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ILDIKÓ GYŐRFFY

THESIS STATEMENTS OF

Effects of the accessibility potential on the regional disparities concerning the Hungarian subregions

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CONTENT

1. Rationale of the research

Taking a philosophy of science approach, from the two fundamental measures, historical science emphasises the importance of time dimension, whereas geographical and regional sciences highlight the regularities of the regional characteristics of space, natural, economic and social phenomena. Apart from the researches associated with location theories, however, spatial view has not become an integral part of economics. Mainstream economics did not treat the issue of geographical "location" and "distance" as priority in the course of studying the economic processes *[Erdősi, 2000; Nemes Nagy, 1998; Varga, 2009.]*.
With the appreciation of spatiality, and its "re-discovery" in the 20th century, studying the connection of space and time is an important focus of regional research again. At the same time, the interest in modelling transport infrastructure networks and relationships is continuously growing.
Although there are several different impacts arising from the development of the transport infrastructure, it is well established that the quality standards of the transport networks are in a strong connection with the economic situation of an area.
A number of significant problems arise in connection with the spatiality of the economy – e.g. enterprises' selection of location, the phenomenon of unequal geographical distribution of production, or the externalities stemming from the concentration of production. Transport network has an effect of shaping spatial structure regardless of sub-sector; which is capable of improving sectoral and regional structure, as well as the international competitiveness of specific companies at microeconomic level. Companies treat the distance from input and output markets as an important factor in their decisions about selecting a location, which is primarily explained by the minimisation of transport costs.
The infrastructural position through the terms of the availability and attractiveness of locations is able to affect on the internal and external capital flows, on the freight and passenger movements as well as on the market size. The transport system can also have an effect on the intensification of the regional connections, therefore its development increasingly become an important purpose *[Baum, 2002; Jensen-Butler, 2005; Button, Hensher, 2005.]*.

In addition to the transport conditions, the physical parameters, extension and coverage of the networks, the effects of the location, accessibility becomes an important research topic nowadays. Networks are assets of the availability which can be a basic factor of the regional development process. Excellent availability means also extensive internal connections that are able to take advantage from the external relations. The multi-directional relationship has the advantage as a simple physical demand: the region does not suffer from defenceless - whose absence would set the external relations back – and there is no economic and social dependence caused by constraint relations. E.g. the Budapest-centrality of Hungary can be felt in the development level of the national spatial structure and in the relations between the regions *[Erdősi, 2005; Fleischer, 2006]*.
During the research my personal interest motivated me mostly. I examined the Hungarian transport system, the infrastructural terms of the Hungarian road infrastructure, its role in the economic and social life, the possible directions of development. In addition I studied transport, transportation issues.
At the beginning the focus of the analysis meant the physical parameters of the network, I evaluated the negative effects and the required costs and also made comparative analysis with other EU member states regarding the parameters of the network. Taking into consid-

eration, that the transport infrastructure is closely related to the regional development, it can be a reason for regional disparities, this field of research also held special significance. During the years of PhD, my topic was increasingly directed towards the accessibility analysis, with regard to the competitiveness of the territorial units.
I joined to the educational activities of the Institute of World and Regional Economics as a PhD student. My educational duties are closely related to my research activity, especially the "Regional economics", the "Regional international economic relations" and "International transportation". From 2005 I also attend to develop the teaching material for these subjects.
In my paper I analysed also the relationship between the development data and accessibility indicators particularly in terms of centre-periphery relations. With the transport infrastructure investments the literature usually reports that one of the most positive effect is the shortening access time, however, this is not the same as the accessible population mass, that can change the relative positions of the subregions significantly.
Regarding the territory, during my research I mainly focused on the North-Hungarian region. The main problems of the Hungarian regions – in infrastructural aspects – arise from the inadequate road and rail networks – bad condition, quality and low weight-bearing capacity – that are able to delay the economical and social development to a great extent mostly in those settlements that are in the periphery of the regions, in a relative confinement. Taking the North-Hungarian region as an example, mostly the inadequate density of the minor-, access- and connecting roads cause disadvantages, and the low-quality transport services in the rural areas that restricts the economic growth, it might be a reason for areal disparity. The development of these factors, to streamline and enlarge the regional road infrastructure would be necessary and have to be in a dominant position in the future to make the quality of life better, to ensure the connections into the global economic to assist, increase the economic development processes and to improve our competitive potentials.

1. 1. Research background and methodology

Regarding the literature review I studied the appearance of the spatial aspects in the economic theory that question mostly start with the role and effect of the distances through the scientific research.
The appearance of space, spatiality can be discovered in the classical German school, however in the view of mainstream economics the phenomena of space lacks. With the rediscovery of the spatiality in the 20th century, the transport infrastructure as centrifugal force is highlighted in the centre-periphery model, through this the accessibility and its effect on the economic processes was examined in my paper *[Figure 1]*.
Accessibility can be measured with different content and by several methods. The base question of the examination is usually to clear that those territories that has better accessible terms are developed more or not. Firstly I tried to find out, that the improvement of the road infrastructure through the better availability what kind of spillover accompanies, how it effects on the social-economical situation of a region, how strong will be the impacts on the convergence process, or can we speak about direct effects at all?

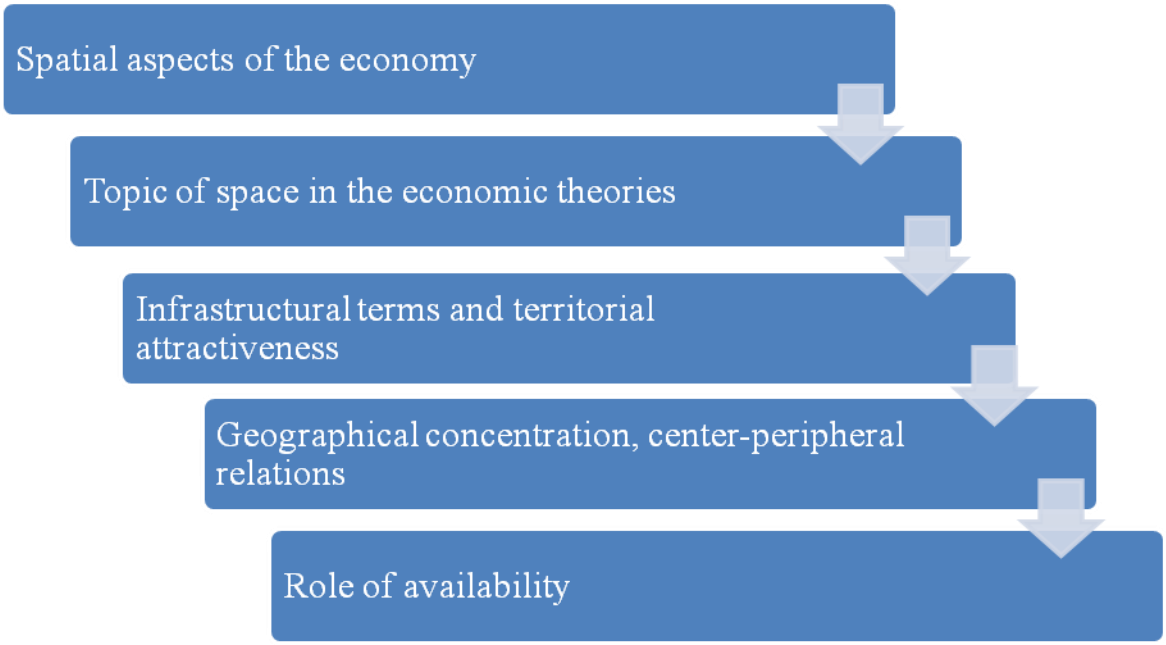

Table 1: Literature background of the research
Source: own compilation

The main aim of my dissertation was to define centre and peripheries in geographical point of view. One of the main research questions refers to this aspect: if a territory is defined as a geographical periphery, does it mean periferity in an economical aspect as a negative term automatically. Availability and relative geographical position can be defined by simple availability models based on access time.
The potential values of the complex model are more multiple; with their application the unit of accessible population and income in a certain time period can be determined. With these calculations the relative and the centre-peripheral position of the subregions can be set up and ranked.
With the adaptation of the gravitation and potential model we assume that the intensity of the economic activity is partly can be explained by the distance from the central pole of an area. Under the basic idea, the growth of the traffic volume between two settlements is directly proportional with the population mass and inversely proportional with the square of the distance. The model determines the space based on the regional mass (e.g. population or absolute volume of GDP – in my case this latter was replaced by the income before tax) and distances between the settlements.
As the model in the analysis is made up by internal and own potential, according to the methodology those places, regions are considered as excellent available areas, or areas with high potential, which are themselves reported as major economic forces (regarding to the absolute volume of population or income), or located near the most important gravity centre.
During my research I aimed to quantify whether a central position in a particular dimension what other role status can get in another aspect, and concerning the availability what kind of casual connections can be detected.

Below I summarise the analysis of the hypothetical statements that was the starting point of my work [Figure 1].

Hypothesis 1: In practice, the impact of the expansion of public road infrastructure on the local economy is measured by the reduction of the availability time of a region/settlement. This, however, may distort comparing to the accessible population per unit time that is presumably closer to the real result.

I used potential model and performed centrality-calculations in order to test my hypothesis.

Hypothesis 2: The population potential of domestic county-seats significantly disperses, which are hardly or weakly influenced by the developments.

I tested my hypothesis using cluster analysis.

Hypothesis 3a.: In spite of the infrastructural developments between 2000 and 2009 the catching up of marginalised subregions is slow or not achieved.
b: The catching up in the subregions of Northern Hungary is presumably of faster pace because the proportion of the expansions of road-network done in the region specifically increased.

I tested my hypothesis using potential model and cluster analysis.

Hypothesis 4: The majority of the subregions of county seats get in a presumably more favourable availability category on the basis of income potential than population potential.

I applied income potential to test my hypothesis.

Hypothesis 5: It is likely that the geographical periphery is identical with the economic periphery.

I applied distribution ratios to test my hypothesis.

Hypothesis 6: The multi-factor competitive disadvantage is more likely to be typical in the geographical periphery.

The testing method of my hypothesis was multiplicative factorisation.

Hypothesis 7: The evolution of economic development indicators can partly been explained by the distance from the municipalities playing central roles, the direct impact of availability is presumably not significant.

