ECONOMIC STRUCTURE AND REGIONAL LABOR PRODUCTIVITY DIFFERENTIALS IN POLAND

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Abstract: The aim of the paper was an attempt to verify the impact of the regional industry-mix on the large regional disparities observed in the levels of the regional labor productivity in Poland. The analysis was carried out using a modified shift-share analysis method. Obtained results showed that in the majority of Polish regions importance of industry mix component in shaping the diversity of labor productivity was very limited. Large regional disparities in regional levels of labor productivity may therefore resulted from internal factors affecting the competitiveness of individual regions.

Keywords: labor productivity, regional disparities, shift-share analysis.

1 INTRODUCTION

An increasing number of regional studies, including economic studies, is connected both with uneven distribution of production factors within a region and also uneven efficiency in utilization of the production factors. As a result we can observe the increase in the diversity of economic performance of regional economies. One of the aspects of this diversity is high level of regional labor productivity differentials.

Because of existing and even increasing differences in regional labor productivity in Poland the main aim of presented paper is an attempt to verify the impact of the regional industry-mix on the large regional disparities observed in the levels of the regional labor productivity across Poland. In order to verify the role of the particular industry-mix for the regional labor productivity level, a modified shift-share analysis method will be conducted. This method will allow to check if industry-mix observed in particular regions had significant impact for regional labor productivity differentials.

The rest of the paper is structured as follows: in the section 2 previous results concerning the role of industry-mix for the regional labor productivity differential will be presented. Section 3 discusses the data and the scope of regional labor productivity differentials in Poland. Section 4 describes used model and obtained results. A short conclusion will be presented in section 5.

2 PREVIOS RESULTS

The existing literature concerning determinants of regional productivity differentials, indicates that one of the potential source of observed differentials is regional industry-mix.

The study conducted by Estban [2000, p. 253-364] for chosen regions from European Union and countries such as Belgium, France, Italy, Portugal and Spain and performed for 6 sectors elucidated the extent to which existing regional inequality in labor productivities can be attributed to differences in the sectoral composition of activities, rather than to productivity gaps that are uniform across sectors. The obtained results showed that regional specialization has a very minor role and that interregional differences can be explained by uniform productivity gap only. Similar results were presented by Di Giacinto and Nuzzo [2005, p. 1-31]. They attempted to do progress in the empirical explanation of wide labor productivity differentials across Italian regions. In first step they used shift-share technique in order to assess the role of the industry mix in determining such disparities. Their findings suggest that composition effects appear to justify only about one third of the productivity gap suffered by the Italian regions and the most important drivers of labor productivity were industry-by-industry

productivity disparities caused by different level of R&D investment, transport infrastructure, the efficacy of political and social institutions, agglomeration economies, financial markets development and geographical factors. Ezcurra et al. [2005, p. 679-697] in the study conducted for 197 NUTS2 regions belonging to 15 European Union Member States in the period of 1977-1999 tested for the respective roles of regional and sectoral factors in productivity convergence in the analyzed countries. An analysis based on methodology involving a combination of shift-share technique showed that the greatest contribution to overall inequality in production per worker in the European Union can be attributed mainly to the regional component, industry mix, therefore, appears to have contributed relatively little to regional dispersion in average productivity over the 23 years covered by the study.

Yang and Lahr [2008, p. 1-31] using multiregional input-output tables and disaggregated employment data, decomposed change in labor productivity growth for seven regions of China between 1987 and 1997 into five partial effects – changes in value added coefficients, direct labor requirements, aggregate production mix, interregional trade, and final demand. They found that the increase of labor productivity for regions and sectors in China mainly comes from the decreasing labor input per unit of gross output and from changes in value added share of gross output. The aggregate production mix, interregional trade, and final demand also have important but smaller effect on most of regions in China. Decker et al. [2009, p. 1-10] examined the determinants of state labor productivity in USA during the 1989 to 2000 period. They estimated their model for two sub-periods (1989 to 1995 and 1996 to 2000) in order to isolate the labor productivity boom of the late 1990s. The obtained results indicate that the determinants of labor productivity changed during the productivity boom of the late 1990s. During the period 1996 to 2000 greater industrial diversity appeared to have stimulated labor productivity, whereas in the earlier period, 1989 to 1995, specialization promoted labor productivity. The changes in industry mix as potential source of regional disparity during 1990s in China was also confirmed in a study conducted by Li and Haynes [2010, p. 1-29]. This study was performed for the three major economic sectors, agriculture, manufacturing, and services from 1995 to 2004.

