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Club convergence of labour productivity in agriculture: Evidence from EU countries

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Abstract: This paper studies club convergence in relation to labour productivity in the agriculture industry of 28 European Union countries for the period 2005 to 2018. The countries were divided into three groups which were homogeneous in terms of level of development in the agricultural sector. The presence of convergence in the groups of countries was verified by using a panel-data model of conditional β-convergence. Then, convergence processes were investigated within clubs of countries. Convergence processes took place in the groups of countries with low and medium levels of labour productivity. In the club of countries where labour productivity was high, opposite processes (i.e. divergence) were observed.

Keywords: agricultural sector; convergence processes; European Union; panel model; productivity

Since the beginnings of the agriculture industry, its nutritional function has occupied a strategic position among other sectors of the economy. Its social function is not less important. In the face of growing global ecological problems, the function related to the reduction of external costs and the production of public environmental goods has also become complementary (Baer-Nawrocka 2018). Agriculture, like the economy as a whole, is constantly changing due to the impact of various factors. As the economy develops, the agricultural sector's role in generating national income is overtaken by the industrial and service sectors (Csaki and Jambor 2009). These agricultural changes can also be observed in the European Union, which is characterized by vast internal diversity. The agricultural heterogeneity results from natural conditions, production potential, the level of socioeconomic development of individual countries, as well as different membership periods in the European community (Cuerva 2011; Nowak et al. 2016). Western European agriculture embarked on different developmental paths than Central and Eastern European agriculture. Changes in agricultural practices should also be viewed from the perspective of the desired directions of its advancement. The accession of Central and Eastern European countries to the EU, combined with the possibility of obtaining financial support, has contributed to increased changes in agricultural sector dynamics (Bański 2018).

However, the problem of inequalities at the level of agricultural development among the EU countries still draws public attention (Cuerva 2011; Kijek et al.

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2019). It is now recognised that excessive developmental differences in spatial systems are not positive attributes, which is the basis for opposition to those processes, as well as for pursuing a policy of levelling territorial development differences. This assumption underlies concepts of the European integration (Cuerva 2011). The goal of the European community is harmonious development: in other words, correcting development disparities between individual regions and supporting technologically or economically challenged regions (Adamowicz and Szepeluk 2018).

Analysis of the process of equalising economic development between countries with different functioning conditions is an important issue that has challenged economists for years. However, different approaches are applied to study the process of convergence. In addition to so-called classic convergence concepts (i.e. β – less developed countries/regions show a faster rate of economic growth than more developed countries/regions and σ – GDP per capita variability reduces over time), one can distinguish a club convergence concept introduced into the economic literature by Baumol (1986), who identified convergence of productivity within a subset of national economies. The development of the club convergence concept may be found in Galor (1996). Club convergence has gained in importance over the years, as the main issue economists focus on is whether levels of development or productivity tend to converge or diverge in the long run, and whether such trends apply to all or only limited groups of economies (Alexiadis and Kokkidis 2010). Club convergence is interesting not only from a theoretical point of view but also from the viewpoint of economic policy. One should attach particular importance to a study on club convergence in relation to groupings of countries such as the European Union. A more balanced distribution of income among regions/countries promotes resource efficiency as well as economic and social cohesion in the community.

The effective use of production resources, including labour resources, is the basic determining factor of the competitiveness of production potential on both international and global scale (Baer-Nawrocka 2018). Productivity in agriculture can be calculated either as partial productivity or as total factor productivity (TFP). One of the more dynamic directions of empirical research is analysis of TFP changes in agriculture in the EU countries (Hamulczuk 2015; Barath and Fertő 2017; Kijek et al. 2019). However, for some purposes, a partial productivity measure may be more useful than TFP. For policymakers interested in agriculture and standards of living, the measurement of labour productivity (i.e. output per unit of workforce used) may be more informative than TFP. It should be noted that majority of research on convergence processes of labour productivity in agriculture (McErlean and Wu 2003; Cuerva 2011; Baer-Nawrocka and Markiewicz 2012; Gołaś 2019) does not directly consider the specifics of individual countries/regions. Such an approach may lead to bias in convergence tests because convergence processes of productivity may be restricted to a specific set of economies with similar economic, structural, and natural conditions. Gutierrez (2002) also argues that differences in countries' economic development levels should be considered in studies on convergence processes of agricultural productivity.

Among the few studies on the club convergence of agricultural productivity, worthy of mention is Alexiadis (2010). Using the methodology proposed by Baumol and Wolff (1988), Alexiadis identified a club of countries in which convergence processes take place and which are characterised by divergence of agricultural productivity. Unfortunately, Alexiadis (2010) did not provide an answer to the key question posed by Baumol and Wolff (1998), which concerned the way in which countries achieve membership in the convergence club and on what basis they are sometimes ejected. To our knowledge, this question about labour productivity remains unanswered. Studies on the convergence of labour productivity in agriculture have become increasingly important over the years due to conditions of sustainable economic development (O'Donnell 2010).

