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DEMETER, Gábor – PAPP, István – F. ROMHANYI, Beatrix – HORBULAK, Zsolt – FÖLDVARI, Péter – PENZES, János. A Fine-Scale Longue Durée Investigation on Regional Inequalities in the Kingdom of Hungary (1330–1910). In *Studia Historica Nitriensia*, 2025, vol. 29, no. 2, pp. 302-334, ISSN 1338-7219; e-ISSN 2585-8661; DOI: <https://doi.org/10.17846/SHN.2025.29.2.302-334>.

Though the possibilities of comparative spatial analysis in historical research have significantly broadened, there are still several difficulties challenging longue durée investigations. These originate from the uneven availability of indicators of development for the different time horizons, which makes temporal comparisons difficult; the changing explanatory power of available indicators over time; the changing administrative boundaries; and the problems of data harmonization when the analysis involves many countries. In this study we demonstrate a possible solution to these problems using a municipal level database containing more than 12,000 territorial entities and over 100 variables for the historical Kingdom of Hungary tracing cores and peripheries for several time sections, namely the 1330s, 1786 and 1910. Besides illustrating the spatial and temporal shift of backward zones between 1330 and 1910, the Williamson-hypothesis on trends in inequalities was also tested in the investigation.

Keywords: Regional Inequalities; Peripheries; Longue Durée Comparison; hGIS+database; Kingdom of Hungary; 1330 – 1910;

DEMETER, Gábor – PAPP, István – F. ROMHANYI, Beatrix – HORBULAK, Zsolt – FÖLDVARI, Péter – PENZES, János. Výskum dlhodobých regionálnych disparít v Uhorsko od 1330 do 1910 na úrovni obcí. In *Studia Historica Nitriensia*, 2025, roč. 29, č. 2, s. 302-334, ISSN 1338-7219; e-ISSN 2585-8661; DOI: <https://doi.org/10.17846/SHN.2025.29.2.302-334>.

Aj keď sa možnosti komparatívnej priestorovej analýzy v historickom výskume výrazne rozšírili, stále existujú určité problémy, ktoré sú pre výskum „longue durée“ výzvou. Problémy pramenia z nerovnomernej dostupnosti ukazovateľov rozvoja pre rôzne časové horizonty, čo sťažuje ich vzájomné porovnávanie; mení sa vypovedacia schopnosť dostupných ukazovateľov v čase; menia sa administratívne hranice územných jednotiek a v prípade analýzy viacerých krajín je problém aj harmonizácia dát. Štúdia demonštruje možné riešenie týchto problémov pomocou databázy na úrovni obcí. Databáza obsahuje viac ako 12 000 územných jednotiek a viac ako 100 premenných pre Uhorsko. Výskum sleduje centrálnu aj periférnu oblasti v niekoľkých časových horizontoch, konkrétne pre roky 1330, 1786 a 1910. Okrem grafického znázornenia priestorového a časového posunu zaostalých oblastí medzi rokmi 1330 a 1910 sa v rámci skúmania testovala aj Williamsova hypotéza poukazujúca na rozsah nerovností.

Kľúčové slová: regionálne disparity; periféria; longue durée výskum; hGIS+databáza; Uhorské kráľovstvo; 1330 – 1910;

1 Introduction – sources¹

As the Carpathian Basin belonged to one political formation prior to 1920, economic development was characterized by monocentric policies in most of the second millennium (with the exception of the Ottoman era). By digitising serial historical sources and involving other scientific disciplines for their evaluation, it has become possible to analyse the longue durée trends and patterns of economic processes in the historical Kingdom of Hungary (without Croatia) – in other words, we intended to identify the cores and peripheries and their shift under different political regimes between 1330 and 1920.

Tracing both longue durée trends and patterns of development requires a systematic collection and harmonization of digitized datasets derived from archival serial sources and a special, inter- or multidisciplinary approach that involves historical statistics, methods of regional sciences such as multivariate statistics, spatial data processing and GIS-aided geographical approach to visualize data beyond the traditional philological and paleogeographical skills that help to read out and interpret the sources.

Our analysis is based on data derived from settlement level serial sources from four historical periods. The last (and most detailed) census of the Kingdom of Hungary was concluded in 1910 and the retrieved socio-demographic data are organised into a huge GIS database (GIS_ta Hungarorum project) by us. Beyond the official volumes of the Statistical Bureau from the 1910s² other works focusing on settlement taxes and agrarian incomes

¹ Research was supported by the HAS RCH Lendület “Ten Generations” project (Gábor Demeter), the Bolyai János Research Scholarship of the Hungarian Academy of Sciences (János Péntes) the National Research, Development and Innovation Fund of Hungary K 145924 (Beatrix F. Romhányi) and project Overcoming Digital Divide in Europe and Southeast Asia “ODDEA” Project No. 101086381 Call: HORIZON-MSCA-2021-SE-01-1 (Zsolt Horbulák).

² A Magyar Szent Korona országainak 1910. évi népszámlálása. Első rész. A népesség főbb adatai községek és népesebb puszták, telepek szerint. Magyar Statisztikai Közlemények. Vol. 42. Budapest 1912, 883 pp.

were used too, to derive variables seen on table 1.³ The database was recently extended to the eighteenth century (see <http://gistahungarorum.abtk.hu> as an interactive version), by integrating the settlement level data of the Josephinian census from 1785-1787 (published in 3 volumes);⁴ the first Regnicolaris conscription after the Ottoman era from 1715/1720 covering more or less the whole county (inc. Transylvania) as published by Acsády in 1896 (without his ethnic data which are absolutely unreliable);⁵ the so-called *Lexicon locorum* from the 1770s containing much reliable data on religion and spoken language for each settlement;⁶ the settlement-level conscription of tenants, including their legal status (*colonus*, *inquilinus*, *subinquilinus*, tax-payer freeholder, noble settling on peasant plot), their landsize, meadows, direct state taxes paid and their duties (compulsory workdays: *corvée*) and gifts in kind to the landlord in 1786, a source still unpublished.⁷ In order to substitute the 1786 data for the missing 2000 settlements of Transylvania we used the settlement-level conscription from 1750 published by Ladislau Gyémánt et al.);⁸ finally the standardized and reorganized data of the three volumes of Vályi (1797)⁹ were also integrated into our database to identify constraints of agrarian production.

A Magyar Szent Korona országainak 1901–1910. évi népmozgalma községenkint. Magyar statisztikai közlemények. Vol. 46. Budapest 1913, 727 pp.

A Magyar Szent Korona országainak 1910. évi népszámlálása. Második rész. A népesség foglalkozása és a nagyipari vállalatok községenkint. Magyar Statisztikai Közlemények. Vol. 48. Budapest 1913, 1092 pp.

A Magyar Szent Korona országainak 1910. évi népszámlálása. Harmadik rész. A népesség foglalkozása részletesen és a vállalati statisztika. Magyar Statisztikai Közlemények. Vol. 52. Budapest 1914, 1312 pp.

A Magyar Szent Korona országainak 1910. évi népszámlálása. 4. rész. A népesség foglalkozása a főbb demográfiai adatokkal egybevetve s a népesség ház- és földbirtokviszonyai. Magyar Statisztikai Közlemények. Vol. 56. Budapest 1915, 377 pp.

³ Magyarország művelési ágak szerinti területe és földjövödelme. Buda 1865, 545 pp.

Abaúj... Zólyom vármegye adóközségeinek területe és kataszteri tisztajövödelme művelési áganként és osztályonként az 1909. évi V. t.-c. alapján (in 64 separate volumes). Budapest 1914

A debreczeni / kassai / kolozsvári / budapesti / besztercebányai / nagy-szebeni / pécsi / pozsonyi / szatmári / szegedi / temesvári kataszteri kerület összes becselőjárásainak osztályozási vidékenkénti előleges tisztajövödelmi fokozatai és sommás osztálykivonatainak összeállítása. Budapest, 1882 – 1883.

JEKELFALUSSY József (ed.). A községek háztartása és pótdójuk. Az 1881. évi jóváhagyott költségvetések alapján. (Hivatalos Statisztikai közlemények 21). Budapest 1883, 529 pp.

Magyarország községeinek háztartása az 1908. évben. Magyar Statisztikai Közlemények. Vol. 39. Budapest 1913, 949 pp.

Current spatial data published in the 2010s from the 8 successor-states of the Kingdom of Hungary were also collected, harmonised and processed for a spatio-temporal comparison (see references).

⁴ Az első magyarországi népszámlálás (1784–1787). Budapest 1960, 389 pp.

Pótlás az első magyarországi népszámláláshoz 1786–87. Budapest 1975, 91 pp.

DÁNYI, Dezső – FARAGÓ, Tamás – LÁSZLÓ, Géza. II. József népszámlálásának községi adatai. A [KSH Népességtudományi Kutató Intézetének Történeti Demográfiai Füzetek 15. Budapest 1996, 122 pp.

⁵ ACSÁDY Ignác. Magyarország népessége a pragmatica sanctio korában 1720–21. Budapest, 1896, 496 pp.

⁶ ILLÉS, József (ed.). *Lexicon locorum Regni Hungariae populosorum anno 1773 officiose confectum*. Budapest, 1920, 335 pp.

⁷ Magyar Nemzeti Levéltár [National Archives of Hungary] Országos Levéltára (MNL OL), Magyar Kancelláriai Levéltár (1770–1848) [Hungarian Chancery Archives (1770–1848)]. 1785/86-i úrbéri összeírás (1785–1786) [Urbarial conscription (1785–1786)]. A 39, 3688/1786. Data for 1767: FÓNAGY, Zoltán. A nemesi birtokviszonyok az úrbérrendezés korában. Adattár. Vol. 1-2. Budapest 2013, 1536 pp.

⁸ GYÉMÁNT, Ladislaus et al. (eds.). *Conscriptiō fiscală a Transilvaniei din anul 1750*. I–II. București; Cluj-Napoca 2009–2016, 1272 pp.; 1276 pp.; 671 pp.; 1056 pp.; 733 pp.

⁹ VÁLYI, András. Magyar országnak leírása... Vols. I–III. Buda 1796, 704 pp.; 736 pp.; 688 pp.

Thus, besides data on 1910 (and on 2010 for the eight successor countries, which we do not analyse here) we have two more sets of socio-economic and demographic indicators in 1720 and 1786, mostly on the rural population and agriculture. Finally, we processed and integrated the papal tithe register from the 1330s, using the work of Fejérpataky (1887) and Croatian data published by Buturac (1984) and some other variables (table 1). This constituted the earliest time horizon of our investigations.¹⁰ The reason for including data was that it covered the whole territory of the kingdom, and tithe was a proportional tax (unlike war subsidy from the 1490s that is available also for the whole country, but was a head-tax) that allowed us to estimate agrarian output. It is possible to extend the database with further time sections,¹¹ but this requires more time.¹²

It is evident that not all medieval-early modern terms and variables can be interpreted according to modern schemes. It is also not surprising that the number of “valid” indicators decreases as we go back in time. The harmonization of data of different kinds and to correspond them with modern terms requires special skills and a thorough statistical knowledge of how to measure development.

2. Literature and methods

As a result of dynamically broadening spatial datasets and improving processing methods, the possibilities of *longue durée* investigations and regional analysis in history have broadened substantially since the first attempts of Braudel.¹³ Historical research using GIS has become widespread allowing a shift in focus from vertical (societal) to horizontal (regional) structures. However, despite the general interest towards spatial historical analyses and the broadening of its geographical scope¹⁴ there are still numerous obstacles to overcome.

First, many studies focus on a single indicator, such as the reconstruction of historical GDP,¹⁵ which is difficult and the indicator itself is biased. Though its substitution has been

¹⁰ FEJÉRPATAKY, Ladislaus (ed.). *Rationes collectorum pontificorum in Hungaria. Pápai tizedszedők számadásai*. Monumenta Vaticana Hungariae vol. I/1. 1281–1375. Budapest 1887, 524 pp.

BUTURAC, Josip. *Popis župa zagrebačke biskupije 1334 i 1501 godine*. In *Starine*, 1984, vol. 59, pp. 43–107.

¹¹ The conscription of 1828 just published online at the *AdatbázisokOnline* of the Hungarian National Archives were not used, as these are still under processing.

¹² Processing ca. 10 variables for 10,000 settlements may take one year according to our experience, if done only by 1 person. Reading Ottoman *defters* is even slower, after 8 years of work we only processed 50% of the data on tax units and taxes in the 16th c. available for Hungary.

¹³ CLOUT, Hugh. D. *The Land of France 1815 – 1914*. Routledge Library Editions: Rural History 3. London 1983, 2018, 186 pp.

