DOI: 10.2478/vjbsd-2023-0001

ACHIEVING SUSTAINABLE TRANSPORTATION FROM THE PERSPECTIVE OF ROAD ACCESSIBILITY AND REGIONAL CORRELATIONS OF COUNTY SEATS IN HUNGARY

Áron Kovács*, Tamás Tóth, Henrietta Nagy, Imre Lévai

Milton Friedman University, Hungary

Road traffic is a sub-sector, which has implications for almost all economic activity through transportation, and directly affects the economy and social processes of a region or country. The conscious and sustainable accessibility of the capital and county seats is particularly important in terms of goods distribution, labour mobility and access to services. Necessary research was conducted using Google Maps' 2022 summer data and Hansen's gravity model. The study identifies county seats that require development and facilitates the mapping of regional relationships between the capital and the county seats.

Keywords: traffic, transportation, shipping, accessibility, county seats, regional correlation, logistics

Introduction

Regional analysis of transportation is a multidisciplinary field, combining historical, geographical, technical and economic sources and research methods. "Good quality, efficient transportation means the coordinated operation of complex subsystems, which continuously ensures socio-economic development and growth and harmonious regional development, while maintaining people's life quality and protecting the environment" (Tánczos, 2000). Transportation is considered as the ‚circulation system of economy' and thus it is a key element of location theories and regional economics, and overcoming distance is a prerequisite for a functioning economy (Tiner, 2008). This is well illustrated by Thünen's (1826) theory of agricultural location, where land rent depends on the quality of the land cultivated and its accessibility to the market. The more accessible the land from the market, the higher the land rent. Producers profit less if they deliver from a greater distance, and thus the lower the rent on their land. While Thünen shows correlation between agricultural production and road accessibility, Weber's theory (1909) interprets the correlation between industrial production and the role of railways (capable of moving large quantities of goods quickly) in selecting location. He believed that industrial sites should be selected where transportation costs are lowest (the Launhardt-Weber triangle). August Lösch disagreed with this premise in his "Maximum Income Model", since the solution in site selection is not to minimise transport costs but to maximise profit. Production should be placed at the centre of a spatial triangle enclosed by 3 main components: raw material supply, energy base and the consumption market.

In the 18th century, navigable rivers and canals were the main transportation routes for industry due to poorly developed road networks. The transport needs of industrial production are generally continuous, while those of agriculture are seasonal (Szabó, 2008). The transport needs of industrial production are generally continuous, while those of agriculture are seasonal (Szabó, 2008). The situation improved considerably with the development of the railways, as a close relationship developed between the transport network and industrial facilities. In the 20th century, the situation changed radically as road networks became denser, road transportation vehicles were able to transport larger quantities, motorisation allowed access to more remote locations, competition arose among transportation companies, and thus transportation costs and finally prices, began to decrease (Aboelnaga et al., 2019). The issue of transportation development also appears in Wallerstein's centre-periphery worldview model (Wallerstein, 1983) in the form of contrasting developed, easily accessible (outstanding) and underdeveloped, hard-to-reach (lagging) regions. In geographical terms,‚the centre is the point that is closest (most accessible) to other points in the set (region), while the periphery is the furthest points' (Nemes and Nagy, 2009). 'In Hungary today, the capital and its agglomeration form the central core area, the Austrian border region is an example of a dynamic periphery, the eastern border regions are examples of the outer periphery, and areas that can be considered inner peripheries are found in both the Transdanubian and the Great Plain regions' (Nemes and Nagy, 2009). Transportation as a factor also played a significant role in competitiveness models. Although Porter (1994) argues that transportation factors of a region are very important competitiveness factors, they are not the primary (main) component (Nagy-Spiegler, 2022), as the economy of countries with a competitive transportation network is not necessarily competitive. Transportation, and especially motorways, is identified as one of the factors influencing productivity growth. In the competitiveness of cities, transport is presented as an infrastructure asset, as well as the main road access to major markets (Huovari, Kangasharju and Alanen, 2001). Infrastructure is a generic term for economic conditions (road networks, transport, ports, utilities, etc.) that are not directly involved in the production process but indirectly influence the possibilities for developing production (Abonyiné Palotás, 2007). Transport can be said to be a necessary basis for the social division of labour, while it became an almost exclusive instrument for the geographical division of labour.

