

# The labor productivity level, dynamics and differences in the European Union regions

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**Abstract** The aim of the paper is to analyze the level, dynamics and differences in the labor productivity across European Union regions over the period 2000-2011. The conducted research indicates that the level and dynamics of the regional labor productivity in analyzed period were undergoing significant changes, mostly the positive one. The results of the conducted studies also showed existence of the substantial and systematic decline in the differences between the labor productivity levels across all EU28 regions (the only exception was 2010). While the differences observed between the labor productivity levels in regions from old UE15 countries were lower but quite stable, thus the observed decline in the disparities across all regions had to result from the process of convergence between regions from the new and old EU members states.

**Keywords** labor productivity, regional disparities, regional convergence

## 1. INTRODUCTION

The lively discussion present in economic literature and concerning the current state and prospects of future development of particular economies is more often transferred from national to regional level. This trend is particularly visible among the studies covering the economic performance of the EU Members States and results mainly from the uneven distribution of production factors and differences in the effectiveness of its use among EU regions. This fact reflects in the existence of economic inequalities between regions, which are hard to see in the studies conducted at national level. In result regions became a subject of national and EU policies pursued in order to foster long-run economic development and to reduce socioeconomic inequalities.

The assessment of the actual situation and the prospects of future development of particular economies or regions is based (most frequently) on the analysis of the level and dynamics of GDP per capita, but in the opinion of the author, labor productivity is better proxy of the actual and potential prospects of economic situation. In addition this measure allows for assessment of efficiency in the use of available resources. Labor productivity is the ratio of a volume measure of output (which is normally gross domestic product GDP or gross value added GVA), to a volume measure of input i.e. labor resources available in given economy (most commonly used measures of labor resources are: workforce, hours worked, number

of people in employment). Thus, this ratio allows us to specify the effectiveness of the use of available resources, which is responsible for the development process of the regional economies [Jarmołowicz and Kuźmar 2014, s. 333].

Consequently, the aim of this study is to analyze the level, dynamics and differences in the labor productivity levels across European Union regions over the period 2000-2011. It is important to underline that the identification and evaluation of particular determinants of labor productivity at regional level is not a subject of this study.

The rest of the paper is structured as follows: the section 2 presents importance of the labor productivity as an efficiency measure of use of available resources. Section 3 discusses the data and the scope of regional labor productivity level, and also dynamics and differences among the European Union Regions. A short conclusion will be presented in the last section.

## 2. LABOR PRODUCTIVITY AS A MEASURE OF ECONOMIES' EFFICIENCY

Adam Smith already pointed out on the importance of labor productivity as the basic economic concept responsible for the wealth of nations. In the first three chapters of Book I, he wrote: a country's income depends upon the productivity of its labor force, which in turn depends on specialization and the division of labor driven by exchange (trade) and limited by the extent of the market [Smith, 1976]. Also contemporary, the analysis of the level, dynamics and determinants of labor productivity constitute an important basis for the studies on the growth and economic development, both at the country level as well as the regional level. According to P. Krugman [1994, p. 11]: productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker. In the opinion of A. Blinder and W. Baumol [1993, p. 778]: over long periods of time, small differences in rates of productivity growth compound, like interest in a bank account, and can make an enormous difference to a society's prosperity. Nothing contributes more to reduction of poverty, to increases in leisure, and to the country's ability to finance education, public health, environment and the arts. M. Porter and Ch. Ketels [2003, p. 7], suggested that: a nation's standard of living is determined by the productivity of its economy,

which is measured by the value of its goods and services produced per unit of the nation's human, capital and natural resources. Productivity depends both on the value of a nation's products and services, measured by the prices they can command in open markets, and the efficiency with which they can be produced. Productivity allows a nation to support high wages, a strong currency and attractive returns to capital, and with them a high standard of living.

Productivity is commonly defined as a ratio of a volume measure of output to a volume measure of input used. Thus it is an average measure of the efficiency of production. Productivity is measured most often by the multi-factor productivity, labor productivity or capital productivity. Labor productivity measures the relation between a volume of output (goods and services) and a volume of input used, such as the total number of hours worked or total employment. Improvements in labor productivity allow a given quantity of output to be produced using fewer resources or more and better output to be produced from the same resource base. Strong productivity growth allows countries to enjoy higher material living standards, including improved health and education services [OECD, 2001].

