

Toth, Geza

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Centre-Periphery Analysis About the Hungarian Public Road System

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Introduction

The purpose of the first part of this paper is to summarize fundamental assertions on peripherality taken from special literature, thus describing the causes and effects of evolved situation. It is aimed by our research to specify Hungarian centres and peripheries at LAU2, LAU1 and NUTS3 levels (settlement, subregional, county level) by way of an accessibility model. Spatial distribution of Hungarian population is analysed in the light of peripherality, and finally the question is posed, whether good accessibility unambiguously represents advantageous stage of development.

Special literature references

The term periphery bears dual meaning. On the one hand, it means a *peripherally situated part of a region*, but beside geometrical position, the other meaning is a *negative quality*. *Promotion of the close-up of rural, peripheral regions and hindrance of their lag behind* are regarded as the main goals of infrastructural investments. From the aspect of transport a region is considered peripheral, according to Prof. Erdősi's view, if the centre of agglomeration *cannot be reached by three-hour-return-travel* (Erdősi, 2000). We are of the opinion, that in our accelerated world this travel distance is slightly less – in Hungary the theoretical limit can rather be set at *two-hour-return-travel*.

All peripherality models are based on the assumption that the intensity of economic activity in any regions can at least partly be attributed to the distance from a given town or industrial site. Besides, all of them emphasize the importance of local peculiarities, which result in the distortion of effect distribution relative to the concentric scheme of the centre. Later theories discuss advantages of agglomeration (i.e. advantages of spatial proximity of economic actors).

Fujita listed these advantages (Fujita-Krugman-Venebles, 1999) to three groups:

1. proximity to suppliers of intermediate inputs and to buyers of intermediate outputs (connectivity)
2. advantages of labour force (reserve) availability
3. fast information flow potential

Fujita, Krugman and Venebles proved, that existence of agglomerational processes can be verified by mathematical models within the Fujita model through connectivity, with the

exclusion of the other two parameters. They pointed out that decrease in transport costs (both for industrial and agricultural products) will accelerate the process of agglomeration.

So these theories examine causality elements of peripherality: costs of transport and lack of agglomerating economies. The outcome is that these models are only restrictedly suitable for regional planning, considering that the process of agglomeration greatly depends on physical connections, nevertheless, it is a much more complex process, so the entire interrelationship cannot be described by mathematical models.

Keeble (Keeble–Offord–Walker, 1988) argues that „peripherality is a synonym for relative accessibility to an economic activity, or the lack of it”. Accessibility is the main „product” of a transport system, with typical feature that it determines the locational advantage of a region relative to other regions. *Regions with better accessibility to input materials and markets are more productive, more competitive and hence more successful than more remote and isolated regions* (Linneker, 1997). According to our own researches, the connection is not straightforward, however, it is true for several areas, though it cannot be generalized.

Consequently, it is difficult to empirically verify the impact of transport infrastructure on the regional development. Several researchers state that there is positive correlation between transport infrastructure and per capita GDP (Biehl, 1986, 1991; Keeble–Owens–Thompson, 1982, Keeble–Offord–Walker, 1988). This correlation, however, primarily reflects historical agglomerational processes in many cases, and not the presently existing causality. (Bröckner–Peschel, 1988).

It is even more difficult to explore interrelationship between economic indicators (growth or decline) and transport infrastructure investments. The reason for this is that *additional investment in countries with developed transport infrastructure will bring only marginal benefit*. In such countries strong impacts on regional development can be achieved only if *investment results in removing a bottleneck* (Blum, 1982; Biehl, 1986, 1991).

The issue is that whether construction of transport infrastructure reduces regional disparities. Certain research activities proved that investments driven by regional development policies have not reduced regional disparities in backward European regions (Vickerman, 1991), whereas others pointed out that *disappearance of barriers among regions (as a result of investments) disadvantaged peripheral regions in many cases* (Brocker–Peschel, 1988).

It means a problem that new infrastructural systems are not built between the core and periphery but within and among core regions, because demand for transport is highest there (Vickerman, 1991/a-b). Therefore, *core regions of Europe (among others the trans-European*

networks, TEN)) will have the benefit of investment. In the peripheral regions small and medium- size companies create or can create new jobs in several cases. These companies, however, *are not concerned in transport corridors, but they need good regional transport infrastructure (Erdősi, 2000).* Naturally, multinational companies can also invest in peripheral regions, but in Hungary they mainly settled down because of low labour costs without long-term planning, so existence or lack of motorways was not a major factor for them.

We quote some factors to point out, what problems appear at peripheral regions for the impact of developments.

On peripheral regions the scope of manufacturing activities is relatively narrow, and it is typical that branches with lower value added dominate. It is debatable that *diminishing transport costs alone can create competition advantage.* In some rural counties of the United States for example, where motorway is available, not much more significant increase was measured than in counties without motorway. Parallely those provincial towns, where motorway connection exists, did not develop faster than those towns with only one motorway (Isserman–Rephann–Sorenson, 1989; Briggs, 1980, Rephann–Issermann, 1994). This naturally does not mean, that existence of motorways in rural areas would not be a positive factor. Positive interrelationship was confirmed in some provincial regions of the United States between the per capita income and the existence of motorways. (Eyerly–Twark–Downing, 1987). Some experts argue that transport costs can have significant impact on the general level of regional growth. Others debate this statement, and say that primarily town centres will grow despite the decentralization pressure generated by the motorway (Boarnet–Haugwout, 2000).