The development of the motorway network is often seen as the main means of reducing regional disparities (Erdősi, 2000a; Nemes-Nagy and Németh, 2005; Németh, 2005, 2006; Tóth, 2004; Vörös, Polányiné, 2001). It should also be noted that economic growth increases the demand for transportation, while economic recessions decreases it (Ruppert, 2000), and that a developmental effect of motorways can only prevail in growing economies (Erdősi, 2000a).

In any case, the transportation system must be considered as an active structural element of space, which responds to socio-economic regional

conditions, and as a factor influencing the behaviour of economic agents, competitiveness, economic and social diversification (Erdősi, 2000b).

Material and methods

The geographic scope of the research covers the capital city and the county seats of Hungary. The level of the investigation was the lowest territorial unit of the vector map available for free download. This means the NUTS3 (county) and LAU2 (municipality) territorial units.

The research focussed on the road accessibility of Budapest and the county seats. In general, capital cities and county seats are home to a country's highest decision-making bodies, its most important institutions, educational and cultural centres, logistic hubs, and the starting or end points for freight transportation. Foreign investment is also typically located in the capital and the administrative centres, as the highest levels of international relations and multinational company representations are present here, as are the representations of multinational companies (Nagy et al., 2018). These areas are usually the most developed in the country and their accessibility is therefore very important for the population of the country. Nowadays, a large portion of both passenger and freight transportation is carried out by road, so the research has also analysed road accessibility.

The survey sought to answer questions such as: what is the road accessibility of the capital and county seats like? Are there common features in the accessibility of these counties? To what extent and in what ways do they differ from each other? What are the disadvantaged areas of Hungary in terms of accessibility and logistics? Is there a correlation between accessibility and logistics potential?

To answer these research questions, the study primarily used an accessibility analysis. The accessibility of the capital city and the county seats was collected using a Google Maps, which is available to anyone. The data is accurate, up-to-date and reflects the traffic conditions in the country, as the application takes into account the maximum traffic speed allowed on a given stretch of road and calculates accessibility accordingly, considering the best time/distance ratio. The accessibility data has been collected using motorways and toll roads.

The analysis identifies the extreme points of the region, but does not provide information on the territorial potential. Gravity models are applied in various fields, for example in the United States, primarily to determine the air transport catchment areas of major cities (Erdősi, 2000b). Hansen's gravity model (Hansen, 1959) as a 'location potential indicator' based on the well-known Newtonian physics – has been adopted by regional research, because there is a force of attraction between two areas, whose strength depends on the geographical distance between the two areas and the size of their output (population, GDP, income, etc.).

The relationship can be described by the following formula:

$$P_i = \sum \frac{B_j}{d_{ij}^2}$$

where: P_i – the location potential of a given municipality; B_j – the mass of available goals, number of workers, etc.; d_{ij} – the distance in minutes between settlements *i* and *j*

The gravity model expresses an inverse relationship between the distance and the available mass (population in this case). The larger the population of the county seat and the closer the settlement, the greater the dependence (attraction) between the county seat and the settlement. Therefore, we used population data (from 2015) for the settlements for variable Bj. Determining the strength of the attraction zone is an important factor because it reflects the logistical potential of a centre (capital, county centre) from which the associated municipalities can still be reached without significant financial investment and major time loss.

Population data for the surveyed territorial units were provided by the yearbooks and reports of the National Statistical Office (2015). To determine the catchment areas of the capital cities, we used the so-called Hansen's gravity model (Hansen, 1959), which is based on Newtonian interplanetary gravity. The cartographic representation of the results was facilitated by QGIS, a free and open-source geographic information system software.

