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20 Years of Productivity in European Agriculture: Is There a Convergence?

20 év termelékenység az európai mezőgazdaságban: van-e konvergencia?

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Introduction

The productvitiy of European agriculture has been extensively analysed during the previous decades by agricultural economists worldwide. However, the analysis of the long term performance of European countries in agriculture is somehow missing from the literature. Although many studies exist on the various aspects of the story, evidence seems to be scrappy. The aim of this paper is to analyse the long term performance of European agriculture, thereby putting the different elements of the puzzle together. In doing so, the paper analyses whether there was a convergence in agricultural performance to the level of EU-15 countries or not.

The paper is structured as follows. The second section provides a literature review on the topic, followed by the demonstration of the methodology used. The fourth section provides descriptive evidence on the performance of European agricultural productivity, followed by the analysis of convergence, based on productivity indicators. The fifth section discusses the possible reasons behind different performances, while the last chapter concludes.

Literature review on productivity in EU agriculture

A large amount of scientific literature is dedicated to productivity analysis in European agriculture. One part of the literature in efficiency analysis is focusing on total factor productivity (TFP) changes. A recent report of the European Commission (EC, 2016), for instance, found that agricultural productivity in Europe, measured by total factor productivity growth, has increased over time, though at a slower rate in recent years than in the past (around 1% yearly increase between 1995 and 2005, while approximately 0.8% increase between 2005 and 2015). Such productivity growth was mainly driven by the shrinking number of agricultural workforce and by the larger pace of growth in Central and Eastern Europe. Baráth and Fertő (2017) analysed productivity and convergence in European agriculture and found that TFP has slightly decreased in the EU between 2004 and 2013, while supported the productivity convergence hypothesis across the member states. Matthews (2014) also analysed the productivity performance of the new member countries and highlighted their impressive performance.

Literature dedicated to efficiency analysis in agriculture is also dealing with impacts of agricultural and food policies on agricultural productivity. Probably the most recent and extensive analysis on the impact of public subsidies on farm technical efficiency is provided by Minviel and Latruffe (2017), presenting a meta-analysis of empirical results on this issue, based on data gathered from a systematic literature review. In general, they find that subsidies are commonly negatively associated with farm technical efficiency in the majority of the studies. Moreover, Minviel and Latruffe (2017) argue that 25% of the models find a significant positive effect, around 50% find a significant negative effect, while the rest report non-significant effects. Furthermore, studies published in 2003 or before are more likely to have reported a negative effect, arguing that decoupling had a positive effect.

Another strand of the literature using economic modelling to argue for the positive effects of subsidies on agricultural productivity growth. Zhu et al. (2012), for instance, investigated the role of CAP subsidies on the technical efficiency of German, Dutch and Swiss dairy farms for 1995-2004 based on FADN data using regression modelling. Their results suggest that a higher degree of coupling in farm support negatively affects farm efficiency. In other words, decoupling increases efficiency while coupling decreases it. Rizov et al. (2013) also claim that coupled subsidies impact negatively on farm productivity in the period before the decoupling reform was implemented; after decoupling the effect of subsidies on productivity is more nuanced and in several countries it turned positive. They used structural semi-parametric modelling using FADN data for EU15 countries for 1980-2008 as a method of analysis.

On the whole, it seems that productivity in European farms varies to a great extent, though the gap between Old and New members somehow narrows. As to policy oriented analysis, the vast majority of the studies argue that subsidies are commonly negatively associated with farm technical efficiency. Studies also find that decoupling increases efficiency while coupling decreases it. Furthermore, studies published in 2003 or before are more likely to have reported a negative effect, arguing that decoupling had a positive effect.

