

# REGIONAL SPECIALIZATION AND GEOGRAPHIC CONCENTRATION OF INDUSTRIES IN ROMANIA

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**Abstract.** There are many studies in the regional economics literature which have approached the issues of regional specialization and concentration. The definitions of both regional specialization and geographic concentration of industries are based on the same production structures, reflecting the same reality. Regional specialization expresses the territorial perspective and depicts the distribution of the sectoral shares in one region, usually compared to the rest of the country, while geographic concentration of a specific industry reflects the distribution of its regional shares. In order to explore the main characteristics and the interaction between regional specialization and sectorial concentration in Romania and to achieve a better understanding of the topic, we combined “traditional” statistical measures like Herfindahl Index and Krugman Dissimilarity Index with methods envisaging the amplitude and the speed of structural changes. Concentration of industries and specialization of regions were measured for 1996-2005 period on the basis of the Gross Value Added data, by branch and by region, provided by Romanian official statistics.

**Key words:** specialization, concentration, region, Romania

## 1. Introduction

Many studies in the regional economics literature have approached the issues of both industrial specialization of regions/countries and geographic concentration of industries, considered by many as “two sides of the same coin”.

This topic is becoming increasingly important for Romania since the transition to the market economy had already strongly reshaped the industrial structure and, following the recent accession to EU, further changes are expected in order to accommodate to the new enlarged economic environment. Moreover, the ongoing international evolution viz. integration, globalization, new technological opportunities and the changing demand are currently bringing about new challenges and the need for countries and industries to adapt more rapidly.

The aim of our research is to investigate whether economic activities in Romania become more geographically dispersed or not and whether the economic structure of the regions is converging or is becoming more different. For this purpose we are to employ different statistical measures of both regional specialization and geographic concentration, in an attempt to capture various sides of these phenomena.

The paper is structured as follows. In the next section we give a short overview of the relevant literature, with reference first of all to the main theoretical contributions and then briefly discuss the empirical studies concerning the specialization patterns in European countries and in Romania as well. Section 3 describes the methodology used to work on data. Sections 4 and 5 move on to provide our basic empirical results on economic specialization of regions and geographic concentration of economic activities. We present evidence showing that these two processes are developing at different speeds and, sometimes, in opposite directions. Section 6 provides concluding comments.

## 2. Theory and empirical evidence on specialization and concentration

The models and empirical studies which focus on regional specialization and industrial concentration mainly originate in trade theory and location theory, dating back in the 19th and then 20<sup>th</sup> century.

One of the main streams of the literature dedicated to regional specialization refers to the mechanisms of this process, usually described by Ricardo's comparative advantage theory (1817) and Heckscher-Ohlin's factor endowment theory (Heckscher, 1919, Ohlin, 1933). In another register the Keynesian approaches to growth theory predict less specialization as a result of income convergence through the equalization of factor productivity (Armstrong and Taylor, 2000). Moreover, the models based on product differentiation and economies of scale have demonstrated an increasing emphasis on intra-industry trade (world trade in similar products) rather than on inter-industry trade (world trade in different products), as predicted by traditional trade theories (Marshall (1920) and described by Krugman (1991)).

Another category of models deals with the determinants of location and specialisation. Of a special interest are the mobile factors, considered the engine of the agglomeration process. The improvement of the factor endowment in the destination region increases its attraction as location for other manufacturing activities leading to a cumulative process (Krugman, 1998 and Fujita, Krugman and Venables, 1999).

The size of the regions has been also taken into consideration in relation with the level of productive specialisation, being a priori assumed the existence of an inverse relationship between these two variables. Ezcurra et. al. (2006) discusses the idea that larger regions have a lower level of specialization than the smaller regions owing to the more heterogeneous population and variations in physical factors.

Regional specialization is usually analyzed in connection with industrial concentration, the latter being focused on "the distribution in the geographical dimension" (Aiginger, 1999, p.15). As pointed out by Aiginger and Rossi-Hansberg (2006), in fact specialization and concentration might be seen as the two sides of the same coin and, from statistical viewpoint, they can be addressed as two perspectives which derive from a matrix with the columns referring to countries (or regions) and the rows to industries. The specialization perspective can be analysed when the columns are considered, while concentration can be interpreted by each row. Aiginger and Davies (2004) have demonstrated by means of a mathematical model a preliminarily intuitive finding, namely that "if inequalities tend to increase down the columns, so they should also increase along the rows" (p. 7).

