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Augusto Cusinato
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Editors

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**"Knowledge economy and competitiveness:
Economic trajectories of French cities since the 1960's" ¹**

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ABSTRACT

The French economy, as well as those of mature industrialized countries, is going through a period of intense change. This period is characterized by two major (and interrelated) trends: (a) a transition from the industrial age to what is more and more commonly referred to as the "age of the knowledge economy" and (b) a redrawing of economic geography at a global scale.

Numerous studies analyze the spatial impact of this change, and especially on cities. They focus on larger cities (globalization, metropolisation) and on specific territories (industrial districts, clusters...). Furthermore, the attention is put on location of innovation, innovative products, firms or activities, using mostly one-dimensional indicators (patents, scientific publication...).

We propose to discuss the adaptation of cities to the economic change in the context of a more general pattern. More precisely we analyze the linkage between the innovation process and the structure of urban systems. The structure of urban systems is a persistent configuration of relative and relational properties differentiating cities. The major structural features shared by all city systems are hierarchical differentiation and socio-economic specialization of cities. Feedback processes can be observed, through which social and technological change occurs in every town and city, while the particular features of this propagation of innovation determine functional and size differentiation among cities. While most innovations induce smooth change, without any deep structural transformation and only slightly affect the urban hierarchy (cities are co-evolving), some of them emerge in correlated bundles, which can accelerate the hierarchization process, or even lead to the emergence of new types of cities, via specialization.

In order to assess this theory, we lead detailed analysis of the evolution of economic specializations of French cities, especially by the observation of Knowledge-creating Services (KCS). Our aim is to show how the urban hierarchy is linked to the hierarchical process of diffusion of innovation, spatial division of labor and dynamics of competition between cities.

We built a harmonized database on French cities (*aires urbaines*) depending on the proportion of employment in around 30 sectors of economic activity from the 1960's. Using factor analysis, we can finely describe the adaptation of each city to economic change, which then draw real trajectories.

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Furthermore, from the CLAP database (on location of firms with their employment and detailed economic activities), we lead analysis on KCS in French cities in 2008.

KEYWORDS

Cities, urban system, economic activity, innovation cycles, KCS, France

I. INTRODUCTION

The economy, and especially the French one, as well as economies of mature industrialized countries, is going through a period of intense change since 50 years. This period is characterized by two major (and interrelated) trends: 1) firstly, a transition from the industrial age to what is more and more commonly referred to as the “age of the knowledge economy” and 2) secondly, a redrawing of economic geography at a global scale. Numerous studies analyze the spatial impact of this change, and especially on cities. They focus on larger cities (with the globalization or metropolisation process for example) and on specific territories (industrial districts, clusters...). Furthermore, the attention is put on location of innovation, innovative products, firms or activities, using mostly one-dimensional indicators (patents or scientific publication...).

In this paper, we propose to discuss the adaptation of cities to the economic change in France in the context of a more general pattern. More precisely we analyze the linkage between the knowledge and creative activity, the innovation process and the structure of urban systems. For that, we propose to analyse this linkage through the Knowledge-Creating Services classification (KCS), according to this book approach.

We consider cities as places of maximizing social interaction, innovation, hybridization and crossbreeding. They are matrix of emergence of creativity and particularly the larger ones. Thus, urban populations, and more generally all urban stakeholders as firms, local authorities and citizens, are at the heart of a competitive process of innovation search and adoption that is accelerated by the increased circulation of ideas, models, innovations and skills. The aim is to show how the urban hierarchy is linked to the hierarchical process of diffusion of innovation, spatial division of labor and dynamics of competition between cities.

II. HYPOTHESIS

Our main hypothesis is that city size matters. Since larger cities are more diverse, both in terms of economic profile and of human and social capital, their functions demonstrate a higher level of complexity in terms of urban economy. In that way, the propagation of innovation among towns and cities has been formalized as a hierarchical diffusion process. Indeed, the largest cities are the first to capture the benefits of the innovation, and later on they let them filter down the urban hierarchy. Larger cities concentrate a larger part of anything « new » at any time and they become larger because they were successful in adopting many successive innovations. This is explained by the higher levels of information, of skilled labor and the diversity and capacity of infrastructures that are the distinctive attributes of large cities.

As a consequence, they have also developed broader diversity of activities, and attained higher levels of social and organizational complexity. These characteristics explain why they have a greater probability to adopt any further innovation at an early stage. Later, many of these innovations become part of the activity of all towns and cities, since they meet needs that become commonplace. But the functioning costs in these large urban areas are also much higher, and many activities are forced to migrate out to smaller settlements where they can sustain their economy.

Besides the effects of hierarchical selection, there is a second type of asymmetry that is created in urban systems by the innovation process. Sometimes, the resources for which exploitation becomes profitable are not available in every location; this gives rise to urban specialization because the related economic activities can only develop in a few urban sites. Thus urban specializations are partly explained by the unequal diffusion of some innovation cycles that are linked to spatially concentrated resources. But they may also result from the hierarchical diffusion process itself. That is, when a plant relocates from a large city to a small town, this small town becomes specialized in the activity of the plant.

III. DATA : HOW TO APPROACH INNOVATION PROCESS

In order to approach innovation process in urban systems, we elaborate databases that combine demographic data and data related to urban industries and especially Knowledge-Creating Services categories. We lead analysis on 354 French cities which are defined as functional urban areas ("aires urbaines"). The data deals with population and employment from the seven censuses that occurred since the 1960's². Each city is described by the share of employment in 32 economic sectors that have been harmonized following the NES - French national industry classification that was used until 2008. It is a challenge to harmonize the 4 economic activities nomenclatures that were used since 1962. But it is possible if we consider sectors not in their specific meaning but according to their stage in innovation cycles.