It is worth drawing attention to some hazards. The relation between infrastructural and regional development is quite complex: *reduction of transport costs may give rise to the development of small-size enterprises, which supply to local markets.* In case of certain branches (especially for producers to small markets at high costs) *reduction in transport costs will eliminate those hindrances, which granted protection from external competition, and thus outsider companies penetrating to peripheral markets can deteriorate positions of local producers and traders* (Rietveld–Bruinsma, 1998; Garrison-Souleyrette, 1996). Local outlets and warehouses are often closed down, since companies think it cheaper to supply these areas from central regions. Naturally, there may be actors in the market, who remain competitive in the sharp contest, and improved infrastructural conditions *open up new markets, and motorway construction may cause further reduction in costs.*

The outcome of competition among regions depends on several factors. One of them is *the branch structure of regions*. Another major factor is the flexibility of *labour market*. In several cases, namely, those who are not enough skilled for a job, *or cannot adopt to new challenges for other reasons, cannot make use of the opportunity*.

The most often occurring negative change observed has been *the relocation of production activity to central regions* (Parrott, 1998). Phenomena, affecting peripheries, can naturally be derived from the interaction of several factors, however, it is unambiguous, that their evolvement is greatly backed by the motorway investment.

Some examples show, that formerly isolated settlements *attained node position by motorway construction*. In these settlements an increasingly large number of activities started to flourish within a short time, in result of which these settlements shortly got into a central position within the respective region (Moon, 1988).

It is ascertainable that infrastructural developments are inevitably necessary for the upgrading of peripheral regions, but these investments alone are ineffective. Only with the employment of supplementary policies for regional development can sufficient effect be attained (Simon, 1987; Banister–Berechman, 2001).

Data and methodology

For the examination of central-peripheral relations in Hungary we used the centrality index employed and introduced by foreign researchers in papers, and we selected potential model version. Its advantage is that it takes both the mass of accessible destinations and the time necessary for accession into account. For the analysis we used the digital road database of GEOX company, which has been digitalized from a military ground map DTA-50, scaled 1:250,000 as road network coverage, which shows national road network sections as per status on 1 January 2005. Using a route-optimizing programme Arcview 3.2 geographical information system we determined accessibility of 3,167 settlements of Hungary (3,144 settlements + Budapest and its districts) from every other 3,166 settlements.

In our research the concept of accessibility always means physical accessibility, more precisely access time in minutes. In preparation of road network data stock, routes have been coupled with speed limits, relevant to the respective road category (i.e. according to the Hungarian traffic regulations KRESZ travel speed limit within inhabited area is 50 km/h, and outside inhabited area is 90 km/h, on motor road it is 110 km/h and on motorway speed limit is 130 km/h) and access times were determined for all route segments (for sections from

crossing to crossing). On networks we determined minimum access time demand of optimal routes by using ArcView Network Analyst programme among all settlements of Hungary. This procedure is equivalent with defining the optimal access route between two points of the graph, where graph edges are route segments and resistance data relating to the edges are time data necessary for passing through.

Masses of accessible destinations have been calculated with the population of each settlement.

Calculation of the centrality index

At calculation of the index fundamental researches have been taken into account (Schürmann–Spikermann–Wegener, 1997; Spikermann–Neubauer, 2002; Spikermann–Aalbu, 2004; Schürmann–Talaat, 2000; Halden–McGuigan–Nibet–McKinnon, 2000), with minor modifications.

1. Inner potential

$$I A_i = \sum_j W_j \exp(-\beta c_{ij})$$

where $I A_i$ is the settlement's inner accessibility potential, W_j is the mass to be accessed from settlement i (in the present case it is population) c_{ij} is access time (depending on the type of road) in minutes, β is a weight (at present 0.1). In our research we used 0.1 weight, because in several similar researches this value was used (Simmá *et al.*, 2001)

Since centrality index has been calculated for settlements, among which magnitude disparities are quite significant, we considered calculation of own potential important, as well. In many cases, namely, the potential of settlements with high population number would be relatively small, if we disregarded from population number within a settlement, in other words, what accessible destination is available. So a product or service should not necessarily be transported, if it can be marketed within the settlement.

For calculation of the inner potential the inner area of respective settlement was taken into account. Taking the total area of a settlement as a circle, the radii belonging to each settlement were calculated and made proportionate to road distances within settlements.

Travel time values in minutes were determined from these distances, taking 50 km/h average travel speed.

2. Own potential

$$O A_i = W_i \exp(-\beta * r)$$

where $O A_i$ is the settlement's own accessibility potential, and r means time necessary to cover the length of settlement's radius at 50 km/h speed.

Finally, the inner and own potentials were added and centrality indices of settlement calculated.

3. Centrality index

$$\sum A_i = I A_i + O A_i$$

Findings

Prior to introduction of results, it is necessary to note, that the present research took only domestic roads and accessible destinations into account, therefore, result contained herein can be evaluated only in these circumstances.

