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ECONOMIC AND ENVIRONMENTAL ASPECTS OF AGRICULTURAL EFFICIENCY OF NEW AND OLD MEMBER STATES OF THE EUROPEAN UNION – IS THERE A CHANCE TO REDUCE THE DIFFERENCES?

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ABSTRACT: The study brings attention to a significant problem: the gap in eco-efficiency between EU countries depending on the date of accession. This study aims to analyse eco-efficiency at the micro-level (farm) between two distinct groups of EU Member States: those that joined before 2004 and after 2004. The survey covered individual commodity farms dealing with field crops. The research used data from the Farm Accountancy Data Network from 2013 to 2020. The study uses input-oriented Data Envelopment Analysis (DEA) and the Malmquist productivity index. The study concludes that farms in countries that acceded to the EU before 2004 feature a higher eco-efficiency level. On the other hand, farms from the EU Member States that joined the EU at the expansion stage after 2004 have gradually reduced the distance, which is reflected by the increased dynamics of the eco-efficiency index in the period under review.

KEYWORDS: agriculture, Data Envelopment Analysis, efficiency, environment, productivity

Introduction

The Common Agricultural Policy (CAP) has a special place in the Green Deal strategy of the European Union's (EU) policy. According to the assumption of the Green Deal, the objectives of CAP measures include primarily increasing the share of EU agriculture into actions oriented at climate change, improving the management of natural resources, ensuring a fair economic return to farmers and reinforcing biodiversity protection (European Commission, 2020). It means that CAP will be implemented in an economic, environmental and social aspect. However, the environmental aspect is the most pursued one.

The specific objectives of CAP for the years 2023-2027 are to be accomplished through national strategic plans prepared by individual EU member states. This gives the member states the possibility to customise their measures (European Commission, 2022).

A customised approach to shaping the agricultural policy at the national level testifies to a significant diversity of EU agriculture when new member states joined the EU after 2004. Agriculture in the countries of Central and Eastern Europe underwent a difficult period of transformation in the 1990s from a centrally-planned economy into a market economy (Richterova et al., 2021), which made its development take a different path than in the EU-15. The accession of new member states to the EU after 2004 provided a chance to catch up with the development level of the Western member states of the EU. In 2017, a proposal for implementing the concept of 'two-speed Europe' or 'multi-speed Europe' (Kasprzak, 2017) emerged, which could reverse the trend towards reducing differences in development and simultaneously contribute to further polarization of the level of productivity and income of farms in the EU member states. The Rome Declaration, signed on 25 March 2017, on the 60th anniversary of the Treaty of Rome, reads, "We will act together, at different paces and intensity where necessary, while moving in the same direction (…). Our Union is undivided and indivisible" (European Council, 2017). The goals set out in the declaration included working towards completing the Economic and Monetary Union and developing a Single Market (European Council, 2017), which can be regarded as the continuation of assumptions of the Community's economic policy.

Referring to the agricultural sector, the extension of the European Union after 2004 led to its dynamic development, which increased the overall productivity of new member states above the level presented by the EU-15 (Nowak & Kubik, 2019). According to the new guidelines of CAP, the intensification of agricultural production gives way to measures promoting sustainable agricultural production (Czyżewski et al., 2021). Therefore, new member states will search for solutions to further increase their productivity and simultaneously reduce their adverse environmental impact.

The study highlights a significant issue: a disparity in eco-efficiency among EU countries based on their date of accession. There remains a notable dearth of research focusing on trends aimed at mitigating the discrepancies in eco-efficiency levels across EU member states.

Based on considerations, we undertook to accomplish the objective of the study, that is, evaluate and compare the eco-efficiency of farms in the current member states of the European Union, specialising in field crops, between two groups identified according to the time criterion (date of accession of the member state to the EU).

The paper sets forth and verifies the following theses:

- the eco-efficiency level of farms in member states that joined the EU after 2004 was lower than in member states making the EU-15,
- the eco-efficiency dynamics of farms in member states that joined the EU after 2004 was higher than in member states making the EU-15.

