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## Convergence in Labour Productivity in Agriculture: A Comparison Study

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**Abstract:**

**Purpose:** The article compares the processes of convergence and divergence in labour productivity in the agricultural sector of the EU candidates (CCs), the Eastern Partnership countries (EPCs) and the EU member-states.

**Design/Methodology/Approach:** The analysis includes calculations of the convergence indicators and additionally dynamics and mean annual rate of variation.

**Findings:** The study attempts to illustrate whether we are dealing with convergence or divergence processes in terms of labor productivity both among CCs and EPCs as well as CCs, EPCs and EU countries. As shown by the calculated convergence indicators during the period under study the agricultural sector of the CCs and the EPCs was slowly adapting to labour productivity in the EU-28. However, simultaneously there was divergence among the CCs and the EPCs in the indicator under study. The research revealed that changes in this indicator were influenced both by the increase in gross value added and reduction of employment in the agricultural sector.

**Practical Implications:** The study of the convergence process in labour productivity using statistical methods is an important element in testing economic theories in the field of convergence research in the CCs and EPCs and it shows which countries may become competitive in the future in the EU market.

**Originality/Value:** Showing the importance of convergence process in labour productivity in the CCs and EPCs with the EU we can observe its impact on the future integration process of the CCs and EPCs. The results of the research are important from the point of view of the contribution to the economy of European integration, both in theoretical and empirical terms, but above all in the field of sectoral policy, which is the Common Agricultural Policy (CAP). A comprehensive approach to the subject of research and its multidirectional nature, as well as the obtained results will be important both for the agricultural policy of the studied countries, as well as for the CAP and for the Polish agriculture.

**Keywords:** Adaptation of agriculture, convergence processes, productivity, employment, gross value added, mean annual rate of variation.

**JEL classification:** Q18.

**Paper Type:** Research study.

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## 1. Introduction

Nowadays we can observe the process of adaptation of agriculture in the European Union candidate countries (CCs) and Eastern Partnership countries (EPCs) to agriculture in the European Union (EU), although they are not members of the Community yet. These processes are noticeable in analysis of different indicators characterising agriculture in these countries, especially covering longer periods of time. The process of adaptation is aided by the processes of convergence, which can be observed in different aspects of agriculture. These phenomena can also be observed in the productivity of factors of production in the agricultural sector. They seem to be the most noticeable in the productivity of labour resources.

Although labour productivity is a partial measure of productivity, this measure is still a main element of differences in the economic performance of regions and regional 'competitiveness' (Martin, 2001). 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 (Pontarollo *et al.*, 2012). Changes in this indicator prove the development of agriculture in these countries. Labour productivity is an important indicator as it gives information about the amount of income in the agricultural sector. This indicator shows the adjustment processes that are necessary to adapt agriculture in the CCs and EPCs in the process of integration of the countries applying for membership in the EU.

The income situation of people employed in agriculture is very important because the agricultural sector is an important element financing the budget not only in many EU countries but also in the CCs and EPCs. This fact might confirm the thesis that in wealthy economies agriculture is shrinking and its contribution to the GDP is minimal. However, the significance of agriculture is not weakening, because understanding the defectiveness of reproduction processes in agriculture and the need to return the economic surplus which leaks to its surroundings is the condition of its effective retransfer through the budget mechanism (Czyżewski and Matuszczak, 2012). The inclusion of the countries whose agricultural sectors are at different levels of development into the orbit of the single market requires that the conditions of competitiveness should be equalised so as to maximise value added in the community (Zegar, 2010). This category gives a possibility to show differences in the new value generated by business activity.

