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"Cities networks and economic performances: a comparative study on European and US cities"

Gilles Van Hamme, Université Libre de Bruxelles
Kathy Pain, University of Reading
Sandra Vinciguerra, University of Reading

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Introduction

Globalization and city networks are two faces of the same coin. As economies across the world become more and more integrated, global cities play an ever growing role as nodes in the global economy. They are the places where global networks of firms can source concrete assets, i.e. a large diversity of qualified labour, advanced services and communication and transport infrastructures. They are also the places where global firms connect with each other, where face to face contact takes place and where distance to the rest of the world therefore tends to be minimal. In this context, the academic and policy literature focusing on the "competitiveness" of (big) cities tends to emphasize the idea that "bigger is better" (Turok, 2006). Finally, as Sassen (19991) has argued, globalization goes hand in hand with the concentration of strategic functions, resulting in increasing agglomeration of commanding functions in (global) cities. Hence, to classical competitive advantages of cities – such as size and diversity of labour, the diversity of services or the importance of markets –, we must add their role as increasingly interconnected nodes in a globally integrated economy.

A whole body of literature has developed around this general idea in order to try to understand how the network enterprises that now characterise global and globalizing cities, actually operate in practice through cities in the world economy - what is their geography and their dynamics? In a way, this "city network paradigm" tends to be circular in the sense that many contributions to the literature focus on network dynamics and the changing network connectivity ranking of cities without trying to test the links between network positionality and structural features, on the one hand, and economic performance, on the other. The precise aim of this paper is to assess the link between city network connectivity and economic performance.

Theoretical framework

Globalization has been one of the dominant paradigms in economic geography, and more generally in social sciences, for the last two decades (Peck, 2003). In several fields of geography, mainly urban geography and economic geography, theorization of the network paradigm has emerged as a natural consequence of globalization (Friedman, Wolff, 1982; Sassen, 2001; Castells, 1996; Beaverstock *et al.*, 2000; Veltz, 1996). The network paradigm starts from the assumption that economic globalization profoundly reshapes the spatial pattern of the economy at a regional scale and gives decisive advantages to the most connected places through different types of networks (social, economic, transport etc.). Here, the old paradigm of territories and nation-states is replaced by a new paradigm of places, flows and networks.

Building on seminal theoretical works, a large body of related empirical research has emerged from the end of the nineties. Taylor and collaborators in particular have drawn on Sassen's conceptualization of the production of a "global city" role as a consequence of the simultaneous dispersion and concentration of advanced producer services and Castells' (1996) theorization of a "space of flows" produced by organisational networks that operate within and between cities on a global scale. The business generated inter-city relations that are the outcome of these processes confer connectivity on cities world-wide however this connectivity defied measurement until the late nineteen nineties (Beaverstock *et al.*, 2000). The basic idea of empirical measurement was to build a matrix of city connectivity according to the presence of large transnational companies in the principle domains of advanced producer services, namely banking/finance, insurance, accountancy, law, advertising and management consultancy. From this idea, many papers have focused on describing diverse other global city networks (Alderson *et al.*, 2010; Pereira, de Rudder, 2010), in order to understand the position and dynamics of a single city, or the relationships between two cities (dyads) (Pain, 2008a). Alternative methodologies have also been proposed, notably by incorporating the financial links between enterprises (Rozenblatt, 2008).

However when it comes to understanding the relationship between city connectivity and the wider city, regional or national economy – the central preoccupation in the urban competitiveness literature - we find both the lack of a theoretical framework and of empirical evidence. While connectivity is supposed to be one of the key inputs to urban innovation and competitiveness today, the competitiveness literature provides scant empirical evidence to support this. On the other hand most theoretical and empirical studies of city networks are concerned with understanding city connectivity and its actual dynamics rather than with how these might impact on economic performance. In this respect, the city network/globalization literature appears rather circular and uninterested in integration with others areas of urban and economic geography. In particular, the city networks and urban/regional competitiveness approaches, whether relational, evolutionary or other, mainly either seem to ignore and avoid each other.

