FINE-GRAINED PATTERNS OF THE DIGITAL DIVIDE: DIFFERENCES OF BROADBAND ACCESS WITHIN FINLAND

Paper for the 43rd ERSA Congress, Jyväskylä, 27-30 August 2003

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ABSTRACT

Access to the Internet plays a central role in the development of an information society. However, because of the required telecommunications infrastructure is very expensive to build, there is no sufficient demand for a market-based provision of relevant telecommunication infrastructures in many areas. Therefore, some citizens and other actors are left without an (up-to-date) access to the Internet. The resulting gap between individuals and social groups with and without access to the Internet, which is also often linked with a lack of money, skills and/or motivation to use it, is referred to as the Digital Divide. Several (national, regional and local) governments implement policies at diminishing it, by means of providing access to the Internet in such regions where the market does not provide it, and by enhancing the citizens' 'information society' resources. This article investigates the territoriality of broadband access to the Internet in Finland. Not surprisingly, the empirical results support the view that regions with higher population densities have a better access. With regard to the debate on the Digital Divide, it is interesting to observe that variations in broadband access to the Internet do not follow administrative borders, but their spatial patterns are much more fine-grained. Clearly, this has implications for efficient and righteous information society policies, and for an evaluation of the effectiveness of such policies.

Key words: Internet access, digital divide, telecommunications infrastructure, spatial differences, ESPON

1 INTRODUCTION

There are several technologies available for connecting to the Internet. They vary, for instance, in terms of infrastructure requirements, pricing, and service level. The most common criterion for classifying the available technologies is their data transfer capacity. The high-speed (high capacity) broadband connections, which usually offer a fixed pricing scheme, are often seen as the embodiment of an information society. This has raised special interest in them in policy making at various levels of government. Yet it should be mentioned already here that the classification into broadband (high-speed) and narrowband (low-speed) technologies is not unequivocal.

The aim of this paper is to explore spatial patterns and differences in a broadband Internet access in Finland. For this purpose, the available technologies are classified into the following three groups: traditional narrowband including modem and ISDN connections, various broadband technologies, and mobile connections. In addition to an empirical mapping of broadband availability, the implications of the findings with respect to the ongoing debate on the so-called Digital Divide are discussed.

Section 2 of this paper presents a conceptual framework for analysing infrastructures such as Internet connections. In the third section, the spatial patterns of broadband availability are described, and compared with some characteristics of different regional units. Section 4 raises the Digital Divide, elaborating possible motivations for, and strategies of, policy intervention.

2 DEVELOPMENT OF INFRASTRUCTURE

Investments in any infrastructures may be viewed either as demand-driven, or alternatively as strategic, aiming at enhancing demand for the services utilising the capacity which is thus created. Irrespective of which of these two approaches is followed, the development of infrastructure can be conceptualised as a virtuous circle, depicted in Figure 1.

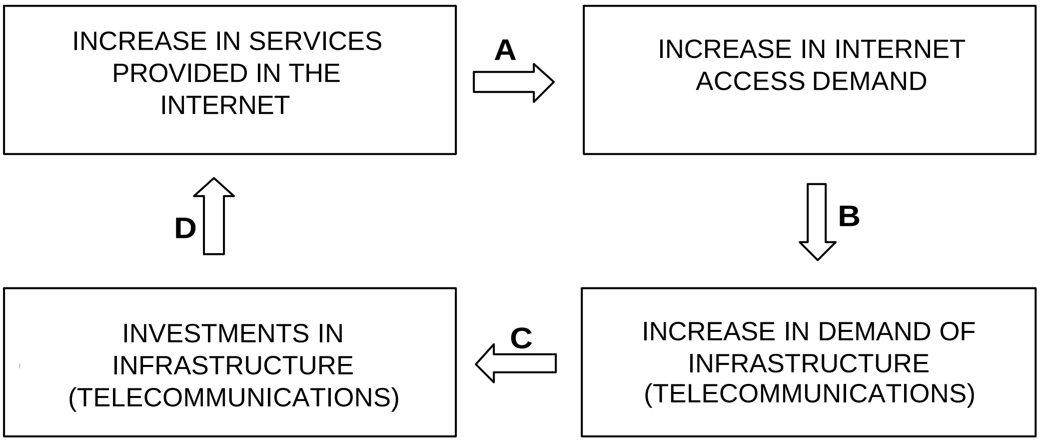

Figure 1. Virtuous circle of infrastructure investments. (Adapted from Johansson 1989, 6).

