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Impact of the High Speed Trains on the European Cities Hierarchy

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Impact of the High Speed Trains on the European Cities Hierarchy

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Abstract

The European space is marked by the recent beginning of the dualism nation-region. In it the cities take on a fundamental role because their success becomes the success of the territories around. Manuel Castell has maintained that the city is the social structure in which any territorial phenomena (from the economical development processes to the relations between classes or ethnic groups, from the public intervention to the financial accumulation) takes on its bigger strength because in it are concentrated the focusing in the territorial transformations. Obvious the cities are not the same, for physical or functional dimension; besides every innovation adds and modifies the relational system previously created. Aim of the paper is to analyse the factors generating the urban hierarchies to the European level and the impact on it of the new high velocity nets. In the first section it is carried out a reading/analysis of the hierarchies in the urban European system, as outlined in a series of studies. The second section analyses the role of the communication infrastructures in the building of the hierarchies and, in the third, is deepen the impact of the building of European high speed network on the fluctuations in the cities hierarchy. The paper asserts that the hierarchy is influenced by the growing of this infrastructure only for the second level positions, while the head positions are not influenced by it. One of the possible conclusion is that in a mature situation as the European territorial system, the urban structure seems to be well organized around poles with a strong persistence. This does not mean that a city could not climb the hierarchies, although this is possible only if a number of preconditions and of support policies are verified and with the remarks that this does not seem to affect the head positions, characterized by large stability.

Keywords
European cities; High speed train; Impact on cities hierarchy

City and territorial systems

The dualism between nation and region characterizes the European area since the Community policies have assumed the regional entities as reference entities like States and since the federalist (or separatist) pressures in some nations have, at the same time, widened; in this dualism the cities don't play an incidental role but, paradoxically, increase their importance because their success tends to become the success of the surrounding territories.
In 1983 Manuel Castell argued that the city, among the anthropic organized structures, is that where any spatial phenomenon (from the processes of economic development to the relations among classes or ethnic groups, from the public action to the capital accumulation) takes its greatest strength; moreover, just in the "urban arena", to borrow from Kirby (1995), the more polarized spatial transformations are concentrated.

The transformations of the world economic sphere after the 1960s have caused substantial changes in the relations between institutional actors. The focus has shifted from the leading role of national states to new relations characterized by concerted actions and partnerships; they have seen other players to assume an important role in the economic processes (Sassen 1997, Jacobs 2003), because the expansion of the free trade and the support of new communications technologies have accelerated the trend towards a greater liberalization and have led to a new geo-economic order where the centrality of the States is strongly disputed (Hill and Fujita 2003).
This new geography – and the resulting new form of the global economy – has created a global network based primarily (but not exclusively) on economic exchanges and focused on cities established as global cities (Friedmann 1998, Castells 1997, Sassen 1997), that are the places with the highest concentration of specific urban poles, as for knowledge, for management and for control of the production processes.
This repositioning was also aided by a reorganization of the States in order to increase the competitiveness of their cities (Brenner 1999), also at risk to reduce their role and their political importance. Obviously, cities are not equal, both for physical size than for functional dimension; every innovation, moreover, adds and alters the relationship's system characterizing one moment of their history.
This paper want to analyze the factors that generate and measure the urban European hierarchies and to identify the impact on them of new high-speed networks. The first part of the paper is based on the analysis of a series of studies centered on the compilation of hierarchies in the European urban system; then the paper analyzes the role of communication infrastructures in the construction of the hierarchies and, finally, it deepens the impact of the European high speed network on the cities and on their hierarchical position.

The urban hierarchies in Europe

The concept of hierarchy within a system of cities has been addressed by many studies both in America and Europe. It is universally accepted that it is in the nature of cities that they form hierarchies.
The "central place theory", for example, uses this assumption; Bourne in 1975 argued that the diffusion of innovations could be modeled as an expansion's process starting from the national cities and arriving at the less important centers. This theory is closely connected with the concept of "world cities": in the 1980s the researchers began to analyze it and to apply the model with special attention to the effective dynamics, asserting that they are not imposed by national and continental boundaries (Friedman 1986).
Previously, in 1966, Lukermann had stressed one of the critical factors of these researches: it is not possible to understand the relational complexity and the hierarchies among cities simply by considering the population and the contained functions; it is necessary, on the contrary, to extend the analysis identifying and measuring flows, exchanges, connections and relationships. In other words to determine a hierarchy it is necessary to go beyond a summary function or a system of measurable indicators and to introduce in the analysis also the network system, in order to highlight dependencies and relationships.
A lot of studies have analyzed the cities on the basis of the notion of "urban hierarchy". In general these classifications are based on measurable factors chosen to a certain result even if, overall, the variability of the underlying assumptions don't seem to affect too much the final result (Taylor 1997).