Given the above facts, our purpose here is to study club convergence of labour productivity in agriculture of the European Union countries from 2005 to 2016, taking into account the endogenous nature of the club creation process. The research covers the period of EU expansion into Central and Eastern European countries at a time when trade and administrative barriers were being removed.

MATERIAL AND METHODS

This research tests convergence processes of labour productivity in agriculture. In our study, the labour productivity index is expressed as the Gross Value Added (GVA) of agriculture at constant prices (2005 = 100) per 1 full-time employee (AWU – Annual Work Unit) in this sector. According to Martin (2001), this measure shows differences in the economic results of regions and

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is directly shaped by various factors determining regional competitiveness. The level of labour productivity is also widely recognised as one of the most important economic developmental parameters in any country. Increases in productivity lead to lower costs, market dynamisation and an increase in the wealth and competitive purchasing power of societies. This particularly applies to the agricultural sector, in which the level of labour productivity in EU countries is strongly diversified and significantly lower than in other sectors of the economy (Gołaś 2019). This measure in convergence studies was used by Cuerva (2011), Martín-Retortillo and Pinilla (2012), and Gołaś (2019).

We assume here that club convergence means an explicit regionalisation of the convergence process, which results from the diversity of structural factors, including permanent location or agro-natural advantages but also considering the importance of baseline conditions in terms of growth potential. Therefore, we decided to use the set of influencing factors associated with trajectories of convergence. These factors describe the economic importance and structural features of agriculture, resources and quality-of-production factors and the relationships between them, as well as the level of development of the country and agriculture. The importance of structural conditions for the increase in labour productivity, especially those expressed in the structure of farms and the level of employment in this sector, are emphasised by Polyzos and Arabatzis (2006) and Novotná and Volek (2016). It is worth noting that the level of agricultural labour productivity is influenced not only by the size of the labour force but also by the quality of labour resources related to human capital, which can be approximated by the level of education of farm managers (Giannakis and Bruggeman 2018). Martín-Retortillo and Pinilla (2012), in turn, emphasise the importance of such determinants as the relationship between land and labour resources and the intensity of production. Giannakis and Bruggeman (2018) highlight the role of the economic development [measured by the Gross Domestic Product (GDP) per capita] in shaping agricultural labour productivity.

The research methodology is divided into two steps: club determination and convergence testing. In the first stage, we divided the countries into homogeneous groups according to structural and economic similarities found in their respective agricultural sectors. In line with a theoretical framework, we assume that convergence processes follow different trajectories within particular groups of countries. To identify these groups, we used two methods: the *k*-medium method and Ward's hierarchical clustering method. Applying these methods enables us to benefit from the complementary advantages of both methods. The hierarchical method makes it easier to determine the number of groups, while the *k*-means method, which is ostensibly an endogenous method of club determination (Zhang et al. 2019), allows for their efficient identification. The variables that we used to determine homogeneous groups of countries are presented in Table 1.

As mentioned previously, these variables relate to the production potential of agriculture, the intensity of agricultural production, production results, the importance of agriculture for the economy, as well as the development level of a particular country. In line with the literature on agricultural economics, these conditions with human capital indicators are important for labour productivity (Penda 2012; Kijek et al. 2016). Human capital influences the productivity of physical capital in the accumulation of knowledge and skills (Barro and Sala-i-Martin 2004).

In the second stage, we examined the convergence of labour productivity in 28 EU countries. Initially, a test for conditional β-convergence across all countries was carried out using a panel data model. Islam (1995) demonstrates the advantage of the panel data approach over a cross-sectional approach: the latter causes a systematic downward bias in the estimated magnitude of β-convergence and misses unobserved determinants that affect the long-run labour productivity steady state. The potential impact of unobserved determinants reveals why panel data models have so often been applied in convergence studies. Panel models allow researchers to account for time-

Table 1. Variables for cluster analysis

Name	Description
GDP	Gross Domestic Product per capita at market prices
GVA	share of agriculture in total Gross Value Added (%)
AA	agricultural area (% of total area)
SAP	share in the EU agricultural production (%)
LP	land productivity (agricultural production per 1 ha of arable land; EUR/ha)
IC	intermediate consumption per 1 ha of arable land (EUR/ha)
SFAT	share of farms with a manager with "full agricultural training"

