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Differences of Broadband Network Infrastructure, e-Readiness and Usage in EU Rural Regions

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Abstract

Different indicators and complex indexes can be used for ICT-level comparisons between countries. But usually just simple indicators are available for analyzing smaller territorial units within a country. By contrast, a multi-dimensional regional analysis allows to evaluate a given region in several ways, recognizing its strengths and weaknesses and development potential. The main aim of our research is to evaluate the availability and usage of broadband network infrastructure and the subscriber services in regional level, because the implementation of certain projects concerns principally the smaller areas directly. We used correlation analysis for find out whether there is any relation among the ICT and socio-economic indicators, regardless of the causal link between them. In the case of Hungary we present the development over time and regional differences of different indicators, which are related to the usage and availability of broadband networks. We tried to examine which factors have contributed to the change of these indicators, and to determine how the results obtained have contributed for the development of a region, what the direct or external effects are. The units of the analysis are the NUTS-2 regions of EU, but those member states, where any of the chosen indicators wasn't available; their regions have not been included in the present analysis.

Key words

Broadband networks, rural areas, regions, Hungary.

Introduction

The fusion of telecommunications, information technology and media industries are perceptible generally, and it embraces more and more socioeconomic areas. These three industries called IST (Information Society Technologies) on the whole and this signify its significant role in social advancement. The convergence of the different telecommunication networks leads to the development of an intelligent, uniform protocol-based and service-flexible network which we known generally as NGN (Next Generation Network). This means the standardization of present mobile and different line networks. The appearance of NGN is a natural process because this development generated by the market. Service providers offer more modern and cheaper technology to their clients with more modern and cheaper technology; meaning the clients get all they need owing to a 'one-stop' service. The line, cable and mobile service providers also have the opportunity to introduce integrated service packs and they appear on each other's market. Furthermore, the number of Internet subscribers is growing rapidly, new multimedia and interactive applications with high bandwidth demand are spreading, and costumers require ever faster and better quality services. This requires an increasing amount of data transmission at an ever increasing speed, but this becomes rather difficult on the existing networks.

Materials and methods

The IDI (ICT Development Index) was released by International Telecommunication Union (ITU). It compares developments in ICT. The index combines 11 indicators into a single measure that can be used as a benchmarking tool globally, regionally and in a country level. These are related to ICT access, usage and skills, such as households with a computer, the number of Internet users and literacy levels. It measures the digital divide and examines the development. The NRI (Networked Readiness Index) examines the extent of countries' rediness in three main fields the extent of countries' readiness and ability for network economy and

utilization of info-communication opportunities. The three fields are: 1. The general economic, regulatory and infrastructural environment of info-communication; 2. The readiness of individuals, firms and governments for application and utilization of ICT; 3. The extent of actual usage of latest available ICTs. The DOI (Digital and ICT Opportunity Index) is a composite index using a set of 11 indicators and equal weights in order to create a single value that can provide the base of cross-country comparison. DOI and ICT-OI illustrate different aspects of the digital divide. For instance, the DOI includes tariffs and developing services (such as mobile broadband), whereas the ICT-OI focuses on more traditional ICTs (such as television, fixed telephone network, education). Kolko (2010) worked out a methodology in connection with broadband access. He laid down, that these estimations give a clear picture of geographic differences in broadband availability and can be used to analyze factors affecting supply and, in future research, to assess the effect of broadband availability on social and economic outcomes. Because of this we determined the three main groups and the scope of factors for certain groups on the basis of NRI components or dimensions, that there are three important stakeholders to consider in the development and use of ICT: individuals, businesses, and governments (Dutta et al., 2004). We used regression analysis to find out whether there is any relation among the ICT and socio-economic indicators, regardless of the causal link between them. In the case of Hungary we present the development over time and regional differences of different indicators, which are related to the usage and availability of broadband networks. We tried to examine which factors have contributed to the change of these indicators, and to determine whether the results obtained have contributed for the development of a region, what the direct or external effects are. The major data sources are the EU strategies which have developed after 2004, the statistical database of EU, ITU and WEF. As regards the Hungarian analyzing, the data of national government agencies and the Central Statistical Office also have been used.