For example, Friedmann (1996) has produced a hierarchy of the world cities where the main factor is the presence of control and command functions of economic leader companies, namely the location of their head offices, deriving more than a hierarchy among cities, a hierarchy among economic systems.
Another very common factor for defining the hierarchy among world cities is the relevance of the infrastructure system, in particular related to air transport. This analysis generally provides an interesting state of the connections among the cities, able to highlight the economic and social development's mechanisms.
A third factor is the location of innovative service's production systems characterized as one of the strengths of the new global economy (Sassen 2000): all cities are service's centers, but in the new globalized economic system there are particular types of services able to meet new needs for a globalized system of activities. To carry out their activities, the global companies must locate where these activities exist and where information flows are continuous and reliable.

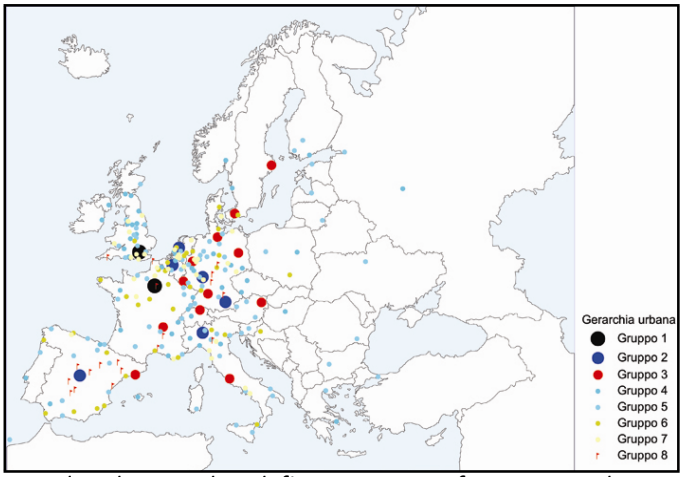

Table 1 – The synthesis of the analyzed researches defines a system of European urban centers that presents a stable hierarchy in the upper level. This hierarchy is less stable in the central and final positions

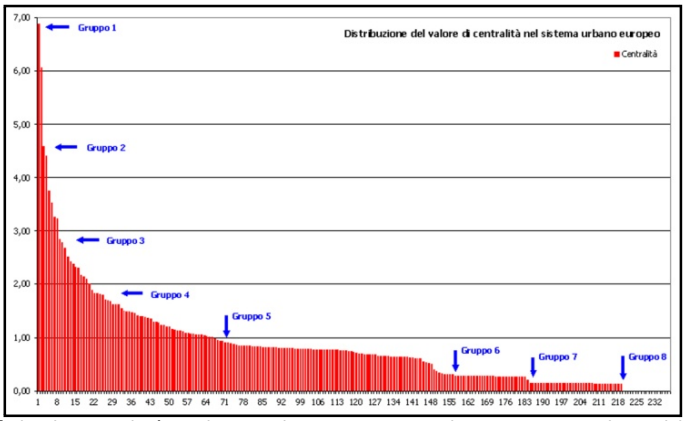

Table 2 – The distribution of the hierarchy's value in the European urban system . The table is the transposition of the Table 1

The studies on the hierarchy between the city have focused two key aspects:
1. the system of indicators needed to better delineate the hierarchies;
2. the hierarchy itself, namely the determination of the relevance degree of the city.