Results and discussion

Accessibility is a key factor in transportation and logistics. The concept of accessibility encompasses the facilities that an individual or business located in one region can obtain by travelling to another region where it can carry out an activity of interest to it (Tóth and Kincses, 2007). According to Banister and Berechman (2001), accessibility is one of the most important issues at the national and regional levels. Accessibility is the result of investment in transport networks and affects the distribution of labour and goods between countries and regions.

The majority of jobs are concentrated in the capital and county seats, so motorways should improve accessibility of the capital as well as larger cities. Considering logistics and mobility needs, it would be desirable if the capital could be reached (by car or public transport) within two hours maximum, and the county seats within one hour (Erdősi 2000a). The study considers regions within the country that are unable to meet this requirement as peripheral. These

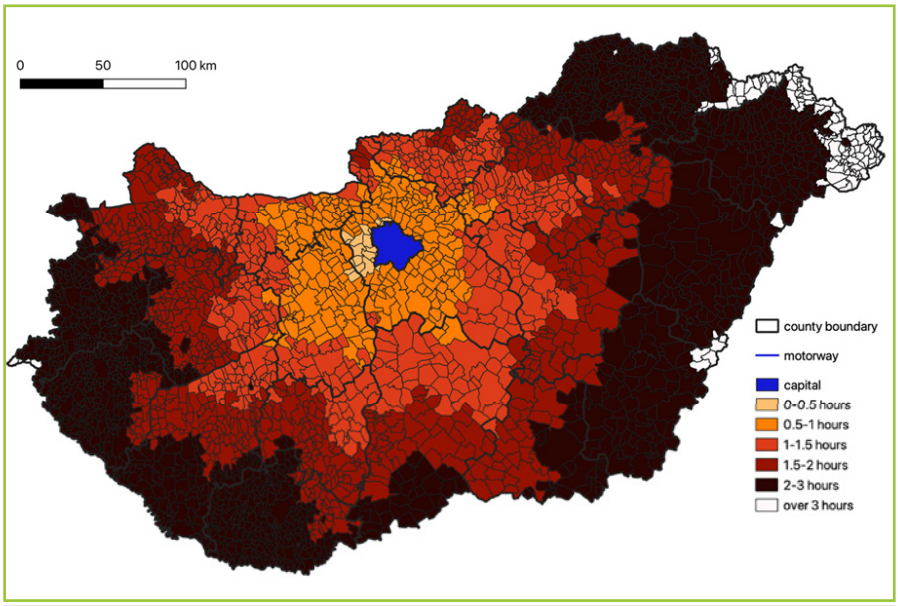

Figure 1 Road accessibility of Budapest (capital) (in hours)
Source: the author's own editing based on Google Maps for the period 29–30. 8.2022