Although the bulk of the literature on specialization and concentration implicitly or explicitly treated these two phenomena as interrelated, there are some empirical outcomes suggesting they would rather be considered as independent processes since they "might not in all cases move in the same direction, and are probably going to take place at different speeds" (Dalum et al., 1998, p. 2). Furthermore, the model in Rossi-Hansberg (2005) was used for empirically proving that specialization and concentration may even go in opposite directions when transport costs change. More specifically, as transport costs lower the degree of concentration tend to increase, while the level of specialization decrease (Aiginger and Rossi-Hansberg, 2006).

Based on the framework outlined by the corresponding models and theories, the empirical studies undertaken in Europe with regard to the productive specialization dynamics until the beginning of 2000s display several characteristic features such as (Hallet, 2000): most studies use

national data (i.e. at country level); time periods vary between 10 and 25 years; the most frequently analysed variables are production, employment or trade in manufacturing sector; the indicators propose either a sectoral perspective (“concentration”) or a geographical perspective (“specialisation”); most of statistical analyses explain the results by specific industry characteristics (factors, scale, R&D intensities, etc.) or country characteristics (centrality, income, etc.).

As regards the competitiveness objective as one of the pillars of the EU’s cohesion policy, Aiginger (1999) highlights a twofold significance of specialization and concentration to this issue. First, the firms’ decisions regarding their optimal size and location, without former national boundaries, represent an important way of enhancing efficiency and competitiveness via integration. Second, there is a growing policy concern that countries’ specialization in narrow groups of products might increase the demand risk for individual countries.

As far as Romania is concerned, studies on regional specialization and industrial concentration have been undertaken both in national and international context. For example, Traistaru, Nijkamp and Longhi (2002) have focused on regional specialization and location of industrial activity in several accession countries (Romania, Bulgaria, Slovenia, Hungary and Estonia). Starting from the idea that Central and East European countries have experienced since 1990 increasing integration with the EU via trade and FDI the authors have aimed to identify and explain the economic effects of economic integration on patterns of regional specialisation. The research questions envisaged the changes in regional specialization patterns since 1990, whether greater specialization implies greater polarisation, to what extent relocation of manufacturing activities has taken place, the relationship between regional specialization and growth. Besides specific features for various countries the overall conclusion has been the existence of a negative correlation between regional specialization and regional GDP per capita and unemployment rates and the association of lower growth of regional GDP per capita with higher unemployment rates. The impact of increasing economic integration with the EU on regional structural change and growth has been also analysed, highlighting the changes in regional specialization patterns as well as the relationship between regional specialization and growth (Traistaru, Iara, Pauna, 2002).

The question of regional specialization has been analysed in national context too, mainly addressing the influence of transition, restructuring and privatisation on this process (e.g. Russu, 2001; Mitrut and Constantin, 2006; Andrei et al., 2007). The results highlight structural changes of a low significance to most of industries in the first ten years. These changes were determined by basic factors such as the removal of the COMECON<sup>1</sup> market and the openness of foreign trade towards the EU countries as well as by temporary action-based factors, including political (e.g. the war in the former Yugoslavia) and economic (e.g. the raise of oil price) ones (Russu, 2001). They supported the increase in the share of some industries unable to face competition forces (e.g. metallurgy) and disfavored other industries, of high recovery and development potential in the future (e.g. machinery and electric appliances).

### **3. Statistical measures of specialization and concentration**

As emphasized by the existing literature, the definitions of both regional specialization and geographic concentration of industries are based on the same production structures, reflecting the same reality (Aiginger, 1999).

Regional specialization expresses the regional perspective and depicts the distribution of the sectoral shares in its overall economy, usually compared to the rest of the country. A region is

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<sup>1</sup> Council of Mutual Economic Assistance

considered to be highly specialized if a small number of industries have a large combined share in the economy of that region.

