PROGRESSIVE URBAN GEOGRAPHY - DETERMINING FACTORS OF URBAN COMPETITIVENESS IN HUNGARY

PROJECT CLOSING REPORT

GENERAL OVERVIEW

The main aim of the research was to examine the geographical (spatial and settlement category level) differences of the creative economy, digitalization and innovation in Hungary, and to explore the role of these economic processes in the geographical characteristics of urban competitiveness.

Our starting hypothesis suggested that becoming a creative, smart, and innovative city will fundamentally increase the competitiveness of cities, but due to path dependency at the level of each city category we can discover significant spatial differences in Hungary. In this way, the competitiveness-enhancing effect of the above processes shows significant geographical disparities and occurs in different city categories through different ways and mechanisms.

The basic question of research was to what extent do creative economy, digitalization and smart solutions, and innovation contribute to increasing the competitiveness of Hungarian cities and what geographical patterns can be outlined?

The research questions of the project were as follows:

- What geographical (spatial and regional) differences can be detected in the competitiveness of Hungarian cities?
- What are the relative positions of cities in the creative economy, digitalization and innovation, and what are the territorial characteristics of different city categories?
- What are the creative, digital, and innovation hubs in the Hungarian city network and what can be determined about the geographical patterns of their occurrence?
- What are the determinative geographical contexts and mechanisms between the competitiveness and the creative, smart, and innovative development and potential of cities?
- What do we know about the digital embeddedness of future generations within the urban society, and what territorial and social processes can be outlined regarding the X, Y and Z generations?
- What do international trends show, and what are the most important experiences of international comparative analyses?

The research project was originally planned for 36 months (01.11.2018-31.10.2021), however, due to the negative impact of the coronavirus epidemic on basic research, the project duration has been extended in several steps until 31 August 2023, as allowed by law. During the project period there were no personnel changes that adversely affected the successful implementation of the research.

WORK PLAN AND WORKFLOW

In the work plan we elaborated 6 broad work packages (WPs) with concrete goals and responsible researchers. As a result of the pandemic, we had to revise the work plan somewhat along the way, but the expected outcomes were fully achieved. In the following section we briefly summarize the work plan and the objectives of different work packages.

WP1 – Theoretical and methodological foundation of the research

1) Review of international and national literature.
2) Settling the methodological foundations of the research

WP2 – Geography of digitalization and smart cities

1) Exploring the geographical characteristics of digitization and its current development trends in the Hungarian city network.
2) Exploring current trends and geographical aspects of the smart city concept and development taking place in Hungary.

WP3 Geography of the creative economy and innovation

1) Exploring the most important national, regional, county, and settlement level development processes of the creative economy in Hungary, defining the hubs of the creative and knowledge intensive industries (leading settlements), and setting up a creative city order based on the weight of creative economy.
2) Exploration of the innovative hubs of the city network, and their spatial breakdown; Ranking the Hungarian cities by the level of innovation.

WP4 Geography of competitiveness

1) Investigation of the cities' competitiveness based on quantitative and qualitative methods. Ranking the Hungarian cities by the level of competitiveness.
2) Exploring the geographical and spatial patterns of competitiveness.
3) Carrying out international comparative analyses.

WP5 Synthesis of scientific results

1) Exploring the role of creative economy, digitization, and innovation in the urban geographical characteristics of competitiveness.
2) Carrying out comparative studies based on the rankings and territorial characteristics of hubs.

WP6 Dissemination of research outcomes

SUMMARY OF SCIENTIFIC RESULTS

In the initial phase of the project we carried out the conceptualisation and operationalisation of the research, reviewing the relevant national and international literature and methodologically grounding our research.

New scientific results on the urban geography of digitalisation

The traditional East-West dichotomy of the Hungarian territorial system still seems to be reflected in ICT use in Hungary, the west-east slope was clearly detectable in the spatial change in mobile cell data. However, there is growing spatial concentration that results in the weakening of the traditional West-East slope that is more and more replaced by the distance from Budapest and to a lesser extent from the regional centres. These trends can be explained by the growing importance of Budapest and its agglomeration in the Hungarian creative economy.