Rural areas and broadband services

1. Demands for developments

Rural development issues were addressed in the context of the eEurope Action Plan. Focus areas here included flexible and remote working methods, eBusiness within craft and other rural sectors, rural access to eGovernment services, and technologies for improving rural broadband coverage. Communication technologies and broadband Internet are increasingly perceived as a critical factor in social and economic development. They provide their connectivity for a range of innovative applications in areas like smart energy, electronic health services, e-government, and of course in the agriculture (Szilágyi, 2012). Building next generation infrastructure in rural areas, by this decreasing the extent of digital gap and reducing the disparities, is one of the main goals (Botos, 2012). Bottlenecks in broadband services are to be expected to materialize in poor social strata, rural, areas and small enterprises in countries facing the greatest efforts (Struzak, 2010). This theme is being continued under eEurope's successor initiative, where inclusion is one of three main pillars. Making ICT products and services more accessible, including in Europe's less-developed regions, is an economic, social, ethical and political imperative. NGN are seen as important instrument to bring competition and dynamism in the broadband sector in rural areas (Ruhle et al., 2011). And it has an effect on other economic sectors also (Péntek and Herdon, 2009). There are increasing returns to broadband telecommunications investments, which are consistent with the persistence of network effects (Koutroumpis, 2009). One important factor for growing is that the Internet plays a great role in spreading knowledge in an economy (Choi – Yi, 2009). Therefore, economic growth is positively related to the use of the Internet. The growing availability of high bandwidth is likely to enhance business growth opportunities for service providers (Picot and Wernick, 2007), furthermore it can enhance economic opportunities in rural areas by stimulating the development of home businesses and telecommuting and by facilitating access to education and training (LaRose et al., 2011). Demand for the convergence of line and mobile networks primarily arises from the service side provided for clients, and network developments are increasingly dependent on marketable services. The main factors which affect the developments are: 1. distance of customers; 2. general economic characteristic; characteristic of enterprises. The first key factor in costs is the distance of the customer. Thus, more densely populated areas are far less expensive in terms of investments per customer (Höffler, 2007). The second factor group is the general economic characteristic. Inside in this feature a very important fact

is the types of the economic sectors, which are typical in the certain region. Economic performance is lower in those regional economies which highly geared towards agriculture and manufacturing sectors and have relatively low incomes. It results lower ICT spending, fewer investment, infrastructure and service development (Preston at al., 2007). Furthermore ICT characteristics of public sector – which on regional level means local governments and public bodies - have to be considered. The characteristics of enterprises (penetration, usage, etc.) got in the third group. If these factors don't reach a sufficient level of development, telecommunication companies are not willing to invest in modern infrastructure development in rural areas because the expected profit is of high uncertainty (Moutafides and Economides, 2011). Due to this it is necessary that governments play role in network developments.

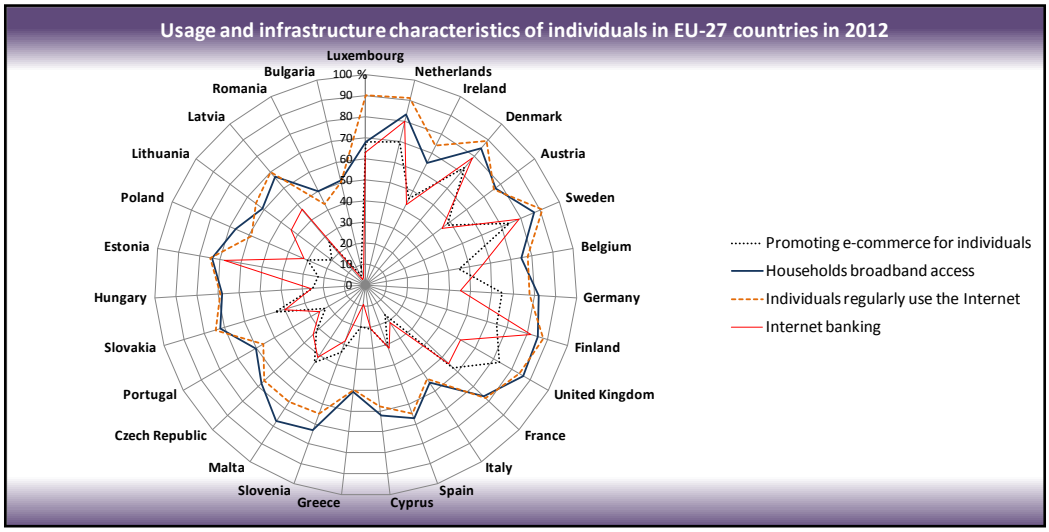
2. Differences between countries and regions