The importance of different productivity measures has recently been the subject of some debate in academic and policy circles [Sargent and Rodriguez 2000, p. 2]. On the one hand there are those who argue that total factor productivity is the appropriate measure of productivity growth, and that labor productivity is a much cruder measure. On the other hand, there are those who argue that TFP depends too much on arbitrary assumptions, and that labor productivity is more closely related to current living standards, which is what society ultimately cares about [May, 2000].

Due to the importance of labor productivity referred to in the literature as a measure of current living standards, and also some difficulties in obtaining the data on the level of capital accumulation in EU regions (which are necessary to estimate properly the TFP), the labor productivity ratio will be used.

### 3. DATA AND SOURCES

The data used in this study comes from the statistical office of the European Union – EUROSTAT. The time scope of the study, due to availability of the data, covered the period between 2000-2011. The study was performed for 243 to 268 regions from 28 Member States (depending on the analyzed period). Regions were distinguished based on The Nomenclature of Territorial Units for Statistic – NUTS, level 2 (in case of Poland this level is consistent with Voivodeships). It is important to notice that as far as regions from the new Member States are concerned, the study covered also the period before the accession to the European Union.

The labor productivity was calculated by the author by dividing the Gross Domestic Product in purchasing power parity (PPP) terms in US dollars (variable *nama\_r\_e2gdp*), by the number of employees for each region (variable *lfst\_r\_lfe2emp*). Table 1 presents the main descriptive statistics of the data on the labor productivity used in this analysis.

Preliminary analysis of the data indicate that there are important disparities in the labor productivity levels among considered regions in analyzed period. It should be also noticed that there are some positive trends, which are related to the increase in the average level of productivity and reduction of the disparities between the regions with the lowest and the highest levels of productivity. In the

following sections, a detailed analysis of these processes will be presented.

**Table 1. Labor productivity in EU regions**

Year	Regions number	Min. Value	Max. Value	Average	Standard deviation
2000	243	7738,19	139906,13	44882,46	17067
2001	249	8701,23	141810,70	46159,37	17273
2002	252	10163,47	154060,53	47749,66	17590
2003	257	10820,35	147061,71	47477,75	17282
2004	257	11603,77	159382,56	49785,58	17788
2005	266	12287,77	170723,14	50940,75	18089
2006	266	14175,21	171512,76	52983,83	18622
2007	268	15729,63	179167,72	54875,93	19097
2008	268	17607,97	175109,33	54497,09	18710
2009	268	16831,31	167036,18	52101,78	17334
2010	268	17040,13	180674,17	54567,31	18437
2011	268	16485,33	171818,06	56258,90	18746

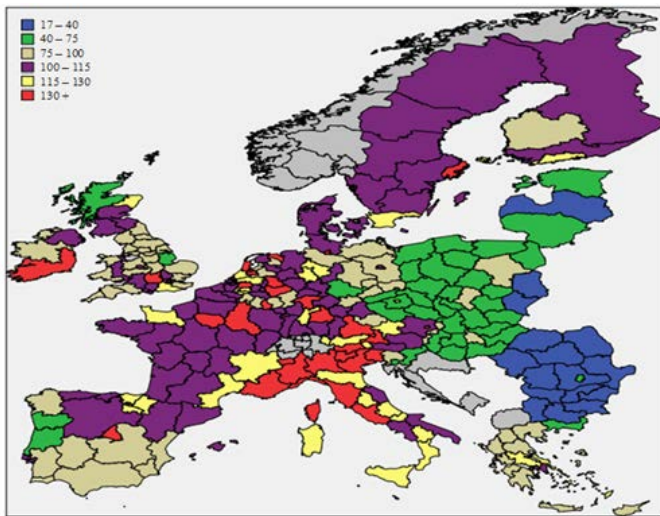
Source: own estimation base on EUROSTAT data.

In an attempt to analyze the dynamics and variation in productivity at regional level it should be point out that there are some important methodological difficulties arising from the different sizes of the regions and from the fact of varying number of regions within individual countries. For example in the smallest EU countries such as Cyprus, Denmark, Estonia, Lithuania, Luxembourg, Latvia and Malta there is no additional allocation under class NUTS-2, which means that the whole country is treated as a single NUTS-2. In order to ensure the comparability of the obtained results, in particular concerning the diversification of the level of labor productivity, the author decided to assign weights to the regions designated as a percentage of the level of GDP of each region to the total value of GDP for all of the analyzed regions.

