

# NETSCAPE

## Europe and the Evolving World City Network

Preliminary paper

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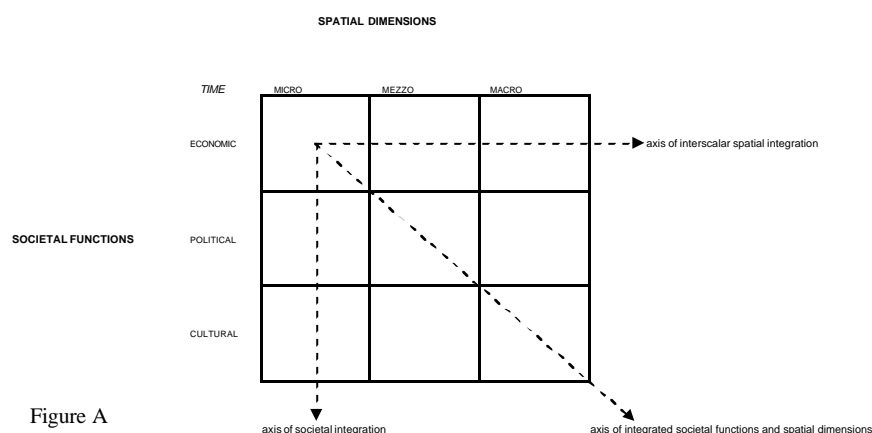
### Abstract:

The conception of the city as a ‘node’ and a ‘place’ is deeply rooted in human development. The ancient Egyptian hieroglyphic for the city consists of a cross (the external networks) inside a circle (the place), already synthesizing the dual ‘global’ and ‘local’ roles of the city (Camagni, 1993). Today, theories by authors such as Friedmann, Sassen and more recently the GaWC research group, continue this age old understanding, remodelling it to suite the increasing complexity of our contemporary world. A system in which the interdependencies between economic and city development are becoming greater each day. Within this endeavour we aim to contribute to a further understanding of the interdependencies between firms and cities (nodes and linkages) at different spatial scales. These relationships and hierarchies are theoretically and empirically explored, structured into two main parts: (1) Theoretical Developments of the World City Network; and (2) Transitions of the European City Network. The first part is explored using a simple template, which approximately organises the work into *time*, *scale*, *spatial dimensions* and *societal functions*. In the first part we explore evolutionary moments, in the development of our current ‘city network’ paradigm. In the second part we specifically focus on contemporary concepts in modern Europe, followed by an empirical analysis that reveals the functional and spatial relationships between European cities and firms within our global ‘netscape’.

### INTRODUCTION:

The understanding of the interdependence between city and economic development follows a long historical tradition in which the transition of the city as both a real and conceptual entity can be traced, from simplified models towards today’s highly complex network systems. Observing the vast amount of research on these topics, it is obvious that the properties of these systems always concern both societal functions and spatial dimensions. Therefore we have defined a simple template (figure A) to structure the first part of this paper, from which the ‘network’, is defined as a systemic entity, resulting from the organization of societal functions within spatial dimensions. These network properties can be ordered under time and *micro*, *mezzo* and *macro* scales.

#### NETWORK PROPERTIES



However, our focus is not to write a merely historical account, but instead to try to target how the network model developed, as a concept, within a growing awareness of spatial scale. The three scales will therefore be our primary ordering unit. Furthermore, as indicated in the diagram, the formation of the network across societal, spatial and integral axes of connection is shown. Downwards it is possible to understand a part of the network, across societal functions, but within one spatial scale. Left to right, the network can be investigated across spatial (horizontal and vertical) scales, but within one societal function. Diagonally, the network is expressed as an ‘integral’ understanding between directions. It is this diagonal, integral understanding which forms the ultimate challenge in understanding the world city network – the understanding of the *meta* scale - an interdisciplinary endeavour that will prove be extremely difficult, considering the rising complexity of our current network system.

Therefore, the naïve pursuit of a ‘complete’ or ‘realistic’ understanding, should be avoided and instead researchers should come to terms with the network’s essential characteristic, i.e. ‘its persistent incompleteness’. Instead, we should pursue improved but ‘partial’ and ‘plausible’ understandings, and for this reason, we will concentrate mainly on the economic slice of the ‘societal functions’, across the three scales. A further detail of this slice is shown below (figure B). We see that the network can be explored horizontally within scales (ovals) or vertically between scales (overlap). The rest of this essay will be roughly structured on the basis of this diagram, with the prioritized order being firstly *time/scale*, secondly *economic function* and *spatial dimension* (network and space). In this way partial insight is made into the sophistication of economic functions, their spatial distribution, and how this leads to evolutionary steps in the formation of the world city network, such as - *core-periphery relations, variations in network intensity, representation and extent of firm-city relations, degrees of regional collaboration and competition*. Important in this theoretical and empirical exercise is how these issues, lead to the *conceptual* development of the city, within a steadily globalizing world.

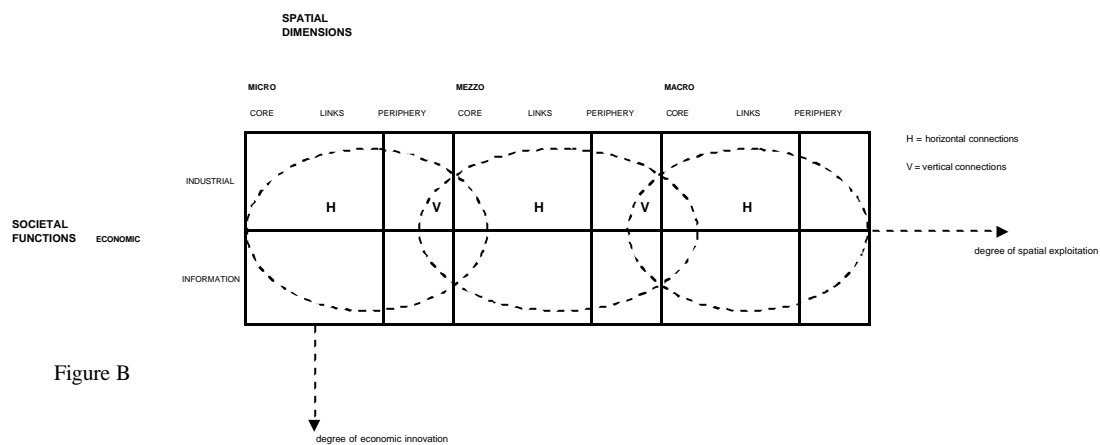


Figure B

# 1. Theoretical Evolution of the World City Network:

## 1.1. Conceptions at the micro scale:

In his book *Power and Profit*, (2002) Peter Spufford looks back at the medieval European network model, showing it to be the first conscious organization of primary and secondary cities and networks, polarized into a North-South supraregion. He shows that multi-locational firms already played an important role in this system, including the provision of services within an emerging intercity network. Furthermore he indicates the sophisticated organization of the Northern pole (the Hanseatic League), in creating trade monopolies for its members, characterised by headquarter functions within the Hanse cities, the affiliated merchants represented in other cities; and the non-Hanse cities with which they traded. Important here is that Hanseatic merchants operated not as individuals but as participants in a number of separate businesses, one of the principle agents of the city network formation. This medieval period of the network reaches its apex around 1300 after which Europe falls into a long economic decline (especially the 17<sup>th</sup> century), or the unfolding of Braudel's (1979) 'longue duree', in which he depicts the economy being, 'reduced more than ever to 'archipelagos of cities', meaning a reduction of inter-city network connections.

The end of the 17<sup>th</sup> century's depression, around 1650 (Bairoch, 1988), also forms the end of the 'city archipelago', where the introduction of the Westphalia Treaties (1648), served as the official confirmation that states would be the new political building blocks of society, and where 'city centred economies' transformed into 'state centred economies'. The modern world-system ushered in a new political order based upon a new territorial organization, which took away political power from cities and the social centralization within the states took away their identity (Taylor, 2004). This conception has been central to city development since the seventeenth century, where by the mid twentieth century cities were ardently seen as capital centres within nationally demarcated territories. Cities became part of the development of hegemonic states through which a new pattern of urbanization was created. Paris and London, 'mark a turning point in world history' (Braudel, 1981), by producing national markets without which the modern nation state would not exist. They serve as centres of political administration, bureaucracy and culture, becoming symbols of state power and become population centres and thus nodes of consumption. This paved the way for the emergence of large-scale monopolistic merchant chains within these capitals (Fields, 1999). Up until today, the nation state is perceived as the primary unit of power, where cities merely constitute national urban systems (Taylor, 2004).