For the purposes of this paper the first step is the choice of a set of researches on the urban hierarchical cities, as follow. The aim of this step is to compile a framework of the choices made in the research sector.

a. DATAR, 1989. The research identifies 8 hierarchical classes and it is implemented on a series of economic variables, as the presence of multinational companies, the infrastructure's typology, the quality of workforce and a number of variables connected to the cultural economy, as special structures, exhibitions or production of information. The hierarchy is very influenced by the population. The classes are built by distributing the cities on the basis of scores from 16 to 90; the main three classes are well defined (the first includes only Paris and London), while the other four seem to have a somewhat arbitrary division (Lever 1993).
b. Beaverstock, Taylor, Smith, 1999. The study is organized in two parts. The first summarizes the result of 15 studies performed from 1972 to 1999, all focused on developing lists and hierarchies of world cities; are reported the cities considered in each list and the total of references in a range from 1 to 15. On these data our paper has founded a parameterization in 5 classes of the number of references: 1. 15 references, 2. 13 references; 3. 7 to 10 references; 4. 3 to 4 references; 5. 1 to 2 references. In the second part of the work Beaverstock and others propose a classification of world cities based on the presence of global services for business (accounting, advertising, finance, legal services). The list is consistent with the GaWC inventory of world cities and the breakdown of the 122 centers (the European are 53) in 6 classes has performed using a series of logical criteria (http://www.lboro.ac. uk/gawc/). The 6 classes are defined as follows: 1. world cities class alfa; 2. world cities class beta; 3. world cities class gamma; 4. cities with relative capability of transformation in world cities; 5. city with some capability of transformation in world cities; 6. city with minimal capability of transformation in world cities.
c. DATAR, 2003. The analysis involves the European cities with more than 200,000 inhabitants. DATAR researchers create the ranking with indicators related to some activities of international level (headquarters of large groups, port's moving, airport's passengers, international conferences, museums, universities and other) and with indicators related to productive activities, to economic diversification and to specialization. Cities are classified into 7 categories, namely: 1. world-class metropolis; 2. major European cities; 3. European cities; 4. cities of European importance; 5. potentially large cities of European importance; 6. cities of recognized national importance; 7. other cities of national importance (Rozenblat and Cecille 2003).
d. Taylor, Derudder, 2004. The paper focuses on the concept of "permeability". It identifies and determines the importance of the centers in relation to their ability to affect the system of connections between Europe and rest of the world. While the global route urban arenas are in strong connection with other territorial of the world, the city urban arenas are isolated into their geographic location, but they have good potentialities to connect with the European and the global levels. The resulting hierarchical levels are 5: 1. global route arenas with high levels of global connectivity (1A); 2. global route arenas with average levels of global connectivity (1B); 3. global route arenas with low average levels of global connectivity (1C); 4. European urban arenas (D2), 5. Trans-regional urban arenas (J3).
e. Hall, 2005. The paper is based on researches carried out as part of the European Space Development Project (ESDP). The hierarchy is formed by 3 classes of cities: 1. cities with high level of central services: it includes the main cities, whether or not national capitals, and the major centers belonging to the "European Pentagon". Within the European Union, these cities have the highest multimodal accessibility, are linked by large air corridors and are connected by high-speed rail lines. 2. gateway city or sub-continental capital: they are national capitals and major commercial centers outside the "European Pentagon". They usually are the hubs of the national airlines and the center of the high-speed rail system; they are not yet connected with the system of the Pentagon, although in many cases they are very close. 3. little capitals of provincial level. They are comparable to the former category but they are characterized by

smaller cities affecting territorial spaces more limited for population and economic output. In many cases they are situated in the European periphery.

Each research analyzes a specific list of cities and proposes a specific hierarchical structure of the European urban system. In particular:

- DATAR, 1989: 159 centers divided into 8 hierarchical levels;
- Beaverstok et alia, 1989 (a): 29 centers divided into 5 hierarchical levels;
- Beaverstok et alia, 1989 (b): 122 centers divided into 6 hierarchical levels;
- DATAR, 2003: 180 centers divided into 7 hierarchical levels;
- Taylor et alia, 2004: 79 centers divided into 5 hierarchical levels;
- Hall, 2005: 39 centers in 3 hierarchical levels.

On the basis of the above-mentioned studies the paper has built a derived hierarchy based on the position occupied by a city in the mentioned works.

The first passage is the assignment for every K city and for every research of a score (n_K) ranging from 1 (highest hierarchical level) to z (minimum hierarchical level). The second passage is the standardization of the data using the reciprocal of the score ($1/n_K$) and bringing the scores in the scale 0÷1. In this scale, if the result tends to 1, the city is in a lead position, if it tends to 0 is in queue. The obtained results reveal the existence of three main groups of cities:

a. a group of European driving cities, with strong connections and ascendancies at the world level;
b. a middle group of cities, of international level but less uniform in their performances;
c. a group of national and over-regional level, very changeable and unstable.