Literature on convergence

The term convergence is probably most commonly used in the framework of European integration, linked to the term 'cohesion'. Within this framework, convergence can be defined as 'increased cohesion'. Contrary to divergence and status quo, convergence results in more equal levels of development in any measurable aspect. Convergence has always been at the very heart of European integration since Europe is characterised by a very diverse set of countries with different economic, social and environmental situation, aimed to be 'levelled off'. Therefore, convergence of economic performance as a goal was highlighted in Article 2 of the Maastricht Treaty. As reaching convergence is not a natural process, policy makers established several structural policies to achieve this goal. In terms of funds, European Regional Development Fund (ERDF), European Social Fund (ESF), Cohesion Fund (CF), European Agricultural Fund for Rural Development (EAFRD), European Maritime and Fisheries Fund (EMFF) and Instrument for Pre-Accession Assistance (IPA) are all serving or have served the goal of convergence.

Regarding application of the convergence theory to agriculture, there are various methods to approach this issue. According to de Jong (2018), price, productivity and income are the three areas where convergence is analysed empirically in agricultural markets. His analysis, for instance, in the European dairy sector has not found structural convergence patterns in any of the three dimensions.

As for price convergence, most studies are coming from the price transmission literature, analysing whether price fluctuations are softened by the retail sector or not. Sosvilla-Rivero and Gil-Parejo (2004) studied price convergence for various consumer price indices in Europe and found some evidence for convergence of traded goods. Conclusions of price transmission empirical research vary greatly depending on the sector tested, the methodology chosen and the frequency of the data used in the analysis (von Cramon-Taubadel et al. 2006). However, price transmission is generally found to be imperfect, meaning that a price change at the producer level is not fully transmitted to consumers. Bakucs et al. (2014), by applying a meta-analysis on the existing literature, showed that price asymmetries are more likely to exist in sectors with higher numbers of fragmented farm producers, higher political interests and higher concentration of retailer powers.

As to productivity convergence, Timmer et al. (2010) examined the gap between European and American productivity growth and suggested that EU productivity levels were less than half of the USA. The authors investigated the patterns of convergence across European countries from 1980 to 2005 but could not find convergence in agriculture. Matthews (2014) reached similar conclusion when stating that productivity growth in CEE agriculture has been consistently lower than that of EU15, while the gap has even grown from 2002 to 2011. Cechura et al. (2014) looked at catching up and falling behind processes in the European milk sector and showed a considerable amount of productivity differences. They found, however, no signs that poorly performing farms were catching up to better performing ones. On the contrary, Baráth and Fertő (2017) analysed productivity and convergence in European agriculture and found some evidence to support the convergence hypothesis, though they also showed that significant differences still existed between EU-15 and CEE levels.

Last but not least, the study of income convergence is probably the most widely studied part in the literature as it is linked to the topics of economic development and economic inequality. If compared to prices and productivity issues, income is found to be the most important by the majority of the studies as it is most directly felt by people (de Jong, 2018). Studies in agricultural economics mainly focus on the convergence of GDP/GNI per capita across countries and regions as well as the income distribution of farmers. Brasili et al. (2006) analysed the convergence of agricultural incomes in the EU and US and found evidence on income convergence. Hansen and Teuber (2011) analysed the impact of the CAP on regional convergence and found that inequality in revenues increased, while cross-sectional inequality softened.

Methodology

This paper uses the productivity convergence option out of the possibilities described above to measure convergence. In doing so, it uses partial productivity measures (land and labour productivity) to conduct its analysis. Although many other methods like data envelopment analysis (DEA), stochastic frontier analysis (SFA), total factor productivity (TFP) exist to analyse productivity in agriculture, they require lot of data. This paper aims to take a more holistic view and does not intend to be too technical in nature. Moreover, given the diversity of structural differences in European agriculture, the same production function for all countries would not hold.

For our approach, distribution analysis seems to be the most appropriate as we are particularly interested in the bimodality of distribution. The Kernel estimation is selected as it is also a useful tool to see whether there exists different groups of regions with same productivity levels. Moreover, in order to statistically assess convergence, Markov chain analysis is applied. This method also seems to be useful as it both has the possibility of statistical inference and of identifying individual regions at the same time. In other words, Kernel density plots demonstrate external distribution patterns, while Markov chains show dynamics of internal distribution. An excellent review of both methods can be found in de Jong (2018).