¹⁴ SCARGILL, Ian. Regional Inequality in France: Persistence and Change. In *Geography*, 1991, vol. 76, no. 4, pp. 343–357; DORMARD, Serge. Economic development and regional disparities in France. In KARL, Helmut – ROLLET, Philippe. *Employment and regional development policy: Market efficiency versus policy intervention*. Hannover 2004, pp. 50–67.; COMBES, Pierre-Philippe et al. The rise and fall of spatial inequalities in France: A long-run perspective. In *Explorations in Economic History*, 2011, vol. 48, no. 2, pp. 243–271; da SILVA, Simone. A. Regional Inequalities in Brazil: Divergent Readings on Their Origin and Public Policy Design. In *EchoGéo*, 2017, vol. 41, pp. 1–17; DíEZ-MINGUELA, Alfonso – MARTÍNEZ-GALARRAGA, Julio – TIRADO-FABREGAT, Daniel, A. Regional inequality and economic development in Spain, 1860 – 2010. *Palgrave Studies in Economic History*. Cham 2018, 302 pp.

¹⁵ CARUANA-GALIZIA, Paul. Indian regional income inequality: estimates of provincial GDP, 1875 – 1911. In *Economic History of Developing Regions*, 2013, vol. 28, no. 1, pp. 1–27.; BUKOWSKI, Maciej et al. Urbanization and GDP per capita: New data and results for the Polish lands, 1790 – 1910. In *Historical*

attempted through hHDI¹⁶ or historical inequalities¹⁷ as a new dimension of measuring development levels, but these attempts rarely offer the fine-scale mapping of the (intra) regional differences. So, optimal scaling is the second obstacle. The third is the time-scale of studies, which remains often limited in case of using multiple (composite) indicators. Fourth, altering administrative boundaries and the changing focus of available conscriptions, or the lack of data covering extensive areas are also obstacles.¹⁸

Compared to the investigations using late nineteenth century data, datasets from the eighteenth centuries or earlier were created with the purpose of taxation of land,¹⁹ therefore they are not ideal either for estimating regional inequalities, development levels or GDP and require special paleogeographical skills.

This article aims at addressing the problems outlined above by executing a fine-scale (municipal level) longitudinal investigation on the regional inequalities in the Kingdom of Hungary spanning over seven hundred years, using a GIS-aided quantitative approach. Tracing and visualizing the *longue durée* shift of peripheries in Hungary between the 1330s and 1910 has never been attempted before. Győri & Mikle²⁰ focus on the present territory of Hungary in their investigation between 1910 and 2010, whereas Beluszky & Győri²¹ did not go back to the nineteenth century, Máténé and Ritzlné²² focused on urban settlements, Mariann Nagy on agriculture²³). The present study also has a methodological focus, when seeking to visualise temporal changes and differences for three time sections. Studies analyzing historical regional inequalities in Austria-Hungary focus on GDP, not on overall development, and these are not fine-scale investigations.²⁴ Studies on the

Methods, 2019, vol. 52, no. 4, pp. 212-227; ENFLO, Kerstin – MISSIAIA, Anna. Regional GDP estimates for Sweden, 1571 – 1850. In *Historical Methods*, 2018, vol. 51, no. 2, pp. 115-137.

¹⁶ For Hungary see: SZILÁGYI, Zsolt. Regional Differences in Development and Quality of Life in Hungary During the First Third of the Twentieth Century. In *The Hungarian Historical Review*, 2019, vol. 8, no. 1, pp. 121-152. In general: PRADOS DE LA ESCOSURA, Leandro. *World Human Development: 1870 – 2007*. In *Review of Income and Wealth*, 2015, vol. 61, no. 2, pp. 220-227.

¹⁷ MILANOVIC, Branko – LINDERT, Peter – WILLIAMSON, Jeffrey, G. Pre-Industrial Inequality. In *The Economic Journal*, 2010, vol. 121, no. 551, pp. 255-272; REIS, Eustáquio. Historical Perspectives on Regional Income Inequality in Brazil, 1872 – 2000. In BÉRTOLA, L. – WILLIAMSON, Jeffrey. *Has Latin American Inequality Changed Direction?* Cham 2017, pp. 143-170.

¹⁸ See for example, RUMPLER, Helmut – URBANITSCH, Peter – SEGER, Martin (ed.). *Die Habsburgermonarchie IX. Soziale Strukturen 2. Teilband: Die Gesellschaft der Habsburgermonarchie im Kartenbild. Verwaltungs-, Sozial- und Infrastrukturen. Nach dem Zensus von 1910*. Wien 2010, 362 pp. Their maps use territorial entities of different sizes for Hungary and Cisleithania.

¹⁹ SCHNEIDER, Ute. Inquiries or statistics? Agricultural surveys and methodological considerations in the nineteenth century. In VIVIER, Nadine. *Golden Age of the State Enquiries. Rural Enquiries in the Nineteenth Century. Rural History in Europe 14*. Brepols 2014, pp. 43-59.

²⁰ GYŐRI, Róbert – MIKLE, György. A fejlettség területi különbségeinek változása Magyarországon, 1910 – 2011. In *Tér és társadalom*, 2017, vol. 31, no. 3, pp. 144-164.

²¹ BELUSZKY, Pál – GYŐRI, Róbert. *Magyar városhálózat a 20. század elején*. Budapest; Pécs 2005, 232 pp.

²² MÁTÉNÉ BELLA, Klaudia – RITZLNÉ KAZIMIR Ildikó. A Trianon előtti magyar városok relatív fejlettségének vizsgálata strukturális egyenletek modelljével. In *Területi Statisztika*, 2022, vol. 62 no. 1, pp. 3-34.

²³ NAGY, Mariann. *Regional Structure of Hungarian Agriculture at the Beginning of the 20th Century*. Budapest 2017, 472 pp.

²⁴ KLAJKA, Pavel – ERLEBACH, Martin. The contribution of spatial interaction modelling to spatial history: The case of central places and their hinterlands in the territory of the Austro-Hungarian Empire. In *Moravian Geographical Reports*, 2021, vol. 29, no. 4, pp. 266-277; SCHULZE, Max-Stephan: *Regional Income Dispersion and Market Potential in the Late Nineteenth Century Habsburg Empire*. [Online]. LSE Working

early regional development trends and patterns of new-born states after 1920 are also sporadic, especially those using statistical analysis.²⁵ Similar complex and at the same time fine resolution research is also rare in Europe. Historical decentralization of Italy and the Holy Roman Empire makes it impossible to execute research on large territory. In eastern Europe the lack of data hinders similar investigations, whereas in western Europe the problem is with too much data still unprocessed.²⁶ A recent conference in Valencia pointed out that though in Portugal and Spain²⁷ similar frameworks to ours do exist, but these do not go before the 19th c., thus data processing in Hungary is outstanding.²⁸ In Poland historical GIS produced remarkable efforts for the 16-18th c.²⁹ but the dismemberment of the state made reconstruction difficult between 1795 and 1920, and neither the Portugal, nor the Polish database was evaluated yet in this manner.

Investigations using similar interdisciplinary methods in Slovakia targeting the early history of the region are rare (despite the possibilities in ecclesiastic conscriptions):³⁰ one may mention the statistical analysis of the conscription of 1720,³¹ the GIS-based historical atlas of Čéplö et al³² for the 18-20th c.; 18th c. towns were evaluated

Papers no. 106/07, 2007. Department of Economic History, London School of Economics, London. Available online: <https://eprints.lse.ac.uk/22311/1/WP106schulze.pdf>.

Recently two new studies deal with regional inequalities in Austria-Hungary and their short-term trends: STÖLLINGER, Roman. Economic Growth in the Habsburg Monarchy 1870 – 1910: Convergence, Catching-up, Confusion. [online] Conference, Falling Behind and Catching Up Southeast Europe and East Central Europe in Comparison. Vienna, 23 June 2016. Available online: <https://wiiw.ac.at/roman-stoellinger-economic-growth-in-the-habsburg-monarchy-1870-1910-convergence-catching-up-confusion-dlp-3961.pdf>; ERFURTH, Philipp E.: Is the European Union More Unequal Than the Habsburg Empire? Examining Regional Inequalities in Habsburg Regions. From 1870 to 2018. [online] Stone Center On Socio-Economic Inequality. Working Paper Series. No. 50. 2022. Available online: <https://stonecenter.gc.cuny.edu/research/is-the-european-union-more-unequal-than-the-habsburg-empire/>

²⁵ GYÖRI – MIKLE, A fejlettség; MAREK, Martin Václav. Souvislosti rozmístění socioekonomických charakteristik obyvatelstva a hospodářství ve vztahu k železniční síti v Československu v letech 1921 a 1930. Diploma thesis, Praha 2015; DEMETER, Gábor. Trends in regional inequalities between 1910 and 1930 in Hungary and the successor states. In *Wschodnioznawstwo*, 2020, vol. 14, pp. 95-115.

²⁶ In Britain the 'Taxatio' was processed in a digital database, 20th c. data also, but data prior to 1800 are not.

²⁷ The Spanish municipal population dataset (ESPOP) 1860 – 1930.

²⁸ Reconciling the irreconcilable: methods and techniques towards a European historical local population database. Valencia (Spain), 24-25 October 2024. ADEIT - Fundación Universidad-Empresa de la Universitat de València. Program available online at: https://aecr.org/wp-content/uploads/2024/10/Diptico-workshop-UV-2024_DEF.pdf

²⁹ See Atlas Fontium, available online at: <https://atlasfontium.pl/language/en/polish-lands-of-the-crown/>. SŁOMSKA-PRZECHA Katarzyna et al. Historical Atlas of Poland 2.0 – over 140 years of joint work of historians and cartographers. [online] 2021. Available online: https://atlas.icaci.org/wp-content/uploads/2021_icc_slomska_historical_atlas_of_poland_abstract.pdf

³⁰ VAVRINEC, Žeňuch. A Munkácsi Eparchia 1775-ben készített sematizmusa / Schematizmus Mukačevskej diecézy z roku 1775. Nyíregyháza 2022.

³¹ KOHÚTOVÁ, Mária. K hodnote daňových súpisov z rokov 1715, 1720 a ich údajom o počte obyvateľstva. In *Historický časopis*, 1984, vol. 32, no. 1, p. 83-100; KOHÚTOVÁ, Mária. Štatistiky obyvateľstva v Uhorsku v 18. storočí. [online], 2016. Available online: <http://www.infostat.sk/vdc/pdf/doc/kohutova.pdf> TIŠLIAR, Pavol – ŠPROCHA, Branislav. Premeny vybraných charakteristik obyvateľstva Slovenska v 18. – 1. pol. 20. storočia. Bratislava 2017, 167 pp.

³² ČÉPLÖ, Slavomir et al. Historický atlas obyvateľstva Slovenska. (18. - 1. pol. 20. storočia). Bratislava 2017, 250 pp.
ČÉPLÖ, Slavomir et al. Vybrané populačné štruktúry na Slovensku (18. - 1. pol. 20. storočia). Bratislava 2016, 3305 pp.

by Žudel,³³ but still, most GIS-aided studies (like of Tišliar and Šprocha) focus on the territory of Slovakia and limit their timescale to late 19th or early 20th c.³⁴

By tracing the historical origins of present inequalities and analysing the location and features of backward areas as well as their shift in time, historical research of this kind can reveal path dependency, thus contribute to present territorial planning³⁵ and can evaluate political systems in the past from a different perspective, by focusing on the spatial dimension of inequalities instead of the more common approach targeting income levels or social differentiation. In short, the Williamson-hypothesis³⁶ can be tested in extended timescale (back in the historical past).

So the key questions we investigate are:

- how can administrative changes and *data harmonization* of eight countries be handled in case of fine-scale investigations and comparing several time-sections;
- *which indicators* are adequate to assess the long-run levels of development in case of changing variable structure (due to the temporal differences in available historical sources) and lacking fine-resolution historical GDP-data;
- what *patterns* of regional development are observable in the long run in the Kingdom of Hungary: where were the main core and peripheral areas located, and how did their location change throughout the centuries?
- what *trends* of regional development are observable in the long run in the Kingdom of Hungary; under which political regime can we observe the deepening of inequalities and how can it be measured; can the Williamson-hypothesis be applied on long-durée historical datasets?

Variables derived from the available historical sources that may have relevance in explaining development are listed in Table 1.

In order to compare the development levels of the settlements for the three time-sections, the above mentioned sets of indicators were converted into a composite indicator reflecting overall development for each period (lacking municipal GDP data). Since in our case there are hardly any overlaps between the variables of the 1330s, 1786 and the 1910 datasets (whereas there is a great overlap between variables for 1910 and 2010, though the explanatory power of single indicators in explaining overall development level changed substantially), the use of the matching-persisting variables would have resulted in a massive loss of information. Therefore, we decided to focus on methodological consistency by

³³ ŽUDEL, Juraj. Obyvateľstvo slobodných kráľovských miest na Slovensku v 2. polovici 18. storočia. In *Geografický časopis*, 1987, vol. 39, no. 2, pp. 148–168; KOLLAI, István: Patterns of Vernacular Conflicts in Medieval And Early-Modern Towns Of Historical Upper Hungary. In *Studia Historica Nitriensia*, 2022, vol. 26, no. 2, pp. 305–322.

