

## Sustainable Agriculture through ICT innovation

**Multi Dimensional Analysis of Broadband Network Developments in EU Regions and Rural Areas**Miklós Herdon<sup>1</sup> – Szilvia Botos<sup>2</sup><sup>1</sup>University of Debrecen

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<sup>2</sup>University of Debrecen**ABSTRACT**

Different indices and complex indexes can be used for ICT-level comparisons between countries. But just simple indicators or absolute indices are available for analyzing smaller territorial units within a country. By contrast, a multi-dimensional regional analysis allows evaluate of 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 regression analysis for find out that weather 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 that the results obtained have contributed for the development of a region, what are the direct or external effects. The units of the analysis are the NUTS-2 regions of EU, but those member states, where any of chosen indicators wasn't available; their regions have not been included in the present analysis.

**Keywords:** Broadband networks, rural areas, regions, Hungary.

**1. INTRODUCTION**

The fusion of telecommunications, information technology and media industries are perceptible generally, and it embrace more and more socioeconomic areas. These three industries we call 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. Appearing of NGN is a natural process because this development generated by the market. Service providers supply their clients with more modern and cheaper technology; meaning the clients get all they need through 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

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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.

## 2. MATERIAL 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 on a country level. These are related to ICT access, use 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 on 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 use 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. In turn, these estimates 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 group 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 for find out that weather 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 that the results obtained have contributed for the development of a region, what are the direct or external effects. The units of the analysis are the NUTS-2 regions of EU, but those member states, where any of chosen indicators wasn't available; their regions have not been included in the present analysis. 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. The major data sources are the EU strategies which have developed after 2004, the statistical

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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.

### 3. BROADBAND DEVELOPMENT FOR RURAL AREAS

#### 3.1 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. 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 *at al.*, 2011). 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 (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 *at 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 sector, which are typical in the given 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). That is why it is necessary that governemnets play role in network developments.

#### 3.2 State of art in EU and its regions

A dense networking infrastructure to support digital communications 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

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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 those cities where the demand for infocommunication services is appropriate for them. But such rural regions where the expected profit do not exceed a certain level from the investment, the development requires state support. 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.

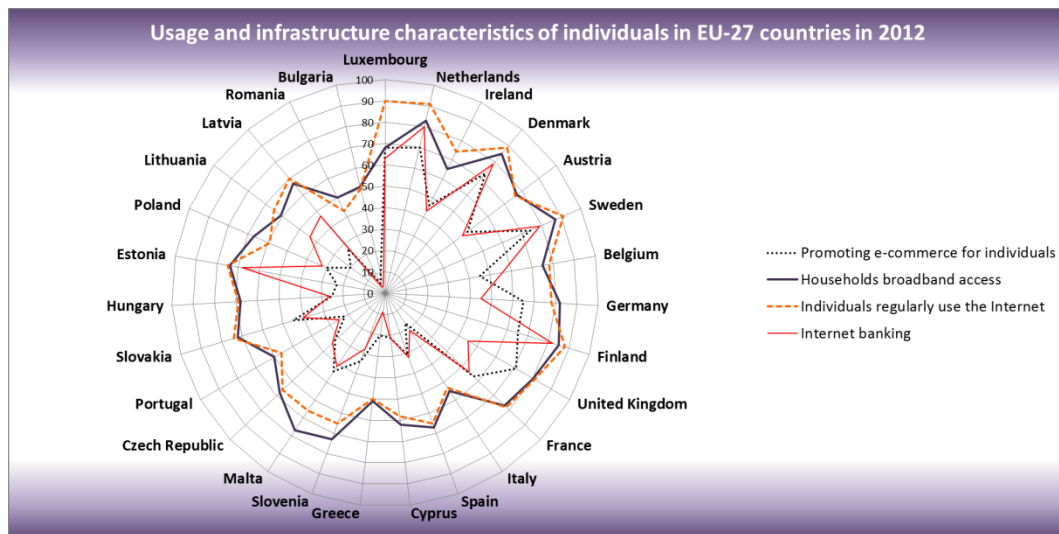


Figure 1. Usage of infrastructure and services

Taking 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, 10.6%. In 17 countries the penetration rate is between 61-80%, with the lowest penetration is 50%, the highest 87% in 2012. As with the regular Internet use shows a low standard deviation (13.3%), 52% of the country is between 61-80%. The lowest value in use 43%, the highest 91%. For specific usage characteristics is much greater variation in the range of around 20%. Promoting e-commerce for Individuals maximum value of 74%, and 82% of Internet banking. Using electronic banking services in the Nordic countries are in the Southern European countries, the widespread worse. The use of e-services regarding Greece, Romania and Bulgaria are very high lags.