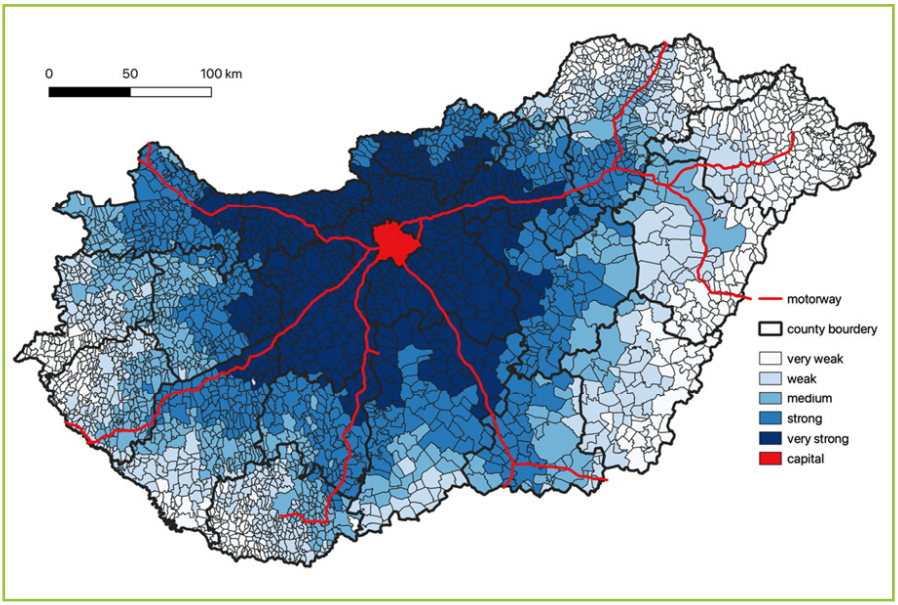

Figure 2 Location potential of Budapest (capital city) based on Hansen's gravity model (potential ranges from 1–3.5 million)
Source: the author's own editing based on Google Maps data from the period 29–30. 8. 2022 and the population data of the Hungarian Central Statistical Office (KSH) for 2015

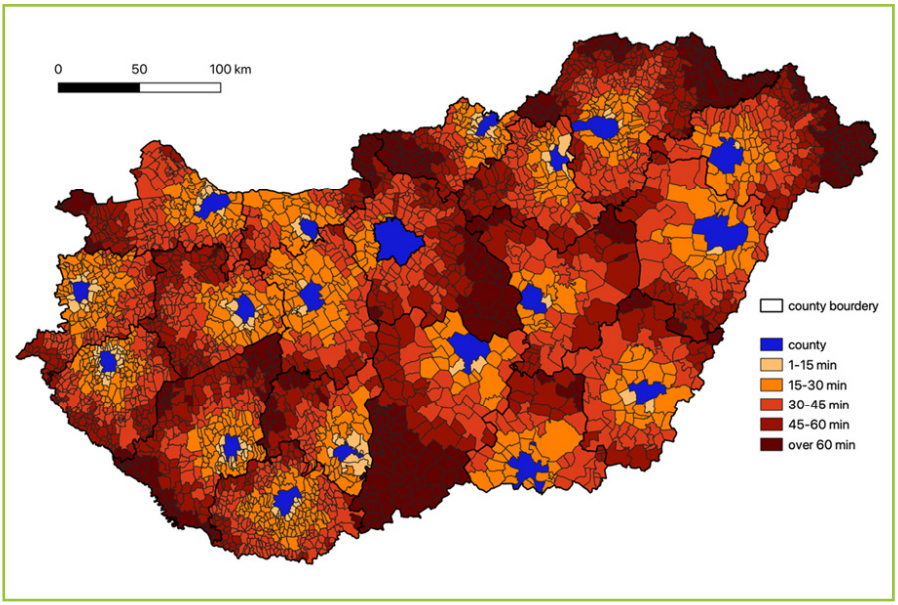

Figure 3 Road accessibility of Hungary's county saets (in minutes) by car
Source: the author's own editing based on Google Maps data from the period 29–30. 8. 2022

disadvantaged areas fall behind others, shunned by foreign capital, and the gap between centres and periphery is widening. Access to these areas poses challenges and additional costs for logistics service providers.

Although Hungary's transportation is capital-centric, 31.4% of its municipalities (149 settlements) cannot reach Budapest within 2 hours. This group also includes 7 county seats (Békéscsaba, Pécs, Szombathely, Debrecen, Miskolc, Nyíregyháza and Zalaegerszeg) (Figure 1). The figure clearly shows that motorways are beneficial for access to the capital and to neighbouring countries, but that warehouse bases are still mostly established in the immediate vicinity of the capital (not in any of the disadvantaged county seats mentioned above) and they try to supply the settlements of the surrounding counties from there.

Budapest has an extensive catchment area, affecting the economic, goods and labour mobility of the country. It is only the more distant municipalities closer to the border, with which it has a "weak" or "very weak" connection (see Figure 2). Goods production is also concentrated mainly in towns with a stronger attraction, that is logistics potential (dark blue areas in Figure 2). Working capital is most attracted to these regions.