I tested my hypothesis by way of regression analysis and path-model.

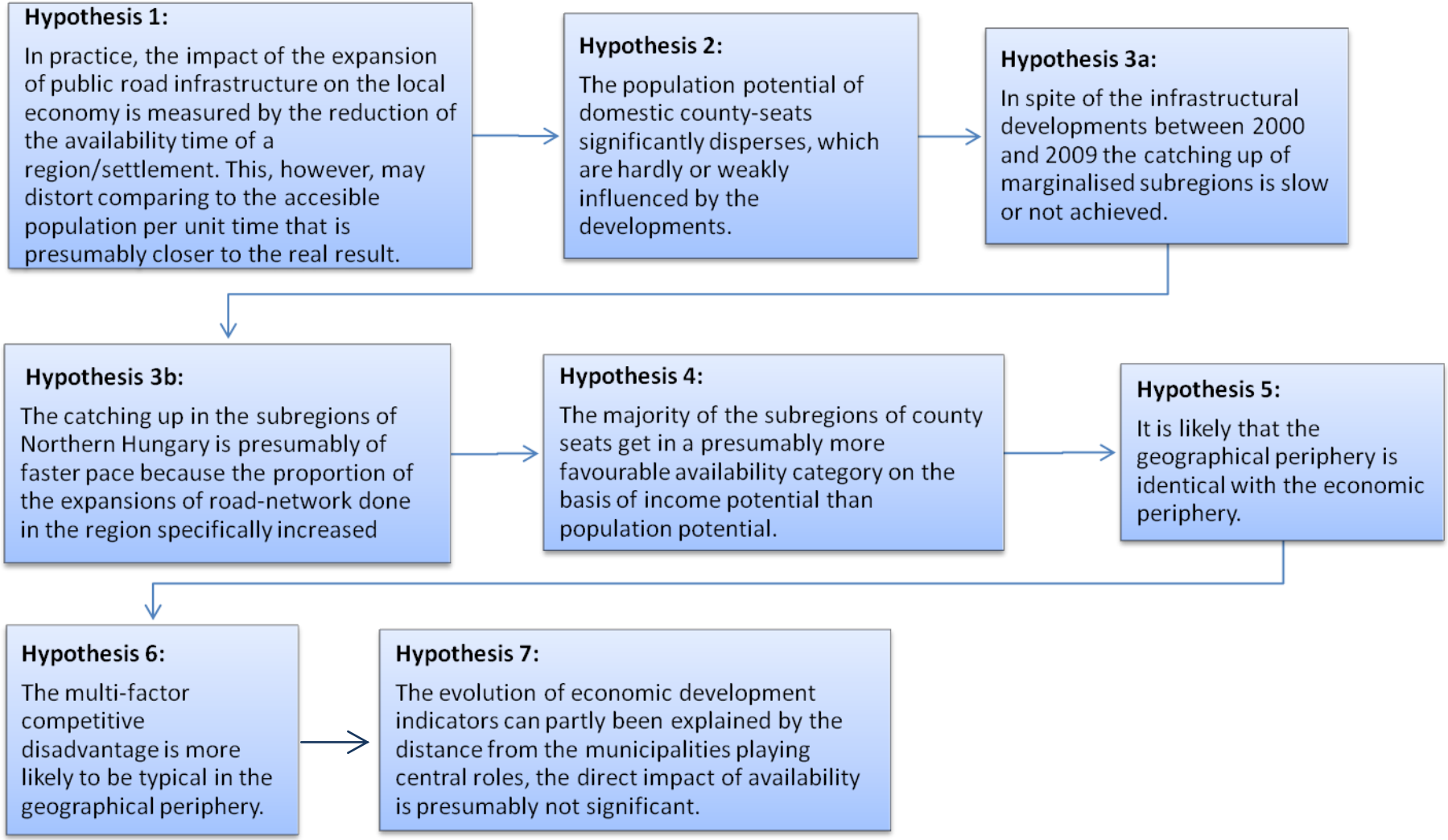

Table 2: Hypothesis of the dissertation
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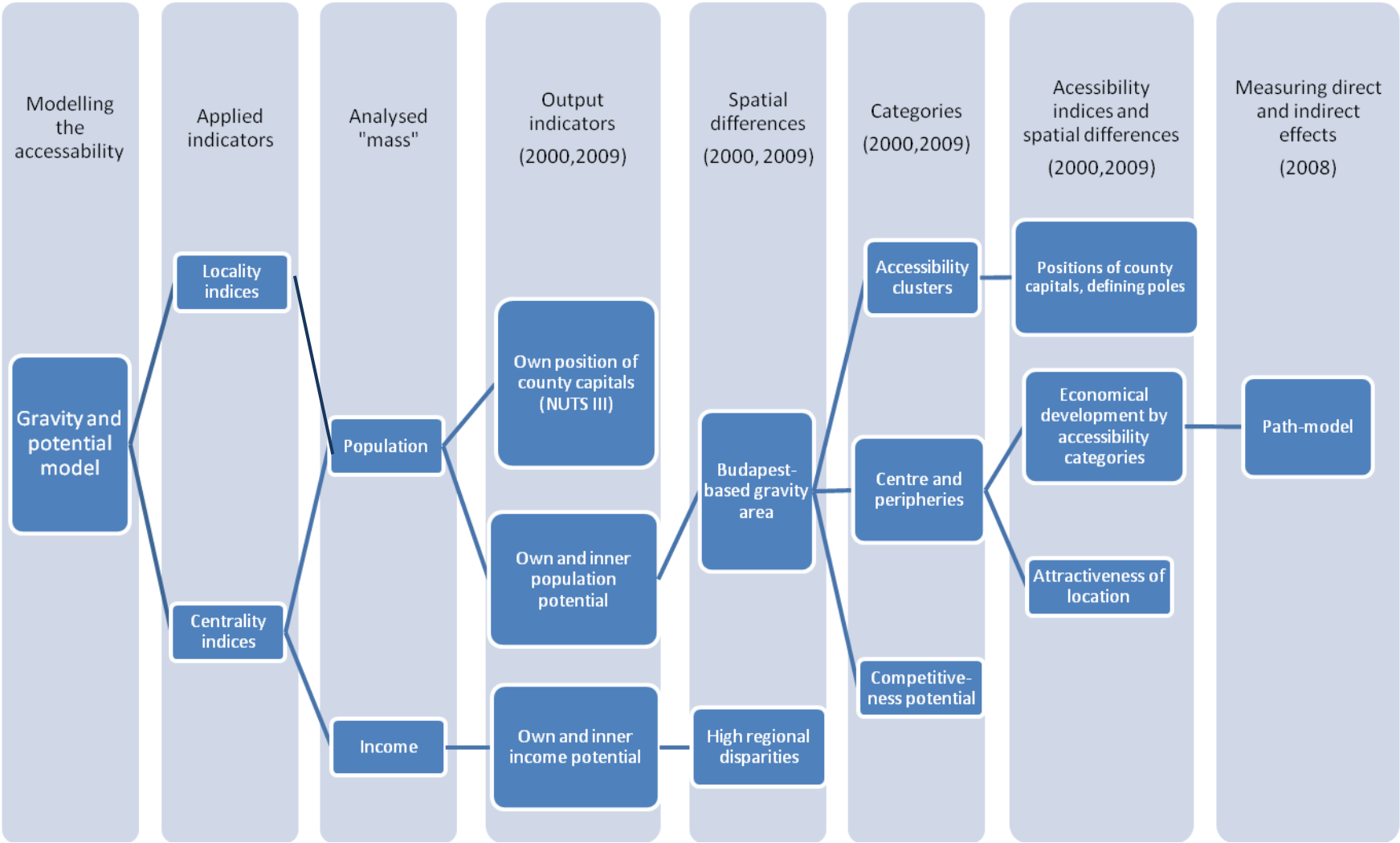

Table 3: Methods of the examination

Source: own compilation

2. New and novel observations of the research

2. 1. Theoretical basis of the research – aspects of the spatiality of the economy

The appearance of spatiality in scientific research begins most often with the analysis of the distance relations: "when economics moves from the 'one point economy' approach and at first it discovers transportation costs as an optimisation and equilibrium factor." [1]
Although the concept of space in economic analyses appeared in Adam Smith's work titled "The Wealth of Nations" (1776) (where Smith placed the analysis of the reasons for economic growth into space), but up until 1990 space-related analyses took place within the framework of the location theory, regional economics, city economics and economic geography *[Varga, 2009.]*. Following this the schools of thought came to the fore that regarded the spatiality of economy as dominant. These approaches view the regional concentrations within a country as the basic unit of testing; they discuss the issue of regional competition and competitiveness.
In my research I wish to emphasise the specific forming directions, tested from geographical and economic aspects, of space and distance.
Nemes Nagy *[1998]* included each of the space-categories into models when evaluating the spatial inequality and arrangement relations, basic elements explaining spatial processes. Space gets more emphasis depending on the different concepts used by the various disciplines: I focused on the triumvirate of distance, localisation and network and tested the following impacts on the regional processes, striving to quantify these parameters.

2. 1. 1. Location-theory approaches

Modern growth theories lack the impacts due to the spatial structure of the economy. Studies discussing the relationship between spatial structure and growth are relatively rare. The integration of growth theory and spatial economics basically appear in three schools. Spatial structure is likely exerting influence on the rate of macro-economic growth by how concentrated the economic activities are located in space; as a result, positive or negative externalities need to be calculated *[Varga, 2009; Horváth, 1998; Krugman, 2002.]*.
The length of the channel of a merchandise from the place of production to the customer, i. e. its range, depends on the market conditions and transport costs, so it is an important factor in selecting a potential catchment area and optimal site. Almost all theories associated with location takes the transportation conditions into account in one way or another.
The traditional location theories are basically modelling the characteristics of the spatial operation of the processing industry and agriculture where the most important goal manufacturing standard products and minimising related costs. Literature suggests *[Table 1]* that location-related decisions are closely linked to production-related decisions.
Nowadays location theories do not emphasise economic motivations, non-measurable factors and economic externalities, historical and political changes, impacts of large international companies when making decisions on location. The concepts of time-space, cognitive space, social space, the new innovations influencing every area of life, as well as the revolution in micro-electronics and information technology also get a role.

[1] Nemes Nagy, J. [2009]: Terek, helyek, régiók. (Spaces, places, regions) pp. 219.

