The Geography of the Internet Infrastructure in Europe

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ABSTRACT

This PhD research is concerned with the analysis of the Internet infrastructure supply across the European cities and the results that this allocation may have for the economic development of the cities. This research's main assumption is that the Internet is first and foremost an infrastructure which facilitates the informational economy by transporting its informational goods and services. The empirical research is firstly focused on explaining the determinant factors for the allocation of the Internet infrastructure across the European cities, uncovering this way the emerging new urban hierarchies. In addition, this PhD research will make an effort in approaching the economic results that this allocation may generate. Maybe is quite early to quantify them (if there are any) but the growing importance of the Information and Communication Technologies (ICTs) in the modern economy justifies this attempt.

Keywords

Internet Geography, Internet Infrastructure.

Overview

This PhD research is focused on the geographical analysis of the Internet infrastructure across the European urban network as well as on the implications that this allocation may generate on the development of the cities themselves as well as on the structure of this network. No matter what the average Internet user thinks, Internet is not a unique system evenly scattered across the globe, weather it is centre or periphery [3]. And despite being a fairly young Large Technical System (LTS), at least for commercial usage, users consider it as a black box, something which is usually related with other older urban infrastructure networks such as water, sewerage etc [4]. In reality, the Internet is based on numerous different and widely dispersed networks, links and routers which are responsible for the global interconnection. From the geography point of view it is remarkable that the allocation of the above technical elements is not equally distributed across the cities, where the Internet's users are located, creating inequalities in the way people and places gain advantages from this.

This research's main assumption is that the Internet is first and foremost an infrastructure and because of this attribute, it serves the modern economy. This infrastructural character is the feature that enables the Internet to play a significant role in influencing potential income, productivity, and employment. The main characteristic of the infrastructure in general is that it is part of the overall capital stock which is important for the subsistence of General Purpose Technologies (GPT), which are essential for the maintenance and growth of production [2]. There is no doubt that the Internet is a GPT [6], with even its most standard applications, such as email, being integral to the production, distribution and exchange of goods and services [1]. But how exactly does the Internet facilitate the modern economy? By transporting the 'valuable goods' of informational economy in much the same way that transportation networks have done over the last 200 years for the industrial products [8]. The latter reflects this research's second assumption that the Internet and the transport infrastructure share significant analytical similarities both at economical and physical level. Not only do both of them facilitate the economy by being part of the infrastructural capital, but in physical terms they are also built up on a network topology.

Before moving on, there is a need to highlight the fact that the roll out of the infrastructural networks, which form the Internet, is largely based on private telecommunication companies' (telcos) investments. By accepting that these investments take place in the frame of a market economy which works efficiently, then it is obvious that the location decisions for these investments are based on the neo-classical approach of demand and supply and the allocation of these networks reflects the telco's perspective for the location of the demand for these services. However, because of the complexity of the subject, it is not easy to predict the location and the volume of this demand. From the above, it is clear that the allocation of the Internet infrastructure is not equally scattered across all urban places.

No matter how new this infrastructure is and mainly how short is the time that is being commercially used, it would not be an exaggeration to presume that the Internet infrastructure may generate impacts related with the development of places. From the geography perspective, what is interesting is the differentiated results that the Internet infrastructure may generate on space. This happens not only because of its uneven distribution among cities but also because of the nature of this specific infrastructural capital. The latter refers to places' differentiated ability to take advantage of this infrastructure, something mainly related with

the level of the knowledge economy. What is also important is the distinction between different types of the Internet infrastructure, the services related with them and how do they facilitate society and economy. For instance, the citizens of most of the European cities are able to enjoy today broadband Internet connectivity. The latter is not only important in terms of economy but mainly for social justice reasons, as it provides access to a variety of remote services, products and mainly knowledge. However, there are other services that might differentiate place's competitive advantage. Vast, redundant and secure connections with important nodes of the global economy system may differentiate places ability to attract Foreign Direct Investments, alter firms' location decisions, assist the growth of local development and differentiate its position on the global ranking of highly interconnected cities.