The concept of metropolitanization provides a first answer to understanding the relationship between urban competitiveness and connectivity. In Sassen's view, metropolitanization is the result of "the massive trends toward spatial dispersion of economic activities at the metropolitan, national and global level, which we associate with globalization, [which] have contributed to a demand for new forms of territorial centralization of top-level management and control operations" (Sassen, 1996). In this perspective, global cities are improving their position because of their capacities to gain a central position in the global networks constructed by firms in the advanced producer services. This capacity relies of course on the existence of dense intra-urban networks and multiple agglomeration effects in strategic functions (Rozenblatt, 2010). In this respect, metropolitanization and globalization are two faces of the same coin.

However, we will argue here that this view raises three main issues.

First, this thesis seems to completely ignore a whole literature for which metropolitanization processes go far beyond the concentration of strategic functions related to globalization. Indeed, the "*new" economic geography* insists on the unavoidable processes of spatial agglomeration (Krugman, 1998). However, while not denying the importance of such agglomeration effects, many authors have criticized the a-historical and a-contextual conceptions developed by the *new economic geography* (Martin, Sunley, 1996; Boddy, 1999). In particular, processes related to institutions, in a broader sense, or the complex untraded dependencies that might also lead to spatial agglomeration are completely ignored (Sunley, 2003; Martin, 2008; Turok, 2006). Highlighting the complexity of urban competitiveness factors is nevertheless not sufficient to understand why metropolitan areas are supposed to regain strength from the eighties onwards. More generally, the question why size might be an advantage or not according to the period considered, is unresolved (Vandermotten *et al*., 2010). In this context, the *regulationist approach*, especially the analysis of the shift from the fordist to the neoliberal regime of accumulation is particularly useful. Processes such as the emergence of a more unstable and segmented market and the orientation and reorganization of firms toward their core business might help in understanding the renewed advantages of metropolises (Boyer, 2004; Harvey, 2005). In this *regulation* perspective, globalization and liberalization should also be understood as an answer to stagnating demand and decreasing profit rates in developed countries during the 1970's, allowing large firms to develop strategies at the global level and to reach all markets across the globe (Duménil, Lévy, 2005). In this new more unstable macro-economic context, the city offers many decisive advantages: a large and diversified source of qualified and low-qualified, flexible and available workforce; a range of services that an enterprise needs when re-centering on its *core-business;* the capacity to bring together all economic players within an economy more horizontal than before; their interface role, and their communications and transport infrastructures, between national, regional, and local scales on the one hand, and the global economy on the other hand.

A second issue is related to scale. Initially, Sassen's global city thesis only focused on and related to a small number of leading world cities. However, the processes described, seemed to go beyond this elite circle of global cities. The size a city should have to benefit from metropolitanization processes nevertheless remains an unanswered question. Evidence from previous studies seem to not only prioritise global cities but also the ability of first national (not always, capital) cities to benefit from

these processes, in the European context at least. In this context, re-concentration of activities and strategic functions do not only occur at the global scale but also at a national scale, even within the integrated European market. This process was certainly true from the 1990's, but seemed to slow down after 2001 (DG Regio, 2009; Lennert *et al*., 2011).

Finally, few empirical studies have actually demonstrated the existence of a re-concentration of activities to the benefit of large cities (see DG Regio, 2009; Lennert *et al*., 2011), and none has been able to disentangle the processes behind it, and especially its unequal strength in time and space.

The purpose of this paper is to explore empirically the relationships between city connectivity and economic performance. To achieve this objective, a clear analysis needs to consider the relevant factors associated with competitiveness in the literature and to disentangle the potential relationships between competitiveness indicators (size, economic structures, labour force qualification, accessibility etc.) and network connectivity.

By using a unique database that includes large European and US cities, such an analysis is possible and might provide first answers about this elusive relationship.