Table 1: Analysis of the impacts of transport distance and transport infrastructure in the economics literature

Author	Thesis
J. H. Thünen	Transport costs influence production and selection of market.
A. Marshall	Transport costs are lower due to shorter distance; the proximity of workplace and the relating availability influences income level and thus labour market as well.
M. Weber	Those areas are prioritised when selecting a location in the case of which market or raw material source can be reached at lower costs.
R. Rodan	Infrastructure is a basic condition of population's needs.
G. Myrdal	It provides an initial impetus for the establishment of network connections, the region develops by way of the economies of scales, which increases private investors' profit and promotes the settlement of further manufacturers.
L. Moses	Transport cost, as an input cost factor, influences the selection of location and consumption rates.
R. Solow	The quantity of inputs available for the region increases with the development of infrastructure, which improves the efficiency of certain factors, productivity.
A. O. Hirschman	The concept of infrastructure is related to the social overhead capital.
R. L. Frey	An important characteristic of infrastructural expenditures is their investment, technical, economic and institutional feature.
W. Ehrlicher	Transport is a "reproducible productive asset".
P. McCann	The change of the relative share of inputs influences the selection of location via demand.
D. Puga	Decrease of transport costs changes the balance between centrifugal and centripetal forces.
Erdősi F.	The more mobile a society is, the greater significance is attributed to the time needed for overcoming space.

Source: own compilation

The approach advocating the primacy of transport costs is objectionable in location theories. Not only the costs but also the expected revenues are dominant in the decision processes of economically oriented companies. Indeed, if a site makes great revenue possible by making use of other factors, then investments may become of secondary significance. That is, the advantages of the construction of a new transport path are not necessarily the decrease of transport costs – a point of consideration should be the extent to which sales and purchase markets can be expanded.

2. 2. Modelling possibilities of accessibility – time and space aspect

Nowadays the topic of accessibility becomes more and more popular as a national and international research field of study. Regarding its aim, the main question is about the connection between the adequate accessibility and development *[Tóth, 2007, Dusek – Szalkai, 2007; Watanabe, 1995.]*.
Availability as well as the infrastructure is defined in different ways according to the different approaches in the economic literature. Generally it is declared that the location of a place is inadequate if it is not easily accessible. According to *Nemes Nagy [2007*] the opposite statement can be also right: e.g. military, defence point of view tough accessibility can be a positive term; in case of tourism it means also attraction, appreciating the "resort-value" of a territory.
Tóth *[2006]* cites Keeble with the definition of accessibility (as the main product of transportation); regarding Keeble, the periferality is synonym with the relative accessibility (or lack) of the economical activity. Problems arise in case of these territories, because the accessibility terms do not increase with the extension of infrastructure, namely the large investments take place, where the demand arises, so the beneficiary places are mostly the centre or core areas.
The results from the explanation of the accessibility and economic content point out that the adequate availability of the economic centre has a positive impact on the companies' internal development decisions and growth rates of the external environment. Foremost in 1954 was the spatial concentration explained, evolved by the better market access *[Pires, 2008.]*.
The accessibility and its "tool", the infrastructural extension can be measured in several ways, that I studied in my dissertation. During the examination of the accessibility roles and spatial movements, the targets are usually the capital city, the regional centre, the county capitals and the motorway junctions on which I want to show beyond with the following analysis *[Nemes Nagy, 2009; Bajmócy, 1999; Edelényi, 2004.]*.

2. 2. 1. Measuring the accessibility potential

Gravity and potential models always refer to moving masses in space. According to the model, the attractiveness of the centre decreases with distance, however, the catchment boundaries are not identical to the administrative borders.
Accessibility is measurable through many methods. Transport geographical studies usually deal with the availability possibilities – in this aspect the middle of Hungary has relatively better position. Coming forward to the borders - because of the base structure of the motorway – the territories are proved to be peripheries in the most cases. From another point of view we could also analyse, how great amount of population, "economical mass" is available. These calculations have high relevance, because – opposite to the accessibility times – they modify the ranking of subregions to a greater extent.

For modelling the territorial structure and territorial flows, mapping the territorial characteristics of the society the models based on physical analogies could be suitable. Potential models are usually used in case of quantitative territorial researches. The gravity model that I have adapted could be used for defining centre and peripheries and derived from Newton's law of gravity- states that any two bodies attract one another with a force that is proportional to the product of their population and inversely proportional to the square of the distance between them *[Nemes Nagy, 2007, Tagai, 2007.]*.

According to Stewart's (1984) simplest basic gravity model, the "population force" can be determined from Pi and Pj "number of population" and physical distance between i and j. Improving this thinking, Bramhall took the time factor into account in 1960. Figure 3 shows that the expected flow intensity of city "A" the biggest between the city "A" and "D", and the slightest between city "A" and "C".

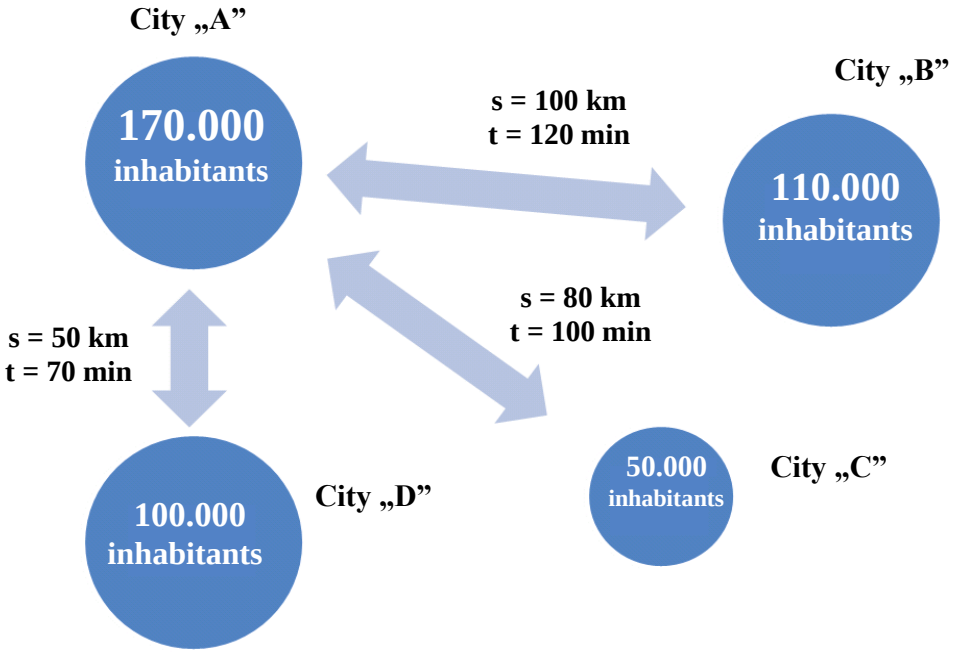

Figure 3: Principle of the gravity model
Source: own compilation on the basis of Tagai, 2007. p. 238.

According to this model, territories that have the biggest potential, they involve the greatest economic power, either they are near by centre, or both. The territorial potential model contains elements of mass (absolute volume of GDP or population) and distance in time and space.

2. 2. 2. Accessibility area of the subregions

A modern economy is characterized by a versatile connection system that provides wide network extension. As a result of the road network development in the country the time-space continuously "shrinks". For the local population not only the improvement of the connections to the centre means the key factor of the progress; it is also a great opportunity, when urban centre exist in the peripheral area that have urban functions. Although the density of the cities in the country is adequate, unfortunately many settlements with "city" range due to their growth and organization tasks cannot play relevant role in the area. Because of the quality of the roads, so the poor accessibility, the level of local services and weak job opportunities the working population is forced to commute. If there are a few settlements that have urban functions in the area, the population have to emigrate. These problems have resulted in a significant proportion of the population with low retention capacity in small villages.
Defining the accessibility potential I have used centrality indices, and made a rank from these values to give the relative positions of the subregions. Making the centrality indices

more comparable, the present subregional positions (from 2009) were used for the year of 2000 as well.
Based on the results the central role position of Budapest and its agglomeration is highlighted, but some large cities have also relevant attractive position in the region as well – eg. subregions of Szeged, Pécs. Due to the substance of the model, conclusions can be drawn regarding the quality of the network among subregional centre and its neighbouring settlements as well (for example the subregion of Pécs belongs to the transitional group but the surrounding areas are in the exaggeratedly peripheral category).

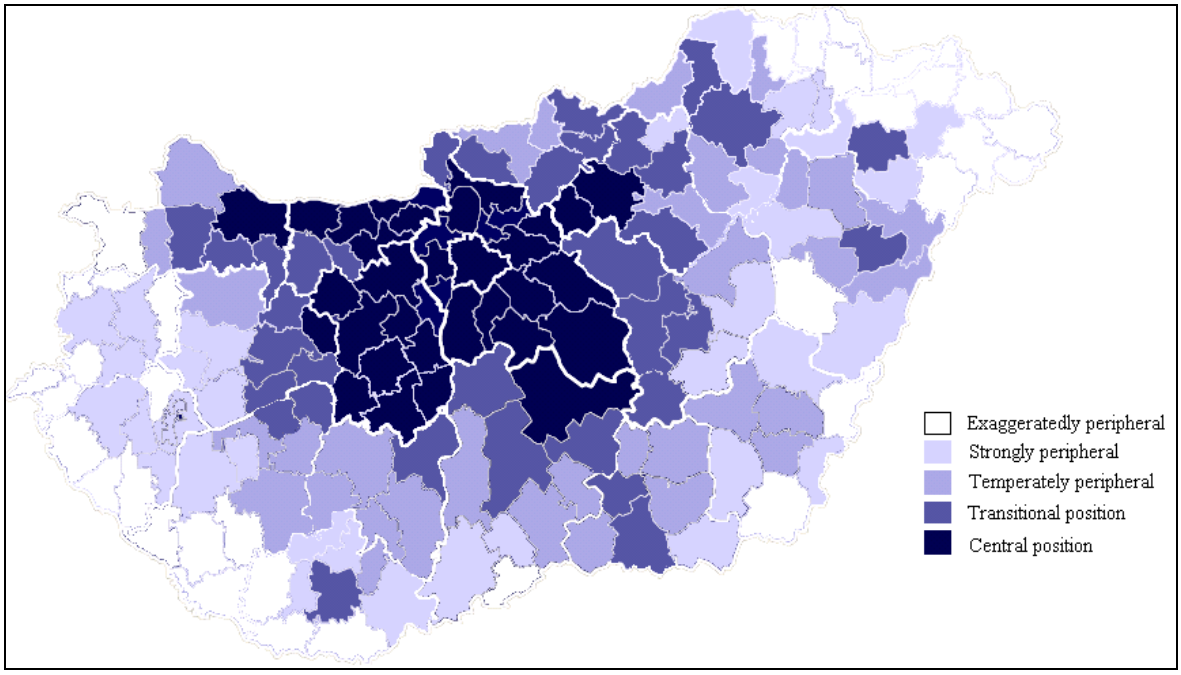

Figure 4: Centre and peripheries by population (2000)
Source: own calculation

The changes in accessibility indices were strongly influenced by the road infrastructure investments - especially the rapid expansion of road network, through reducing the access time of major cities. As of the positions from 2000, most of the subregions in the North-Hungarian region – mostly the eastern border areas – belong to exaggeratedly or strongly peripheral categories. Although some large urban areas are significant, under the shade of the Budapest agglomeration only the motorways' impact can be identified *[Figure 4]*.

