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Regional Income Differences in Hungary - A Multi-Level Spatio-Temporal Analysis

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Regional income differences in Hungary – a multi-level spatio-temporal analysis

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Abstract

This paper has two aims. Firstly, it provides a number of critical reflections of the existing methods of the examinations of intertemporal change of spatial differences of various socio-economic indicators, mainly the per capita income. Practically there are two types of analysis of spatial differences in income level, namely intercountry and intracountry investigations. The diverse growth rate of spatial income level of various spatial units (regions, countries, provinces, counties etc.) is a historical-statistical fact which refers to an unrepeatable, unique and particular historical situation. The descriptions of the convergence or divergence of various spatial units in various time periods contribute to our historical knowledge, but the “testing of convergence approach” has no theoretical basis. Secondly, the larger part of the paper illustrates many theoretical issues by the help of the Hungarian spatial income data between 1988 and 2004. The analysis has four spatial levels, more than 3000 settlements, 168 small regions (NUTS IV level), 20 counties (NUTS III level) and 7 regions (NUTS II level).

Keywords: spatial income differences, methodology, Hungary, convergence, temporal analysis

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Introduction

The first, shorter part of my paper discusses some methodological and epistemological shortcomings of the popular approach to temporal change of regional income differences. It is not at all a comprehensive survey and a detailed critique, rather it prepares and gives reasons to the approach of the second section of the paper, where I offer a historical analysis of Hungarian regional income differences at more spatial levels, stressing on the small region (NUTS 4) level of the country. During presenting this spatial historical economic process, I will point at some lessons which are interesting from a theoretical or methodological point of view. However, because of space limit it is not an aim of this paper to investigate the various reasons which explain the sharp spatial division of Hungary.

1. Comments on classical treatment of spatial income disparities

Thanks to the easy availability of data sets on internationally comparable GDP levels and intracountry regional GDP data, from the 1990's, there are vast amounts of paper which deal with temporal change of spatial income differences. The aim of one part of those papers is pure historical description and explanation of temporal process with the help of historical, demographical, institutional, regional political or other concrete factors. This aim can be supplemented by some lessons, which are important from a theoretical or regional/economic political point of view. The other part of these papers has a more ambitious aim, they want to 'test' the various theories of temporal change of spatial differences, mainly the 'convergence hypothesis' predicted by neoclassical regional economic growth theory or measuring the speed of convergence (the magical 2%). These second types of papers will be soon criticized.

The spatial and temporal extension (the starting point of time period) and the applied zoning system of the investigation depends mainly on the accessibility of data. Of course, there isn't a natural starting point, zoning system and spatial extent of analysis, and the results can be modified due to the change of one element of these three factors. However, as regards the spatial extension, there are three types of these papers: international country level data with many countries, individual countries and European Union with NUTS 2 or NUTS 3 level data. See for example: Andrade et al. (2002), Armstrong (1995), Barro (1991), Barro–Sala-i-Martin (1992), Bergström (1998), Bulli (2001), Byrne et al. (2005), Canova (2004), Caselli et al. (1996), Chen–Fleisher (1996), Chesire–Carbonaro (1995), Evans (1997), Fischer–Stirböck (2004), Hofer–Wörgötter (1997), Kangasharju (1999), Madariaga et al. (2005), Magrini

(1999), Quah (1996a), Quah (1996b), Rey–Montouri (1999), Sala-i-Martin (1996a), Sirlipoulos–Asteriou (1998), Persson (1997), Tsionas (2000), Vohra (1998).

In the literature of intercountry convergence we can meet these types of basic questions: ‘Will relatively poor economies remain poor for many generations? Will the rich countries of the year 2100 be the same countries that are relatively rich today? Is the degree of income inequality across economies increasing or falling over time?’ (Sala-i-Martin, 1996b, p. 1019.) ‘Whether poor countries or regions tend to grow faster than rich ones: are there automatic forces that lead to convergence over time in the levels of per capita income and product?’ (Barro–Sala-i-Martin, 1992, p. 223.). These types of questions are important from a historical point of view. (The second question can arouse science-fiction interest as well.) Of course, the pure historical description of an individual country cannot count on great interest without trying to generalize the results. However, it is a historical question, that in a particular country or groups of countries in a particular time-period with a particular zoning system, the differences in data, which was created by a particular statistical survey method, were decreasing, increasing or unchanging.

The literature about spatial income disparities contributed to our historical knowledge in a significant way. However, its contribution to theoretical knowledge is questionable. If categorical difference between theory and history is not registered, it leads to confusion about the domain and task of both theoretical and historical research. This confusion can be well observed in many papers about the temporal process of regional income inequalities. There are two main ways to investigate spatial economy: the empirical, historical description of concrete, real places, and the abstract, theoretical models and theories of spatial economy. On one hand, people are interested in concrete historical events, on the other hand the human mind is able to abstract from the complexity of the real world, build imaginary constructs, and by seeking theoretical explanations, creates theories. Neither of these two approaches are superior to the other. Competent historical research uses theories in the explanation of real phenomena and theoretical papers use examples from empirical writings to illustrate theory.

The results concerning convergence or divergence describe in a perfect manner the concrete historical patterns of regional inequalities, but there is no epistemological basis to generalize the results. Using various tests of inferential statistics has no reason, since probability theory is applicable, if the examined events can be classified in a class of events. Regional income data has a unique characteristic, they are not homogeneous members of an identifiable class with known parameters in the distribution of values. They are uncertain, but not random, in the sense of probability theory. They are not one actualisation of a repeatable

‘random samples’ derived from a larger population, but a part of spatial economic history. Papers using regional income data describe the concrete *ex post* development of regional income disparities. The usage of word ‘sample’ to the group of countries and regional units is unjustifiable and misleading. This data is the subject of methodological decisions of statistical offices as well, the revisions from time to time change the whole time series.¹ Per capita data and its temporal change can be modified due to the alteration of population data because of census also.

GDP per capita is not an appropriate indicator of regional income differences because of two main reasons: difference of regions of workplaces and the regions where the employed live (it is most important in city regions and the neighbouring regions, like for example Inner London and Outer London); the spatial differences of capital intensive activities. There are other problems with the localization of gross domestic product inside countries. Some papers use the data of International Comparison Program, which results are obviously strongly method-dependent. Other papers exclude ‘special’ regions, for example city-regions and oil mining regions because of problems of localization of GDP. These exclusions can be justified with historical reasons, however, it leads to an unending fruitless discussion about the illusory theoretical ‘evidences’. If these evidences would be named historical and not theoretical, that would not be problematic. Theoretical soundness and the applicability of neoclassical growth theory could be investigated by scrutinizing the underlying assumptions of theory.

I will not use inferential statistical techniques in this paper for the above mentioned reasons. I will not use sophisticated concepts, such as Markov chain analysis, kernel density estimation or unit root tests. I think the spatio-temporal analyses have many interesting possibilities, problems and interesting general lessons without these questionable methods as well.

2. Spatial income differences in Hungary

2.1 Data sources and spatial levels

In this paper I examine only one database, namely the personal income tax register, which is known in Hungary at the settlement level. The problems of this data set are well known (for example missing the illegal incomes or incomes from agriculture), but it is not significant in static analysis and in temporal examination it is not important as well. The source of basic

¹ See for example Friedenber–Beemiller (1997), Brown et al. (2004).

data is the Hungarian Statistical Office and the Ministry of Finance. The spatial levels of investigation and its main characteristics concerning population size can be seen on Table 1 and Figure 1.