Finally, we use another source: the CLAP database (Located Data on Productive System) in order to circumscribe in the best way KCS. This is possible however only for one date, 2008. The CLAP database provides data about location of firms with their employment and detailed economic activities.

² The analysis takes into account 7 french Censuses (1962,1968, 1975, 1982, 1990, 1999 and sometimes 2006)

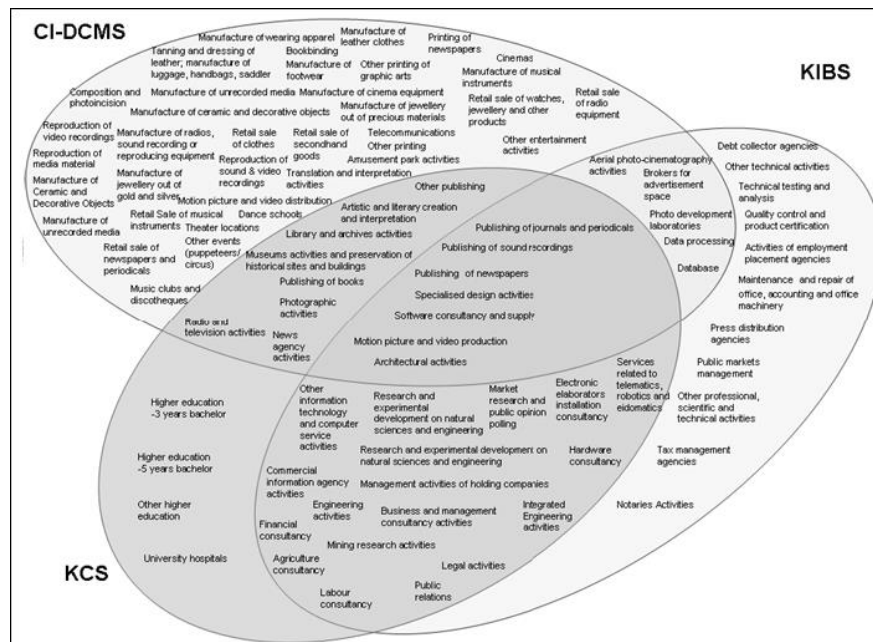


Figure 1. Intersections between the three different classifications of knowledge-based economic activities (Compagnucci, Cusinato, 2011)

This approach to Knowledge-Creating Services (Figure 1) differs from others classification like the Knowledge Intensive Business Services - KIBS (Miles et al., 1995) and the Creative Industry (DCMS, 2001) approaches. It differs from the former because it does not take into consideration those services that, although they have a high technological content, mainly make applicative use of existing knowledge, such as “Data processing”, “Database activities”, “Maintenance and repair of offices, accounting and computing machinery”. By contrast, KCS include “Media” as well as other public activities, such as “Universities and Research Centres”, that are not recorded by the others. On the other hand, KCS differ from Creative Industry classification because they do not encompass the entire creative chain (from the inventive conception and design to the manufacturing production and retail) but only the knowledge-intensive service components of this chain.

IV. MAIN RESULTS ABOUT KCS IN FRENCH CITIES

We introduce a difference among KCS³, between public and private sector because recurrent planning decisions in France have promoted decentralization of public services.

IV.1. Localization of private core Knowledge Creative Services

We count 1.5 million employees in Private-core KCS in the French urban system in 1999. There is a strong differentiation between the share of employment in these creative services among cities (figure 2). Although, the mean is of 3.7 percent, they represent more than 14 percent in Paris, which is the higher score. Half of the employment in Private-core KCS is concentrated in Paris, but there is only 25% of the total employment that is localized in the capital city. More globally, we can

³ We use the KCS classification proposed by A. Cusinato and F. Compagnucci, presented in this book. This classification focuses on core-relative services but also collateral services, both in public and private sectors. In our analysis, we only take into account the core-relative services.

see that largest cities have higher concentration of Private-core KCS : Grenoble, Toulouse specifically, and also Rennes, Nantes, Bordeaux, Montpellier, Marseille, Nice, Lyon, Strasbourg and Lille.