Concerning the case study from the year of 2009 I started out from the assumption that in the analyzed time period the attraction grew in case of the peripheral areas, but there is no significant change in total volume of the available mass, so the effects of the development occur just locally. In 2009, the most peripheral subregions were located in Northern Great Plain and in Southern Transdanubian , also in Szabolcs-Szatmár-Bereg, Vas and Somogy counties – however, taking the average access time into account Somogy county has stepped one category forward, into the strongly peripheral group *[Figure 5]*.

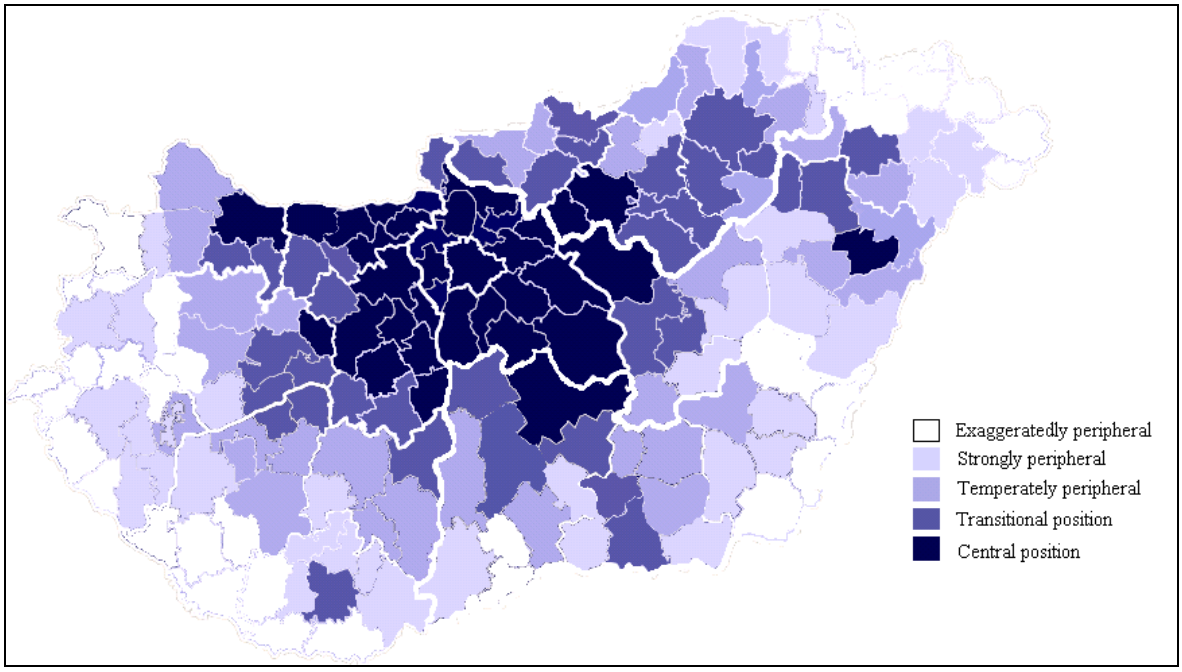

Figure 5: Centre and peripheries by population (2009)
Source: own calculation

The centrality indicators of the North Hungarian subregions positioned positively Heves county. Dividing the indicator into its parts, it is noticeable that only one county seat of the region has significant role due to its own potential value. However, the available mass of population in a certain time period is relatively low from Miskolc. Many subregions of the region, including the agglomeration of two county seats, belong to the second group – their own potential is low, while there is no major force in the neighboring area, as it exists in case of Hatvan.

T1: The relationship between the expansion of the infrastructure and the availability times is direct and inverse; however the change of the two factors is not associated in each case with the growth of a population mass in a unit of time.

2. 3. 2. 1. Clusters based on accessibility in 2000 and 2009

The classification of the subregions was performed with another cluster method. Due to the outliers of the capital city and its agglomeration relevant, shift was observed towards peripheral groups, so during the calculation Budapest and Budaörs were eliminated *[Table 2]*. The first group was created by the cluster analysis contains 53 subregions which internal potential is the smallest and their available population mass in a certain time period is low.
Members of the second cluster have medium internal potential where their own potential is also low – such subregions with small population or low population density, located near catchment areas of major cities (eg subregion of Kazincbarcika, Tiszaújváros).
In case of 12 subregions the internal potential is prominent, to which the second highest own potential (weight of population) values belong.
The position of Tatabánya in the third cluster is due to its higher population density and the proximity of the Budapest agglomeration.

Table 2: County capitals and subregions of Northern Hungary by clusters (2009)

1. Low gravity points in periphery	2. Low gravity points in transition areas	3. High gravity points in central areas	4. Medium gravity points in central areas	5. Prominent gravity points in semi-periphery
Békéscsabai ↓ Kaposvári Szombathelyi Zalaegerszegi	Egri Salgótarjáni Szekszárdi Veszprémi ↓	Székesfehérvári Tatabányai	Kecskeméti Szolnoki ↑	Debreceni Győri ↓↑ Miskolci Nyíregyházai Pécsi Szegedi
Northern Hungary				
Abaúj-Hegyközi Bodrogközi Encsi Sárospataki Sátoraljaújhelyi	Balassagyarmati Bélapátfalvai Edelényi **Egri** Kazincbarcikai Mezőcsáti ↑ Ózdi Pétervásárai **Salgótarjáni** Szécsényi Szerencsi Szikszói Tiszaújvárosi Tokaji	Hatvani	Bátonyterenye Füzesabonyi ↑ Gyöngyösi Hevesi ↑ Mezőkövesdi ↑ Pásztói Rétsági	**Miskolci**

Source: own calculation

Legend: ☐ - changing position (compared to 2000)
↑ - positive tendency
↓ - negative tendency

Into the fourth cluster 24 transitional subregions were listed with relatively high own and inner potential. In case of 7 subregion (cluster 5) the own potential is prominently high (these are e.g. the county seats with large population), but their internal potential are not significant, suggesting that the population weight of the surrounding subregions is low at national level.

T2: The subregions of county seats form a heterogeneous cluster in terms of the potential values of availability in Hungary. The socially appropriate and preferred development of centres with weak gravity (having low population potential) does not necessarily help the subregions to catch up and increase their population potential.

The cluster analysis with the data from the year of 2000 and 2009 shows, that several subregions changed their position due to their population (own) potential, either the result of internal potential or both. Compared to the values from 2000 many subregions changed

cluster that is indicated in the Table 2. Subregion of Pécs, Nyíregyháza, Szeged, Miskolc and Debrecen had extremely high own potential also in 2009. This group was expanded by the subregion of Győr. Its own potential primarily to favourable demographic trends has became higher, but due to the infrastructural improvements in the country the availability relations has changed, that is why Győr came out from the central availability areas, as in case of Veszprém was also occurred. The situation of Székesfehérvár has improved considerably; both the internal and own potential has grown. In case of Szolnok the 4th cluster also represents progress. Its change of position comes from the growth of own gravity as well as the availably population mass. Overall, it can be stated that in the past 10 years, as a result of the infrastructural development the potential of low gravity areas decreased further, while the largest increase can be observed at the extreme gravity centre.

The aggregate data indicate that the values of the subregions in Northern Hungary are lower than the national average. The heterogeneity of the group is also observed here: Northern Hungarian subregional centre are presented in every category from the periphery to the centre based on the available mass of population. Those areas are proved to be centre where the proximity of the highway, Miskolc or Budapest can be felt.
Compared to the year of 2000, several areas changed in the region; among the subregions that were exchanged, the reclassification was always positive. Füzesabony, Heves, Mezőkövesd show significant improvement in terms of the factors, their inner and own potential also increased, while the position of Bátonyterenye has decreased due to both potential values. The connection of Mezőcsát into the economical processes was proved more intensive in 2009, it became transitional area from periphery. The internal potential of Miskolc is relatively low. In 2000, the worst position has Szerencs, Sátoraljaújhely and Encs; in their case the availability of the certain population mass is the most difficult. Members from the 4th cluster have medium internal potential mostly because of the nearness of Budapest.

T3a: The disparity of potentials is gradually decreasing at national level and among the individual clusters in the period of testing. The attractive power of strongly peripheral and transitional regions increased, while the extremely peripheral centres with low own force-field display backwardness, strengthening centre-periphery relations.

Classifying the counties' own potential, the gravity centre of subregions can be outlined. In this case the changing position of the 19-county seats can be explained by the distribution of the population and the radial motorway network. High overlap can be pointed out between the formalized centre that comes as results from the calculations and the centre as development poles designated by the National Spatial Development Concept *[Table 6]*.