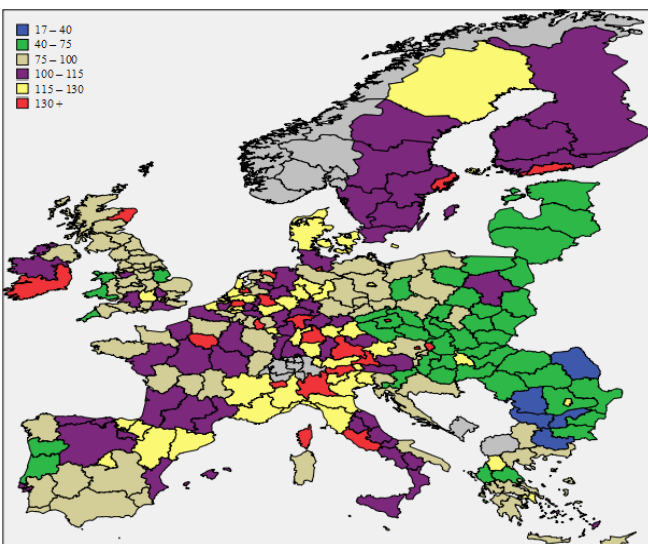
### 4. THE LEVEL AND DYNAMICS OF THE LABOR PRODUCTIVITY IN EU REGIONS

The level and dynamics of the labor productivity in analyzed regions was presented in the figure 1 and 2. The positions (colors) of the regions, was determined as a labor productivity relation to the average level of all analyzed regions (EU28 = 100). In 2000, the lowest levels of productivity (under 40% of average UE level, which was 44 888 PPP\$ per employee) were observed in 16 regions, from countries such like Romania, Bulgaria, Poland and Latvia. The lowest level of productivity was observed in Nord-Est region of Romania, with the value of 7 738 PPP\$ per employee, which accounted for only 17% of the EU average. On the other hand in regions with the highest level of productivity (Inner London – United Kingdom, Brussels Capital Region – Belgium, Luxemburg), its value was over twice as high as the EU average. In the Inner London region productivity amounted to almost 140 000 PPP\$.

In 2011 the average level of productivity increased to 56 259 PPP\$. Positive changes were also observed among regions with the lowest level of productivity. Labor productivity levels under 40% of the UE average, were observed only in 5 less developed regions from Romania. The lowest value was observed still in the Nord-Est region of Romania, but its amounted to 16 485 PPP\$, i.e. nearly 30% of the EU average. The highest levels of labor productivity was observed again in the same regions Inner London – United Kingdom, Brussels Capital Region – Belgium, Luxemburg) its value was over thrice as high as the EU average.

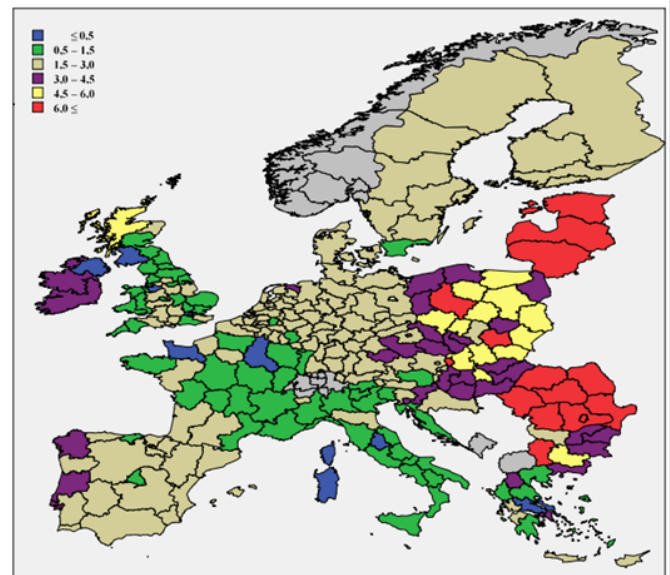
**Figure 1. Labor productivity in UE region in 2000 (UE28 = 100)**

Source: own estimation base on EUROSTAT data.

**Figure 2. Labor productivity in UE region in 2011 (UE28 = 100)**

Source: own estimation base on EUROSTAT data.

When dynamics of labor productivity in analyzed period is considered (see figure 3.), it should be pointed out, that growth of labor productivity in range from 2000 to 2011 was observed in the most of studied regions, (a slight decrease was recorded only in 2 of the 268 analyzed regions: Northern Ireland - United Kingdom, Central Greece - Greece). In addition, the average rates of labor productivity growth, were very diverse. The highest growth rates were recorded in regions with the lowest initial levels of labor productivity from Romania, Bulgaria, Slovakia, Slovenia, Lithuania, these rates stood at an average level exceeding 6% per year. It should also be noted that the average labor productivity growth rate in the regions of the new Member States was significantly higher than growth rates observed in regions from old Member States – EU15. The average labor productivity growth rates amounted to 4.76% and 1.83% respectively.