The empirical analysis is done with the STATA software package. Data on productivity is coming from the FAO database and is analysed from 1997 to 2016 due to data availability. FAO data on land and labour productivity is calculated by dividing agricultural value added by agricultural land and labour size, respectively. Agricultural value added data are measured in constant 2010 US dollars at the farm gate level.

For comparison purposes, we have divided our sample into three different productivity classes: high-productive countries (with productivity exceeding EU-15 average by at least 25%); low-productive countries (with productivity below 75% of EU-15 average) and average-productive countries with the rest.

Results and discussion

Land productivity in Europe shows a huge diversity (Figure 1). The Netherlands has by far the highest land productivity values in all periods analysed, reaching 8000 USD/ha in 2013-2016. The Netherlands was followed by Italy and Finland in land productivity, while the lowest values were observable for Bulgaria, Lithuania and Latvia. All counties expect Germany, Greece, Luxemburg and Bulgaria could increase agricultural land productivity to some extent from 1997-2000 to 2013-2016, though this growth was limited in most cases (Slovakian values should be taken with care due to data reliability issues). In Central and Eastern Europe (CEE), the region in general shows high diversity in terms of land productivity with Slovakian and Slovenian values around EU-15 levels and with a high productivity gap for the vast majority of the countries to western standards. On average, the land productivity gap between CEE and EU-15 remained to be twofold in all periods analysed. A limited convergence is observable in this regard.

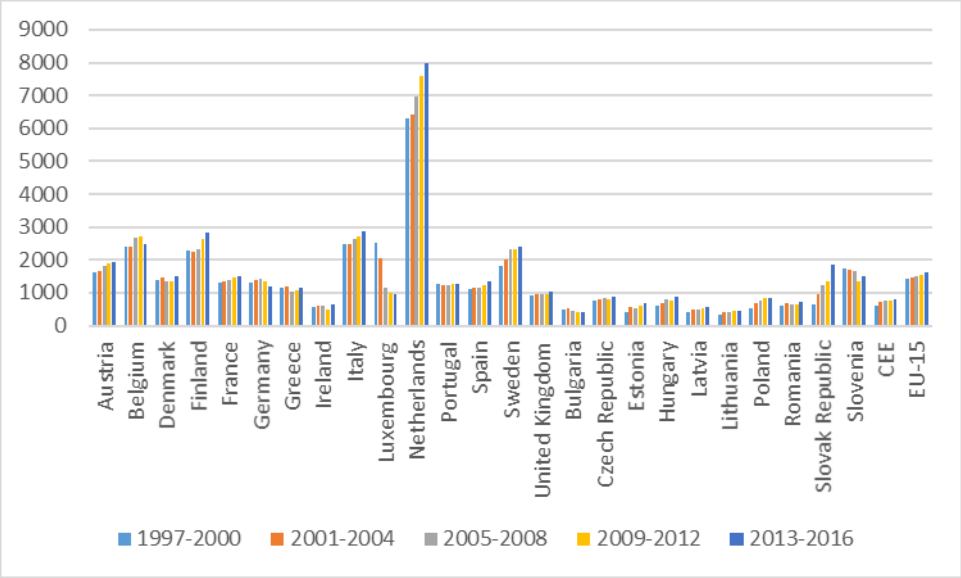

Figure 1. Agricultural land productivity in Europe, 1997-2016, USD/ha
Source: Own composision based on FAO (2018) data

Agricultural labour productivity was also increasing in European countries from 1997-2000 to 2013-2016 (Figure 2), though at a much higher pace than in land productivity. Highest labour productivity growth pertained to Slovakia (+217%), Romania (+214%) and Finland (+139%) from 1997-2000 to 2013-2016, while the lowest was observable for Luxembourg (-42%), Greece (+37%) and the United Kingdom (+38%) in the same period. The highest labour productivity values pertained to France, Finland and the Netherlands, while the lowest were observable for Poland, Portugal and Latvia. Note the high but decreasing productivity gap between CEE and EU-15 countries - in terms of convergence, CEE countries started to approach western standards as in 1997-2000, CEE agricultural labour productivity was 36% of the EU-15, while in 2013-2016, it was 63%. Still, the significant gap existing between 'new' and 'old' member of the EU-15 in terms of agricultural labour productivity can partly be explained by the different specialisation patterns of the two regions with cereal and raw material based production patterns in CEE countries, while animal and processed product based production in EU-15, resulting in higher value added per worker in Western-Europe.