The spatial characteristics of mobile phone users of generation Z in Hungarian cities significantly differ from those of generation X and Y. The use of smartphones, which actually represents a higher level of technology and require more proficiency, decreases with age (smartphone predominance in generation Z). This trend will clearly fade out in the future, as with the ageing of generation Z, technological proficiency will reach an ever higher level in the society. For generation Z, no characteristic spatial pattern is recognizable, which means no significant difference can be detected in the geographical pattern of mobile use. Thus, generation Z could dampen the social and economic tensions created by the digital divide in the long run. Within each generation, more active mobile use in the higher levels of the settlement hierarchy and low activity in the peripheral small settlements can be observed.

In Hungary, following groups of settlements can be identified as defining digital nodes in the city network system:

- Budapest and Budapest Metropolitan Region. The city and districts of the downtown (e.g. districts I., V. and VI.) as well as the cities of the western sector of the agglomeration zone (e.g. Törökbálint, Budaörs);
- Cities along major transport axes and motorways (e.g. Komárom and Lébény along the Budapest–Hegyeshalom axis of M1 motorway leading to the West, Rácalmás – the headquarter of Hankook Tires in Hungary – along the M6 motorway leading to the South);
- Cities and spa towns with significant tourist potential (e.g. Zamárdi and Zalakaros near Lake Balaton, and Visegrád near Budapest);
- Cities located near significant border cross- ings (e.g. Záhony, at the border to the Ukraine).

The "digital desert" of the city network consists of the following groups of settlements:

- Cities located on the periphery from a geographical settlement point of view (e.g. Sajószentpéter in Borsod-Abaúj Zemplén county, and Salgótarján, the county seat of Nógrád county, both counties located in Northern Hungary);
- Settlements located in so-called inner peripheries from a socio-economic point of view (e.g. Rákóczifalva in the Great Plain, Sásd in Southern Transdanubia, and Répcelak in Western Transdanubia).

Results focusing on the social media intercity network did not unfold east-west dichotomy: clusters are usually aligned to the borders of administrative structures. We were able to identify strong intercity links between settlements with similar level of economic development of the meso-level spatial structure that traverse over different counties and regional borders (e.g. the less developed Zala county in Western Transdanubia is rather connected to the least developed Veszprém county of the Central Transdanubia region). Thus, the administrative and inter-city social networks of the regions of Western and Central Transdanubia in the northwestern part of the country does not overlap. The administrative regional and county boundaries between regions of Northern Hungary and Northern Great Plain are increasingly blurred by the spatial pattern of inter-city social network relations and are aligned with a west-east developmental slope. In terms of digital network interconnections, the Southern Great Plain and Southern Transdanubia appear as well-defined autonomous areas. Budapest and Pest county cannot be considered as separate territorial units from a digital network perspective. The agglomeration of Budapest does not constitute a unified cluster, instead it is split into northern, eastern, southern and western sectors.

The average number of connections per user is above average in the Western Transdanubia, Southern Great Plain and the Eastern part of the Northern Great Plain, while below average figures are found in the Budapest agglomeration, the inner peripheries of the Eastern part of the

country and Northern Hungary. Intercity links are particularly strong in the cities along the Budapest-Hegyeshalom and Budapest-Balaton axes, in the Budapest agglomeration, and in Szabolcs-Szatmár-Bereg and Békés counties. In terms of intracity links, the role of cities in the Southern Great Plain and the Northern Great Plain is striking. In the more economically developed areas of the country, networking is more prevalent (high number of intercity connections), while in the less developed areas, autochthonous, closed connections are more prevalent. The two spatial units are roughly separated by the Nagykanizsa-Nyíregyháza line. Our results suggest that in Hungary there is a non-significant but detectable relationship between economic development and social networking.