Several applications of the convergence growth model study convergence in European agricultural productivity and its determinants (Mankiw *et al.*, 1992, Islam, 1995, Schimmelpfennig and Thirtle, 1999, Gutierrez, 2000, Esposti, 2007). Paci (1997) finds no evidence of absolute convergence in labour productivity in a sample of 109 European agricultural regions during the 1980s. Convergence is only found within groups of similar types of farming and it has taken place quicker in Northern Europe. Rizov (2005) finds that the shift to individual farming has positively

contributed to productivity growth in agriculture during the 1990s for 15 European transition countries. Alexiadis (2010) testing regional convergence in agricultural productivity in the 258 EU regions over the period 1995–2004 finds little evidence of absolute convergence, but suggests a pattern of club convergence. Some studies focus on regional convergence of a specific EU country (Esposti, 2007 in Italy) or make extra-EU comparisons (Gutierrez, 2000; Ball *et al.*, 2001; and Rezitis, 2010 with the US). Sondermann (2014) finds evidence for labour productivity convergence in agriculture for 12 EU countries between 1970 and 1998.

Other studies measuring agricultural productivity differences across Europe include Swinnen and Vranken (2010) on agricultural productivity in Central and Eastern Europe, Wang *et al.* (2012) focusing on Western Europe and Matthews (2014) on differences between OMS and NMS. Baráth and Fertő (2016) do find convergence in agricultural productivity among OMS and NMS for the period 2004–2013. Cechura *et al.* (2016) used regional data on the EU dairy sector in 2004–2011 and found no evidence of convergence.

## 2. Materials and Methods

In order to investigate the processes of adaptation in terms of labour productivity the indicator of labour resources productivity was calculated on the basis of gross value added generated in the agricultural sector of the CCs, EPCs and EU-28. The convergence indicator was used to illustrate the processes of adjustment of labour productivity in agriculture in the CCs and EPCs to the EU standards.

$$\sigma(t) = \sqrt{\frac{1}{n} \sum_{i=1}^n (\log y_i(t) - \bar{y}(t))^2} \quad (1)$$

$$\bar{y}(t) = \frac{1}{n} \sum_{i=1}^n \log y_i(t) \quad (2)$$

$\sigma(t)$  – GVA dispersion per agricultural employee in the group of all countries in year  $t$ ,

$y_i(t)$  – GVA per agricultural employee in country  $i$  in period  $t$ ,

$\bar{y}(t)$  - mean GVA per agricultural employee in period  $t$ .

The convergence model has the advantage that it has a stronger theoretical base for productivity growth assessments, drawing on the seminal contributions of Solow (1956; 1957) and Swan (1956) and a variety of applications in growth models. Barro and Sala-i-Martin's (1991) introduced the notion of  $\sigma$  –convergence, which refers to decreasing crosscountry dispersion in productivity, i.e., that differences in productivity levels become smaller over time. Another approach is the time series approach, which is mostly based on stochastic approaches like cointegration. The sigma convergence indicator shows the dispersion of the trait under study in a particular group of countries.

Standard deviation of the gross value added logarithm per agricultural employee was used to verify the sigma convergence. A decrease in the sigma convergence indicator over a particular period of time indicates a decrease in the disproportion between the traits under analysis. Otherwise, there is sigma divergence (Barro and Sala-i-Martin, 1992). Dynamics indicators and the mean annual rate of variation were calculated on the basis of all of the trait values so as to illustrate variation in the phenomenon under study. The research involved spatial and time analysis. The aim of the study was to make an international comparison of indicators for the CCs, EPCs and EU-28. The analysis of variation in these coefficients was based on the data, which covered a period of ten years, i.e., 2004-2014. International databases of the UNSD and FAO were mostly used in order to guarantee comparability. The data from statistical offices from individual CCs and EPCs were used only if the international databases did not provide such information.

### 3. Results

Gross value added (GVA) per employee, farm or ha of farmland is usually used as an indicator illustrating actual economic diversification and development of the agricultural sector in a particular country. Simultaneously, the indicator shows the processes of adaptation taking place in a given country. Gross value added (GVA) per employee indicates labour productivity. It is a basic measure used in comparisons assessing the conditions of competition. Simultaneously, it shows progress in the processes of adaptation and challenges the CAP must face before the EU extension. It is noteworthy that labour productivity is a basic economic measure illustrating the effects of agricultural production. It depends on a large number of different factors, such as the number of people employed in agriculture, its standard and usefulness of soil for farming (Kulikowski, 2002).

