The Testing of Williamson’s Hypothesis in View of the Social and Economic Development of Microregions in Hungary

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This study aims at testing a hypothesis published by Jeffrey G. Williamson in 1965, according to which the correlation between the state of development and inner differentiation of individual area units can be described with an inverse U-shape curve. For the purpose of measurements, we have worked out a complex relative development index to perform, in space and time, a comparative analysis of the social and economic development of the area units under review. We have tested the practical applicability of the hypothesis through time and cross-sectional examinations, compared our results with the findings of others and provided an overall assessment.

Keywords: Williamson’s hypothesis, regional development, development differences, complex development index, microregion

1. Background and objectives of the study

According to Williamson’s hypothesis10, the relationship between the state of development and the inner differentiation of area units can be described with an inverse U-shape curve. Consequently, the more developed area units tend to display higher and lower inner differentiation, respectively, in the lower and higher development range. When examining the process in time dimension the same inverse U-shape curve can be seen, which means that in the initial stage of development the inner differentiation increases, while after a certain level of development the inner differentiation decreases parallel with the development process. (Nemes Nagy [2005a])

The development path of the ex socialist

10 Williamson [1965] examined the internal area inequalities of 30 countries on the basis of time-series and cross-sectional data, where development was characterized with per capita income and differentiation was shown with the weighted average deviation of income.
countries shows a special approach to the above described system of relationships of Williamson’s hypothesis (Figure 1).

Figure 1. Application of Williamson’s hypothesis to ex socialist countries

These countries were outside the classical model before the change of the political system as they were characterized by a strongly downward state of nivellating\(^{11}\) resulting in a diversion from the trend determined by the model. After the change of the political system the ex socialist countries introduced market economy. With this move the relationship between their state of development and inner differentiation shifted to the trend determined by Williamson’s hypothesis. As before the change of the political system these countries were characterized with a relative inequality, manifested in the above mentioned downward state of nivellation, this process meant an increase in development differences. (Nemes Nagy [2009])

This testing of the hypothesis under domestic conditions is not the first attempt. The most recent and complete study available currently in this field is a work by Németh–Kiss [2007] in which the authors used personal income tax base earnings to analyze the internal income differentiation of Hungarian counties and microregions and the main determinant factors. Based on deviation and distribution type indicators, the authors performed a time-series analysis of the period between 1990 and 2004 to find that the differentiation of municipalities within Hungary follows a relationship determined through Williamson’s hypothesis. The income differences between the municipalities displayed a quick and substantial rise during the years after the change of the political system, and then came a stagnation of several years, followed by a clear but slight nivellation after 2000. As the extent of nivellation was much lower

\(^{11}\) It means a relatively balanced development arising from a strongly centralizeed political and economic administration and from the state subsidies paid to maintain loss-making economic sectors even at the expense of foreign indebtedness.
than that of the differentation taking place at the start of the period, the income differences between Hungarian municipalities showed an aggregate growth during the period from 1990 to 2004. According to the results of the cross-sectional analyses performed at the level of microregions, most of the area units under study can be found on the downhill section of the inverse U-shape curve because there is a negative correlation between the state of development and the inner differentiation, which means that the inner differentiation of the more developed microregions tends to be lower and this relationship tends to become stronger during the study period.

As far as the analyses performed in the time dimension, there are findings similar to the above ones in the study of Nemes Nagy–Németh [2005] where the authors confirm, based on their time-series analyses performed from 1988 to 2003, that the income differentiation of Hungarian microregions shows a quick rise after the change of the political system, a high-level stagnation from the mid 1990s and then a slow mitigation after 2000. According to the authors, the slight income convergence found at the end of the period is due to a drop in the income generating capacity of certain export-driven regions and the substantial and regionally distributed rise in the wage of civil servants. It should be noted also in connection with this study that the end-of-period nivellation was unable to compensate the strong initial differentiation and thus the income differences between the microregions displayed a continuous growth during the entire study period.