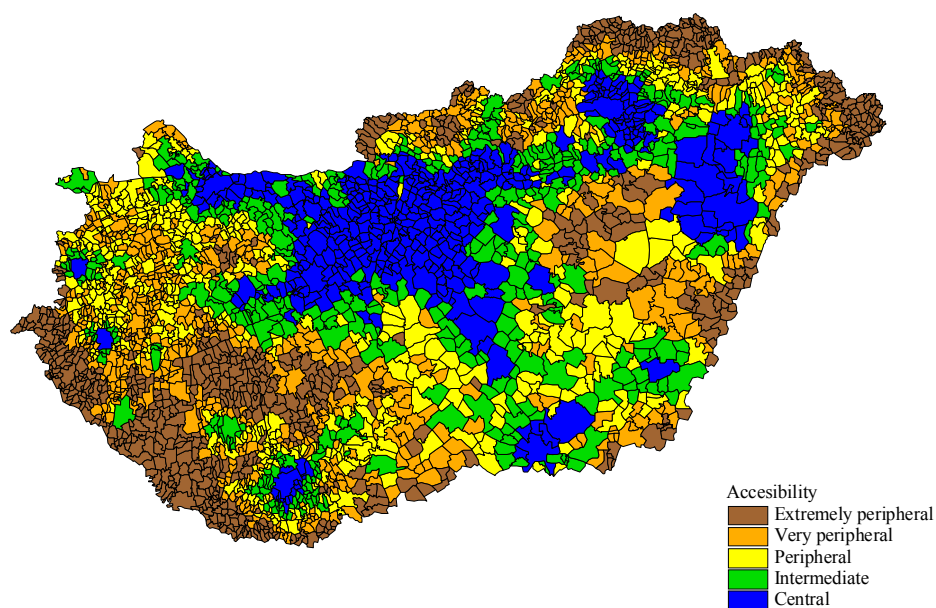
Examining results on the map, some general conclusions may be drawn. On accessibility terms *Budapest's districts and major conurbations are in the most advantageous position in Hungary*. In national comparison the least accessible settlement is Felsőszölnök. On accessibility terms the most disadvantageously located areas, that is *the most significant peripheries can be found in Somogy, Tolna, Jász-Nagykun-Szolnok counties, just like in the border areas of Southern Transdanubia and Northern Hungary*. On accessibility terms greatest regional disparities can be observed in Pest, Borsod-Abaúj-Zemplén and Szabolcs-Szatmár-Bereg counties.

Table 1.

<i>County features of centrality index</i>				
Counties	Maximum	Minimum	Median	Max/Min
Budapest	909 682	376 988	647 524	2,4
Baranya	119 387	6 780	31 004	17,6
Bács-Kiskun	117 075	11 592	34 169	10,1
Békés	82 272	11 022	34 141	7,5
Borsod-Abaúj-Zemplén	163 535	6 218	33 450	26,3
Csongrád	126 782	16 577	40 329	7,6
Fejér	273 950	23 496	72 949	11,7
Győr-Moson-Sopron	121 995	15 635	39 008	7,8
Hajdú-Bihar	160 467	13 823	31 632	11,6
Heves	168 930	17 340	47 002	9,7
Komárom-Esztergom	161 626	21 485	66 214	7,5
Nógrád	88 804	13 315	32 320	6,7
Pest	579 269	6 344	126 112	91,3
Somogy	66 453	7 323	19 291	9,1
Szabolcs-Szatmár-Bereg	112 385	5 504	29 484	20,4
Jász-Nagykun-Szolnok	88 713	12 480	34 050	7,1
Tolna	61 237	8 298	24 459	7,4
Vas	77 308	4 940	32 347	15,7
Veszprém	84 730	15 568	32 896	5,4
Zala	68 355	9 079	26 715	7,5
<i>Hungary</i>	909 682	376 988	647 524	2,4

For further investigations we divided the magnitude of centrality index dispersion to five equal categories (extremely peripheral, very peripheral, peripheral, intermediate, central), and settlements have been listed to categories on this basis (see Fig. 1).

Fig. 1

Centrality of settlements, 2005

Source: author of report

Through preparation of the centrality index we gained a comparison aspect. Namely, settlements would fall into completely different categories, if not only Hungary's road network was taken into account, but Central Europe, or even broader circle of reference would be examined (to do so, outer potential calculations should also be taken account of, Nemes Nagy (editor), 2005).

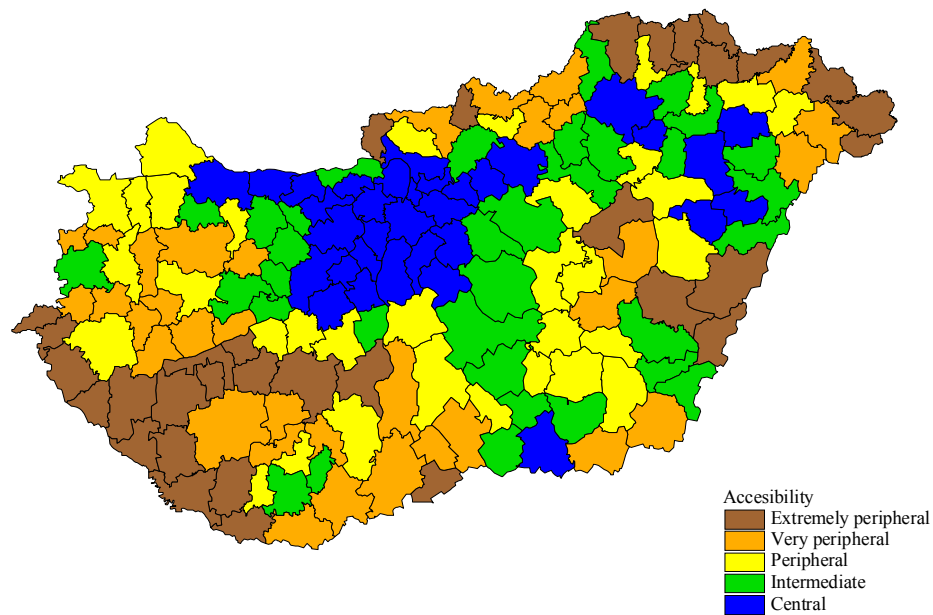
Relativeness of peripherality is shown by another factor as well, that *however many new motorways of public roads are built, duality of centre-periphery will still exist*. In result of investments a certain part of settlements will pass to another category, but the major part of them will remain in the original category. *Therefore, the primary task of transport development is to assure such supply level to peripherally accessible settlements that should not hamper economic development*. In western countries, looking back on luckier past history, the case is increasingly such, and peripherality concept seems to lose its spatial content (i.e. the second meaning of peripherality, meaning aggregately disadvantaged situation.)