The analysis showed that the agricultural sector in the CCs and EPCs was slowly adapting to the EU-28 standards. The analysis of labour productivity during the period of ten years revealed its convergence both in terms of the CCs and EPCs adapting to the EU-28 and within the EU-28 itself (Table 1). However, the analysis of variation in these indicators among the CCs and EPCs only shows the occurrence of the opposite process, i.e. divergence. It is also necessary to note that between 2004 and 2014 the average labour productivity was increasing in all the groups of countries under analysis. In spite of this fact, this indicator in the EU-28 was still 6 times greater than in the CCs and EPCs. Moreover, during the period under study the difference increased by almost 1.5 times.

In 2014 among the CCs the highest income per employee was generated by Montenegrin farmers, i.e. almost \$16,000 (like in Cyprus, Portugal and Greece, Table 2). On the other hand, the lowest labour productivity was noted in Georgia and Azerbaijan, i.e., about \$812. Labour productivity of farmers in the CCs and EPCs is still very low, except Montenegro, Turkey, Belarus and Bosnia and Herzegovina. This situation was caused by historical underdevelopment of

agriculture and other sectors of the food economy in the CCs and EPCs. In most of the CCs and EPCs both the farm structure and employment structure are unfavourable and inefficient. Too many people of low productivity are employed in agriculture in these countries and too much land is used inefficiently for farming purposes. This structure causes serious problems in transferring land to the most productive farms, which use farmland efficiently. It is no longer possible to observe the situation where very small farms use farmland very efficiently and it results in greater productivity per ha than in large farms. Offering employment outside agriculture is a prerequisite to eliminate unnecessary labour force and improve productivity in agriculture.

**Table 1.** Indicators of convergence and mean labour productivity in the agricultural sector of the CCs, EPCs and EU-28 between 2004 and 2014

	Convergence indicator										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
EU-28, CC,EPC	0.539	0.520	0.515	0.526	0.518	0.523	0.527	0.526	0.536	0.512	0.502
EU-28	0.365	0.349	0.343	0.353	0.335	0.343	0.354	0.345	0.362	0.341	0.337
CC and EPC	0.348	0.359	0.373	0.378	0.368	0.400	0.398	0.399	0.392	0.403	0.390
Mean labour productivity (thousand dollars per employee)											
EU-28, CC,EPC	17.1	16.6	16.9	17.6	19.3	19.9	20.2	20.9	21.0	20.8	21.5
EU-28	23.1	22.2	22.6	23.6	25.9	26.5	26.9	27.9	28.1	27.5	28.5
CC and EPC	3.1	3.4	3.7	3.7	4.0	4.4	4.4	4.7	4.4	5.2	5.2

a) GVA generated in agriculture, hunting, forestry and fishing at fixed prices as of 2005;

b) The missing data were supplemented with information from the following sources: Armenia - 1995-2001 - Statistical Yearbook of Armenia 2001, p. 35 and 2002, p. 70. published by National Statistical Service of Republic of Armenia; Belarus – 2000, 2005-2009 and 2014 – Statistical Yearbook 2012, p. 147. published by National Statistical Committee of the Republic of Belarus; Bosnia and Herzegovina – 2006-2007, 2012-2014 - Persons in Paid Employment, published by Bosnia and Herzegovina Agency for Statistics of Bosnia and Herzegovina, Sarajevo, p. 2 - for individual years; Macedonia 2009-2010 – 25 Years of Independent Macedonia (2016). published by Republic of Macedonia State Statistical Office, Skopje, p. 20.

**Source:** The author's compilation based on the UNSD (accessed on 22 November 2020) and FAOSTAT (accessed on 25 November 2020).