In the usual market process, the virtuous circle of infrastructure development starts from the arrow A. For example, an increase of Internet based services leads to a growing demand volumes for Internet access (A), which triggers additional demand for infrastructures needed to connect to the Internet (narrowband, broadband or mobile technologies, B). In the next stage of the circle, the increase in demand leads to infrastructure investments (C), which for its part facilitate various service applications (D).

Demand oriented development of infrastructure may also start from a need arising from the market. The need is, for example, satisfied by an Internet based service, which in turn generates demand for Internet access (A). This phenomenon is referred to as demand pull. Overall, in this case infrastructure development is due to derived demand. The investor's key problem is to adequately forecast the demand so that bottlenecks are abolished and the construction of unprofitable capacity is avoided.

The alternative possibility is to see infrastructure as a means of strategic development, the supply of which is motivated by efficiency or equity grounds. In this case, the circle starts from the arrow D in Figure 1. For example, the construction of broadband capacity for connecting to the Internet can be assumed to enhance the provision of Internet - based services, increasing the demand for Internet access (A). This can be seen in itself as a valuable outcome, and it may then lead to a growing demand for connections (B), and thus maintain investments in the required infrastructures (C). Arrow D is also the starting point if a new infrastructure is pushed to the market, the case of supply push. The aim of supply push is to generate applications for the infrastructure. In turn, these applications are hoped to meet a demand of the market (A).

Obviously, the current infrastructure capacity for Internet connections is mainly based on derived demand, that is, it has resulted from market processes. Yet there is also a strategic component in its supply, and different countries seem to implement different policies in this respect. Overall, "(T)erritorial distribution of telecommunications in Europe is at once a presupposition, a medium and an outcome of complex intertwined supply and demand -side dynamics. Existing coverage can determine where further supply is needed and whether demand is generated and preserved. It can also be seen as the means by which telecommunications services are supplied and demand is met. In addition, and perhaps most importantly, territorial distribution is a result of investment decisions taken by suppliers based on market demand." (CURDS et al. 2003, 59).

3 TERRITORIALITY OF BROADBAND ACCESS IN FINLAND

It goes without saying that technological infrastructure as such is only one precondition for the development of information society. Yet its role is not secondary, and in fact it seems to have received increasing attention in recent years at the European level as well as in individual countries and regions. This is to a considerable degree due to the observation that several key (audio and video) applications of Internet by households and firms presuppose high-speed (broadband) connections. Thus such connections are seen to form a key network infrastructure of information society.

Aspects of developments towards information society have been depicted by a number of statistical investigations in recent years in European countries. Yet a survey of this material reveals that a regional dimension of these ongoing changes has received only scant attention. In particular, this holds true for the territoriality of network infrastructures which provide access to the Internet. For instance, there is no comparable data how these connections cover various EU countries in terms of regional classifications such as NUTS divisions or a urban/rural division. (See CURDS et al. 2003)

The present paper is a case study, describing the spatial patterns of broadband access in an individual country, Finland. The relevance of this country's experiences for broadband policies can be argued, firstly, on the grounds that it is commonly seen as one of the prime examples of information society even in a global context (see, e.g., Castells & Himanen 2002). Secondly, its spatial characteristics include low population density, which is bound to be a constraint to a market-based roll-out of expensive broadband infrastructures.