3 DATA AND SOURCES

The verification of the importance of regional economic structures on the regional disparities observed in the levels of the regional labor productivity in Poland was conducted with the use of data collected from the Local Data Bank prepared by Central Statistical Office of Poland. The period of the analysis due to the lack of more recent data was constrained to the period 2006–2011. The study was conducted for 16 Polish regions in accordance with NUTS2 standard (in case of Poland regions remain corresponding to a voivodeships) and in decomposition for the three major economic sectors, agriculture, manufacturing, and services. This classification was developed by Fisher [1933] which decompose the economy into: primary sector, consisting of agriculture, secondary sector, formed by industry and the tertiary sector, incorporating all other activities that did not fit in the first two sectors. Clark [1940] began to use the term "services" to apply to all activities of the tertiary sector, treating it as a complement to other sectors. The author of the paper decided to compute the regional level of labor productivity independently. The level of regional labor productivity for each sector was calculated as the relation between regional gross value added for particular sector and employment in this sector. Thus, the mean regional labor productivity was calculated as mean of labor productivity for each sector weighted by the employment shares for each sector.

The high level of regional inequality in labor productivities in Poland in analyzed Period was confirmed by the Gini coefficient

(The Gini coefficient measures the inequality among values of a frequency distribution for example levels of income or productivity) and coefficient of variation (see Table 1 and Figure 1).

Table 1. The variation of regional labor productivity in Poland

	Gini coefficient	Coefficient of variation
2006	0,126	22,98%
2007	0,128	23,11%
2008	0,125	22,21%
2009	0,128	22,86%
2010	0,134	24,36%
2011	0,131	23,63%

Source: Own estimation, based on data from Central Statistical Office of Poland.

Figure 1. Regional labor productivity in Poland in 2011

Source: Own estimation, based on data from Central Statistical Office of Poland.

As we can see on the table 1 the value of Gini coefficient ranged in analyzed period from 0,12 to 0,13. In the countries where the level of inequalities in the regional labor productivity is the highest (for example United States, Turkey, Mexico) the value of this indicator was ca. 0,26, on the other hand in the countries with the lowest level of disparities (Denmark, Sweden) the Gini coefficient had a value of 0,04 [OECD 2008, s. 64]. The large regional differences in the level of labor productivity in Poland was also confirmed by the high value of the coefficient of variation – ca. 23% in analyzed period.

Such high inequalities come from differences in the levels of labor productivity in individual voivodships. Figure 1 presents the regional labor productivity in the comparison to the average value for Poland (Poland = 100) in 2011. The highest level of labor productivity was observed in Mazowieckie voivodship (the labor productivity amounted to 144% of the national level). The high, above the national average, levels of regional labor productivity has been observed also in voivodships such as Dolnośląskie, Pomorskie, Śląskie and Wielkopolskie. The lowest levels of labor productivity, under the 70% of the national average, was observed in voivodships such as Lubelskie, Świętokrzyskie and Podkarpackie.

4 DATA AND SOURCES

In order to verify the potential role of the industry-mix observed in particular region, for the existing differences in labor productivity levels in Polish regions the modified shift-share approach proposed by Estban [2000] was utilized. This method allows to assess the extent to which the different regional specialization (sectoral composition of activities) affects the regional labor productivity.

