GIStorical Studies

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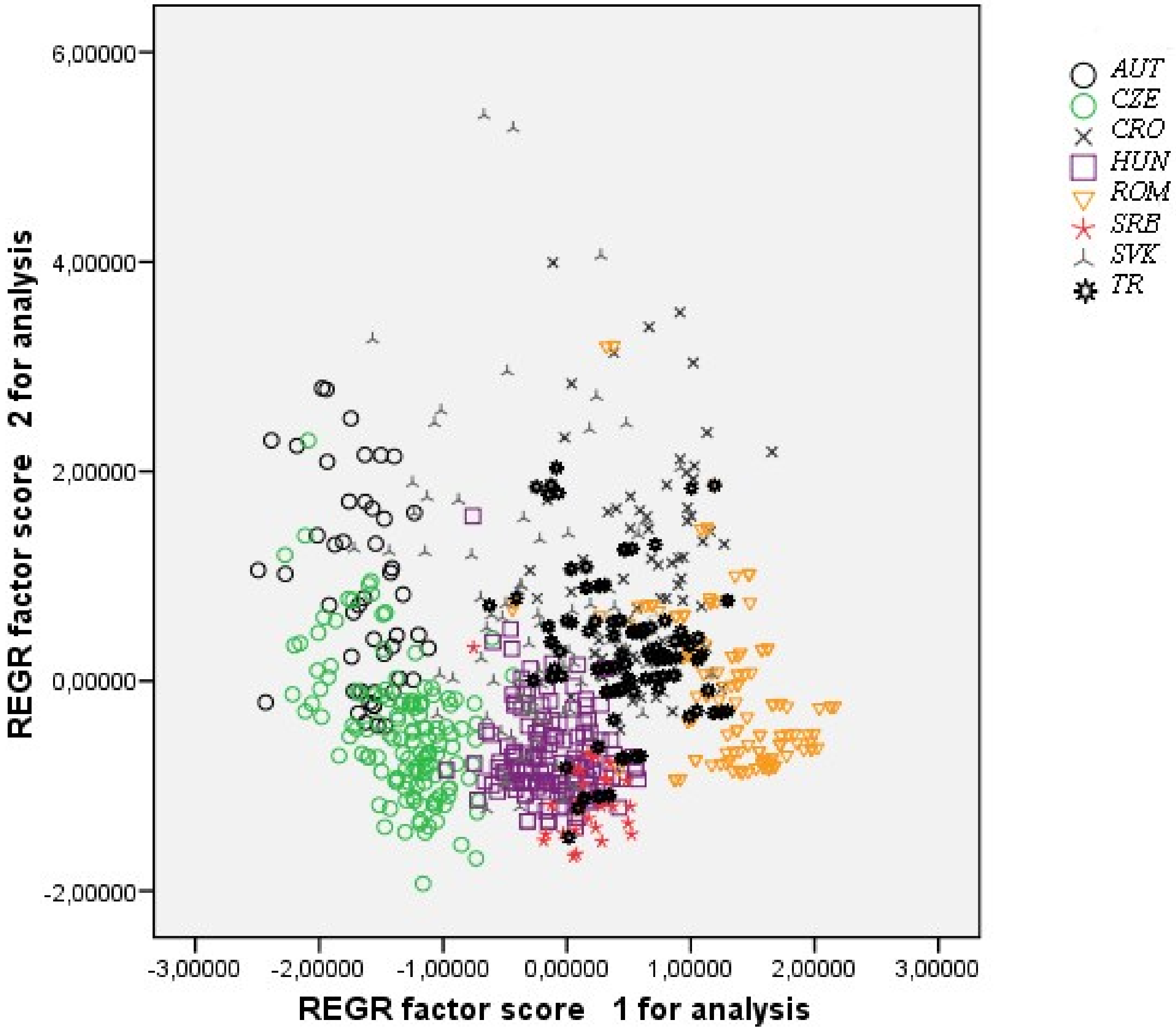
DEMETER, Gábor – PÉNZES, János – RADICS, Zsolt

The Effect of Geopolitics on Regional Development: Did Changing Borders Influence the Regional Development Level in Central-Europe Between 1920-1940?



Aims[1]

The aim of this study is to investigate whether there existed a significant fault line in the cultural level and development stage in the Central and Lower Danubian Basin in the first half of the 20th century, or a gentle slope showing the phenomenon of gradual socio-cultural and economic transition describes the situation better (in accordance with the Tobler-hypothesis). We also examined how the existing and changing borders between 1920-1938 affected these differences using statistical analysis of data from 850 districts of 6 countries.