³⁴ TIŠLIAR, Pavol – ŠPROCHA, Branislav. Zaznávaný a nepoznaný Cenzus 1919 či len kuriozita? In *Historický časopis*, 2015, vol. 63, no. 2, pp. 253–274; TIŠLIAR, Pavol – ŠPROCHA, Branislav. Malé dejiny veľkých akcií: sčítanie ľudu z roku 1919. In *Studia Historica Nitriensia*, 2021, vol. 25, no. 1, pp. 113–130; TIŠLIAR, Pavol – ŠPROCHA, Branislav. Sťahovanie obyvateľstva vo výsledkoch sčítaní ľudu 1921 a 1930 na Slovensku. In *Studia Historica Nitriensia*, 2024, vol. 28, no. 1, pp. 21–43; PRŮCHA, Václav et al. Hospodárske dejiny Československa v 19. a 20. storočí. Bratislava, 1974; SRB, Vladimír. Obyvateľstvo Slovenska 1918–1938. Bratislava 2002, 28 pp.

³⁵ ACEMOGLU, Daron – ROBINSON, James. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. New York 2012, 544 pp.

³⁶ WILLIAMSON, Jeffrey, G. Regional inequality and the process of national development: a description of the patterns. In *Economic Development and Cultural Change*, 1965, vol. 13, no. 4, pp. 3–84.

1330	1720	1780s	1910 (and 1880)	2010
• paid tithe, categorised; • number of parishes; • markets, fairs, tolls; • presence of fiscal administration; • presence of church hierarchy; • place of authentication, categorised; • number of mendicant friaries; • number of Pauline monasteries; • urban privilege received before 1340; • correction index (when there was more than one parish church in a settlement and the cumulated sum of the tithe exceeded 20 grossi)	• ratio of tenants (<i>colonus</i>); • ratio of lodgers (<i>inquilinus</i>); • ratio of burghers and freemen (<i>civilis, libertinus</i>); • area of ploughland per peasant; • area of meadow per peasant; • change in the ratio of tenants up to 1786 • grain production • technological level of cultivation (field system) (not visualised here)¹	• soil quality, • schools and priests; • ratio of tenants; • ratio of the poor living in other's house (<i>subinquilinus</i>); • area of vineyard per peasant; • area of ploughland per tenant; • number of days of corvée (<i>angaria</i>) per peasant; • total sum of taxes per peasant; • ratio of strangers (<i>extraneus</i>) compared to the conscripted; • ratio of the absent compared to the conscripted; • number of families per house; • closeness to market; • ratio of the burghers compared to the number of families; • value of services in kind per peasant	• selected from 48 original variables using PCA; • average rate of infant mortality in 1901-1910 measured to total death, %; • non-earners measured to 100 earners in 1910*; • share of industrial earners to all earners in 1910, %*; • net cadastral income per capita in 1910-ben, Kronen*; • settlement income per capita in Kronen in 1908*; • state direct tax per capita per one person in 1909*; * available for 1880 too	• selected from 12 variables reconstructed for the 8 successor state of the Kingdom of Hungary using PCA; • average migration rate in 2001-2011 measured to 1000 prs; • average death rate in 2001-2011 measured to 1000 prs; • share of population with maximum elementary school measured to the population above 7 yrs, %; • share of population with degree measured to total population, %; • registered unemployed from all inhabitants in 2010, %; • gross income per capita in 2010 calculated in Ft²

Table 1: Indicators derived from historical sources and used in the composite development indices in the different periods³

¹ Situation in 1720 is analyzed by DEMETER, Gábor – HORBULÁK, Zsolt. Demografický obraz Uhorska v 18. storočí na základe súpisu duší z rokov 1715 a 1720. In Historická demográfie, 2025, vol. 49, no. 1. pp. 25-57.

² The situation in 2010 was analyzed by DEMETER, Gábor. Estimating regional inequalities in the Carpathian Basin – Historical origins and recent outcomes (1880–2010). In Regional Statistics, 2020, vol. 10, no. 1, pp. 23-59.

³ See sources above in introduction.

applying Principal Component Analysis (PCA) for each time section to reduce the numbers of interdependent indicators.³⁷

After this the values of the chosen indicators were normalised,³⁸ and then a composite index of development (CDI) was created by aggregating the normalised values of the single variables selected by PCA. This procedure was repeated for all time sections.³⁹

Historical Hungary certainly had a huge advantage in providing a unified statistical framework, while in 2010 its territory was divided between eight countries. However, the numerous administrative changes between 1330 (4400 parishes) and 1910 (12500 settlements) made a direct comparison of the different time-sections virtually impossible. In order to make our snapshots from different time sections comparable (to overcome the obstacles caused by the superposition of two different administrative divisions) we decided to fit a uniform grid network on administrative boundaries.⁴⁰

The 5×5 km size of grid cells was calculated based on the optimization method developed by Netrdová et al.⁴¹ Thus we had more than 11,000 cells very similar to the real number of administrative entities in 1780-1910. However, such a good resolution was not applicable for the 1330s due to missing data, therefore when comparing the development map for the 1330s with the 1780s we used a 10×10 km grid cell resolution. This reduced the number of cell entities to 4000, which was very similar to the number of medieval parishes.⁴²

³⁷ PCA allows the systematic narrowing of correlating variables, at the same time maintaining the variance of the original database. Instead of using the factor score values of the first or all derived principal components for further processing, we have selected a one-one indicator from each group that showed the greatest correlation with the derived components. For the reliability of PCA, KMO and variance values were used. PCA results for 1786: KMO = 0,71, total variance explained: 77%, 14 variables grouped into 6 components. PCA results for 1910: KMO = 0,65, variance explained: 74%, Nr. of factors = 3. PCA results for 2010: KMO = 0,64, variance explained: 61%. Nr. of factors = 3.

Finally, we omitted natural population increase/decrease, which in our opinion is an ambivalent indicator of spatial development. (Population growth shows strong correlation with welfare only until 1900 in Hungary, after this a "random walk" process occurs. FÖLDVÁRI, Péter. A magyarországi demográfiai átmenet nemlineáris időszerelemzése. In *Demográfia*, 2008, vol. 51, no. 2-3, pp. 244-258.)

³⁸ Rescaled between 0 and 1. The ranking was reversed for the ratio of the poor living in other's house, ratio of the absent compared to the conscripted, extent of corvée and value of in-kind services per peasant in case of the 18th c. investigations, mortality rates in the case of 1910, etc.

³⁹ Temporal comparison of the maps illustrate aggregated development levels of municipalities. The problem of changing administrative boundaries was solved using a weighted grid network.

⁴⁰ JAKOBI, Ákos. A grid: aggregált és dezaggregált rácsmodellek a területi egyenlőtlenségek vizsgálatában. In *Területi Statisztika*, 2015, vol. 55, no. 4, p. 322-338. Another important feature of the grid models is that, due to their raster nature, raster analysis techniques can be performed, while they retain their vector data storage format.

The problem of temporal comparison of maps can be overcome, in a different way too, if e.g. 1910 administrative boundaries are projected back in the past and applied for all time-sections (this requires the aggregation of detached settlements).

⁴¹ NETRDOVÁ, Pavlina – NOSEK, Vojtěch – HURBÁNEK, Pavol. Using Areal Interpolation to Deal with Differing Regional Structures in International Research. In *International Journal of Geo-Information*, 2020, vol. 9, no. 126, pp. 1-14.

⁴² One methodological problem with gridding techniques has to be mentioned, that certain distortions can appear here too. If the administrative territory of a settlement is too large, for example, containing many grid cells (Debrecen, Szeged, Subotica), the development of their peripheral villages is indicated higher than in reality, as the core city's values are extrapolated to them.

To perform the composite development maps for the different time sections, the CDI values of the 5x5 km cells were ranked in deciles from 1 (best 10%) to 10 (lowest 10%) for each time section and visualized using a continuous cold-hot scale. These rankings also served as basic values for the overlay maps used for temporal comparisons: the dynamism of changes was illustrated by subtracting the decile values of each cell of the two comparable maps.⁴³

However, composite development does not reflect on the strengths and weaknesses – even a settlement with low composite development value might have outstanding values regarding one or two indicators. Furthermore, the concept of development itself also changes in time: the mercantilist idea considered the equation: more people = more money as valid, however, by the end of the 18th c. physiocrats put emphasis on more land = more production = more money, since they recognized that ‘many people with small parcels’ (overpopulation, demographic pressure) is an unfavourable outcome. On the other hand, we expect that our composite indicators illustrating more than one aspect of welfare are still better than GDP, which is one-dimensional, focuses on the economic aspect only, does not allow fine-resolution reconstructions (thus tracing internal inequalities), and it cannot be calculated for the past. To substitute GDP, we decided to rely on proxy indicators to economic welfare, like agrarian tax (agrarian production) / area (available both for the Middle Ages and the 16-17th centuries), representing the purely economic aspects. These were accompanied by several other indicators representing education, health, etc. It is also important to note that having the same set of variables for each time section is not a necessity, since the weight of factors explaining development might change over time (see e.g. literacy, gradually losing its significance between 1880 and 1950). Before analyzing the picture obtained from the composite indicator, some of the single indicators are also shown here on maps, to illustrate the different patterns (like agrarian output, population increase, health care, distance from railways – Appendix 1). The different pattern indicates that indicators do correlate with each other (see Appendix 3 too).

3. Discussion

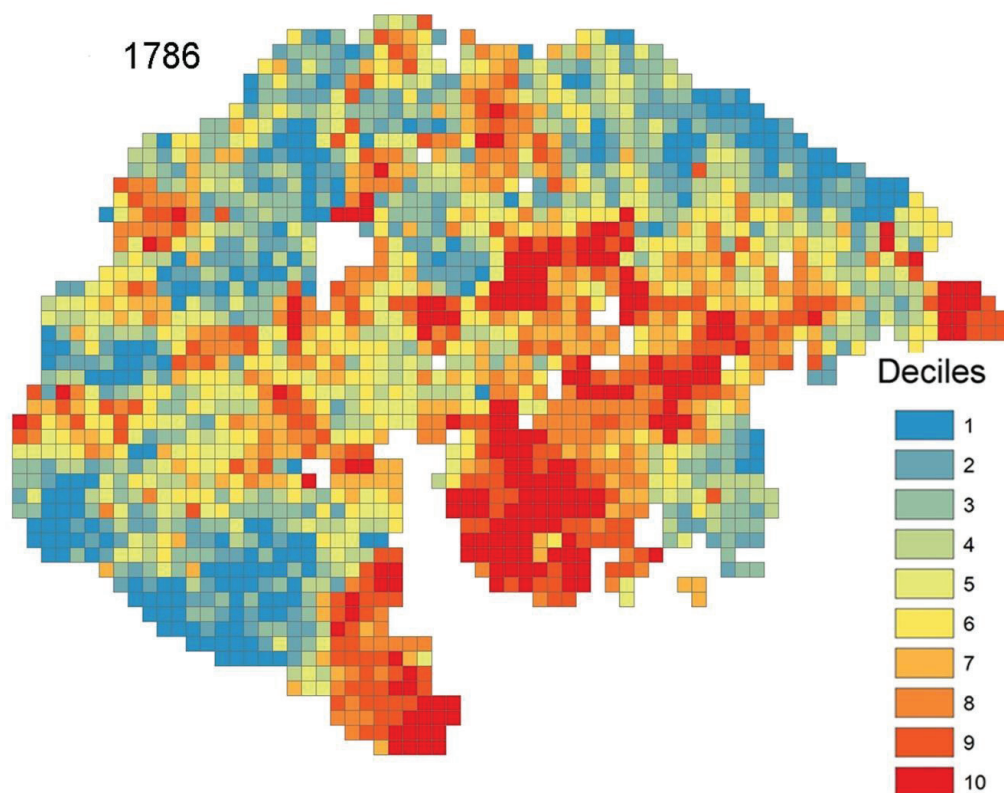
3.1 *Patterns of development after the expulsion of the Ottomans (late 18th c.)*

The Composite Development Index (CDI) for 1786 was created using twelve variables referring to socio-economic and demographic features of the agrarian class (Map 1). (Data were not available for Transylvania). According to the results, surprisingly, just hundred years after the expulsion of the Ottomans the long-harassed Great Plains seemed to be the most developed compared to the north-western areas, that were falling back (apart from the Danube-axis around Bratislava and the ore mining towns in the North, which were prosperous and developed) though these were not harassed by the Ottomans in the seventeenth century! But, since this latter north-western stripe served as a refuge area for the population, it became overloaded and crowded by 1700. This was accompanied by low soil quality and small parcels.⁴⁴ On the other hand, the relatively empty plains offered greater

⁴³ As rescaled CDI values range from 1 to 10, the maps illustrating the differences between two time sections show values between -9 and +9. Decile values thus represent relative (change) in development: a settlement may improve its development levels, but at the same time it can fall back in the ranking!