The shift-share analysis was originally proposed by Dunn [1960], as a forecasting technique for regional growth of employment (regional employment dynamics). The essential

idea is to analyze the extent to which the difference in growth between each region and the national average is due to the region performing uniformly better than average on all industries or to the fact that the region happens to be specialized in fast growing sectors. Later Estban [1972] modified the standard two factor decomposition and extend it to the sum of three components. The first component named structural, indicates the growth share attributable to the particular industry-mix of particular region. The second one named differential, measures the part due to the region growing faster at the sectoral level (due to internal factors). Finally, the third component named allocative, measures the covariance between two previous components. This can be interpreted as the contribution to the regional growth deriving from its specialization in those activities where region is most competitive.

Even contemporary researches use the shift-share technique in order to verify sources of regional employment dynamics. You can find recent application to the Poland for example in Batóg and Batóg [2007], Kudłacz [1998] or Woźniak [2010].

As we can find in Estban [2000, p. 5] even though the shift-share analysis was originally considered as a technique to analyze the regional employment dynamics, it is quite straightforward to extend it to the decomposition of interregional aggregate productivity differences. Aggregate average productivity per worker is the weighted sum of the productivities at the sectoral level. Thus, a particular region can have an aggregate productivity per worker above the mean because of two reasons (or a combination of both). On the one hand, it can be that in all, or most, sectors this region has a productivity per worker above the mean. On the other hand, it can be the case that sectoral productivities are not different from the mean, but that this region is specialized in those sectors with higher productivity per worker. For instance, the average productivity in agriculture, in industry or in the service sector could be identical across the EU regions. Yet, the regions specialized in industry would have an aggregate productivity per worker higher than those specialized in agriculture.

The presented above assumptions can be formally written as follows. See also Estban [2000, p. 1–15], Di Giacinto and Nuzzo [2005, p. 1-31], Jiang et al. [2014, p. 1-31]. Letting p_i^j denote sector's j share of employment in region i that $\sum_j p_i^j = 1$, for all regions i, thus p^j denote the Polish mean sectors's j share observed at national level. Similarly, by denoting x_i^j and x^j as sector's j output per worker, respectively for region i and for the whole country. The aggregate labor productivity can be computed as an employment weighted average of productivity at the industry level, which for the particular region can be denote as $x_i = \sum_j p_i^j x_i^j$ and for the whole country as $x = \sum_j p^j x^j$. The differences in labor productivity between region i and the national average $(x - x_i)$ can be viewed as the sum of three different effects [Estban 2000, p. 6].

The first assumes that differences in the regional labor productivity could be caused by the industry-mix component μ_i of region i. Which measures the differential productivity accruing from region i sectoral composition, once we assume that the sectoral productivities in each Polish region is the same. Formally we have:

$$\mu_i = \sum_j (p_i^j - p_j) x^j \qquad (1)$$

μ_i takes positive values if the region is specialized $(p_i^j > p_j)$ in sectors with high productivity at the national level (for example services) and despecialized $(p_i^j < p_j)$ when most of activities are focused in the sectors with low productivity (for example agriculture). The μ_i component takes value equal to 0, if the regional industry-mix would be equal to the national one.

The second, differences in regional labor productivity could be caused by the intra-industry differences π_i. This component focuses on the contribution of intra-sectoral productivity differences to the shift between regional and national average productivities. Here, it is assumed that the region's economic

structure coincides with the national average and, formally can be written as follows:

$$\pi_i = \sum_j (x_i^j - x^j) p_j \qquad (2)$$

π_i takes positives values, if the particular region has bigger values of productivities in the given sector than the national average $(x_i^j > x_j)$ and negative values in the opposite situation. The component is equal to 0 if the sectoral labor productivities in particular region coincides with the national average $(x_i^j = x_j)$.

The third of analyzed components , potentially important in explaining differences in the regional labor productivity, is a combination of the two previous effects and measures the efficiency of each region in allocating its resources over the different industrial sectors. The allocative component can also be viewed as measuring the co-variance between sectoral specialization and productivity advantages. Formally we have:

$$\alpha_i = \sum_j (p_i^j - p_j)(x_i^j - x^j) \qquad (3)$$

α_i is positive if the region is specialized, relative to the national average, in sectors whose productivity is above Polish average and negative if below.