Data and method

In the framework of a European Spatial Observation Network (ESPON) project on globalization, a unique database on cities has been built which includes structures, connectivity and performance indicators for European and US cities, each with a population size of more than 500,000 inhabitants.

All indicators have been collected at the city-region (functional city) Level. In Europe, we have used the Large Urban Zones (LUZ) provided by the Urban Audit. While the basic idea is to consider the "influence area" of core cities through daily commuting, exact definitions differ across Member States. Moreover, in order to find more relevant indicators, we have been obliged to use the NUTS3 proxies of LUZ, that is the NUTS3 that best fit the LUZ area defined by the Urban Audit[1] (Lennert *et al*., 2011). However, in most cases, spatial delimitations only differ in the margins of the functional cities (LUZ), without affecting the measures used in this paper, whether these are structural data (the level of education for example) or absolute indicators such as the number or value of connections, because major hub functions are always included within the LUZ area (ports, airports, or advanced producer services mostly locate in the core areas of these cities). In the USA, the delimitation of Metropolitan Areas has been provided on the same principle, but in a much more homogenous way throughout the US territory. The Office of Management and Budget (OMB) has defined a « Core Based Statistical Area » throughout the country. Metropolitan Areas include all counties which send more than 25% of their workers to the core area. This definition is also used by the US census Bureau and the Bureau of Economic Analysis which makes the collection of data for US metropolitan areas easy. Delimitations are thus roughly comparable between Europe and the USA as long as we use large urban zones and Metropolitan areas. On this basis, we have built a database for all European and US functional cities with more than 500,000 population.

As far as connectivity indicators (GAWC connectivity) are concerned, we assigned all cities included in the dataset to their correspondent European NUTS3 regions and US Metropolitan Areas, in order to integrate the connectivity indicators to the other regional information. Gross city connectivity, in particular, refers to the value of connections interlinking a given city to other cities included in the "World City Network" generated by advanced producer services (Taylor 2004); all values are ratios of the most connected city in the world city network.

[1] The basic idea is to consider that a large urban zone can be approximated by a NUTS3 area when more than 70% of the population of this NUTS3 resides in the LUZ. The NUTS classification is a hierarchical classification of territories across the EU and near neighbours (Norway, Switzerland, Turkey). NUTS 3 corresponds for example to *Kreise* in Germany or *Departement* in France. It is not totally homogeneous because of its reliance on pre-existing national administrative divisions.

Using the database, we have undertaken statistical analyses with economic performance as the dependent variable and connectivity in different networks as independent variables to test whether the network position of cities is important to explain their economic performance. The focus of this paper is on city position in advanced producer services but we also consider other types of network to measure the position of cities (see annex for description): air connections, maritime connections, economic commanding functions and political commanding functions (only for European cities). We introduce these different network indicators separately in the regression because of their high level of collinearity, except for connections in maritime networks. The exact indicator used in the regressions is the number of extra-continental connections, except for economic and political commanding functions for which this does not make much sense. This is because we want to test city position in global networks rather than intra-continental connections, however, we would like to highlight that this barely affects the results. We define economic performance in two different ways: the GDP per inhabitant in the second half of the 2000's and the growth of GDP during the years 2001-2008.

To avoid problems related to collinearity between variables, all indicators have been log-transformed.

A series of control variables is used: size (population), economic structures (the share of five economic sectors), level of education and accessibility (only for European cities). As for regressions on GDP growth, we also consider GDP per inhabitant at the starting date for the analysis and population growth during the period under consideration.

These analyses are undertaken separately for US and European cities, because the data and delimitations are not perfectly comparable and the urban dynamics we are trying to understand are either global or continental, but mainly not specifically transatlantic.