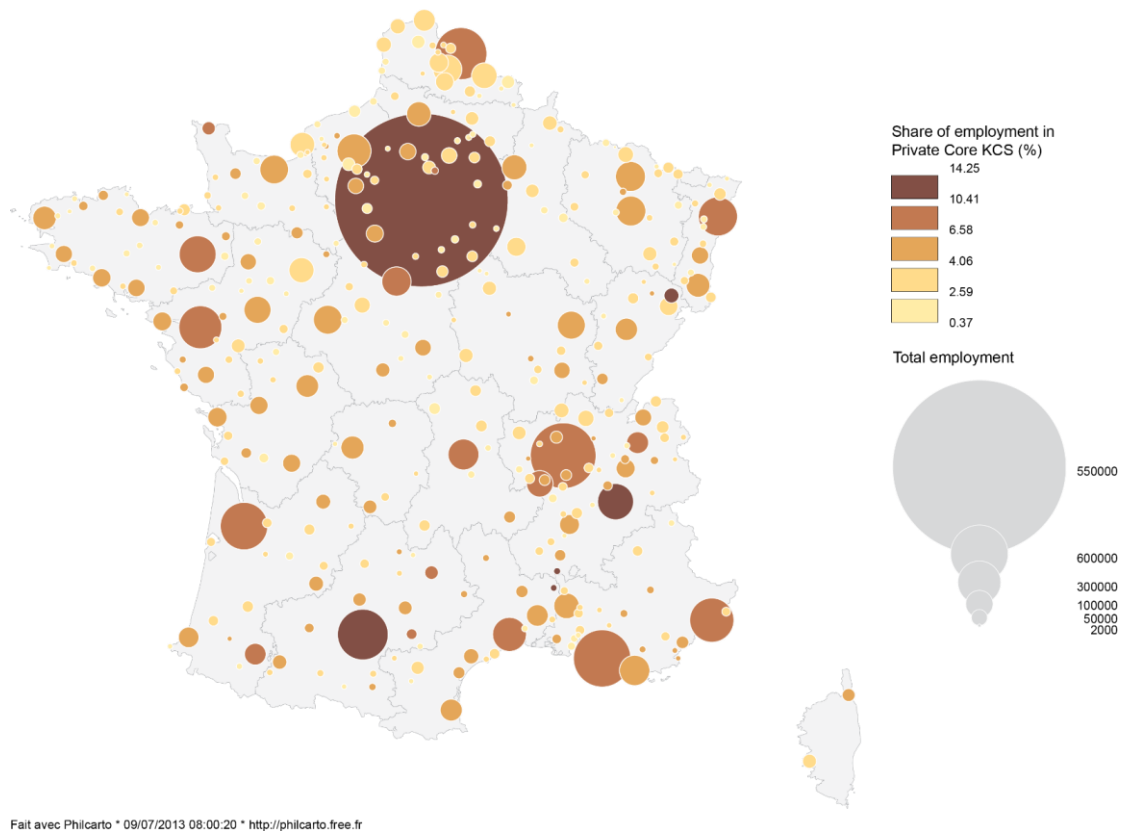


Figure 2. Location of *Private-Core* KCS employment in the French urban system, 1999

On the other hand, smallest cities show a share of employment in Private-core KCS below the mean.

We seem to have a strong relationship between city size and the weight of private core KCS. We will analyze more systematically this relationship using scaling laws after.

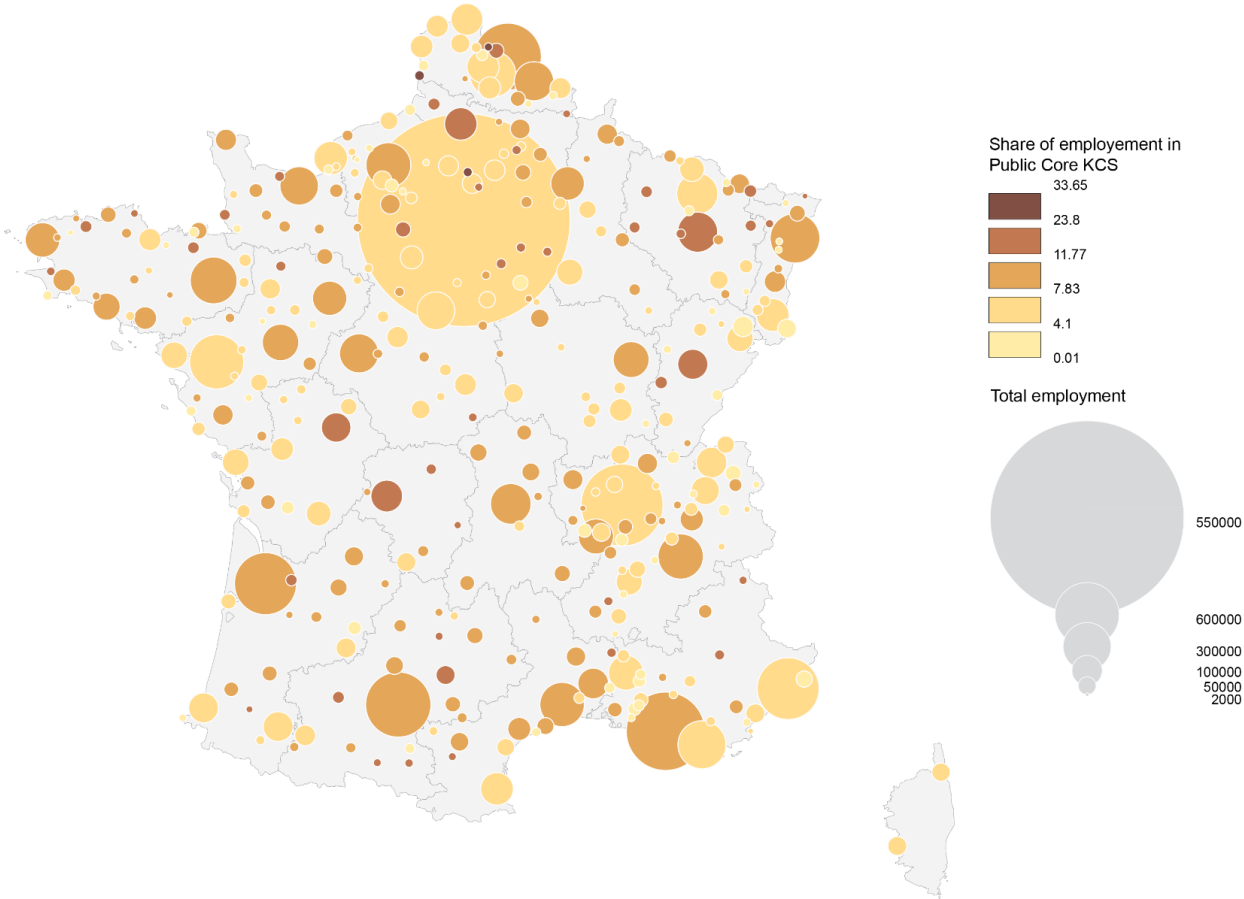
Nevertheless, there are some exceptions, anomalous to that relationship. We see that two small cities in the Rhône Valley have a strong share of employment in private core KCS : Pierrelatte and Bagnols-sur-Cèze. These two cities are well-known because they both have nuclear power plants. The choice of these cities has been made according to physical conditions (proximity of the river, not too close of a big settlement, etc.), and that lead to their attractiveness for other knowledge and high tech activities.