Indicators of information society have not yet become an established part of official statistics in Finland. Yet some such indicators have been collected in special studies, which aim at developing relevant concepts and comparable frameworks (see, e.g., Nordic Statistical Network 2002). With regard to infrastructures, a particularly interesting study is the survey conducted by the Finnish Ministry of Transport and Communications, which deal with the availability of telecommunication services at a NUTS5 level in year 2001 (MINTC 2002). The survey includes data on the availability of various telecommunications technologies and competitive conditions in Finnish municipalities, which are relatively small administrative units (448 municipalities in the country of 5.2 million inhabitants).

The above mentioned data make it possible to construct the broadband availability index which can be used for regional comparisons. This summary statistic of four alternative technologies (ADSL, cable modem, fibre, WLAN) is defined by the following equations:

$$A_j = \left(M_j / F_j\right) \cdot 100 \qquad (1)$$

$$M_j = \sum_{j=1...448}^{i=1..4} T_{ij} \qquad (2)$$

$$F_j = \sum_{j=1...448}^{i=1..4} T_{ij}\,(M_j * P_j) \Big/ \sum_{j=1...448} P_j \qquad (3)$$

Equation (1) is formula used for calculating the broadband availability index. Of its components, Equation (2) yields the average availability of broadband technology T_i in municipality j, and Equation (3) the average availability of broadband access to Internet in Finland. For the calculation of index A_j, each of the four broadband access technologies are given scores in each municipality on a 5-point scale: (a broadband connection) available to everyone or almost everyone = 5; available to at least half of the municipality's residents = 4; available to less than half of the residents = 3; available to only a small part of the residents = 2; not available = 1.

The range of availability indices is from 68.8 to 123.1. There are only 8 among the 448 municipalities without broadband availability. These municipalities are mainly located on coastal areas and in the Baltic archipelago, where the roll-out of ADSL and other broadband connections is difficult due to geographical barriers. Table 1 presents a comparison of the index on the NUTS5 level by the municipal classification of Statistics Finland. In this grouping, municipalities are divided by the proportion the population living in urban settlements and by the population of the largest urban settlement into three categories. The table shows clearly how the availability of broadband reflects the urban-rural divide, and how the companies seem to base their roll-out strategies strictly on population potential and customer densities.

Table 1. Broadband availability and number of broadband providers by statistical grouping of municipalities.

		Broadband availability Index		No of Broadband providers	
	N	Mean	Median	Mean	Median
Urban	68	97.4[1]	93.1[2]	2.79[1]	2.00[2]
Semi-Urban	75	89.9[1]	85.1[2]	2.01[1]	2.00[2]
Rural	305	86.3[1]	85.1[2]	1.49[1]	1.00[2]
All Municipalities	448	88.6	85.1	1.77	1.00

[1] ANOVA and Kruskall-Wallis –tests indicate significant mean differences at the .01 level
[2] Median-test indicate significant differences at .01 level.

The relation of market potential and broadband availability is further illustrated in table 2 which presents the correlations between the index A_j and several characteristics of municipalities. Overall, the correlations contain a lot of variation but two conclusions can be drawn: Firstly, there is a strong correlation between the broadband availability and number companies providing these services, demonstrating the important role of market forces in determining the development of information and communications infrastructure in Finland. Secondly, the correlations seem to be systematically both lower and less significant among the rural and semi-urban municipalities than they are among their urban counterparts. This may indicate that even in Finland broadband technology is not left purely to market forces, and instead of 'wait and see' approach, there has likely been a lot a bcal activity on an 'uncommercial basis' in order to enable high-speed subscriber lines available also in less densely populated regions.

Table 2. Correlations between the broadband availability index and several characteristics of municipalities.

	Popula-tion	**Population density (inh./km^2)**	**Degree of urbanisa-tion (%)**	**Pop. with completed secondary education (%)**	**Income per cap (in state tax.)**	**Age >64 yrs (%)**	**Broad-band provi d-ers (N)**
Urban	.54*	.42*	.28	.36*	.13	.04	.82*
Semi-Urban	.11	.01	-.12	.14	-.01	.06	.74*
Rural	.08	.16*	.24*	.16*	.05	-.08	.62*
All	.49*	.45*	.45*	.45*	.33*	-.27*	.78*

* Correlation is significant at the 0.01 level.