Within the newly instated 'national system' paradigm, the initial understanding of the interdependence of urbanization and economic development, through population, trade and production, can be found in Adam Smith's (1776), *The Wealth of Nations*, in which he explicated the role that cities play in facilitating trade, within a national, market-economy. In this period, agricultural productivity doubled, consequently freeing labourers in great numbers for non-agricultural forms of labour, and hereby providing the first shift towards the Industrial Revolution (1770s/1780s). At the start of the 19<sup>th</sup> century, 60% of England's labour force ceased to be employed in agriculture and urban populations rose to 23% (Bairoch, 1988). It is not surprising that within this time of fast urbanization, that Thomas Malthus wrote his *Essay on*

*Population* (1798), focusing on the city development and sustainability within the demographic transition from agrarian to industrial society. The previously agriculture-oriented city started to produce and consume manufactured goods, such as textile, iron, water-power and pottery. British, French and Belgian cities began to densify and intensify with small industries and services and the main linkages between regional cities in the vicinity became toll-roads and canals, from which revenue was collected.

A clearer core-periphery relationship in this era can be found in Von Thünen's (1826) *Isolated State*, where a primary 'spatial model' of the relationships between *core* (isolated city market and profit maximization), *linkage* (navigable canal/transport costs) and *periphery* (isolated agricultural production in an isolated state) was conceived. In the model an added sub-centre suggests early competition and hierarchy. The 'isolated state' could no longer provide for its growing populations, where we see that this 'closed system' or 'nation-state' thinking, slowly starts 'opening up' at the advent of steam-powered engines, railways and shipping, where relations between the British, French, Belgian, German and American nation-states, intensifies.

A further evolution of the understanding of hierarchies of competing and collaborating cities (nodes and linkages) within sub-regional and national levels (micro-scale) is shown in Walter Christaller's *Central Place Theory* (1933). These new hierarchies are driven by the new technological innovations of electrical and heavy engineering, and where existing infrastructural *linkages* are intensified with international cable and wire communications. City populations continue to densify, although slower than the 20<sup>th</sup> century, caused by the equalization of levels of urbanization on the international plane. Economic functions started to diversify, such as the emergence of giant firms, cartels, trusts, mergers, monopoly and oligopoly; and banking and finance services start to concentrate in major cities.

Still at the micro-scale, this train of thought was further developed by Walter Isard (1960) in his book *Methods of Regional Analysis*, which still conceived the city and its proximate services, as the primary unit of scientific inquiry within nation states - at least more so than intercity relations. This fixated focus is strange in an era of Fordist mass production, intensifying economic internationalization, multiplant locations, competitive subcontracting, increasing firm concentration, divisionalization, hierarchical control, transnational corporations - plus added highways and airline *linkages*. It is therefore reasonable that Isard, in his updated book (1998), upscales his work, placing more emphasis on interregional analysis and the functioning of a system of regional cities (Taylor, 2004).

*The above depict sophistications of the city network as a micro-scale understanding. Although there is a relative up-scaling of the periphery, we cannot talk of vertical interscalar relations yet. However, horizontally there is a definite progression of societal functional relations. The nation-state becomes a controlling device to regulate the internal to external activities, and instating capital cities as control centres and symbols of power. The nations and their inclusive cities are optimised for production, using steadily sophisticated technologies and analytical techniques, but the demand for foreign goods starts to the linkages and awareness between nations.*

## 1.2. Conceptions at the micro - mezzo scale:

It appears that J. Reynaud (1841) in *'le systeme general des villes'* was the first in identifying systemic spatial and functional regularities of 'cities within systems' (Pumain, 1999), which is understandable at a time when the economy started to recover, aided by steam powered innovations, which intensified the network linkages between cities, and allowed firms and markets to expand. This forms the first conscious conception of systemic, vertical and horizontal linkages between micro and mezzo scales.

Later on, in the 20<sup>th</sup> century, with the revival of the European economy, a new era of transcontinental links is forged, where Fordist mass production and the expansion of the network through highways and airlines proliferates and where international economies and nations start to propagate. At this time the micro to mezzo network concept reinforces itself, as can be seen in the classic studies, *The Nature of Cities*, by Chauncy Harris and Edward Ullman (1945) and *Cities as Systems within Systems of Cities*, by Brian Berry (1964), where the main premise is that cities are comprised of both internal relations and external relations to other cities, including the intensification of interfirm and political hierarchies and widespread strategies of collaboration and cooperation.

In the 60s to 80s a new trend emerged in which cities were seen as 'systems of cities'. In studies by Brian Berry (1960), Larry Bourne (1975), Peter Hall (1980), Ron Johnston and many others, the core focus is on 'systems thinking' as a prerequisite to understanding how cities develop within themselves and in relation to other cities. For instance in Bourne and Simmons studies (1978) they show that within a set of regional or national cities, a particular city cannot be studied independently, but rather as a subset within the overall system (set). They show that the system creates 'feedback effects which regulate growth and change'. This however delivered a relatively simple hierarchical model (Taylor, 2004), 'a national system dominated by metropolitan centres and characterized by a step-up hierarchy' (Bourne, 1975).

It was also in this period that 'cities in national systems' were analysed as a relation between city rank and city population – the 'primate city distribution' versus the 'rank size rule'. In this it was shown that the more advanced a national economy is e.g. the United States, the more proportionate city growth is to city size, creating a consistent linear distribution. Cities in third world countries, by contrast, show a big difference between primary city and all other national cities. This model assumes that all countries have the potential to develop complete national urban systems, 'following that cities in modern, industrial economies constitute national urban systems' (Taylor, 2004).

*From the mid 19<sup>th</sup>, to the late 20<sup>th</sup> century, we gradually see a tension rising between nation-state and city systems thinking. It illustrates the age-old clash between control (delimitations) and freedom (connections). It represents an important conceptual transformation of the network model, within a steadily 'internationalizing' world. There is a further up-scaling of the core/periphery relationship and an increase of interscalar awareness; the networks speed up the flow of tangibles and intangibles; but also an intensifying worldwide polarization emerges.*

### 1.3. Conceptions at the micro - mezzo - macro scale:

#### *Historical perspectives of a world city network:*

Thinking from the current network paradigm, the book *The Human Web*, by historians J.R and W.H. Mc Neill (2003), analyses the complete chronological progression of mankind, as a gradual formation of worldwide networks or 'webs', which started according to the authors, with the development of speech. These networks allowed for trade and communication and have become more and more complex and diverse over time, especially since the advent of industrialization, population explosions and the more recent development of globalization. The study is not specifically city orientated and focuses more on continental, empire and national geographic units.

In Janet Abu-Lughod's book, *The Transcontinental Archipelago of Cities*, she illustrates a late medieval city system, which although spanning eastern and western cities, cannot truly be considered a network, due to the incoherence and technological slowness of the system. She instead calls it an 'archipelago', as trade was not directly possible between cities at the 'outer extremes' and instead depended on middle cities which acted as in-between hubs. The archipelago was more an overlapping of regional networks, leading to the invention of the service activities of sedentary merchants, transporters and agents representing the sedentary firms in cities beyond the home city (Taylor, 2004).

According to Braudel, what links modern day *capitalism* to the process of urbanization is the role played by cities as catalysts for trade and markets. This *world economy* distinguishes itself from its predecessor, the *market economy*, through (1) being 'an economically autonomous section of the planet', (2) containing a dominant capitalist city, defined by its international linkages. The dominant city is the 'world city' at that specific point in time, and this can shift, as seen by the domination of Venice, Antwerp, Genoa, Amsterdam, London and New York over recent centuries. From these relationships emerges an urban 'hierarchy' consisting of an order of cities and their linkages (Fields, 1999).

#### *Conceptual transitions within an 'internationalizing' world:*

What particularly starts to emerge in 'city systems' thinking are specific definitions of (1) infrastructural linkages and (2) the significance of firms and (3) their spatial structuring within the urban system. For instance, Pred (1978) assumes, 'multilocal organizations are the major source of intermetropolitan and interurban interdependencies', which together form a web of service, goods, control and information flows. A key point is made by Pred, that the hierarchy of this system is derived by the firms and not the cities.

It is at the close of the 70s that the nationally oriented thinking of city systems becomes criticized as being too hermetic (closed system) and where external international influences becomes more seriously considered (open system). As stated by Bourne and Simmons in 1978, 'one neglected aspect of research on city systems is the effect of influences derived from outside the nation'. It is only since the restructuring of the world economy in the 70s as 'the international division of labour' and its primary units, the 'multinational corporations' that world city thinking starts to

make significant progress (Taylor, 2004). Firms were perceived to have 'global reach' (Barnett and Muller, 1974) and operate in a 'world without borders' (Brown, 1973), indicating an initial insight that the nation state was dissolving.