Results

In the first step of the analysis, we simply show correlations between connectivity in advanced producer services, GDP per inhabitant (2008) and GDP growth (Table 1). This shows a significant correlation between GDP per capita and connectivity in both Europe and the US: the more connected is a city, the wealthier it is in the year 2000. However, this finding tells us nothing about the direction of the causality; for example, big and wealthy cities might develop connections in advanced producer services more than other cities. In contrast, neither in the EU nor in the US, do we observe a relationship between economic growth and connectivity at the eve of the same decade. In this period, it seems quite clear that more connected cities have on average not performed better than the others.

Table 1. Correlation (R Pearson) between economic performances and connectivity*

	European Union				USA			
	GDP per inhabitant 2008	Growth of GDP, 2000-08	Growth of GDP per inhabitant 2001-08	N	GDP per inhabitant 2008	Growth of GDP, 2000-08	Growth of GDP per inhabitant 2001-08	N
Standardized Connectivity 2000	-	-0,021	-0,042	75	-	0.003	0.061	38
Standardized Connectivity 2008	0,534**	-	-	75	0,377*	-	-	38
Gross connectivity 2008	0,543**	-	-	81	0,488*	-	-	59

* Significant at 0.05

** significant at 0.01

In a second step, we run analyses controlling for classic competitiveness indicators (education, accessibility, initial GDP per inhabitant etc.) as well as other connectivity indicators (air and maritime connections in particular). The results are shown in Table 2a and 2b for GDP per inhabitant in 2008 and in Table 3a and 3b with GDP growth between 2001 and 2008 as the dependent variable.

As for GDP per capita, we obtain a powerful model with R^2 of 0.831. Looking at the results, connectivity in advanced producer services never significantly impacts on GDP per capita in European cities, even when this variable is isolated from other connectivity indicators. Among the connectivity indicators, only air connections with non European cities are significantly related to GDP per capita. If we look to control variables, the following variables are correlated to cities' GDP per inhabitant: the share of other services in a negative way; accessibility and the level of education in a positive way; and the East/West dummy variable (being in the West increases GDP per capita). Hence, classical competitiveness indicators are significant but we also highlight the importance of air connections to the world.

A similar model has been launched for US cities however, compared to the European model, the accessibility measure is missing, and political functions have not been considered (the latter is not as relevant for US cities while the former is unavailable). Compared to the European model, a lower part of the variance among the US cities in GDP per capita is explained by the model. This might be explained by the lower variance in GDP per capita within US cities in contrast to Europe where national contexts in a less integrated market continue to explain important contrasts in the city level of GDP per capita. Also, the model confirms the importance of classical variables of competitiveness: the negative impact of the share of other services (basic services to the population); the positive impact of the level of education. When we analyze connectivity indicators, we observe the importance of commanding functions of US cities to explain higher GDP per capita. Also, in contrast to Europe, connectivity in advanced producer services is significantly related to GDP per capita, when not introduced with other connectivity indicators to which it is closely related.

Because economic development in cities is such a complex and systemic process, we should interpret these results with care. The correlations observed in this model are the result of long historical processes, and we cannot say whether accessibility, the level of education and air connections explain differences in GDP per capita in European cities, because these variables are all part of a systemic process of development, that also includes the multi-scale embeddedness of cities.

Table 2a. Regression model for GDP per inhabitant in 2008, for European cities with more than 500000 inhabitants

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	6.440	1.109		5.809	.000		
	Sector c_e (%) 2006	.084	.087	.079	.967	.335	.174	5.748
	Sector f (%) 2006	.067	.059	.060	1.122	.264	.397	2.520
	Sector g_h_i (%) 2006	.051	.123	.024	.412	.681	.338	2.961
	Sector j_k (%) 2006	.261	.136	.191	1.912	.058	.116	8.652
	Sector l_to_p (%) 2006	-.204	.113	-.114	-1.804	.073	.288	3.478
	Education 2001	.246	.048	.247	5.163	.000	.501	1.996
	Accessibility 2006	.421	.067	.407	6.233	.000	.270	3.702
	East West dummy	.216	.062	.220	3.467	.001	.286	3.499
	Extra European maritime connections 2006	.002	.010	.007	.161	.872	.701	1.427
	Extra European flights 2008	.026	.012	.114	2.215	.028	.438	2.286
	Commanding functions 2008	.008	.004	.098	1.868	.064	.417	2.396
	Political functions 2008	-.003	.023	-.005	-.124	.902	.809	1.237
	GAWC connectivity 2008	-.004	.005	-.044	-.793	.429	.370	2.703