It also shows the strong influence of advanced services and communications in the definition of hierarchies. For this reason the following passage has interested the analysis of the European high-speed network and the distribution of the stations. To this aim it has been necessary to insert in the list of the cities a certain number of centers with high speed nodes (in activity or planned) but not present in any of the six analyzed hierarchies. These centers have been added with a score of 0 in the cities data-base.

The role of communication infrastructures for the construction of hierarchies

The second part of the study focuses its attention on the role of communication's infrastructures in the construction of urban hierarchies.

This aspect it has already been analyzed previously by a series of studies; the "growth-pole theory", destined to the analysis of the development poles, and other similar, highlights the benefits of agglomeration associated with the spatial concentration of people and activities. According to these theories, economic development in the geographic space doesn't distributed evenly and the imbalance, which is the normal state in the development, it is strictly related to the existence of differences among territorial poles, some of which present a greater development than others.

The phenomenon is related with the presence, the quality and the extent of the infrastructural system. Back in 1957 Myrdal had analyzed in his researches the polarization's effect of the most important infrastructures (ports, airports and railway junctions), arguing that they can change the existing hierarchies and that the most important transport nodes have, with greater capability, the makings of creating economic development and new regional disparities.

The existence of the disparities is accompanied by the evidence that an urban system is an interdependent structure of cities or other agglomerations related each other and connected on the basis of spatial and functional relationships that can be of two types:

– hierarchical, if the relationships are vertical and based on relationships usually one-directional (central places model);
– reticular, if the relationships are based on network of cities collaborating in multi-directional but horizontal ways (van den Berg and van Klink 1992).

The European urban system has structures referable both to the hierarchical model that to the reticular model. There are predominant cities (for example, London and Paris), but also independent networks of cities; in addition, the European urban system is continually changing and for its close interdependency the development of a center influences positively or negatively the other.

Fundamental is the action of the subjects working in the cities, better if encouraged by the parallel actions of the local governments in terms of strategic policy and strengthening of economical positions. Also the impact of new infrastructures – in the case in point the high-speed railways – depends significantly on how the urban players react to the new opportunities offered by their construction and by the rising of external accessibility (Pol 2003); their action is important for to improve the position of the centers that cannot be changed by the simple creation of the infrastructure.

The increasing of type and quality of infrastructure means to improve the accessibility to that place.

The accessibility is a key indicator to determine the advantage's increase of a localization over another; it is usually assumed that areas with better access could be more competitive, more productive and more appetizing than others (Spiekermann 2005). Due to their characteristics the accessibility's indicator is one of the most analyzed in the territorial studies and it is often a "border" element among different sectors, such as urban and regional studies and mobility studies.

Long-distance infrastructures connect the towns and increases the possibilities of interconnections and exchanges. It is possible that the building of high-speed networks influences the development and the transformation of the European cities system because it act in three main directions:
– strengthening of the existing hierarchy among the cities, especially as regards the positions of head, namely those of greatest importance;
– promotion and improvement of the position of intermediate cities;
– inclusion in the European hierarchy of new centers, with the final result of strengthening the urban grid system.

If one considers the high-speed network it easily verifies as the first European cities connected has been the well positioned cities in the continental hierarchy. The cause is simple: a significant number of inhabitants and a rich supply of industrial and tertiary activities ensure greater use of transport services and less time to return on investment.

The realization of the European high-speed network and its impact on the cities hierarchy

The above mentioned studies was the start point for structuring a database concerned 238 centers, each associated with the following data:
– population;
– hierarchical position of the center in the above studies;
– presence of high-speed railway in operation or planned;
– presence of one o more airport;
– number of passengers in transit in the airports.