Finally, we can note that there is no clear regional differentiation even if the old industrial regions have a less share of employment in private core KCS (Nord Pas de Calais especially).

IV.2. Localization of Public-core Knowledge Creative Services

The pattern of the distribution is totally different for the Public-core KCS (figure 3). The largest cities, as Paris or Lyon, are not the places where the share of employment in Public-core KCS is higher. But, the regional capitals as well as numerous medium-size cities are more concerned.

Some small cities particularly show a strong share, as Berck, on the north coast, where there is a specialized hospital that host serious injured people from all around the country. This establishment is part of the public health system and there are also many training schools in this field of health studies. Another example with Poitiers, a city where the number of students is the highest in France compared with the total population. We find here a large part of employment in education system (University, etc.).



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Figure 3. Location of *Public-Core* KCS employment in the French urban system (1999)

To pursue this approach of innovation in French cities by the prism of KCS, we propose to analyze in a systematic way the link between city size and distribution of employment in this kind of services.

IV.3. City-size and distribution of KCS

At a given moment, from our evolutionary theory of cities, 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. The corresponding activities can then exhibit three different scaling parameters:

$$x = y^\beta \text{ (} x \text{ is the number of employed in an urban industry and } y \text{ is the size of the city)}$$

Leading technologies, and especially KCS, 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, $\beta < 1$. We measure scaling parameters using data on economic sectors employment and city size population.

So, we ask the question of the scaling parameter of KCS, that we understand as the most innovative activities, in the way of our theory. It seems that it fits it, because the β is clearly above one (figure 4), for private and public core (1.24 and 1.23). The R^2 is very strong for Private-core KCS (0.88) but much less for Public-core KCS (0.57). We find similar results for Private-core related KCS, with a β of 1,17 (R^2 0,83) and Public-core related KCS with a β of 1,09 and a good fit for R^2 (0,91). These values allow to confirm that the classification KCS fits very well with our theoretical proposal (in terms of stylized facts) because it reveals the strong link between the size of the city and its ability to capture innovation, to catch the more innovative activities (with high level of skilled and tasks which require high knowledge) at early stage.

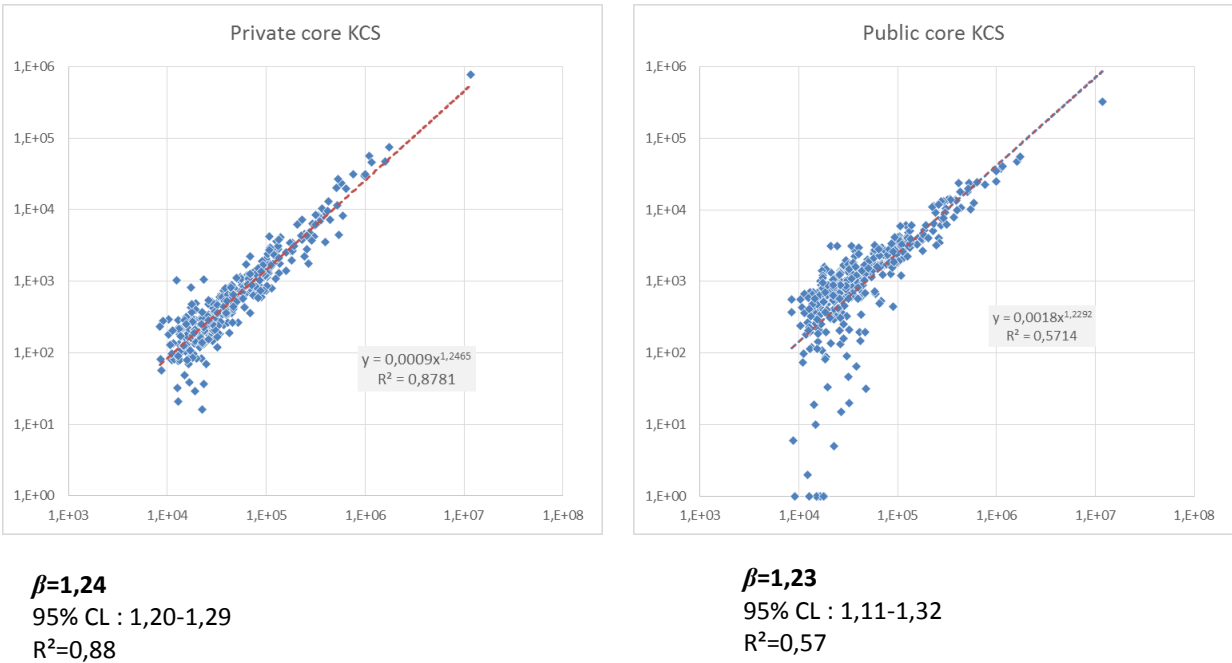


Figure 4. Private & Public Core KCS and city size

We find here a kind of paradox in the French urban system about the public services that which is both concentrate power in the capital city, but also deploying a constant politics to decentralize public services all around the country. It was the case for the National School of Administration (ENA) in Strasbourg or l’Ecole Normale Supérieure in Lyon and more generally the localization of decentralized state services (prefectures which are state local government), defense, public security, and also well-known festival like Cannes Film Festival or Avignon Theater Festival.