The sum of three different effects, can be write as follows:

$$x_i - x = \mu_i + \pi_i + \alpha_i$$

(4)

In equation (4) the gap between regional and national average productivities is decomposed additively into the three components. Each component aggregates one source of potential regional productivity differentiation.

5 RESULTS

The results of the analysis of the source of exiting differences in regional labor productivity across Polish voivodeships was presented in Table 2. According to the presented results, it could be concluded that in the most of Polish voievodshieps for the differences in labor productivity were responsible the intra-industry differences, described as π_i .

The only exception was Śląskie voivodeship, where the difference in labor productivity could be explained in the analyzed period by the specialization in the sectors with the higher productivity levels (manufacturing and services). In the first 2 years of analysis (i.e. 2006 and 2007) also in Dolnośląskie and Zachodniopomorskie voivodeshieps for the bigger than average labor productivity levels responsible was a specialization in the sectors with higher than average labor productivity level.

However, in subsequent years in the Dolnośląskie voivodeship there was a significant increase of the labor productivity level, which was not associated with the change in the sectoral structure of the economy. The particular industry-mix was also an important factor responsible for the level of the labor productivity below the national average in the Lubelskie, Siwętokrzyskie and Podkarpackie voivodeshieps. It was caused mainly by high share of agriculture (above 30%) in the regional industry-mix.

The results also indicate that the least important component was α_i, which describe the efficiency of each region in allocating its resources in the sectors with higher than an average labor productivity.

It can be concluded that, the most important component responsible for the inequality in the regional labor productivity in Polish regions were the intra-industry differences. These differences could be caused by the specific for each region set of characteristics affecting the level of labor productivity, i.e. internal competitiveness of the region. On the other hand, meaning of industry-mix specific for each region is very limited.

Table 2. Shift-share analysis result

	2006				2007				2008			
	xi - x	η	π	α	xi - x	η	π	α	xi - x	η	π	α
Dolnośląskie	3,5	3,8	0,0	0,3	6,1	3,1	3,0	0,0	8,5	2,1	5,7	0,6
Kujawsko-pomorskie	-4,6	2,0	-2,7	0,2	-3,0	2,3	-0,6	0,1	1,5	2,7	-4,5	0,3
Lubelskie	-30,4	8,7	-23,7	2,0	-32,0	8,0	-26,4	2,4	-30,4	6,4	-26,2	2,2
Lubuskie	-20,9	2,1	-21,4	1,7	-20,9	1,7	-21,2	1,4	-16,3	1,8	-16,7	1,3
Łódzkie	-19,7	0,4	-19,4	0,2	-22,8	1,9	-21,8	0,8	-25,7	1,6	-24,8	0,8
Małopolskie	-14,8	1,7	-13,0	0,2	-11,1	0,5	-10,6	0,0	-10,3	0,5	-9,8	0,1
Mazowieckie	47,3	4,2	40,2	2,9	44,5	4,1	37,2	3,2	38,0	3,1	32,0	2,9
Opolskie	-9,7	1,4	-8,7	0,4	-6,7	1,3	-5,9	0,4	-7,1	0,4	-7,2	0,4
Podkarpackie	-26,4	5,2	-21,6	0,4	-27,6	5,5	-22,6	0,4	-28,1	4,3	-24,5	0,7
Podlaskie	-14,5	6,1	-11,1	2,7	-17,1	4,8	-14,3	2,0	-22,0	5,0	-19,4	2,4
Pomorskie	16,0	2,9	12,5	0,6	11,3	3,0	8,4	0,0	7,4	3,5	4,2	0,3
Śląskie	6,1	4,0	1,7	0,4	7,7	4,4	3,3	0,0	9,3	4,3	5,9	0,8
Świętokrzyskie	-24,2	8,9	-15,7	0,4	-26,3	8,6	-18,6	0,9	-24,9	6,4	-19,9	1,5
Warmińsko-mazurskie	-19,4	0,4	-19,6	0,2	-22,1	0,3	-21,8	0,7	-22,6	0,3	-22,3	0,5
Wielkopolskie	3,6	1,3	5,6	0,8	6,8	1,7	8,8	0,3	12,9	2,5	16,1	0,6
Zachodniopomorskie	5,9	4,9	3,1	2,1	9,2	5,2	6,9	2,9	9,4	4,9	7,1	2,6