Table 1 The spatial levels of analysis (with maximal, mean and minimum inhabitants of spatial units, 2000)

Spatial level	Population (in thousand)					
	Number of units	Maximum	Mean	Minimum	Maximum	Mean
	With Budapest			Without Budapest		
Region (NUTS 2)	7	2858	1474	1005	-	-
Country (NUTS 3)	20	1797	516	222	1061	448
Small region (NUTS 4)	168	1797	61	8	288	51
Settlement	3064	1797	3,4	0,015	211	2,8
Moving average with 65 km bandwidth (regional level)	3064	-	-	-	-	-
Moving average with 200000 inhabitants (small region level)	3064	-	-	-	-	-

The longest time period of analysis reaches from 1988 till 2004. Personal income tax was introduced in 1988, this is the first year with available income data on settlement level. This database is fairly large: $3064 \cdot 17 + 168 \cdot 17 + 20 \cdot 17 + 7 \cdot 17$ basic data, and the 16 changes of data, and the 15 changes of changes in data. The original income per capita data was transformed and expressed in the average income. Increasing and decreasing of level of per capita income means what was the change of relative position of spatial unit compared to country average. Budapest was excluded from most parts of analysis, because its position is well known (Table 2), and its data represents first of all not a spatial difference but a difference in the settlement hierarchy. It means that if the geographical position of Budapest would be different its income level would be only slightly different because of its strong own potential. This cannot be maintained by the other, smaller spatial units, of which its surrounding area has a much stronger impact on its income.

Table 2 The average income per capita in Budapest in percentage of country level

1988	1990	1992	1994	1996	1998	2000	2002	2004
136,7	144,1	152,1	154,2	149,9	153,4	153,3	152,9	151,4

2.2 A general look to spatial income differences in Hungary

In the areal distribution of the income per capita in Hungary the following spatial factors play significant roles:

- east-west location;
- distance from Budapest;
- distance from the county capital;
- size of the settlement;
- transport-geographical location.

All of the listed factors played an important role in the differentiation of incomes in the period between 1988 and 2004, although naturally not to the same extent. The importance of east-west location increased in a significant way, the other factors changed moderately. Income is increasing with western position, closer to Budapest, closer to county's capita, with the increasing size of settlement and near to the main transportation arteries.

The standard deviation of personal income per capita can be seen on Table 3. The first years of period the differences increased quickly, then the changes were moderate and from 1999/2000 begun a small decrease. This three time period can be seen on the Figure 2 also, which was created with more spatial level and more indicator of differences.

Table 3 Standard deviation of income per capita in various levels (in percentage of average income) White cells: increasing differences. Grey cells: decreasing differences.

Year	Level of analysis			
	Region (n=7)	County (n=20)	Small region (n=150*)	Settlement (n=3064)
1988	17,3	19,6	22,1	25,4
1989	18,4	21,2	23,9	27,6
1990	19,9	23	26,1	30,2
1991	17,9	21,2	25,4	30,7
1992	22,1	26,4	29,8	34,6
1993	22,7	27,1	30,8	35,6
1994	23,5	27,7	31,5	36,5
1995	22,6	26,7	30,7	35,8
1996	22,3	26,3	30,5	35,7
1997	23,3	27,3	31,4	36,4
1998	24,2	28,3	32,2	37,1
1999	24,4	28,8	32,8	37,6
2000	24,6	28,3	32,3	36,9
2001	24,3	28,3	32,1	36,6
2002	23,7	27,1	31,1	35,7
2003	22,1	25,3	29,3	34,1
2004	23,1	26,3	30,4	35,0

*Small region zoning system till 2003

Of course, this method of analysis has a spatial character, we can see only the spatial differences, without its location. This shortcoming can be overcome with the help of maps. On next Figures a map series can be seen which depict vividly the spatial distribution of income and its change. In Figure 3 the moving average of the incomes calculated within a circle of 65 kilometres radius in 1990 and 2000 is shown, on which we can very well see the regional split of Hungary. (The radius was chosen because in Hungary it is equal to the NUTS2 level.) On maps created with constant 200000 inhabitant radius (equal to small region level) the differences between size of settlements take shape also, the county's capitals rise above their surrounding area (Figures 4-6). As regards the temporal change, in the first period the increasing differences along settlement hierarchy (or between cities and villages) was more significant than in second period, when the spatial differentiation (western-northwestern growth) was of great importance.

As regards the neighbourhood effect, it was examined on three levels (NUTS 3, NUTS 4 and settlement) (Figure 7). In the decreasing period of the neighbourhood effect that took place up until 1993, the large and fast development of the areal differences occurred. In this time period the areal changes were sectorally determined by the partial disappearance of socialist industry and not by the neighbourhood effect. The areal differences increased moderately after 1993, although the neighbourhood effect had gradually increased and comparing to previous periods the small regions or settlements that differed from their environment in a positive or negative way, became more similar to their neighbours. County level data confirm this as well, but such an amount of data in itself would be too little to describe the process, because of the few areal units. It can be stated that in the spatial differences of income in the whole country, the neighbourhood effect is significant and it has played a more increasing role in recent years, after decreases between 1988 and 1992.²

2.3 Small region level

The time period of analysis is 16 years, from 1988 till 2003. Budapest is not included, the original data was transformed and expressed in an unweighted average of 167 small regions.

² Moving averages and autocorrelation on settlement level was calculated with the help of a simple Visual Basic program.

2.3.1 Trends

The parameters of linear trends can be seen on Figure 8. Determination coefficient above 80% has occurred first of all in small regions with durable growth. Perpetual decreasing is more infrequent. The high level of determination coefficient does not mean, of course, that we can anticipate further increase with more security. Quite contrary, the turning of trend has more probability after a longer period of growth. The correlation between β_0 and β_1 is 0,32. The small regions with higher starting position have more frequent a positive β_1 than the small regions with lower starting position. However, this correlation has a decreasing tendency (counting the trends between 1988 and 1999 it was 0,39, then years to years 0,38, 0,36, 0,33).

2.3.2 Stability and standard deviation of changes

It is an interesting question that temporal changes were even or unstable. The determination coefficients of trends give an answer to this question. Beside this I examined the change of signs of changes and the standard deviation of changes and the absolute levels.

During the 16 years there were 15 changes to income level and 14 changes to the growth of the income level that means altogether 2338 different signs. From that 1187 times (50.8%) the signs correspond to the previous sign and differ 1151 times. This shows a random change. Only a few small regions with longer decreasing or increasing trend have ten or more same successive signs (Figure 9).

The highest standard deviation of the income level of certain years can be observed in fast growing small regions and the biggest loser, the former mining center Komló (Figure 10). The smallest standard deviation was in underdeveloped small regions with agrarian character, in which there aren't dominant industrial companies. The biggest standard deviation of the change of income levels occurred in small regions with one dominant industrial company (chemical works in Tiszaújváros, ironworks in Dunaújváros, Opel in Szentgotthárd, nuclear-power station in Paks) (Figure 11)

2.3.3 The highest and lowest level of relative incomes and the highest difference between two years

In a simple case the starting and ending point of time period is equal to minimal or maximal level of incomes. The maximal level coincides frequently (51 times) with the first

year, 1988. There aren't small regions with county capital in this category (Figure 12). On the opposite side are 31 small regions, in which the lowest level was in 1988. Their location shows a well observable spatial pattern also. In every year several small regions reached the maximum or minimum level of relative position during the time period.

The variations can be measured with the highest difference between two following years and with the highest difference between two differences of three following years. These differences would be in country level extraordinarily large in the case of war also. The differences demonstrate very well the local economic 'shocks' which can occur independent from country level processes due to the problems or success of local companies. Otherwise it shows that there needs to be caution because of outlying data of one year: it cannot be known without qualitative information, that it is a turning point in trend or one-time 'random' effect stands in the background. (Figure 13)

The case of Bélapátfalva (the name of a small region in north-eastern Hungary) is very interesting. In this lagging region the large cement factory, the biggest employer, was closed down in 1999. The severance pays were often equal to two years salary. Therefore in 1999 the increase of relative incomes in this small region was 16%, but the next year the decrease was 22%. The difference of these two years is 38% which is extraordinarily excessive (however, the difference of income per workers is much larger). There are many other similar examples. It is impossible to explain these hectic jumps of data without qualitative information.