Source: Authors

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invariant heterogeneity by applying fixed effects that may act as proxies for geographically specific factors. In this case, convergence may be conditional on these specific time-invariant characteristics. Using Evans and Karras's (1996) approach, the model specification is as follows:

$$\Delta \dot{y}_{it} = \alpha + \beta \dot{y}_{i,t-1} + \mu_i + u_{it},\ i = 1,\ldots,N;\ t = 1,\ldots,T \quad (1)$$

where: y_{it} – labour productivity in country i at time t;
$\dot{y}_{it} = y_{it} - \overline{y}_t; \overline{y}_t = \frac{1}{N}\sum_i y_{it}; \overline{y}_t = \frac{1}{N}\sum_i y_{it}; \Delta \dot{y}_{it} = \dot{y}_{it} - \dot{y}_{i,t-1};$
μ_i – country's fixed effect; u_{it} – idiosyncratic error term; α and β – parameters; β is negative if the countries converge and zero if they diverge.

After analysing the convergence of labour productivity across all countries, the convergence for subsets of countries was verified. For this purpose, we use the following model:

$$\Delta \dot{y}_{itk} = \alpha + \sum_{k=1}^{K} \beta_k D_k \dot{y}_{i,t-1,k} + \mu_i + u_{it},$$
$$i = 1,\ldots,N;\ t = 1,\ldots,T;\ k = 1,\ldots,K \quad (2)$$

where: y_{itk} – labour productivity in country i at time t in club k;
$\dot{y}_{itk} = y_{itk} - \overline{y}_{tk}; \overline{y}_{tk} = \frac{1}{N_k}\sum_{i \in N_k} y_{itk}; \Delta \dot{y}_{itk} = \dot{y}_{itk} - \dot{y}_{i,t-1,k};$
μ_i – country's fixed effect, u_{it} – is an idiosyncratic error term, α and β – parameters; K – number of clubs; N_k – number of countries in a club k; D_k – dummy for the club k; β parameters inform on convergence processes in clubs.

RESULTS AND DISCUSSION

The study was conducted for a sample of 28 EU countries from the period 2005 to 2016, using Eurostat data (Eurostat Database 2020). The following countries were included in the study: Austria (AT), Belgium (BE), Bulgaria (BG), Cyprus (CY), the Czech Republic (CZ), Germany (DE), Denmark (DK), Estonia (EE), Greece (EL), Spain (ES), Finland (FI), France (FR), Croatia (HR), Hungary (HU), Ireland (IE), Italy (IT), Lithuania (LT), Luxembourg (LU), Latvia (LV), Malta (MT), the Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Sweden (SE), Slovenia (SI), Slovakia (SK) and the United Kingdom (UK).

In the cluster analysis, the mean values of variables for the period 2005 to 2016 were used. Averaging the values of discriminatory variables found that club convergence is a long-term trend and that structural conditions change over time (Galor 1996). The results of countries' classification using the Ward method are presented in Figure 1.

The dendrogram shows that there are 3 groups of countries which are homogeneous in terms of agricultural characteristics and growth conditions. It also shows Luxembourg, which is closest to the group of highly developed countries. Therefore, when clustering using the k-means method, we specified 3 clusters. The results of the country groupings are presented in Figure 2. In addition, Table 2 presents the characteristics of the level of productivity for 3 groups of countries.