The role of borders have substantial literature. Borders have rather coercive than stimulating effect, if considered rigid (Reichman, 1993), as they can distort market (Lösch, 1962), however certain territories might get new opportunities by ridding of the rivals. And in our case, after 1920, both economic (turn to protectionism) and political circumstances made borders rigid and the restructuration of markets was also observable. (Vojvodina and the Slovakian Plains became the only supplier of a protected market due to Czechoslovakian and Yugoslavian protectionism and the physical geographical conditions – but was the rest of the Hungarian Plains rival for them earlier?).

There is another assumption that borders very often coincide with, or deepen structural gaps between regions or countries (Nijkamp et al., 1990), especially if the previously mentioned phenomena became predominant. The question is: did the new borders after 1920 create new, or emphasize existing differences further, or on the contrary, they rather eliminated them in the Danubian Basin? Did these borders coincide with existing fault lines or they rather divided territories of same cultural pattern and levels?

In order to answer these questions we decided to collect and evaluate data for the Interwar period, referring to cultural and economic development at district level from the former Austria-Hungary (without Galicia) and Romania (without Bessarabia-Republic of Moldova). Historical works comparing such huge area published up to now have hardly ever gone below regional or county level (while works of good resolution hardly went beyond national borders), when the question of regional developmental differences was examined. This erroneously implied the *a priori* hypothesis that regions did exist in historical times (committing the mistake of projecting the present situation into the past – a preconception that hardly works). Contrary to this, our presumption was that micro-level approach should be introduced ignoring state borders and regions, and this will enable us to describe and delimit regions (even with cross-border characters), ruptures, sloping etc. and compare the borders of regions with the state border. Our idea was supported by the methodological argument that detailed entities could be aggregated whenever needed (for example if the pattern is too fragmented, mosaic-like, which hinders the delimitation of development regions), while a reversed process is impossible.

In order to examine these questions a quantitative analysis of cultural and economic differences for Austria-Hungary, and Romania (a successor state) was carried. Using data from the 1930's (after the dismemberment of this more or less economically united region), we examined the persistence of old structures (if these still survived after 20 years, it referred to strong regional characteristics), and the modifying effect of borders. Our examination reveals that Austria-Hungary was not united or homogeneous regarding cultural aspects, and more significant fault lines existed along the internal borders of the two main constituents (even 20 years after its dissolution), than it could be measured between the successor states, like Hungary and Romania in the 1930's.

Methods and material

In order to carry out the above mentioned examination 10 variables referring to economic and cultural development were collected from the database compiled by Rónai A. (1945) for more than 850 districts, and multivariate statistical analysis was carried out to analyze the above outlined

[1] This study has been supported by the Hungarian Research Fund K 111 766.

questions. In our survey we used specific (per head) data in order to eliminate differences originating from different population and territory size.

A, From among indices representing employment structure we used the percentage value of non-agrarian workers (trade and commerce, industry, public services).

B, Demographic indices may also represent cultural level and differences: net reproduction rate and death rates were calculated for each territorial units.

C, As purely cultural index the proportion of illiterate people was selected,

D, From among economic variables referring to agriculture the income/unit area of meadows, crop yield/ha was used in our examination. The low availability and reliability of the data made it impossible to extend the survey on more variables.

These phenomena were illustrated by Rónai on maps separately. These maps were informative, but we wanted to create a complex, combined map. Since we had more than 8500 data (850 cases for 10 variables) in the database, we decided reduce the dimensions of data by applying PCA. This gave us also possibility to select independent variables (those variables that are grouped into the same factor show the phenomenon of multicollinearity, with great correlation coefficients among each other, therefore cannot be considered independent). While reducing the number of variables, PCA also enabled us to illustrate the development level of territorial units on 2 or 3 dimensional scatterplots.

Using SPSS, principal component method, the original 10 variables were driven back into 3 factors retaining 43+20+9% of the variance of the data structure, showing 0,79 KMO-Bartlett test of sphericity, which makes our examination reliable. The rotated component matrix (*table 1*) – created by varimax rotation – contains correlation coefficients between the original variables and the derived factor. The first factor comprises variables referring to demographic situation and alphabetization.

The second factor showed great correlation with the proportion of arable land and with the overpopulation in agriculture, while the third represented the proportion of public servants. The second factor cannot be used directly as determinative to development, as both overpopulated areas may have improved agricultural technologies (Czech areas), and poor areas can also be described by rural overpopulation (Serbia, Bulgaria, etc.).

The original variable values can be substituted by the factor score value (an imaginary value composed of values of the numerous variables belonging to the same factor) for each district after carrying out the PCA. As the proportion of industrial population and the crop yield/ha showed great, but negative correlation coefficient with the 1st factor, this means that high values of the factor scores in 1st factor represent an indicator for traditional (preindustrial, rural) societies.