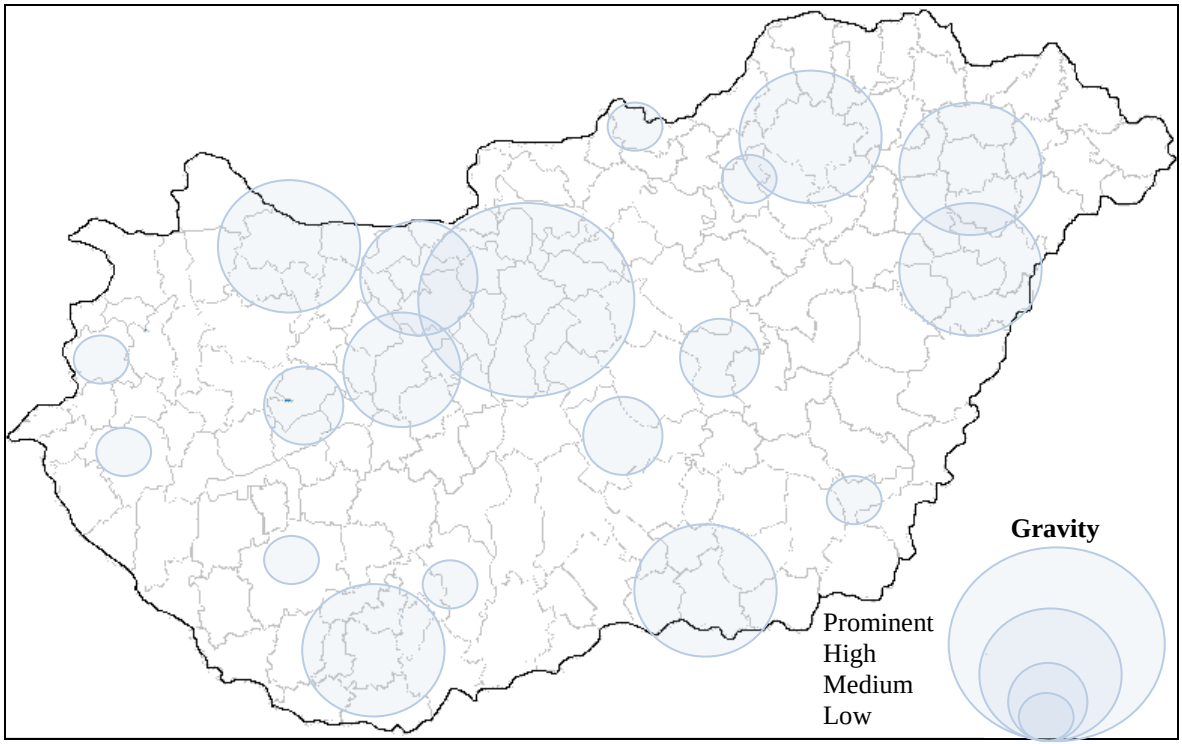

Table 6: Gravity of county capitals based on cluster analysis (2009)
Source: own calculation

It is also noticeable that the central and peripheral positions are always relative; we cannot talk about position without reference point *[Nemes Nagy J., 2009.]*. Concerning the development of other territories, adequate or inadequate situation is always changing. With the development of the accessibility terms, less and more adequate availability conditions still remain.

2. 3. 2. 2. Changing subregional positions

Compared to the data from 2000, the own potential, so the own gravity field of the North-Hungarian subregions shows no growth in any case. The smallest decline belongs to the indices of Eger and Encs, the largest decline affects the area of Bátonyterenye, Sátoraljaújhely Pétervására and Bodrogköz. However, the centrality indices show an average increase in 2009, that was a result of the growth of the internal potential values. Also at regional and national level the subregion of Füzesabony shown the greatest improvement; its internal potential has grown with more than 30 percent due to the highway investments.
Outside the region the subregion of Veresegyháza is eminent with its own potential. Mezőkovácsháza is noticeable as a negative example, where the own potential value in 2009 was slightly above the 85 percent of the data in 2000. Due to the negative demographic trends, as it was expected, the national average of the own potential values slightly (1%), but also decreased. The higher value of the centrality indices for the year of 2009 comes from the 7 percent growth of the internal potentials, so the available mass of population from a subregion in a certain time period became higher.

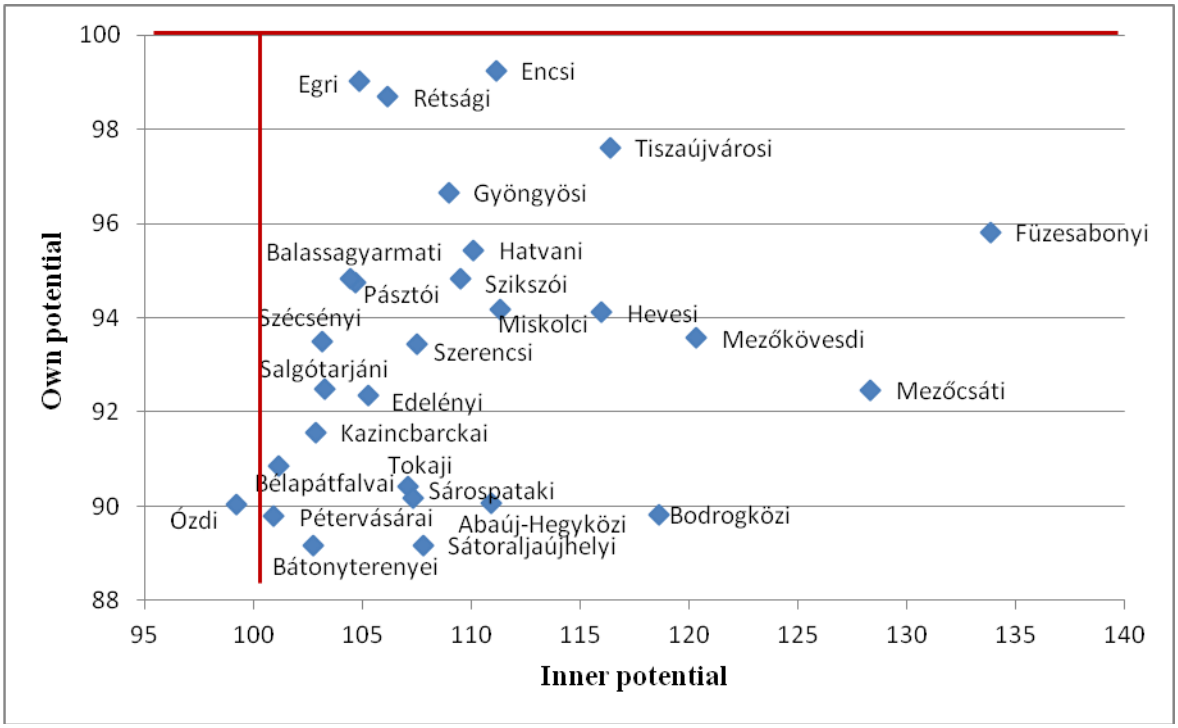

Table 7: Centrality indices of Northern Hungary(2009) compared to 2000 (population weight, %)
Source: own calculation

T3b: The gravity of Northern Hungary's subregions, represented by population potential, and their attracting power grew more significantly than the national average between 2000 and 2009, however the infrastructure-effect and the potential-growth are lower than expected due to the unfavourable demographical tendencies.

2. 3. 4. 2. Income potential analyses of the subregions

In addition to the population potential the centrality calculations can be weighted with income indicators as well, because it is closely related to the demand and supply of the spatial relations.
The income potential for 2000 and 2009 was carried out by the analogy of the population potential calculations, where the personal income before tax was included in the model as weight.
Based on my fundamental hypothesis the availability potentials (weighted by the taxpayers' all incomes) distribute the central gravity area, due to the larger cities. In case of the income potential values – opposed to the population weight – the central role of the Budapest agglomeration prevails less. The total regional income, as a mass differs significantly from the population potential at subregional level.
In case of the centrality index of income the subregions that belong to lower interval have higher concentration. The highest and lowest ratio of values also illustrates this difference: there is more than 33-fold difference between Budapest and Őriszentpéter – in contrast, there were 8-fold differences at the population potential values.
The results of the income potential highlighted the central role of Central and Western Transdanubia. Nógrád and Borsod county had weaker position, mostly because of the low rate of tax payers. Based on the gravity area of income, Debrecen, Pécs, Szeged and Győr

is significant, however, in case of the population potential these areas got into a lower category. This means that the income weight of these counties is higher despite of the lower population catchments, so in their case the available income in a certain time period is averagely higher. This result depends on the higher number and proportion of taxpayers and the average growth of the personal income level.

Examining the subregional level the map (categorized with income potential) is mosaic that shows significant differences compared to the results of the population potential. This is explained by the relevant differences of income among the subregions; in the group of the peripheral regions there are isolated areas with central access in many cases *[Figure 8]*.

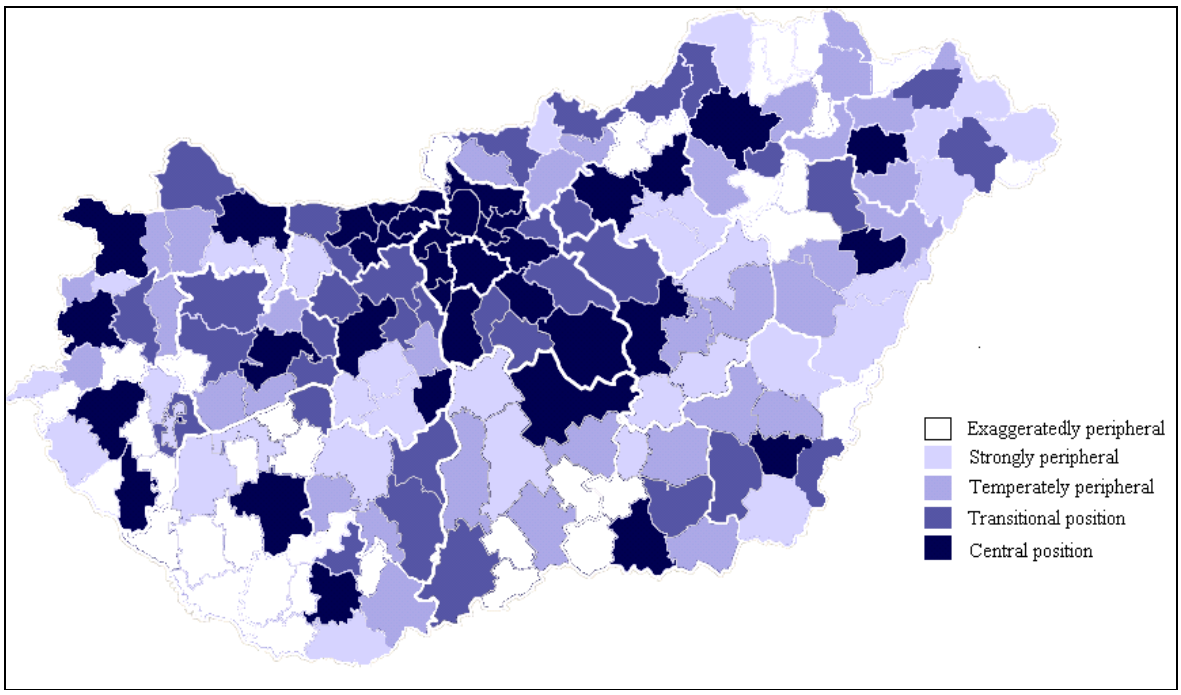

Figure 8: Centre and peripheries by income (2009)
Source: own calculation

The relative range indicators were determined by the population and income availability values for the year of 2000 and 2009 in order to make the data set with different average comparable.