⁴⁴ DEMETER, Gábor. Területi egyenlőtlenségek a történeti Magyarország területén a reformkor előtt (1773 – 1796). In *Magyar Gazdaságtörténeti Évkönyv*, 2022, vol. 6, pp. 143-188.

parcels and better soils (not to mention tax exemptions), attracting the population from the North (and from abroad) after the expulsion of Ottomans in 1699.



Map 1. Composite development (agrarian) level of settlements 100 years after the expulsion of Ottomans (1780s) based on 12 variables (table 1), reclassified into deciles, calculated at 10×10 km grid cells. Red colour indicates higher development, blue colour represents backward areas.

Source: author's own edition

Focusing on the area of future Slovakia, the ore-mining central, mountainous parts, furthermore Spiš and Orava in the north beside Bazin, Modor, Szentgyörgy around Bratislava were the most developed (as compared to the entire kingdom). Eastern Slovakia (Zemplín, Šariš) and the valley of the Hron and Váh were underdeveloped.

3.2 Measuring regional development in the Middle Ages – creating grid-map for entities with no exact boundaries

The above example illustrates a situation with good data supply and explicit (traceable) administrative boundaries, which enabled us to perform gridding without resulting in many “empty spaces”. But can we extend the time horizon of our investigation, if settlement boundaries are unknown or unconsolidated, or the settlement density is much smaller? The question is not purely of methodological character, but has practical significance too, as it may help solve some of the historical problems of the region. Namely, it would allow the comparison of socio-economic-demographic situations before and after the Ottoman era. The Ottoman conquest (1541-1699) had a deep impact on the settlement structure

and development of the Hungarian Kingdom, but yet no country-scale and at the same time fine-resolution investigation quantified these changes. To execute such an investigation three problems have to cope with:

- (1) is there a historical source that can help reproduce the settlement structure of the country for the pre-Ottoman era?
- (2) does any of the medieval sources provide quantifiable data series to identify centres and peripheries, and
- (3) how can the lack of definite settlement boundaries be handled to make a pre-Ottoman map comparable with a post-Ottoman map? The simple gridding of points (identified medieval settlements) would result in numerous empty grid cells, thus subtracting the two maps (the pre- and post-Ottoman) would also inherit this unfavourable feature.

For the entire Kingdom of Hungary, the only more or less comprehensive source of the medieval settlement network is the papal tithe list set up between 1332 and 1337. Supplemented with additional parish registers from the same period, like the parish register of the Zagreb Diocese from 1334⁴⁵ we are able to reconstruct 97 per cent of the parish network of the era comprising altogether 4417 parishes in 4049 localizable settlements, while 187 parishes (c. 4 percent) remained unidentified.

This dataset offered a unique possibility to investigate regional differences of the Carpathian Basin in medieval times. Furthermore, the results may be comparable with other European kingdoms of the time, especially with England and France where similar lists subsist from the late-thirteenth and early-fourteenth century.⁴⁶ Thus, the place and weight of the Hungarian kingdom in fourteenth-century Europe can be better assessed.

The economic capacity of the settlements could not be estimated in any other way as tax registers covering the whole kingdom hardly survived, and their interpretation is often problematic. The royal tax levied on the peasant hides did not depend on the plots' income, the paid sum was equal all over the kingdom. Contrary to this, both the tithe and the papal tithe were levied proportionally (10 per cent of the income), therefore the papal tithe list is a better source for our purposes – measuring differences in production (development) (Map 2). As the taxable goods were grain and wine (husbandry is not included!), this tax mainly represents the volume of agrarian production, therefore the CDI calculated for the fourteenth century had to be calibrated further by using additional indicators e.g., the presence of higher administrative and economic functions, of mendicant friaries etc.⁴⁷ Nonetheless, since in pre-modern times the primary sector was predominant in the economy, and CDI is based dominantly on agricultural data even in the eighteenth century too (Table 1), the results from the pre- and post-Ottoman era are comparable and thus long-term changes are detectable.

⁴⁵ ROMHÁNYI F., Beatrix. Plébániák és adóporták – a Magyar Királyság változásai a 13. – 14. század fordulóján. In *Századok*, 2022, vol. 156, no. 5, pp. 907-939.

⁴⁶ KÜMIN, Beat. The English Parish in a European Perspective. In FRENCH, K. et al. *The Parish in English Life 1400–1600*, Manchester 1997, pp. 15-32; POUNDS, Norman J. G. *A History of the English Parish: The Culture of Religion from Augustine to Victoria*. Cambridge 2000. 593 pp.; LOT, Ferdinand. *L'état des paroisses et des feux de 1328*. In *Bibliothèque de l'École des chartes*, 1929, vol. 90, pp. 51-107. pp. 256-315.

⁴⁷ However, these are not measured on a continuous scale, just as existing or non-existing (0-1 values).

The 400 years between the 14th and 18th c. snapshots is quite large. Illustration of patterns before and after the Ottoman conquest is therefore limited due to social and structural changes and the differences in the conscription methods. Research is in progress to introduce new time sections for 1500 and for 1570s. An atlas to study Medieval Hungary has just been published containing hundreds of maps to illustrate socio-economic phenomena.⁴⁸ The processing of Ottoman tax conscriptions will be finished by 2029.⁴⁹ The nature of taxation is very similar to that of the 1330s – both are proportional taxes, measuring agrarian output. Thus we are able to calculate output/area both for the 14th and 16th c. after adjusting Ottoman currency to denarius. This allows us to connect late Medieval and Ottoman data and trace changes in patterns. However, as the Ottoman database is still under construction, therefore our reconstruction on tax burdens and agrarian outputs are limited here now to some counties (see data in Table 2), showing tax burdens / area and agrarian output before and during the Ottoman rule.⁵⁰

Medieval county	Medieval parishes (1330s)	Total tithe in 1330 (den.)	Tithe/ parish area (1330)	War subsidy / area (similar to the tithe, 10% in 1495)	Supposed value of ninth (<i>nona</i>) / area (1495)	Total tax / area in 1495 (=30% of production)	Total grain + wine production in <i>denarius</i> per area in 1495	Pre-Ottoman tax/area without <i>decima</i> to church (tithe) in denarius ⁵¹	Tax/ area in the 1570s (at 1:1 akçe: denarius rate) ⁵²	Tax/ area value in 1579 calculated by 1:1.66 akçe: denarius rate (data given in denarius)
Baranya	203	10857.3	304	262.6	300	866.6	2888	566.6	711.3	1180
Somogy	243	9360.6	236	173.7	230	639.7	2132	409.7	430.1	713
Tolna	144	4666.3	166	220.4	170	556.4	1854	386.4	712	1181
Pozsega	67	2261.3	187	188.5	190	565.5	1885	375.5	558.1	926

Table 2. The size and types of taxes in four counties of South Transdanubia and Slavonia before the Ottoman period and at the beginning of the Ottoman conquest.

Data comparable are indicated the same. 1 Florin = 100 denarius

The comparability of visualised data, however, was challenged by the fact that the fourteenth-century parish boundaries are unknown, and for the comparison with the post-Ottoman period they needed to be substituted somehow. To overcome this obstacle and to approximate missing settlement boundaries for the fourteenth century, geometrically

⁴⁸ F. ROMHÁNYI, Beatrix. *Kisatlasz a középkori Magyar Királyság történeti földrajzának tanulmányozásához* (11–16. század) – A Historical Geographical Atlas of the Medieval Kingdom of Hungary (11th – 16th century). Budapest 2024, 176 pp.

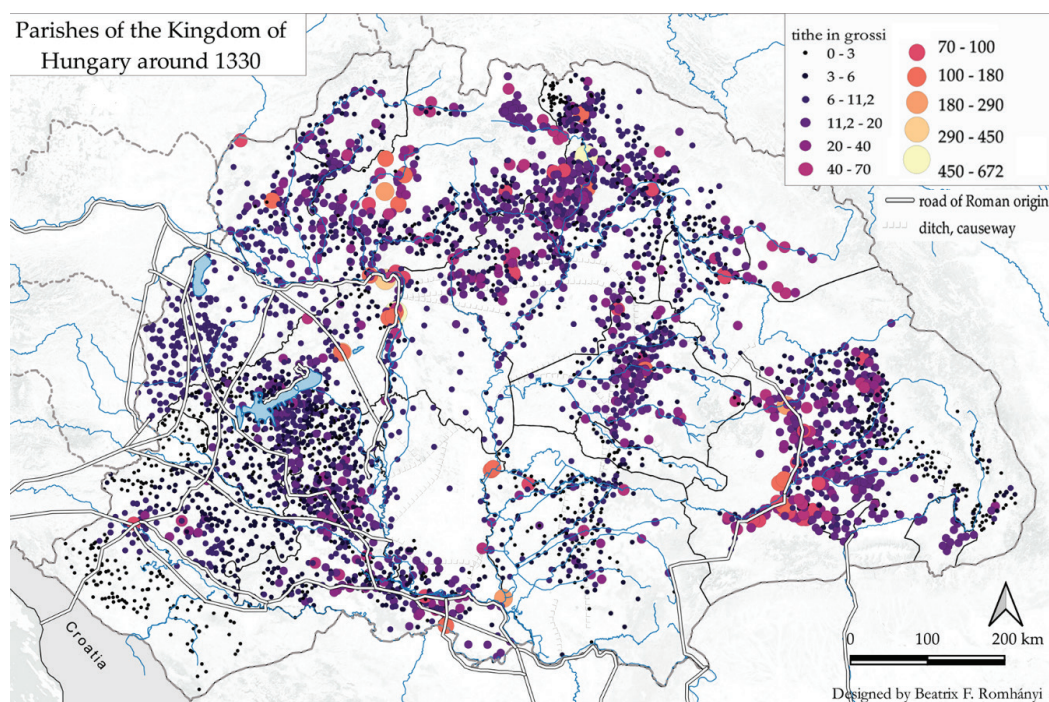
⁴⁹ See atlas at: <https://mnl.gov.hu/mnl/ol/terkepek>

⁵⁰ For comparison we abandoned Ottoman territorial units, reconstruction was made for medieval counties.

⁵¹ Calculated value for comparative purposes, as Ottomans did not collect it and local people abandoning Roman Catholic faith (90% of Hungary) also did not pay that.

⁵² Taxation rate cannot be higher than 25%, thus agrarian output can be estimated.

calculated (Voronoi) polygons were calculated for the whole territory (Map 3). These polygons are created based on equal distance from the parish centers and using the well-known boundaries of the dioceses (a higher hierarchic level above the level of parishes).⁵³ Tithe per parish area was also recalculated using these Voronoi-polygons as supposed boundaries of the parishes for 1330 (Map 2b), thus we were able to obtain data similar to the 18th-19th c. “income/hectare”-type data. This is a great step forward to approximate output/unit- type variables (like GDP/capita): since data on population is missing from the 14th c., we are unable to calculate output/capita or output/economic unit. (The number of *porta* is available for the entire area of the country only from a later period, 1494, but the tax-system changed by then, therefore we cannot merge the two datasets on papal tithe and *porta* numbers). So, output/area remains the only solution for the 14th c. to measure economic intensity, and since tithe is a proportional tax on agrarian production, we can estimate the pattern of regional differences in agrarian intensity.