Following completion of all planned motorway investments in Hungary (by appr. 2030), centre-periphery relations will still exist, since on accessibility terms there will be more or less advantageously situated settlements and regions even then (at overall much better accessibility terms than now). By then in Hungary not inevitably those settlements will be underdeveloped, which are less accessible, and accessibility and socio-economically based peripherality will segregate.

In Hungary undoubtedly *Budapest and its conurbation are the centre of accessibility*, and their broader environment. On accessibility terms *rural county headquarters and their agglomeration* are important. The largest number of *peripherally located settlements can be found on the Hungarian Great Plain and in Southern Transdanubia*.

In our further investigations we considered necessary setting the extent of centrality at subregional and county levels as well (see Figs. 2-3). To do so, the settlement level potentials have been aggregated at a higher level, and averages of all levels were taken as subregional, county-level and regional potentials. At different levels these data have been categorized similarly to the former procedure.

At subregional level subregions of the Budapest conurbation can be regarded as central, as well as further subregions connected to them along motorways (to the east till Gyöngyösi subregion, while to the west till Győri subregion). According to this calculation Miskolci, Tiszaújvárosi, Nyíregyházai, Hajdúböszörményi, Debreceni, Hajdúszoboszlói and Szegedi subregions can be considered central.

Centrality of subregions, 2005

Source: author of paper

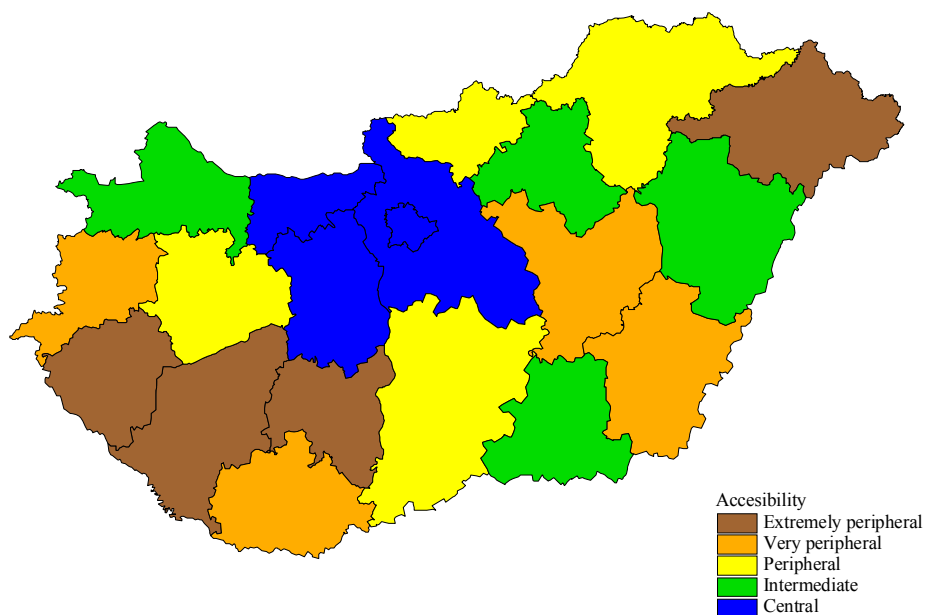
At county level Budapest and Pest, Komárom-Esztergom and Fejér counties are central.

Distribution of population by settlement accessibility

In general it can be stated that 19.4% of population as per state on 1 January 2005 live on peripheral settlements (belongs to categories 1-3). Somogy county is in the worst situation (where 64.5% of population live in peripheral settlements) Tolna county (51.3%), and Nógrád county follow (46.8%), while Budapest (0%), Komárom-Esztergom county (1.3%) and Pest county (1.6%) are in the best situation. If we examine, which of the counties are, where the share of inhabitants living in extremely peripheral settlements is extremely high, it can be stated that Somogy county is in worst situation with 32.0% share, followed by Zala county's 15.4%, and Tolna county's 12.3% share.

Fig. 3

County's centrality, 2005



Source: author of paper

Table 2

County population in light of centrality, 2004

(%)