Table 1. *Rotated component matrix of used variables*

Rotated Component Matrix	Component		
	1	2	3
industrial population %	**-0.865**	-0.150	0.170
mortality %	**0.881**	-0.011	-0.146
net reproduction rate %	**0.530**	0.362	0.351
illiteracy %	**0.852**	0.221	-0.126
arable land %	0.070	**-0.912**	-0.023
yield (t/ha)	**-0.666**	-0.469	-0.037
income/ha of meadows	**-0.722**	0.411	0.006
density of agricult. pop.	0.236	**0.760**	-0.149
public servants, free occupations %	-0.189	-0.104	**0.912**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Results

Factor scores enable us to define both the ranking of districts within a factor and to illustrate them in graph. Analyzing the ranking of districts based on the first factor (comprising indicators of traditional societies) one may conclude that among the first 100 one can find only Slovakian and Romanian-Transylvanian districts, while among the last 100 only Austrian and Czech districts were observed. The latter were the most industrialized and least rural unit areas, with the highest yield/ha and industrial population.

Taking a closer look on the scatterplot (*figure 1*) showing the distribution of districts in the virtual space defined by factor 1 and 2, one may come to the conclusion, that some countries occupied a distinct, separate sub-space. The transition zone between Czech and Austrian districts was thin, these countries showed visible differences regarding their development level compared to other countries or regions. The same was true between Austria and Hungary and between the Czech and Hungarian districts, (and after 1920 in Czech-Slovakian relation). In the former cases the borders of 1920 were definitely segregating territories of different type, while in the latter case new state borders were unable to solve the obvious territorial differences by the 1940's. So, Czechoslovakia was composed of two territories at different stage of development. Contrary to this, the Hungarian, Serbian and Slovakian districts (of the former Hungarian Kingdom) were similar and overlapping with each other regarding their level of development, as these district were scattered and mixed with each other on the diagram. The Hungarian and Czech districts were characterized by the least scattered pattern, while Slovakian districts showed great variability, representing an E-W slope in geographical terms. Considering Romania, Transylvania overlapped with the *Regat* and with Hungary as well, representing a wide transition zone between them. Therefore, here the phenomenon of gradual cultural transition could be observed based on the data from the 1930s. Compared to Czechoslovakia, the Romanian state unified territories characterized by smaller differences. Some districts belonging to Slovakia also overlapped with Transylvania, the gradual shift here was also observable. The location of the countries in this virtual space clearly corresponds with their geographical position. The chart proves the existence of a regional W-E slope with greater steepness, discontinuity on the west, and gentle differences towards the east.

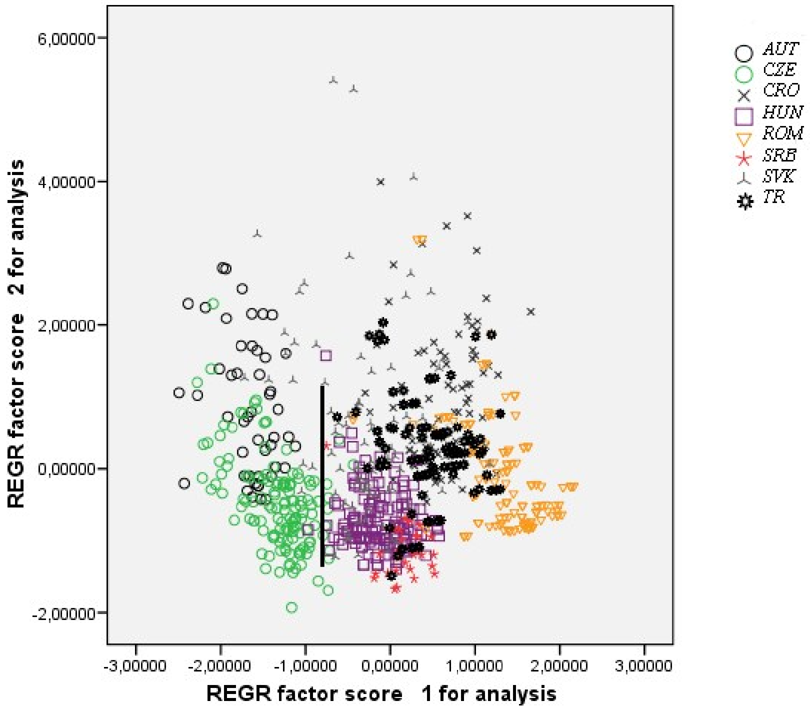


Figure 1. *Development of districts in the 1940's based on the first 2 factor score values. The vertical line symbolizes a rupture in the level of development coinciding with borders, while in the case of other districts and borders a wide overlapping transition zone occurs*