Geographic concentration of a specific industry reflects the distribution of its regional shares. A highly concentrated industry will have a very large part located in a small number of regions.

Most of the Romanian empirical studies carried out in this field employ indices like Herfindahl Index, Krugman Dissimilarity Index, Gini Index and others, each one having some advantages and limits. In order to expand this analysis and to achieve a better understanding of the topic we added to the usual indicators of specialization and concentration statistical measures of amplitude and speed of structural changes.

We have chosen an absolute measure – Herfindahl Index – and a relative one – Krugman Dissimilarity Index – together with an indicator of the absolute amplitude of time structural changes – the coefficient of structural changes - and also an indicator that captures the relative speed of structural reallocation of employment – the Lilien Index. Static and dynamic analysis have been combined by means of comparing the same indicator for different years, and also by using indicators that explicitly consider time variation.

Concentration of industries and specialization of regions have been measured on the basis of the Gross Value Added and the number of employed population, both very popular in most empirical studies on this topic. Industry and regional data sets for this study were provided by Romanian official statistics (Territorial Yearbooks). The common sectoral classification available for the entire time span is limited to nine economic branches.

Due to the limited availability of comparable regional data we had to restrict our research to a ten year long period, divided into two time intervals: a period of prevalent economic decline (1996-2000) and one of sustained economic growth (2001-2005).

The first statistical measure that we employed is the *Herfindahl-Hirschman Index*, probably the most commonly used indicator of concentration/specialization:

$$H_j^C = \sum_{i=1}^n (g_{ij}^C)^2 \text{ and } H_i^S = \sum_{j=1}^m (g_{ij}^S)^2 ,$$

$$\text{where: } g_{ij}^C = \frac{X_{ij}}{\sum_{i=1}^n X_{ij}} = \frac{X_{ij}}{X_j} \text{ and } g_{ij}^S = \frac{X_{ij}}{\sum_{j=1}^m X_{ij}} = \frac{X_{ij}}{X_i}$$

$H_j^C$  - the Herfindahl index for concentration

$H_i^S$  - the Herfindahl index for specialization

i – region; j- branch

X – Gross Value Added or employment;

$X_{ij}$  - Gross Value Added or employment in branch j in region i;

$X_j$  – total Gross Value Added or employment in branch j;

$X_i$  - total Gross Value Added or employment in region i;

$g_{ij}^C$  - the share of region i in the total national value of branch j;

$g_{ij}^S$  - the share of branch j in the total value of region i.

The Herfindahl index is increasing with the degree of concentration/specialization, reaching its upper limit of 1 when the branch j is concentrated in one region or the region i is specialized in only one branch. The lowest level of concentration is 1/n i.e. all regions have equal shares in branch j, while the lowest specialization is 1/m i.e. all branches have equal shares in region i. This means that the lower-bound of the Herfindahl Index is sensitive to the number of

observations, limiting direct comparisons (e.g. to countries having exactly the same number of regions), which is its main shortcoming. Another limit of the indicator is due to the fact that the Herfindahl index is an absolute measure and big regions having larger shares mainly influence the changes in the concentration/specialization (the index is biased towards the larger regions).

The second indicator is the well-known **Krugman Dissimilarity Index** used for measuring either concentration ( $K_j^C$ ) or specialization ( $K_i^S$ ):

$$K_j^C = \sum_{i=1}^n |g_{ij}^C - g_i| \text{ and } K_i^S = \sum_{j=1}^m |g_{ij}^S - g_j|, \text{ where } g_i = \frac{X_i}{X}, g_j = \frac{X_j}{X} \text{ and } X \text{ stands for}$$

the total (national) Gross Value Added or employment.

It is a relative measure of specialization/concentration which is employed for comparing one branch/region with the overall economy. A slightly different form of the index may be used to compare two countries/regions. Its values range from 0 (identical territorial/sectoral structures) to 2 (totally different structures).