**Figure 3. Average labor productivity growth rates (%) in 2000-2011**

Source: own estimation base on EUROSTAT data.

## 5. THE DIVERSITY OF REGIONAL LABOR PRODUCTIVITY IN EU COUNTRIES

In order to evaluate the level of disparities in regional labor productivity in analyzed regions measures such as coefficient of variation and Gini coefficient index have been used. In addition, salter graph method allowed for a visual examination of the distribution of labor productivity dynamics. In case of both coefficient of variation and Gini coefficient index, analysis were conducted separately for the regions from old member states EU15, and for the all regions from EU28. As a measure of labor productivity Gross Domestic Product in purchasing power parity (PPP) terms in US dollar, by the number of employees for each region weighted by the share of each region in the total value of Gross Domestic Product.

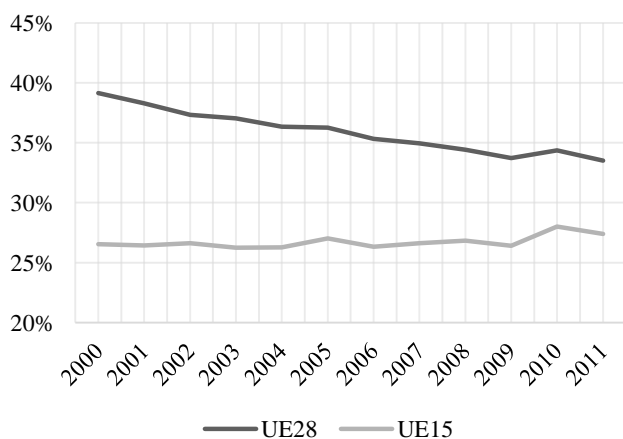
Figure 4 presents the coefficients of variation (in %) of regional labor productivity across our sample separately for the regions from EU15, and for the all regions EU28 regions over the period 1985–2008. Two main findings emerged from the study.

First the coefficient of variation among EU15 regions remains relatively stable (and much lower than in EU28 regions) at around 26%. The results confirm the findings of previous analysis (see for example Ertur et al., 2006; Magrini, 2004; Monfort, 2008) that convergence among EU15 regions has been strong up to the mid 90's but the process has since then lost momentum. From 1980 to 1996, the evolution of disparities among EU15 regions indeed features a clear downward trend. On the contrary, from 1996 onwards, it remains relatively stable. It is also interesting to note the increase in the coefficient of variation after 2009, this indicator reached the highest level – ca. 28% in 2011. This change could arise from the difficult economic situation in the region, caused by the global crisis.

Second, the coefficient of variation among EU28 regions decreases gradually from 39% to 34% during 2000–2011 (the only exemption was 2010). The stable level of variation observed among EU15 regions, indicates that the decline in the overall level of variation was due to significant decrease in diversity level between the

regions from new and old Member States. These changes have occurred mostly because of the increase of labor productivity among regions from new Member States. But, it should be noticed that the level of variation observed in all regions of the EU, despite positive changes, is still significantly higher than the level observed in the regions belonging to the old Member States.

**Figure 4. Cross-region differences in overall regional labor productivity**



Source: own estimation base on EUROSTAT data.

In order to assess the inequality in labor productivity distribution the Gini coefficient was calculated. The Gini coefficient measures the inequality among values of a frequency distribution (for example, levels of income). A Gini coefficient of zero expresses perfect equality, where all values are the same (for example, where everyone has the same income). A Gini coefficient of one expresses maximal inequality among values (for example, where only one person has all the income or consumption, and all others have none) (Dagum 1980, s. 1791–1803).