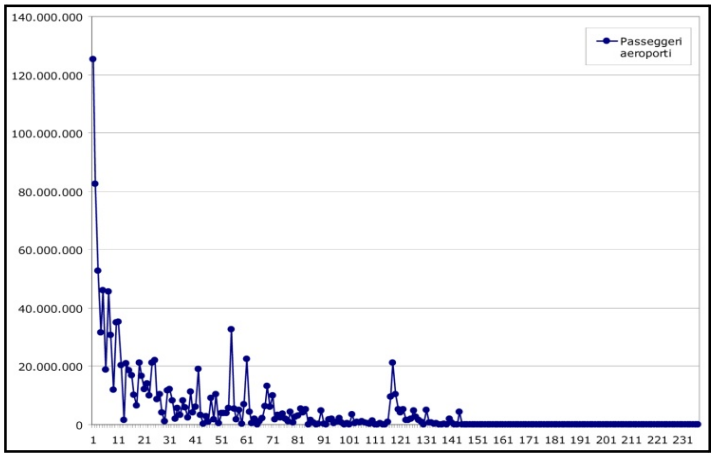

Table 3 – Distribution of the passenger traffic in the European airports using the same urban hierarchy of the table 2. It is to notice the likeness of the two results

Aim of the analysis is the definition of a synthetic hierarchy to associate with the presence of high-speed railways nodes, used as a discriminating control's factor.
To this end, the data on the population and on the partial hierarchies have been standardized in the scale 0÷1. The level of centrality of the city was used for the standardization of the data on passenger traffic in the airports, using an algebraic measurement's way: the calculation of centrality has been applied only to this data, using the total population and the total number of passengers as reference values. The used formula is the following:

$$C = S_i\text{-}P_i*(S_t/P_t),$$

where S_i indicates passenger traffic in the i_{th} center; S_t shows the passenger traffic in all the 238 centers; P_i indicates the population for the i_{th} center and P_t denotes the population in all the 238 centers. The results have been standardized in the range 0÷1, using the following formula:

$$x_s = (x_i\text{-}x_{max}) / (x_{max}\text{-}x_{min}).$$

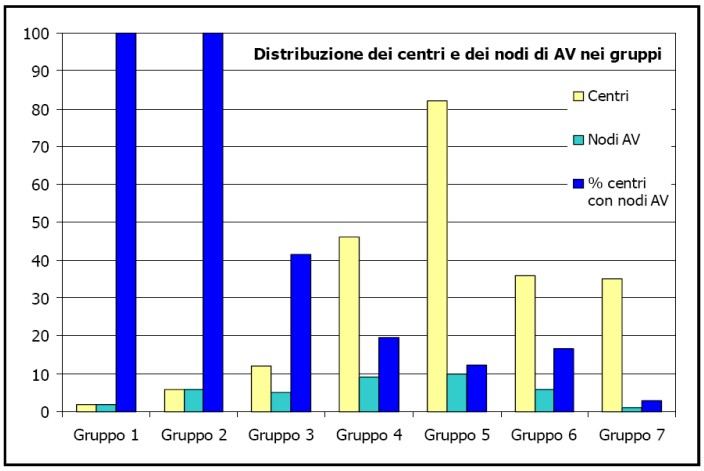

Table 4 – Comparison between urban hierarchy and presence of high speed train stations. The higher levels are totally equipped, but descending in the classes the number of centers with this infrastructure decreases

The final results show a hierarchy of centers in which it is possible to identify a sequence of 8 groups having homogeneous values (for the list of the cities see the note at the end):
– Group 1 (from 6.87 to 6.06): 2 centers, London and Paris, both nodes of high speed (100%).

– Group 2 (from 4.58 to 3.23): 6 centers (Frankfurt am Main, Milan, Amsterdam, Brussels, Madrid, Munich), all nodes of high speed (100%).
– Group 3 (from 2.84 to 2.00): 12 centers, of which 5 nodes of high speed (41.6%).
– Group 4 (from 1.89 to 1.01): 46 centers, of which 9 nodes of high speed (19.6%).
– Group 5 (from 0.98 to 0.50): 82 centers, of which 10 nodes of high speed (12.2%).
– Group 6 (0.39 to 0.20): 36 centers, of which 6 nodes of high speed (16.7%).
– Group 7 (from 0.14 to 0.13): 35 centers, including 1 high-speed node (2.9%).
– Group 8 (0.00): 18 centers that do not belong into any of the hierarchies analyzed at the start, but have the characteristic of being all high speed nodes.

The reading of the results clearly shows the persistence of the European hierarchical system and a very high correlation between position in hierarchy and equipment of high-speed nodes. The cities belonging to the upper two groups in fact have nodes of high speed, while, proceeding from third to seventh group, the percentage of centers with high-speed nodes reduces with a fairly regular pattern.