The most influential paper linking world cities to the international division of labour can be found in Friedmann's (1986) concept of 'the world city hypothesis' and can be considered as the essential gauge of our contemporary network paradigm. In seven theses Friedmann defines the 'spatial organization of the new international division of labour', such as a *functional* thesis, a *hierarchical* thesis and a *global-local* thesis. The first shows a city's assigned functional dependence within a world economy. These three functions are *headquarters centres*, *financial centres* and *articulator cities* that link national or regional economies to the global. The second thesis shows that cities are hierarchically structured according to *finance centres*, *corporate headquarters*, *international institutions*, *business services*, *manufacturing*, plus *transportation* and *population size*. This leads to two levels of hierarchy i.e. primary and secondary cities which are in turn organized in a 'north-south' division as core and semi-periphery cities, and also 'east-west' in three continental subsystems (Asia, America and West Europe). In Friedmann's third thesis he states that a city's role in the world economy is directly reflected in the structure and change of the local economy. Cities are furthermore centres 'through which flows of money, workers, information, commodities' are transmitted, which articulate the 'economic relations' of their 'surrounding field or region' into the global economy (Taylor, 2004).

The outcome is an extremely polarized socio-economic structure, defining *global cities* (e.g. Tokyo), *multinational cities* (e.g. Milan), *national cities* (e.g. Buenos Aires) and *subnational cities* (e.g. San Francisco) – all into a world city hierarchy. Although a gigantic leap forward, the network is not entirely an open system at this stage, as it takes the national delimitation to a higher level, by creating the three world economic regions. Friedmann achieves to encompass the scale of the system, but not the elaborate structure this entails. Furthermore, the selected variables only constitute a handful of influences which define cities of the world.

#### *Conceptual transitions within a 'globalizing' world:*

The move from world city to global city concepts is most clearly emphasised in Saskia Sassen's famous book *The Global City*, comparing New York, London and Tokyo, which are observed within the context of telecommunication and information technologies. According to Sassen the dispersal affected by the new technologies demands new control and organizational functions, which has led to the emergence of 'a new type of city' – i.e. the 'global city'. These cities function in four specific ways: as (1) 'command points' and (2) 'key-locations' for leading finance and business services, resulting in cities becoming (3) sites for production and innovation in these sectors and as (4) markets for these products. According to Sassen these are the 'first global service centres' in history. Sassen follows a similar approach to Friedmann, but concentrates more on the production of advanced producer services and only briefly touches on the 'vast multinational networks' and their 'global integration of affiliates'.

Manuel Castells, argues in, *The Rise of the Network Society* (1996), that we have transcended into the 'information age', where 'networks constitute the new social morphology of our societies' and 'reshape the material basis of society'. He shows

that in the network society, the dominant form of space as a 'space of places', is strongly reinforced by a new 'space of flows'; which occurs through a triad of (1) networked physical and electronic circuits, (2) new spaces of social practice and (3) organizational networks of the societal elite. It is the second layer that is to be understood as the 'node', 'hub' or 'city' into which the other two layers are fused. They are the strategically important functions – the operation or control centres of the world urban system, 'that co-ordinate interaction across the network'. Castell's manages to elaborate Sassen's global triad, with a network city research, that postulates a 'global network' connecting centres 'with different intensity and at a different scale'. Furthermore he argues that this 'spatial system of advanced service activities defines the global city as 'not a place, but a process'.

In the light of Friedmann, Sassen and Castells, Peter Taylor, in his book *World City Network* (2004), demonstrates how with the advent of multinational corporations, the traditional urban service functions has gone global. A new network of major financial and business service firms is being formed providing services to globalizing corporate clients. By analysing the location strategies of leading global service firms in various cities, the flows between different metropolitan centres is depicted, leading to a ranking of *alpha*, *beta* and/or *gamma* world cities. This results in either exogenic horizontal networks, or endogenic vertical networks, which would be interesting to integrate. Although this dual approach is a progression in city network theory, it only unveils the world of advanced producer services and does not show the intricacies and interdependencies between different economic layers. Furthermore Taylor's sophisticatedly defined 'Cartesian diagrams' are so abstracted or geographically decoded, that they are not easily accessible or understandable, in a world where communication is paramount.

Bryson, Daniels and Warf (2003), in their studies, unveil the common myth, that high-end service firms and their corresponding elite workforce are the most influential today. Furthermore they address the performance of the world city network, stressing that the core world city 'service' network is highly polarised, due to six reasons: (1) rising per capita incomes, (2) demand for health and educational services, (3) increasing administrative division of labour, (4) size and role of the public sector, (5) expansion of global trade in services, (6) externalization or outsourcing of service functions. At the level of global city 'performance' the model has been challenged as not being the exclusive preserve of large metropolises (Warf and Ericson, 1996) and that under conditions of contemporary globalization all cities are globalizing (Markuse and van Kempen, 2000), where for instance cyberspace is not essentially hierarchical as it operates in innumerable networks across an uneven landscape. However, we should consider that although all is affected, there remain different degrees of globalization and probably always will.

Roberto Camagni (1993) appears to have created the most informed model of a hierarchical global structure of cities. His diagram of 'the hierarchy of city networks' combines three levels of spatial organization, namely: the territorial (state), competitive (hierarchical) and network (co-operation). Furthermore he organises cities in order of regional (bottom), national (middle) and world cities (top). In a more recent model, found in *Global City-Regions* (ed. Scott, 2002), Camagni proposes a more sophisticated 'intellectual device', in which two logical dimensions of global city-regions is explored. The first, the *spatial logic*, distinguishes two theoretical



approaches i.e. the city as both *territorial* and *network*. The city as a *cognitive logic* forms the second dimension and includes both *functional* and *symbolic* approaches. By crossing these two dimensions in a simple matrix, four roles of global cities are derived – *city as cluster*, *city as interconnection*, *city as milieu* and *city as symbol*.

According to Anne Bretagnolle, Denise Pumain and Celine Rozenblat, the structure of world city systems is however not the result of equilibrium, produced by antagonistic forces, or market mechanisms, or any optimization constraint. Instead in their research they show that the spatial and functional structure of urban systems is the product of a complex evolutionary process, involving mainly *a competition between cities*. This competition was first historically oriented towards the political control of territories, then towards the control of economic and social networks, through trade and under changing technological conditions. In this process cities are both anticipating innovation and adapting to it by imitation (Allen, 1997). The emergence of innovation and adaptation to innovation are partly random and partly determined by the former structure of the city systems.

The integration of network theories, into a more consistent development model, in which global, regional and urban economies are integrated into an interwoven urban-economic landscape, forms one of the key challenges in economic geography. As Crang (1997) puts it, ‘content is being rethought in terms of what social and spatial portions of life count as economic and non-economic (if any) and how these interrelate’. The challenge for a city to improve its performance within the global city network requires the innovation of its social, economic and spatial competitiveness. It is therefore important to unravel why certain cities are more capable of attracting and sustaining global corporations, or as Ann Markusen (1996) terms it, ‘the puzzle of stickiness in an increasingly slippery world’.

#### *Tentative conclusions:*

This part of the paper has served to plot a provisional, journey through the *netscape* of urban evolution. It shows how the conceptions of city networks have evolved over time, by which we can to some degree attempt to conceive its future trajectory. Some trends can be identified from this history.

We see that firm-city networks, multi-locational industries and services are age-old entities, and have always produced core – periphery differentiations, with hierarchies of city formation, but also a combined densification and dispersal. It appears that the urban hierarchies are defined through firms and not the cities themselves. What is new is the magnitude of this polarization, where an upscaling has taken place from city, to regional, to national, and even today supraregional political delineations. It appears that this is caused by population growth and innovation and the acceleration of the transport and communication system, motored by cities which have become the catalysts of trade and markets. The higher the velocity of the network, the more expansive and dense it becomes (stacking). The political delineations serve as control mechanisms to regulate the internal and external flows and have in a sense facilitated the expansion of the world city network.

It is obvious that there has always been a division of labour and class polarization, due to the networks inherent characteristic of adhering to regional 'parasitical' autonomy. There does seem to be an increase of integration and a prospect of possible meta-scale integration in the future, in which the vertical and horizontal dimensions of these systems may someday become coherent. Today, the previous layers of the network's development seem to all be immediately present, where agrarian, industrial, service and today's information economies exist simultaneously, revealing a system of partly integrated fragments. It is obvious that network growth depends highly on economic cycles and the areas where these cycles are in recession, stability or recovery. To survive these cycles, the network continuously attempts to innovates itself, through mechanisms of competition and collaboration, market disequilibrium, and combinations of intradependence (within subsystems) and interdependence (between subsystems) - where profit maximization is pursued. This however means a constant tension between open 'flow' and closed 'border' conditions, in which private, public and political arenas are determined. We also see that as the complexity of the network arises, so too does the amount of services needed to manage it, in itself reproducing boosted economy and labour, where there is an obvious value-shift from material to immaterial commodities, where creativity, adaptability and innovation become the bullion of the future.

The conceptual model of the city network itself continuously innovates and becomes progressively more scientific, serving as a particular device for future research and development. The world city network, has transformed from a static model (Von Thünen) to geometric (Christaller), mechanistic (Isard), network (Friedmann), processor (Castells) and even Cartesian (Taylor) model. The question, then becomes what the next stage of the 'world city network's evolution will be? Will it become another fixation on a metaphor of control, or can it shift from pursuing absolute realities towards concepts which carry adaptive, incomplete, partial and plausible truths?