2.3.4 Types of changes

Up to this point the various indicators described the change in one favoured point of view. Every data takes a part in the formation of results, but the form of time series was characterized only partly (such as maximum, minimum, standard deviation). In this section the ways of changes, independent from its absolute level, are under examination. Figure 14 illustrate the problem. In the four part of the figure we can see four identical ways of changes on different absolute levels. The dissimilarity matrix, which contains $167 \cdot 166 / 2$ different elements, is interesting from this point of view, however, since its extra size, complexity and unfigurability necessitates other procedure of pattern recognition. Cluster analysis is able to identify relatively homogenous groups of cases. This procedure is not devoid of the arbitrary methodological decisions. This is not a problem itself, I made the classification in many ways to control the impact of applied methods. If there would be great differences between results, that would show the untypifiability which is valuable information also.

I chose the non-hierarchical K-means method because of many reasons. The tractability of results in many cases was itself a good reason for using this method. As regards the data transformation, the division with average and counting with differences of averages is a sufficient modification. Standardization of data would be a mistake since it give a greater weight those years, in which the differences were small. There are many possibilities to give the differences: only the differences of successive years (15 data), differences between furthest years also (altogether 120 data), the cumulated data from starting year (15 data), or a mixed method. I made the analysis with each possibility, the results were only slightly different. In most cases the classification of atypical small regions were different. On Figure 15 can be seen the results, which was created with 15 successive change and the change between 1988 and 2003, altogether with 16 data per small region. Four typical ways of changes can be identified: 1. growing till 2000, then moderate decreasing; 2. moderate increasing in total period, with fast growing till 1991, then stagnation; 3. decreasing till 2000, then moderate increasing; this group is the most different from the absolute income level point of view; 4. drastic decreasing with permanent industrial and labour market crisis; 5. atypical small regions (with one dominant employer). Between the first, second and third group the boundary line is not sharp, there are interim small regions, which are only slightly closer to its cluster center than to the second nearest cluster center.

3. Conclusions

Spatial convergence hypothesis disregards from the very essence of space, namely that space creates differences, which is manifested in many ways from intrasettlement level till world level. Traditional approach to spatial income differences stresses too much to the pure quantitative data. The numbers explain nothing without investigating parallel the institutional, historical, demographical and other factors. It is obvious that there are not automatic forces that lead to convergence over time in the levels of per capita income and product. If it would be sensible to speak about the test of convergence hypothesis, then we could say that convergence hypothesis as theoretical hypothesis is falsified by the Hungarian case. By the way, this hypothesis is neither able to explain the income differences in the arbitrary 'initial points'. There are periods with increasing and periods with decreasing differences of incomes. Reference to 'long run' is metaphysical, the length of 'long run' is unspecified. The only result that can be generalized from Hungarian data is that the temporal change of spatial

income differences can both decrease and increase in accordance with concrete historical causes.

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Figure 1 Spatial zoning systems in Hungary (NUTS 2, NUTS 3, NUTS 4 level)

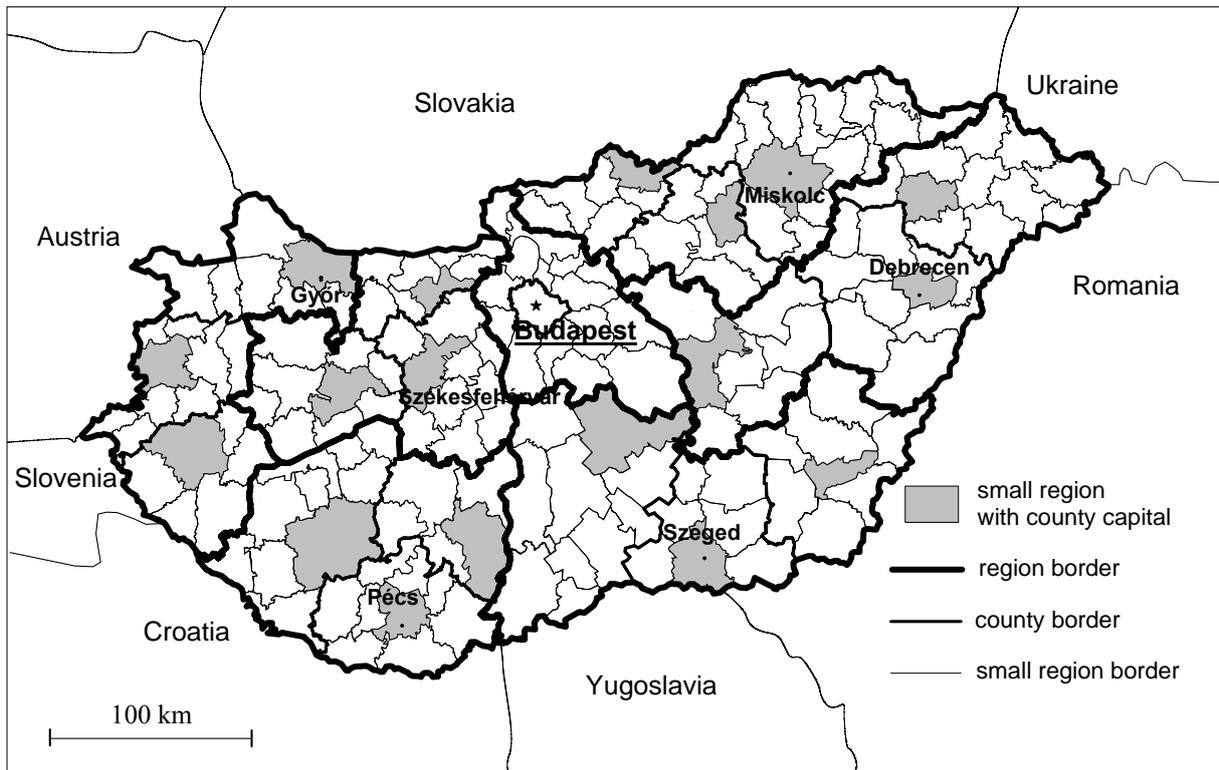


Figure 2 Temporal change of spatial differences in Hungary (with more spatial level and indicator)