The motivation for choosing such a research field is the growing importance of the Information and Communication Technologies (ICTs) in the modern economy. ICTs, which include the Internet, play a significant and growing role in the new economy era, with processes of production, distribution and exchange increasingly being reliant on them. But what makes this research field important is the fact that we can only observe the beginning of ICTs extended usage. Society's and economy's dependence on ICTs will be growing and apparently this procedure's results will be more momentous in the near future.

This PhD study will be facilitated by empirical research based on quantitative methods and data related with the Internet infrastructure. Two will be the main parts of this. The first will be related with the geographical analysis of the Internet infrastructure in European cities and more specifically with an explanatory analysis of the spatial allocation of this infrastructure. For the needs of this analysis a dataset is being developed, regarding the aggregated bandwidth and the evolution of this at metropolitan / regional level, the number of different backbone providers, the existence and the traffic at the Internet Exchange Points etc. The general idea is to create a thick dataset in order to approach the allocation of the Internet infrastructure supply at city level. Then, using statistical methods, an explanatory analysis will take place in order to specify the socio-economic factors which determine this allocation, which also reflects telcos' perspective for the demand for these services, and also to classify the European cities according to their Internet infrastructural supply and their connectivity.

The second part of the empirical research will be dedicated to the exploration of the results that the allocation of this infrastructure may generate. Because of the Internet's short commercial existence any results generated by this might be still uncertain. However, even if this is the case and taking under consideration the growing importance of the Internet on the economy and society it is worth to try approaching them. What is critical is to identify cities' ability to absorb the benefits that this infrastructure is related with. And as it was stated before, this is mainly related with the city's level of knowledge economy. So, clustering European cities according to their knowledge economy and comparing those clusters with the allocation of the Internet infrastructure might provide us with some first indications about the developmental results that the allocation of this infrastructure may generate. What would be also interesting is to approach city's potential to be benefited by the Internet infrastructure located there. There are plenty of similar studies regarding the transport infrastructure. Using the analytical similarities between those two different infrastructural networks, a gravity model for approaching this potential could be built based on the Internet infrastructure supply. What is more, using longitudinal analysis, we can try to model the economic results of this infrastructure and identify the direction of causality between economic growth and the investment on Internet infrastructure.

Up to now a first explanatory analysis for the distribution of the backbone networks[1] in European Union (EU25) has already taken place using factor and principal component analysis. According to this, it seems that the volume of a region's connectivity is positively correlated with centrality both in terms of the geography of the European space and national urban hierarchies. In addition, the spatial characteristics of a region, such as its degree of urbanization and its accessibility level as well as the presence of transport hubs seem to have an influence on backbone distribution. Moreover, this first analysis resulted in a clear-cut relation between the development level and the agglomeration of the backbone networks with great network connectivity being usually observed in prosperous, dynamic and productive regions. Last but not least, knowledge economy level is also a significant factor in shaping backbone infrastructure's spatial distribution. Traditional tertiary centres like regions with high percentage of employment in service industries, low percentage in secondary sector have already attracted such infrastructure. In addition dynamic regions in monetary terms, which are focused on service sector and are characterized by a high percentage of employment in service industries or by the existence of world leading companies' headquarters, are also benefited by a high connectivity. So, it could be said that the backbone geography in EU25 is predictable, since it is reflects largely the existing spatial, development and knowledge economy structures. The Internet and the backbone networks do not challenge new paths but they bolster the present core areas in terms of centrality, wealth and knowledge.

What is considered to be the main contribution of this study is the analysis of the Internet infrastructure supply in Europe. There some studies on this field but they are largely focused on USA [3], [5], [6] [7], [9], [11] and [10]). This is not surprising since the Internet begun in USA. However, recent developments in Europe have increased the need for investigating spatial allocation of the Internet infrastructure in this region. In addition, there is also a gap in identifying the results of this infrastructure's agglomeration. It may be quite early to quantify the impacts of these new services, but there is a need to approach the economic results that the agglomeration of this infrastructure may create.

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