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## **2. Transitions of the European City Network:**

### **2.1 Theory: Conceptualizing Firm and City Networks in Europe.**

#### *A Europe of Political Concepts*

In the second part of the paper we focus on the current understanding of European urban networks, which slowly emerged over the last two millennia, and rigorously developed since the late 18<sup>th</sup> century (Lepetit, 1998, Matin, 1984). A supraregion which reflects an evolving territorial history, conflicts and marriages, feudal dominance and exploitation, trade configurations and tensions between urban and rural traditions. A complex system of nations and cities has resulted from this evolutionary process, of urban hierarchies and transport and communication networks. Castells (1993) reasons the particular historical tradition of European cities to be 'strategically important to the next stage of urban civilization'. Therefore a further study of the European system is important, seeing that globalization is very regional in nature (Taylor & Walker, 1999), a notion recently reinforced in the study *Multinational Enterprises are Regional, not Global*, by Alan Rugman and Cecilia

Brain (2003). As a rule, when studying Europe, we see an interplay between economic forces and political intervention, where cultural traditions only retard or accelerate ongoing capitalistic development processes. One significant transition is the current transformation of European nation-states, which started since the end of the Cold War. This has brought us to the contemporary process where cities articulate their local regional economies into the new global economy. Within the development of a single European market and the assumed increase in competition between European cities, several attempts have been made since the late 1980s, to map the changing economic spaces of Europe in terms of cities, with a preoccupation of defining new urban hierarchies (Taylor, Hoyler 2000). This ranging from the 'blue banana' of French regional planning authority DATAR (Brunet, 1989), illustrating the axis from London to Milan; the 'European sunbelt' from Madrid to Barcelona to Northern Italy; to 'boomerangs' (Gorzela, 1996) and even the 'red octopus' (van der Meer, 1998).

### *A Europe of Specializations*

Kunzmann and Wegener (1991), suggest we use 'The European grape' as a metaphor representing the polycentric structure of the European urban system, reminding us of an asymmetric version of Christaller's (1950) 'spatial order in Europe'. However, more important than his metaphor, is the derivation of three aspects which determine spatial development in Europe, i.e. (1) increasing spatial specialization, (2) resulting spatial differentiation and (3) spatial polarization – trends which can be observed at all levels of decision making, be it European, national or regional (Kunzmann, 1996). City-regions are becoming functionally specialized due to faster information and transportation flows, which have led to Europe becoming a highly regionalized economic structure, extending from the South of England, across the Benelux countries and western Germany into northern Italy. This concentration, recently termed the 'blue banana' has emerged since the thirteenth century (Braudel, 1979). The core of today's European economic activities is still similar to the city belt that dominated economic development in pre-industrial Europe. The other European regions have always tended to be on the margins of economic activity, assigned to the periphery or semi-periphery of this world economy (Wallerstein, 1974).

### *A Mosaic of European Regions*

Based on NUTS regional analysis, Martin Heidenreich has analysed the division of economic sectors in Europe, in which 3 gradations of service regions and 5 gradations of industrial regions have been defined, where it is clearly shown that the 30% service regions, which enjoy a much higher GDP per capita, in contrast to the remaining 70% industrial regions are different yet nonetheless complementary. The resulting fragmented 'blue banana' contains the highest concentration of both efficient industrial and metropolitan service functions, the strengths lying primarily in advanced services and industrial products. This dual concentration points to the complementarity and reciprocal reinforcement effects found between industrial and service regions. This suggests proximity and embedding. Furthermore the analysis explores the two hypotheses of Appold and Kasarda (1988), namely the *delocalization thesis* (role of transport and communication costs) and the *restructuring thesis* (role of available resources in a region). In the first it is shown how simple, labour-cost-intensive activities, through network advantages and cost benefits, have located

towards the European periphery. Parallel to this an upgrading of urban service has occurred in the core regions, with a 'stronger orientation towards innovation and producer related services' (Heidenreich, 1998).

#### *A Europe as Interregional and Intraregional Archipel*

The gradual expansion of the city region to a wider hinterland is a Europe-wide phenomenon. The scaling up of functions to adapt a city region to global or at least international standards leads to growing intraregional specialization of single territorial units. The regional convergence/divergence tendencies of European regional development depends increasingly on regional innovative capabilities and on localized learning, which in turn shape the attractiveness of the region towards outside resources. The regional dimension also includes economic, social, cultural and institutional factors, all of which are critical to the locational choices of multinational corporations, especially with regard to innovative capacity (Cantwell, Iammarino, 1998). While old categories in land use or regional physical plans are obsolete, the emergence of new spatial categories can be observed (Ache *et al*, 1991; Kunzmann, 1993). According to Klaus Kunzmann Europe today consists of an interregional network of fragmented intraregional spaces. The categories of specialized intraregional spaces are: (1) international finance and service centres; (2) modern R&D spaces; (3) restructured industrial complexes; (4) modern production complexes (just-in-time regions); (5) interregional distribution centres; (6) urbanized transportation corridors; (7) urban backwater space; (8) rural industrial complexes; (9) marginalized rural worlds; (10) gentrified rural areas; (11) aerovilles (airport cities); and leisure worlds (Disney worlds). It seems that the European network, is as it were, a microcosm of the world network.

#### *A Europe of Globally Networked Cities*

According to Peter Taylor and Michael Hoyler (2000) of the research group GaWC, Michael Dunford (1998), is impressed by the historical continuity of Europe's urban axis, which is related to 'long term processes of circular and cumulative causation which have permitted the almost constant adaptation to changing circumstances of established cities with critical concentrations of people, economic infrastructures, know-how and political power'. In Taylor and Hoyler's study on the current spatial order of European cities (2000), they argue that the new spatial order of European cities is not only influenced by these 'long term processes', but have become more determined by globalization and world-region building. This conclusion is drawn by a theoretically-informed multivariate analysis, in which 53 European cities have been identified and their relationship to 46 global producer service firms. From this a new spatial order was derived, classified into two 'spine city' components (major and minor); and three components measuring European peripheral regions 'far east', 'far west' and a triangular combination of north, south-east and south-west. One of the findings is that London is neither very European nor very British, relating to its global role and with which they conclude that there can be no 'Europe of cities' in a systemic sense, under present conditions of globalization.

## 2.2 Empirics: New Insights into the current Firm and City Networks of Europe.

According to Pred (1978) urban hierarchies are defined through firms and not the cities themselves. If this is the case, then what is the current status of this age-old phenomenon? What are the current internal European firm-city relations (functional and spatial) in this supraregion, and what are Europe's external city relations with the world? In other words, what is the European slice of the world city network?

To engage with these questions, this chapter is divided into *economic functions* and *spatial dimensions*, still following the division of figures 1 and 2. Based on a 'eurocentric' dataset of 8398 firms and 2184 cities worldwide, the *first* section analyses (1) the share of the top multinationals (MNC) in European cities, under five economic sectors; (2) the affiliates and subsidiaries of these MNCs and the cities where these firms are based; (3) the over or under representation of firms in cities, classified per sector; (4) the share of all firm-city connections, within and beyond Europe; and (5) the coherence between city economic profiles and connectivity. The *second* section maps the datasets using a 'geographic information system' (GIS). In this way we reveal the empirics of the European 'netscape' in a geographically recognisable way. The main focus is to understand the spatial distribution (core, linkages and periphery) of European related firms and cities. This is done by (1) mapping the clustering of top MNC headquarters in European cities; (2) then mapping the linkage intensities and densities, of all subsidiaries and affiliates, of the top 100 MNC headquarters. This reveals intra-connections within Europe (horizontal) and inter-connections (vertical) from Europe to the rest of the world. The maps depict sectoral, sub-sectoral and also two specific key firm networks.

### *Economic functions:*

Multinational firms are key agents of globalization and urbanization processes, although it should be stressed that they form only a part of the whole picture. Of the 500 (Financial Times) top global MNCs, 48% are USA based, 31% are European based, 13% Japanese, and 8% are accounted for in the rest of the world. It is the European one-third share which will be our main focus, starting with the localization of these headquarters in European cities. In (table 1) we show which cities are the key attractors for MNC headquarter location, organized under the five sectors of *basic materials, manufacturing, trade, consumer services and producer services*. Not surprisingly, London has a royal share of the total firms under each sector, for instance 21% of all producer firm headquarters; and a 16% share of all 500 headquarters in Europe. Because this only illustrates the 'headquarter potential' of cities, we further constructed a database of all the affiliates and subsidiaries of the top 100 European MNC headquarters. This was thoroughly executed using a consistent method and reliable data resources at the Erasmus University, which led to an initial dataset of the connections between 8398 firms and 2109 cities.