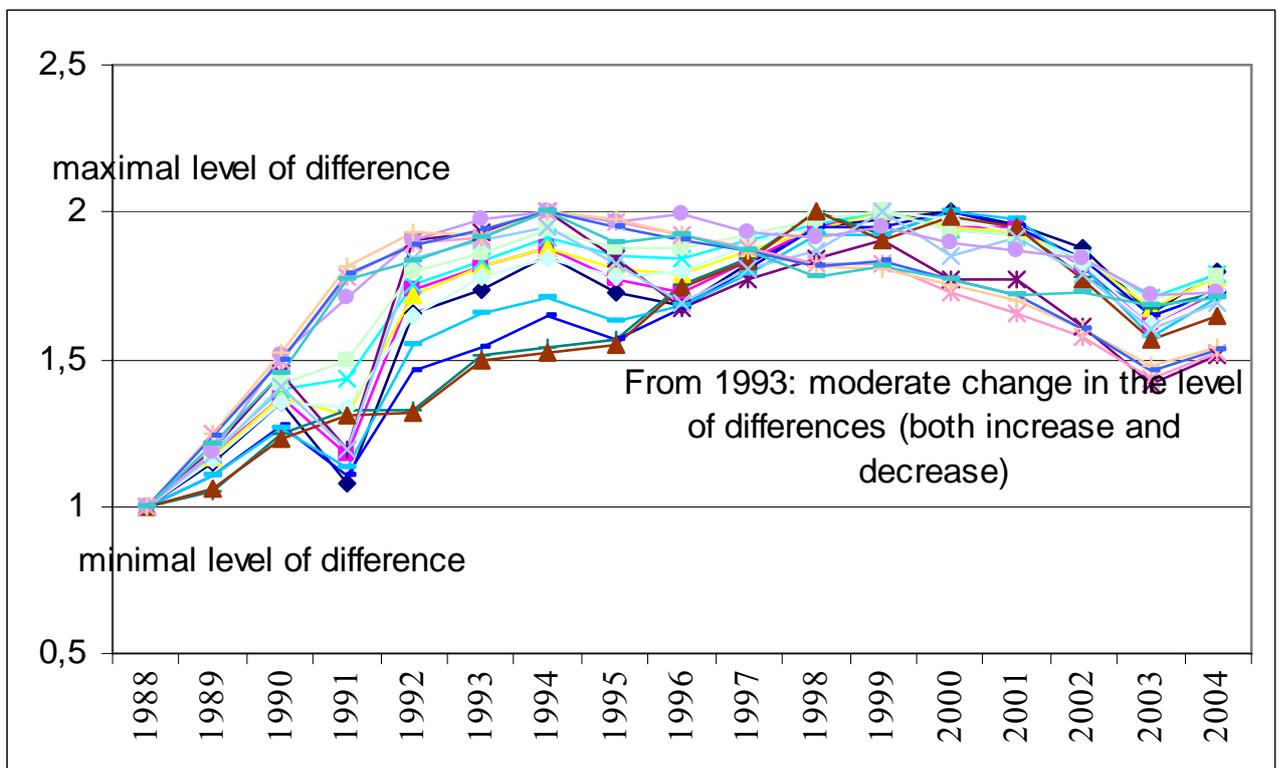


Figure 3 Spatial distribution of income per capita (with spatial moving average on settlement level, $r=65$ km.; Budapest not included)

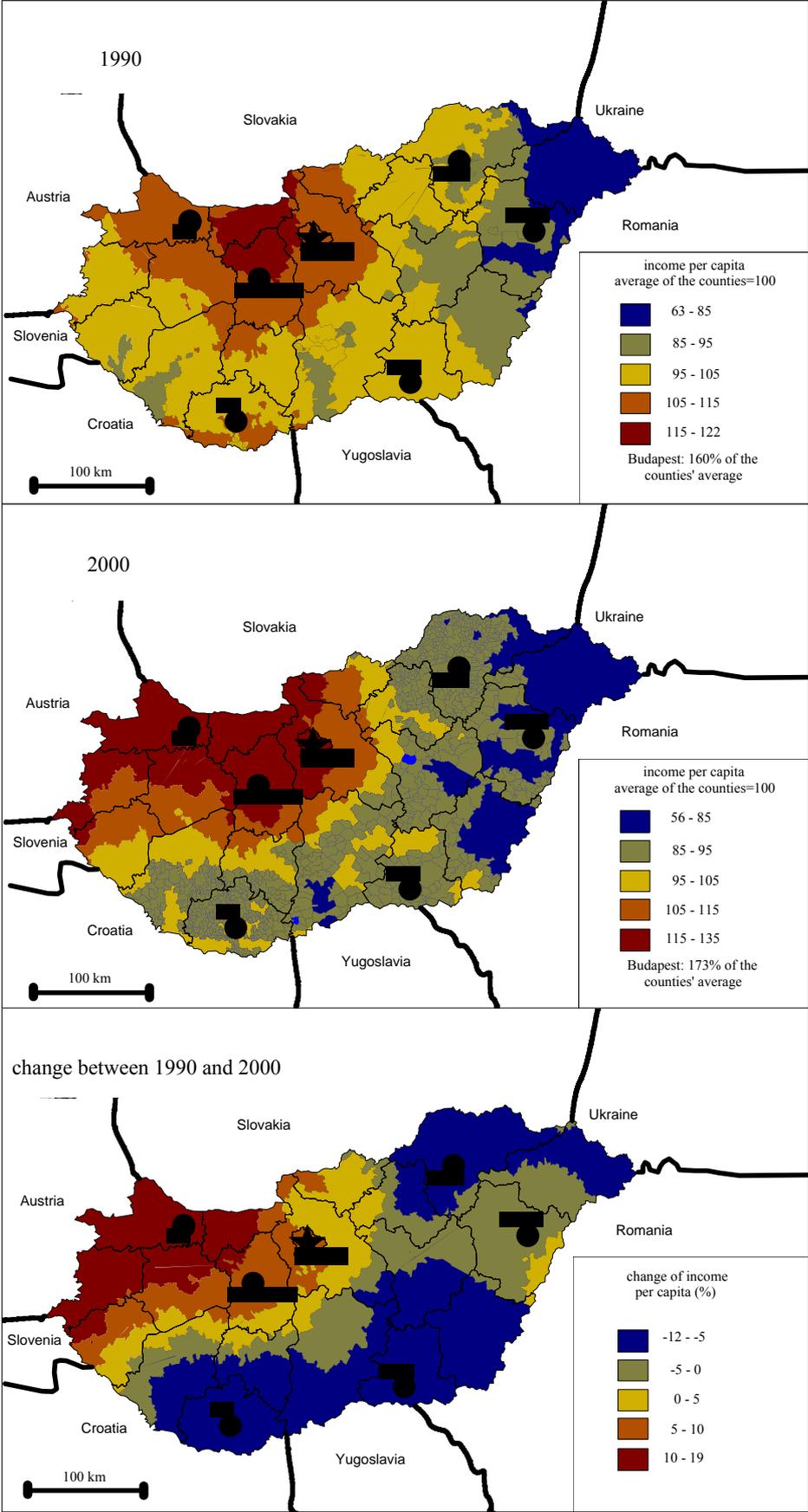


Figure 4 Spatial distribution of income per capita, 1988 (with spatial moving average on settlement level, $r=200000$ inhabitants; Budapest not included)

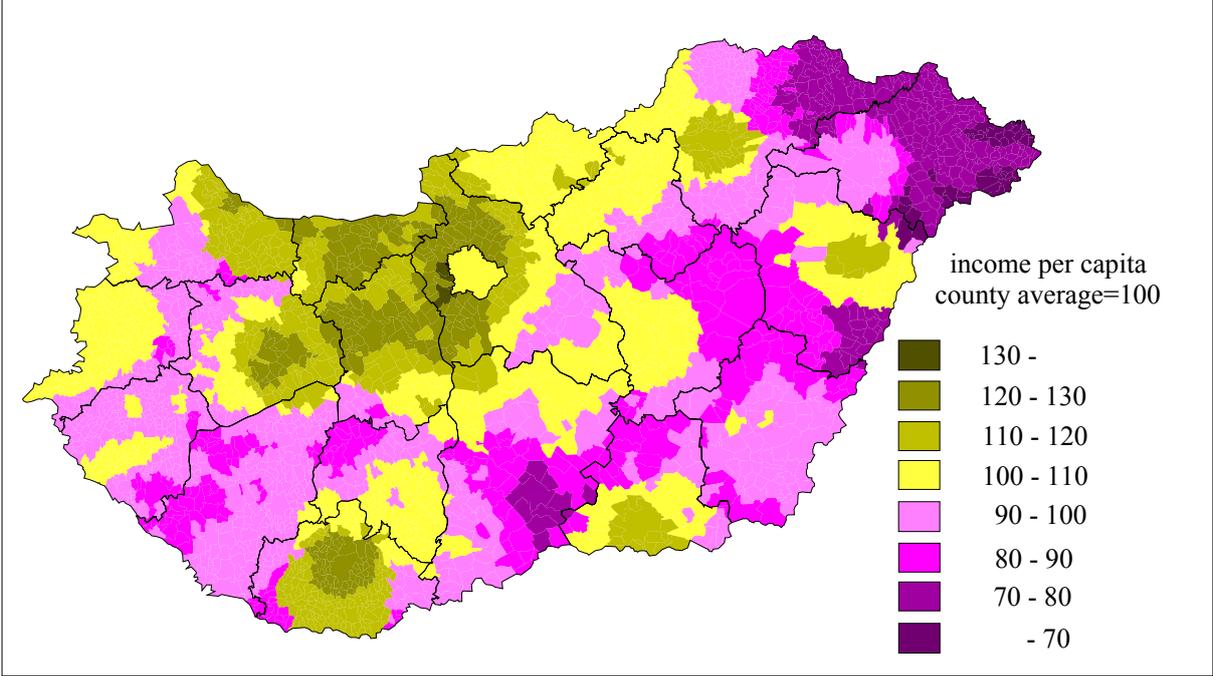


Figure 5 Spatial distribution of income per capita, 2002 (with spatial moving average on settlement level, $r=200000$ inhabitants; Budapest not included)