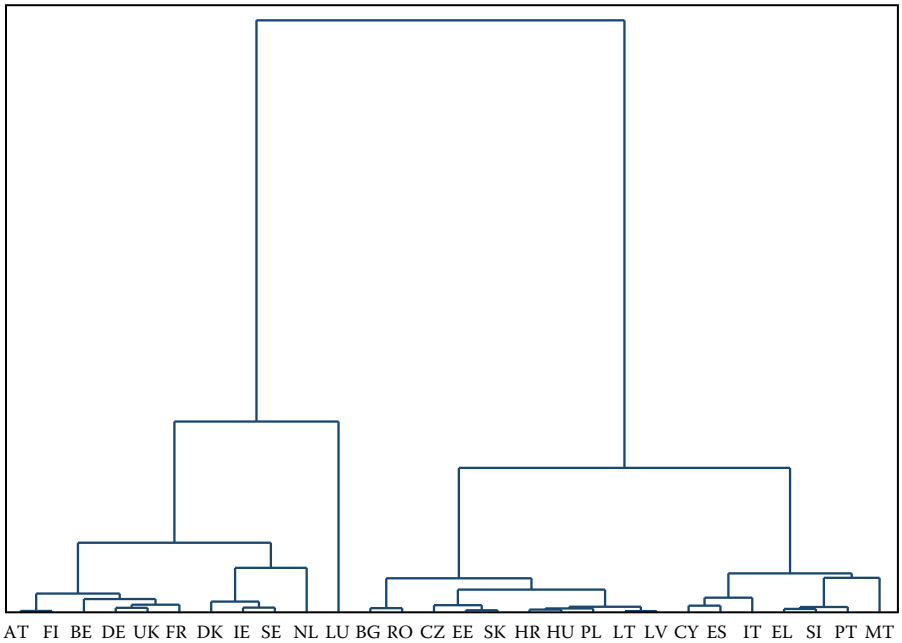

Figure 1. Dendrogram for Ward cluster analysis

AT – Austria; BE – Belgium; BG – Bulgaria; CY – Cyprus; CZ – the Czech Republic; DE – Germany; DK – Denmark; EE – Estonia; EL – Greece; ES – Spain; FI – Finland; FR – France; HR – Croatia; HU – Hungary; IE – Ireland; IT – Italy; LT – Lithuania; LU – Luxembourg; LV – Latvia; MT – Malta; NL – the Netherlands; NO – Norway; PL – Poland; PT – Portugal; RO – Romania; SE – Sweden; SI – Slovenia; SK – Slovakia; UK – the United Kingdom

Source: Authors' calculations based on Eurostat Database (2020)

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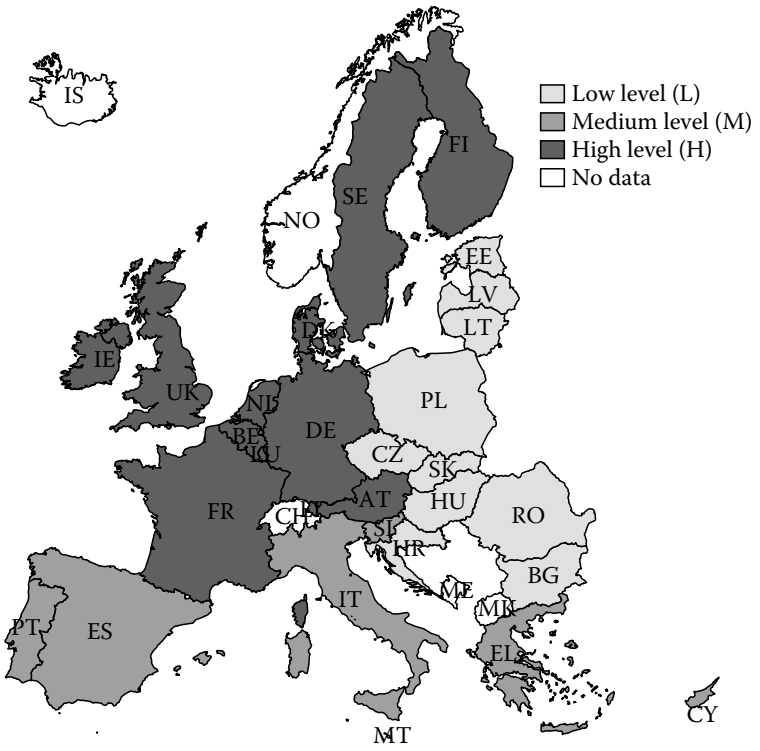

Figure 2. Classification of 28 EU countries according to the level of agricultural development

For countries' abbreviations see Figure 1

Source: Authors' calculations based on Eurostat Database (2020)

The group of countries with the highest level of agricultural development, measured by labour productivity, includes 11 countries belonging to the so-called Old Union (EU-15) (i.e. Austria, Belgium, Germany, Denmark, Finland, France, Ireland, Luxembourg, the Netherlands, Sweden, and the United Kingdom). Agricultural development was at a medium level for 7 countries, 4 of which belong to the EU-15 (Greece, Spain, Italy, Portugal), and the other 3 are the newest member states (Malta, Cyprus, Slovenia). The other countries that joined the EU in 2004 or later were classified as having a low level of agricultural development (Figure 2). The classification results confirm that the gap of agriculture productivity still exists between the new and old EU member states. A number of studies have noted this gap, including Nowak et al. (2016) and Barath and Fertő (2017). Csaki and Jambor (2019) emphasise in their study that system transformation and the accession to the European Union had a significant impact on the current agricultural situation in Central and Eastern Europe. Central and Eastern European countries have followed similar development paths (i.e. market mechanisms, restructuring of public institutions) and applied similar growth models based on foreign capital inflows (Grela et al. 2017).