Of all these city-firm connections (table 2), 13% (279) of the cities hold 68% (5675) of all connections (8398), based on the criteria that these cities have 4 or more linkages. 87% (1830) of the cities hold 32% (2723) of all connections, selected on the basis of having only 1 to 4 linkages. Although in the rest of this paper we will focus only on the top end of connections, it should not be ignored that the bottom end does account for a third of all European connections. Furthermore, the table indicates the

distribution of these connections over the five sectors, and also grouped under *goods* (basic materials + manufacturing) and *information* (producer services + consumer services + trade). The bottom bar shows the percentages of the sectors, divided into top-end and bottom-end cities. We see that the bottom-end is primarily successful in basic materials and manufacturing, while the top-end is adept in the information services.

From this, we questioned which cities have the most connections. Using the top-end (> 4 connections) cities, a ranking was made (table 3). The table shows the top 20 of the 279 top-end cities and the 'location index' distribution over 5 sectors. We see for instance that New York, London and Paris (core cities) are ranked highest due to their total scores over sectors, while Munich scores highest on producer services, Amsterdam highest on trade, Luxembourg highest on consumer services, Houston highest on manufacturing, and Houston and Milan highest on basic materials. Furthermore, (graphs 1 to 5) represent the correlation between the location indexes (per sector) of firms in cities (x-axis), and the city-firm connectivity (y-axis). Cities under the dotted line have an under-representation of these sectoral firms, and above the line, an over-representation.

Next we analysed the producer services sector in more detail, namely the sub-sectors of finance and insurance. Real estate, one of the usual FIRE sub-sectors, was not identified in our top-end city-firm relations. In (table 4), the top cities in relation to finance and insurance are depicted. From this the number of connections, the percentages of these sub-sectors of all connections per city, and the specific location coefficients can be found. Also shown at the bottom of the table are the total distributions of these sub-sectors over all city-firm connections. In (graphs 6 to 7) a similar approach to the other graphs is carried out, but specifically for the sub-sectors of finance and insurance. We see for instance that Brussels is under-represented for finance, but over represented for insurance. In (graph 8) the location coefficients of both insurance (y-axis) and finance (x-axis) are correlated, in interrelation to the connectivity of the cities (bubble size). We see for instance that Zurich is reasonably successful in finance, but not in insurance, and that its overall connectivity is moderate.

In (graph 9) a comparison is made (relative to London), between the *sectoral similarity*, (the degree of economic profile similarity) of all cities, and their level of connectivity. Disregarding the latter, we would find that London, San Francisco and Prague have a similar economic profile, but taking connectivity into account, would place Paris, Brussels and Milan as the most similar (in connection and profile) to London. From this a basic conclusion can be made. The more cities are similar (x, y extremes and axis), the more competitive their relationship might be. The more dissimilar, the more the relationship could indicate existing or potential collaborations.

Last, under the economic functional study, an analysis was carried out concerning the supranational share of the overall European city-firm linkages (table 5). Indicated are a total division over the EU, North America, Asia, South America, Africa, Polynesia and the Middle East. We see that Europe has almost 50% connectivity within the supranational region itself, in which we can conclude that the intricate webs between MNCs and their partner firms are both regionally powerful, and increasingly globally intense. In the table, five other units are shown, in which a more specific division is made,

based on the hierarchic order of the subsidiaries and affiliates. These subdivisions have however not been used in this research (yet), but for now exemplify a more particular relationship. In this relationship we see that for 1<sup>st</sup> and 2<sup>nd</sup> order subsidiaries and affiliates, the share of connectivity is European, while for the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> order partners, the weight lies in North America.

### *Spatial dimensions:*

What is Europe's contemporary netscape? This is the fundamental question of this section, in which the nodes, cores, linkages and peripheries of Europe are mapped using GIS, and where the intensities and densities of the network are unfolded. This reveals two distinct categories of map. The first, depicting the internal network within Europe itself (mezzo scale), as a consolidated *horizontal* and *vertical* web of firms and cities. The second exposes Europe's acquired *vertical* linkages to external cities and regions (macro scale). In (figure 1) we see a representation of the top 100 MNC headquarters across European cities, in which London, Paris, Amsterdam, Munich, Zurich and Madrid form the primary nodes. We also see a dispersed arrangement of secondary cities, such as Bilbao, Rome, Glasgow, Oslo; and a ridge of cities from Randstad to Milan. These cities accommodate the 100 firms which account for 68% of the market capital, of the top 500 MNCs of Europe. Therefore this chain of cities forms the primary core of Europe. The remaining 400 firms account for 32% of the market capital, and when added to the top 100, we see a proliferation of nodes (figure 2), especially in the European periphery, such as Athens, Istanbul, Helsinki, Oslo and Dublin. The Ruhr/Randstad area is densified within the range of these firms.

This however only shows us nodal intensities, but what are the intercity network relationships? Based on the previously mentioned database, in which the top 100 firms and all their affiliates and subsidiaries were collected, we mapped the number of city-firm connections (figure 3a). The map reveals an intricate network of all five economic sectors, in which the previous map's nodes are elaborated and intensified due to the addition of the partner firms. We see a collection of new tertiary cities - high connectivity ones such as Sicily, La Coruna, Budapest and Belgrade; and lower connectivity ones such as Malaga, Valencia, Porto, Minsk, Warsaw, Cork, Galway and Belfast. These cities form the tertiary support of the European core regions, but could also be regarded as the European periphery. The network intensities (connections and thicknesses) reveal the complexity of economic activity within Europe. London, Randstad to Milan, forms the 'Eurocore', with four main extensions towards Glasgow, Porto, Helsinki, and Belgrade. The once clear, symmetric 'blue banana', has evolved into a multifarious, asymmetric, European netscape.

In (figure 3b to 3e), the network is separated into the five economic sectors. In 3b it is shown that the primary link of basic materials is London – Milan, with secondary ones, Paris – Ruhr, Rome – Bern, and London – Glasgow. The primary agglomeration of manufacturing falls in the NW European zone, as shown in 3c, but with the strong linkages of Zurich – Helsinki, London – Stockholm and Toulouse – London. There is also an evident axis of core manufacturing cities between Madrid and Helsinki, which together with patterns in the trade sector (3d), appear to contribute most to the disintegration of the 'blue banana'. In figure 3e, we see the clustering of consumer services, where the concentrations are evidently and obviously in cities with the highest populations.

In figure 3f we expose the producer services network, which strongly resembles the Eurocore of the top 500 HQs map (figure 2), indicating a strong coherence between headquarters and producer services. Primary nodes in this map are London, Paris, Milan and Munich; while the strongest links are Stockholm – London – Paris – Sicily, London – Amsterdam, and Dublin – Amsterdam. A further deepening of the producer service network is shown in the financial (figure 3g) and finance (figure 3h) sub-sectors, as well as the respective top firms of these sub-sectors, namely HSBC Holdings (figure 3i) and Allianz AG (figure 3j). In this way sub-levels of the network can be mapped to discover more specific understandings, for instance the radial strengths of Allianz AG from Munich (headquarter) to Stuttgart, Ruhr cities and Randstad cities (especially Rotterdam, due to port related insurance).

In the first section of the mapping we presented the internal, horizontal and vertical cores, linkages and peripheries, within Europe. In the next section we explore Europe's vertical, outbound, connections to the rest of the world, remembering that Europe accounts for 31% of all global top MNC headquarters, and internally accounts for 47% of all Eurocentric activities, while the rest is distributed worldwide (table 5). In (figure 4a), these functional relationships are spatially represented, where it is clear that North America accounts for 31% of the connections, Asia 10%, South America 5% and so fourth. Interesting is that the west coast of North America has substantial relations to Europe, but also the Caribbean zone. The southern world cities are primarily coastal ports, suggesting the supply of basic materials and manufactured goods to Europe, which is more evident in (figure 4b) where Johannesburg-Durban, Perth, Rio de Janeiro play an important role. Manufacturing is shown in (figure 4c) in which North America, the Caribbean and SE Asia play an important role. It is also interesting that West African and Southern African cities are well represented. Trade is most related to North America's west coast, and a few South American port cities (figure 4d). The strongest linkages for consumer services (figure 4e) are once again with North American, west coast cities. Once again it is interesting to see that Africa has a high concentration of activities, although relatively small.

Besides the usual suspects, the producer service map (figure 4f) shows strong relations with Bangkok, Kuala Lumpur, Jakarta and Singapore and higher up with Beijing, Seoul, Japan, Shanghai and Taipei. A further deepening into the producer service network is shown in financial (figure 4g) and insurance (figure 4h) sub-sector maps, followed with the respective top firms from each of these sectors, HSBC Holdings (figure 4i) and Allianz AG (figure 4j). In the HSBC holdings map we see the company's strongest relations with Kuala Lumpur and Tokyo, but also at this scale of network analysis, we see interesting fragments appearing, such as the intense Singapore – Hong Kong link. For Allianz AG, Tokyo, Bangkok, Kuala Lumpur, Singapore, Jakarta, Sidney and Auckland account for this firms eastern linkages. A very strong insurance link is situated between New York (trade gateway to Europe) and Minneapolis (trade gateway to USA's Great Northern Plains).