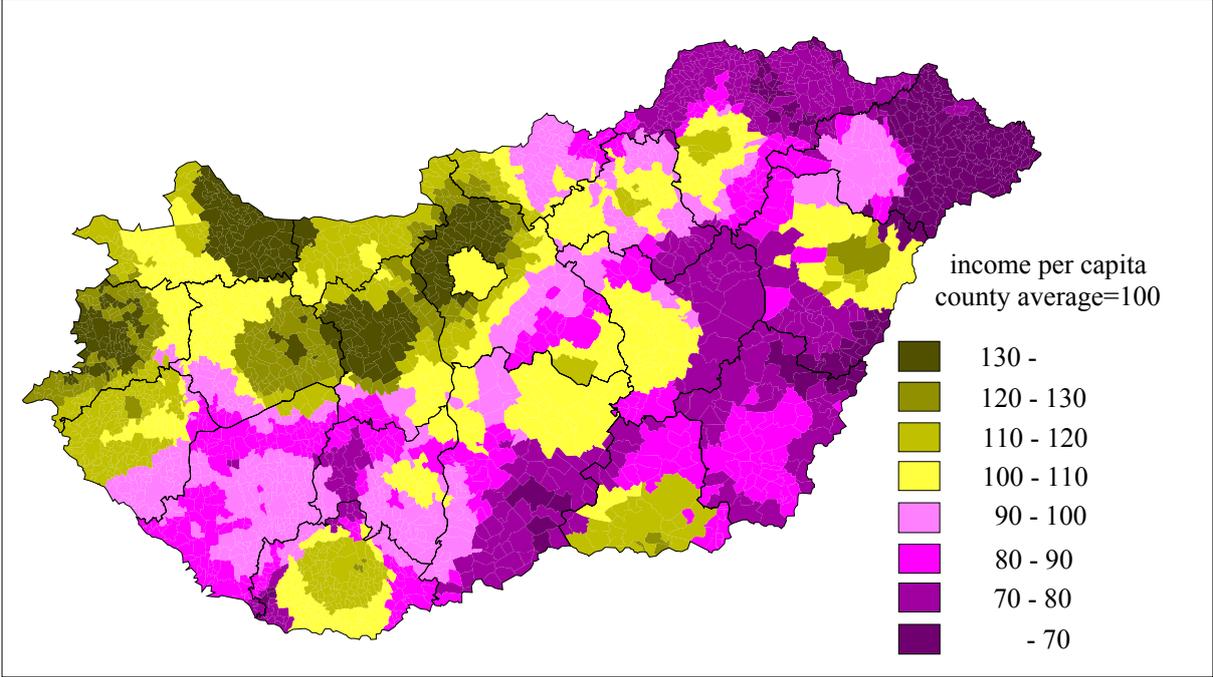


Figure 6 Change of spatial distribution of income per capita between 1988 and 2002 (with spatial moving average on settlement level, $r=200000$ inhabitants; Budapest not included)

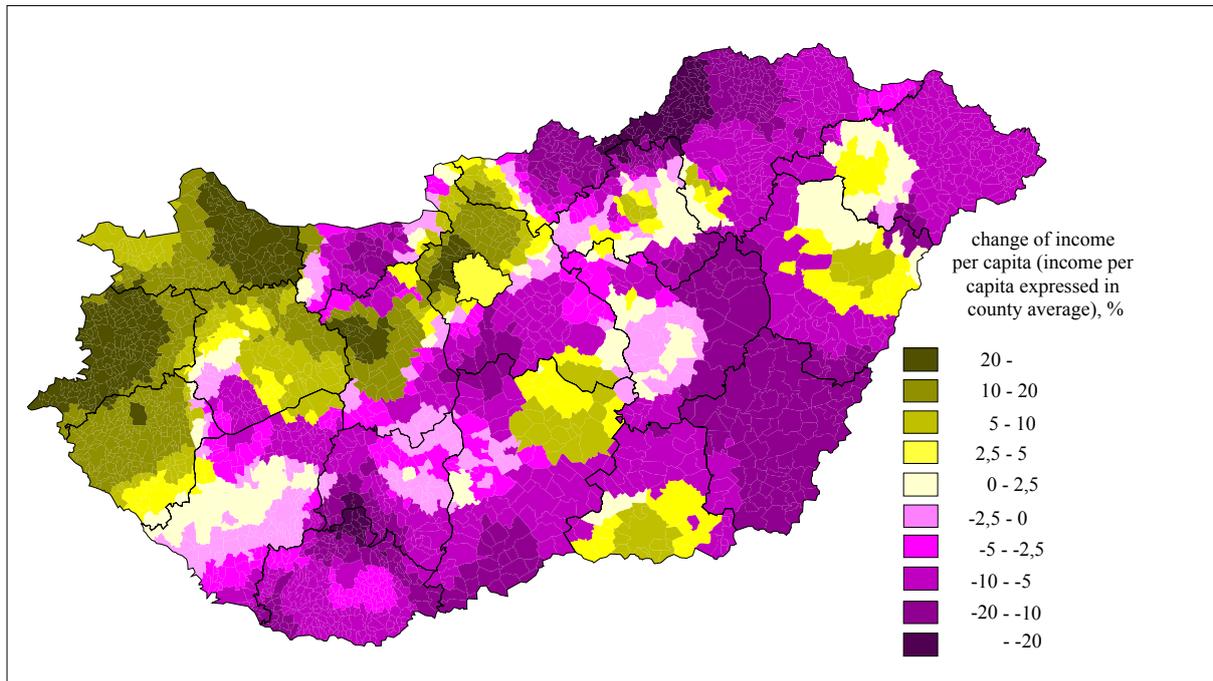


Figure 7 Spatial autocorrelation of income per capita in Hungary (Moran I)

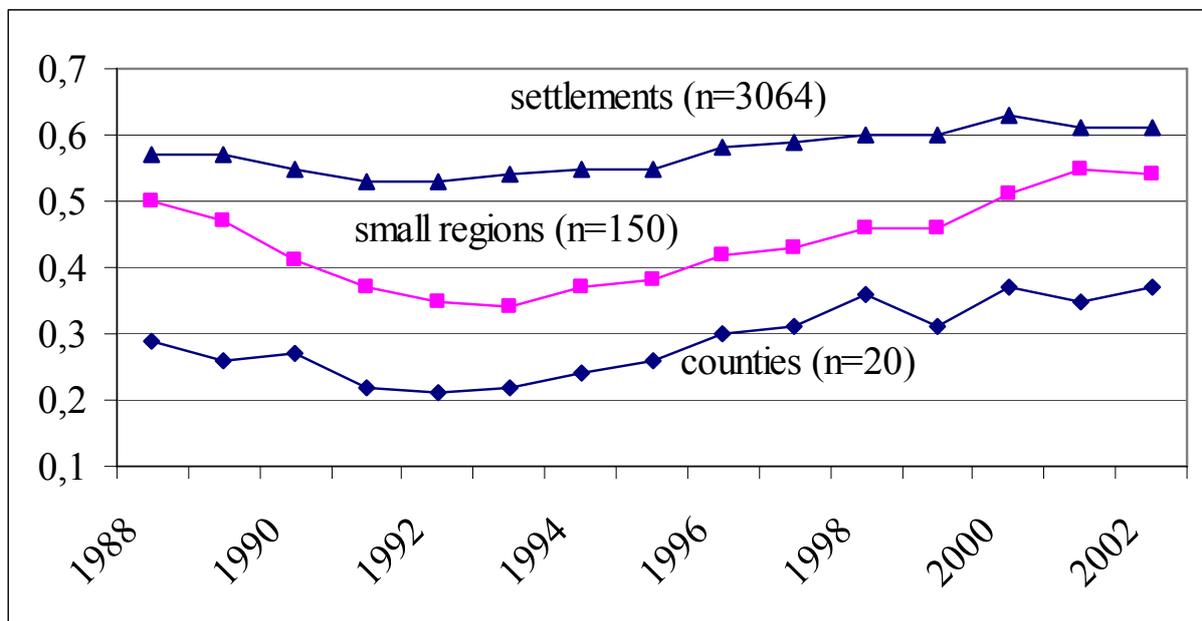


Figure 8 β_1 parameter and determination coefficient of linear trend (relative level of income per capita, 1988-2003)