Figure 2 illustrates the territorial variation of availability indices at different levels (NUTS5, NUTS4, NUTS3 and province, which is close to NUTS2). The indices are scaled so as the average of NUTS5 regions weighted by population is 100. The figure shows very clearly that the distribution of the indices is skewed so that the number of above the average scores at NUTS5 is only 40 (n = 448), and at NUTS4 not more than 14 (n =82). This implies that densely populated areas are clearly in a better position. Actually, the dark blue areas in NUTS4 map largely correspond to the network of cities. At the NUTS3 level, there are 6 above than average regions, and only one province (~NUTS2) is above the Finnish average.

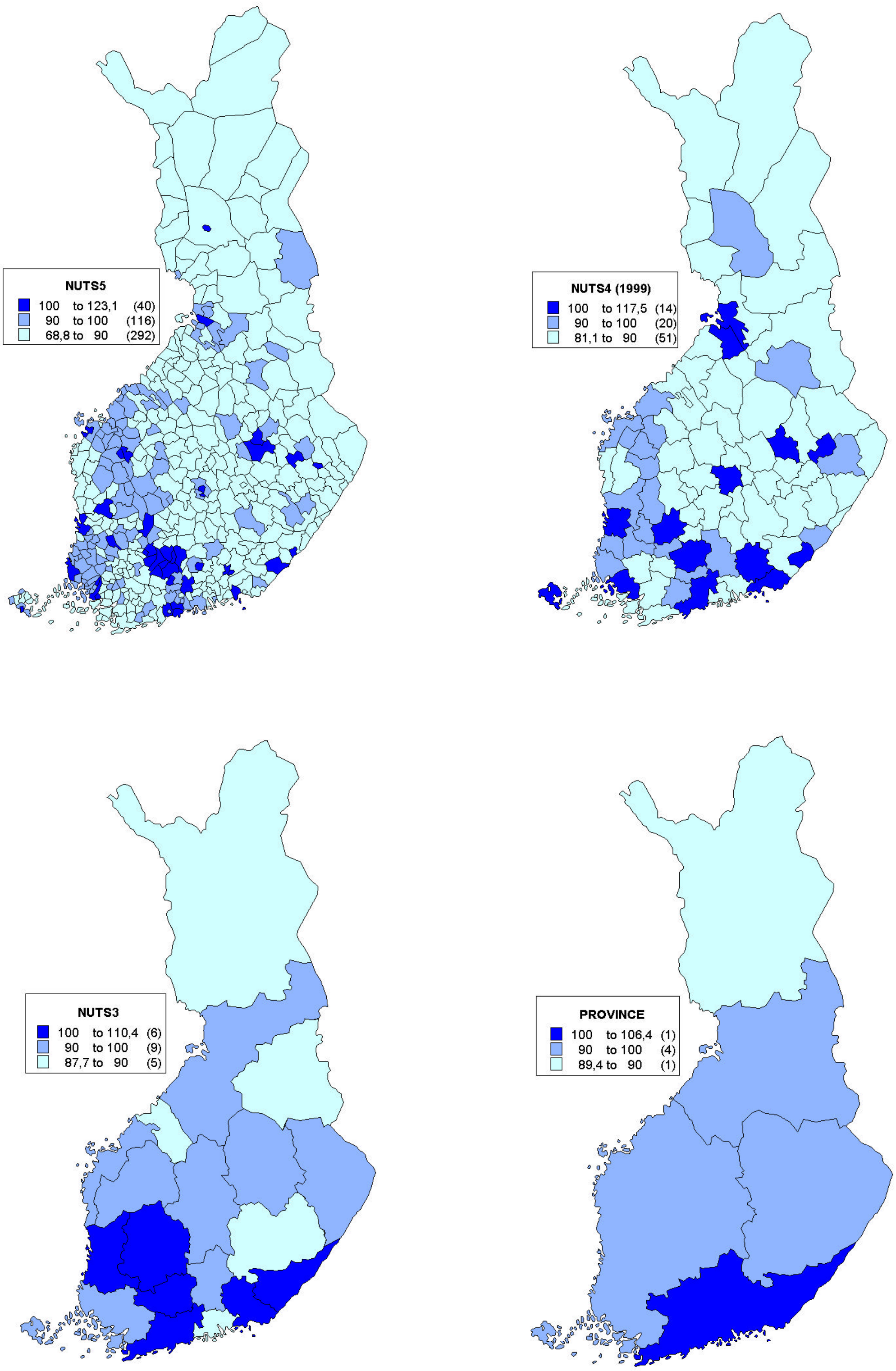

Figure 2. Broadband availability index A_j at NUTS5, NUTS4, NUTS3 and PROVINCE (~NUTS2) levels (100 = average weighted by population).

In a broader context the maps presented in Figure 2 describe the well-known modifiable area unit problem (MAUP) of a correct spatial scale: If we do not observe a phenomenon at a scale at which it is occurring, we are unlikely to get insight into the phenomenon we are analysing. The problem is of course present everywhere in spatial analysis, but let's consider it seriously in this specific case: In Finland, for example, the basic telecom network (fixed lines & ISDN, mobile telecommunications) is available everywhere, except in very remote and extremely isolated places. Thus, the differences in supply exist only in more advanced telecom services (ADSL, cable etc), but the spatial nature of those differences seem to be local rather than regional: cities and densely (sparsely) populated areas are in a better (worse) position in all NUTS2/3/4 -regions, and therefore, information of differences in telecom supply may be only available at a relatively fine spatial scale.

The main point is, however, the change in message and the loss of information from NUTS5 through NUTS4/3 to Provinces. The intensive averaging and aggregation to arbitrary scales seem to destroy just those patterns and characteristics that are interesting and typical in this case. In other words, the results change when aggregating smaller spatial units into larger ones, and thus, use of a 'too large' spatial scale may lead to misleading results of the spatial pattern in concern.