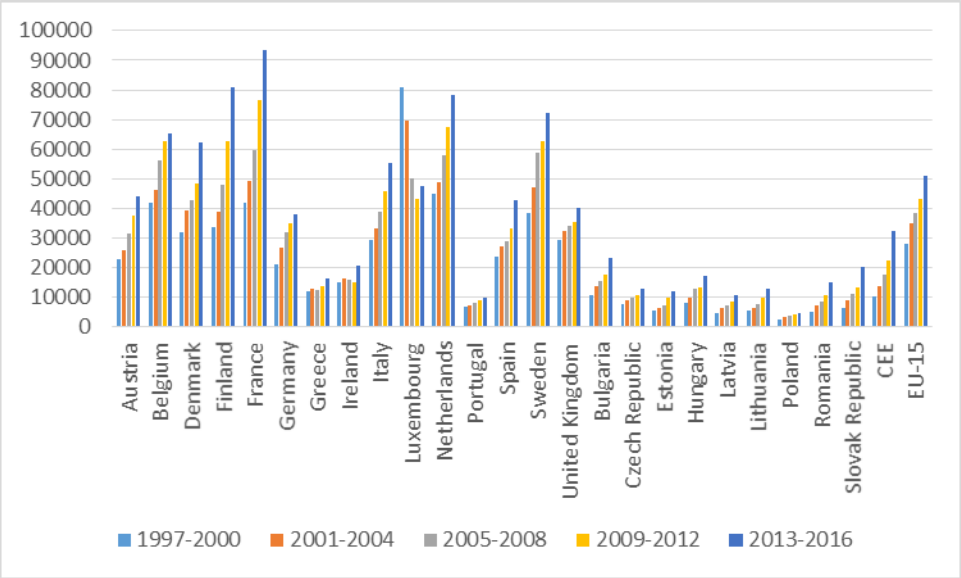

Figure 2. Agricultural labour productivity in Europe, 1997-2016, USD/ha
Source: Own composision based on FAO (2018) data

By applying Kernel density functions and Markov chains to our sample as described in the methodology section, further patterns of European agricultural performance become available. As evident from Figure 3, there is no clear of distribution of land productivity visible for the years analysed. There is a peak around 1000 euro/ha but in terms of convergence, Figure 3 shows status quo. If convergence would occur, the peak should move to the right over time. The persistent gap of low productivity regions seems to have remained here.