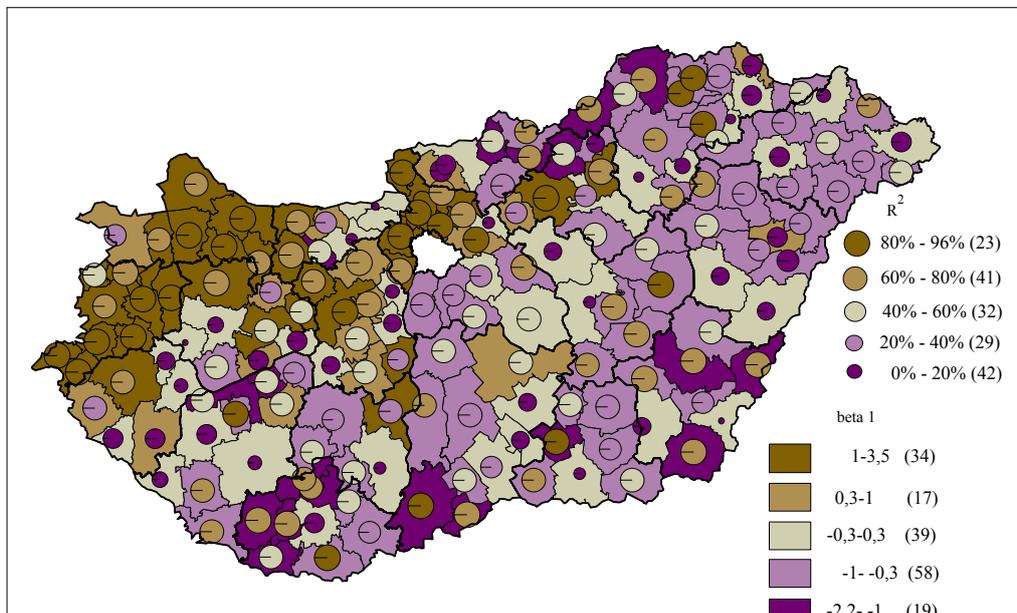


Figure 9 The number of same signs of variations in successive years (relative level of income per capita, 1988-2003)

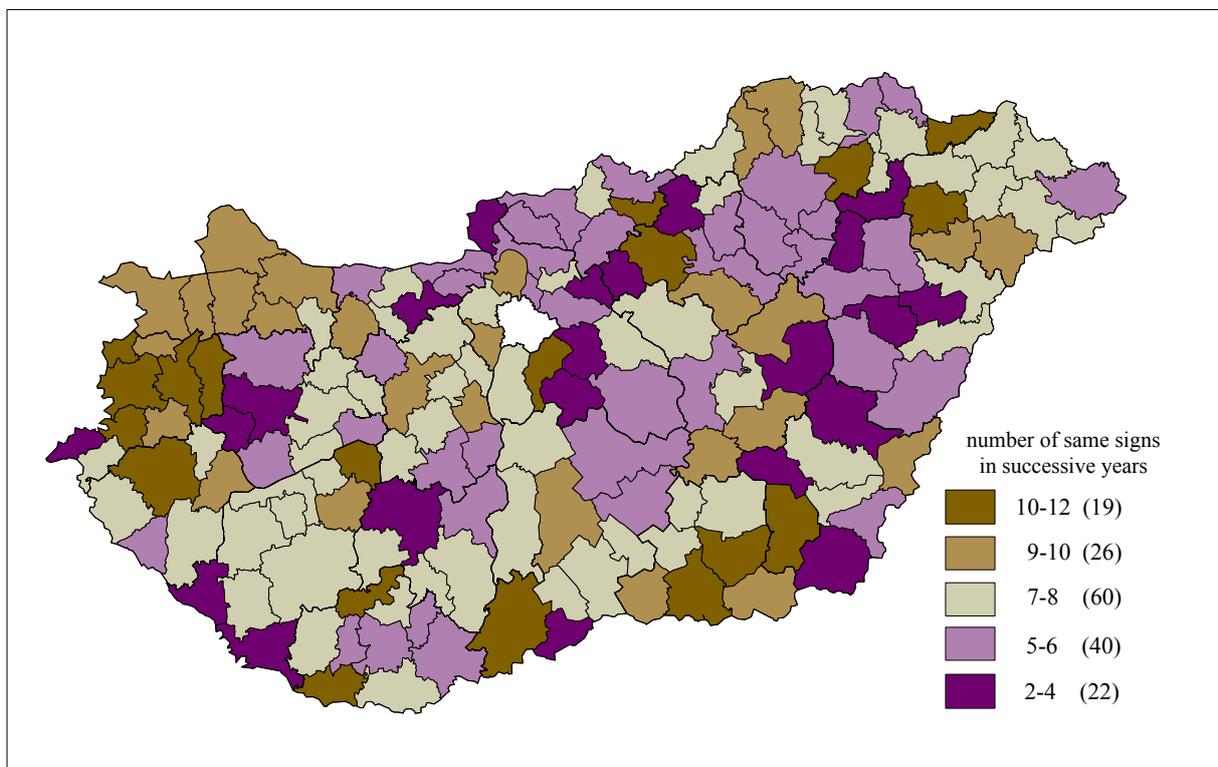


Figure 10 Standard deviation of absolute level (expressed in county average) of income per capita, 1988-2003

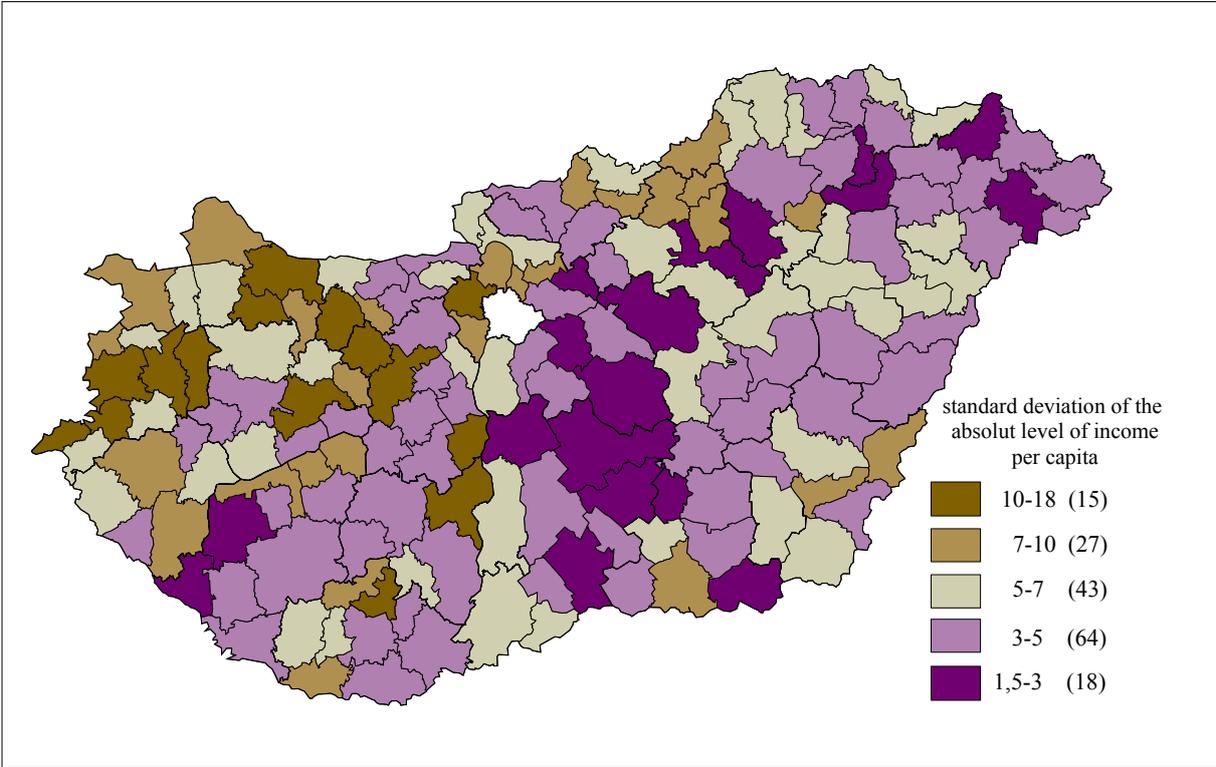


Figure 11 Standard deviation of change of absolute level (expressed in county average) of income per capita, 1988-2003