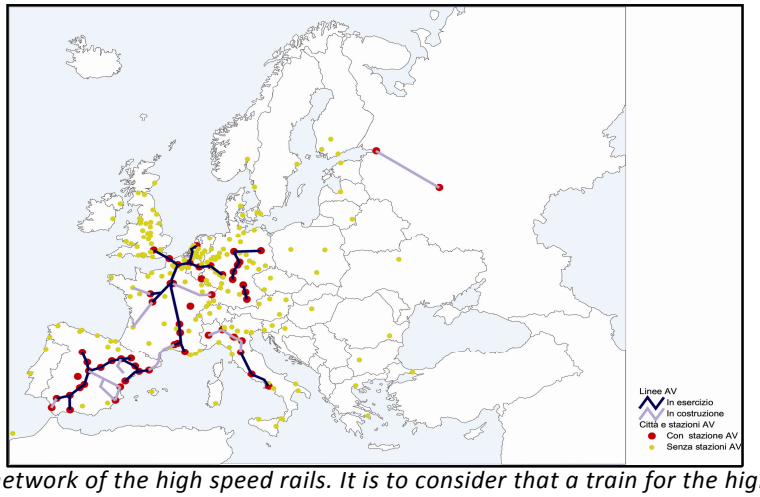

Table 5 – The European network of the high speed rails. It is to consider that a train for the high speed can also run on normal railways lines

It's therefore manifest the need to shift the focus towards the hierarchical intermediate and lower positions because it is exactly within these that major changes will occur.

If the driving-cities are favoured in the maintenance of their positions, what happens to the intermediate cities? Are they hopelessly doomed to be still or can they assume positive evolutionary processes? The results suggest as probable that the cities positioned in the central and closing positions are deeply interested by the potential changing processes descending from the inclusion of new infrastructure, as that connected with high speed railways.

On this question it is necessary a reasoning more deep.

A first consideration derives from the comparison between the hierarchies discussed in the first part of the paper and the hierarchy above built. From this comparison happens a different instability between the lead and the secondary positions: while the former are seized by the same cities in all the classifications (low flexibility), the latter are highly variable and the position differs considerably in a lot of cases (high flexibility).

Which are the causes of the phenomenon? The possible answer is that the presence of marked differences between two centers in relation to the supply of a function tends to grow or, at least, to stabilize the differences; this happens moreover always to advantage of the stronger city.

Moving to the mid-low position of the hierarchy the fluidity is due, probably, to the indicators used in the research but it also depends by an objective factor, namely the ability of these centers to

throw their presence on the international scene after the inclusion of new functions and new poles of attraction including the creation of nodes of high-speed networks.
A second consideration is that the connection with high-speed networks makes the cities more attractive to those activities in which national and international interactions are essential; besides, the activities located in a more or less extensive area around a node of this type can gain strong positional benefits influencing also their hierarchical position of the host city and increasing the gap to disadvantage of the empty cities.
This means that the node can create a polarizing force on the regional economy, making stronger the urban areas that already have a leading position and encouraging others that are equipped of new infrastructures.
A third consideration interests the relations between urban center and nearby areas because the carrying out of an high-speed node represents a factor establishing new centralities and influencing with some effects the location's preferences of economic activities. The more dynamic of them tend to move to the new centralities to take advantage of the connection's speed; others, more traditionalist, refuse to move thinking that to maintain a peripheral position helps them better manage their market areas for less rivalry.
If this is true, it is equally true that the possibility of scaling the urban hierarchies depends on two factors:

1. the temporal distance between a center and the nearest with an higher level (ability of the lower center to become a support pole of the bigger);
2. the overall policies attending the action on the high-speed node with diversified operations, such as the construction of intermodal networks reaching the local node and encouraging its use and sustainability (European Commission 2001) or the plugging in of innovative and qualitative functions for making attractive a center and a territory.