A dense networking infrastructure to support digital communication is the obvious backbone of any information society. New broadband and wireless technologies are being funded and developed so that eventually all citizens and businesses in urban and the most rural areas (the last mile and the last inch) will be connected. Deployment of broadband will not happen overnight. Upgrading, replacing, and adding to communication infrastructure is not cheap. For service providers the turnover of investment is crucial. Service providers develop the infrastructure of those cities where the demand for info-communication services is appropriate for them (Moseley – Owen, 2008). But in such rural regions where the expected profit does not exceed a certain level from the investment, the development requires state support (Riding et al., 2009). State can influence the investment decision-process of local governments and enterprises in its interest by indirect devices, because they are independent entities and the final decision about an investment is theirs.

Taking into account infrastructure there is no big difference between the EU Member States (Figure 1). The household broadband penetration in terms of the lowest standard deviation was 10.6%. In 17 countries the penetration rate was between 61-80%, with the lowest penetration which was 50%, the highest 87% in 2012. As with the regular Internet usage shows a low standard deviation (13.3%). The lowest value in use was 43%, the highest 91%. Considering specific usage characteristics there is much greater variation in the range of around 20%. Promoting e-commerce for Individuals maximum value was 74%, and the Internet banking was 82%. Using electronic banking services in the Nordic countries were more widespread than in the Southern European countries. The usage of e-services regarding Greece, Romania and Bulgaria are very high lags.

We analysed 123 regions from 13 EU Member States. 5 Danish, 17 Dutch, 9 Austria, 11 Belgium, 8 Sweden, 18 Italian, 19 Spanish, 7 Portuguese, 8 Czech, 4 Slovaks, 7 Hungarians 8 Romanian and 6 Bulgarian (Figure 2).

According to the per capita GDP of countries ranked, three clusters can be distinguished. The first group



Source: own processing

Figure 1: Usage of infrastructure and services.