If we have a look at others industry sectors other than just KCS, we can observe different beta parameters. The Table 1 computes scaling parameters for different economic sectors according to their stages in the innovation cycle. We propose this for France and USA, in a comparative way. It is quite interesting to observe very close results that suggest common processes. Among these business services, financial activities are a good proxy for measuring the leading current innovation cycle. In both urban systems, the β exponent is clearly above 1 and with almost the

same value: 1.15 and 1.14 (but significantly lesser than Core KCS). Employment in hotels and restaurants in France can be conceived as a proxy of the innovation of tourism. This activity widespread during 1960's and can now be considered as a diffusing activity. The β exponent is very close to 1 and the quality of fit is very good, both in France and US. Only a few small towns have a higher proportion of employees in hotels and restaurants than on average in the urban systems. These cities are specialized and we can now raise the issue of the durability of their dynamism.

Stages in technological development Innovation cycle	Economic sector (NAICS / NES)	Power-law exponent (β)	
		France	US
Innovation	- Professional; scientific; and technical services / Consultancy and assistance activities	1.21	1.21
	- Finance and insurance / Financial activities	1.15	1.14
	- Wholesale trade / Wholesale trade	1.11	1.09
	- Administrative and support and waste management services / Renting and other business activities	1.07	1.11
Common place (adapting)	- Accommodation and food services / Hotels and restaurants	1.04	0.98
	- Construction / Construction	0.99	1.01
Mature	- Retail trade / Retail trade	0.97	0.98
	- Health care and social assistance / Health, social work	0.96	0.96
	- Manufacturing / Manufacturing	0.92	1.00

Table 1. Synthetic view of different scaling parameters in economic activities (France & USA)

In some cases, we can identify some sectors which remain in small towns (mature sectors), and are characterised with β exponent below 1. Manufacturing as a whole is found much more in small cities than in larger ones ($\beta = 0.92$).

From these results, we have now some evidences of *three scaling parameters that link urban system hierarchy and stages in technological development*. An activity whose participation to the current innovation cycle is large scales superlinearly with city size. A diffusing one scales linearly and finally mature ones scale sublinearly with city-size.

We can first conclude that the distribution of employment by economic sectors among cities, is not completely stochastic, but depends on city size. The repartition of employment among cities is not simply a proportional process but there is a clear superlinear effect whereby leading economic sectors, as KCS, are disproportionately located in the largest cities of national urban systems.

V. TRAJECTORIES OF FRENCH CITIES IN ECONOMIC SPACE

After this cross-sectional analysis, to go further and to assess out theory, we analyse the evolution of economic activity over the time. For that, we built a harmonized database from 1962 to 2008 with industry classification. Given the spatial and temporal scale, we are forced to use categories whose content is not homogeneous in terms of product innovation and process. We made a principal component Analysis (PCA) on a table which describes cities according to the share of

employment in economic sectors. The average structure of economic activities of the cities differs only slightly from the analyses on a single date.