It can be observed which are the typical counties where the divergence is significant regarding the personal income and the population weight as well. Most of the eastern counties of Hungary and the South Transdanubian region is lagging behind in the regional development.

Concerning the tendencies, the results of the county level shows that the regional disparities decreased compared to the data of 2000s. The disparities in case of the income indicators (beside Pest county) are the largest in Somogy, but the values of Borsod-Abaúj-Zemplén, Heves and Szabolcs-Szatmár-Bereg are also above the average with larger subregional disparities inside the county *[Table 3]*. Especially in Borsod and Hajdú-Bihar the gap decreased significantly (in case of population potential), but it is negative that despite the significant growth the values are still above the average.

Table 3: Relative range values of the centrality indices at subregional level

	weight of population			*weight of pers. income*		
	2000	*2009*	*2009/2000*	*2000*	*2009*	*2009/2000*
Bács-Kiskun	0,613	0,634	1,034	0,692	0,697	1,007
Baranya	0,538	0,533	0,991	0,565	0,550	0,973
Békés	0,471	0,351	0,745	0,515	0,373	0,724
Borsod-A.-Z.	0,675	0,591	0,876	0,693	0,627	0,905
Csongrád	0,314	0,335	1,067	0,340	0,348	1,024
Fejér	0,375	0,366	0,976	0,477	0,442	0,927
Győr-M.-S.	0,484	0,491	1,014	0,557	0,557	1,000
Hajdú-Bihar	0,438	0,391	0,893	0,477	0,433	0,908
Heves	0,553	0,611	1,105	0,666	0,694	1,042
Jász-N.-Sz.	0,334	0,392	1,174	0,381	0,458	1,202
Komárom-E.	0,367	0,358	0,975	0,398	0,394	0,990
Nógrád	0,200	0,227	1,135	0,274	0,287	1,047
Pest[2]	1,766	1,602	0,907	2,175	1,882	0,865
Somogy	0,586	0,662	1,130	0,681	0,746	1,095
Szabolcs-Sz.-B.	0,610	0,590	0,967	0,643	0,621	0,966
Tolna	0,132	0,135	1,023	0,178	0,186	1,045
Vas	0,396	0,339	0,856	0,455	0,374	0,822
Veszprém	0,523	0,507	0,969	0,618	0,576	0,932
Zala	0,264	0,310	1,174	0,249	0,304	1,221
Country level	**3,536**	**3,319**	**0,939**	**4,948**	**4,232**	**0,855**

Source: own calculation

Although the examination of the income potentials also led to relevant conclusions regarding the effects of the transport infrastructure, henceforth in case of the central-peripheral definitions the population potentials was applied.
During the analysis of the indicators the gravity area that springs from the population as a mass was compared to other indicators – having regard to the fact that the potential values based on income data inherently carries effects of the personal income tax and the unemployment rate.

T4: The findings of the income potential calculations prove that the indices divide the central catchment area. So, the central role of the Budapest agglomeration is less in case of the subregions' income potential – as opposed to the population weight.
The regional differences decrease more intensively in national average, in terms of income potential, but regional differentiation is typical for the subregions of nine counties.

[2] Calculated with the value of Budapest..

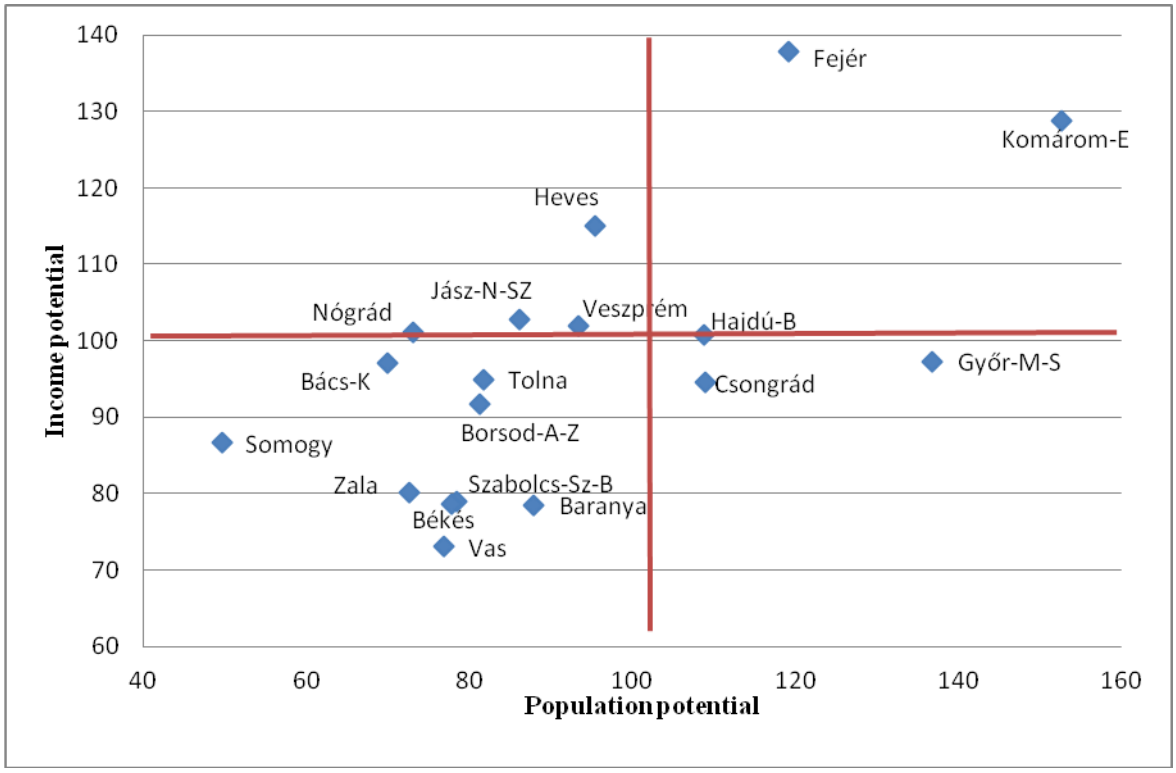

Figure 9: Centrality of the subregions by population and income potential related to the national average (2009)
Source: own calculation

Eliminating the value of the capital city from the database, in case of the population and income potential of the 19 county capitals, the significant difference is observable especially at the results of the population mass (taking the average as 100%).
At county level, the disparities are lower: the value of the most backward county (Vas) is more than 70 percent of the average concerning the income potential, while based on the results of the population potential, the difference is relevant. The capital county is almost 2,5 times higher than the average.

2. 3. Accessibility and regional disparities

Regarding the previous categories of the subregions based on population potentials I analysed the distribution of some indicators by accessibility categories. I have chosen mainly that indicators, those correlates with the regional development.

Table 4: Distribution of the population (2009, %)

NUTS III	Accessibility categories					
	Exaggeratedly peripherial	*Strongly peripherial*	*Temperately peripherial*	*Transitional position*	*Central position*	**Sum**
Borsod-A.-Z.	11,5	20,3	14,8	53,4	-	100,0
Heves	-	4,1	6,9	48,0	41,0	100,0
Nógrád	-	-	60,1	39,9	-	100,0
Hungary	**9,8**	**14,8**	**13,2**	**19,4**	**42,8**	**100,0**

Source: own calculation, KSH

Almost 40% of the Hungarian population lives in peripheries that shows a worse position in case of certain indicators also. Concerning the centrality indices, the position of Vas, Békés, Szabolcs-Szatmár-Bereg and Baranya is noticeable: there the population rate regarding the exaggeratedly peripheral subregions is extremely high – Nógrád and Borsod has also worse data than the national average. In the opposite, many subregions of Fejér and Pest county give a positive example. The higher distribution of the unemployment population compared to the lower ration of the inhabitants in the periphery is noticeable.

Table 5: Distribution of unemployment per 1000 inhabitants (2009, %)

NUTS III	Accessibility categories					
	Exaggeratedly peripheral	*Strongly peripheral*	*Temperately peripheral*	*Transitional position*	*Central position*	**Sum**
Borsod-A.-Z.	15,9	27,7	14,9	41,5	-	*100,0*
Heves	-	5,4	10,8	54,3	29,4	*100,0*
Nógrád	-	-	65,2	34,8	-	*100,0*
Ország	**18,9**	**21,0**	**18,5**	**21,4**	**20,2**	**100,0**

Source: own calculation, KSH

In North-Hungary – mainly in the county of Borsod –the shift is significant: 44 % of the unemployment people live in exaggeratedly and strongly peripheral subregions that is with 14 % higher than the ratio of the total population. From this fact it is drawn up, that the peripheries in Hungary have higher unemployment mass than the other territories *[Table 4, 5.]*.

Table 6: Enterprises per 1000 person (2009, pcs)

NUTS III	Accessibility categories					
	Exaggeratedly peripheral	*Strongly peripheral*	*Temperately peripheral*	*Transitional position*	*Central position*	**Average**
Borsod-A.-Z.	57	55	60	74	-	*63*
Heves	-	66	75	92	85	*84*
Nógrád	-	-	80	67	-	*73*
Ország	**77**	**93**	**94**	**98**	**111**	**101**

Source: own calculation, KSH

The indicator of the registered enterprises per 1000 person also shows monotone growing tendency from the peripheria towards the centre. In Nógrád this fact is not as simple: this problem is because of the position of the county capital, that takes place in the category of the temperately peripheria.