The subsequent sections of the paper are organised as follows: Section 2 outlines the theoretical framework on eco-efficiency, the methodological approach and previous relevant studies, Section 3 details the method employed and provides a description of the research sample, Section 4 demonstrates the findings and discusses the results and Section 5 provides the study's conclusion.

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An overview of the literature

The term eco-efficiency was coined by Schaltegger and Strum (1990) to depict a tool for measuring sustainability. As the name itself implies, eco-efficiency integrates economic and environmental issues (Figure 1) – so it is also referred to as economic-environmental efficiency (Picazo-Tadeo et al., 2011). A standard eco-efficiency analysis combines two of the three components of sustainable development – the economic and the environmental component (Czaplicka-Kolarz et al., 2010), due to which it tends to be called a measure of environmental sustainability (Czyżewski et al., 2021).

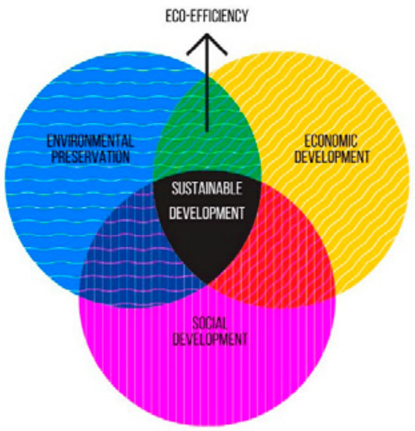

Figure 1. Relationship between eco-efficiency and sustainable development

The idea of eco-efficiency was disseminated by the World Business Council for Sustainable Development (WBCSD) in 1992 (Richterova et al., 2021). WBCSD defines eco-efficiency as a management strategy that combines environmental and economic performance, enabling more efficient production processes and the creation of better products and services while reducing resource use, waste, and pollution along the entire value chain. The concept creates more value with less impact by unlinking goods and services from the use of nature. Not only can it save production costs, but it can also open up new sources of revenue for companies (WBCSD, 2023).

Eco-efficiency is about doing more with less and simultaneously taking care of the environment (Madden et al., 2023). The general formula of eco-efficiency is a simple statement: it is a relationship between a product or service or its influence on the environment (Verfaillie & Bidwell, 2000):

$$\frac{product\ or\ service\ value}{environmental\ influence}, \tag{1}$$

A maximum numerator value and reduced denominator is a desirable trend for the eco-efficiency formula. The effect of a specific product or service on the environment refers to its production (Picazo-Tadeo et al., 2011).

Measuring eco-efficiency has become an important aspect of agricultural performance evaluation in recent years and, hence an object of research. This review of publications refers to literature on measuring the eco-efficiency of agriculture in EU member states. It is worth noting that these studies vary significantly in terms of the method used, spatial range and selection of variables.

Studies on eco-efficiency generally employ the following methods:

- Data Envelopment Analysis (DEA) – a predominant method primarily used due to the lack of necessity to determine the functional relationship and the possibility to introduce multiple inputs and outputs (Kobiałka & Kubik, 2017), e.g. Pishgar-Komleh et al. (2021), Richterova et al. (2021), Coluccia et al. (2020), Gołaś et al. (2020), Staniszewski (2018), Picazo-Tadeo et al. (2011),