Conclusions

The paper has analyzed the urban hierarchies and the factors influencing them; it has assumed that these hierarchies can be changed more easily in the central and final positions.
In a mature situation as the European territorial system, the urban structure seems to be well organized around poles with a strong persistence. This does not mean that a city could not climb the hierarchies, although this is possible only if a number of preconditions and of support policies are verified and with the remarks that this does not seem to affect the head positions, characterized, as said, by large stability.
In the past the urban research said that the electronic communication and the dematerialization of the work's location would have a disruptive impact on cities. We have seen that this has not happened, as the example of a lot of cities apparently going to an irreversible decline shows.
This has led to revisit the starting assumptions, and to argue that the current information's and electronic society acts on the cities as well as in the past all the economic activities have acted, i.e. emphasizing the leadership role of cities: in addiction the current economy's structure tends to encourage even more the existing hierarchies, given the high concentration of knowledge and skills necessary for its running.
Is it possible to suppose that this it also happen with regard to mobility and that new infrastructures (including those for high-speed) can only act supporting the prominence urban positions rather than to go against them.

Note

Group 1: London, Paris
Group 2: Frankfurt am Main, Milan, Amsterdam, Bruxelles, Madrid, Munchen
Group 3: Hamburg, Barcelona, Rome, Zurich, Luxembourg, Copenhagen, Berlin, Wien, Stuttgart, Lyon, Stockholm, Dusseldorf
Group 4: Lisbon, Athens, Geneva, Dublin, Manchester, Edinburg, Cologne, Bologna, Rotterdam, Prague, Helsinki, Budapest, Strasbourg, Hannover, Bordeaux, Warsaw, Bristol, Leipzig, Glasgow, Basel, Marseilles, Oslo, Turin, Antwerp, Leeds, Lille, Birmingham, Bratislava, Bonn, Grenoble, Seville, Bilbao, Nuremberg, Goteborg, Moscow, Newcastle upon Tyne, Dresden, Liverpool, Bern, Belfast, Palma, Nottingham, Rennes, Southampton, The Hague, Genoa
Group 5: Sofia, Venice, Malaga, Toulouse, Nice, Florence, Aberdeen, Nantes, Thessaloniki, Bari, Eindhoven, Palermo, Trieste, Cagliari, Verona, Catania, Freiburg im Breisgau, Kiev, Utrecht, Munster, Clermont-Ferrand, Rouen, Liège, Leicester, Aachen, Mannheim, Bremen, Cardiff, Nancy, Graz, Charleroi, Poznan, Taranto, Valladolid, Augusta, Oporto, Zaragoza, Linz, Santander, La Coruna, Hanseatic city of Lubeck, Metz, San Sebastian, Bielefeld, Saint Etienne, Le Havre, Kingston upon Hull, Plymouth, Cordova, Sheffield, Luton, Istanbul, Las Palmas de Gran Canaria, Neaples, Mulhouse, Bergamo, Vilnius, Tallin, Salzburg, Derby, Riga, Osnabruck, Bournemouth, Valencia, Saint Petersburg, Blackpool, Tampere, Turku, Erfurt, Southend on sea, Parma, Vitoria Gasteiz, Magdeburg, Dortmund, Reggio Calabria, Essen, Mönchengladbach, Bucarest, Lausanne, Ljubljana, Wiesbaden, Avignon
Group 6: Malmö, Montpellier, Granada, Cracovia, Cadice, Angers, Padova, Gand, Aarhus, Cannes, Tarragona, Brest, Pamplona, Digione, Gijon, Alicante, Orleans, Tours, Arnhem, Nimega, Reims, Brunswick, Karlsruhe, Lens, Valenciennes, Haarlem, Enschede, Saarbrucken, Brescia, Kassel, Kiel, Messina, Vigo, Coventry, Murcia, Zagabria
Group 7: Groninga, Bochum, Swansea, Chemnitz, Stocke on Trent, Halle sul Saale, Rostock, Portsmouth, Breda, Tolone, Brighton, Salerno, Middlesbrough, Darmstadt, Preston, Leida, Coblenza, Mons, Heerlen, Caserta, Chatham, Carrara, Aldershot, Bethune, Dordrecht, Le Mans, Livorno, Modena, Odense, Tilburg, Oviedo, Amiens, Wuppertal, Caen, Duisburg
Group 8: Marne-la-Vallée, Nimes, Castellon de la Plana, Reggio Emilia, Wurzburg, Lerida, Ingolstadt, Gottinga, Guadalajara, Toledo, Calais, Ciudad Real, Valence, Fulda, Segovia, Puertollano, Huesca, Calatayud

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