As it is clear from the above studies, the process-based analyses typically identify development with a major factor i.e. income. An ever growing group of researchers (Ayres [1998], Dabóczi [1998], Heltai [1998], Pataki [1998], Sen [1998], Daly [2001]) disputes this approach by saying that development cannot be identified only with material wealth. Greater income is not the objective but only one of several tools of development. In this regard Nemes Nagy [1998] says that the state and pace of regional development is a complex multi-dimensional phenomenon that can be described only with many indicators. That is why in our study we attempt to measure the state and pace of social and economic development in the area units under review with the help of a complex relative development index created by us and use it to examine the practical implementation of Williamson’s hypothesis. Although certain other Hungarian authors have already used complex indicators to measure social and economic development (Csatári [1996], [1999], Dobosi [2003], Faluvégi [2000], [2003], Hahn [2004], Csatári–Farkas [2006], Kovacsicsné [2006], Nagy [2006], Faluvégi–Tipold [2007], [2009]), these studies have either produced results for a particular year or analyzed social and economic development for two—distant—years and given an assessment for the interim period on the basis of the results of such two years. It is clear from the foregoing that Hungarian literature lacks
complex time-series studies involving multiple indicators and that is why we have conducted our study.

With regard to the foregoing, we are trying to answer the following questions in our study:

- What changes took place in the social and economic development of Hungarian microregions in the period between 1996 and 2007?
- What correlations can be seen between the state of development and the inner differentiation of the area units under study?

As it has already been mentioned above in connection with Nemes Nagy [1998], the state and pace of development is a multidimensional phenomenon that is hard to measure and define. Nevertheless, a research study must always clarify the essence of the studied phenomenon. Accordingly, in line with the development approach of Németh [2008], we consider more developed, in social and economic terms, the area unit which is better positioned—along the dimensions specified by the study indicators—in space than the other area units or in time than itself.

2. Frameworks of the study

With due regard to the time limits of the information available in the data collection period, the analysis covers the period between 1996 and 2007.

For the purpose of setting up an information base for the study, we read not only the authors referred to above but also some other studies that were somehow connected to our work (Fazekas [1997], Molnár et al. [2002], VÁTI [2002], Lengyel [2003], Biró et al. [2004], Barna–Molnár–Juhász [2005], Beluszky–Sikos [2007], Lu Kovics [2007], Lőcsei–Szalkai [2008]). Based on the studies and our own technical considerations, we collected for each of the twelve years under study a total of 140 municipality-level and microregion-level base data that were used to generate for each area unit of each study year a total of 220 ratios, which were then considered the base indicators of our study.

Based on our previous studies and the practice applied by other authors (Csatári [1996], [1999], Faluvégi [2000], Molnár et al. [2002], ifj. Lőkös–Lőkös [2003], Obádovics [2004], Ritter [2008], Németh–Kiss [2007]), we have

12 This is what Nemes Nagy [2005a] means by saying that “domestic research does not go beyond the static assessment of area structures” (p. 12).
13 Data from the National System for Regional Development and Physical Planning were used for the study.
14 The 220 study ratios described the following fields: demographics (15), business potential (38), income (23), capital investments (6), unemployment (14), tourism (48), infrastructure (16), human infrastructure and human capital (35), municipality budget (11), environmental load (14).
excluded Budapest from the study due to its dominant position in the country and the resulting distortion impact on the findings. Therefore our study involved a total of 173 microregions and—in view of data availability—3124 municipalities.

3. Determining the level and pace of social and economic development

The large number of initial indicators enabled us to pick the indicators from several similar ones for the final study that were most suitable in terms of technical and mathematical aspects.

As to technical aspects, the following considerations were thought important:

– the indicators must provide the widest possible, yet detailed and transparent coverage for the dimensions of social and economic development;
– in cases where a dimension is characterized in a detailed manner, not a single part of the entire picture must be left out as it would entail loss of information;
– each dimension must be characterized with about the same number of indicators in order to avoid any extreme under- or overrepresentation of certain dimensions;
– the indicators must measure the same impact only once in the model.

As to mathematical aspects, main component analysis parameters were considered, according to which:

– the communality value of the indicators must be the highest possible but minimum 0.25
– the main components having an eigenvalue above one must retain the highest possible share but minimum 60% of the total deviation of the standardized indicators
– the KMO value of the study indicator structure must be the highest possible but minimum 0.5

15 Consequently, a total of 3297 area units were involved in the study.
16 It should be noted that the purpose of main component analysis was not to capture the dimensions (main components) of the process under study but to identify an indicator structure that is a source of time and area information, suitable for statistical weighting and, at the same time, that represents a continuous system.
17 See the referred parameters in the publications of Szélényi [2004], Székely–Barna [2005], Ketskeméty–Izsó (2005), Sajtos–Mitev [2007].
18 As to retained variance, it should be noted that according to Székely–Barna [2005], 33% is an acceptable level.
the number of area units involved in the main component analysis must be at least five times the number of indicators that make up the final indicator structure.