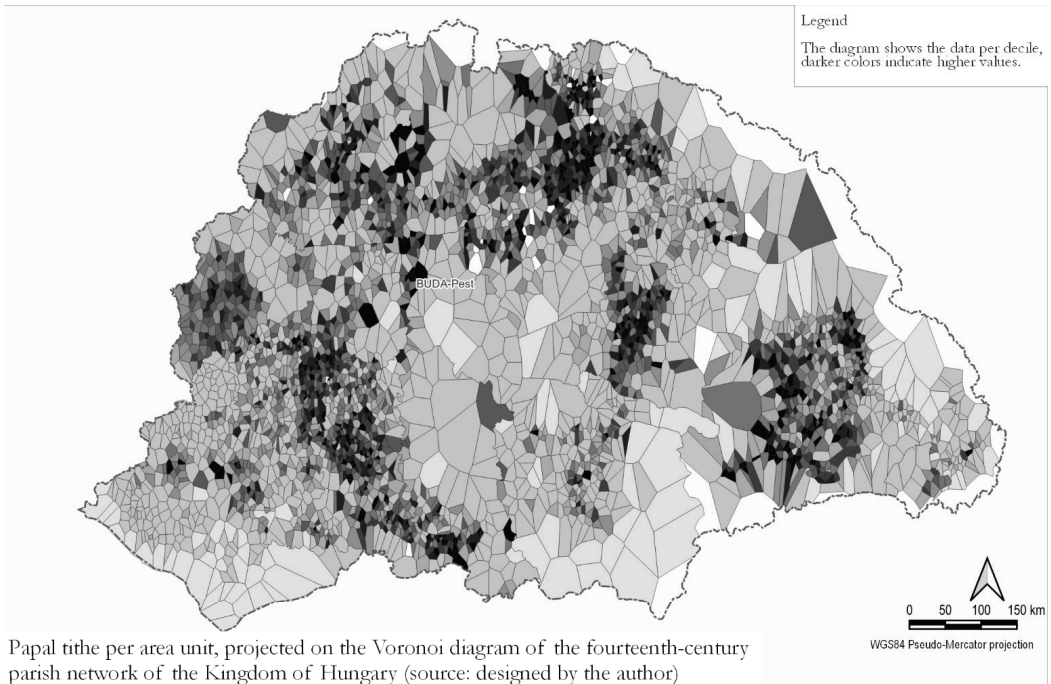


Map 2a. The location of identified parishes and the tithe paid around 1330.

Source: author's own edition based on literature in footnote 9.

The generated tithe/area map indicates a better situation for Western Transdanubia and Southern Slovakia as compared to the map based on absolute, not-weighted tithe/parish values (Map 2a, 2b), while the Danube-axis performs a bit weaker. This means that settlements (parishes) with smaller administrative areas were not necessarily poorer in the Medieval Ages, than settlements with greater area. This would change dramatically after the Ottoman era. For example, Northwestern Slovakia or Burgenland performed better based on this indicator in 1330 as it did in the 18th c. after the Ottoman wars, or even in 1910

⁵³ Cells along the kingdom's border need to be handled with caution as these regions were very sparsely populated.

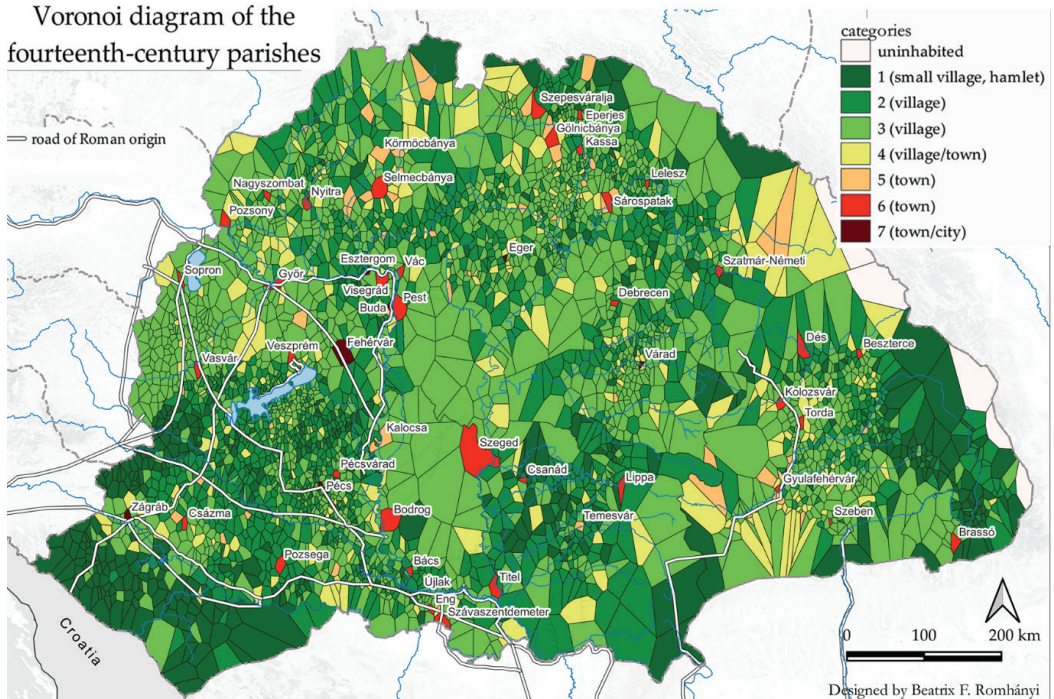


Papal tithe per area unit, projected on the Voronoi diagram of the fourteenth-century parish network of the Kingdom of Hungary (source: designed by the author)

Map 2b. Tithe per parish values in 1330 – weighted by the supposed area of the parish (Voronoi polygons used to substitute unknown administrative boundaries).

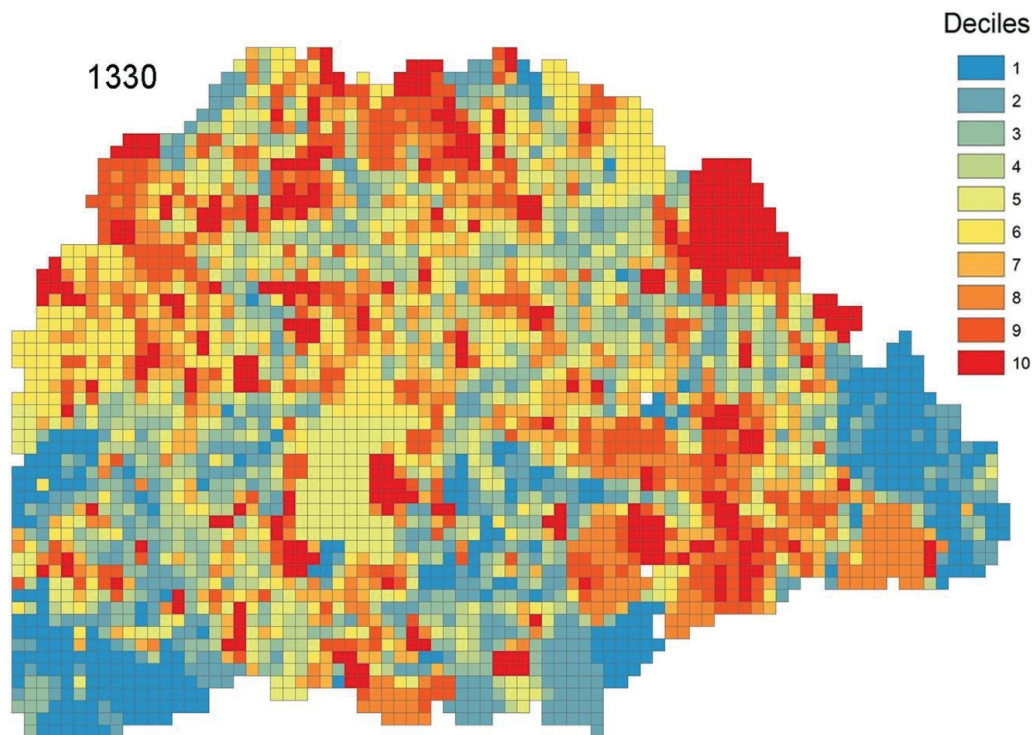
Source: author's own edition based on literature in footnote 9.

Voronoi diagram of the fourteenth-century parishes



Map 3. Hierarchic rankings of parishes according to the indicators given in table 1. (Voronoi polygons were used to substitute unknown administrative boundaries of the identified parishes).

Source: author's own edition based on variables in table 1 and literature in footnote 9.



Map 4. Patterns of deciles of the development indicator around 1330 calculated to 10×10 km grid network, based on the Voronoi polygons replacing the unknown parish and settlement boundaries.
Source: author's own edition based on sources in footnote 9.

(based on direct tax/hectare or agrarian income/hectare or composite indicators created from indicators recorded in table 1).

Aggregating other indicators to the tithe/area we created a Composite Development Index for medieval times too. Map 4. confirm that mining had a key role in producing (central) incomes in medieval times. Maramureş (salt), Southern Transylvania, Central Slovakian towns (ores), Börzsöny Mts. were among the most developed regions based on CDI together with other territories where development was determined by other sectors: Sopron-Ödenburg and Srijem (wine), Buda-Visegrád-Esztergom, Kalocsa, Szeged, Eger, Oradea/Nagyvárad (central functions) and Debrecen towns, Saxon Lands in Transylvania (economic productivity), Danube-axis between Bratislava/Pozsony and Buda (trade and commerce). The Szeklerland, the southern Plains and southern Transdanubia were lagging behind (however the old Roman routes along the Drava were still flourishing). To understand the situation of these backward regions one should add among the possible explanations, that the southern plains were devastated the most by the Mongol invasion of 1241 and probably could not recover; that the income from husbandry is not included in the tax values used up in our investigation, while it is well known – as the inscription on the map of Lazarus clearly indicates – that the southern plains, the Danube-Tisza Interfluvium were focusing on husbandry even before the Ottoman attack and not on grain production. Neither climatic explanations – the effect of Little Ice Age on precipitation and ground water levels in the plains – can be neglected. Considering CDI decile values

(multidimensional approach to development), the southern flow of Hron and Váh (the homeland of Matúš Čák) were more developed in the 1330s compared to the picture in the 1780s! (It was in favourable also in 2010: it seems that decentralized, multipolar systems – that is the age of oligarchs in the 14th c., and the establishment of new states on the ruins of the Kingdom of Hungary after 1920 – show similar patterns for Slovakia despite the 700 years difference). Southern Slovakia in the 1330s was less developed compared to 1910 concerning its CDI decile values (however by 2010 it fell back to the 1330 levels regarding decile values). Central Slovakia in 1330 was among the leading regions, what is more interesting it managed to maintain its relative position in the 1780s, despite the decreasing significance of gold and silver production (copper substituted these by the 16th c., see the activity of Thurzó family). Westernmost Slovakia was also developed both in the 1330s and in the 1780s, whereas the northwestern parts remained backward in the 1330s, in the 1780s – and even in 1910.

3.3 The analysis of regional development patterns in 1910

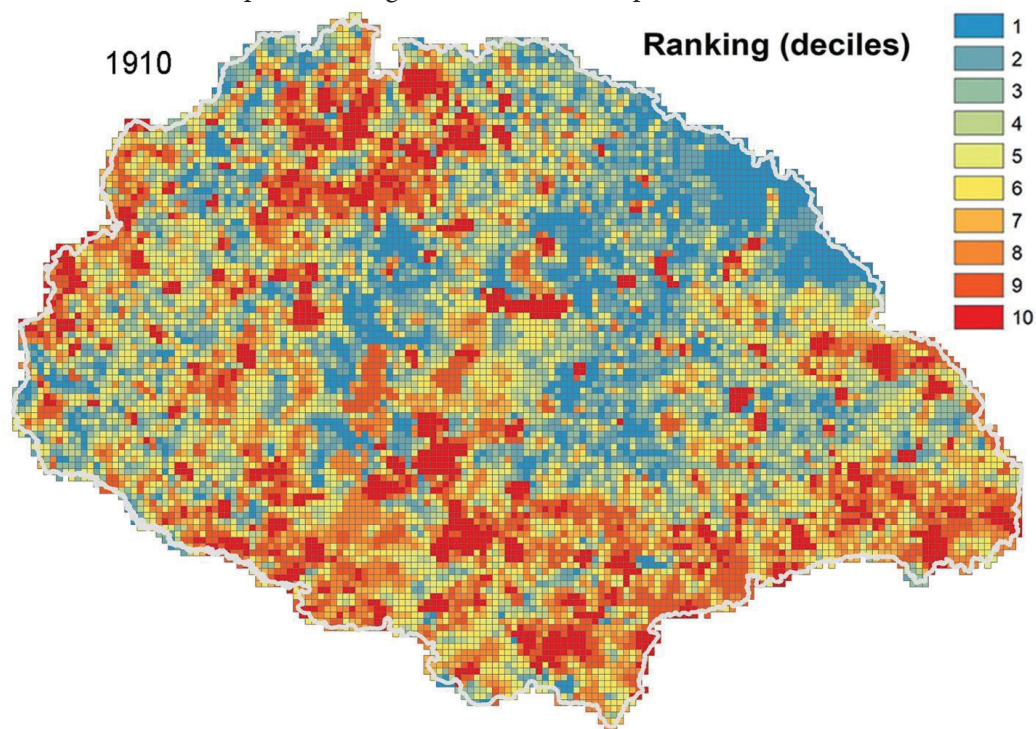
Though GDP/capita grew in Hungary quickly between 1870 and 1910 (according to Schulze's data), this manifested in uneven regional development rates. Despite increasing literacy, infrastructural development and the growth of industrial tax revenues relative to agricultural incomes, stagnating and declining per capita agricultural outputs point to a social and structural crisis, a lack of intensification that could cope with the high population increase rate. The share of smallholders forced to work as day labourer grew, while the share of non-agricultural wage earners increased by only five percentage points between 1900 and 1910 (Table 3), so declassed peasants could not be restratified into higher value-added sectors such as industry or trade. However, as a consequence of the natural development of the capitalist economy, regional disparities regarding per capita income and wealth, distance from the railways and literacy rates, had fallen by 1910, after an initial increase.