The lagging behind is also noticeable comparing the national and regional data: the strongly peripheral territories in Heves and Borsod-Abaúj-Zemplén represent much worse value than 93 (the national average). In Nógrád and Borsod this difference lives also in the transitional group. These indicators are less even than the national value of the exaggeratedly peripheral cluster *[Table 6]*.

Table 7: Income per capita (before tax) by availability categories (2009, %)

NUTS III	Accessibility categories					
	Exaggeratedly peripheral	*Strongly peripheral*	*Temperately peripheral*	*Transitional position*	*Central position*	**Average**
Borsod-A.-Z.	87,84	90,08	100,43	102,88	-	95,13
Heves	-	89,84	89,64	98,78	109,50	99,26
Nógrád	-	-	98,30	96,76	-	97,53
Ország	**88,93**	**90,82**	**89,80**	**100,97**	**118,46**	**100,00**

Source: own calculation, KSH

The values of income before tax per capita are also indicating the region's lower economic potential. On the positive side, the data of Borsod is higher in the temperately peripheral and transitional categories, however, there is a gap against Heves; averagely in 2009 Borsod was lagging behind.

Table 8: Characteristics of income before tax by availability cathegories (2000, 2009)

	Accessibility categories					
	Exaggeratedly peripheral	*Strongly peripheral*	*Temperately peripheral*	*Transitional position*	*Central position*	**Value**
2000						
Weighted standard deviation (%)	83,29	80,14	56,41	70,11	104,23	**207,31**
Share of total volume (income, %)	0,54	1,24	1,21	5,19	91,82	**100**
Share of total volume (population, %)	10,10	13,74	14,65	22,27	39,24	**100**
Entropy	0,0003	0,0011	0,0010	0,0121	2,1484	**2,1629**
2009						
Weighted standard deviation (%)	83,53	71,30	53,69	74,69	109,84	**183,46**
Share of total volume (income, %)	0,54	1,43	1,27	4,84	91,92	**100**
Share of total volume (population, %)	9,12	14,14	14,12	19,71	42,91	**100**
Entropy	0,0003	0,0014	0,0011	0,0119	1,9684	**2,0196**

Source: own calculation, KSH

Next to the above mentioned indicator, more factors were involved in order to estimate the spatial disparities. These calculations were reasonable due to the comparison of the groups in spatial distribution aspect, to analyze what proportion of the regional inequality comes

from the heterogeneity among the aggregated groups. The results clearly indicate a high degree of regional disparities for the benefit of the central areas. While 43 percent of the Hungarian population lives in central areas, their share of the income before tax in total is almost 92 percent.
The results confirm that the average difference from the average value decreased at subregional level compared to 2000. However, regarding the availability categories, the trend of this change is diverse: the disparities increased inside the areas with exaggeratedly peripheral, transitional and central position. This is mainly due to the fact that with the better accessibility terms certain subregional capitals became available in geographical mean, but not in economical mean at the same time. On the other hand, the major catchment areas, such Budapest, Budaörs are outlined with faster growth trend than the average.
Trend of inequality within the groups is relevant as well as the entropy between the groups due to the income and population distributions that were discussed above *[Table 8]*. The results show that in addition, inequality increased in certain groups, differences became lower among them. I.e. by getting into a better category, spatial disparities can be higher even in the prosperous groups due to the lower convergence of income.

T5: The economic indicators of economic development of the regional units being tested, their distribution, display close relationship with the evolution of the availability categories based on centrality indices. The economical central-peripheral situation coincides with the geographical centre-periphery categories.

2. 3. 1. Competitive types by accessibility categories

In order to determine the development trends, competitive analysis are prevalent methods. The definition of competitiveness became key idea in various topics of economics over the past two to three decades in which content two questions are conceptualized mostly in the literature: how to define and what kind of indicators can be measured with.
Due to compass limitations of the dissertation it was not my intention to examine the reasons and consequences of global competition, its occurring and possible quantification in the literature; however, I tried to categorize the competitiveness potential of the subregions with a certain method.
With the method of multiplicative factorization the GDP per capita as a measure of economic development can be divided into other components. Nemes Nagy *[2005]* defined the composition of income based on the following triadic resolution: the development is decomposed by the following individual factors:

*specific regional income = work productivity * employment rate *age structure*

Defining the types of competitiveness the value of components was determined on subregional level. The individual factors were compared to the national level, where gaps means 0 or benefit is represented by 1.
In this study the subregional development comes from the income before tax per capita values, therefore labour productivity corresponds to the indices of employees' (i.e. the taxpayers') income before tax, the employment factor means the ratio of the taxpayers per active population, the demographic factor means the active population per the total inhabitants. The classification is based on relative positions, defining two competitive groups including more competitive types.

Due to the basic hypothesis it was assumed that the peripheral areas are more likely characterized by complex and multifactorial competitive disadvantage compared to the regions with competitive advantage. Based on the results it can be shown that in some subregions labour productivity, while in other cases employment gap occurs, or both *[Annex 1.]*

T6: Most of the subregions of the "extremely and strongly peripheral" categories defined on the basis of the availability potential struggle with complex and multi-factor competitive disadvantage.

2.4. Testing the direct and indirect effects of accessibility potential

During my research I proceeded from that basic question that those areas that can be considered as centre or periphery from geographical point of view, respectively, can they be considered similar from economical point of view as well? The economical classification corresponding to the foregoing points was explained by income before tax per capita, as a built in dependent variable. The variables in the model were chosen based on the national references. During the analysis I aspired to reveal the connection between accessibility potential of the subregions, the development and the income level, respectively.
The path analysis is series of linear multi variable regressive estimations. In the first step we are going to see how the primary variables affect together the indicators belong to the secondary group. In the second step we are going to see the common effect of the primary and the secondary variables on the tertiary variables, finally all the variables are applied together *[Németh, 2008; Székhelyi.–Barna, 2002; Tóth, 2008.]*.
In the regression analysis after the literature review and running of the correlation analysis I have used the following indicators as independent variables that explain the dependent variables (income before tax).

1. Accessibility, relative geographical position

Centrality indices of the subregions (ELER)

2. Economical factor

Ratio of dwelling construction (LAKASEP; pcs/1000 dwellings)
Ratio of dwellings connected to the public sewerage network (KOZCSAT; %)
Enterprises per 1000 inhabitants (VALL_SU; pcs/thousand inhab.)
Ratio of joint venture (TARSAS_AR; %)
Ratio of registered corporations in the sector of industry, constructions and service (VALLALK_R; %)
Number of passenger cars per 1000 inhabitants (SZGK; pcs/thousand inhab.)

3. Social factor

Population density (NEPSUR; inhab./km2)
Change of total population (NEPES_VALT; 2000-2008, %)
Natural increase or decrease per 1000 inhabitants (TERMSZ; ‰)
Net migration balance per 1000 inhabitants (VAND_KUL; ‰)
Ratio of registered jobseekers (NYT_KER; %)

4. Relative level of development

Income before tax per capita (JOV; thousand HUF)

Regarding the groups of variables, the following hypotheses can be defined:

- accessibility: the higher the availability and population potential of the subregion is, the more favourable value is expected concerning the development indicators (i.e. the income before tax per capita is higher).
- economic factor: the better the economical force (represented by the analyzed indicators) of a subregion is, the higher the expected level of income grows.
- human potential: the more favourable the demographic situation of a subregion is, the more advanced they are.

In the sense of path analysis we assume that the primary independent coefficients (in my case the accessibility and relative geographical position determined by centrality indexes) influence the secondary coefficient, namely the deviations of the economical situations, which have effects on the tertiary coefficients (social factor). We also assume that primary and secondary coefficients have not only indirect effect on the development, through the tertiary coefficients, but also direct ones. The arrows illustrate this causal connection. So the effects are staggered, amplifying or attenuating each other *[Tóth, 2010; Csite - Németh, 2007; Németh, 2005; Dabasi Halász., 2009; Kecskeméty, 2005.]*.

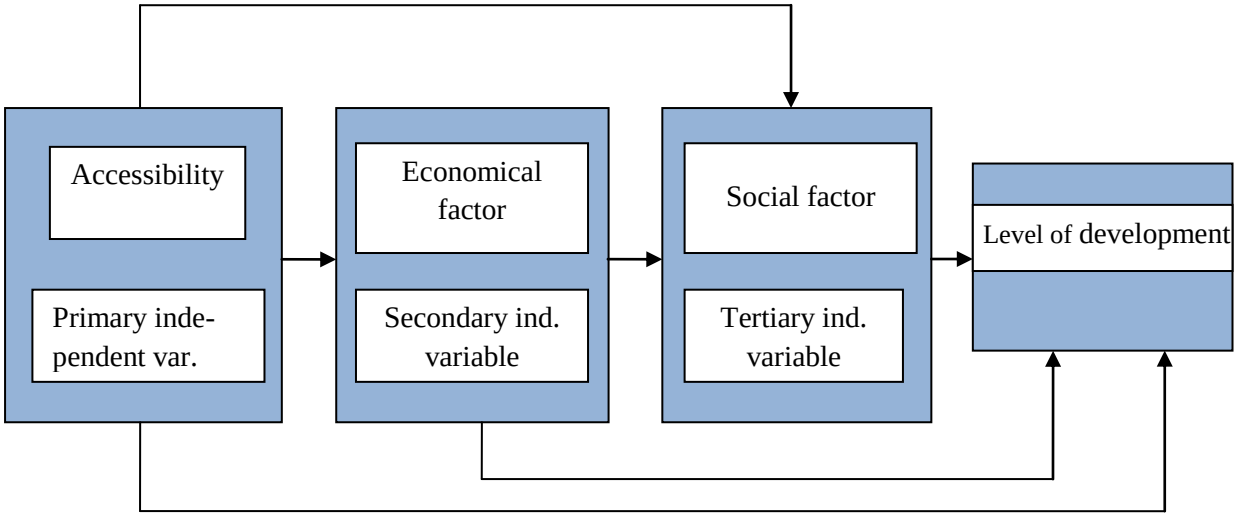

Figure 10: Casual relations among the group of variables
Source: own calculation, KSH

According to the references that deal with regional model the path analysis reveals the effect of those indicators which does not have exclusive effect on development relations but through other independent coefficients do. In the same time that is even not a problem if the coefficients have strong relations with each other *[Németh, 2009; Székelyi-Barna., 2002.]*.

In the below presented regional model I tried to explain the specific incomes with the role of accessibility, namely with the population potential, its direct and indirect effects through other variables.