Our results on ICT device usage were based on big data analysis of mobile communication cellular data and ranking analyses on weighted average calculations. Our results on social media networks were based on network research analyses of the iwiw social media (Hungary's leading social media platform between 2002 and 2014, with more than 4 million users in 2008) and ranking analyses were based on weighted average calculations.

New scientific results on the geography of the creative economy and smart cities

The creative economy has a cyclical development, following the Kuznets cycle in urban geography. Due to the wave nature of the creative economy, different economic sectors (cultural industries, creative industries, ICT) are dominating and influencing urban development over time.

The post-socialist urban development in Hungary can be divided into three phases based on the development of the creative economy: the transitional age, the creative age and the intelligent age. The creative age is characterised by creative cities based on cultural and creative industries and a follow-up strategic approach. The intelligent age is characterised by smart cities based on knowledge-intensive and ICT-based smart cities, a proactive strategic approach and bottom-up socio-economic processes.

The creative economy in Hungary had been developing dynamically before the global economic crisis, but the crisis has broken the sector's momentum. The recession mainly affected the creative industries, without causing a significant disruption in the development of knowledge-intensive industries. The economic crisis mainly led to the disappearance of capital-poor, less resilient and less profitable creative companies.

The settlement hierarchy has a fundamental influence on the location of the creative industries, leading to increasing spatial concentration. The role of Budapest and the weight of the Budapest agglomeration in the Hungarian creative economy has been steadily increasing, and the crises have not been able to significantly break or influence this. Thus, in large cities and metropolitan regions, the creative economy can successfully contribute to weathering periods of economic crisis.

The Budapest metropolitan region plays a prominent role in the development of the creative economy. The process is more dynamic in the agglomeration zone than within the administrative boundaries of Budapest. In terms of the number of creative enterprises and workers and the volume of revenues, the most creative municipalities in Hungary are located in the Budapest agglomeration (Budakalász, Budakeszi, Diósd, Budapest, Törökbálint, Piliscsaba, Pomáz, Biatorbágy). The creative economy in the agglomeration zone is a key driver of new creative sub-centres contributing to the polycentric urban development.

The creative economy is actively shaping the geographic space, the structure and urban fabric of cities, thus it is reshaping the role and meaning of geographic place. Thanks to the spatial shaping power of the creative economy, urban development is moving towards the emergence of the mosaic city. The current stage of urban development in Central and Eastern Europe and Hungary is the mosaic city.

ICT plays a key role in the development of smart cities in the intelligent age. The Budapest agglomeration, and especially the agglomeration zone, is a prime area for the development of the ICT sector. In Hungary, since the turn of the millennium, a knowledge-based restructuring of the creative economy has been taking place, which in the long term will promote the development of smart cities in the Budapest agglomeration.

According to the results of the expert in-depth interviews carried out in the framework of the project, Hungary has the most favourable situation in the development of smart subsystems in terms of mobility, and the least favourable situation in terms of living conditions and people. Among smart city developments, those related to conctruction and property management are at the top of the list. The socio-economic and infrastructural conditions of the cities of the county have a key role to play in adapting the smart city concept and in smart development in the urban hierarchy.

According to results of the expert questionnaire survey (n=96) and public questionnaire survey (n=549), there are fundamental gaps in the field of smart transport in Hungarian cities (especially in rural cities). There is a need to improve digital services in the field of public transport (e.g. wifi on local buses), applications supporting local transport, and there is a particular gap in the spread of city cards. The presence of smart buildings in cities is minimal. In the case of local governments, there are fewer applications developed in-house to support the lives of local residents, in addition to the national, public electronic customer management facilities. Most cities do not have an agreed smart city strategy and have not taken concrete steps in this direction. Local authorities generally do not have a department or a professional staff responsible for smart development. In particular, there is a lack of major start-ups, research institutes, R&D or ICT companies of county or regional importance in the lower tiers of the settlement hierarchy. The above examples show that the Hungarian cities (especially the medium and small cities) are lagging behind in the field of smart urbanisation, which is reducing their competitiveness. This calls the attention of policy makers to the urban development steps that need to be taken to ensure that our cities meet the requirements of the intelligent age.