	Net cadastral income per acre in Kronen (K)	Net cadastral income per capita in K	Utilized land per capita (acre)	Distance from nearest railway station (km)	Share of literate persons (1 = 100%)	Workers in household industry per 100 prs
average, 1910	6.26	16.64	3.38	8.59	0.51	0.33
average, 1880	6.00	19.69	4.31	25.00	0.30	0.31
average, 1865	5.80	17.20	4.10	65.53	n.a	n.a

	State direct tax per capita (K)	Settlement wealth per capita (K)	Settlement income per capita (K)	State direct tax, measured to net cadastral income	Smallholders working as daily labourers (1 = 100%)	Share of non-agrarian earners (1 = 100%)
average, 1910	12.91	29.67	6.22	1.05	0.65	0.21
average, 1880	6.38	13.15	1.36	0.42	0.27	0.17

Table 3. The changes in the value of some development indicators.

Due to the mentioned uneven regional development, spatial pattern of the Composite Development Index (CDI) obtained for 1910 (Map 5, table 1) shows a mosaic spatial structure, with urbanized zones in focus of the developed areas. Besides these, the historical Spiš County and the northern mining towns in today's Slovakia were outstandingly developed, and the stripe ranging from Levice/Léva to Rožňava/Rozsnyó represented another developed region. Another axis of developed settlements stretched from Braşov through the Transylvanian Saxon territories to Banat's ore and coal mines. This region is divided from the northern axis by the underdeveloped Transcarpathia and Maramureş regions. The almost contiguous Nyírség-Szatmár-Bihar (Satu Mare – Bihor) area conspicuously separate the more mosaic-like Inner Transylvanian areas from the developed areas of the Hungarian Great Plains. From the Mátra Mountains region to Bačka (or to Szeged), there is a significant underdeveloped zone (of which only major towns stand out), which blends into the developed zone of South Transdanubia. In the neighbourhood of the undeveloped SW-Transdanubia, the area of Burgenland showed patterns of development. Instead of the East-West or North-South slope, so characteristic in present Hungarian geographical literature, in 1910 a concentric pattern along the Bratislava-Budapest-Debrecen axis was observable.



*Map 5. Patterns of deciles of the complex development indicator in 1910 calculated to 5×5 km grid network. Red colour indicates higher development, blue colour represents backward areas.
Source: authors' own edition based on literature in footnote 1-2.*

As for the Slovak regions, Central Slovakia maintained its relatively good (above country average) position in 1910 too, as well as the westernmost edge around Bratislava and the Spiš region. Industrialization played a key role in maintaining their position, since the agro-economic potential of these regions did not improve as it did so on the plains. However, industrialization in 1910 was not able to create continuous zones of development, its

effect was measurable only in the cores. Practically this means that these industrial centres were able to attract population and raw material, but had yet little emitting effect on their surroundings. Furthermore, the industry was in the phase of territorial concentration, many small industrial enterprises disappeared as seen on maps published in our previous study.⁵⁴ The southern valley of the Hron and Váh lost their significance, whereas the areas around the Nové Zámky/Érsekújvár – Košice/Kassa line gained importance (partly because of the transversal railway line).

Much has been discussed about the reasons of the situation above, thus we do not go into details, since we put emphasis on tracing changes (trends) and patterns in this study.

3.4 Longue durée comparison of medieval, post-Ottoman and late nineteenth-century development patterns

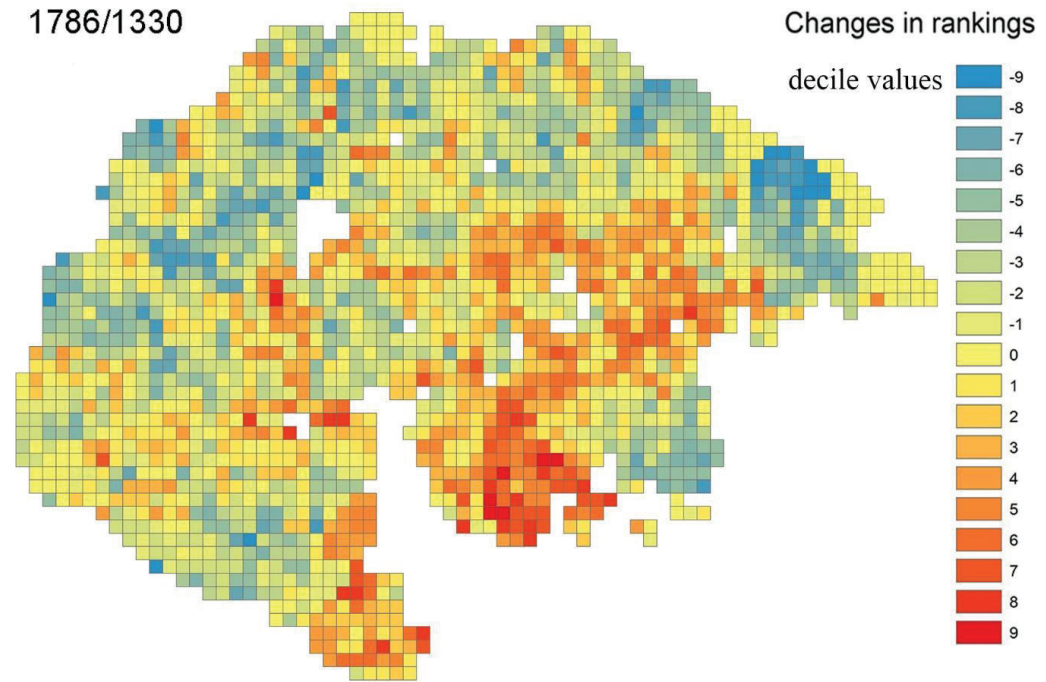
In order to illustrate changes caused by the Ottoman period and the subsequent reconstruction, the grid cell maps created for 1330 and 1786 were compared using the CDI values ranked in deciles. Though we have data for 1720 too, to illustrate the patterns of inequalities just prior to the reconstruction of the country, the data from the 1780s are more diverse and fit the modern concept of development better. 1330 might be far from the Ottoman era, but, as we mentioned, we do not have proportional tax covering the whole country that could represent differences in production/development levels for the 15th c. – only head taxes are available. The processing of Ottoman taxation is in progress, but since it is not finished yet,⁵⁵ therefore 1330 and 1786 were used to symbolize pre-Ottoman acme and post-Ottoman reconstruction. (First outputs for the tithe tax – as proxy for agrarian production – per capita can be seen in Appendix 2)

To execute this comparison a 10×10 km grid was created from the Voronoi polygons shown previously (and not from settlement-points), as finer resolution was not applicable for the situation in the 1330s due to the empty cell values (missing data) (Map 1, and Map 4). The difference of the map from 1330 and 1780s, illustrating the changes of these four hundred years, was created with the same resolution (Map 6).

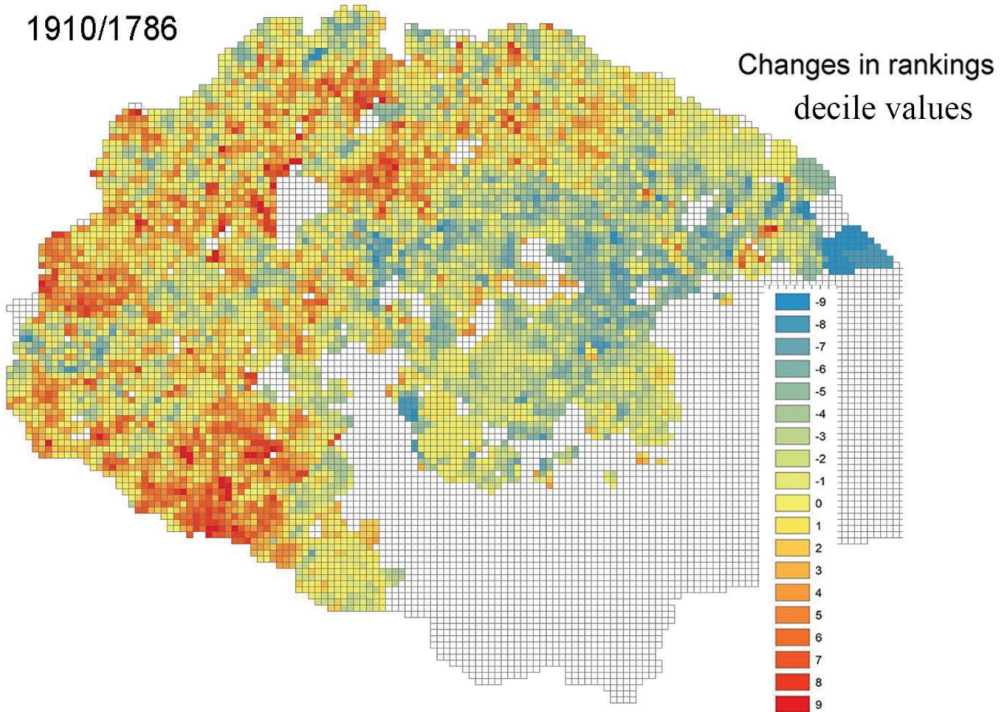
The pattern of changes suggests that areas ruined by the Ottomans recovered quicker, while those territories where the original settlement structure persisted (small villages with 500 inhabitants and an administrative area of 4-5 km radius) – and financed the wars against the Ottomans for 150 years through their high taxes – stagnated, while they also served as a refuge area with increasing demographic pressure on low quality soils and spall peasant plots. In the center of the country where the original settlement network was destroyed by the Ottomans in the Great Plains, brand new structures of cooperation emerged ('tanya'-farms, husbandry, townlets of 5-10,000 people) during the Ottoman occupation, which proved to be competitive. In other words, in this case "tabula rasa" offered better chances for economic growth than the survival of old structures. This puts the adaptivity of local people and Ottoman conquest into a different light at least from economic aspect, whereas it is also a good example of path dependency, i.e., when existing structures hinder further development.

⁵⁴ DEMETER, Gábor – HORBULÁK, Zsolt. Regional socio-economic inequalities before and after the collapse of the Hungarian Kingdom: modernization, "magyarization" and economic exploitation from a different perspective. In *Historicky časopis*, 2021, vol. 69, no. 5, pp. 889-919.

⁵⁵ The third stage of processing *tapu defters* begins in 2025 and ends in 2029 thanks to a new application won in December 2024 by Éva Sz. Simon.



Map 6. Difference of development levels measured in 1786 and 1330 based on decile values at 10×10 km grid size. Red colour indicates catching up, blue colour represents regions falling back.
Source: author's own edition based on literature given in footnote 3-9.



Map 7. Difference between regional development levels in 1910 and 1786 using a decile classification at 5×5 km grid resolution (for input variables see Table 1).
Source: author's own edition based on literature given in footnote 1-2 and 3-7.

As a next step we compared the situation in 1786 to that in 1910 using now again the finer resolution of 5×5 km cell size in order to illustrate the regional inequalities (uneven development and the shift of backward areas) generated by the transition from preindustrial to industrial societies. The differences of decile values from the two time sections (Map 7) suggest that the Great Plains, booming in the 18th c. began to stagnate, while Southern Transdanubia and present-day Slovakia, lagging behind in the eighteenth century, gained new impetus and produced a rapid increase, similarly to Northern Burgenland, the development of which was fuelled by the closeness of the Viennese markets.⁵⁶ Similar dynamism and amelioration in positions can be produced even without the closeness of such a huge consumption centre – the rise of Slovakia was based on raw material and industrial products. In Southern Transdanubia (which was devastated by the Ottomans and not recovered by 1786, unlike the Great Plains) growth was based on agriculture – largely on latifundia and not on peasant smallholdings (contrary to the surroundings of Vienna, where both types of economies flourished). However, Map 5 (as compared to Map 4 and Map 1) indicates that the rise of future Slovakia did not mean that the region was able to overcome its earlier backwardness – the northern and eastern parts of the region were still among the underdeveloped areas in 1910 together with large parts of Transylvania, which might explain the dissatisfaction of the local people with Hungarian centralism, nationalism and liberal economic policies, all constituting a part of the “modernization scheme”. Some of the minority regions in the peripheries met only with one by-product of this “modernization”, i.e. “Magyarization” through schooling.⁵⁷

The above mentioned confirm our hypothesis, that beside the language question, land question and debates on broadening the suffrage,⁵⁸ regional differences also contributed to the growing tensions that became ethnicized by 1910 resulting in the collapse of the state (1920). This dissatisfaction also explains the changing patterns of development levels by 2010, as some of the formerly backward minority regions in the Northwest managed to emerge in Slovakia, whereas some regions dominated by ethnic Hungarians fell back either in Slovakia (Southern Slovakia) and Serbia/Yugoslavia (Vojvodina). However, Romania was unable to raise the level of development in the acquired Transylvania after 1920.⁵⁹

3.5 Permanent cores and peripheries

The visualisation of the medieval dataset and its comparison with the maps illustrating CDI values in the 1780s, 1910 and 2010 led to several findings. It became clear that the highly developed region between Vienna and Budapest in 1910 or 2010 existed already in 1330; Maramureş (salt mines) and southern Transylvania were more developed in the 1330s than in 1910, etc.