Using either factor 1 and 3 or 2 and 3 the districts of the countries overlapped and intertwined, therefore it can be stated, that the *main dividing factor between these territories is the 1st factor which comprises mortality, net reproduction rate and illiteracy while shows negative correlation with industrial population, yields, etc.*

After this, we examined the correlation between the chosen indicators (*table 2*) for all the 850 districts. As the 9 variables were grouped into 3 factors, it was sure that the phenomenon of multicollinearity occurred. Spearman rank correlation showed that the greater the industrial population, the smaller the mortality (r= -0,778) was: the effect of the industrial revolution was evident in that case. However, within certain territorial units this phenomenon was not so deterministic, as it was *generally* for the whole region: for example in Romania without Transylvania the correlation coefficient was only -0.494, in Austria -0.400, etc. The same phenomenon was observable in the case of industrialization and illiteracy (r= -0.776).

Industrialization (% of population employed in industry) resulted in higher yields concerning regional levels (including all 850 districts): the value of the correlation coefficient was remarkable (r=0.644), and this is surprising only at the first sight, since the effect of industrial revolution should also appear in agriculture (intensive cultures, engines, crop rotation, etc.) according to the literature. As *figure 2* proves, the classification of cases according to countries results in an evident overlapping even when only two indicators are considered.

As illiteracy also showed great, but negative correlation with yields, referring to traditional, rural structures (the more illiterate people live in the country, the smaller the yield is), using a *regression model* we examined which variables are dominant in influencing crop yield/ha. (The same phenomenon is true in the case of mortality and crop yield). Analyzing the results shown in *table 3* it is evidence, that beyond the availability of arable land, the proportion of industrial population has the greatest influence on yields (a 0.25% increase in industrial workers results in a 1% increase in crop yields/ha). As a correlation matrix can only verify or deny the connection between the phenomena, but neither can explain it, nor make distinction between cause (triggering effect) and consequence, the usage of partial correlations and regression analysis was reasonable. *Partial correlation* indicated that both illiteracy had effect on the relation between industrialization and crop yields (original r-value in *table 2* decreased to 0.341 when controlling for illiteracy), and industrialization also had effect on the relationship between crop yield and illiteracy (r increased to -0.406 controlled for industrial population). Overpopulation was also an urging factor itself for modernization (even without the above mentioned processes and indices). According to investigations using partial correlation, the progress of industrialization also influenced the relationship between yields and mortality (r= -0.345 controlling for industrial employees %). So these phenomena can be driven back to multiple reasons.

Table 2. *Correlation matrix of variables*

Spearman rank correlation	agrarian density	industrial pop. %	mortality %	net repr. rate %	illiteracy %	arable land %	crop yield/ha	income/ha	public servants %
agr. density	1.000	-0.420	0.311	0.323	0.418	**-0.621**	-0.450	-0.001	-0.228
industrial pop. %	-0.420	1.000	**-0.778**	-0.519	**-0.776**	0.038	**0.644**	0.555	0.333
mortality %	0.311	**-0.778**	1.000	0.433	**0.824**	0.057	**-0.653**	**-0.655**	-0.240
net repr. rate %	0.323	-0.519	0.433	1.000	0.462	-0.117	-0.513	-0.369	-0.049
illiteracy %	0.418	**-0.776**	0.824	0.462	1.000	-0.131	**-0.675**	-0.557	-0.275
arable land %	**-0.621**	0.038	0.057	-0.117	-0.131	1.000	0.327	-0.420	0.044
crop yield/ha	-0.450	**0.644**	-0.653	-0.513	**-0.675**	0.327	1.000	0.317	0.205
income/ha	-0.001	0.555	**-0.655**	-0.369	-0.557	-0.420	0.317	1.000	0.126
public servants %	-0.228	0.333	-0.240	-0.049	-0.275	0.044	0.205	0.126	1.000

Table 3. *Standard beta values of variables influencing crop yield/ha* (regression analysis)

R = 0.766	Standardized Coefficients Beta
agr. density	**0.111**
mortality %	-0.357
illiteracy %	-0.142
arable land %	**0.375**
income of meadows	-0.055
industrial pop. %	**0.241**
net repr. rate %	-0.173