How does this information lost by aggregation affect the optimal policy choice, considering a nation aiming for equal broadband availability? Let's consider the extreme case: Policies are based on the information of provinces (~NUTS2, see Figure 2). Policy recommendations were to support development in all other but the southernmost province. A look at the NUTS5 availability map in Figure 2, however, reveals that there are plenty of municipalities also in other parts of the country, which have better than average availability of broadband. These municipalities would be supported as well, if province level information is used to build the policy. To conclude, the information loss due to the aggregation of information leads to misjudged policies.

The same problem due to aggregation emerges in policies, which are based on NUTS5 information. The actual pattern of broadband availability is far more fine-grained: it is due to the characteristics of broadband technologies, they are low-range technologies and relatively expensive. Thus, they are only available in regions with high-density population. Such areas are not restricted by administrative NUTS-regions. Thus, basing policies on regional administrative borders would be wrong in the broadband case, since the actual availability pattern is more fine-grained.

The only solution for equalizing a fine-grained phenomenon, like broadband, is to base regional policies on the real regional differences, which are the causes of differences in availability. In the case of broadband, these would be the distribution of population, education and income. In other words, if broadband availability (the digital divide) was to be reduced, policies should target areas of low-density population, low education levels and low income – and these areas should be on a finer scale than NUTS5. The other option would be to adjust the policies to target on developing mobile broadband technologies, and securing that these would be everywhere available.

4 BROADBAND AND DIGITAL DIVIDE: ANY LESSONS FROM THE FINDINGS?

The empirical findings presented in Section 3 illustrate that there are important regional differences in broadband availability in Finland. Essentially, the very basic difference is binary: there either is, or is not, a broadband access to the Internet on your place of location. This is due to the technological properties of the most commonly used technology: ASDL broadband connections are accessible inside the radius of approximately 5 kilometres from a relevant switchboard. However, when these binary data are aggregated on a regional basis, a quite different pattern of territorial differences is observed. In the present case, its most striking feature is the impact of aggregation level on the conclusions. The maps of Figure 2 make it possible to draw strikingly different generalisations in terms of different NUTS divisions.