This drove us to outline regions that can be identified as permanent peripheries and persisting cores regardless of political regimes, socio-economic structures. This investigation

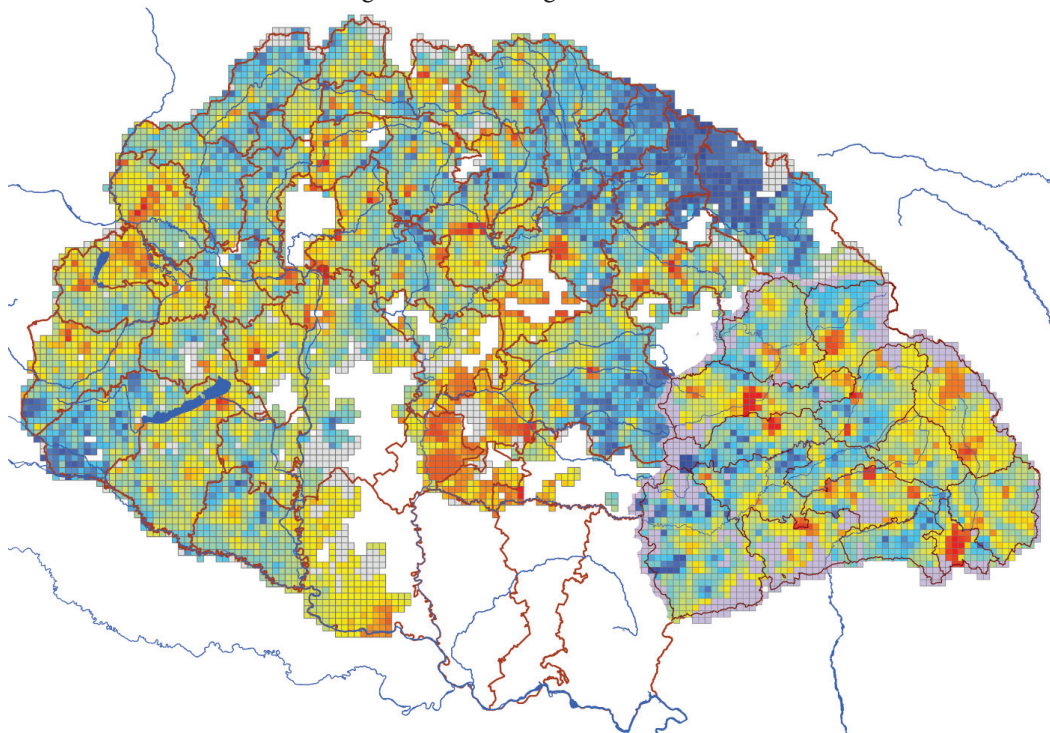
⁵⁶ HORVÁTH, Gergely K. Bécs vonzásában. Az agrárpiacosodás feltételrendszere Moson vármegyében a 19. század első felében. Budapest 2013, 695 pp.

⁵⁷ KÖVÉR György. „Statistikai asszimiláció” Magyarországon 1880 – 1910. In Századok, 2016, vol. 150, no. 5, pp. 1221-1258.

⁵⁸ KÖVÉR, György. Magyarország társadalomtörténete a reformkortól az első világháborúig. In GYÁNI, Gábor – KÖVÉR, György. Magyarország társadalomtörténete a reformkortól a második világháborúig. Budapest 2003, pp. 9-186.

⁵⁹ DEMETER, Trends in regional inequalities.

was limited between 1720 and 2010 (because the involvement of the medieval dataset would produce too many blank areas) and was carried out simply by aggregating the decile rankings of each grid cell for the four investigated time sections.⁶⁰ The results are illustrated on Map 8. The region Bratislava-Sopron around Vienna, the southern Great Plains, towns of Central Slovakia, the Győr (Raab) – Budapest axis were the key permanent cores, and Zala, Western Transylvania, Zakarpattia/Kárpátalja, Northwestern and Northeastern Slovakia were the backward regions in the long-run.



Map 8. Aggregated decile values for four time sections: 1720, 1786 (1750 for Transylvania), 1910 and 2010 to identify continuously developed and backward regions of the Kingdom of Hungary and its successor states. Warmer colours represent continuous cores, colder colours represent continuously underdeveloped areas. Source: author's own edition based on sources in footnote 1-9.

3.6 Long-run trends in regional inequalities – testing the Williamson-hypothesis

Though the dynamics of development and the changes in territorial patterns of inequalities can be assessed based on the visualized patterns, this method can not give information on the general deepening or diminishing of inequalities in different time sections. Therefore, in this part we abandon the GIS-aided approach to spatial inequalities, switching to statistical analysis.

The deepening or diminishing of inequalities can be assessed by calculating the average of normalized CDI values for the most developed and least developed 20% of the settlements for each time section (without giving a territorial dimension to the investigation), or by comparing the average levels of development for each time section (Fig. 1).⁶¹ The

⁶⁰ As for each time section cell values of CDI range from 1 to 10, thus four time sections produce an interval between 4 and 40.

⁶¹ CDI values were rescaled between 0 and 1 for each time section to make them comparable.

rate of divergence/convergence can also be assessed using the quotient of the normalized average CDI values for the most developed and least developed 20%. This method offers a possibility to test the relevance of the Williamson-hypothesis (used to measure the extent of inequalities) in the historical past on fine-scale data for a large region. The increase in spatial inequalities is evident after the expulsion of the Ottomans as figure 1 suggests: the trends during the reorganization (1720–1786) of the country confirm the Williamson-hypothesis. The subsequent development into capitalism (1786–1910) causes stagnation in terms of inequalities (but not in HDI or in GDP between 1880 and 1910),⁶² while the era of globalization (1910–2010) shows a decrease in inequalities, (as Williamson suggested for the twentieth century in general), even despite the numerous border changes, decentralisation and economic restructurations followed by economic integration to the EU.

If we add a brand new time section for 1880 (as a dozen of variables available for 1910 were also recorded in 1880), splitting the era between 1786 and 1910 referring to the political reforms of enlightened absolutism, and the era of the dualist Austria-Hungary, then it becomes evident that the average normalized level of development decreases after 1880, and while the most developed 20% continues to progress, the least developed 20% falls back. Thus the distance between the most and least developed 20% increases after 1880. Compared to this, between 1786 and 1880, the increase in average normalized level of development took place hand in hand with the decrease of inequalities, as the development of the leading 20% halted, while the least developed 20% began to catch up. All in all, the post-Ottoman reconstruction period (1720-1786) and the „national liberalism” of the first stage of capitalism (1880-1910) was characterized by increasing inequalities. The disintegration of the economic space (after 1920) not only led to a change in the territorial pattern of peripheries, but inequalities also decreased, the development level of the top 20% decreased, that of the bottom 20% increased, while the normalized mean value stagnated.

We have already argued that it is not necessary to have always the same variables when creating a composite development indicator, because their explanatory power might change, and some may fall out, new indicators can appear (and the structure of conscriptions do not allow us to use the same indicators for all time-sections). However, it is possible to estimate the changing role of the same external factors for 1780, 1880 and 1910, through regression analysis (SPARE, OLS). The results for this can be seen on Figure 2. One may assume that the role of ethnicity and religion in determining development, increased until 1880, then decreased, similarly to the role of accessibility to linear infrastructure and resources, whereas the role of soil quality continuously decreased (confirming transition from rural to industrial societies), other geographical features' role increased.

4. Conclusions

Our study can primarily be interpreted as an experiment on the utilization of an enormous database containing approximately 9 million settlement level data from the 1330s to 1910 offering the *longue-durée* analysis of the history of cca. 300,000 sq kms from a different (new) historical geographical perspective. Beyond illustrating the regional patterns and shifts of cores and peripheries for several time sections, and testing the Williamson-hypothesis on historical data of the past, our experiment was also targeted to resolve the

⁶² SCHULZE, Regional Income Dispersion; SZILÁGYI, Regional Differences in Development.

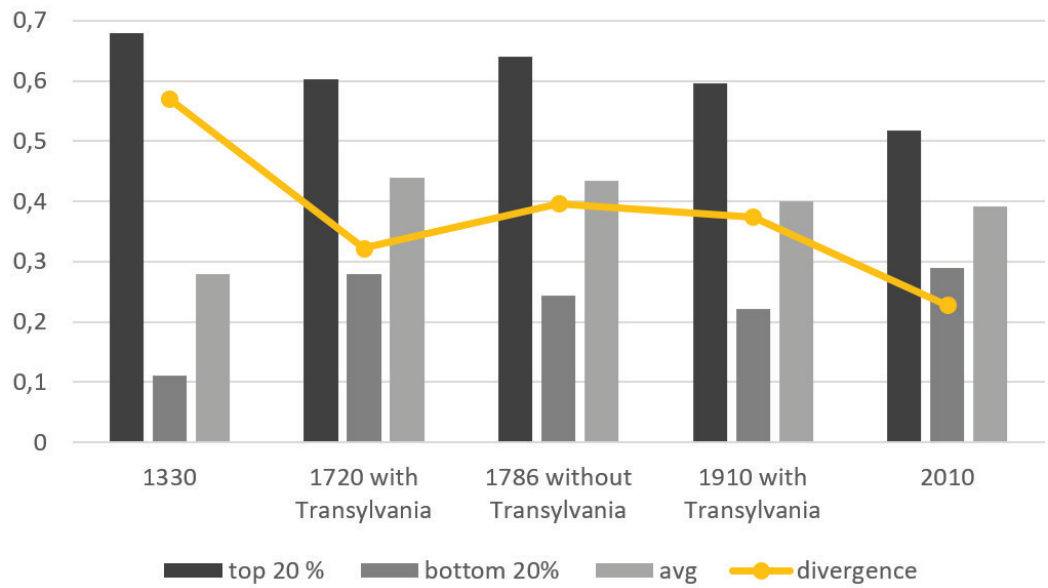


Figure 1. Trends in regional inequalities in historical Hungary and its successor states based on the rescaled composite development levels for the settlements (1330 – 2010).

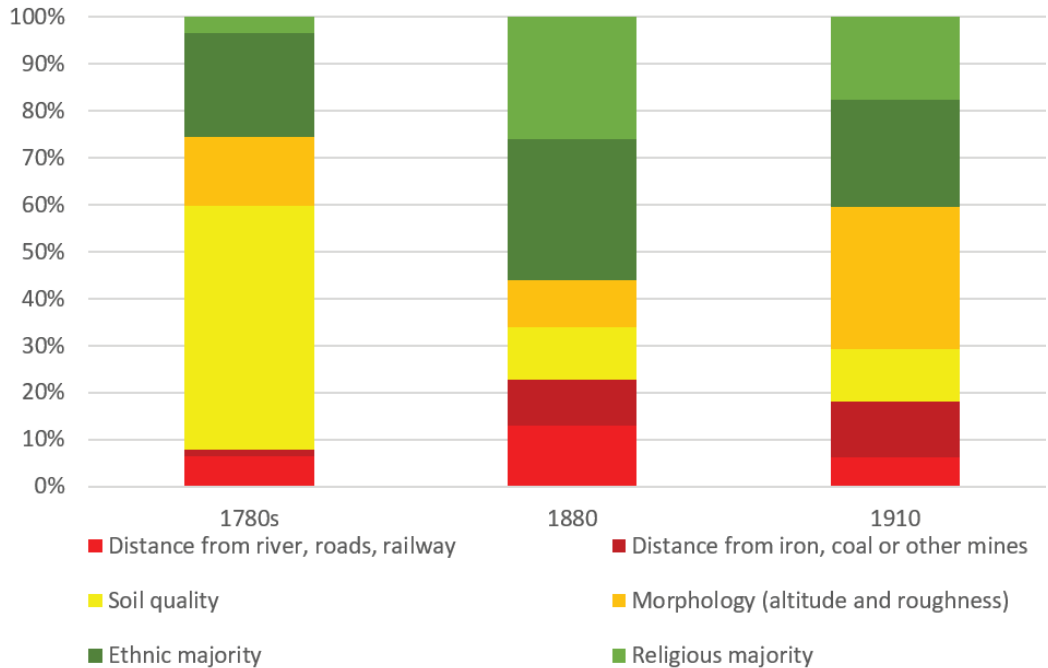


Figure 2. Changes in explanatory power of external factors on development (authors' calculation based on the data of GISa Hungarorum).

methodological problems of visualizing the results emerging during a *longue durée* comparative investigation, such as

- (1) changing administrative areas
- (2) lack of exact boundaries for the investigated entities,

- (3) the changing accessibility and relevance of indicators in time (that makes comparison difficult),

We proved that our visualization methods (gridding, development maps) can be adapted both to a medieval dataset and to modern or contemporary ones. The *longue durée* regional approach enabled us to discuss some new ideas and explanations regarding structural changes, path dependency and regional trends of development for the Kingdom of Hungary and its successor states, that way contributing to the better understanding of East Central Europe's history. Former conclusions based on "average values" or GDP/capita,⁶³ or results of local investigations that were extended to the whole area of the kingdom (which is methodologically problematic) can be probed and compared to our results.