As a first step, we performed a selection of indicators for the first and last year of the study period at the level of microregions by conducting a main component analysis of the initial set of indicators and, after the exclusion of the indicator with the lowest communality and MSA value, by performing another analysis. This procedure was repeated until we arrived to a perfect structure in terms of mathematical criteria. Then we made a technical assessment of the filtered indicators and performed the required adjustments with a view to causing the least possible damage to the already achieved mathematical criteria.

As a next step, we conducted the main component analysis, with the already established indicator structure, for each year of the study period at the level of microregions and municipalities. Then, strictly in line with the already fulfilled technical criteria, we replaced the indicators to perform some minor but absolutely necessary adjustments that were needed in order to improve compliance with the mathematical criteria without damaging the already fulfilled technical criteria. As a result, we have identified the following 34 indicators for each year of the study period and for each area unit under study:

1. Population density (persons/km²)
2. Resident population aged below 15 years/resident population aged above 60 years
3. Balance of migration/1,000 inhabitants
4. Natural reproduction /1,000 inhabitants
5. Number of enterprises in the building industry/1,000 inhabitants
6. Number of enterprises in mining, processing industry, electricity, gas, heat and water supply/1,000 inhabitants
7. Number of enterprises in agriculture, forestry, game management and fishing/1,000 inhabitants
8. Number of enterprises in the services sector/1,000 inhabitants
9. Corporate income tax payable/inhabitant
10. Net export sales/inhabitant
11. Total domestic income/inhabitant
12. Number of persons receiving regular social aid from municipality/population, %

Demographics 1–4.; Business potential 5–8.; Income and aids 9–12.; Unemployment and human capital 13–17.; Tourism and trade 18–21.; Infrastructure 22–27.; Human infrastructure and human capital 28–34. Nevertheless, although certain initial dimensions were not included in the final indicator structure for mathematical reasons, their impact could be substantially felt in the above 34 indicators.
13. Number of registered unemployed without primary school education/working-age population, %
14. Number of registered unemployed with primary school education/working-age population, %
15. Number of registered unemployed with secondary school education/working-age population, %
16. Number of registered unemployed with higher education/working-age population, %
17. Number of long-term (over 180 days) registered unemployed/registered unemployed, %
18. Number of restaurants, patisseries, bars and wineries/1,000 inhabitants
19. Number of retail shops (excluding pharmacies)/1,000 inhabitants
20. Foreign guest nights spent at places of accommodation/1,000 inhabitants
21. Domestic guest nights spent at places of accommodation/1,000 inhabitants
22. Number of residential units built during the year (excluding resort places)/housing stock, %
23. Housing stock/1,000 inhabitants
24. Sewer length/water conduit km
25. Number of gas consuming households/housing stock, %
26. Number of cars at year end/1,000 inhabitants
27. Number of main telephone lines/1,000 inhabitants
28. Number of qualified nursery attendants/1,000 nursery-age inhabitants
29. Number of kindergarten teachers/1,000 kindergarten-age inhabitants
30. Number of full-time primary school teachers/1,000 primary school-age inhabitants
31. Number of full-time secondary school teachers/1,000 secondary school-age inhabitants
32. Number of family physicians/1,000 inhabitants
33. Number of mother and infant care nurses/1,000 nursery-age inhabitants
34. Number of cinema visits/1,000 inhabitants

In view of the established technical criteria, the above indicator structure is considered suitable for the description of the phenomenon under study. The human field may seem a bit overemphasized but it is evident that business potential, income, tourism and trade are all economic fields. Also, unemployment is again, at least partly, an economic field in this breakdown. In addition, infrastructure is also not independent of the economy, so the overemphasis is not relevant at all.