The possible implications of this MAUP on policy were discussed above. From a policy perspective, the even more fundamental issue here is the question whether territorial differences in broadband access matter for the digital divide and whether something should be done, and could be done, to alleviate the problem.

OECD (2001, 4) defines the term digital divide by referring to "…the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities. The digital divide reflects various differences among and within countries." As to the digital divide within countries, it concludes that: "Internet access levels are higher in capital cities and highly industrialised and advanced regions than in rural and peripheral regions", and further "(N)etwork infrastructure tends to be more expensive and of lower capacity and quality in remote areas" (OECD op cit, 27).

The latter assertion has been confirmed by many empirical studies. Malecki (2003), for instance, in his investigation of rural areas in the US, emphasises a low density of population as their key problem, because it leads to a low density of markets. Johnson (2000) states that isolated rural areas are usually provided with telecommunications infrastructure, but typically they lag one technological generation behind urban and growing rural areas.

Viherä (1999) provides a conceptual framework for the existence of the digital divide from a demand perspective. She argues that the differences in peoples' communication capabilities result from three factors: access, competence and motivation. Communication capabilities exist only if all these three factors are satisfied, depicted by the overlapping area of the three circles in Figure 3.

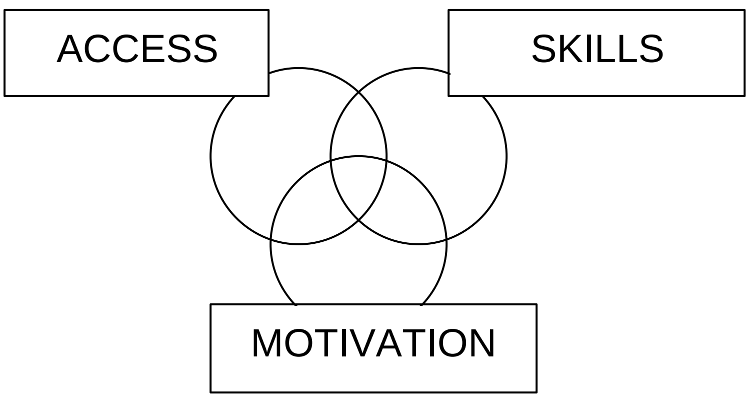

Figure 3. Components of communication capabilities. (Viherä 1999)

In Figure 3, access refers to the existence of the equipment and availability of infrastructure needed for communication. Competence, that is, communication skills, can only be achieved by experience. Motivation is the net utility gained from communication – it should satisfy the needs, and its costs should be less than the utility tion – it should satisfy the needs, and its costs should be less than the utility derived from it.

With respect to territorial differences, rural areas usually lag behind in all three of the factors mentioned in Figure 3. In an urban/rural comparison, rural citizens tend to have lower access possibilities because of less demand, weaker skills due to less experience, and less motivation due to higher costs and a lack of available services. For the present purposes, the main message of Figure 3 is simply that availability of a network is a necessary, but far from being sufficient, precondition for an individual's successful participation in an information society. Whether it is in practice an important constraint, remains largely an open issue here. However, some indirect evidence can be produced by analysing correlations between broadband availability and Internet take up: see Figure 4.