Our third indicator, the **Lilien Index** captures the speed of the sectoral employment reallocation in the economy, as the main factor of differences in specialization (Lilien, 1982). The Lilien Index is calculated for each region  $i$  as:

$$L_i^S = \sqrt{\sum_{j=1}^m \frac{X_{ij}}{X_i} (\Delta \log X_{ij} - \Delta \log X_i)^2}, \text{ where:}$$

$\frac{X_{ij}}{X_i}$  - the share of branch  $j$  in the total employment of region  $i$ ;

$X_{ij}$  - employment in branch  $j$  in region  $i$ ;

$X_i$  - total employment in region  $i$ ;

$\Delta$  - the first difference operator

Based on his index, Lilien (1982) found that a large part of the time-series variation in the U.S. unemployment since World War II can be considered the result of employment reallocation shocks in the economy. The outcome is partly contested by some authors considering we have to take into account the potential correlation between this index and the effects of aggregate cyclical disturbances. Nevertheless, the Lilien Index is still considered to be a useful measure of the speed of structural changes. The higher the value of this indicator, the faster the structural changes and the bigger the reallocations of employment between branches. It also indicates the ability of an economy to flexibly react and quickly adapt to changes in aggregate demand.

The last indicator is the **coefficient of absolute structural changes**, used for measuring the average change in sectoral or territorial shares recorded in different units of time:

$$\tau_{g_1-g_0} = \sqrt{\frac{\sum_{i=1}^n (g_{1i} - g_{0i})^2}{n}},$$

where  $g_{1i}$  and  $g_{0i}$  are the sectoral or regional shares  $i$  in two time periods 1 and 0.

The indicator increases with the intensity of the time changes in either specialization or concentration.

#### 4. Sectoral specialization of the Romanian regions

The analysis of Herfindahl index points to a clear decrease in the level of sectoral specialization in 2005 against 1996, for all Romanian regions, irrespective of the variable used: Gross Value Added (Table 1) or employment (Table 2). This should be considered a positive evolution from the point of view of the economic vulnerability usually associated with a high degree of specialization (e.g. the mining industry in Southern Romania). Developed regions tend to have a lower level of specialization and we should note that recent EU studies found a rather stable economic specialization in production (based upon broad economic sectors) and a decline of specialization in employment (Marelli, 2006).

**Table 1. Statistical measures of specialization based on Gross Value Added data**

	Herfindahl Index				Krugman Dissimilarity Index				Coefficient of structural changes (percentage points)	
	1996	2000	2001	2005	1996	2000	2001	2005	1996-2000	2001-2005
NE	0.2044	0.1712	0.1854	0.1484	0.1319	0.2570	0.1676	0.1574	3.39	3.40
SE	0.1966	0.1599	0.1817	0.1549	0.1007	0.1207	0.1134	0.1068	4.70	2.69
S	0.2346	0.1783	0.1923	0.1860	0.1412	0.1707	0.1678	0.1844	5.10	3.49
SV	0.2181	0.1842	0.1969	0.1712	0.1158	0.2338	0.2270	0.1754	4.60	3.54
V	0.2010	0.1586	0.1760	0.1675	0.1098	0.0479	0.0969	0.0688	6.54	2.92
NV	0.2076	0.1528	0.1736	0.1594	0.1303	0.1205	0.0686	0.0685	7.41	2.30
C	0.2598	0.1829	0.2242	0.1870	0.1637	0.1433	0.1921	0.1387	5.83	2.91
BI	0.2105	0.1791	0.2006	0.1625	0.4191	0.4263	0.4676	0.3726	9.70	3.79

Source: author's calculations

The highest levels of specialization in production were in 2005 in Center and South regions (industry), while the degree of specialization in employment had bigger values for all regions, reaching its maximum in North-East and South-West regions (agriculture) and minimum in Bucharest-Ilfov (Tables 1 and 2).

As the level of specialization reduced, the Krugman Dissimilarity Index diminished in some regions and amplified in many others, proving an increasing divergence in sectoral structures among the regions. Except for Bucharest-Ilfov, Krugman Index was relatively low in Romania in 2005 when compared to Poland (0.508) or Lithuania (0.328), but is much higher than in EU15, where it is below 0.150 for most of the countries, reaching a minimum of 0.063 in Austria and 0.064 in Deutschland (Marelli (2006), based on regional employment data).