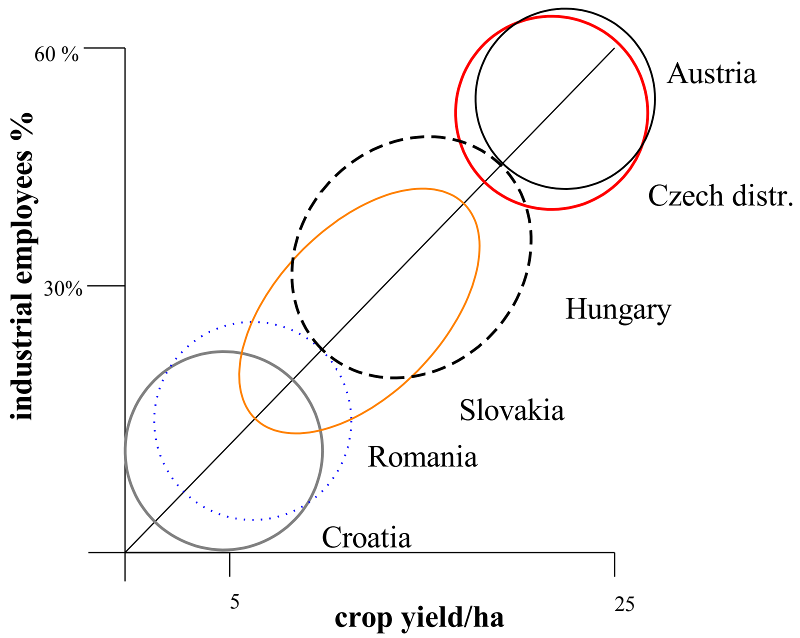


Figure 2. *Territorial differences of crop yield and industrial employees in %. Symbols represent the virtual space covered by districts. A linear regression can be observed*

The question still to be investigated is whether the situation in the 1930s is a direct consequence of the situation in the 1900s or there was any (either positive or negative) trends of convergence or divergence between the regions within a generation. In other words, did borders influence the situation (either by creating and deepening differences or by eliminating them), or not? Using the settlement-level database created for the 1910s[2] we aggregated several variables to district level (in order to make the two time horizons comparable), and selected those that showed normal distribution (aggregation remarkably reduced the number of usable variables), thus could undergo a similar PCA (for which normality of data is an essential condition). 18 variables were thus selected. From the 5 factors defined the indicators showing the greatest correlation with the given factor were selected, reducing the number of selected variables to 6 (*table 4-5*):

- proportion of deceased children measeured to total deaths (%)
- the proportion of wage-earners
- proportion of industrial employees measured to total employees (%)

[2] Project GISta Hungarorum (OTKA K 111 766), http://www.gistory.hu/g/en/gistory/otka.

- agrarian income per capita
- local incomes per capita
- state direct taxes per capita

The PCA grouped these six variables into 3 factors explaining altogether 85% of the total variance, producing 0.65 KMO Bartlett test of sphericity. It is worth mentioning that these did not all coincided with the variables selected for the 1930s (for example literacy was omitted), but mortality, industrial population and agrarian income were among the common variables.

Table 4. *Selected and aggregated variables from the settlement level database in 1910. The variables showing the greatest correlation with the factors are marked*

Rotated Component Matrix[a]				
	Component			
	1	2	3	4
mortality rate	-0.194	0.695	-0.179	0.459
ratio of wage earners	0.211	0.758	-0.139	-0.179
ratio of industrial earners	0.024	-0.042	0.927	0.020
proportion of smallholders	-0.653	-0.379	-0.176	0.232
settlement income per capita	0.524	-0.076	0.003	0.757
children mortality rate	0.334	0.753	0.164	-0.190
income per estate	0.881	0.119	0.267	0.115
settlement wealth per capita	0.180	-0.147	0.358	0.783
industrial enterprises over 20 workers	0.244	-0.192	0.855	0.215
birth rate	-0.045	0.945	-0.168	-0.025
agrarian income per capita	0.907	0.053	0.146	0.243
state direct tax per capita	0.819	-0.024	-0.140	0.330

Table 5. *The results of the PCA on the set of variables (final selection)*

	Component		
	1	2	3
proportion of industrial population	0.045	-0.009	**0.987**
agrarian income per capita	**0.850**	0.227	0.131
settlement income per capita	**0.883**	-0.118	0.039
state direct tax per capita	**0.924**	0.130	-0.070
children mortality rate	0.113	**0.870**	0.142
ratio of wage earners	0.034	**0.870**	-0.148

The first main component referred to different types of incomes, the second referred to the demographic indicators (it was the first factor in the previous investigation). The last main component showed great correlation with only variable symbolizing the progress of industrialization. This means that the structure of factors was different in this case. Per capita incomes represented a separate factor, as well as industrialization. In the first investigation these were abundant only indirectly by showing great, but negative correlation with the demographic indicators and with illiteracy. In the next step we calculated the factor score values (as a hypothetic complex variable representing the features of all other in the same group) for these variables in order to reduce the number of dimensions, and visualized the results on separate maps for each factor (*figure 3-4*).