#### *Concluding remarks:*

In this research we show a brief historical overview of how the physical and conceptual model of the world city network developed, with a summary of tentative conclusions at the end of part one. The empirical research in part two has engaged with a few of these conclusions, unravelling partial understandings of the present



condition of the world city network. In this European 'netscape' (figure 4k), we see how communication and transport have allowed for a significant upscaling and complexifying of the core – linkage –periphery context, but also a 50% dependency on extra-European connections, in which we can say that this supraregion is currently determined by an equal share of both regional and global activities. Therefore a historical understanding of 'long term processes' (Castells) and the understanding of global forces (Taylor) are both important to Europe's future. These display horizontal and vertical hierarchies of connectivity. In the separate maps we indicated the different goods and information sectors, where it is also important to note that primary cities have an incremental stacking of these sectoral functions, signifying various interdependencies between these. Related to this, we have seen in the graphs, that cities have various gradations of economic profile, in which there are similar ones (likely competitors) and dissimilar ones (likely collaborators).

Furthermore we see that Europe has an approximate 80% dependency on services to maintain the city-firm system. We see increasing intraregional and interregional spatial specialization, differentiation and polarization, at all scales – signifying the accelerated continuation of an age-old trend. We see a disintegration of the previously, clearly defined 'blue banana', possibly due to new EU policies and the role of transport and communication benefits. There is still a diffuse, fragmentary Eurocore present, in which the majority of innovation, consumer and producer services exist. In the above, we sum up our observations, which can only fractionally contribute to an understanding of the infinitesimal complexity of this system, whereby we can only contemplate about the next stage of the netscape's evolution.



Figure 1



Figure 2

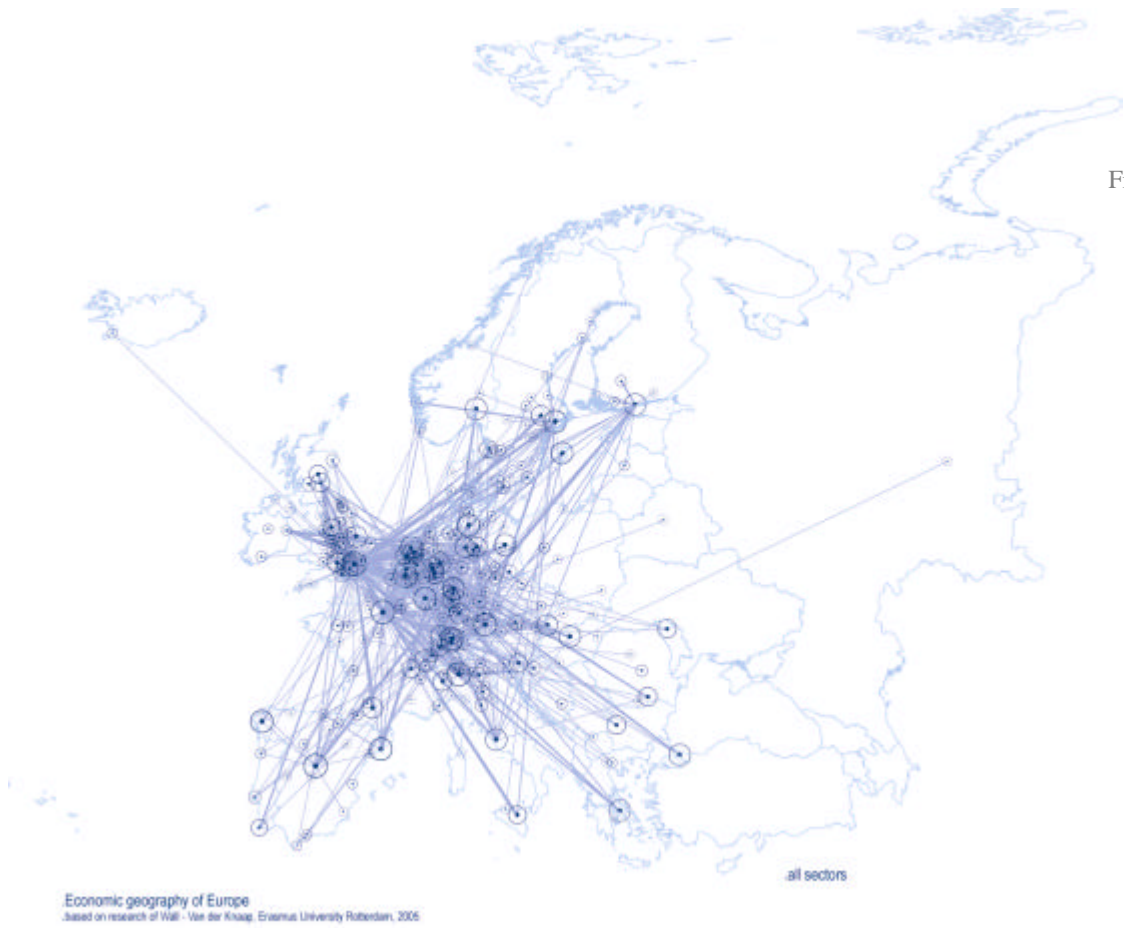


Figure 3a

Figure 3b



Figure 3c



Figure 3d

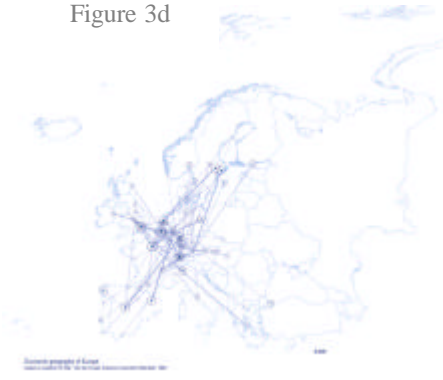


Figure 3e

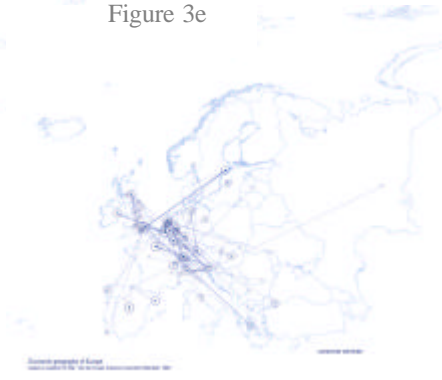




Figure 3f

Figure 3g



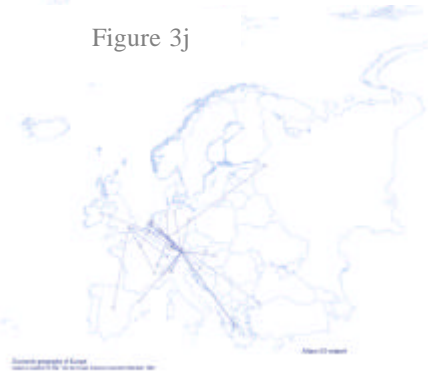
Figure 3h



Figure 3i



Figure 3j



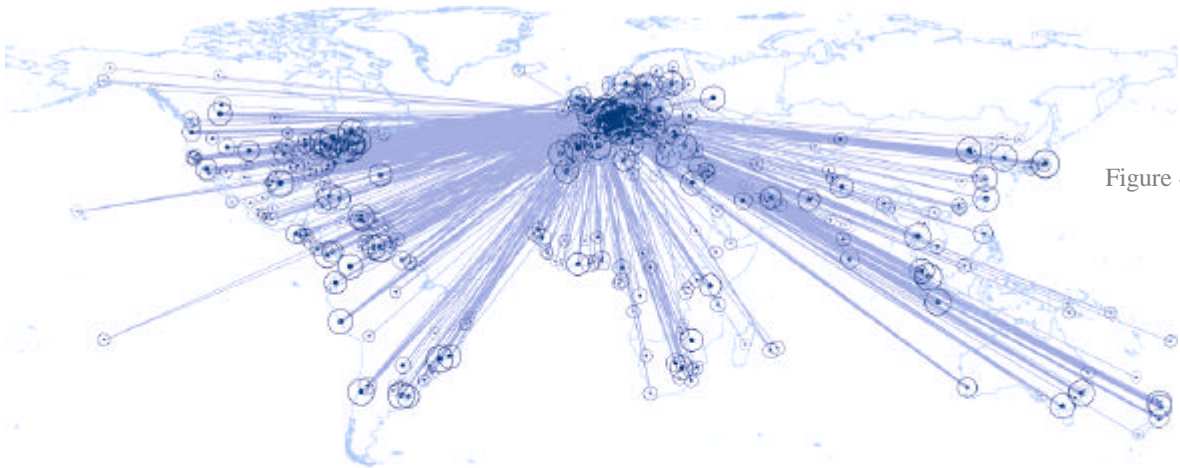


Figure 4a

Economic geography of Europe in relation to the world  
 based on research of Wai - Uwe der Knaap, Erasmus University Rotterdam, 2005