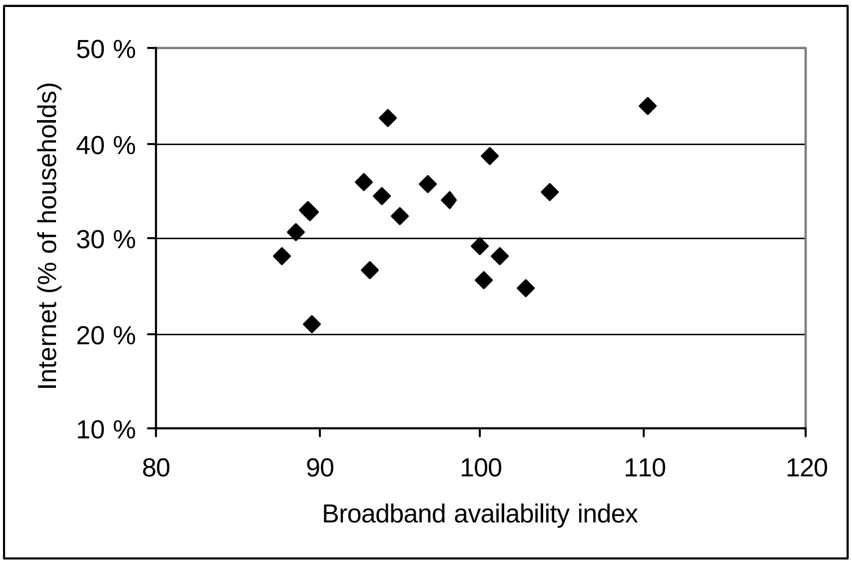

Figure 4. Internet take up and broadband availability: NUTS3 regions in Finland in 2001.

The striking feature of the findings is that the outlier region of Uusimaa (including the capital city) region exerts decisive importance for conclusions. If it is included in the data, the correlation between broadband availability and Internet take up presented in Figure 4 is found positive, even if fairly low, 0.31. But if this most metropolitan region is excluded from the data, the respective correlation is not far from zero (0.06). Thus it is not possible to argue in the Finnish case that broadband availability would generally explain regional differences in Internet take up. This implicates that information society policy should rather create demand and motivation among the consumers, and not promote publicly funded investments, if the aim is a rapid and nationwide rollout of broadband.

However, even if broadband availability might not be the key issue in explaining a territorial digital divide, it is indisputably a policy concern in several countries. This raises the question whether the findings of this study might have implications for information society policies.

In general, the arguments in favour of a policy intervention derive either from efficiency or equity considerations. Both of these motivations support an active, strategic development of infrastructure. (Cf. Figure 1) The efficiency gains can be derived either from network externalities, as the network's value to a user is higher the more users there are, or from the repercussions of broadband availability on economic growth. The equity argument, for its part, is usually formulated in terms of service obligations, according to which every provider of infrastructure or operator utilising infrastructure should provide service to all parts of the country, and even at a uniform price. As there are in many cases significant cost differences, this necessitates regional cross-subsidies in one form or another. Basically, the equity argument is political. For instance, access to Internet is at the moment seen as part of the universal service obligation in the EU context, but broadband access is not (for the Universal Service Directive, see Directive of the Council 2000/0183/COD).

The presence of network externalities has also another potential implication, as networks with externalities typically require a 'critical mass' to exist: Suppose, that a service is available over an existing distribution network. Say, a journal is available everywhere in local stores, in urban and rural regions. Next, the journal, or the same content, becomes available over the Internet. Suppose, that a broadband connection is required due to the rich content of the journal. For reasons of convenience, customers with broadband access move from the traditional distribution network, the store, to the Internet. As a consequence, the critical mass of the traditional distribution network might be undercut, and the traditional distribution network dies. Customers living in rural areas are the ones who suffer from the deterioration of the traditional distribution network, since they have no broadband access.

In practice, national policies differ to major extent with respect to the commitment of broadband access in EU countries. Finland is one of those countries where a wide-spread availability of broadband is seen as a relatively important policy target. In this respect there would be no need to see the above observations on existing territorial disparities as a problem if they would be only a temporary phenomenon: a result of short lag in roll-out on broadband, or soon to be abolished by new technologies with ubiquitous coverage.

Unfortunately, this does not seem to be the case. The low density of demand, and nodal qualities of new technologies imply that the 'rural penalty' in the provision of infrastructure, broadband in this case, is here to stay. In these conditions, the relevant policy mix facilitating a widespread access to broadband includes (a weak or strong version of) USD, and measures aimed at spatially concentrating demand so that a market-based provision of network infrastructures would become profitable to potential investors.

ACKNOWLEDGEMENTS

This paper is an outgrowth of the European Spatial Planning Observation Network (ESPON) programme funded project 1.2.2. 'Telecommunication Services and Networks: Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion' (see www.espon.lu).

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