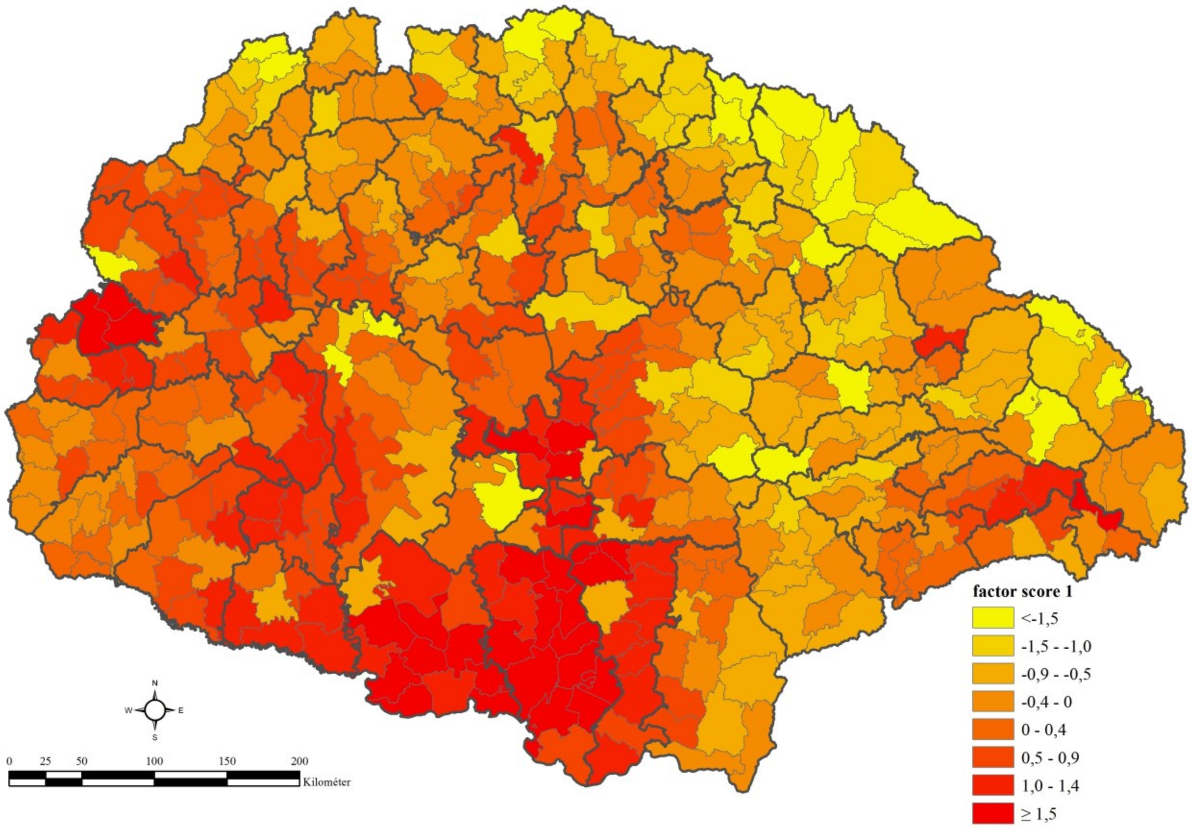


Figure 3. *Differences in the development level of Hungary in 1910 at district level based on the first factor (for constituents see Table 5)*