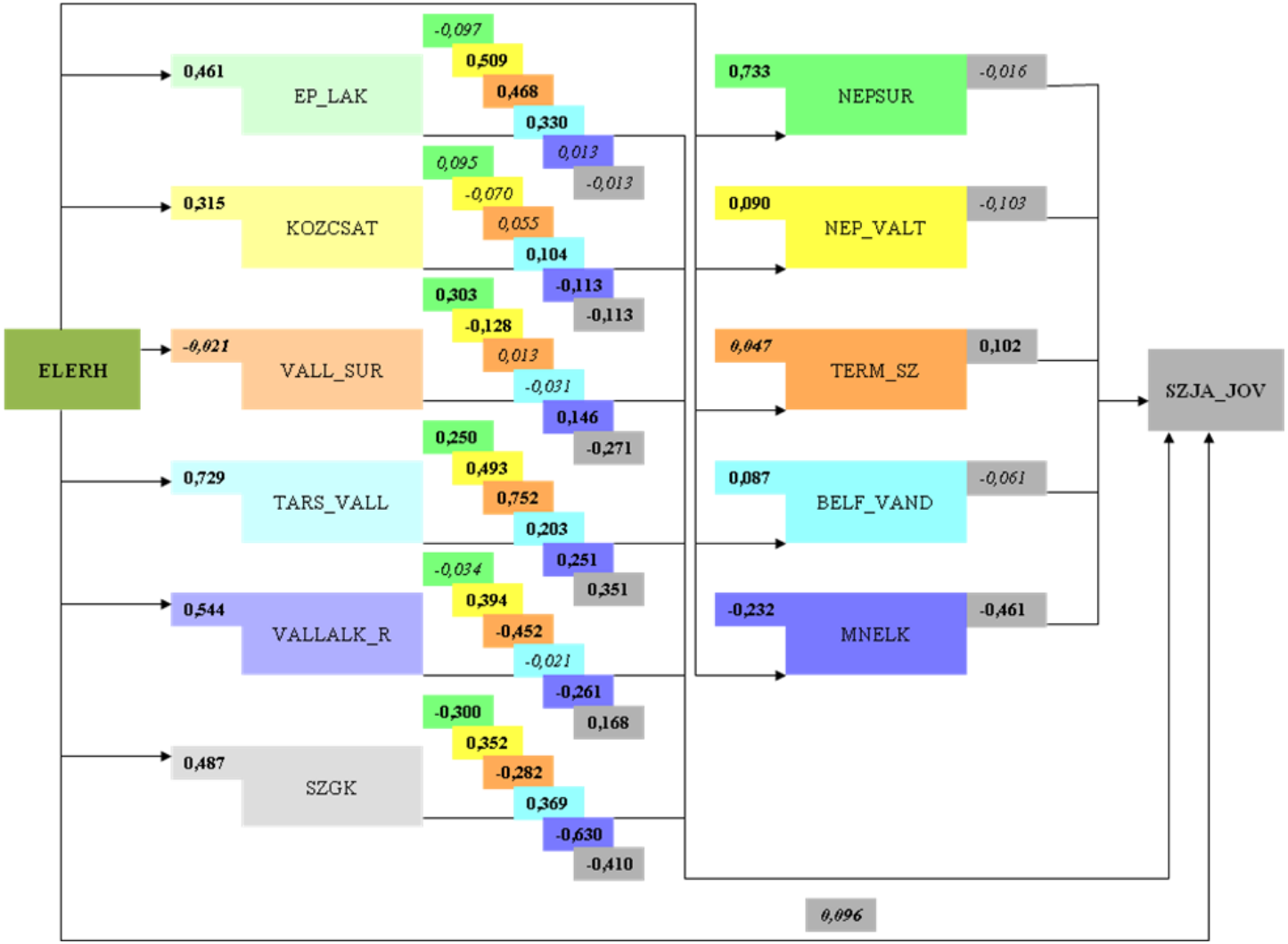

Figure 11: Casual relations of the group of variables in the path-model
Source: own calculation, KSH

As the first step of the path analysis I examined the regional distribution of the income per capita that makes the base income before tax, with multi variable linear regression. The variables contained by the examination together explain the income per person with the value of 81,7% R^2. Among the variables the registered job-seekers (with negative slope) and the proportion of the joint companies has the most significant role in the explanation.
The direct effect of accessibility is non-significant, with the value of 0,096. In addition, the indirect path can be calculated as following: all the path is added together from the primary variables to the dependent variable, and the appropriate path will be multiplied as through the primary and secondary variables, then the primary and tertiary variables [Table 9].

Table 9: Direct and indirect path of the income explanation

Independent variable groups of the model	Accessibility (standardized β)
1-2-3-4.	0,093
1-2-4.	0,362
1-3-4.	0,085
indirect	**0,540**
direct	***0,096***
Total	**0,636**
R^2	**0,401**

Source: own calculation, KSH

The effect of the accessibility indicators on the regional development (i.e. in the present study on the income level) indirectly prevails through the economic and social indicators as the results (in the table 9) show. The expansion of the network, the reduction of the availability time – depending on favourable demographic trends – so the higher population potential have effects through the economical and social indicators that refers to better standard of living.

T7: The path-model suggests that the relative geographical situation defined with population-potential and availability exerts only an indirect impact on the income level of subregions, as indicated by the economic and social indicators involved, the indirect effect seemed insignificant.

3. Further research prospects

Regarding the statements of the literature the infrastructural development is a key element of the competitiveness of the region, as it increases the economical efficiencies and promotes the integration into the global and international economy. Taking international experiences into consideration the observation is relevant that the inadequate macro regional infrastructural terms can become a fundamental obstacle of the regional development and convergence. This problem is relevant also in Hungary, while despite the availability of the certain spatial centre progressed, most of the analysed areas are lagging behind, that backwardness effects unfavourably also for many cities and the centre of the region *[Nagy, 2007.]*.

In my dissertation I tried to point out the problem that in case of the infrastructural development the shortening access time is highlighted in the practice as the most important result.

However, this is not equivalent with the accessible population mass that characterizes the change of accessibility more accurately. The effect is not the same when an area with lower population comes 10 minutes closer than with a high population mass. The population potential – that was represented by the accessible population mass in a certain time period (namely the centrality index) – has indicated how the gravity of the subregions changed as a result of the shortening access time and demographic tendencies.
Examining the effects of population and infrastructure (based on the data of 2000 and 2009) the population potential would have been bigger in each subregion in Northern Hungary, if the number of inhabitants in 2000 had not declined that extent by 2009. In this content the infrastructural development had not that positive influence in the region that would have been expected.
Taking the income before tax as weight of the centrality calculations the Budapest-based character of the country remains no longer prevailed. The county seats with higher gravity were outlined that show great overlap with the developing poles agreed in the development plans. The reasons for these are the higher ratio of taxpayers in the subregion, the higher level of income before tax that was examined also from the side of accessibility.
In the period of 2000 and 2009 as a result of the infrastructural investments the spatial differentiation of the population and the income potential declined on national level, but there were certain areas where because of the weaker demographic indicators the results showed lagging behind. Mostly the exaggeratedly and strongly peripheral areas are characterized by none or slow convergence.

During the accessibility examination the differences between the categories indicated that in the exaggeratedly and strongly peripheral areas the results of the indicators are much worse, while towards the central areas are more favourable. However, based on the results of the path-model the obligate, direct impact of the infrastructural development is not relevant. Although the improvement of the infrastructure is an essential factor in the convergence of peripheral areas, they own impact is not able to generate spatial development: with the extension of the infrastructure the growth indicators do not change significantly where the base factors are missing.
The results of the path-model (that was adopted in my dissertation) pointed out that there is no significant direct effect. Only (through economical-social data) indirect impacts can be expected by the accessibility indices that are affected by the shortening access time and demographic trends.
Many development trends aim to transform the radial form structure into network scope that exploits economic connections in order to begin a new development path, however it is not expected to start development processes in the region only as a result of infrastructural improvement. Due to the indirect effects the main issue is to examine, which line is capable to create attractive terms for investments and private capital. In addition it is need to be ensured that the impacts of the policies can be measured, the results have to be monitored regularly. For these an indicator calculation should be used similar to the potential method in national development plans that could prove a certain development process represented by the higher available mass of population or income.
Moving on the examined topic of subregional accessibility potentials, in the future I am planning to analyse the areal positions in international environment as well as indirect effects on other development terms.

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6. Annex

NUTS III	Availability categories				
	Exaggeratedly peripheral	*Strongly peripheral*	*Temperately peripheral*	*Transitional position*	*Central position*
Budapest	-	-	-	-	1110
Bács-Kiskun	0000	0000	0001	0001	0011
Baranya	0001	0001	-	1110	-
Békés	0001	0000	0000	-	-
Borsod-A.-Z.	0001	0000	0001	0101	-
Csongrád	-	0000	0000	0010	-
Fejér	-	-	-	0001	1111
Győr-M.-S.	0010	0011	0011	0011	1110
Hajdú-Bihar	-	0001	0001	0001	1111
Heves	-	0000	0000	0000	0110
Jász-N.-Sz.	-	0001	0001	0001	0010
Komárom-E.	-	-	-	1111	1111
Nógrád	-	-	0000	0000	-
Pest[3]	-	-	-	0010	1110
Somogy	0001	0001	0000	0011	-
Szabolcs-Sz.-B.	0001	0001	0001	0011	-
Tolna	-	0000	0001	1111	-
Vas	0011	1111	-	-	-
Veszprém	0001	0011	0001	1111	1111
Zala	0001	0001	0010	-	-

Source: own calculation

Legend

1111	better situation than the average to all aspect
1110	unfavourable position of the demographic factor only
1101	unfavourable position of the employment factor only
1011	unfavourable position of the labour productivity factor only
1100	favourable position of the labour productivity factor
1010	favourable position of the employment factor
1001	favourable position of the demographic factor
0110	unfavourable demographic position
0101	unfavourable employment position
0011	unfavourable position of labour productivity
0100	unfavourable position of employment and demography
0010	unfavourable position of labour productivity and demography
0001	unfavourable position of labour productivity and empoloyment
0000	below the average in each factor

Source Nemes Nagy J. 2004: Új kistérségek, új városok Új versenyzők? p. 16

[3] without Budapest.