**Table 2. Statistical measures of specialization based on employment data**

	Herfindahl Index				Krugman Dissimilarity Index			
	1996	2000	2001	2005	1996	2000	2001	2005
NE	0.2785	0.3234	0.3221	0.2600	0.1732	0.2031	0.1945	0.2389
SE	0.2369	0.2682	0.2693	0.2160	0.1588	0.1008	0.1151	0.0973
S	0.2768	0.3089	0.3116	0.2486	0.1184	0.1405	0.1478	0.1505
SV	0.2841	0.3210	0.3202	0.2589	0.1877	0.1938	0.1914	0.2046
V	0.2288	0.2331	0.2364	0.2071	0.1009	0.1193	0.1213	0.1414
NV	0.2610	0.2849	0.2835	0.2275	0.0969	0.0988	0.0828	0.0912
C	0.2580	0.2393	0.2440	0.2069	0.1870	0.1843	0.1860	0.1583
BI	0.1907	0.1613	0.1631	0.1519	0.6023	0.7050	0.6959	0.6133

Source: author's calculations

The Herfindahl Index and the Krugman Dissimilarity Index of specialization both showed significantly higher values when computed out of employment data, but their time tendency is mostly the same (Table 2). Bucharest-Ilfov region displays a sectoral structure strongly different from all other regions.

**Table 3. Amplitude and speed of changes in specialization based on employment data**

	Lilien Index		Coefficient of structural changes (percentage points)	
	1996-2000	2001-2005	1996-2000	2001-2005
<b>NE</b>	0.1887	0.1887	3.42	2.80
<b>SE</b>	0.1643	0.2079	2.39	3.35
<b>S</b>	0.1986	0.2070	3.74	3.20
<b>SV</b>	0.1928	0.1836	3.20	3.00
<b>V</b>	0.1490	0.2019	2.23	3.23
<b>NV</b>	0.1683	0.2178	3.05	3.60
<b>C</b>	0.1678	0.2139	2.97	2.90
<b>BI</b>	0.1855	0.2456	2.78	3.07

*Source: author's calculations*

The values of the coefficient of absolute structural changes have a small variation from a region to another or between the two time periods envisaged. There was a slightly reduction of its values during the interval 2001-2005, a period of sustained economic growth, compared to the previous interval of economic decline, for all regions, irrespective of the data employed. In 2001-2005 period, the economic sectors changed their shares in a region on average by 2.30-3.79 percentage points based on production data and by 2.80-3.60 percentage points based on employment data (Tables 1 and 3).

The Lilien Index also points to significant structural changes and reallocation of employment between sectors, thus proving that the economy is adapting to changes in the aggregate demand. Nevertheless we should keep in mind that it only partially shows the region's ability to change, since the shift of resources that occurs within the framework of each sector cannot be captured by the Lilien Index.

## **5. Geographic concentration of economic activities in Romania**

The Herfindahl Index for concentration shows lower values than the specialization index and little variation in respect to the data employed. One possible explanation is that we used rather broad economic sectors because of the unavailability of a finer regional disaggregation of branches.

Another difference regards the lack of a clear tendency in results. Most of the regions recorded increases in concentration, but there were also a few branches, such as industry, reducing their level of regional concentration.

From the production point of view, the most concentrated sector was in 2005 constructions (Bucharest-Ilfov), while the biggest concentration in employment was recorded for real estate transactions and other services (Bucharest-Ilfov), closely followed by agriculture (North-East and South-East).