Our results on the creative economy and smart cities are based on statistical analyses, document analysis, in-depth interviews, questionnaire surveys and visualisation (thematic mapping).

New scientific results on the geography of innovation

To investigate the role of innovation in the urban landscape, we developed a model of innovation potential based on a multidimensional innovation, space, stakeholder model (ITS model). The innovation potential is assessed by seven sets of indicators generated by factor analysis (labour market, networking, business accessibility, knowledge production, social activity and industry potential) and their background variables (78 proxy variables in total).

Our results show a positive correlation (0.355) between the size of the municipality and the value of innovation potential within the Hungarian urban population, which is basically due to a stronger relationship at the highest levels of the hierarchy of municipalities (cities with a population of more than 50 000 inhabitants). At lower levels of the hierarchy, the correlation is less pronounced or undetectable. The average values of innovation potential by settlement category suggest that the larger the city, the greater its innovation capacity.

Cities in the northern part of Western and Central Transdanubia, along the Budapest-Hegyeshalom axis, have a significant innovation potential. Among the large cities Budapest, Győr, Szeged, Eger and Székesfehérvár stand out, while among the medium and small cities Gödöllő, Jászfényszaru (Samsung) and Rácalmás (Hankook Tire) have a high innovation potential. The cities of Kiskunság and Bácska Loess reef have a low innovation potential, as do the cities on the inner periphery of the eastern part of the country and those along the

northeastern and eastern borders. Cigánd, Battonya, Mándok, Újszász, Abádszalók and Borsodnádasd occupy the last places in the innovation ranking.

Determinants of competitiveness and synthesis of research findings

The creative economy and ICT are actively shaping both geographic and virtual space, thereby transforming the role and meaning of physical space. In the case of Hungary, it is mainly in the northern part of the country (both east and west) that digital networks are diverging more significantly from traditional administrative territorial structures, where a significant transformation of traditional economic patterns is expected in the near future. The cluster analysis of digital networks can help to rethink the traditional spatial structure of Hungary and to outline a new network-based spatial structure.

Digitalisation is closely linked to economic development, prosperity and welfare. Our results show that both social network indicators and measures of mobile communications significantly predict average urban-level income in Hungary, and their geographical patterns are closely linked to the well-being of Hungarian cities. Our results suggest that economic development is primarily related to the level of embeddedness in inter-city networks. The direction of causality here is rather twofold, i.e. it is not the case that dense connections create wealth, or that higher levels of wealth lead to more social connections. Here we see a complex interaction of historical trajectories and current economic and social processes.

New sub-networks of nodes and links are emerging in Hungary that are independent from the trajectories of the administrative spatial divides of past and present. There is an emergence of new hubs in city structures in digital networks and the growing importance of second-tier cities. This process is particularly marked in the western and northwestern, and northern and northeastern part of the country, respectively.

To synthesise our research results and assess the competitiveness of Hungarian cities, we have carried out ranking tests based on the weight of competitiveness in the local economy of the creative economy (number of businesses and employees, revenues), the number of events characterising ICT device usage (data traffic, incoming and outgoing calls, and SMSs), and the value of innovation potential.

Our rank correlation calculations show that within the Hungarian city network, innovation has the strongest influence on competitiveness, while the importance of the creative economy and digitalisation is similar, but somewhat behind innovation.