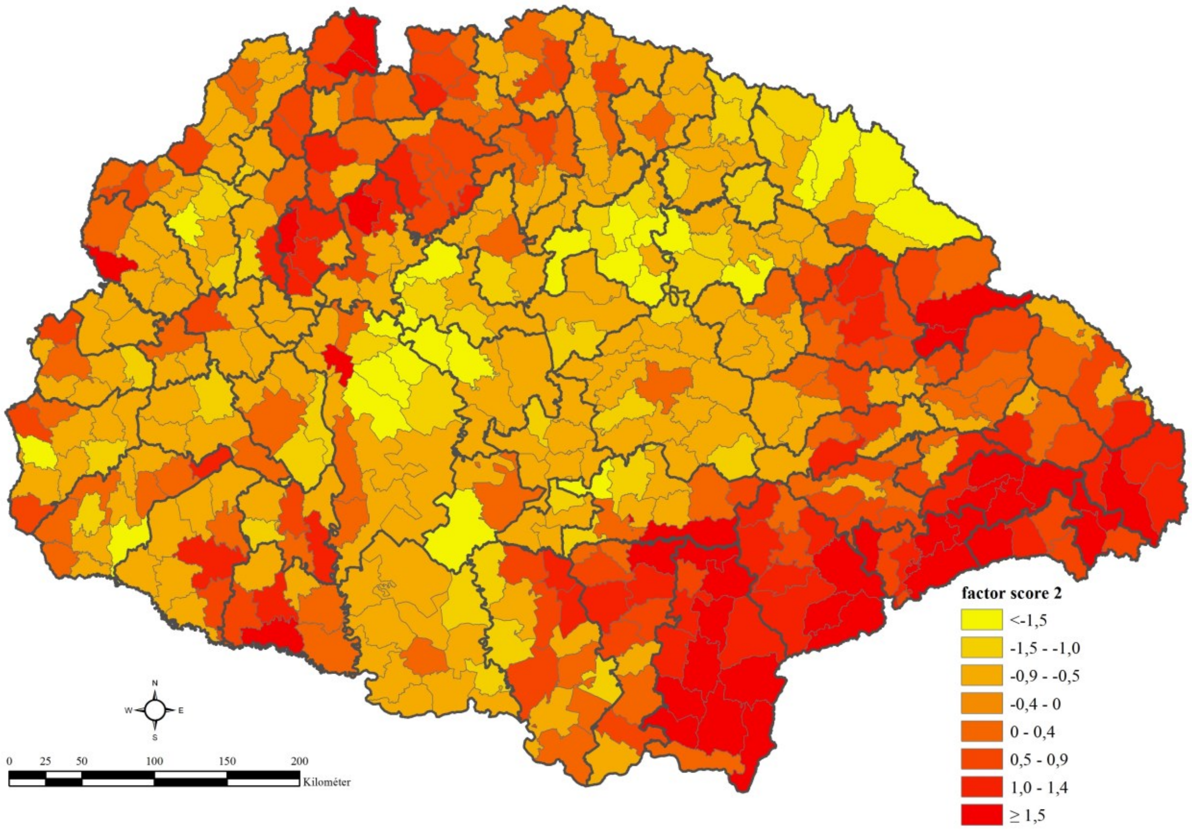


Figure 4. *Differences in the development level of Hungary in 1910 at district level based on the second factor (for constituents see Table 5). The scale is reversed: high values refer to critical situation.*

Unfortunately we did not have the same data for the Cisleithanian parts, thus we were unable to trace the fault line between the two major constituents (the maps of Katus on taxability for the 1860s suppose great differences), but for the Slovakian, Romanian and Yugoslavian border the picture is informative enough. Based on the first factor (per capita settlement and agrarian incomes), the differences (though remarkable) did not assume the presence of fault lines. The situation is rather characterized by gradual changes (it is true that the territory of Hungary after 1920 showed better performance based on per capita incomes, than the area inherited by successor states – with the exception of Vojvodina, which was characterized by high per capita agrarian incomes). Based on the second factor (children mortality, earners) there is an evident fault line in Transylvania (but this did not coincide with the borders in 1920) and in Central-Slovakia (right along the 1920 borders), vanishing in the West along the Slovakian Plains. However, these differences were mitigated by the third factor referring to the progress of industrialization. As this showed high values in Central-Slovakian districts, but low ones in Vojvodina, it smoothed most of the sudden differences. While the second factor showed critical values in East-Transylvania, the better values of industrialization eliminated the differences. Nevertheless, territorial inequalities were abundant, but were characterized by gentle sloping instead of fault lines (*figure 5*).

An overlay of the three maps confirms our previous results: though the peripheries of the Hungarian kingdom were evidently determined by deteriorating values regarding development, fault lines (more than 1 interval differences between 2 neighboring districts) were not observable along the borders of 1920, with the exception of the following places: upper Tisza (Czechoslovakia-Romania), Ipoly (Czechoslovakia-Hungary). On the contrary, more internal fractures could be identified in Zemplén-Bodrog and in Heves County within Hungary, along the Danube in Hungary and in the western mountains in Transylvania (Romania). This means that internal peripheries also existed as early as in 1910 (and in 2000 too) and assuming a N-S or E-W slope is too simplifying.