One of the main goals of European integration is to reduce development disparities between member countries. In the early stages of the European integration development, the productivity among countries was relatively equal, but as the community expanded, the disparities grew. Equalising differences in labour productivity levels in agriculture plays a special role. Research showed that the average value of the labour productivity index for 2005–2018 ranged from 5 617.6 EUR/AWU in the group with the lowest level of agricultural development to 29 903.5 EUR/AWU for the group with the highest level (Table 2). There was also a wide gap between the minimum and maximum values in individual groups, as well as across the entire sample. The difference in the value of labour productivity in the research period between the country with the lowest (Bulgaria) and the highest (the Netherlands) level was 18-fold. None of the countries newly admitted to the EU reached the average level of labour productivity for EU-28. In such countries as Bulgaria, Poland, Romania, Latvia, and Hungary, the level of labour productivity did not even reach 5 000 EUR/AWU.

Table 2. Descriptive statistics of productivity for three groups of countries

Group of countries	Mean	Min	Max
Low level (1)	5 617.6	1 666.9	14 180.7
Medium level (2)	16 286.8	4 527.6	44 332.0
High level (3)	29 903.5	8 036.6	115 759.8

Source: Author's calculations based on Eurostat Database (2020)

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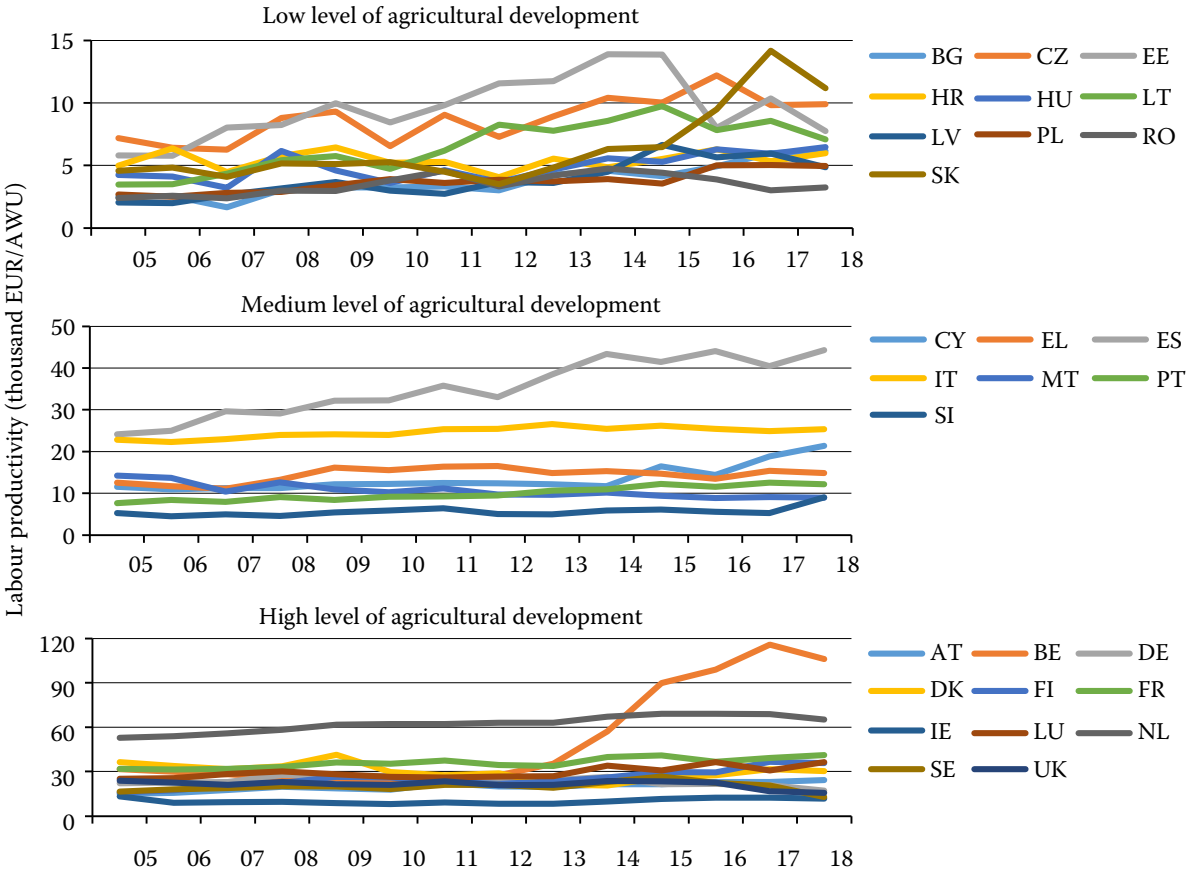

Figure 3. Trends of labour productivity in agriculture in different groups of EU countries

AWU – Annual Work Unit; for countries' abbreviations see Figure 1
Source: Authors' calculations based on Eurostat Database (2020)