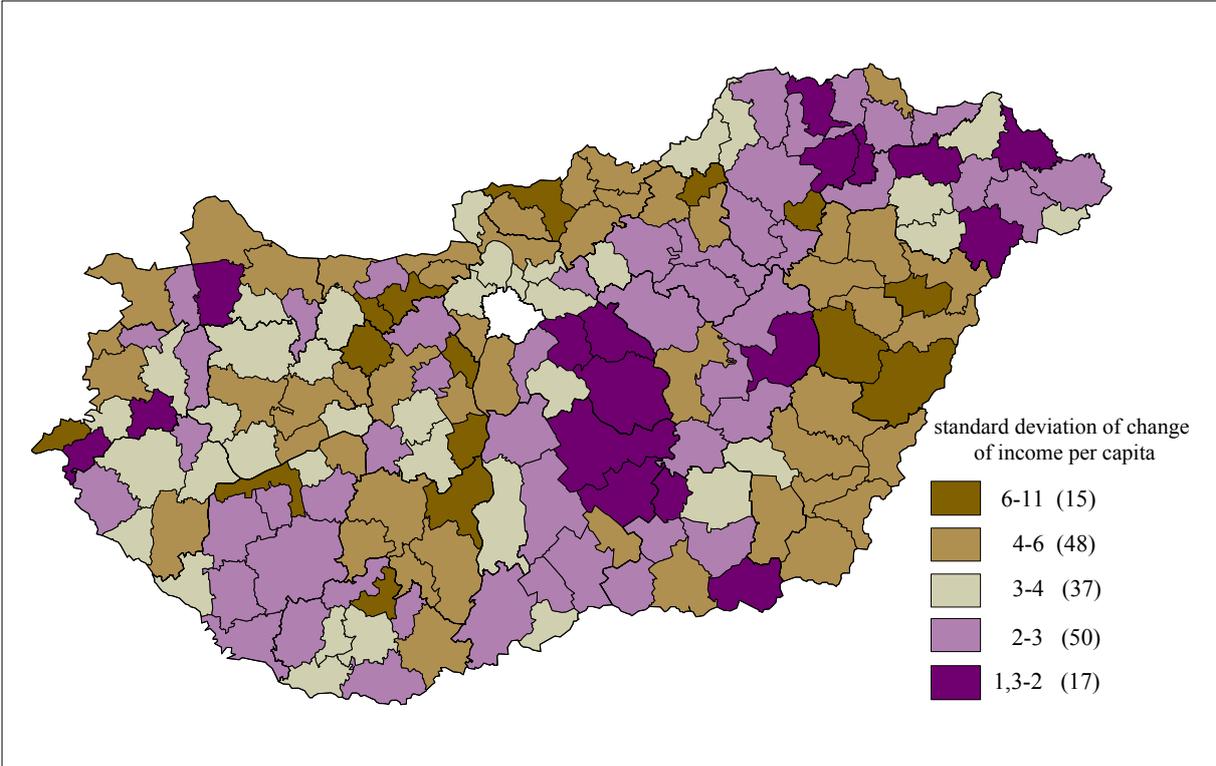


Figure 12 The year of maximal level of income per capita (expressed in county average)

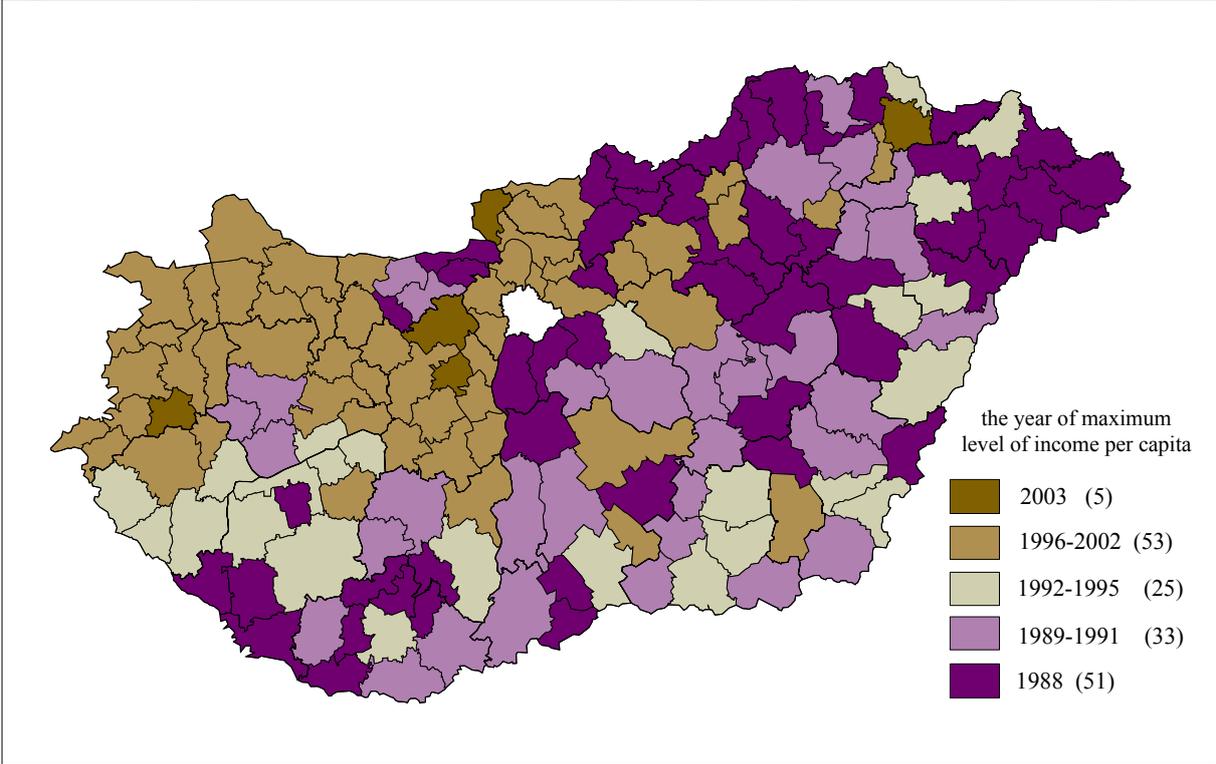


Figure 13 Maximal difference between two changes of income per capita in successive years