- Life Cycle Assessment (LCA) – a method evaluating the effects of a product or service on the environment during its 'life cycle' from the design stage until its disposal (Michałowska, 2021), e.g. Renouf et al. (2018),
- DEA and LCA, simultaneously – e.g. van Grinsven et al. (2019), Rybaczewska-Błażejowska and Gierulski (2018),
- Index analysis – searching for new ways to assess eco-efficiency, e.g. through Environmental Sustainable Value (ESV), presented in the work by Czyżewski et al. (2019, 2021),
- Emergy analysis – valuable insights into agricultural systems by considering the natural and economic flows involved in the production of agricultural goods. Emergy indices combine economic efficiency, low use of non-renewable resources, and minimum load on the environment, e.g. Zadgaonkar et al. (2022), Lewandowska-Czarnecka et al. (2019),
- Cumulative energy intensity of production – evaluating the energy usage involved in a specific production process, encompassing not just conventional fuel or electricity consumption but also energy inputs linked to human labour, agricultural machinery operation, and other materials utilised in production, such as fertilisers and seeds, e.g. Kuczuk and Pospolita (2021).
- Referring to the spatial range, studies were devoted to:
- selected region of a specific member state: Picazo-Tadeo et al. (2011),
- selected EU member state: Coluccia et al. (2020), Gołaś et al. (2020),
- comparisons between member states: Pishgar-Komleh et al. (2021), van Grinsven et al. (2019), Fandel and Bartova (2018), Rybaczewska-Błażejowska and Gierulski (2018), Staniszewski (2018),
- comparisons between EU regions: Richterova et al. (2021), Czyżewski et al. (2021).

Fandel and Bartova (2018) found that new member states showed a higher increase in total factor productivity (TFP) than the old ones. However, a significant increase in eco-efficiency was observed mainly in the agriculture of old member states of the EU. Still, countries with a high level of eco-efficiency (the Netherlands, Italy, and Denmark) achieved relatively high performance in agricultural production from 2006 to 2015. It means that eco-efficient agriculture can reach identical TFP as eco-inefficient agriculture.

The observations of Staniszewski (2018) were similar. He explained that for old member states, sustainable intensification is mainly an increase in organic farming productivity without reducing economic productivity.

Pishgar-Komleh et al. (2021) indicated that the Netherlands, Belgium, Italy and Malta are the most eco-efficient countries, while the lowest eco-efficiency levels were noted down for Slovakia, Latvia, and Estonia. The highest mean eco-efficiency rating for all EU member states was recorded in 2011, 2012, and 2017. A comparison of the eco-efficiency results between old and new member states of the EU showed that the old member states scored higher. Variability rating revealed low variability, followed by high stability in the European agricultural sector, in particular in the Netherlands, Italy, and Malta.

The results of the analysis carried out by Rybaczewska-Błażejowska and Gierulski (2018) demonstrated that agriculture in ten member states of the European Union (i.e. Belgium, Bulgaria, Estonia, Finland, Greece, Italy, Malta, the Netherlands, Romania, and Sweden) is relatively eco-efficient. In the remaining 18 member states of the EU-28, agricultural sectors are to a varying degree, eco-inefficient. It means that their agricultural sectors consume too many natural resources (in particular energy), use too many fertilisers, and generate considerable air emissions compared with the current GDP (Gross Domestic Product) per hectare.

It is worth noting that not only do the quoted authors refer to different research methods, but the set of variables describing eco-efficiency they use is not identical. This means that the study results may differ depending on the adopted variables. This paper focuses on delimiting a standard set of variables for evaluating eco-efficiency and evaluating eco-efficiency in a new time perspective. In the future, it will allow us to verify the effectiveness of the current CAP measures by conducting a corresponding analysis after 2027.

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Research methods

The primary measure of efficiency was the frontier approach where several different methods can be used in making model estimates. Work to improve these methods has been going on for more than 50 years. In literature, an unambiguous classification of frontier methods is adopted given the parametric and non-parametric approach. The most commonly used methods are (Coelli, 1996):

- Data Envelopment Analysis (DEA),
- Stochastic Frontier Approach (SFA).

The assumptions of DEA were presented for the first time by Charnes et al. (1978). The approach developed intensively after the 1950s (Ćwiąkała-Małys & Nowak, 2009).

DEA is a tool for determining the relative efficiency of DMU objects (Decision Making Units). DEA is a deterministic mathematical programming technique applying Farrell's approach to measuring efficiency (Charnes et al., 1994; Coelli et al., 2005). This method is used to evaluate the effectiveness of entities running various activities, both in the public and private sectors. It is also used to analyse charitable organisations or ones pursuing social programmes. Its beneficial features include (Kulawik, 2014):

- the lack of necessity to determine the functional relationship,
- the possibility to use multiple inputs and outputs in different units of measure,
- the possibility to determine the returns to scale.