At the level of microregions our indicators fully satisfy the required mathematical criteria. Compliance at the level of municipalities is 100% for

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20 Minimum values: communality 0.30; retained variance 71.9%; KMO 0.869
KMO, 98% for communality and 33% for retained variance. At the level of municipalities our indicator structure fails to reach the established statistical threshold in certain cases but given that the sewers indicator having a lower than expected communality is the sole factor to represent environmental load, it was allowed to remain in the study for technical reasons. As far as retained variance is concerned, it should be noted that, according to Székely–Barna [2005], 33% is already acceptable. Furthermore, Molnár et al. [2002] produce their aggregate indicator—to measure the complex development of domestic municipalities—from the linear combination of such main components which have a total retained information content of 48.7%. In view of the foregoing, the identified set of indicators is considered suitable, also in terms of mathematical considerations, for the implementation of the study at the level of municipalities and microregions.

The promising KMO values obtained for the indicator structure prove that the identified set of indicators forms a closely integrated system with a strong latent structure being in the background (Székely–Barna [2005], Ketskeméty–Izsó [2005]). Therefore it is suitable for describing social and economic development in the form of an aggregate index. As it has been already mentioned above, some other Hungarian authors also used aggregate indicators in order to assess the development differences among domestic microregions. In addition, the regions eligible for area development support are also identified through the use of a complex indicator based on a scoring procedure (67/2007 (VI. 28.)). However, in the above cases it is not an objective to perform time-series analyses or to consider the study indicators with different weights. In this study the indicators were weighted with the communalities determined during the main component analysis. As the communality of the indicator simply means how close is the relationships between such indicator and the indicator structure, if the indicators are weighted with their own communality then the bigger weight will be assigned to the indicator that forms a more integral part of the indicator structure and thus provides a bigger part of its own information content to the system consisting of the indicators. For similar reasons, Lukovics Miklós [2007] uses the square root of communalities for weighting in his doctoral thesis22.

For the purpose of aggregation, after the determination of the weights the indicator values were normalized with the help of the formula used also for HDI creation (see for example: Husz [2001], Obádovics–Kulcsár [2003], Rechnitzer–

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21 Minimum values: communality 0.188; retained variance 55.1%; KMO 0.829
22 In this case no square root was taken of the communalities as in this manner the weight values vary in a wider range and the weighting of indicators becomes more differentiated. It should be noted here that Veres Lajos [2001] also uses main component analysis in his doctoral thesis to create the TRANS indicator. Furthermore, Molnár et al. [2002] and Bíró et al. [2004] use the main components’ retained variance to weight their own indicators in order to arrive at the complex relative development index.
Smahó [2005], Csit–Németh [2007], Józan [2008], Egri–Ménes–Tánczos–Törőcsik [2009])\textsuperscript{23}. When assessing the base formula of HDI, Trabold–Nübler [1991] point out that the normalized value of the relevant indicator of an area unit will change from one year to another also in the case when the actual indicator value does not change but the extreme values are modified. It means that the time-series comparison of normalized values is impossible. This problem can be eliminated if the extreme values are fixed. If the extreme values of the given indicator are identified with the highest and lowest values measured in time and space then the area units under study will become comparable in both time and space from zero to one along the given indicator. As to the given normalized indicator the area unit found in the worst position for the entire period in any year in terms of such indicator will be assigned 0, while 1 will be assigned to the area unit that is best positioned in terms of the given indicator. It is summarized in formula (1).

\[
N_{ijk} = \frac{X_{ijk} - X_{j_{\text{min}}}}{X_{j_{\text{max}}} - X_{j_{\text{min}}}} \quad (1)
\]

\[
\text{FI}_{ik} = \frac{\sum_{j=1}^{34} c_{jk} * N_{ijk}}{\sum_{j=1}^{34} c_{jk}} \quad (2)
\]

where:
- \(X_{ijk}\) means the value of indicator \(j\) of area unit \(i\) in year \(k\)
- \(X_{j_{\text{min}}}\) and \(X_{j_{\text{max}}}\) mean the min. and max. value of indicator \(j\) in space and time
- \(c_{jk}\) means the communality of indicator \(j\) in year \(k\)
- \(N_{ijk}\) means the normalized value of indicator \(j\) of area unit \(i\) in year \(k\)
- \(\text{FI}_{ik}\) means the complex relative development index of area unit \(i\) in year \(k\)
- \(1 \leq i \leq 3297\) \hspace{1cm} \(1 \leq j \leq 34\) \hspace{1cm} \(1 \leq k \leq 12\)

It is clear from the foregoing that the value of an indicator normalized according to formula (1) will show the relative position of the given area unit compared to itself in the function of time and compared to the other area units in the function of space and time. This enables us to aggregate thirty-four indicators by area unit and to position each area unit on the basis of aggregate indicators. For such purpose we used formula (2) to calculate the weighted mathematical mean value of the normalized indicators for each year of each area unit.