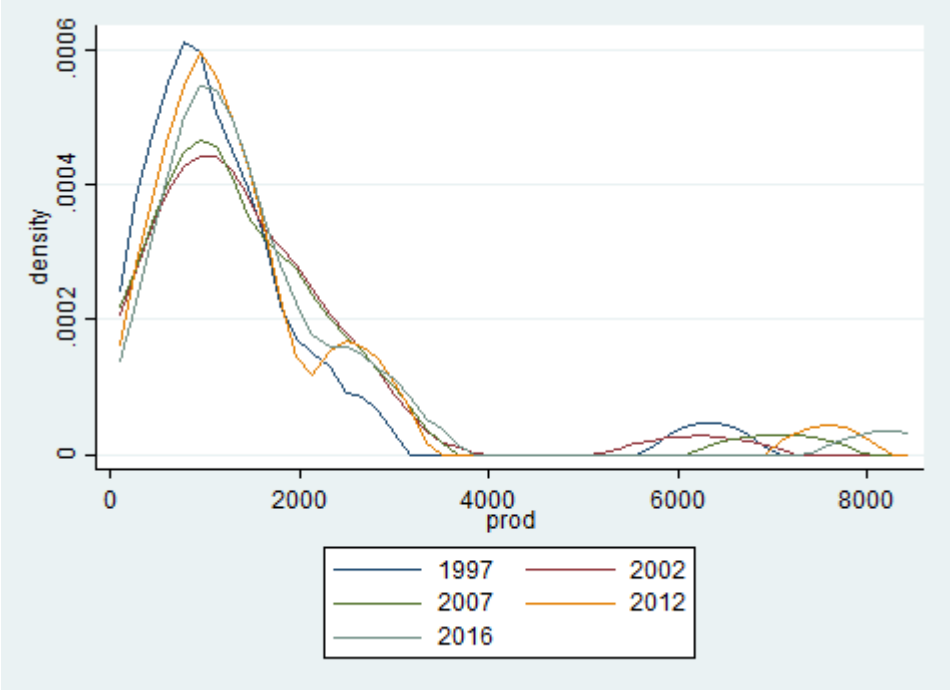

Figure 3. Kernel density plot for land productivity in agriculture in Europe, 1997-2016
Note: Kernel function was based on the Gaussian method
Source: Own composision based on FAO (2018) data

Markov transition probability matrices seem to end up in the same conclusion (Table 1). 80% of European countries remained in their productivity class in terms of land productivity from 1997-2000 to 2013-2016, while 12% of countries even showed signs of decreasing land productivity. Consequently, it was 8% of countries able to increase their land productivity in the period analysed. In other words, no significant signs of land productivity convergence was observable in European agriculture between 1997 and 2016.

Table 1: Transition probability matrix for European land productivity (from 1997-2000 to 2013-2016)

Initial distribution		<75%	76-124%	>125%
12	<75%	0.40	0.08	0.00
8	76-124%	0.08	0.24	0.00
5	>125%	0.04	0.00	0.16

Source: Own composition based on FAO (2018) data

In terms of labour productivity, results also suggest limited convergence. The Kernel density plot shows some more diversity among the countries analysed in labour productivity, especially in the lower end (Figure 4). However, the lack of convergence here is at least as evident as in Figure 3 – density do not change in time.

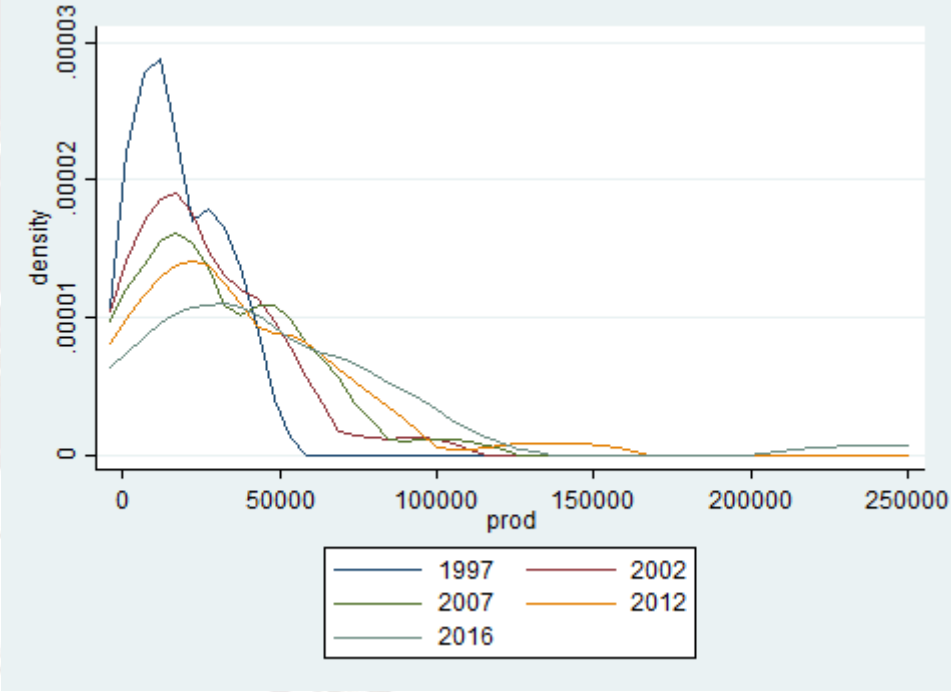

Figure 4. Kernel density plot for labour productivity in agriculture in Europe, 1997-2016
Note: Kernel function was based on the Gaussian method
Source: Own composision based on FAO (2018) data