**Table 4. Statistical measures of concentration based on Gross Value Added data**

	Herfindahl Index				Krugman Dissimilarity Index				Coefficient of structural changes (pp*)	
	1996	2000	2001	2005	1996	2000	2001	2005	1996-2000	2001-2005
Agriculture <sup>1)</sup>	0.1418	0.1435	0.1433	0.1434	0.3894	0.3927	0.4053	0.3894	1.16	1.34
Industry <sup>2)</sup>	0.1301	0.1286	0.1293	0.1287	0.1934	0.1475	0.1321	0.1446	1.16	1.42
Construction	0.1348	0.1364	0.1338	0.1631	0.1675	0.1131	0.1037	0.2161	1.49	3.91
Trade <sup>3)</sup>	0.1361	0.1618	0.1623	0.1593	0.0774	0.1884	0.1839	0.1665	3.39	0.60
Transport and communications	0.1407	0.1464	0.1458	0.1517	0.1117	0.0984	0.1044	0.1650	1.63	1.34
Real estate transactions and other services	0.1527	0.1841	0.2161	0.1516	0.1512	0.2969	0.3886	0.1412	3.60	5.02
Public administration and defense	0.1304	0.1991	0.1483	0.1504	0.2518	0.3547	0.1415	0.1408	11.24	0.41
Education	0.1317	0.1295	0.1302	0.1309	0.2200	0.2096	0.2082	0.1906	0.78	0.82
Health and social assistance	0.1280	0.1276	0.1272	0.1293	0.1897	0.1502	0.1541	0.1315	1.31	0.89

Source: author's calculations

\* in percentage points

<sup>1)</sup> including hunting and silviculture, fishery and pisciculture

<sup>2)</sup> including electric and thermal energy, gas and water.

<sup>3)</sup> including hotels and restaurants

The increase in the degree of concentration in most of the main branches was accompanied by a rise in their regional dissimilarities, as Krugman Index points out. There is a relatively strong concordance between the results of Herfindahl and Krugman indices.

**Table 5. Statistical measures of concentration based on employed population data**

	Herfindahl Index				Krugman Dissimilarity Index				Coefficient of structural changes (pp*)	
	1996	2000	2001	2005	1996	2000	2001	2005	1996-2000	2001-2005
Agriculture <sup>1)</sup>	0.1477	0.1489	0.1488	0.1482	0.2721	0.2823	0.2838	0.2773	0.12	0.28
Industry <sup>2)</sup>	0.1299	0.1287	0.1289	0.1279	0.1180	0.1112	0.1069	0.1251	0.96	0.67
Construction	0.1306	0.1298	0.1301	0.1476	0.1964	0.1717	0.1700	0.2953	3.22	0.76
Trade <sup>3)</sup>	0.1286	0.1282	0.1293	0.1311	0.1384	0.1403	0.1326	0.1664	0.71	1.31
Transport and communications	0.1322	0.1323	0.1348	0.1386	0.1969	0.2068	0.2372	0.2557	0.91	1.83
Real estate transactions and other services	0.1694	0.1652	0.1694	0.1767	0.3943	0.3794	0.3988	0.4298	0.89	0.90
Public administration and defense	0.1306	0.1318	0.1297	0.1330	0.1275	0.1643	0.1369	0.1643	0.81	1.05
Education	0.1300	0.1293	0.1296	0.1304	0.0879	0.0866	0.0897	0.1119	0.58	0.33
Health and social assistance	0.1290	0.1278	0.1275	0.1286	0.0514	0.0684	0.0584	0.0703	1.12	0.93

Source: author's calculations

\* in percentage points

<sup>1)</sup> including hunting and silviculture, fishery and pisciculture

<sup>2)</sup> including electric and thermal energy, gas and water.

<sup>3)</sup> including hotels and restaurants

The coefficient of structural changes shows little average movement in the territorial distribution of the branches, but our broad disaggregation of branches may hide stronger internal movements within each branch.

## 6. Final remarks

In this paper we have explored the main characteristics and the interaction between regional specialization and sectoral concentration. Several common statistical measures of specialization and concentration, together with specific measures of sectoral structural changes were employed in order to highlight the different sides of these phenomena and to compare the results.

The major findings of the study are that during 1996-2005 the speed of structural changes within regions was rather high, significant reallocations of employment took place in order to adapt to the changing economic environment and Romanian regions become less specialized while the industries become slightly more concentrated. This outcomes of our research support the theories stating that divergent evolutions of specialization and concentration are possible (e.g. the Rossi-Hansberg model), but we shall have to check the robustness of such findings on a longer period of time

In terms of economic policy, these conclusions provide useful information to be considered when decisions relating to investment funds allocation or employment policies are adopted.

Further research will be needed in order to explore the driving forces of specialization and concentration in Romania and to deepen the analysis, both in absolute and relative terms, and not only at national scale, but also at the EU level.

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