As results from the analysis of the mean annual rate of variation during ten years, there was a high increase in labour productivity in the CCs and EPCs, as compared with the rate in EU-28. In many CCs and EPCs the rate ranged from 6.2 to 9.4% (in Turkey, Armenia, Montenegro and Belarus), and it was comparable to the rate noted in particular years in Belgium, Estonia, Latvia and Slovakia. On the other hand, during the period under study the mean annual rate of changes in Georgia and Macedonia was low and it was comparable to the rate in Slovenia.

**Table 2.** Labour productivity and mean annual rate of variation in the agricultural sector of the CCs and EPCs between 2004 and 2014

	Labour productivity (dollars per employee)										Mean annual rate of variation (%)	
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013		2014
Albania	2324.9	2366.6	2471.4	2559.1	2779.9	2869.9	3125.3	3307.3	3521.5	3573.0	3681.5	4.0
Armenia	1248.5	1424.3	1450.2	1624.0	2070.3	2064.2	1703.4	1865.1	2112.0	2298.3	3274.1	7.2
Azerbaijan	731.8	773.4	766.8	789.1	817.4	821.7	791.7	822.7	853.6	891.1	857.1	1.7
Belarus	3723.6	4918.7	5287.1	5633.4	6226.7	6692.4	6816.3	7331.6	8015.8	8060.8	8429.3	9.4
Bosnia Herzegovina	4824.0	5094.7	5388.7	5732.7	5615.6	6155.1	5910.0	5899.4	5230.5	6523.8	7068.4	3.0
Montenegro	7448.5	9173.8	9258.2	8177.0	10327.8	12446.0	13056.0	16623.0	13875.1	19889.6	15958.6	8.6
Georgia	714.4	801.4	701.7	758.1	724.0	677.0	649.4	704.7	678.4	755.0	766.7	0.2
Macedonia, FYR	4,327.8	3,621.5	3,557.9	3,956.4	4,378.7	6,749.3	5,596.9	4,036.1	3,696.8	3,672.9	3,740.1	-0.1
Moldova	830.8	846.1	1056.2	720.2	1081.4	1119.9	1261.1	1303.6	1120.8	1483.8	1582.2	5.1
Serbia	3478.5	3403.9	3861.4	3491.8	3158.8	3276.7	3819.7	4044.0	3372.4	4023.1	5298.1	1.2
Turkey	5669.4	6859.6	8953.1	8434.8	8501.1	8646.0	8218.2	8224.2	8545.8	8897.9	9365.9	6.2
Ukraine	1731.2	1750.8	1964.6	1946.6	2410.4	1869.5	2120.1	2219.9	2186.5	2179.2	2765.2	3.2

**Source:** The author's compilation based on the same sources as in Table 1.

Labour productivity can be improved by increasing income or reducing employment or by both options at the same time (Rosner, 2001; Pontarollo *et al.*, 2012). The comparison of variation in the labour productivity indicator in 2014 and 2004 shows that the rate was not always in agreement with variation in the gross value added. The agricultural sector in the CCs and EPCs was considerably diversified both in income and its determinants. The diversification can be illustrated with GVA. This rate is an important criterion of the economic assessment of different branches of production, including agriculture. It illustrates increase in the value of goods as a result of a particular production process. The comparison of variation in the gross value added per agricultural employee during the period under study shows that the rate increased in all the CCs except Macedonia, where it dropped by nearly 14% (Table 3). The greatest increase was observed in Armenia and Belarus – the rate almost tripled and was comparable to the one noted in Slovakia and Estonia. It is noteworthy that among the CCs the greatest GVA was observed in Turkish agriculture, where it reached \$52.3 billion (it was comparable to the rate noted in France).