	R	R Square	Adjusted R Square	Std. Error of the Estimate
Quality of the model	.911[a]	.831	.816	.1867913

Table 2b. Regression model for GDP per inhabitant in 2008, for US cities with more than 500000 inhabitants

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	13.629	2.240		6.085	.000		
	Sector c_e (%) 2008	-.014	.054	-.024	-.254	.800	.346	2.891
	Sector g_h_i (%) 2008	-.392	.305	-.143	-1.287	.202	.241	4.151
	Sector j_k (%) 2008	.000	.149	.000	-.002	.999	.213	4.696
	Sector l_to_p (%) 2008	-.746	.243	-.413	-3.067	.003	.163	6.123
	Education 2005-2009	.421	.069	.467	6.139	.000	.512	1.953
	Extra European maritime connections 2006	.014	.008	.099	1.640	.105	.807	1.240
	Commanding functions 2008	.009	.003	.198	2.685	.009	.546	1.831
	Extra European flights 2008	.002	.007	.015	.225	.823	.635	1.576
	GAWC connectivity 2008	.007	.004	.135	1.757	.082	.500	2.002

	R	R Square	Adjusted R Square	Std. Error of the Estimate
Quality of the model	.858[a]	.736	.710	.1397560

In the next models, we try to explain cities' economic growth in the 2000's with classical indicators of competitiveness and connectivity at the beginning of the period. Results confirm the simple correlations shown in Table 1: connectivity in advanced producer services does not significantly impact on cities' economic growth during this period. When controlling for indicators of competitiveness, connectivity does not impact significantly on city economic growth either in the EU or in the US. Furthermore, none of the connectivity indicators significantly impact on economic growth during the 2000's. In other words, economic competitiveness does not appear to be as strongly related to participation in global networks and, in particular to connectivity in advanced services as might be supposed. In contrast, some other competitiveness indicators, apart from maritime connections in the US, show a significant impact on the economic growth of cities. In Europe, education level and the share of construction in local GDP has a positive impact while high share of other services has a strong negative impact on economic growth. In the US, the impact of education is also significant and the share of manufacturing also negatively impacts on city economic growth. In contrast to Europe, we find no impact of the share of other services but a positive impact of population growth.

These results are important because they contradict the previously unsubstantiated expectation of the importance of connectivity as a factor in city economic growth in the globalization era. How should we interpret this result?

First, as stated in the introduction, some theoretical approaches take the view that metropolitanization should be considered a qualitative process – the re-concentration of strategic functions – rather than a purely quantitative one (Sassen, 2001), which would assume a higher growth in the most connected metropolitan areas. Nevertheless, most of the literature implicitly or explicitly assumes that

connectivity to global networks would improve city performance without testing this relationship empirically.

Second, the period considered might have a significant impact on the results. As suggested in considering theoretical context, some studies (Lennert *et al*., 2010; DG Regio, 2009) have shown that the biggest metropolitan areas or first national cities had better performances in the 1990's, suggesting a slowing down of the importance of metroplitanization processes in the years 2000. However, these studies do not explain this reversal trend.