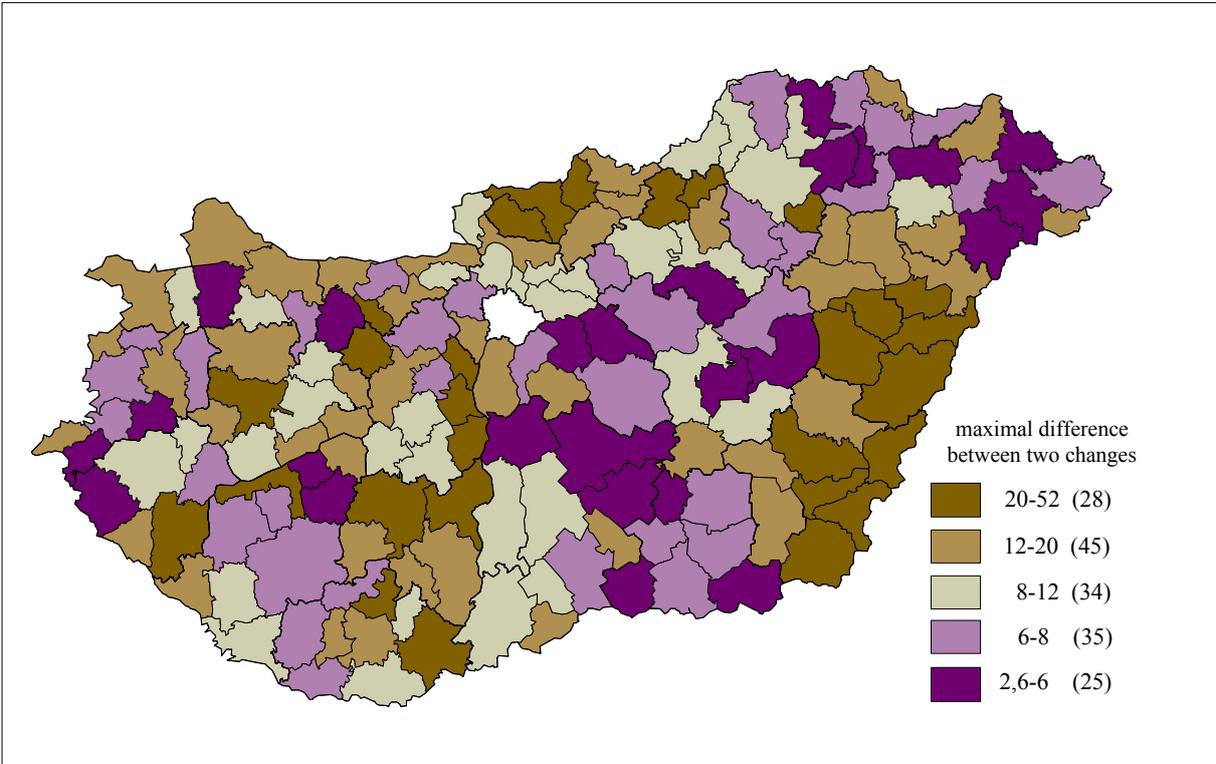


Figure 14 Identical temporal changes on different level

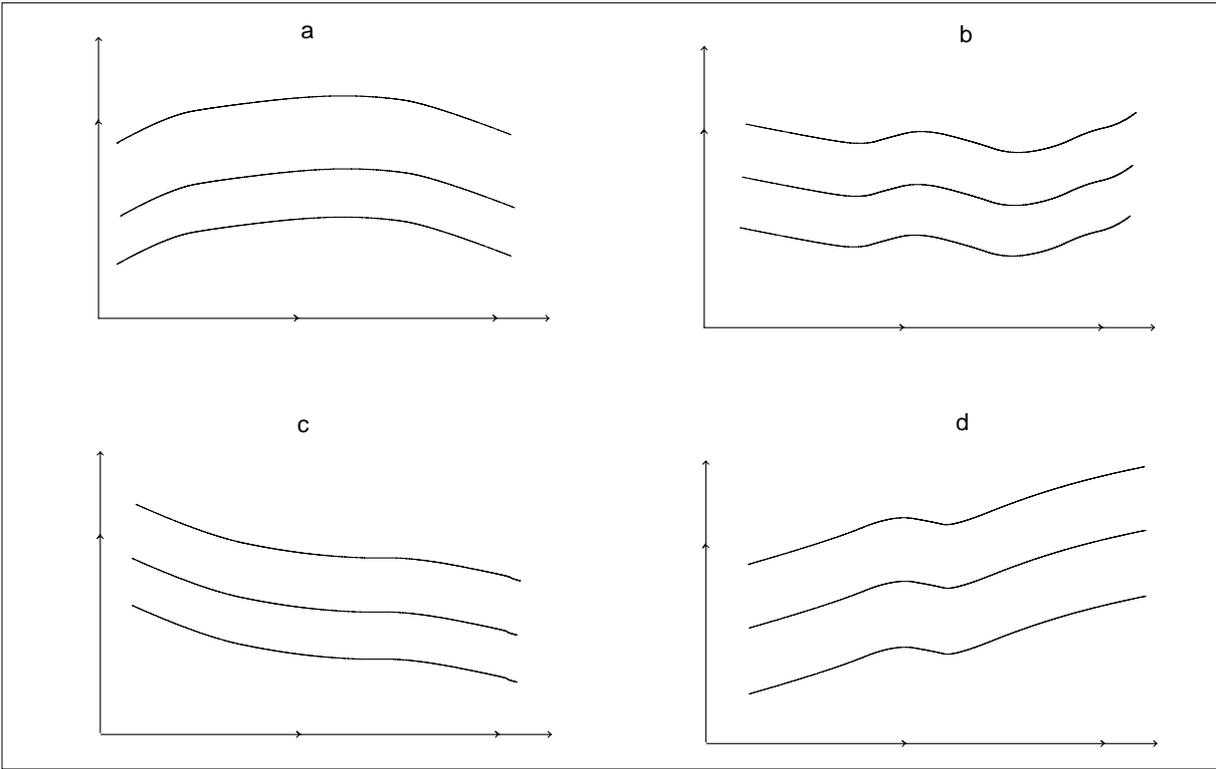


Figure 15 Types of changes of income per capita, 1988-2003

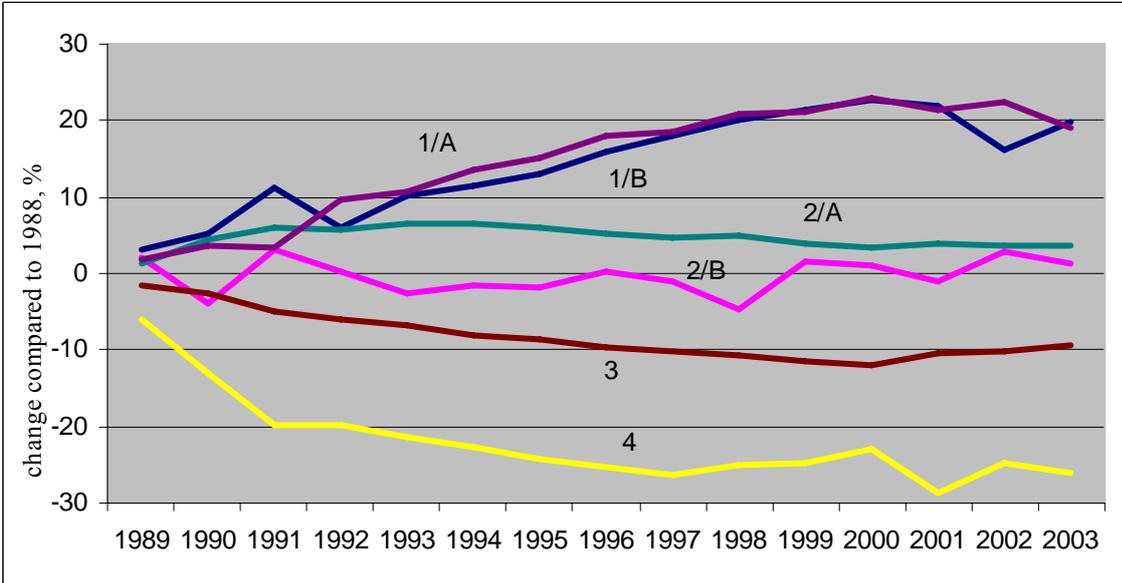


Figure 16 Spatial distribution of types of changes of income per capita, 1988-2003