Counties	Accessibility categories					Total
	Extremely peripheral	Very peripheral	Peripheral	Intermediate	Central	
Budapest	–	–	–	–	100,0	100,0
Baranya	6,5	9,1	12,5	17,3	54,5	100,0
Bács-Kiskun	2,9	9,4	14,4	41,1	32,1	100,0
Békés	5,7	10,6	11,4	39,4	32,9	100,0
Borsod-Abaúj-Zemplén	5,0	6,2	10,5	18,6	59,7	100,0
Csongrád	0,1	3,1	7,4	28,1	61,3	100,0
Fejér	–	2,0	3,0	9,3	85,7	100,0
Győr-Moson-Sopron	0,0	3,1	12,8	34,7	49,4	100,0
Hajdú-Bihar	3,6	7,0	4,6	14,4	70,4	100,0
Heves	1,0	10,1	5,9	13,3	69,7	100,0
Komárom-Esztergom	–	0,7	0,6	13,8	84,9	100,0
Nógrád	5,6	15,6	25,7	40,0	13,2	100,0
Pest	1,0	0,2	0,5	4,9	93,5	100,0
Somogy	32,0	26,5	6,0	7,5	28,1	100,0
Szabolcs-Szatmár-Bereg	9,4	10,7	16,0	30,9	33,0	100,0
Jász-Nagykun-Szolnok	4,8	13,4	17,6	31,9	32,2	100,0
Tolna	12,3	22,3	16,7	34,6	14,1	100,0
Vas	8,9	6,8	27,4	24,0	32,9	100,0
Veszprém	0,9	8,0	16,7	37,7	36,7	100,0
Zala	15,4	14,2	16,5	32,8	21,2	100,0
Hungary	4,3	6,6	8,6	19,0	61,5	100,0

Relationship between accessibility and economic development

One of the important, if not most important questions is the link between accessibility and the level of economic development. Therefore, we compared centrality index with the income, falling under personal income taxation. To assure comparability scale transformation of both data-sets have been implemented, so both data-sets have been converted to 0 and 100.

Between accessibility of population and economic development a moderately strong ($r=0.51$) linear relation can be ascertained. Similar values were achieved in our former investigations as well (Tóth, 2005). In the next step we considered important detailed investigation of county's economic development according to the formerly described centrality categories.

Table 3

Per capita income on settlements in light of centrality , 2004

(Euro)

Counties	Accessibility categories					Mean
	Extremely peripheral	Very peripheral	Peripheral	Intermediate	Central	
Budapest	–	–	–	–	3 188,3	3 188,3
Baranya	1 117,6	1 158,1	1 443,4	1 559,6	2 158,5	1 799,4
Bács-K.	1 079,1	1 227,5	1 202,7	1 494,3	2 138,6	1 619,6
Békés	1 034,8	1 261,5	1 408,6	1 498,7	1 983,8	1 592,4
B.-A.-Z.	974,9	1 013,9	1 401,5	1 288,5	1 904,8	1 632,6
Csongrád	1 546,3	1 135,7	1 259,8	1 528,3	2 102,1	1 844,9
Fejér	–	1 329,1	1 266,2	1 766,0	2 438,7	2 317,5
Gy.-M.-S.	875,7	1 756,9	1 835,3	2 094,7	2 642,3	2 318,0
H.-B.	1 010,6	1 042,9	1 047,1	1 419,4	1 865,2	1 671,0
Heves	1 192,6	1 260,3	1 152,3	1 536,3	2 125,8	1 890,4
K.-E.	–	1 816,2	1 929,0	2 123,9	2 333,6	2 298,5
Nógrád	1 359,2	1 409,0	1 808,4	1 895,5	1 643,4	1 734,7
Pest	2 090,2	2 160,8	1 273,7	1 543,1	2 300,5	2 255,8
Somogy	1 203,3	1 532,8	1 429,9	1 662,7	2 209,8	1 616,9
Sz.-Sz.-B.	888,5	1 038,2	1 135,6	1 315,0	1 851,6	1 391,2
J.-N.-Sz.	933,4	1 254,6	1 401,7	1 538,4	2 346,6	1 701,9
Tolna	1 080,4	1 401,1	2 376,7	1 741,1	2 621,8	1 814,1
Vas	1 982,2	1 685,6	1 968,9	2 298,6	2 744,4	2 283,1
Veszprém	1 599,6	1 566,6	1 649,0	2 065,0	2 493,3	2 103,1
Zala	1 650,7	1 527,4	1 656,5	2 250,2	2 755,2	2 057,4
Hungary	1 211,9	1 310,2	1 514,6	1 673,2	1 993,4	2 097,8

(1 Euro=265 Ft)

At national level it can be stated, that *intermediate and central regions with good accessibility terms are much more developed than those on the peripheries*. In national data it is remarkable, that *improvement in accessibility is coupled with increasing economic growth*. Among counties it is only Nógrád county, where not a centrally positioned location is the most developed. There are some examples as well, when deterioration of accessibility within

peripheries of counties is not unanimously accompanied by economic decline. This also proves that link between accessibility and economic development is quite complex.

Table 4

Net returns on sales of enterprises in light of centrality, 2004

(%)

Counties	Accessibility categories					Total
	Extremely peripheral	Very peripheral	Peripheral	Intermediate	Central	
Budapest	0,0	0,0	0,0	0,0	100,0	100,0
Baranya	1,7	2,3	4,9	11,8	79,2	100,0
Bács-K.	0,8	3,8	8,5	34,4	52,6	100,0
Békés	1,8	3,2	7,5	40,3	47,1	100,0
B.-A.-Z.	0,8	0,5	5,5	8,6	84,6	100,0
Csongrád	0,1	0,5	1,4	15,1	83,0	100,0
Fejér	0,0	0,2	0,3	0,9	98,6	100,0
Gy.-M.-S.	0,0	0,5	4,8	12,8	81,8	100,0
H.-B.	0,8	1,1	0,8	13,3	84,0	100,0
Heves	0,5	1,8	1,6	2,6	93,4	100,0
K.-E.	0,0	0,1	0,0	7,8	92,1	100,0
Nógrád	2,3	4,5	29,1	58,6	5,4	100,0
Pest	0,2	0,0	0,2	0,9	98,7	100,0
Somogy	5,8	69,5	1,4	1,8	21,4	100,0
Sz.-Sz.-B.	4,2	3,2	8,9	20,0	63,7	100,0
J.-N.-Sz.	0,8	5,4	6,4	15,6	71,8	100,0
Tolna	4,3	13,1	29,3	27,0	26,3	100,0
Vas	20,2	0,7	11,3	12,5	55,2	100,0
Veszprém	0,1	2,5	6,6	32,3	58,4	100,0
Zala	5,6	4,2	6,7	42,1	41,3	100,0
Hungary	1,0	2,7	2,2	6,6	87,5	100,0