\textsuperscript{23} It should be noted that the values of the unemployment and social aids indicators were distracted from 100\% during normalization to ensure that the higher values mean better positions also in the case of these indicators (Nemes Nagy [2005\textsuperscript{a}]).
unit. The aggregate indicator obtained this way was called complex relative development index.

4. The testing of Williamson’s hypothesis in time dimension

As it is clear from various publications cited in connection with the hypothesis tested in this study, deviation type indicators can be efficiently used to measure changes in development differences. Nemes Nagy [1998] also notes that following the normalization of indicators their deviation and relative deviation will change. Therefore, prior to determining the deviation type indicators of the complex relative development index, we examined the time-series correlation between the deviation and relative deviation of the original and normalized indicators. According to the obtained results, there is a function-like positive correlation between the deviation of each original and normalized indicator. It means that a rise in the deviation of the original indicator is coupled with a linear rise in the deviation of the normalized indicator. According to the results regarding the relative deviation, there is a function-like correlation between the original and the normalized values in the case of twenty-eight indicators. Four indicators showed a correlation above 0.99, while two indicators displayed only poor or average correlation. Our results confirm that analyses based on deviation type indicators can be efficiently performed. However, it should be noted that no conclusions can be drawn from individual indicator values given that they always change during the normalization process. It means that only the change of such values in the function of time can be evaluated. In view of the foregoing, the widespread use of the indicator and the easy interpretation of the results, we used relative deviation to measure the changes in the state of development between microregions, which is shown in the function of time in Figure 2.

The data show that the development differences between microregions increased during the study period. However, based on the extremely stable regression function, it is also clear that the differentiation of microregions had a decreasing trend all through the study period. It means that although the development differences increased in the average of the study period, the rate of such increase gradually reduced. When evaluating the results together with the findings of Nemes Nagy–Németh [2005] it can be seen that the differentiation process measured on the basis of complex development shows a time shift in comparison with the income-based differentiation process. While the issue of income shows a stagnation at a high level of differentiation from the mid 1990s until 2000, complex development starts to display a stagnating tendency only after 2003. The slight nivellation detected for the income processes cannot be

24 Balance of migration/1,000 inhabitants; Natural reproduction/1,000 inhabitants.
seen in the pattern of complex development differences. The change in complex development differences after 2000 means—in line with the findings regarding the income processes—that the pace of differentiation decreases slowly but firmly from 2001, followed by a nivellation between 2003 and 2005. However, it is only temporary and therefore such nivellation does not represent a trend.

![Figure 2. The process of differentiation in Hungarian microregions on the basis of complex development](attachment:figure2.png)

The time shift between the income-based and complex development differentiation processes probably comes from the fact that, on one hand, the changes of income conditions become visible much faster in the differentiation processes and, on the other hand, that complex development is obviously influenced by several factors, which means that the factors of differentiation were more numerous and powerful than the factors of nivellation during the period that followed the change of the political system. As far as the comments made with regard to Figure 1 and 2 are concerned, it can be stated that, although showing some delay in comparison with the income processes, Williamson’s hypothesis seems to be valid in the time dimension also for the complex development of Hungarian microregions.

25 The complex development index was determined also for the entire country. Its value of 0.22 in 1996 increased to 0.25 in 2007, which means that with the passing of time a development also took place at national level.
5. The cross-sectional testing of Williamson’s hypothesis

In order to answer our second study question, for each year under review a linear regression function was placed over the point diagram generated from the complex development index of microregions and from the relative deviation of municipality-level complex development indexes within the microregions. The slope of the regression functions clearly shows the direction and intensity of correlation between the state of development and inner differentiation of the microregions for a given year. By plotting the annual slope of such functions in the function of time it is possible to see the direction of processes that took place in the field of microregion-level development and inner differentiation during the study period.