Linear programming is used (in non-parametric methods) for delimiting a frontier enveloping all data points as seen from the top. Here, the production function is determined by the most 'efficient' units in a sample – it is a frontier function and the observations below the curve are considered to be ineffective. Significantly, efficiency determined by this method is a relative measure (Daraio & Simar, 2007). The DEA can be used in two efficiency variants: first, where the objective is to maximise the output while maintaining a specific level of input (output-oriented model) or second, pursuing the reduction of input to the minimum while maintaining a specific output (input-oriented model) (Coelli, 1996).

The review of literature contributed to selecting the DEA as a suitable tool for evaluating the eco-efficiency level of agriculture of the EU member states in this paper. We applied an input-oriented approach with a fixed efficiency of scale (Coelli, 1996). We decided that, following the general eco-efficiency formula (equation 1), we should pursue a reduction of negative environmental impacts by limiting the consumption of certain means of production. Utilising a pressure-generating technology set, one can estimate eco-efficiency through the application of an input distance function using DEA (Kuosmanen & Kortelainen, 2005).

Malmquist productivity indices were utilised to calculate the changes in eco-efficiency over time. The Malmquist indices, alongside decomposition analysis, were computed using the formula established by Caves et al. (1982):

$$M_o(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}\right)\left(\frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)}\right)\right]^{1/2}, \tag{2}$$

Enhancements in observed productivity, as indicated by the Malmquist index, may result from advancements in the production technology employed (technical progress) and/or technical efficiency. Consequently, the aforementioned index can be decomposed in the following manner:

$$M_o(x^{t+1}, y^{t+1}, x^t, y^t) = \left(\frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}\right)\left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})}\right)\left(\frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)}\right)\right]^{1/2}. \tag{3}$$

The first bracket measures the change in technical efficiency (technical efficiency change) between periods *t* and *t+1* (shift towards production capacity limit). The square bracket expresses technical progress (technical change), indicating the geometric centre of the shift in technology in periods *t* and *t+1* at input level *xt* and *xt+1.*

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The study leveraged data from Farm Accountancy Data Network (FADN), which is the largest database gathering information from single farms. FADN has collected farm economics data from an annual sample of around 60 000 farms across the EU for more than 60 years, representing 2.6 million farms (Farm Economy Focus, 2024). It is the only database in which cooperating farms are a representative sample of commodity farms operating in the EU and which retrieves and processes data according to uniform rules. In addition, FADN is a tool supporting the programming and implementation of CAP. In the field of observation of FADN, farms account for about 90% of the Standard Output (SO) in a given region or member state of the EU. The SO is defined as a five-year mean value of specific agricultural (crop or animal) production per 1 ha of crops or per one animal in one year under average production conditions in a given region (Floriańczyk et al., 2018).

The study utilises data from the FADN pertaining to farms specialising in field crops, which constitute the largest group within the FADN database, comprising nearly 30,000 farms. Furthermore, the selected variables were deemed most suitable for conducting an eco-efficiency analysis for this specific group of farms. Since no data are available in FADN regarding the years 2005-2012 for Croatia, which joined the EU in 2013, we decided that the study would cover the period from 2013 to 2020. The study did not include Luxembourg either due to the lack of data for 2014. The adopted study period made it possible to assess changes which occurred during the membership of old and new member states in the EU structures.

The calculations were based on one output and three variable inputs:

- output Y_1 – Total output SE131 (EUR/farm),
- input X_1 – Fertilisers SE295 (EUR),
- input X_2 – Crop protection SE300 (EUR),
- input X_3 – Energy SE345 (EUR).

We used an input-oriented approach with constant returns to scale CRS (Coelli, 1996) according to the methodological framework proposed by Kuosmanen and Kortelainen (2005). Despite the significance of economies of scale in farming, typically viewed as a variable returns to scale (VRS) activity, Gómez-Limón et al. (2012) and Picazo-Tadeo et al. (2011) contend that from an environmental standpoint, farming can be regarded as a constant return to scale operation.