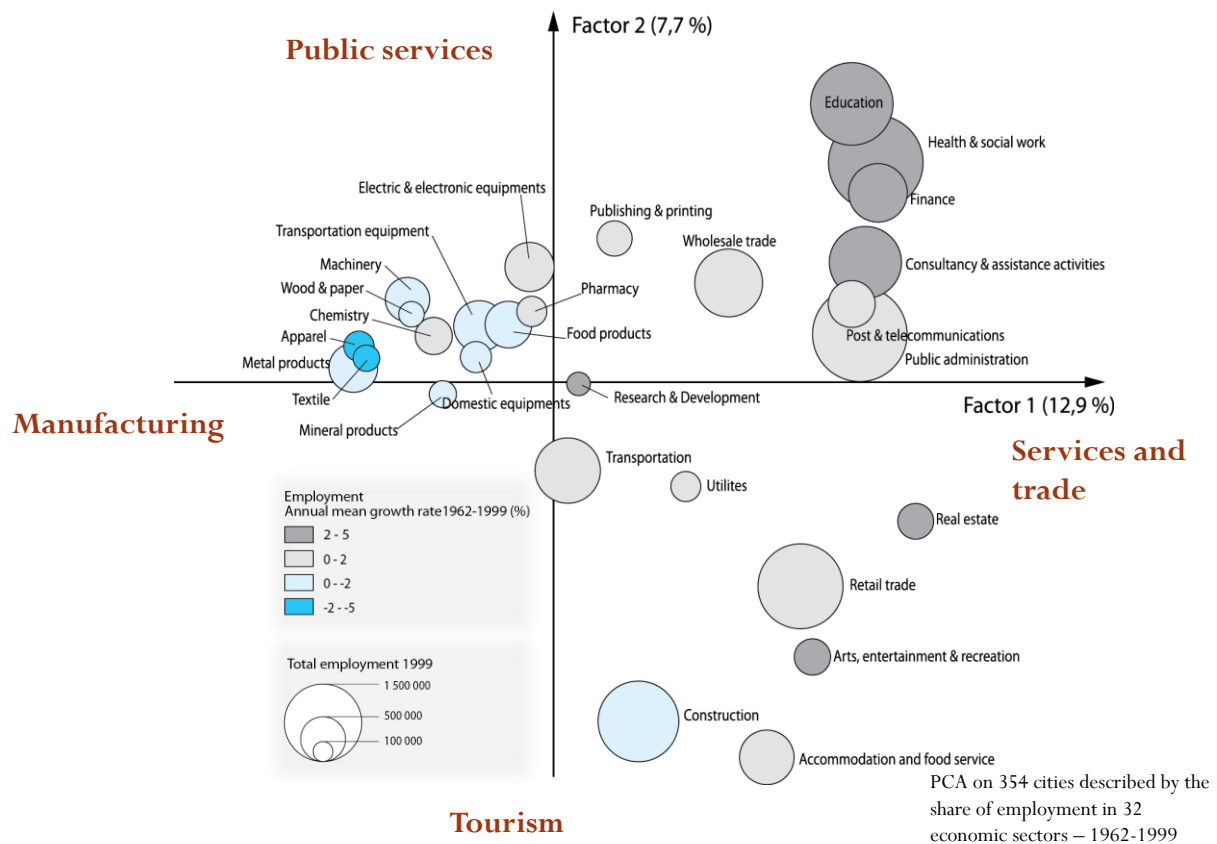


Figure 5. Main features of the economic differentiation of French cities since 1962 to 1999

The main differentiation (Figure 5) between cities opposes manufacturing cities and others where services and retail are much more present. It will mean the process of expansion of the service sector, and correspondingly deindustrialization.

The second dimension differentiates cities according to substitutions occurring within the residential economy. It opposes the new "central services" (education, health, social work, banking and insurance), growing between 1962 and 1999, to retail trade and personal services.

The third dimension of the PCA (Figure 6) is much more interesting for us, because it involves activities that are clearly related to knowledge, information and skill level, very close to the KCS classification. We can see that above, business services (consultancy and assistance, research and development) combine with art and recreational activities, and some high-technology industries (chemicals, pharmacy, electrical and electronic equipment, mechanical...). Down in the figure, we find traditional activities like retail trade, personal services, agribusiness, apparel, wood and paper, construction which are activities where the skill level is generally lower. This dimension reflects the growth of a more technical economy with more skilled jobs in manufacturing (engineers, technicians) and the emergence of a knowledge economy.

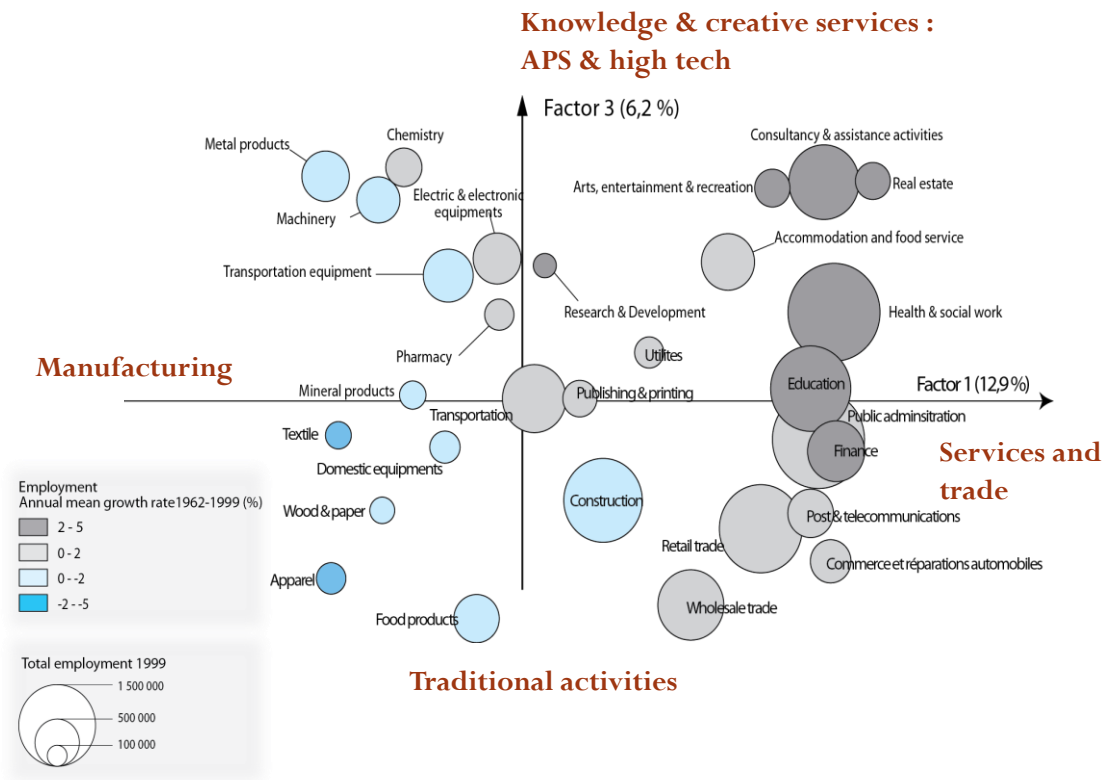


Figure 6. Main features of the economic differentiation of French cities since 1962(2)

We focus here on the trajectories of the largest cities in these three economic dimensions presented by the PCA to further compare the evolution of this upper class of cities.

What is remarkable on the figure 7 is the shape of these trajectories. It reveals the transformation of the economic profiles of all cities. The path from left to right means the expansion of the service sector; the path from the bottom up shows the development of education, health, and social work. Even if there are some differences in the adaptation of cities from time to time, with some cities adopting the change earlier, but the others often close the gap in the following periods. It reveals the co-evolution of cities, which mimic, compete with each other, by the game of urban actors (companies, governments, households, stakeholders).