Budapest and the regional centres (Székesfehérvár-Veszprém, Debrecen, Szeged, Pécs) are at the top of the competitiveness ranking of Hungarian cities, while only medium-sized cities in the Budapest metropolitan region with significant development potential, strong local economies or prosperous companies (Biatorbágy, Törökbálint, Komárom, Esztergom) have a chance to reach the top of the competitiveness ranking. Small towns on the periphery or inner periphery with less integrated in digital networks, inward-looking, less creative and innovative local economies, mostly from Northern Hungary and the Northern Great Plain (Cigánd, Nyírmada, Borsodnádasd, Mándok, Dombrád), were at the bottom of the list. Among the large cities, Nyíregyháza, Miskolc and Érd have unfavourable competitiveness, while among the medium-sized cities Nagykőrös, Kazincbarcika and Baja have poor indicators.

In the framework of international comparative studies, the competitiveness of Central and Eastern European capitals (Budapest, Vienna, Bratislava, Prague and Warsaw) was examined in terms of economic performance (e.g. share in national GDP, GDP per capita, export-import ratio, public debt to GDP), digitalisation (e.g. Internet penetration, online shopping), smart developments (e.g. smart transport and street lighting, smart traffic analysis), innovation (e.g. R&D) and the creative economy (e.g. cultural facilities) using a complex set of indicators. Our

results show that Budapest is ranked third among the capitals surveyed, behind Vienna and Prague but ahead of Warsaw and Bratislava.

Dissamination of scientific results

Originally we planned at least 2 articles in Q1-Q4 international scientific journals; at least 4 papers in Hungarian journals at the Q3-Q4 levels; 1 thematic edited volume in Hungarian;
Next to paper publications we planned at least 2 presentations at international conferences; at least 4 presentations at national conferences; visualised thematic maps prepared during the project; 3 informative presentations for the public; and, 1 professional project website throughout the whole project lifetime and in the following 5 years of the maintenance period;

Actual outcomes of the dissemination

1 Q1 (D1) paper published in the highest scientific category (IF:4,802), 3 Q2 papers, 6 papers in Hungarian language journals (MTA "A" category), 1 paper in English language journal (other category), 1 book/monograph, 4 book chapters in Hungarian and 2 book chapters in English, 2 thematic maps in the National Atlas of Hungary on Social Geography, 1 scientific dissertation (Doctor of the Hungarian Academy of Sciences) based on the research results of the project. A website presenting the results of the project (varosrehabilitacio.net) is up and running.

Presentations at international conferences

- Egedy, Tamás: Changing geography of the creative economy in Hungary at the beginning of the 21st century- From Smart Cities to Smart Regions in Central, Eastern and South Eastern Europe- Network Conference of Spa-ce.net- Bratislava, 22. November 2018.
- Egedy, Tamás: Changing geography of the creative economy in Hungary 7th EUGEO Congress on the Geography of Europe - Re-imagining Europe's Future Society and Landscapes; Galway, 15-18. May 2019. ***(Own thematic session on „Creative and smart cities in Europe")***
- Egedy, Tamás: Geographical characteristics and territorial patterns of digitization in Hungary. CATference 2019 - 8th International Urban Geographies of Post-communist States Conference. Belgrade, 26-28. September 2019.
- Egedy, Tamás: Urban geographical impacts of the creative economy and infocommunication technologies in Hungary.8. EUGEO nemzetközi földrajzi kongresszus (EUGEO2021) – Prague, 28. June – 1. July 2021. ***(Own thematic session entitled "On the Way from Creative Cities to a Smart Future")***
- Egedy, Tamás – Benkő, Melinda: Development and Planning of a Discontinuous Urban Area in Budapest's Inner-city – „Real vs. Virtual City". Symposium Southern Europe and Beyond. Comparative and Multi-Situated Perspectives on Middle Class Housing. Session II – Policies. Milan, 21. October 2021. (***Invited presentation***)
- Egedy, Tamás: Urban geographical patterns of the relationship between mobile communication, social networks and economic development in Hungary.
- CATference 2022 - 9th International Urban Geographies of Post-Communist States Conference. Budapest, 27. June – 1. July 2022.
- Egedy, Tamás: Urban geographical patterns of the relationship between mobile communication, social networks and economic development in Hungary. 61th ERSA Congress - Disparities in a Digitalising (Post-Covid) world – Networks, Entrepreneurship and Regional Development. Pécs, 22-26. August 2022.
- Egedy, Tamás: Urban geographical patterns of the relationship between mobile communication, social networks and economic development in Hungary. EUGEO Congress, 4-7. September 2023. ***(Own thematic session entitled "Creativity rulez!")***