Given the study assumptions, the analysed community was divided into two groups:

- farms located in the member states which acceded to the EU before 2004. In this paper, they are referred to as old member states (OMS),
- farms located in the member states which acceded the EU after 2004 – referred to as new member states (NMS).

The study used DEAP software version 2.1 available on the website of CEPA – the Centre for Efficiency and Productivity Analysis (CEPA, 2023).

Results of the research

Table 1 shows the computed value of eco-efficiency indices for farms from the examined member states of the EU. The analysed member states include Denmark and the Netherlands as fully efficient countries throughout the analysed period (index = 1). These member states are the eco-efficiency benchmark for other EU member states. Farms in these countries were classified in the group of old member states (OMS). In turn, for the most eco-efficient countries from the group of new member states (NMS), the mean eco-efficiency index in the analysed period was 0.981 (Malta) and 0.861 (Slovenia), respectively. The comparison between the groups referring to the lowest index value also implies a more advantageous position of OMS, where Greece noted down a mean index of 0.603, while among OMS, it is Latvia with a mean index of 0.499 in the analysed period that scored the lowest.

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Table 1. Eco-efficiency indices of EU member states from 2013 to 2020

Member state	Year								
	2013	2014	2015	2016	2017	2018	2019	2020	Mean
Old member states (OMS)									
Belgium	0.868	0.973	0.932	1.000	0.998	1.000	1.000	1.000	0.971
Denmark	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Germany	0.477	0.565	0.586	0.730	0.656	0.690	0.731	0.682	0.640
Ireland	0.497	0.639	0.744	0.692	0.943	0.862	0.807	0.734	0.740
Greece	0.550	0.657	0.662	0.696	0.579	0.575	0.551	0.557	0.603
Spain	0.592	0.646	0.730	0.709	0.687	0.765	0.775	0.701	0.701
France	0.587	0.667	0.659	0.620	0.719	0.667	0.658	0.601	0.647
Italy	0.608	0.910	0.936	0.929	0.844	0.885	0.841	0.769	0.840
Netherlands	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Austria	0.695	0.883	0.973	1.000	0.961	0.999	1.000	1.000	0.939
Portugal	0.574	0.754	0.536	0.703	0.690	0.833	0.825	0.566	0.685
Finland	0.548	0.772	0.874	0.729	0.657	0.805	0.675	0.776	0.730
Sweden	0.612	0.693	0.835	0.809	0.756	0.751	0.853	0.795	0.763
New member states (NMS)									
Bulgaria	0.438	0.537	0.561	0.529	0.578	0.637	0.580	0.533	0.549
Czech Republic	0.418	0.525	0.511	0.573	0.507	0.560	0.563	0.569	0.528
Estonia	0.478	0.638	0.764	0.612	0.642	0.637	0.700	0.614	0.636
Croatia	0.429	0.486	0.627	0.663	0.678	0.646	0.547	0.556	0.579
Cyprus	0.539	0.430	0.809	0.673	0.719	0.626	0.559	0.561	0.615
Latvia	0.358	0.448	0.542	0.513	0.494	0.488	0.543	0.603	0.499
Lithuania	0.373	0.491	0.572	0.508	0.553	0.531	0.543	0.613	0.523
Hungary	0.409	0.560	0.644	0.679	0.625	0.656	0.598	0.634	0.601
Malta	0.847	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.981
Poland	0.444	0.577	0.649	0.558	0.593	0.640	0.595	0.581	0.580
Romania	0.510	0.657	0.687	0.702	0.717	0.697	0.635	0.487	0.637
Slovenia	0.592	0.854	0.908	1.000	0.892	0.863	0.899	0.877	0.861
Slovakia	0.405	0.449	0.454	0.605	0.498	0.552	0.536	0.596	0.512

Source: author's work based on www.agridata.ec.europa.eu [16-01-2024].