Figure 3. Correlation between the state of development and inner differentiation of microregions in the function of time

The diagram and regression function in Figure 3 show that the inner differentiation of the more developed microregions tended to be higher from 1996 until 2001. However, the differences in the inner differentiation of such area units tended to level. As from 2002 the correlations became just the opposite: the less developed microregions became more differentiated. This tendency continued until the end of the study period i.e. the differentiation of the less developed microregions tended to increase in comparison with that of the more developed microregions. The direction of the revealed processes is the same as the direction expected under Williamson’s hypothesis. According to the
correlations, before 2002 most microregions were found on the uphill section of the inverse U-shape curve but after 2002 most of them slipped to the downhill section. It means that during the study period they gradually shifted from the uphill section to the downhill section. When evaluating the results together with the findings of Németh–Kiss [2007] it is clear, as seen during the time dimension analysis, that there is a shift (delay) of the complex development process in comparison with the income-based differentiation. When examined on income basis, most microregions are found on the downhill section of the inverse U-shape curve as early as from 1990, which means that the more developed area units tend to be less differentiated. However, when examined on the basis of complex development, most microregions are found on the downhill section of the inverse U-shape curve only after 2001, which means that the more developed area units tend to become less differentiated only in this period. As to the time difference between the two processes, the description given above for the time dimension analysis may be held applicable.

The fact that the direction of the revealed processes is in line with the expectations attached to Williamson’s hypothesis does not automatically mean that the hypothesis fully holds true also for the cross-sectional examinations. Actually, direction says nothing about the shape of processes. Thus, as a next step, we tried to confirm whether the complex relative development and the inner differentiation of Hungarian microregions can be described with an inverse U-shape curve. In order to answer the question, for each year under review a second-degree polynomial regression function was placed over the point diagram generated from the complex development index of microregions and from the relative deviation of municipality-level complex development indexes within the microregions. Under our assumption, if the inverse U-shape does exist in the above system of correlations then the second-degree polynomial regression function must be a negative parabola in at least one of the years of 2001 and 2002. We expect a negative parabola in one of these two years because, as it is clear in Figure 3, the slope of the regression line turns from positive into negative exactly in this period, which means that most microregions must change position from the uphill section to the downhill section of the inverse U-shape in this period. In view of the parameters of the generated regression functions (Table 1.), it is clear that a convex curve is obtained in each year of the study period\(^{26}\), which means that none of the years under review produced the inverse U-shape in the cross-sectional examinations.

\(^{26}\) It should be noted here that both the shape and direction of the regression function obtained by Németh–Kiss [2007] for year 2004 are identical with the shape and direction of our function.
Table 1
Main parameters of the second-degree regression correlation for the complex development and inner differentiation of Hungarian microregions

<table>
<thead>
<tr>
<th>Year</th>
<th>a(^*)</th>
<th>b(^**)</th>
<th>c(^***)</th>
<th>min. point</th>
<th>R(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>4108.42</td>
<td>-1764.48</td>
<td>192.72</td>
<td>0.215</td>
<td>0.230</td>
</tr>
<tr>
<td>1997</td>
<td>4791.92</td>
<td>-2099.19</td>
<td>232.51</td>
<td>0.219</td>
<td>0.303</td>
</tr>
<tr>
<td>1998</td>
<td>6486.64</td>
<td>-2861.86</td>
<td>319.10</td>
<td>0.221</td>
<td>0.356</td>
</tr>
<tr>
<td>1999</td>
<td>4658.80</td>
<td>-2007.18</td>
<td>219.72</td>
<td>0.215</td>
<td>0.309</td>
</tr>
<tr>
<td>2000</td>
<td>4129.52</td>
<td>-1934.14</td>
<td>229.70</td>
<td>0.234</td>
<td>0.253</td>
</tr>
<tr>
<td>2001</td>
<td>4222.51</td>
<td>-2004.62</td>
<td>241.40</td>
<td>0.237</td>
<td>0.210</td>
</tr>
<tr>
<td>2002</td>
<td>4953.00</td>
<td>-2380.30</td>
<td>289.75</td>
<td>0.240</td>
<td>0.253</td>
</tr>
<tr>
<td>2003</td>
<td>4190.17</td>
<td>-2004.31</td>
<td>243.62</td>
<td>0.239</td>
<td>0.214</td>
</tr>
<tr>
<td>2004</td>
<td>3385.26</td>
<td>-1640.85</td>
<td>202.60</td>
<td>0.242</td>
<td>0.171</td>
</tr>
<tr>
<td>2005</td>
<td>3293.35</td>
<td>-1705.76</td>
<td>224.58</td>
<td>0.259</td>
<td>0.157</td>
</tr>
<tr>
<td>2006</td>
<td>3828.46</td>
<td>-1926.86</td>
<td>246.26</td>
<td>0.252</td>
<td>0.097</td>
</tr>
<tr>
<td>2007</td>
<td>2594.93</td>
<td>-1349.16</td>
<td>179.21</td>
<td>0.260</td>
<td>0.143</td>
</tr>
</tbody>
</table>