In regard to net returns on sales of enterprises it can be stated, that at national level the picture is very concentrated on behalf of central areas. Among 19 counties of the country there are 16, where peripherally accessible settlements' (categories 1-3) net returns of sales of enterprises does not even reach 20% of the county level. There are three counties, where net returns on sales in peripheral settlements is between 20-50% of the county's average (Vas, Nógrád, Tolna) and one county (Somogy), where it exceeds the above.

Relationship between accessibility and employment

As a next step we investigated how accessibility is related to economic activity and employment. At this stage we had to face a methodological problem, since the number of employed is surveyed by HCSO on full-scope basis in the frame of population census every 10 years. A possible methodological alternative is to replace the number of employed by the

number of tax-payers (Nemes Nagy, 2005). At these terms the number of tax-payers as a percentage of population in working age represented employment rate.

Table 5

Employment in settlements in the light of centrality, 2004						
Megyék	Accessibility categories					Mean
	Extremely peripheral	Very peripheral	Peripheral	Intermediate	Central	
Budapest	–	–	–	–	71,3	71,3
Baranya	51,5	53,2	59,5	61,2	68,1	63,3
Bács-K.	54,3	57,4	59,2	62,7	68,4	63,3
Békés	54,7	60,0	63,9	65,1	69,0	65,1
B.-A.-Z.	48,8	46,8	54,3	51,7	59,7	56,4
Csongrád	71,5	55,6	60,5	64,7	68,0	66,2
Fejér	–	64,3	60,3	65,7	70,7	69,8
Gy.-M.-S.	53,7	66,6	70,8	70,1	73,6	71,8
H.-B.	50,2	52,0	50,4	57,4	63,1	60,5
Heves	61,6	56,2	53,1	60,1	68,7	65,4
K.-E.	–	69,9	69,3	69,9	70,0	70,0
Nógrád	57,6	58,8	63,9	65,0	62,5	63,1
Pest	66,3	64,0	56,8	58,4	63,8	63,6
Somogy	54,8	63,2	61,6	64,1	70,1	62,4
Sz.-Sz.-B.	46,9	46,4	49,0	52,5	60,9	53,7
J.-N.-Sz.	47,9	54,5	59,6	61,9	70,9	62,7
Tolna	54,1	60,6	66,4	65,3	72,4	64,2
Vas	68,7	71,1	72,7	75,1	78,1	74,6
Veszprém	67,1	68,7	66,7	70,7	74,2	71,2
Zala	65,9	65,3	68,0	72,3	76,4	70,6
Hungary	54,9	57,7	61,3	63,4	68,0	65,3

It has been ascertained that employment in advantageously located regions (intermediate and central) is higher in most cases than at peripheral regions. The most striking exception is Csongrád county, where in extremely peripheral areas much better share than the national one has been achieved, and centrally located settlements in the county slightly lagged behind. There are several counties, through which motorways run, that is their accessibility can be considered as relatively advantageous, however, average employment rate of the county remains only around the national average, or lags slightly behind it. So existence of a motorway link does not mean economic boom for the entire county!

Infrastructural investment developments in peripheral regions, nevertheless, can bring favourable booming impact, if this development is coupled with complex economic development programmes.

Relationship between accessibility and competitiveness

Remarkable studies appeared recently on the questions of interpretation of the concept regional competitiveness and its measuring possibilities, the results of which we intended to build in our paper. These show how relative household income can be split to a product of numerically illustratable and clearly understandable socio-economic factors. (*Lengyel 2000, Nemes Nagy 2004*). Using some mathematical conversions (logarithm values should be taken) the product is reduced to a much easily usable sum according to the next formula:

$$\log\left(\frac{\text{Income}}{\text{Population}}\right) = \log\left(\frac{\text{Income}}{\text{Employed}}\right) + \log\left(\frac{\text{Employed}}{\text{Active population}}\right) + \log\left(\frac{\text{Active population}}{\text{Population}}\right)$$

Since we set our measurements at settlement level, income should remain the income of the respective year falling under personal income taxation, the number of employed can be approached by the number of tax-payers in the respective year, women aged 15-59 years and men aged 15-61 years are considered active population, while population means the number of permanent population. Incomes per tax-payers approach productivity of economies in regions alongside roads, share of tax-payers within the active population gives acceptable estimate for employment, while share of active population within total population as a kind of measure of age-structure, considers younger demographic feature as positive regional source.

Breakdown by the above factors was employed for standardization of a region, relying on József Nemes Nagy's results as basis, according to which income disparities are primarily driven by productivity, while the effect of age-structure factor is quite insignificant (*Nemes Nagy, 2004*). The basis for standardization was co-ordination of values of different accessibility groups to the national average, and to the three other factors. Employing technical solutions of Nemes Nagy, 2004, in Table 4 we also marked by 1 factors above the national average and by 0 those below the average. (First figure always stands for population income, while the second for productivity and the third for employment, fourth shows age-structure.) Remaining at the term competitiveness, regions with higher population income than the average were considered advantaged, while those below the average were considered disadvantaged. Within it we state complex advantage, if in the respective region all three components of population income exceed the average, while competition advantage is regarded multi- or single factored, if the condition is valid for two or only one factor. Competition disadvantage is interpreted analogously.