	2009				2010				2011			
	xi - x	η	π	α	xi - x	η	π	α	xi - x	η	π	α
Dolnośląskie	11,6	2,3	8,3	1,0	13,1	2,8	9,4	1,0	19,5	2,7	15,6	1,3
Kujawsko-pomorskie	-11,4	1,6	-10,2	0,4	-10,1	1,0	-9,2	0,1	-8,4	1,2	-7,4	0,3
Lubelskie	-32,5	6,0	-29,0	2,5	-33,9	6,4	-30,6	3,1	-32,8	6,2	-29,7	3,1
Lubuskie	-14,2	2,5	-14,5	2,2	-21,3	1,9	-21,2	1,9	-21,0	1,8	-20,5	2,3
Łódzkie	-24,7	0,5	-24,3	0,1	-22,6	0,6	-22,1	0,1	-23,2	0,8	-22,6	0,2
Małopolskie	-8,8	0,9	-7,8	0,1	-9,3	0,9	-8,3	0,1	-9,6	0,6	-8,8	0,1
Mazowieckie	41,0	3,5	35,3	2,2	50,1	3,3	44,7	2,1	46,7	2,9	42,0	1,8
Opolskie	-10,6	1,1	-9,4	0,2	-10,2	1,2	-8,7	0,3	-10,3	1,3	-8,6	0,3
Podkarpackie	-29,3	4,7	-25,3	0,7	-28,5	5,1	-23,8	0,3	-27,6	5,1	-22,4	0,1
Podlaskie	-21,2	5,9	-18,5	3,1	-21,7	4,4	-20,3	3,0	-22,4	4,3	-20,9	2,9
Pomorskie	12,2	2,7	9,6	0,2	6,2	3,0	3,9	0,7	9,2	3,3	6,7	0,7
Śląskie	6,6	3,6	4,1	1,1	7,2	3,6	3,2	0,4	1,6	3,3	-1,6	0,2
Świętokrzyskie	-26,8	4,9	-23,5	1,6	-33,5	5,5	-29,9	1,8	-33,2	6,4	-28,4	1,7
Warmińsko-mazurskie	-22,0	0,6	-22,2	0,4	-23,1	0,1	-22,9	0,3	-19,5	0,4	-19,0	1,0
Wielkopolskie	16,1	3,3	20,1	0,8	6,5	2,4	9,3	0,3	5,8	1,6	7,5	0,1
Zachodniopomorskie	1,6	3,8	0,2	2,4	4,5	3,0	2,6	1,1	6,3	3,0	4,3	1,0

Note: The result was shown in percentage differences with respect to Poland, Poland =100.

Source: Own estimation, based on data from Central Statistical Office of Poland.

5 CONCLUSION

The aim of present study was an attempt to verify the impact of the regional industry-mix on the large regional disparities observed in the levels of the regional labor productivity across Poland. This diversity remained at a high level throughout the entire analyzed period. The conducted empirical study conducted with the use of modified shift-share technique has shown that the role of different industry mix was very limited (the exception were Śląskie, Dolnośląskie, Zachodnipomorskie, Lubelskie, Podkarpackie and Świętkorzyskie voivodeshieps). The important conclusion which can be made based of obtained results is that the state policy should be aimed at boosting the internal competitiveness of the regions. The exception are Lubelskie, Świętokrzystkie and Podkarpackie voivodeships where the change of the sectoral structure of the economy could be important for lowering of the labor productivity differentials. An important addition to the conducted studies could be boarding the research period and analysis made for a more comprehensive sectoral structure of the economy.

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