Although Budapest has good transportation conditions, it is still unable to meet the economic and social needs of the entire country. As the country's borders are approached, this task increasingly falls on the county seats. These centres can play a key role in job creation and the rational provision of public services (Gulyás, 2013). This is why it is important to explore the accessibility of county seats.

In Hungary, 7.96% of the population (almost 800,000 people) are unable to reach their county seat by road within one hour (dark brown areas in Figure 3). This problem primarily affects the inhabitants of Bács-Kiskun (32.44%) and Somogy (25.96%) counties, while Fejér, Vas, Baranya, Hajdú-Bihar, Zala, Csongrád, Komárom-Esztergom and Veszprém counties are in a more favourable position. The disadvantageous accessibility of the county seats is mainly due to the quality of the road network, the geographical location of the county seat or the network of small villages (Table 1).

Similarly, to the capital, the attraction of county seats to the surrounding municipalities is also strong. The Hansen gravity analysis (Figure 4) highlights county seats with larger populations (mainly Debrecen, Szeged, Pécs and Miskolc), as they have an impact on almost their entire

Table 1 Accessibility of county seats as a percentage of county population

County	0–15 minute	16–30 minute	31–45 minute	46–60 minute	Over 60 minutes
Fejér	25.65	30.25	26.89	17.21	0.00
Vas	37.62	36.99	18.34	7.01	0.03
Baranya	43.69	26.29	24.63	5.16	0.24
Hajdú-Bihar	37.06	28.85	26.15	7.33	0.60
Zala	27.51	11.95	46.75	13.15	0.65
Csongrád	40.03	26.47	18.09	14.56	0.85
Komárom-Esztergom	24.11	39.96	17.56	17.41	0.96
Veszprém	22.13	29.25	28.63	19.03	0.96
Békés	16.91	27.47	43.02	11.20	1.39
Heves	21.68	16.10	23.69	35.30	3.22
Pest	58.91	6.99	21.26	7.30	5.55
Tolna	25.39	30.99	16.63	19.73	7.26
Jász-Nagykun-Szolnok	20.14	17.57	22.88	30.75	8.66
Szabolcs-Szatmár-Bereg	21.54	15.95	33.83	16.49	12.19
Győr-Moson-Sopron	31.72	15.60	29.03	7.94	15.70
Borsod-Abaúj-Zemplén	25.60	15.87	28.40	12.53	17.60
Nógrád	24.99	26.34	15.08	15.97	17.62
Somogy	24.18	11.45	10.66	27.75	25.96
Bács-Kiskun	22.18	14.53	12.83	18.02	32.44

Source: the author's own editing based on Google Maps data from the period 29–30. 8. 2022. and the population data of the Hungarian Central Statistical Office (KSH) for 2015

county. The areas marked in white, on the other hand, are settlements that do not maintain significant connections with their county seats (such as certain areas in Nógrád, Somogy, Tolna, Veszprém, Zala, Heves, and Bács-Kiskun counties). People from these settlements have to make considerable effort to access services in the county centre (healthcare, educational and financial institutions, decision-making bodies, etc.), jobs or special products which are not available nearby, so they tend to orient themselves towards other regional centres. These settlements are only administratively part of their counties, but they are functionally disconnected from them. It would therefore be worthwhile to review the county borders in their case.