Table 6

Counties	Factors of relative income position, 2004				
	Accessibility categories				
	Extremely peripheral	Very peripheral	Peripheral	Intermediate	Central
Budapest	—	—	—	—	1110
Baranya	0000	0000	0001	0001	1011
Bács-K.	0000	0000	0000	0000	1011
Békés	0000	0000	0000	0000	0011
B.-A.-Z.	0000	0000	0000	0000	0001
Csongrád	0010	0000	0000	0000	1011
Fejér	—	0000	0000	0010	1111
Gy.-M.-S.	0000	0011	0010	0011	1111
H.-B.	0000	0000	0000	0000	0001
Heves	0000	0000	0000	0000	1010
K.-E.	—	0010	0010	1011	1111
Nógrád	0000	0000	0000	0000	0000
Pest	0110	1100	0000	0000	1101
Somogy	0000	0000	0001	0001	1011
Sz.-Sz.-B.	0000	0000	0000	0001	0001
J.-N.-Sz.	0000	0000	0000	0000	1111
Tolna	0000	0000	1111	0001	1111
Vas	0010	0010	0010	1011	1111
Veszprém	0010	0010	0010	0011	1111
Zala	0010	0000	0010	1011	1111

Note: 1. population income 2. productivity 3. employment 4. age-structure factor

It can be seen, that centrality itself does not mean advantage in all cases, since on settlements of several counties with good accessibility multifactoral disadvantage, and in regard to Nógrád county complex disadvantage are present. Settlements with temporary accessibility show multifactoral advantage only in Komárom-Esztergom, Vas and Zala counties, but in other cases they show multifactoral and complex disadvantage. Among peripheral regions Tolna county's moderately peripheral settlements can be mentioned, which have complex advantage, and extremely peripheral settlements of Pest county with single-factored advantage can also be outlined. Other settlements in peripheral regions of counties can be described by possessing one of the disadvantages.

Examination of the necessity of new investments

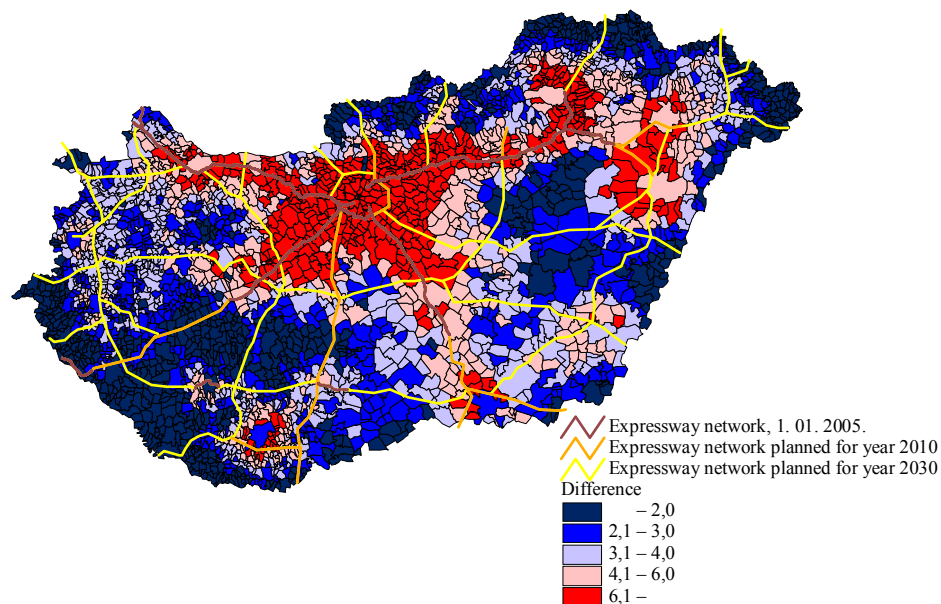
In the following we investigate, what further consequences can be drawn from our model regarding certain areas and what intervention is necessary at road networks. We need to give consideration to these issues, because motorway constructions can attain their favourable impact only through the whole network. The whole network (motorways, motor roads, roads) needs to smoothly co-operate to achieve balanced regional development.

Therefore, we aimed to investigate, to what extent the practical potential (estimated on the basis of access times calculated for road network) and theoretical potential (based on air kilometres) differ.

Owing to the fact that potential values of time data of the road network model (values in minutes) are not directly comparable with the air distance model, based on geographical distance in kilometres, the following method was used. Both potential data sets have been converted to 0 and 100 (scale transformation) and the difference in values received has been shown on a map. On this map (see Fig. 4) at regions marked with blue the practical potential (calculated from accessibility data) was weaker than the theoretical one at a higher extent than the rural average, which means, that these settlements, regions would need accessibility improving investments. Red colour is just the opposite, shows settlements with favourable accessibility. This model makes it possible that in regions where practical potential is weaker than the theoretical one, on the basis of this deviation we could make a proposal for the type of investment to implement.