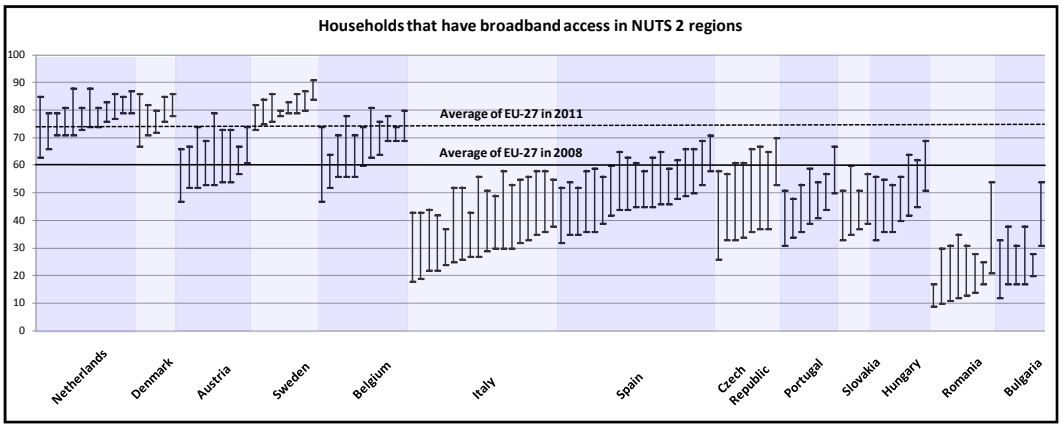


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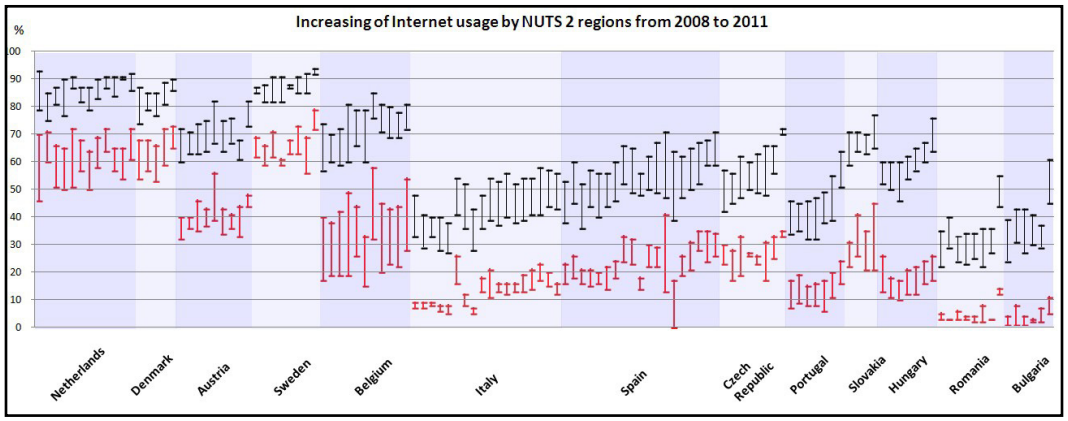
Figure 2: Differences among regions in EU.



Source: own processing

Figure 3: Differences among regions in EU.

was made up of northern and western European countries and regions that were around average or above average in 2008 are well developed, and extent of the development has been an average of 12%. The second group were Southern and Central European countries. The 6 Member States show an average of 57% penetration value and the region standard deviation of only about 7%. The third group includes Bulgaria and Romania. The two countries capital effect is strong, the two metropolitan regions highly advanced compared to the rest of the regions and the scale of these developments is the highest. Within countries, with the greatest development aiming 10 countries of the region in 2008, the worst or nearly worst situation occurred. A study out of 13 was only for 8 countries in 2011 region containing the capital city with the most advanced, further tests are necessary to find out what the determinants are those that affect the regional ICT development level, since in general we can say that in some countries the capital and the metropolitan agglomeration have the best socio-economic indicators. So if, for some countries access to the network is not the best in the region, the question arises why not, and perhaps can answer to the question is what the causal connections are among the socio-economic and ICT indicators.

Two related Internet usage were analyzed by regions in detail. Regular purchases on the Internet and Internet access indicators were closely related to each others. The purchases on the Internet are very low in the Central and Southern European countries. According to the basic indicators such as broadband access the same clusters can be identified. Significant differences were observed by the various indicators between countries and regions within the country (Figure 3).

3. Rural Broadband Development Programs in Hungary

In Hungary started large-scale infrastructure projects were started in 2003 by DSSC (Deputy Secretary of State for Communications) tender dossiers, which made settlements more attractive commercially. Later from 2004 to 2006 one of the most successful tender was ECOP 4.4.2, (Economic Competitiveness Operational Programme) the beneficiaries of it were the local governments, furthermore the less successful was ECOP 4.4.1, which supported SMEs. Both tenders were realized with EU co-financing and 50% of support level. This rate increased to 80-85% in case of ECOP 4.4.2 tender (Gál, 2008). Later, in 2007, EDOP-3.3.1 (Economic Development Operational Programme) tender targeted those micro-regions which are non-beneficial concerning investment. Overall these programs helped the network development with approximately 16 billion HUF. We chose NRI because we make an index for decision support of NGN investments, and NRI contains such social, economical and technological components which are related to broadband network. There is a general macroeconomic and regulatory environment for ICT in which the stakeholders play out their respective roles. Since the index is prepared for regional comparison, of course, the groups contain different components of the NRI (Table 1).

Such data are necessary, which are available on regional level, or may be calculated from existing data. First we analyzed the correlation between internet subscriptions and the basic economical factors. 11 components have been included in the test, and with expansion of database the number of factors will increase. Table 2 and Table 3 contain the results of correlation test.

All three IT characteristics – the number of internet subscriptions (Var. 1), the number of IT enterprises (Var. 2) and number of telecommunication enterprises (Var. 3) – showed the most closely relation with, the population density (Var. 6), the number of cities (Var. 7) the number of households (Var. 9) and the total value of the national economy investment (Var. 11). Certain data may be excluded from components because there is not significant correlation between two variables. So, the average income (Var. 5), the number of municipalities (Var. 8) has shown no correlation with variables in left-hand column. The value of R&D (Var. 10) just slight correlation with elements related to broadband and IT. However with the number of unemployed persons (Var.4) none of the factors show correlation. The explanation of that could be if broadband adoption stimulates economic activity, it might reduce cyclical unemployment, but by definition this is a temporary impact. We examined the relation between those data which related to usage. The results are given in Table 3.