.all sectors

Figure 4b



Figure 4c



Economic geography of Europe in relation to the world  
 based on research of Wai - Uwe der Knaap, Erasmus University Rotterdam, 2005

steel industry

manufacturing

Figure 4d



Figure 4e



Economic geography of Europe in relation to the world  
 based on research of Wai - Uwe der Knaap, Erasmus University Rotterdam, 2005

textile

agriculture services



Figure 4f

Economic geography of Europe in relation to the world  
 based on research of Wai - Van der Knaap, Erasmus University Rotterdam, 2005

.producer services

Figure 4g



Figure 4h



Economic geography of Europe in relation to the world  
 based on research of Wai - Van der Knaap, Erasmus University Rotterdam, 2005

in - finance

Economic geography of Europe in relation to the world  
 based on research of Wai - Van der Knaap, Erasmus University Rotterdam, 2005

in - insurance

Figure 4i



Figure 4j



Economic geography of Europe in relation to the world  
 based on research of Wai - Van der Knaap, Erasmus University Rotterdam, 2005

W&A Holdings PLC network

Economic geography of Europe in relation to the world  
 based on research of Wai - Van der Knaap, Erasmus University Rotterdam, 2005

Altria AG network

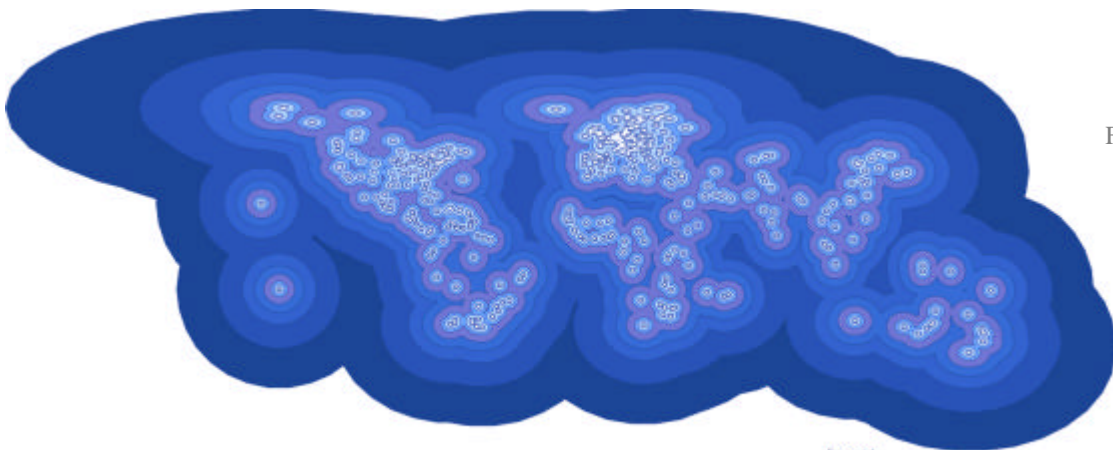


Figure 4k

Economic geography of Europe in relation to the world  
 based on research of Wai - Van der Knaap, Erasmus University Rotterdam, 2005

Ergeprint

**EU CITIES WITH PRIMARY SHARE OF HEADQUARTERS PER SECTOR**

City HQ	Sector	Rank	HQs number	% of total sector	% of all 500 HQs
London	basic materials	1	6	40	16.0
Moscow		2	2	13	0.4
London	consumer services	1	7	10	
Paris		2	5	7	8.7
Zurich		3	5	7	1.0
London	manufacturing	1	20	12	
Paris		2	15	9	2.2
Stockholm		3	9	5	
Madrid		4	7	4	
Milan		5	6	4	1.2
London	producer services	1	25	21	
Paris		2	10	8	
Stockholm		3	6	5	1.6
Rome		4	5	4	2.0
London	trade	1	21	17	
Paris		2	13	11	
Rome		3	5	4	
Madrid		4	4	3	
Stockholm		5	3	2	

Table 1

**SECTORAL SHARE OF CONNECTIONS**

For both cities with more than 4 connections and cities under 5 connections

basic materials	manufacturing	consumer services	trade	producer services	total	goods	information	
136	1965	1370	696	1508	5675	2101	3574	total > 4
170	1450	287	354	462	2723	1620	1103	total < 5
306	3415	1657	1050	1970	8398	3721	4677	TOTAL
44	58	83	66	77	68	56	76	total% > 4
56	42	17	34	23	32	44	24	total% < 5

goods (basic materials + manufacturing)  
information (producer services + consumer services + trade)

Table 2

**TOP 20 CITIES BASED ON LOCATION INDEX OF SECTORAL CONNECTIVITY (outliers excluded)**

ranked cities	basic materials	manufacturing	consumer services	trade	producer services	# connections
New York	87	56	136	121	137	284
London	27	59	126	76	174	201
Paris	75	70	166	92	105	183
Brussels	71	56	183	144	88	155
Madrid	36	70	198	79	90	151
Milan	156	75	83	62	169	141
Tokyo	0	72	76	88	191	127
Singapore	24	59	72	134	189	113
Vienna	82	52	142	96	153	100
Hong Kong	32	29	177	121	159	86
Buenos Aires	33	110	67	145	98	83
Houston, Texas	174	165	26	121	27	79
Dublin	35	104	149	41	93	78
Sao Paulo	144	100	93	63	118	76
Barcelona	75	77	90	121	140	73
Munich	38	57	104	11	228	73
Zurich	155	31	107	113	198	71
Amsterdam	42	42	187	209	79	65
Luxembourg	44	16	249	63	149	63
Frankfurt am Main	47	25	120	203	166	59

Table 3

**FINANCE AND INSURANCE SHARE OF CONNECTIONS**

	#connections finance	#connections insurance	% finance	% insurance	lq finance	lq insurance
New York	72	61	25	21	104	145
London	68	30	34	15	139	101
Paris	45	37	25	20	101	136
Brussels	34	39	22	25	90	170
Madrid	52	24	34	16	142	107
Milan	45	15	32	11	131	72
Tokyo	37	12	29	9	120	64
Singapore	32	12	28	11	117	72
Vienna	31	23	31	23	128	155
Hong Kong	36	14	42	16	172	110
Buenos Aires	11	7	13	8	55	57
Houston, Texas	5	1	6	1	26	9
Dublin	21	12	27	15	111	104
Sao Paulo	18	7	24	9	97	62
Munich	22	14	30	19	124	129
Barcelona	23	8	32	11	130	74
Zurich	37	2	52	3	214	19
Amsterdam	21	12	32	18	133	124
Luxembourg	34	16	54	25	222	171
Frankfurt am Main	21	11	36	19	146	126

#connections total	#connections finance	#connections insurance	% finance	% insurance	
5675	1379	842	24	15	total > 4
2723	252	183	9	7	total < 5
8398	1631	1025	19	12	Total

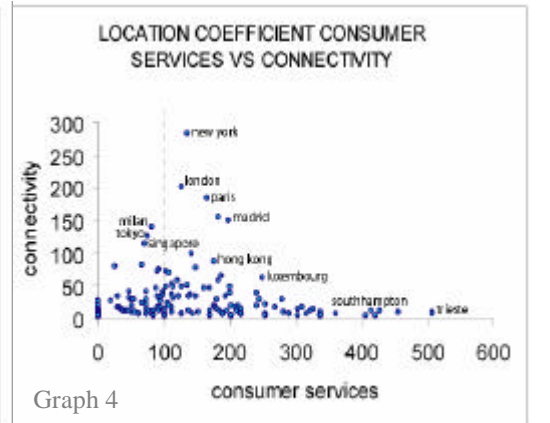
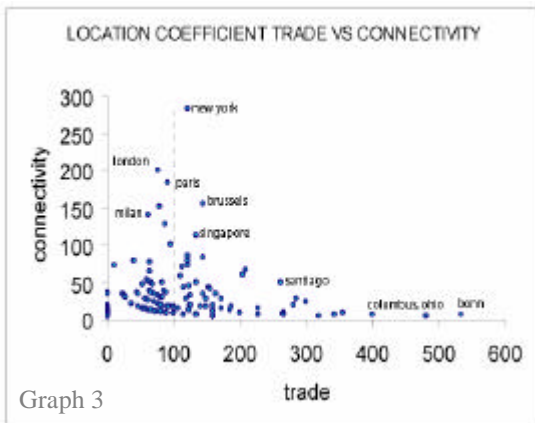
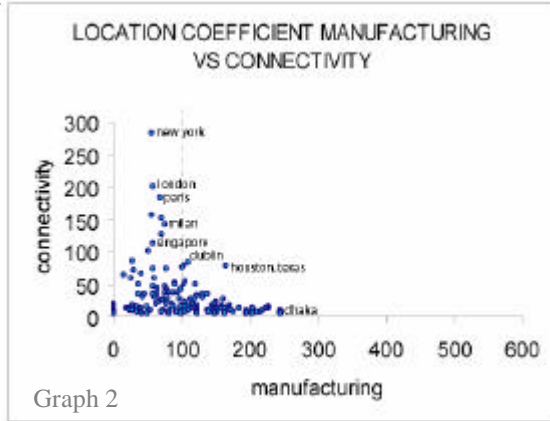
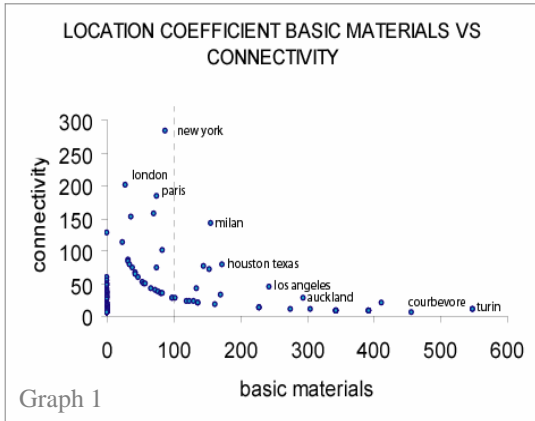
Table 4