Markov transition probability matrices also underpin arguments above. 92% of European countries remained in their productivity class in terms of labour productivity from 1997-2000 to 2013-2016, while 4% of countries even showed signs of decreasing labour productivity. Consequently, it was 4% of countries able to increase their

labour productivity in the period analysed. In other words, no significant signs of labour productivity convergence was observable in European agriculture between 1997 and 2016.

Table 2: Transition probability matrix for European labour productivity (from 1997-2000 to 2013-2016)

Initial distribution		<75%	76-124%	>125%
14	<75%	0.56	0.00	0.00
6	76-124%	0.00	0.20	0.04
5	>125%	0.04	0.00	0.16

Source: Own composition based on FAO (2018) data

Possible reasons behind different performances as well as the lack of convergence are numerous. First of all, CEE agriculture have faced serious challenges in creating a market conforming trade and policy environment. The process of moving towards a market economy, including land privatisation, changing the structure of the economy or de-collectivisation was such a shock that agriculture of many Western European countries could not have even survived (Csaki, 2005). Political changes above were followed by a serious institutional change, which in the majority of the cases, was not a well-thought and organised process. Short term agricultural interests and the lack of long term strategies have determined the way how new institutions have come into existence, resulting in inefficient implementation of even the good ideas (Csaki and Lerman, 1997).

EU accession has also played an important role in determining the performance of CEE agriculture. CEE countries have become part of the European common market, offering many possibilities but also different challenges. The way how the countries used pre-accession EU-provided facilities such as SAPARD, ISPA and PHARE made also impact upon post accession performance. Countries focusing on competitiveness enhancement and production improvement benefited more from these resources as far as post accession sectoral performance (Swinnen and Rozelle, 2006). Slow adjustment to the relatively complicated administrative procedures also played a role in this regard.

The performance of the CEE countries after accession also reflects the structure of farming (Lerman, 2007). The structure except Poland and Slovenia is the result of a difficult process of land privatisation and farm restructuring. The relatively consolidated farm structure with the dominance of small farms proved to be advantageous for these two countries and especially for Poland. The consolidated structure brought higher level of asset endowment as well. In countries with so called "dual" farming structure, both end of the farming are still suffering by a kind of "transition phenomena" (Swinnen and Rozelle, 2006). The small farms are generally too small and farmers are inexperienced and lack of resources, while the large ones still have some heritage of the collective farming system with some embedded inefficiencies.

By ranking individual country performances, Jambor et al. (2016) suggest that Poland and the Baltic countries can be treated as the winners of EU accession in agriculture, while Romania and Bulgaria proved to have used their potentials to the least. Their results also suggest that focusing on high value added agri-food products should be the strategy to reach development in the agriculture sector, though the majority of the countries focused on the production of agri-food raw materials. Limited convergence in the CEE, however, is especially a problem if we take into account the vast amount of EU funds directed to the agricultural development of the CEE region.

Conclusions

The paper analysed convergence patterns in European agriculture. In doing so, it applied Kernel density plots and Markov transition probability matrices and showed that some convergence in agricultural land and labour productivity appeared from 1997 to 2016. This argument was also underpinned by simple descriptive statistics. It seems that CEE agricultural land and labour productivity is still far away from EU-15 levels and this considerable gap has not significantly decreased during the previous decades. While Kernel density plots suggested similar patterns of productivity over time, suggesting limited convergence, Markov transition probability matrices showed the lack performance enhancers – the vast majority of European countries maintained but have not improved their land and labour productvitiy in the period analysed.

Reasons behind different performances are numerous and were also dependent on regional and country specificities. However, it seems evident that the way transition to the market economy was selected, together with institutional, land structure and pre- and post-accession policies have definitely played a role.

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