Fig. 4

Potential deviations after scale transformation



Significant, practically interlaced regions can be found in *Southern Transdanubia*, especially in the vicinity of *Zalaegerszeg*, *Nagykanizsa* and north of *Pécs*, where accessibility is very poor. A part of this deficiency can be solved by the extension of the *M7* motorway up

to the country border, as well as by construction of the motorway M9 up to Szekszárd as soon as possible, which could be developed into an expressway in the next step. Accessibility problems arise in the north of the Lake Balaton, which will presumably be cured by M8 motorway. In this instance it is advisable to build the motorway not only for the sake of accessibility, but for spatial structural reasons, too, and this way the first transversal motorway would be created in Hungary. The significance of this is undoubted both from network and from regional development side.

From accessibility approach there are poorly accessible regions along the river Danube and in the northern part of the Hungarian Great Plain. A major part of inaccessibility along the Danube concerns settlements between the Danube and the Tisza river, so their accessibility will not improve by the construction of M6 motorway, but rather by M8 motorway (Dunaújváros-Szolnok section), and by development of the subordinate road networks.

Although accessibility problems in the northern part of the Great Hungarian Plain are only relatively significant according to this research, *but construction of the planned M4 expressway is very necessary, since there are many dynamic settlements located here with high population number (Szolnok, Törökszentmiklós), and by linking with M8 motorway the western-eastern axis would be established, so the over-centralized infrastructural system of the country would become more balanced.*

Accessibility problems incur also in the northern part of Pest county, in Nógrád county, Borsod-Abaúj-Zemplén, and Szabolcs-Szatmár-Bereg counties, just like at the edge of Győr-Moson-Sopron and Veszprém counties. In these regions lack of expressway causes only minor problem, that of by-roads constitutes a greater one.

Regional development in the light of daily accessibility

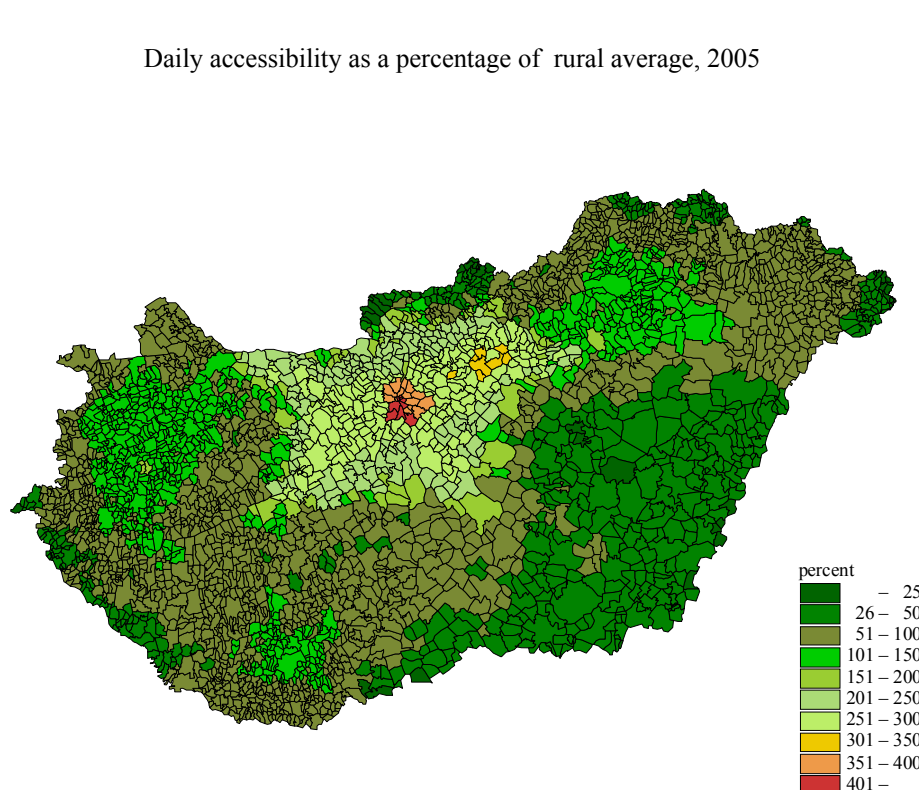
Finally, we endeavoured to investigate, how destinations, recently accessible on the road network influence development possibilities of settlements. For this the daily accessibility indicator has been used (see Fig. 5):

$$A_i = \sum_j W_j f(c_{ij}) \quad \text{where } f(c_{ij}) = \begin{cases} 1 & \text{if } c_{ij} \leq c_{\max} \\ 0 & \text{if } c_{ij} > c_{\max} \end{cases}$$

where W_j is accessible destination (population) reachable from settlement i , while c_{ij} is access time. Regarding daily accessibility 60 minute limit was set ($c_{\max}=60$ minutes) on the

assumption that mainly settlements accessible within this time limit have interactive effect. Thus a factor was received: averagely what population size settlements are accessible within 60 minutes (including itself) from a given settlement, which was drawn as a percentage of rural average (not the national average was taken, because Budapest's position is too outstanding both in population and in accessibility aspects). We assumed that those settlements develop more dynamically, from where higher population number is accessible within the daily 60 minute access time.

According to our analysis the most dynamically developing regions in Hungary are located along the Esztergom-Tatabánya-Székesfehérvár-Dunaújváros-Gödöllő-Vác line, which may become a large town region in the long run owing to the large-scale infrastructural concentration. (Kőszegfalvi–Loydl, 2001). Relatively favourably situated, interlaced regions can be found in the northern side of Transdanubia, and along the Danube in Southern Transdanubia. Accessibility possibilities of settlements in the Hungarian Great Plain and Northern Hungary are much more disadvantageous, which have negative impact on development possibilities, as well.



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