Hall Inc.
- Costa, D. and R. Steckel. 1995. “Long-term Trends in Health, Welfare and Economic Growth in the United States,” NBER Historical Paper 76.
- Cronon. W. 1991. *Nature's Metropolis: Chicago and the Great West*. W.W. Norton & Company.
- Dobkins, L.H. and Ioannides Y. M., 2000. Dynamic evolution of the U.S. city size distribution”, In: Huriot, Thisse eds. *The Economics of Cities*. Cambridge University Press, Cambridge, 217-260.
- Duranton G, Puga D, 2001, “Nursery cities: urban diversity, process innovation and the life of cycle of products” *American Economic Review*, 91(5) 1454-1477.
- Erie, S.P. 2004. *Globalizing L.A.: Trade, Infrastructure and Regional Development*. Stanford University Press.
- Fagan, B. M. 1991, *Ancient North America : the archaeology of a continent* Thames and Hudson: New York
- Feldman M.P, Audretsch D.B, 1999, “Innovation in cities: Science-based diversity, specialization and localized competition”, *European Economic Review*, 43 409-429.
- Fujita M, Krugman P, Mori T, 1999, “On the evolution of hierarchical urban system”, *European Economic Review*. 43 (2) 209-251.
- Glaeser E.L, 1994, “Cities, information and economic growth” *Cityscape*. 1 9-47.
- Glaeser E.L, Berry C.R, 2005, “The divergence of human capital levels across cities” Harvard: Institute of Economic Research. Discussion paper 2091.
- Glaeser E.L., Tobio K., 2007, The rise of the Sunbelt, Discussion Paper Number 2135, Harvard Institute of Economic Research.
- Goldin, C. and Kenneth S. 1982. “Women, Children, and Industrialization in the Early Republic: Evidence from the Manufacturing Censuses,” *Journal of Economic History* 42: 741-774.
- Greene E. B., Harrington V., 1932, *American Population before the Federal Census of 1790*, Gloucester, Massachusetts (reed. 1966).
- Hall, P, Preston, P, 1988, The carrier wave: new information technology and the geography of innovation 1846-2003 (Unwin and Hyman, London)

- Kim S., 1995, Expansion of Markets and the Geographic Distribution of Economic Activities: The Trends in U.S. Regional Manufacturing Structure, 1860-1987, *Quarterly Journal of Economics* 110 (4): 881-908
- Kim S., 2000, Urban development in the United States, 1690-1990. *Southern Economic Journal*, 66(4): 855-880.
- Kim S. 2006. "Division of Labor and the Rise of Cities: Evidence from U.S. Industrialization, 1850-1880." *Journal of Economic Geography* 6: 469-491.
- Kim S. 2007. "Immigration, Industrial Revolution and Urbanization in the United States, 1820-1920: Factor Endowments, Technology and Geography" NBER Working Paper No. 12900
- Kim S. 2009. "Institutions and U.S. Regional Development: A Study of Massachusetts and Virginia," *Journal of Institutional Economics* 5(2): 181-205.
- Madden, C. H., 1955. On some indications of stability in the growth of cities in United States. *Economic Development and Cultural Change*, vol. 4.
- Markusen, A, Schrock, G, 2006, The distinctive city: divergent patterns in growth, hierarchy and specialization, *Urban Studies*, 43(8) 1301–1323
- Paulus, F., Vacchiani-Marcuzzo C., 2015, Knowledge industry and competitiveness: Economic trajectories of French cities since the 1960s, in A.Cusinato, A. Philippopoulos-Mihalopoulos (eds), *Knowledge-creating Milieus in Europe: Firm Cities and Territories*, Springer, pp 157-170.
- MacKenzie R. D., 1933, *The Metropolitan Community*. New York, Russell & Russell, 374 p.
- Moriconi-Ebrard, F., 1993, *L'urbanisation du monde*, Paris, Anthropos, Economica, Collection Villes.
- Pred, A.R, 1977, *City-Systems in Advanced Societies* (Hutchinson University, Londres)
- Pumain D; Paulus F, Vacchiani-Marcuzzo, 2009, "Innovation Cycles and Urban Dynamics" in Complexity perspectives on innovation and social change Eds D Lane, D Pumain, S Van der Leeuw, G West (ISCOM, Springer, Dordrecht) pp 237-260.
- Pumain D; Paulus F, Vacchiani-Marcuzzo, C, Lobo J, 2006, "An evolutionary theory for interpreting urban scaling laws", *Cybergeo:European Journal of Geography*. 343
- Pumain, D, 2010, "Une théorie géographique des villes", *Bulletin de la Société Géographique de Liège* 55 5-15.
- Pumain, D., 2000, Settlement systems in the evolution, *Geografiska Annaler*, 82B, 2, 73-87.
- Scott A.J, 2010, "Space-Time Variations of Human Capital Assets across U.S Metropolitan Areas, 1980 to 2000", *Economic Geography* 86(3) 233-249.
- Rodrigue J.-P., 2013, *The geography of transport systems*. New York Routledge, 3rd edition [online].
- Sokoloff, K. 1984. Was the Transition from the Artisanal Shop to the Nonmechanized Factory Associated with Gains in Efficiency?: Evidence from the U.S. Manufacturing Censuses of 1820 and 1850. *Explorations in Economic History* 21: 351-382.
- Storper, M., Kemeny T., Makarem N.P., Osman T., 2015, *The rise and fall of urban economies, Lessons from San Francisco and Los Angeles*, Stanford, Stanford University Press.
- Strumsky D, 2007, "Invention in the city: Increasing return to patenting as a scaling function of metropolitan size" *Research policy* 36 107-120.
- Wade R. C. (1959), *The Urban Frontier, 1790-1830*. Cambridge, Mass.: Harvard University Press.
- Zahavi, Y., 1974. *Travel time budgets and mobility in urban areas*. Report prepared for the U.S. Department of Transportation and the Ministry of Transport of Federal Republic of Germany, 267 p.