As shown in Figure 3, a number of different labour productivity trends are observable in low-productivity countries. The highest growth of the analysed indicator in 2005–2018 was found in Bulgaria, Slovakia, Latvia, and Lithuania. In the last two research years, Slovakia has achieved the highest level of labour productivity among the countries belonging to this group. A strong upward trend in the productivity indicator was observed in Slovakia in 2014–2017. Csaki and Jambor (2019) indicated similar Slovakian trends. Large fluctuations in the effectiveness of labour factor use in agriculture were observed in the Czech Republic and Estonia. In the first year of research, these countries achieved the highest levels of labour productivity. However, the growth dynamics in 2005–2018 were some of the lowest in the group of low-productivity countries. It is also worth noting Croatia, which was the last country to join the European Union, where the increase in labour productivity was the lowest at only 19%. When looking at the entire group of low-productivity countries, it should be stated that the dynamics of Croatia's growth in 2005–2018 reached 169.8% and were much higher than the other two groups. In most countries with a medium level of labour productivity, its value showed lower fluctuations in the research period. Spain was a country with a high growth rate of GVA per agricultural employee. The level of labour productivity in Spain increased by 83.8% in the period analysed, and its value in 2018 was more than twice the average value in this group. Analysing trends in the group of countries with the highest level of productivity, Belgium stands out, where in the years 2013–2017 a dynamic increase in the labour productivity index was observed. In 2018, its value was triple what it was in 2005. From 2015, Belgium achieved the highest labour productivity in the European Union agriculture industry. The average value of labour productivity for the Netherlands in 2005–2018 was the highest among the 11 countries in this group. But its fluctuations in time were relatively low.

The disproportionate levels of agricultural labour productivity in Western European countries and

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Table 3. Estimates of model parameters of conditional β-convergence for all countries

Explanatory variable	Dependent variable ($\Delta\dot{y}_{itk}$)		
	all	OMS	NMS
$\dot{y}_{t-1}$	–0.303***	–0.154	–0.445***
Const	0.004***	0.097	–0.325***
F-test	12.09	2.43	23.29
(*P*-value)	(0.002)	(0.141)	(0.000)

*$P < 0.1$, **$P < 0.05$, ***$P < 0.01$; OMS – old member states; NMS – new member states; y_{it} – labour productivity in country *i* at time *t*; variables are specified as in the Equation (1)

Source: Author's calculations based on Eurostat Database (2020)

the new member states (NMS) are also highlighted by Martín-Retortillo and Pinilla (2012). Furthermore, Eurostat data shows that in 2005–2016 labour productivity in EU agriculture on average increased by 47.9%. Gołaś (2019) attributes this increase to lower employment numbers in agriculture, especially in the new member states. According to Csaki and Jambor (2019), there is still a significant labour productivity gap between "new" and "old" members of the EU-15 in terms of agriculture. This gap may be explained to some extent by the different specialisation patterns of these two regions with cereal and raw material-based production in CEE countries, and animal- and processed- product-based production in the EU-15, which leads to higher value added per worker in Western Europe. According to the research procedure, we applied the panel data model of conditional β-convergence for all countries in the first step. The results of parameter estimations are presented in Table 3.

The negative estimate of β coefficient indicates the conditional convergence process of labour productivity for all EU countries. In order to separate the convergence effect in the new and old EU countries, the β coefficient for these two groups of countries was estimated. The results clearly show that the convergence process is strong for new member states, while for old member states (OMS) it is much weaker and statistically insignificant. For a detailed analysis, we also estimated individual β coefficients for all countries, allowing us to find specific trajectories of labour productivity changes in the sample countries. The individual coefficients are presented in Figure 4.