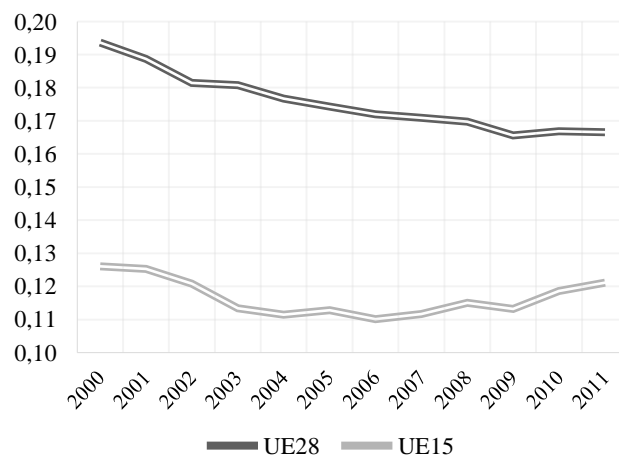
Figure 5 presents the values of Gini coefficient over the period 2000-2011. The data shows that the level of inequality in labor productivity distribution observed in the regions of the EU15 countries is definitely lower than in the case of all the regions of the EU-28. In case of UE15 regions the Gini coefficient decreased from initial level of ca. 0,13 in 2000 to ca. 0,11 in 2006, then began to rise, reaching a level of 0,12 in 2011. Analyzing regional variation in labor productivity within all UE28 regions, we can notice a positive decreasing trend throughout the period from 2000-2011 (the exception were 2002-2003 and 2009-2011, when the Gini coefficient remained constant). The Gini coefficient in this group decreased from initial level of

Salter's graph is another method which allows for a visual examination of the distribution dynamics (Monfort 2008, s. 14). It consists in ranking all regions along the horizontal axis according to their labor productivity and report the corresponding level of productivity on the vertical axis for a base year. Then holding the base year rank positions of regions constant on the horizontal axis, new series show the regions' labor productivity for subsequent years.

As a result, any significant changes in the regional distribution of labor productivity become visible. In addition, regions can be identified and their performance compared. Such graphs can be used to detect patterns of persistence or gradual change in the regional distribution on labor productivity. In particular, the more the series

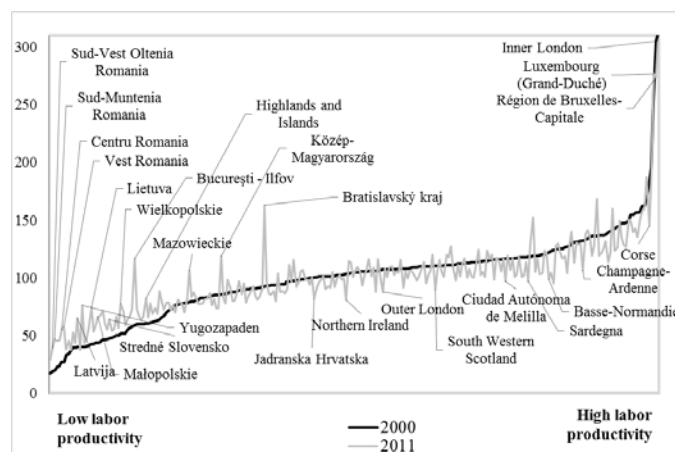
is horizontal, the more it reflects a distribution where disparities are limited.

**Figure 5. The Gini coefficient of labor productivity in UE regions in 2000-2011**



Source: own estimation base on EUROSTAT data.

**Figure 6. Dynamics of labor productivity in UE regions (UE28=100) in 2000-2011**



Source: own estimation base on EUROSTAT data.

The figure 6 reports the Salter graph for the EU-28 regions, comparing the distributions of their labor productivity in 2000 and 2011. The graph indicates a general tendency towards increased horizontality of the series, which is the sign of convergence among EU regions. The graph also shows that this evolution is clearly due to a process where regions with the lowest levels of productivity catch up on the better ones. The frequency of upward movements in the distribution is indeed higher in the low end of the distribution compared to that of downward movements in the high end of the distribution.

## 6. CONCLUSION

The aim of the paper was to analyze the level, dynamics and differences in the labor productivity across EU28 regions over the period 2000-2011. The conducted research indicates that the level and dynamics of the regional labor productivity in analyzed period were undergoing significant mostly positive changes. In 2000, the

lowest levels of productivity (under 40% of average UE level) were observed in 16 regions, in 2011 labor productivity levels under 40% of the UE average, were observed only in 5 less developed regions. The growth of labor productivity in range from 2000 to 2011 was observed in the most of studied regions, (a slight decrease was recorded only in 2 of the 268 analyzed regions: Northern Ireland - United Kingdom, Central Greece – Greece). It should also be noted that the average labor productivity growth rate in the regions of the new Member States was significantly higher than growth rates observed in regions from old Member States – EU15. The average labor productivity growth rates amounted to 4.76% and 1.83% respectively.

The results of the conducted studies also showed existence of the substantial and systematic decline in the differences between the labor productivity levels across all EU28 regions (the only exception was 2010). While the differences observed between the labor productivity levels in regions from old UE15 countries were lower but quite stable. Thus the observed decline in the disparities across all regions had to result from the process of convergence between regions from the new and old EU members states.

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