Third, the importance of connectivity, especially in advanced producer services, may have been overestimated as a factor of competitiveness in contemporary globalization. One explanation is that mechanisms underlined in the case of the biggest 4-5 global cities are less relevant for other cities of more limited size and with lower international functions. Hence, while truly global cities have been able to capture value at global scale, notably through their financial functions, mechanisms are quite different for other cities for which the impact of connectivity might be much more restricted. In all these cities, competitiveness is related to other factors, such as the level of education of the labour force, whose impact is significant in economic growth in both US and European cities. Also, we must underline that cities still have relatively closed economies, as stated by Krugman (1996) in his comparison of Chicago at the end of the XIXth century and Los Angeles at the end of the XXth century. In a service economy, nations and even big cities are in practice relatively closed economies because, despite growing openness in most economic sectors, the wider economy is also shifting more and more toward local services, which are not easily offshored. In this context, factors of growing productivity in local services should also have an important impact on a city's economic growth. However, the complex dialectical relation between city global functions and the "internal" economy has still to be understood, despite some interesting results from Porter for US cities on this subject. Porter's (2006) analysis suggests that the share of specialization in non local services is less important than the nature of this specialization, i.e. the share of high added value sectors in the city economies. But this tells us nothing about the sense of causality between position in the division of labour and the structural characteristics of the cities.

Fourth, these results tell us nothing about the impact of connectivity on economic growth of the EU and of the US as a whole. Indeed, major gateway cities may have a decisive role by allowing US or European territories to sustain their performances in the global economy.

Table 3a. Regression model for GDP growth (average annual growth of GDP in constant prices) between 2001 and 2008, for European cities with more than 500000 inhabitants

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	3.047	1.180		2.581	.011		
GDP per inhab 2000	-.191	.101	-.239	-1.888	.061	.152	6.599
Sector c_e (%) 2001	-.068	.112	-.060	-.607	.545	.244	4.094
Sector f (%) 2001	.330	.107	.226	3.100	.002	.457	2.188
Sector g_h_i (%) 2001	-.094	.156	-.045	-.604	.547	.439	2.277
Sector j_k (%) 2001	-.030	.160	-.024	-.186	.853	.146	6.853
Sector l_to_p (%) 2001	-.398	.123	-.248	-3.232	.002	.412	2.430
Education 2001	.555	.072	.563	7.665	.000	.450	2.224
Accessibility 2001	.063	.114	.065	.551	.583	.174	5.743
pop growth 2001-07	.371	.329	.065	1.128	.261	.740	1.352
East West dummy	-.656	.091	-.678	-7.240	.000	.276	3.618
Extra European maritime connections 1996	-.011	.014	-.043	-.753	.453	.749	1.334
Political functions 2008	-.037	.034	-.061	-1.087	.279	.759	1.317
Commanding functions 2000	.002	.006	.022	.276	.783	.380	2.631
Extra European flights 1999	.005	.016	.026	.324	.746	.376	2.662
GAWC connectivity 2000	.000	.018	.001	.009	.993	.302	3.313

	R	R Square	Adjusted R Square	Std. Error of the Estimate
Quality of the model	.807[a]	.651	.615	.26728

Table 3b. Regression model for GDP growth (average annual growth of GDP in constant prices) between 2001 and 2008, for US cities with more than 500000 inhabitants

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	1.349	3.427		.394	.695		
GDP per inhab 2001	.209	.236	.159	.886	.378	.184	5.433
Sector c_e (%) 2000	-.285	.094	-.376	-3.039	.003	.388	2.576
Sector g_h_i (%) 2000	.177	.364	.057	.486	.628	.430	2.325
Sector j_k (%) 2000	-.400	.221	-.251	-1.809	.075	.309	3.239
Sector l_to_p (%) 2000	.314	.299	.162	1.051	.297	.249	4.013
pop growth 2001-07	.331	.063	.490	5.222	.000	.674	1.484
Education 2000	-.352	.161	-.298	-2.184	.032	.319	3.130
Extra NAFTA maritime connections 1996	.051	.017	.268	2.988	.004	.740	1.351
Commanding functions 2000	-.003	.006	-.056	-.531	.597	.535	1.870
Extra NAFTA flights 1999	-.014	.013	-.115	-1.120	.267	.563	1.775
GAWC connectivity 2000	.011	.018	.072	.627	.532	.455	2.200

	R	R Square	Adjusted R Square	Std. Error of the Estimate
Quality of the model	.748[a]	.560	.495	.2355351

Conclusions

In this paper, we have tested whether city connectivity impacts on city economic performance. We can find no impact of city connectivity in advanced producer services either at the level of GDP per capita in European and US cities or on their economic growth between 2001 and 2008. However, we do find some relationship between city air connections and GDP per capita in European cities and between city concentration of headquarters and GDP per capita in US cities.