However, this amount is not so significant if we consider the labour resources in agriculture in Turkey. In the other CCs and EPCs the volume of GVA in agriculture was lower. Between 2004 and 2014 the rate increased in most of the CCs except Serbia, where it slightly dropped by nearly 2% (it was comparable to the rate noted in Portugal). The greatest increase in the GVA was noted in Armenia – by 64%, and it was comparable to the rate noted in Estonia. It is noteworthy that if the EU was extended by the CCs and EPCs, the GVA would increase by about \$77 billion, i.e. by a relative value of 32.5%.

There was a noticeable influence of reduced employment on the development of agriculture in the countries under analysis. During the period under study in many CCs and EPCs there was a considerable decrease in employment in the agricultural sector, which reached almost 40% (in Montenegro, Moldova, Armenia and Serbia, similar to the decrease noted in the Czech Republic and Portugal).

**Table 3.** The dynamics of labour productivity, GVA and employment in the agricultural sector in the CCs and EPCs between 2004 and 2014 (%)

Dynamics 2004-2014 (%)											
Labour productivity											
Albania	Armenia	Azerbaijan	Belarus	Bosnia and Herzegovina	Montenegro	Georgia	Macedonia, FYR	Moldova	Serbia	Turkey	Ukraine
58.4	162.2	17.1	126.4	46.5	114.3	7.3	-13.6	90.4	52.3	65.2	59.7
GVA											
42.0	64.2	38.5	44.7	11.3	17.9	3.3	5.8	18.3	-1.8	24.1	19.6
Employment											
-10.3	-37.4	18.3	-36.1	-24.0	-45.0	-3.7	22.5	-37.9	-35.5	-24.9	-25.1

**Source:** The author's compilation based on the same sources as in Table 1.

Although during the period under study employment in agriculture was reduced in the CCs and EPCs, in many of them it is still high, as compared with the EU-28. It significantly influences labour productivity in the agricultural sector of these countries, which is generally low (with few exceptions) and does not exceed \$4,000 per agricultural employee (Table 2). One of the causes of this situation is the fact that the offer of non-agricultural employment in rural areas is very limited. Rural economy is poorly diversified and the rate of increase in employment opportunities in the processing industry and services does not compensate for the loss of jobs in agriculture.

Economic diversification of rural areas is an important determinant of the maintenance and development of agriculture. It is a relatively well-known fact that even in the countries where large and highly productive farms are predominant most farmers cannot achieve sufficiently high income parity only from the agricultural activity (Wilkin, 2011). There are large reserves in agriculture in the CCs and EPCs, which would give a possibility to increase income but these reserves are triggered slowly.

Two factors that are directly related to work (the active factor in the production process), i.e. land and capital, prove the weakness of the competitive potential in the CCs and EPCs and they are decisive to low labour productivity in the agricultural sector (Pawlak and Poczta, 2010). It is chiefly caused by excessive concentration of workforce resources, which usually cannot be used productively and are unable to gain satisfactory income. In consequence, over the years this situation has increased divergence in labour productivity and poses particular challenges in the context of the EU extension in the future. This difference in income between the EU-28 and the CCs and EPCs can be attributed to lower productivity and less favourable structure of farms in many CCs and EPCs, where the workload is bigger. Apart from that, low labour productivity is also caused by considerable agrarian fragmentation, resulting in small economic potential of farms.

Overemployment in agriculture causes not only extremely low labour productivity (by European standards) but also a gap in the GDP, which might be bridged by

income generated by the excessive workforce if it was employed outside agriculture (Poczta, 2010). An increase in labour productivity in agriculture and all the resulting consequences (e.g. higher income) cause economic growth in a particular country. This regularity is the most significant in economic assessment of restructuring of the agri-food economy and transformations of rural areas. This tendency and its character affects fundamental forces of development in agriculture (Tomczak, 2001).

In contemporary world economic growth causes an increase in regional disproportions and a decrease in the role of agriculture in the national economy. In consequence, the divergence is progressing. In most developed countries there is increasing divergence between labour productivity and the resulting income per employee in agriculture, as compared with other sectors of the economy (Wilkin, 2003).