**SHARE OF CONNECTIONS BETWEEN SUPRAREGIONS**

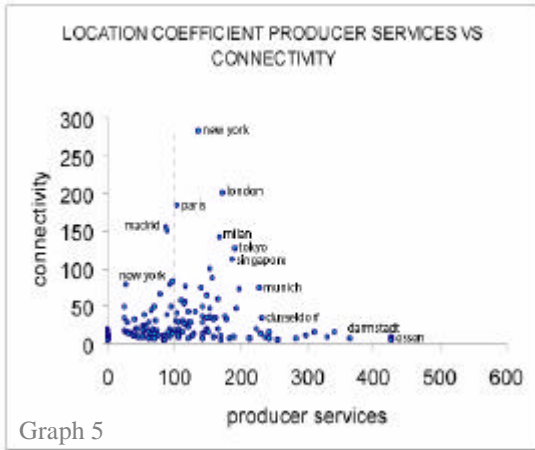
	connections	share		connections	share		
<b>TOTAL</b>	eu	3922	47%	1	eu	1742	52%
	north america	2605	31%		north america	603	18%
	asia	818	10%		asia	421	13%
	south america	397	5%		south america	215	6%
	africa	289	3%		africa	178	5%
	polynesia	247	3%		polynesia	122	4%
	middle east	126	1%		middle east	79	2%
		8404	100%			3360	100%
<b>2</b>	eu	1433	50%	<b>3</b>	north america	758	52%
	north america	871	30%		eu	474	32%
	asia	275	10%		asia	97	7%
	south america	107	4%		south america	53	4%
	polynesia	82	3%		africa	33	2%
	africa	78	3%		polynesia	32	2%
	middle east	31	1%		middle east	13	1%
		2877	100%			1460	100%
<b>4</b>	north america	302	61%	<b>5</b>	north america	69	65%
	eu	146	30%		eu	21	20%
	asia	23	5%		south america	10	9%
	south america	12	2%		polynesia	4	4%
	polynesia	7	1%		asia	2	2%
	middle east	3	1%		africa	0	0%
	africa	0	0%		middle east	0	0%
		493	100%			106	100%

- 1 1st order subsidiaries/affiliates
- 2 2nd order subsidiaries/affiliates
- 3 3rd order subsidiaries/affiliates
- 4 4th order subsidiaries/affiliates
- 5 5th order subsidiaries/affiliates

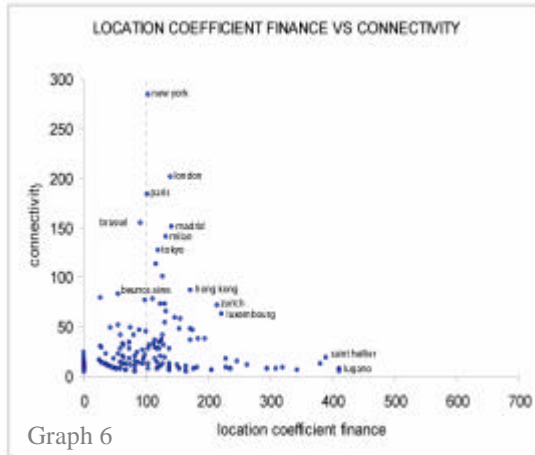
Table 4



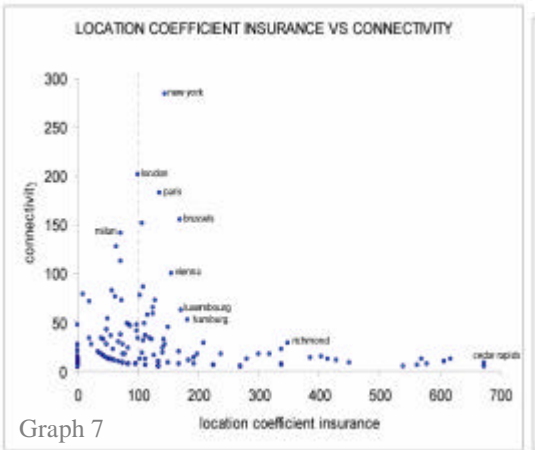




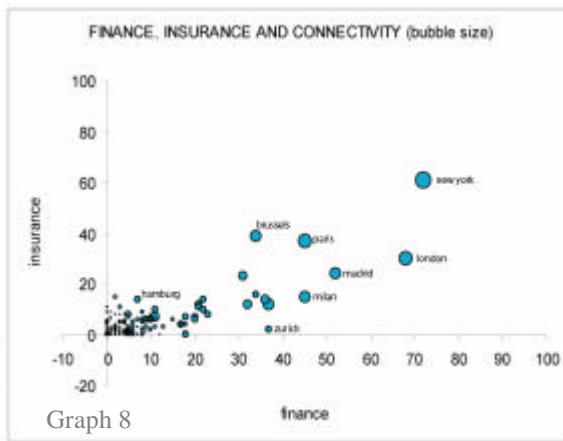
Graph 5



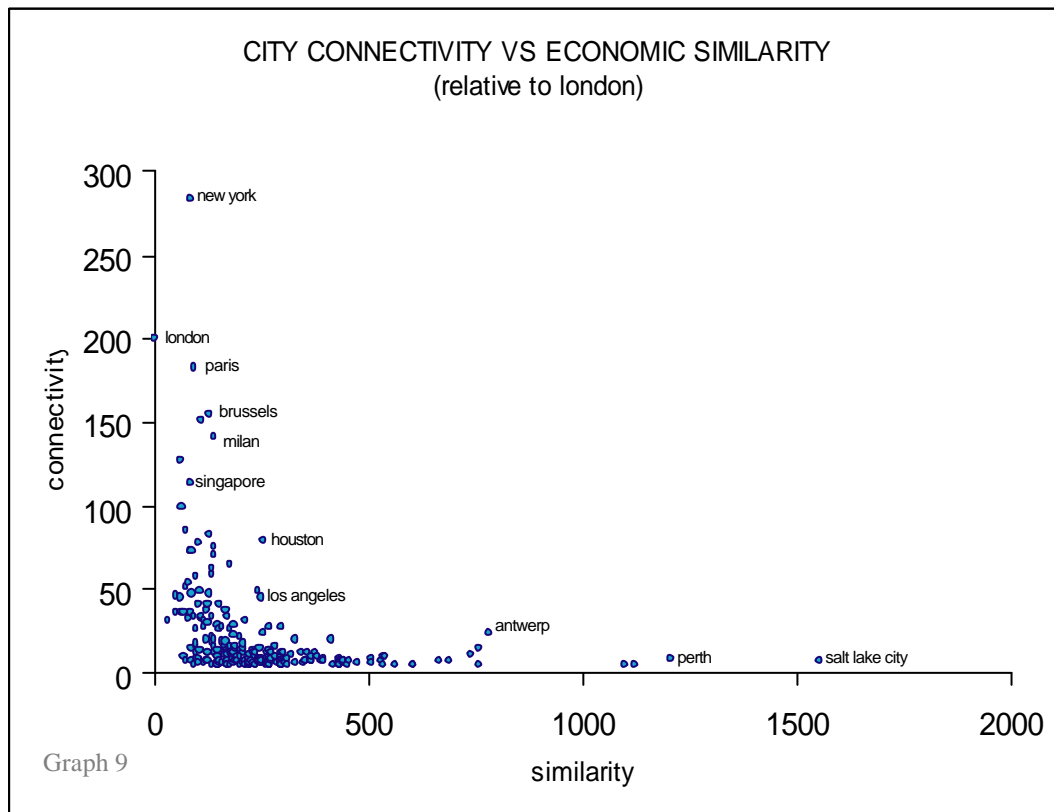
Graph 6



Graph 7



Graph 8



Graph 9