It can be concluded that NMS use the production factor less efficiently and, in addition, they should limit their inputs, which, according to the eco-efficiency formula, should be reduced. Input slacks are expressed as a percentage diminution relative to the input value. The results of the study imply that farms from countries presenting a low level of eco-efficiency should firstly cut the usage of fertilisers and secondly – reduce their energy consumption (Figure 2).

From the point of view of the adopted study objective, it was essential to compare the mean annual eco-efficiency indices for EU member states divided into groups according to the accession date (Figure 3). The mean eco-efficiency index was higher in the OMS group in each year of the period covered by the study. On average, from 2013 to 2020, it was 0.789, while for the NMS, the value was 0.623. The highest eco-efficiency index in NMS was observed in 2015 and, respectively, in 2018 for

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OMS. From 2013 to 2015, the eco-efficiency index value increased in both analysed groups. From 2015, the indices remained at a fixed level: about 0.8 for OMS and approximately 0.65 for NMS.

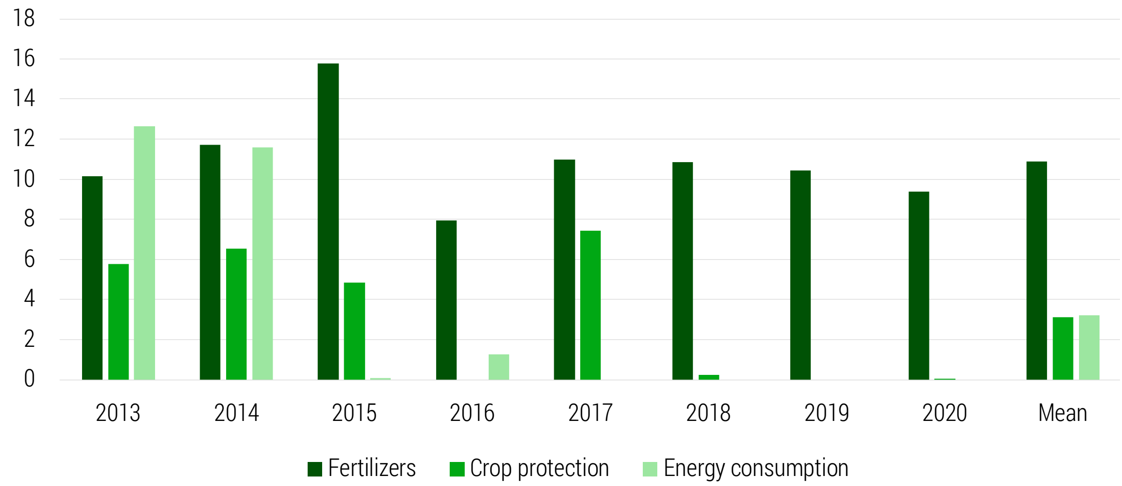

Figure 2. Summary of inputs slacks for input DEA model in years 2013-2020 (%)

Source: author's work based on www.agridata.ec.europa.eu [16-02-2024].