Presentations at national conferences

- Egedy Tamás: A kreatív gazdaság fejlődési tendenciái Magyarországon- A tudomány ünnepe 2018 - Határtalan Tudomány, Tomori Pál Főiskola, Budapest – 2018. november 20. ***(Plenáris előadás)***
- Egedy Tamás – Szabó Tünde – Prorok Márton: A budapesti városstérségben zajló mozgásfolyamatok feltárása mobilkommunikációs cellaadatok segítségével. XVI. Településföldrajzi Konferencia, Bük. 2019. április 11-12. ***(Plenáris előadás)***

- Egedy Tamás: Az IKT szektor gazdasági szerepe és területi jellemzői Magyarországon. Kreatív ipar, digitális gazdaság. SZIE Kautz Gyula Gazdaságtudományi Kar, Győr, 2019. június 12.
- Egedy Tamás A kreatív gazdaság nyomában – Van új a nap alatt? XVII. Településföldrajzi konferencia Bük, 2020. szeptember 17-18.
- Egedy Tamás: A válságok hatása a kreatív gazdaság fejlődésére Magyarországon. A Magyar Regionális Tudományi Társaság 18. Vándorgyűlése Magtérségek és perifériák – lehetőségek és fenntartható jövő. Online konferencia, 2020. október 27–30.
- Egedy Tamás: A kreatív gazdaság fejlődése Magyarországon és a budapesti agglomerációban. A Magyar Regionális Tudományi Társaság 18. Vándorgyűlése Magtérségek és perifériák – lehetőségek és fenntartható jövő. Online konferencia, 2020. október 27–30.
- Egedy Tamás: A kreatív gazdaság városföldrajzi hatásai Magyarországon és a budapesti agglomerációban. BGE kutatói nap (online konferencia) – Budapest, 2021. április 8.
- Egedy Tamás: A kreatív gazdaság fejlődése a budapesti agglomerációban. Magyar Földrajzi Napok 2021 – A Magyar Földrajzi Társaság 74. Vándorgyűlése és 145. Közgyűlése – Gödöllő, 2021. július 2. ***(Plenáris előadás)***
- Egedy Tamás: A kreatív gazdaság és az infokommunikációs technológiák városföldrajzi hatásai Magyarországon X. Magyar Földrajzi Konferencia (online konferencia) – Budapest, 2021. szeptember 24.
- Egedy Tamás: A kreatív gazdaság és az infokommunikációs technológiák városföldrajzi hatásai Magyarországon. XXVII. Országos Urbanisztikai Konferencia – Újraiparosodó városaink. Debrecen, 2021. október 21.
- Egedy Tamás: A városfejlődés és a városrehabilitáció aktuális tendenciái Magyarországon. Urbanista Felsőfokú Szakirányú Továbbképzés 2020-2022 (XII. konferencia, online konferencia) – Budapest, 2021. december 6.
- Egedy Tamás: Új irányok a kreatív gazdaság kutatásában. MRTT 20. Vándorgyűlése – Tér és állam. Budapest, 2022. október 6-7.
- Egedy Tamás: A kreatív gazdaság fejlődése és városföldrajzi hatásai Magyarországon**.** MTA Építészeti Tudományos Bizottság Településtudományi Állandó Bizottsága, Budapest, 2022. október 18. ***(Meghívott, felkért előadás)***

In total, 19 scientific publications (and one dissertation) were published and 22 conference presentations were held during the project.