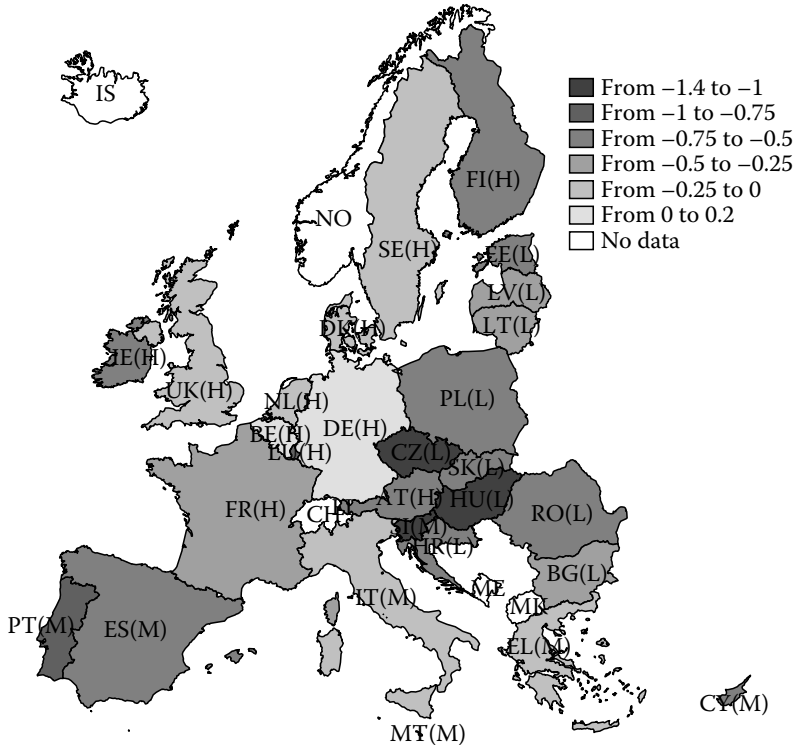

Figure 4. Individual β coefficients of the conditional convergence for all EU countries

For countries' abbreviations see Figure 1; *L* – low level, *M* – medium level, *H* – high level of agricultural development

Source: Authors' calculations based on Eurostat Database (2020)

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Table 4. Estimates of model parameters of club convergence

Explanatory variables	Dependent variable ($\Delta\dot{y}_{it}$)		
	all	OMS	NMS
$\dot{y}_{i,t-1,L}$	−0.495***	–	−0.495***
$\dot{y}_{i,t-1,M}$	−0.329***	−0.381***	−0.298*
$\dot{y}_{i,t-1,H}$	−0.164	−0.164	–
Const	0.003***	0.037***	0.029*
F-test	15.36	72.73	18.71
(*P*-value)	(0.000)	(0.000)	(0.000)

*$P < 0.1$, **$P < 0.05$, ***$P < 0.01$; OMS – old member states; NMS – new member states; y_{it} – labour productivity in country i at time t; L – low level, M – medium level, H – high level of agricultural development; variables are specified as in the Equation (2)

Source: Author's calculations based on Eurostat Database (2020)

The individual β coefficients made it possible to identify the countries that contributed the most to convergence. The dynamics of productivity change in countries such as the Czech Republic and Hungary allowed them to catch up with leading countries, as evidenced by the β coefficient values. It is worth noting that some countries not only inhibited convergence processes but even triggered divergence processes. The mechanism of divergence is twofold. On the one hand, the countries with the highest levels of labour productivity in agriculture and favorable growth conditions can "escape" catching-up countries (e.g. Denmark and Belgium) without experiencing growth restrictions. On the other hand, the countries experiencing catch-up growth may not benefit from the latecomer advantage (e.g. Greece). Matthews (2014) states that the increase in productivity across this sector in Central and Eastern Europe is consistently lower than in the EU-15, and the difference between these groups even increased during the period 2002–2011. Baráth and Fertő (2017), in turn, found some evidence to support the convergence hypothesis, although they also showed that there are still significant differences between the EU-15 and new member state productivity levels. Although there are some tendencies toward convergence in the sample as a whole, we decided to test convergence for groups of countries that share

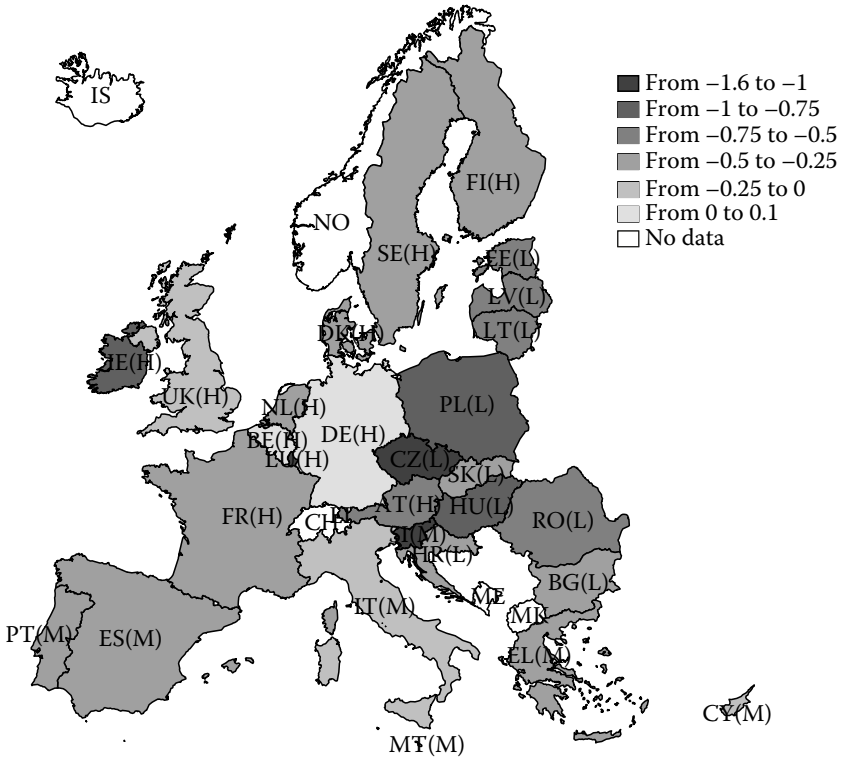

Figure 5. Individual β coefficients of club convergence

For countries' abbreviations see Figure 1; L – low level, M – medium level, H – high level of agricultural development