The basis of the calculation the number of internet subscriptions (Var. 1) are a determining factor with respect to the intensity of usage of e-administration services in each county. In my opinion the number of registrations of client gateway (Var. 3) and electronic date reservations (Var. 4) illustrate well the intensity, therefore we analyzed these. In addition we also chose included the number of persons with diploma (Var. 2) as variable. The result of correlation test that the relation is close, so probably those people use e-services frequently, who hold university degree.

Factors linked to network infrastructure	Individual characteristics	Enterprise characteristics	Public sector characteristics
Number of internet subscribers	Employment	Number and size of enterprises	Territorial characteristics
Characteristics of access network	Unemployment	Number of IT and telecommunications enterprises	Number of settlements with local e-government
Number of settlements and households with optical access	Average income	Website of enterprises	Local e-government services
Use of e-business and degree of internet use	Communications characteristics	Assets	Population and population density
	Number of persons with higher qualification	Investment and R&D	Settlement composition of region (number of cities and municipalities)

Source: own processing

Table 1: Factors which can be taken into account for the calculation of the index.

		Var. 4	Var. 5	Var. 6	Var. 7	Var. 8	Var. 9	Var. 10	Var. 11
Var.1	Pearson Correlation	0.236	0.328	0.794	0.832	0.051	0.931	0.452	0.914
	Sig. (2-tailed)	0.331	0.170	0.000	0.000	0.834	0.000	0.052	0.000
Var.2	Pearson Correlation	0.079	0.379	0.827	0.774	0.008	0.858	0.340	0.915
	Sig. (2-tailed)	0.747	0.109	0.000	0.000	0.973	0.000	0.154	0.000
Var.3	Pearson Correlation	0.336	0.285	0.732	0.844	0.170	0.937	0.332	0.879
	Sig. (2-tailed)	0.159	0.237	0.000	0.000	0.485	0.000	0.165	0.000

Source: own calculation by data of www.ksh.hu

Table 2: Result of correlation between broadband and economical factors.

		Var. 2	Var. 3	Var. 4	Var. 5	Var. 6
Var. 1	Pearson Correlation	0.979	0.964	0.910	0.151	-0.101
	Sig. (2-tailed)	0.000	0.000	0.000	0.538	0.681
Var. 2	Pearson Correlation	1	0.965	0.942	0.172	-0.164
	Sig. (2-tailed)	-	0.000	0.000	0.481	0.502

Source: own calculation by data of www.ksh.hu

Table 3: Result of correlation between data which related to usage.

In the field of IT usage the bottlenecks are households and small enterprises in rural areas and poor social strata (Struzak, 2010). This was confirmed by my calculation also, the two features of enterprises, namely the usage of internet based EDI (Var. 5) and the number of enterprises which have website (Var. 6) didn't show correlation with other factors. To change this attitude, additional stimulus programs and resources are required (Struzak, 2010). The characteristics of SMEs (penetration, usage, etc.) are very important in Hungary, because they mean one of the biggest business sectors considering their number. This sector employs 70% of the employees of national economy, and their contribution to GDP reaches 50%. Correlation test have to be done with each factor which related to the existence of network infrastructure. Since among the variables there are some which have an effect on each other also, multicollinearity analysis should be made. Finally scope of data and factors which may be included in the index actually, can be determined with factor analysis.

Conclusions

NGN are seen as important instrument to bring competition and dynamism in the broadband sector in rural areas and it has an effect on other economic sectors also. The growing availability of high bandwidth is likely to enhance business growth opportunities for service providers. According to the per capita GDP of countries ranked, three clusters can be distinguished. The first group is made up of northern and western European countries and regions that were average or above average in 2008, are well developed, and extent of the development has been an average of 12%. The second group were Southern and Central European countries, which were completed during the year, both regional average, but the gap in the EU-27 average in 2011, is no longer large. The 6 Member States show an average of 57% penetration value and the region standard deviation of only about 7%. The third group includes Bulgaria and Romania. In our opinion a rank can be defined among regions or settlements on the basis of the indicator, in respect of factors related to network infrastructure. The rank can help to realize targeted developing and improving of infrastructure, furthermore this enables to intervene on that place which is bottleneck.

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