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

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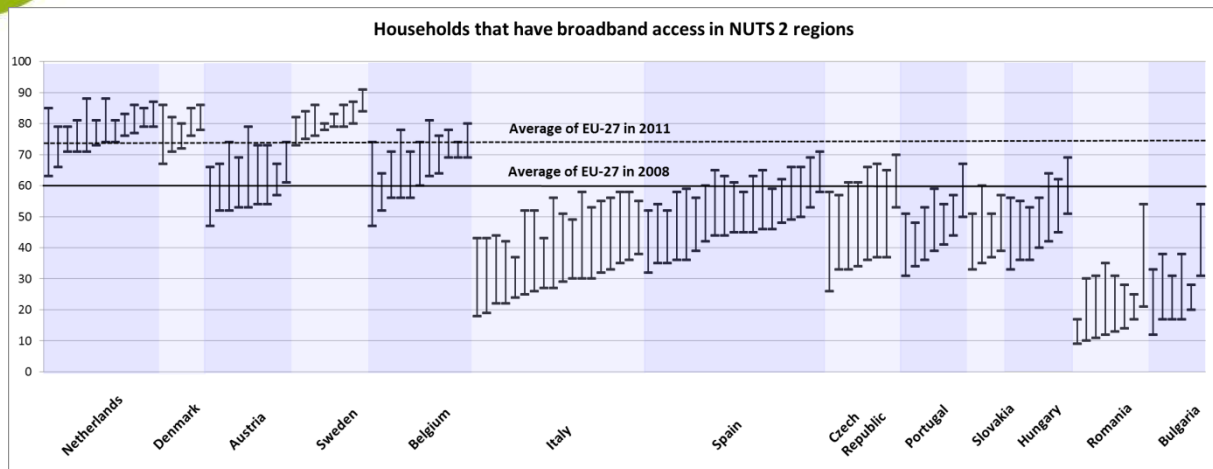


Figure 2. Differences among regions in EU

Household broadband access to the country's 13 regions studied ranges between wide limits, in some cases as well. According to the per capita GDP of countries ranked in order, 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. 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, the greatest amount of development for 10 countries in 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, so further tests to try to find out what are the determinants that affect the regional ICT development level, since in general we can say that in some countries capital and the metropolitan agglomeration has the best socio-economic indicators. So if, for some countries access to the network is not the best in the region, the question arises as to why not, and perhaps can answer to the question is that what are the causal connection between the socio-economic and ICT indicators.

### 3.3 Rural Broadband Development in Hungary

In Hungary started large-scale infrastructure projects in 2003 by DSSC (Deputy Secretary of State for Communications) tender dossiers, which have helped settlements were less attractive commercially. Later from 2004 to 2006 one of the most success tender was ECOP 4.4.2, (Economic Competitiveness Operational Programme) the beneficiaries of it were the local governments, furthermore the less success ECOP 4.4.1, which supported SMEs. Both of tenders realized with EU co-financing and 50% of

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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 aimed those micro-regions which are non-beneficial from the investment point of view. 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 prepares for regional comparison, of course, the groups contain different components from the NRI. 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 included in the test, with expansion of database the number of factors will increase. Table 1 and Table 2 contain the results of correlation test.

Table 1. Result of correlation between broadband and economical factors (Source: Own calculation by data of [www.ksh.hu](http://www.ksh.hu))

		Var.4	Var.5	Var.6	Var.7	Var.8	Var.9	Var.10	Var.11
Var.1	<b>Pearson Correlation</b>	0,236	0,328	0,794	0,832	0,051	0,931	0,452	0,914
	<b>Sig. (2-tailed)</b>	0,331	0,170	0,000	0,000	0,834	0,000	0,052	0,000
Var.2	<b>Pearson Correlation</b>	0,079	0,379	0,827	0,774	0,008	0,858	0,340	0,915
	<b>Sig. (2-tailed)</b>	0,747	0,109	0,000	0,000	0,973	0,000	0,154	0,000
Var.3	<b>Pearson Correlation</b>	0,336	0,285	0,732	0,844	0,170	0,937	0,332	0,879
	<b>Sig. (2-tailed)</b>	0,159	0,237	0,000	0,000	0,485	0,000	0,165	0,000

All three IT characteristic – number of internet subscription (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), number of cities (Var.7), 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 or 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 number of unemployed persons (Var.4) none of the factors show correlation. That would be because 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 2.

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Table 1. Result of correlation between data which related to usage (Source: Own calculation by data of www.ksh.hu)

		Var. 2	Var. 3	Var. 4	Var. 5	Var. 6
Var. 1	<b>Pearson Correlation</b>	0,979	0,964	0,910	0,151	-0,101
	<b>Sig. (2-tailed)</b>	0,000	0,000	0,000	0,538	0,681
Var. 2	<b>Pearson Correlation</b>	1	0,965	0,942	0,172	-0,164
	<b>Sig. (2-tailed)</b>	-	0,000	0,000	0,481	0,502

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) are illustrate well the intensity, therefore we analyzed these. In addition we 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.

In the field of IT usage the bottlenecks are households and small enterprises in rural areas and poor social strata (Struzak, 2010). This 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 employ 70% of employees of national economy, and their contribution to GDP reaches 50%. Correlation test have to make with each factor which related to the existence of network infrastructure. Since among the variables there are which have an effect on each other also, multicollinearity analysis should be made. Finally scope of data and factors which may be included into the index actually, can be determined with factor analysis.

### 4. 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 in order, 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

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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 by 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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