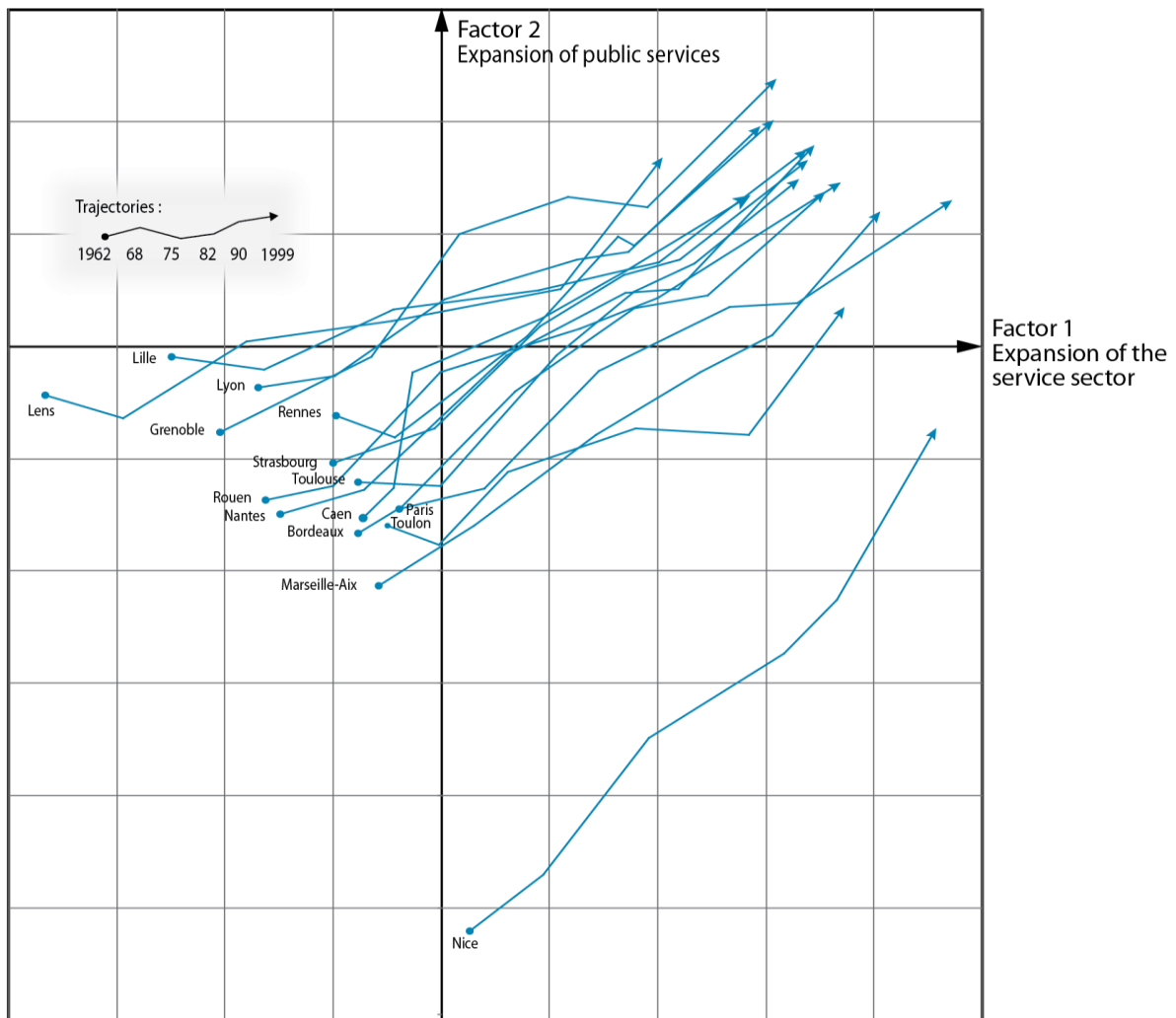


Figure 7. Trajectories of main cities in the economic space 1962-1999: co-evolution

We can notice the trajectory of Nice. The city had known the same evolution but its strong specialization in tourism remain all along the period, so employment in accommodation and food services are much more numerous.

On the figure 8, we reproduce the first dimension on the horizontal axis, which is defined by a more important part of services in urban functions, while the vertical one represents the third dimension, which clearly shows a trend towards more innovative activities. Again, the trajectories are roughly similar. The development of specialized business, arts and recreational services, associated in some cities with high tech, expressed in most urban areas. Montpellier, Grenoble, Nice, Toulouse and to a lesser extent Bordeaux and Nancy are quite in advance, with a significant route along the third dimension from the period 1968-1975.