These results have important implications in policy terms. They suggest that while global network connectivity is certainly important for a few global cities, we don't know the exact impact of connectivity for others. For example, London has experience higher growth due to its high concentration of global gateway functions. But path dependence and the capacity to capture a higher share of added value created may be specific to some global cities like London and New York. It evidently does not work this way for all the other European and US cities and so we cannot say in what ways their network position impacts on their economic performance. Hence, policies that focus on improving the position of cities in global networks are problematic due to the difficulty of impacting on this structural feature (path dependence again) and the uncertain impact this would have on economic competitiveness for the city as a whole. That being said, neither do these results demonstrate the *un*importance of city connectivity as a source of economic performance for national and continental developed economies.

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Annex. Indicators and sources

Name	Indicator	Source in the EU	Source in the US
GDP per inhabitant	The Gross domestic product per inhabitant	Eurostat, own evaluations by affecting NUTS3 data to functional cities in Europe	Bureau of Economic Analysis (BEA)
GDP growth	Gross Domestic product	Eurostat, own evaluations by affecting NUTS3 data to functional cities in Europe	Bureau of Economic Analysis (BEA)
GaWC_connectivity	The number of connections between cities in networks of big firms of high level business services	GAWC , 2000, 2008	
pop	Population	Eurostat, regional data	Census data
Sector c_e (%)	The share of extraction, manufacturing and energy in total GDP (EU) or employment (USA)	Eurostat, own evaluations by affecting NUTS3 data to functional cities in Europe	Bureau of Economic Analysis (BEA)
Sector f (%)	The share of construction in total GDP (EU) or employment (USA)	Eurostat, own evaluations by affecting NUTS3 data to functional cities in Europe	Bureau of Economic Analysis (BEA)
Sector g_h_i (%)	The share of transport and trade in total GDP (EU) or employment (USA)	Eurostat, own evaluations by affecting NUTS3 data to functional cities in Europe	Bureau of Economic Analysis (BEA)
Sector j_k (%)	The share of financial and business services in total GDP (EU) or employment (USA)	Eurostat, own evaluations by affecting NUTS3 data to functional cities in Europe	Bureau of Economic Analysis (BEA)
Sector l_to_p (%)	The share of other services in total GDP (EU) or employment (USA)	Eurostat, own evaluations by affecting NUTS3 data to functional cities in Europe	Bureau of Economic Analysis (BEA)
Commanding functions	Location of headquarters by number of employees across the world	Forbes, 2000, 2007	
Political functions	Indicator taking into account the political functions (international, national and regional)	IGEAT, 2010	
Extra-European flights	Number of flights connecting each city to non European and non neighbourhood cities (not in NAFTA for US cities) (1)	OAG, 1999, 2008	
Extra_European maritime connections	Number of connections with ports not in Europe or in its direct neighbourhood (not in NAFTA for US cities) (1)	*Lloyd's Marine Intelligence Unit* (LMIU), 1996, 2006	
Accessibility	Indicator of accessibility at NUTS 3 level, affected to core cities	Spiekermann & Wegener, Urban and Regional Research (S&W), 2001, 2006	
Population growth 2001-2008	Population	Eurostat, Regional data	Census data
East West dummy	Dummy indicating if the city is located in Central and Eastern new member States		

(1) European neighbourhood includes former USSR except, Western Balkans, Turkey, Syria, the Jordan, Israel, occupied territories and Northern Africa