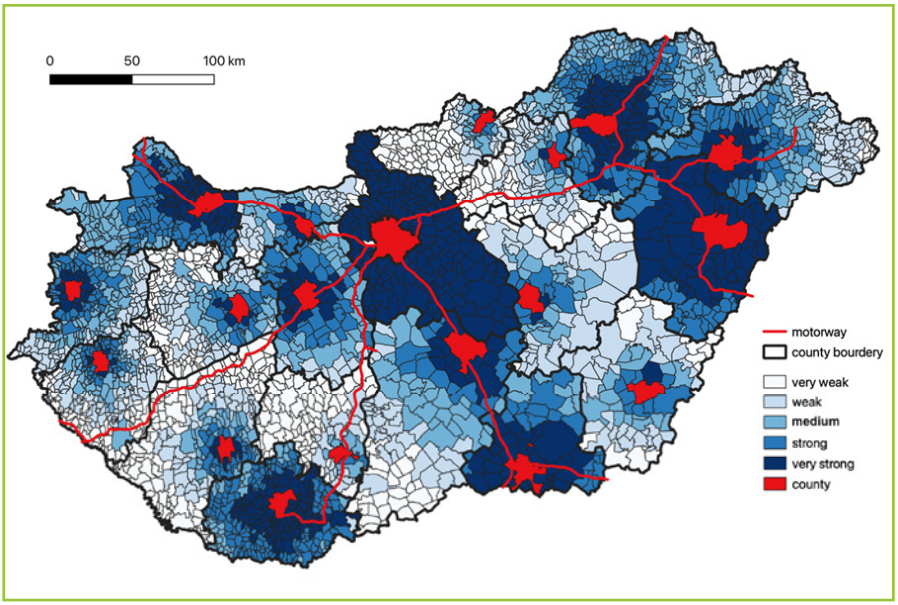

Figure 4 Location potential of county seats based on Hansen's gravity model (potential ranges from 1 to 1.9 million)
Source: the author's own editing based on Google Maps data from the period 29–30. 8. 2022. and the population data of the Hungarian Central Statistical Office (KSH) for 2015

Conclusions

Budapest's transportation infrastructure makes it stand out from Hungary's urban network. The capital attracts a significant proportion of the country to itself, increasing its role in the region. Therefore, its catchment area provides an excellent location for production and logistics investment, but it cannot dominate the entire country, despite the fact that all Hungarian motorways lead to the capital and significantly contribute to its accessibility. Almost one third of the country appears as disadvantaged areas in terms of access to the capital, because people from these settlements cannot reach Budapest by road within 2 hours. They seek a distinguished point in their own surroundings, and this is mostly found in the county seats. Consequently, a country must strive for other developed towns to serve as alternatives to its capital (Figure 5: Debrecen, Miskolc, Szeged, Pécs, Győr, Szombathely), which are located pole-like throughout the country, promoting the mobility of goods and labour in rural areas. In underdeveloped regions, the

beneficiaries of transport modernisation are often small and medium-sized enterprises, which are not only interested in transportation corridors (TEN-T corridors) but also in a well-developed regional transportation system (Erdősi, 2000a). The accessibility of county seats is favourable in Hungary, as only less than 8% of the Hungarian population is unable to reach their county seat within one hour. Following Budapest, it is county seats that have significant logistics potential and supply the surrounding settlements.

Reference

ABOELNAGA, S. – TÓTH, T. – NESZMÉLYI, G. I. 2019. Land use management along urban development axis as one of urban regeneration principles. In Engineering for Rural Development, 2019, no. 18, pp. 944–953. DOI: 10.22616/ERDev2019.18.N382

ABONYINÉ PALOTÁS, J. 2007. Infrastruktúra. Budapest-Pécs : Dialóg Campus, 2007, 184 p.

BANISTER, D. – BERECHMAN, J. 2001. Transport investment and the promotion of economic growth. In Journal of Transport Geography, 2001, no. 9, pp. 209–218. DOI: 10.1016/S0966-6923(01)00013-8

BERNÁT, T. et al. 1978. Általános gazdasági földrajz. Budapest : Tankönyvkiadó, 1978.

ERDŐSI, F. 2000a. A kommunikáció szerepe a terület- és településfejlődésben. Budapest : VÁTI, 2000.

ERDŐSI, F. 2000b. Európa közlekedése és a regionális fejlődés. Budapest-Pécs : Dialóg Campus Kiadó, 2000.

GULYÁS, A. 2013. Települések közötti kistérségi közlekedési kapcsolatok javítását célzó programok többkritériumos értékelése az útállapotok és a bizonytalanság figyelembevételével. Budapest : Útügyi lapok, 2013, p. 2.