In order to select indicators that express the level of development adequately for the comparison of numerous time sections, multivariate statistical analysis (PCA) was applied instead of the common set of indicators (because their number was very low), securing methodological consistency. The use of gridding and decile-values for illustration also served the purpose of comparability. The creation of a composite development index (CDI) based on differing variable sets can be reasoned by the fact that historical HDI can be calculated only for time sections in 1880, 1910 and 1940⁶⁴ while GDP at municipal or district level is completely missing before 1880 (only a provincial level reconstruction was given by Schulze in 2007).

The methodology outlined above also offers the possibility to insert and evaluate new time sections (1500s, 1720, 1828, 1880, 1930), making sampling denser, thus reaching more established results. As the snapshots on development levels and inequalities presented here do not rely on cause-consequence modelling, in other words, in the present investigation we did not make distinction between variables indicating/reflecting development and variables causing development. So, beside inserting new time sections the application of Structural Equation Modelling can be a future step for a better understanding of relationship between variables, that way providing more reliable outputs for regional development patterns.

However, even this short study relying on the comparison of three or four time sections revealed that

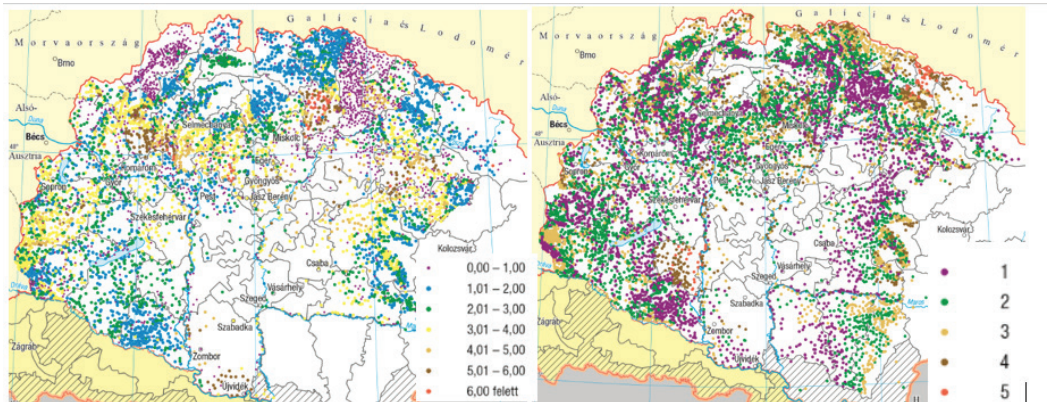
- (1) detecting long-term temporal changes of peripheries is not impossible;
- (2) inequalities grew after 1720, stagnated between 1786 and 1910 and decreased by 2010 after the collapse of the Kingdom of Hungary – confirming the Williamson-hypothesis on historical datasets;
- (3) regarding development levels the Great Plains devastated by Ottomans overtook the unharassed areas by the 1780s until 1910. This means that not only population agglomerations, but also new economic structures were able to create prosperity. This provides a good example of reversal of fortune caused by external challenge, while the constantly backward southwestern Hungary (Zala) represents an example of path dependency.
- (4) among the least developed areas in 1910 many minority regions can be observed (Zakarpattia, Western Transylvania), thus regional inequalities could be easily ethnicized and politicized,

⁶³ MADDISON, Angus. *The World Economy. A Millennial Perspective*. Paris 2001, 653 pp.

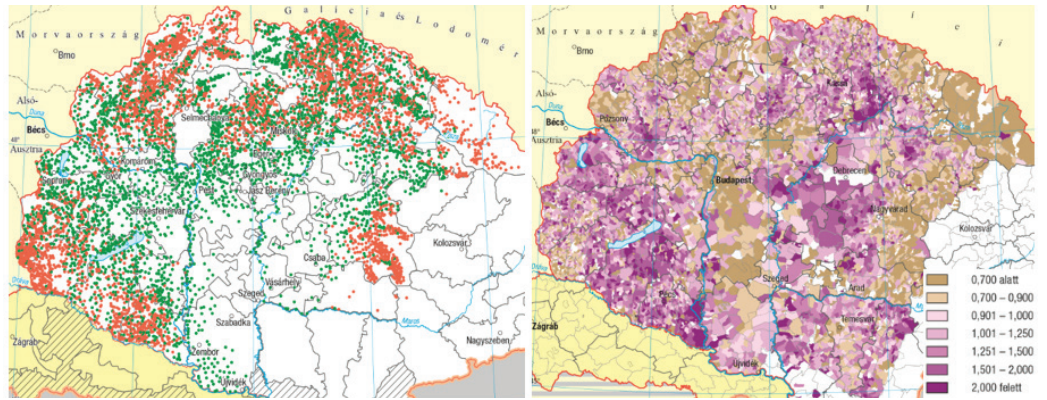
⁶⁴ SZILÁGYI, Zsolt. *Az ismeretlen Alföld*. Budapest 2022, 476 pp.

- (5) after 1920 there has been a great change in the location of peripheries and cores in Slovakia, e.g., the Danube-axis, one of the most (and more or less permanently) developed region regained its primordial importance after the fall of the Great Plains in the 1920s; Western Slovakia rose and Southeastern Slovakia fell back, which is a good example of Acemoglu's the reversal of fortune due to institutional changes.

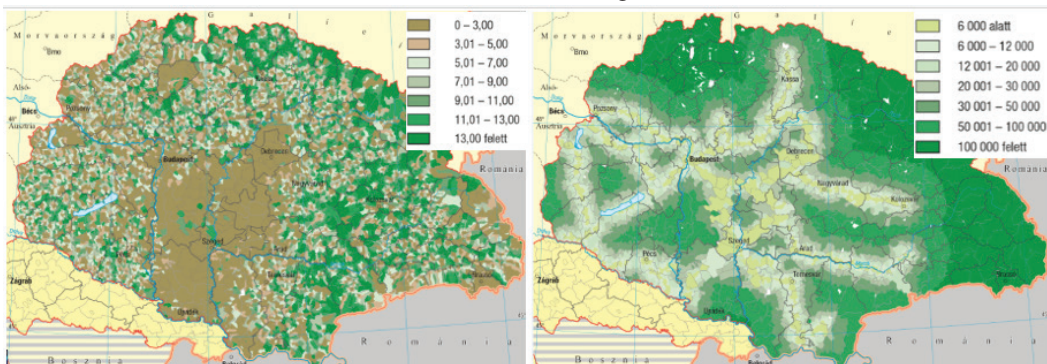
Appendix 1. Maps showing the patterns of individual variables.



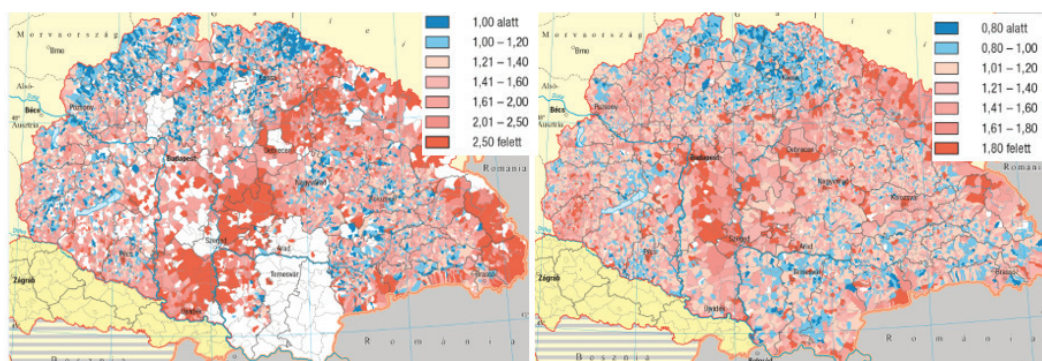
Fertility: grain output compared to sown seed (1720) after the deduction of tax and seed / Soil quality (1= best)



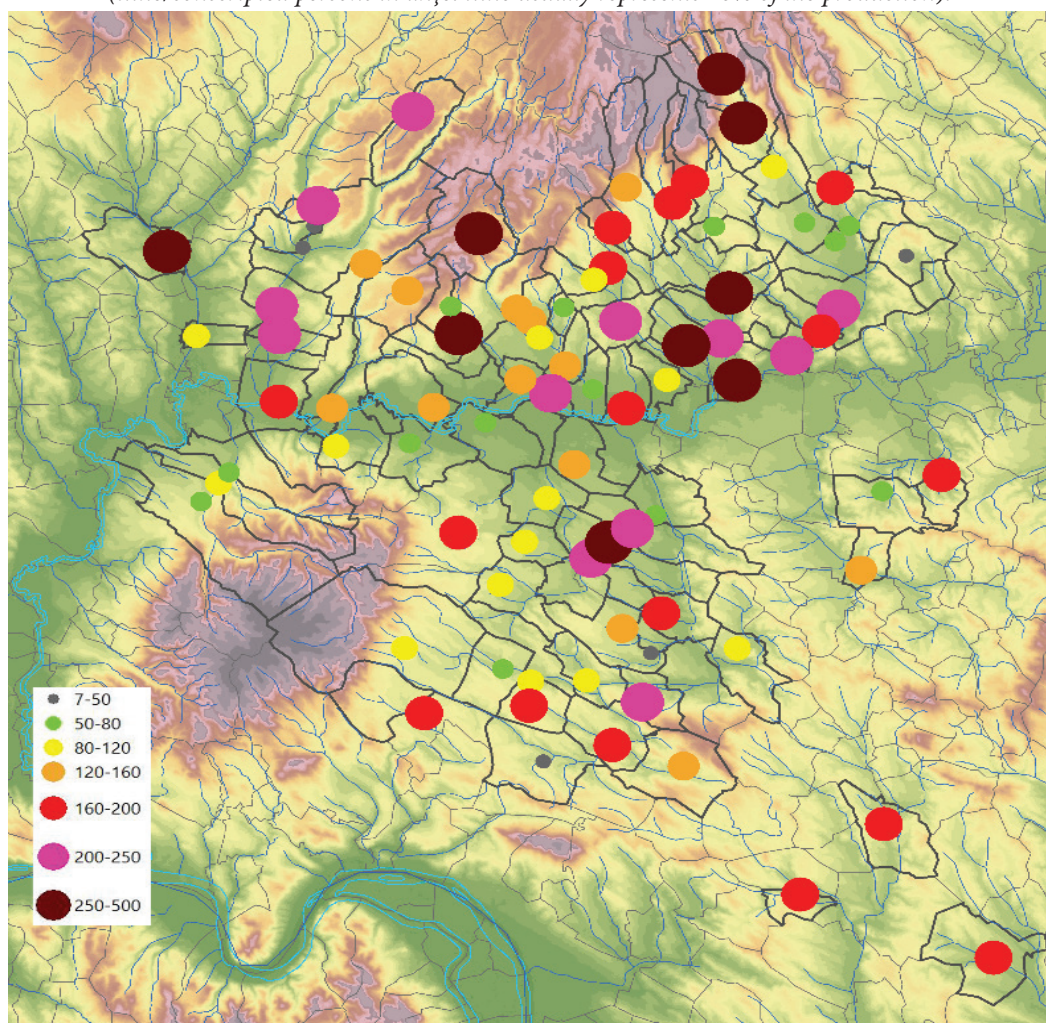
Settlements without schoolmasters (red) in 1775 / Change in net cadastral income 1910/1865



Distance from doctors in 1910 (km) / Distance from railway stations in m (1870)



Appendix 2. Economic performance of settlements along the Ipel' river in the Ottoman era (tithe/conscripted persons in akçe: tithe usually represents 10% of the production).



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