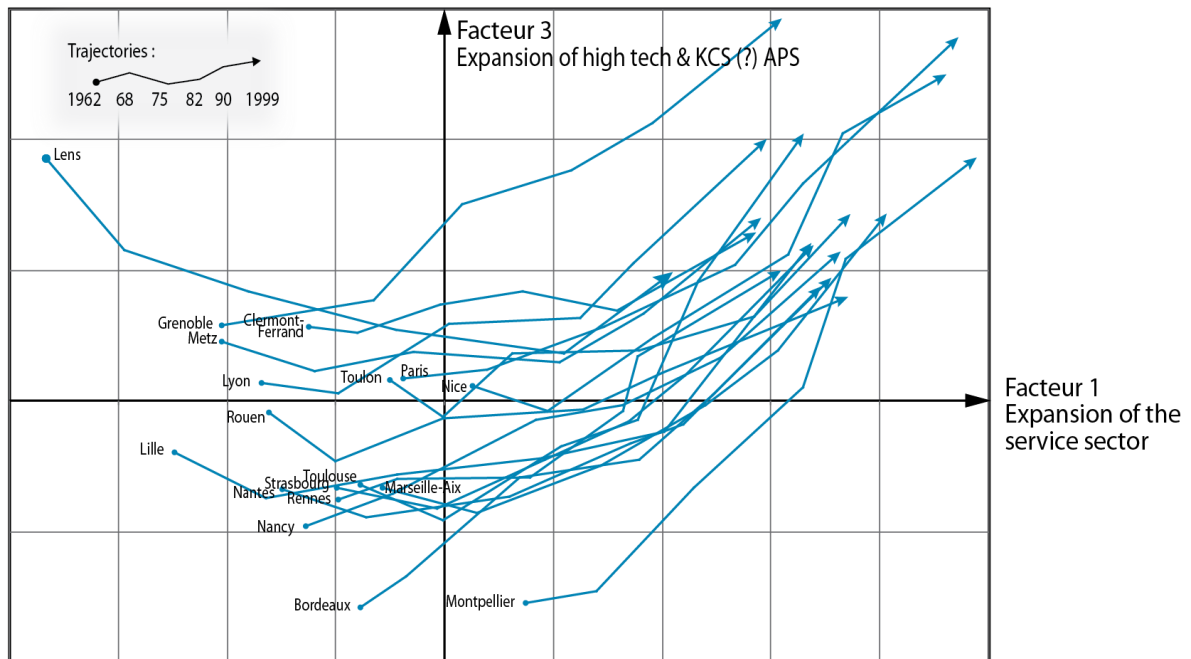


Figure 8. Trajectories of main cities in the economic space 1962-1999:
emergence of specialized cities in high-tech and KCS/APS

Inequalities are stronger between the leading group in 1999 (Grenoble, Paris, Nice, Montpellier, Lyon, Toulouse) and other cities than they were in 1962.

We can see that the trajectory of Lens, a north old manufacturing city, knows a development of KCS and High tech industry later. It is much more delayed compare with the others cities.

In order to have a synthetic view of those trajectories according to the size of the cities, we draw the mean trajectories of cities by classes of size (figure 9). The major process appears to be the co-evolution of cities, with trajectories that are substantially parallel.

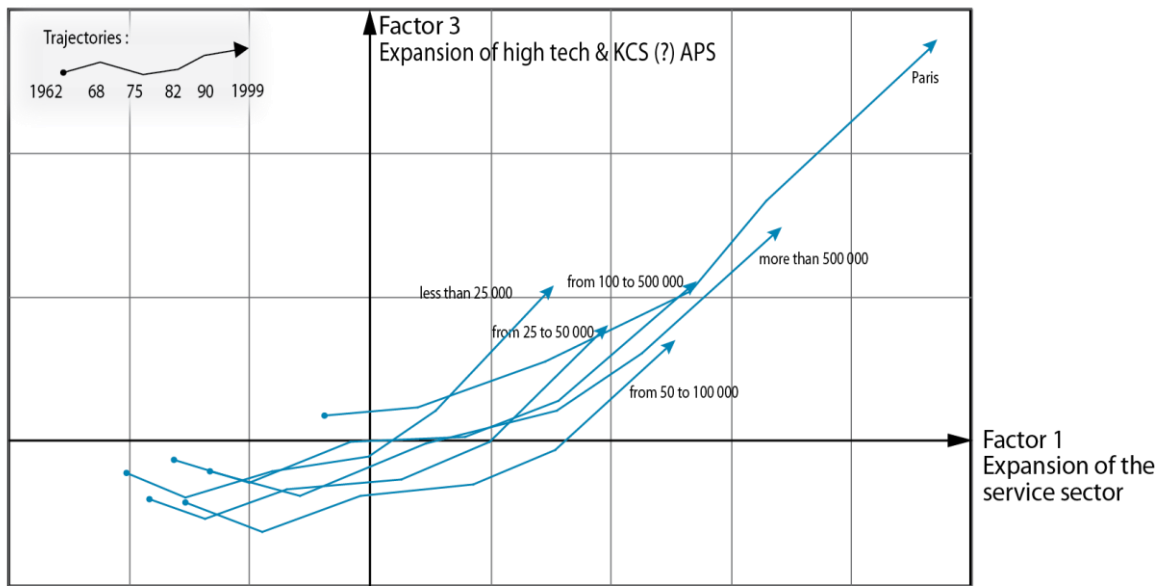


Figure 9. City size and emergence of specialized cities in high-tech and KCS/APS

To this process of common adaptation of each city to economic development, we also notice time lags. Largest cities are, in mean, at the edge in this process of innovation and adaptation to economic change. Medium and small towns appear to be hampering in this dynamic.

VI. CONCLUSION

The diffusion of innovation and specialization has consequences for the dynamics of systems of cities. We have different kind of activities. On one side, activities that can diffuse widely through the system lead to a strengthening of the larger cities. On the other side, there are activities which focus on a few specialized towns. These towns knew a strong development at the beginning of the innovation cycle but later, a relative weakness of their ability to adapt to a new cycle.

From the different analysis, we can advance that there is a specific contribution of the Knowledge Creative Services classification to further understand the urban dynamics. Indeed, it seems a relevant aggregation in order to isolate innovation process in cities. In terms of analysis of functional structure and of evolution of specialization in systems of cities, the KCS classification is a good proxy revealing the similar dynamic of cities and their parallels trajectories. This case-study on french cities shows that the KCS classification has a good explanatory potential in terms of understanding the reinforcement of the high-level of skilled people and of social capital in big cities.

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