HANSEN, W. G. 1959. How accessibility shapes land use. In Journal of the American Institute of Planners, 1959. DOI: 10.1080/01944365908978307

HUOVARI, J. – KANGASHARJU, A. – ALANEN, A. 2001. Constructing an Index Regional Competitiveness. In Modern Economy, 2001, no. 10.

NAGY, H. – KÁPOSZTA, J. – VARGA-NAGY, A. 2018. Is ICT smartness possible development way for Hungarian rural areas? In Engineering for Rural Development, 2018, no. 17, pp. 463–468. DOI: 10.22616/ERDev2018.17.N041

NAGY, D. – SPIEGLER, P. 2022. A közösségi közlekedés vizsgálata a környező városok elérhetősége szempontjából a Sárbogárdi járásban. In Horeczki, R. – Szabó, T. (szerk.). A vidéki Magyarország a pandémia korában. IX. Falukonferencia Pécs, Magyarország, KRTK Regionális Kutatások Intézete, 2022, 250 p.

NEMES NAGY, J. 2009. Terek, helyek, régiók. Budapest : Akadémiai Kiadó, 2009, pp. 206-214.

PORTER, M. E. 1994. The Role of Location in Competition. In Journal of Economics of Business, 1994, no. 1, pp. 35–39.

RUPPERT, L. 2000. Az átalakuló kelet-közép-európai közlekedés és a magyar közlekedés várható fejlődése. In Magyarország az ezredfordulón – Közlekedési rendszerek és infrastruktúrák. (Glatz F). Budapest : Magyar Tudományos Akadémia, 2000, pp. 33–54.

SZABÓ, SZ. 2008. A közlekedés földrajza, A közúti közlekedés, A vízi közlekedés, A légi közlekedés, A nagyvárosi közlekedés. In Fejezetek az ipar- és közlekedésföldrajzból (szerk.: Vidéki I.), Budapest : ELTE Eötvös Kiadó, 2008.

TÁNCZOS, K. – FARKAS, G. 2000. Problems and issues of defining user charges for railway infrastructure. In Periodica Polytechnica Transportation Engineering, vol. 28, 2000, no. 1–2, pp.103–116.

THÜNEN, J. H. 1826. Der Isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie, Hamburg, Perthes. English translation by C.M. Wartenberg: The Isolated State. Oxford : Pergamon Press (1966).

TINER, T. 2008. Egy gazdasági kulcságazat, az infrastruktúra területi fejlesztésének fő sajátosságai. In Területfejlesztés, településfejlesztés. Selye János Egyetem Gazdaságtudományi Kar, Komárno, Egyetemi jegyzet, 2008, pp. 141–171.

TÓTH, G. – KINCSES, Á. 2007. Közúti elérhetőségi vizsgálatok Európában. In Statisztikai Szemle, vol. 85, 2007, no. 5, pp. 432–463. DOI: 10.17649/TET.21.3.1123

TÓTH, L. 2004. Fenntartható fejlődés – fenntartható mobilitás. In Közlekedéstudományi Szemle, vol. 54, 2004, no. 12, pp. 442–448.

VÖRÖS, A. – POLÁNYINÉ CSÁNYI, Á. 2001. Az M8 autópálya várható terület- és gazdaságfejlesztő hatásai. In Közlekedéstudományi Szemle, 2001, no. 12, pp. 449–464.

WALLERSTEIN, I. 1983. A modern világgazdasági rendszer kialakulása. Budapest : Gondolat Könyvkiadó, 1983.

WEBER, A. 1909. Ueber den Standort der Industrien, Tübingen J. C. B. Mohr. English translation: The Theory of the Location of Industries. Chicago : Chicago University Press, 1929.

Contact address

Áron Kovács, Milton Friedman University, Department of Economics and Management, Deputy head of Department

kovacs.aron@uni-milton.hu