Thus, it is possible to conclude that low efficiency of agricultural production and farmers' low income, which reflect considerable agrarian overemployment and fragmentation of farms, do not cause the development of agriculture in these countries or progress in the process of convergence in labour productivity to the EU-28 standards.

It is impossible to expect improvement in the competitiveness of the agricultural sector or increase in agricultural producers' income without noticeable progress in efficiency and productivity (Kulawik, Wieliczko, 2012). However, it is necessary to remember that in all countries, especially in highly developed ones, competitiveness is not thought to be the most important criterion in the assessment of agriculture. Farmers' income is the joint effect of remuneration given by the market and society (Wilkin, 2011).

In view of the EU extension in the future, it is a challenge for the CAP to enable convergence and polarisation, although these are long-term processes. According to the convergence theory, the disproportions are reduced or even eliminated. In highly developed regions the increase in profit in relation to the capital invested is lower than in poorer regions. In poorer regions there is increasing accumulation of capital, which causes production to increase much more rapidly than in richer regions. If there is no adequate intervention policy, market forces tend to polarise rather than equalise the socioeconomic development of regions (Wigier, 2012). This situation is particularly unfavourable for the agricultural sector in the CCs and EPCs and for their adaptation to agriculture in the EU.

#### **4. Conclusions**

During the period under study there were processes of sigma convergence between labour productivity in the CCs and EPCs and the EU-28 and simultaneous processes of divergence within the groups of countries under analysis. This situation was caused both by the increase in gross value added generated in the agricultural sector



in the CCs and EPCs and by the decrease in labour resources involved in agricultural production in these countries.

The continuing low labour productivity in the agricultural sector in some CCs and EPCs is chiefly caused by overconcentration of workforce resources, which usually cannot be used productively and cannot gain satisfactory income. In consequence, it is difficult for agriculture in these countries to adapt to the EU standards.

The integration of the CCs and EPCs with the EU will increase their adaptation to new conditions by improvement in the income situation thanks to funds acquired from the CAP, which are a basic instrument of financial support provided to the agricultural sector in the EU. In individual countries farmers will exhibit diversified activity in acquiring these funds due to different priorities and needs, which depend on the standard of agriculture. In consequence, it will affect the development of farms and the rate of their adaptation to the EU standards.

In spite of the increase in labour productivity in the groups of countries under study, in some of them it is still very low (Albania, Armenia, Azerbaijan, Georgia, Macedonia, Moldova and Ukraine) and it is of low significance to the generation of income. These countries are characterised by unfavourable agrarian structure and high employment in the agricultural sector, which result in low income per employee. In spite of the funds acquired from the CAP, these countries will probably still have problems spending income on consumption and development of farms.

Although it is possible to observe slow convergence between the EU-28 and the CCs and EPCs, there is still considerable diversification in mean labour productivity (it is six times greater in the EU-28) mainly due to the diversified development of agriculture. This diversification can be observed in the structure of production, structure of farms and rate of replacement of labour resources with capital, as compared with the EU-28. This situation was chiefly caused by historical conditions of the development of the agricultural sector in the CCs and EPCs, as compared with the EU-28.

However, it is necessary to stress the fact that the adaptation of the agricultural sector in the CCs and EPCs does not always have to involve full assimilation and adjustment to agriculture in the EU-28, because consecutive extensions of the EU in the future will cause even greater diversification in European agriculture. It results from the fact that the member-states of the EU-15 or even the EU-12 from Central and Eastern Europe developed under completely different historical conditions, which affected their development. In some of them it is still possible to observe this influence. Having taken these factors into consideration, we can conclude that on the one hand, the adaptation of the agricultural sector in the CCs and EPCs after integration may help them to meet the necessary requirements and standards. On the other hand, it may also help these countries to find an optimal position for

themselves by using their unique potential and/or competitive advantage over the other EU countries.

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