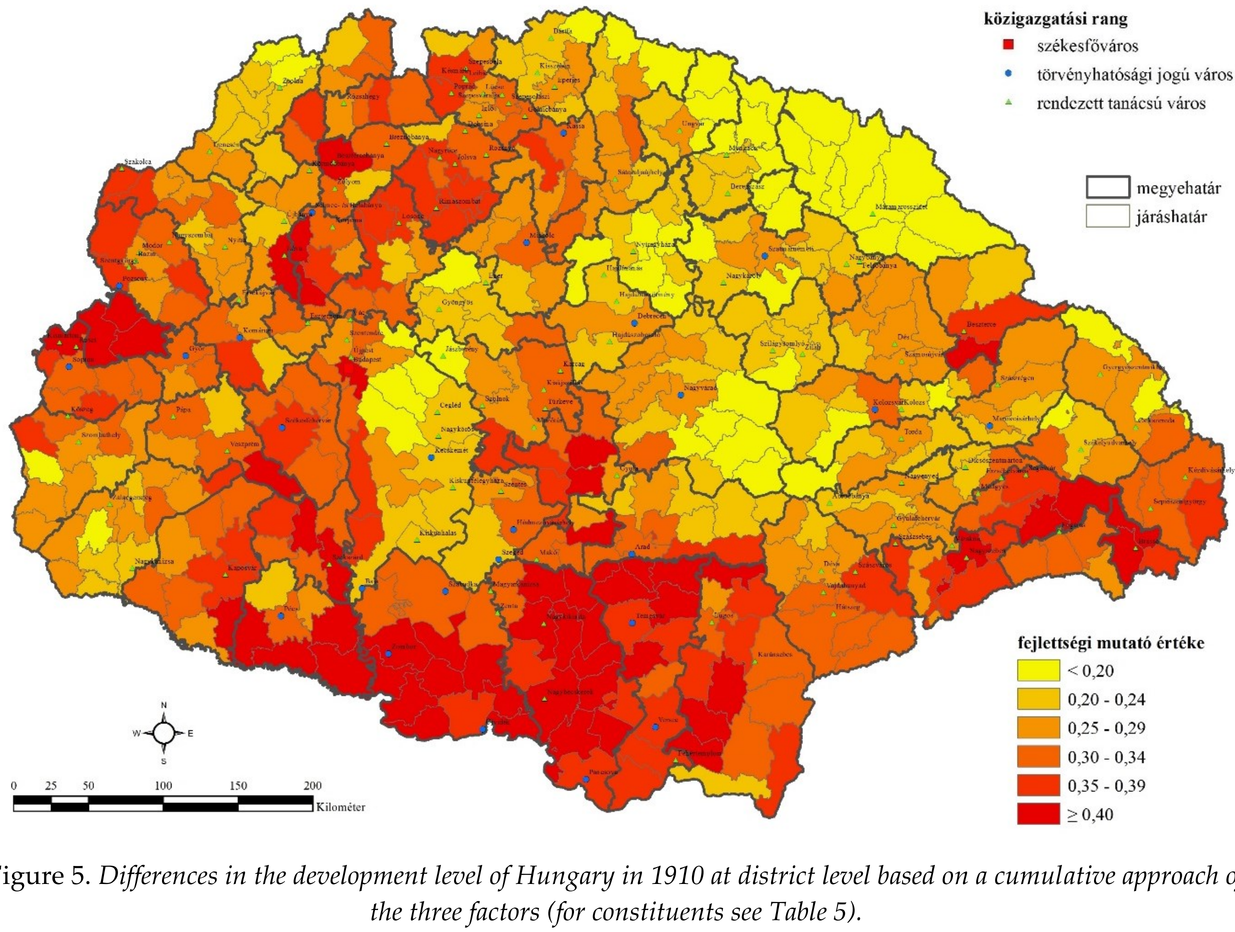


Figure 5. *Differences in the development level of Hungary in 1910 at district level based on a cumulative approach of the three factors (for constituents see Table 5).*

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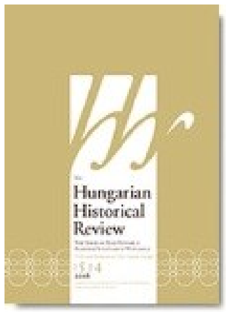

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The Institute of History, Research Centre for the Humanities, Hungarian Academy of Sciences together with the cooperation of the researchers at Pécs University, Debrecen University and Eötvös Loránd University (Budapest) with the support of the Hungarian Research Fund have elaborated a Geographical Information System (including numerous databases and base maps as well) that enables researchers to carry out spatial analyses of socio-demographic phenomena for Austria-Hungary between the 1850s and the 1910s. The goal was to create a transparent, expandable and open system that can be operated under QGIS to promote the work of geographers, historians, ethnographers and other researchers from the neighboring countries in order to ask new questions or to find new answers to old questions from different perspectives. This R&D was named ***GISta Hungarorum*** (referring to the name of the Hungarian chronicles, Gesta Hungarorum) and the datafiles and shape files of maps are available at: http://www.gistory.hu/g/en/gistory/otka free of charge.

GIStorical Studies

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