Source: Authors' calculations based on Eurostat Database (2020)

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similar characteristics and growth conditions. We carried out the analysis of club convergence for 3 groups of countries by applying the cluster analysis. The results of parameter estimations are presented in Table 4.

β coefficients for the club convergence analysis confirm convergence processes in the group of countries with low and medium levels of agricultural development. In the third group of countries there is a divergence process. Similar to the previous analysis, we estimated the convergence effect in the clubs for OMS and NMS. The club with the lowest levels of agricultural development consists of only new EU countries, and the club with the highest level of agricultural development consists of only old EU countries, so the club's β coefficients for OMS and NMS are the same as for all country groups. Only the club with the medium level of agricultural development consists of both OMS and NMS. The convergence process is present in both groups, while it is stronger for OMS than NMS.

To reveal individual trajectories of labour productivity changes within the clubs, we performed a detailed analysis by calculating individual β coefficients. The results are presented in Figure 5.

Our analyses have shown that club 1 has undergone the strongest convergence processes of labour productivity in the agricultural sector. These countries have a lower level of agricultural development than the countries belonging to the other two clubs, but they show faster convergence to a common development plan. Among the club members, countries such as the Czech Republic and Poland are converging the most. In turn, Hungary and Slovenia have the least intensive convergence in this group. It should be noted that convergence processes also took place in club 2, but their intensity was considerably lower than that of club 1, which may suggest the existence of so-called traps of medium development in agriculture. Divergence processes were observed in club 3, with Belgium having the highest β coefficient. Alexiadis (2010) also showed that convergence is limited to a specific group of countries. It is important with regard to implementing the Common Agricultural Policy and Cohesion Policy. Identifying a convergence club clearly helps to define a demarcation line between regions that need support and those that do not.

CONCLUSION

The study tests club convergence of labour productivity in agriculture of 28 European Union countries in 2005–2016. The results show that in an analysis of all EU countries, convergence processes with significantly varying intensities for individual countries were observed. For this reason, we distinguished clubs of countries with similar structural and growth conditions, which allowed us to recognise changes in agricultural labour productivity that occurred in more homogeneous country groups. The research shows that in the club with the highest level of labour productivity a divergence process took place. On the other hand, convergence processes were observed in the group of countries with the low and medium levels of labour productivity. This confirms the assumption that the diversity of agricultural development in countries leads to convergence processes that follow multiple equilibria. Therefore, convergence of labour productivity does not always apply to all economies: only to those with similar economic and structural conditions.

Our contribution to the field of agriculture productivity convergence studies is threefold. First, unlike many previous studies on convergence of labour productivity in agriculture, we focused on club convergence which addresses issues of catching-up processes in the group of countries with similar structural, economic, and sectoral characteristics. Second, we endogenised the process of club formation by applying a broad set of club convergence factors. Finally, we tried to test the strength and direction of agricultural labour productivity convergence in particular countries within identified clubs. To our knowledge, the abovementioned efforts make original contributions to the literature on agriculture productivity convergence. On the subject of integration processes taking place in the EU, the issue of labour productivity should be given a special rank. Low productivity levels in many EU countries hinder the transition to an intensive growth path. All European Union countries are subject to the same Common Agricultural Policy; however, agriculture in these countries varies significantly, both structurally and socially. It should be assumed that without a significant acceleration of broadly understood structural changes in agriculture, convergence processes of labour productivity between old and new member states will not accelerate. Therefore, it seems justified to focus the CAP more strongly on supporting structural transformations of the agricultural sector in Central and Eastern European countries that face such problems.

The study has some methodological limitations that may suggest directions of future research. First,

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the subject of analysis is the agricultural sector of individual EU countries. Considering the regional diversity of agricultural production, it would be worth conducting research on convergence of labour productivity in agriculture at the level of NUTS 2 or NUTS 3 regions. Secondly, the study does not consider the effects of spillovers in processes of labour productivity convergence. Therefore, using the spatial panel model far convergence research would be an interesting direction for future work in this area. Finally, the extension of research period would allow for analysis of the effect of the EU accession.

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