\(^*\) a: determinant of second-degree term  
\(^\ast\) b: determinant of first-degree term  
\(^***\) c: constant

For the purposes of demonstration we have inserted Figure 4 showing the shape of the regression functions obtained for 1996, 2002 and 2007\(^{27}\). Year 2002 was selected from the 2001/2002 period because, as it is clear in Figure 3, this is the year when the slope of the regression line is closest to zero\(^{28}\) i.e. this year is closest to the peak of the inverse U-shape. Figure 3 and 4 and Table 1 clearly show that the correlation between the complex relative development and the inner differentiation of Hungarian microregions does not fully produce an inverse U-shape. In fact, only the uphill and downhill section can be detected, while the concave section expected between these two does not appear. Thus it can be concluded that in the study period the group of least differentiated microregions (range around the minimum value of the functions) is constantly moving from the least developed microregions towards the most developed ones as it is evidenced also by a rising trend of the minimum point of the functions (Table 1). This shifting process is probably not over yet given that, according to the regression function of 2007, the group of least differentiated microregions has not fully moved yet to the maximum point of the development scale. It is interesting to see that in 1996 the inner differentiation of the most developed

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\(^{27}\) For better visibility, the Figure omits the data points belonging to the microregions and shows only the regression functions.

\(^{28}\) The slope is 13.4 in 2001 and -9.6 in 2002.
microregions was almost the same as that of the least developed microregions in 2007\(^{29}\). Actually, this level of differentiation represented the maximum level of inner differentiation in both years. The minimum level of inner differentiation displays a similar correlation at the opposite end of the development scales except that in this case the relative deviations show somewhat greater differences\(^{30}\) and that in 1996 the minimum level of inner differentiation does not apply exactly to the least developed microregions, just as in 2007 it does not hold true only for the most developed ones.

![Figure 4. Correlation between the complex relative development and the inner differentiation of microregions in certain years](image)

6. Conclusion

For the period between 1996 and 2007 a complex relative development index has been worked out to help the time and space analysis of the state and changes of social and economic development in Hungarian municipalities and microregions. Based on the said development index, the study aimed at testing Williamson’s hypothesis so that we can answer two questions: what changes took place in the social and economic development of Hungarian microregions in the study period and what correlations can be seen between the state of


development and the inner differentiation of the area units under study? According to our findings, the development differences between such area units increased during the study period and the differentiation process follows a trend assumed under Williamson’s hypothesis. When our results were assessed together with the findings of studies that analyzed the development differences on income basis, it became clear that the differentiation process examined on the basis of complex development shows a shift (delay) in comparison with the income-based differentiation process. According to our cross-sectional examinations, the direction of the correlation between the state of development and the inner differentiation of microregions in the study period follows Williamson’s hypothesis but the shape of processes does not follow the assumed inverse U-shape. In this case the issue is that during the study period the group of least differentiated microregions is constantly moving from the least developed microregions towards the most developed ones. Accordingly, in each of the years under review the correlation between the state of development and the inner differentiation is characterized by a normal U-shape. The uphill section dominates in the first half, while the downhill section is stronger in the second half of the period. When comparing our results with the findings of the income-based studies referred to above, we were able to see the already mentioned time lag and to observe the same shape and direction of the regression functions.

References


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