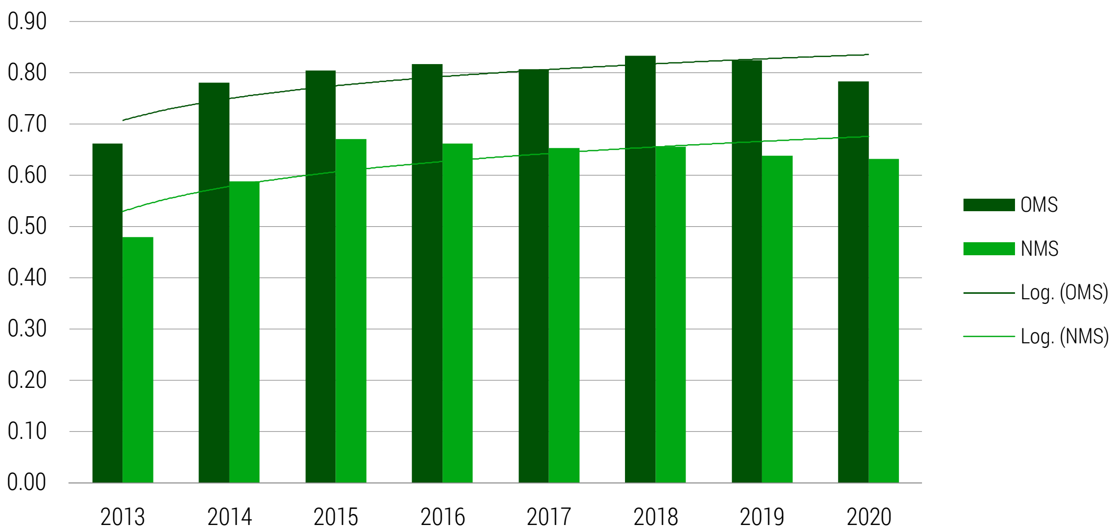

Figure 3. Mean values of eco-efficiency indices for old member states (OMS) and new member states (NMS) from 2013 to 2020

Source: author's work based on www.agridata.ec.europa.eu [16-02-2024].

Eco-efficiency indicators calculated for the period spanning 2013 to 2020 were utilised to compute the Malmquist Productivity Index (TFP) and assess the trends in eco-efficiency over the specified timeframe. The values of the Malmquist Productivity Index pertain to the preceding year. A value exceeding 1 signifies an enhancement in efficiency, a value below 1 indicates a decline and a value of 1 indicates stability in efficiency levels. Subsequently, the indices were dissected into components associated with alterations in technical efficiency and changes in technology. The outcomes of the TFP index analysis conducted for individual countries across the entire study duration are detailed in Table 2.

The Malmquist index computed for all EU member states exhibited a spectrum from 0.963 (Portugal) to 1.061 (Ireland). The average TFP value stood at 1.011, indicating that farms in the EU specialising in field crops augmented their eco-efficiency by an average of 1.1% annually during the period under examination.

Upon examining the categorised facilities into OMS and NMS groups, it was observed that the NMS group exhibited higher average TFP enhancements (+1.6%) in comparison to the OMS group (+0.7%). Within the NMS group, the Malmquist index experienced more rapid growth by an average of 0.9 percentage points per annum.

Table 2. Estimation of total factor productivity change and its components in 2014-2020

Member state	Technical-efficiency change	Technical change	TFP change
Old member states (OMS)			
Belgium	1.021	0.993	1.013
Denmark	1.000	0.979	0.979
Germany	1.052	0.973	1.024
Ireland	1.057	1.003	1.061
Greece	1.002	0.984	0.986
Spain	1.024	0.968	0.991
France	1.003	1.011	1.015
Italy	1.034	0.977	1.011
Netherlands	1.000	0.997	0.997
Austria	1.053	0.970	1.022
Portugal	0.998	0.965	0.963
Finland	1.051	0.971	1.020
Sweden	1.038	0.974	1.012
Mean (OMS)	1.026	0.982	1.007
New member states (NMS)			
Bulgaria	1.028	0.966	0.994
Czech Republic	1.045	0.976	1.020
Estonia	1.036	0.980	1.016
Croatia	1.038	0.960	0.997
Cyprus	1.006	0.984	0.990
Latvia	1.077	0.963	1.037
Lithuania	1.074	0.961	1.031
Hungary	1.065	0.979	1.043
Malta	1.024	1.011	1.035
Poland	1.039	0.968	1.006
Romania	0.994	0.977	0.971
Slovenia	1.058	0.982	1.039
Slovakia	1.057	0.979	1.034
Mean (NMS)	1.042	0.976	1.016
Mean (EU)	1.033	0.979	1.011

Source: author's work based on www.agridata.ec.europa.eu [16-02-2024].

The upsurge in TFP primarily stemmed from the enhancement in technical efficiency, with the technical efficiency indicator registering 1.042 in the NMS group and 1.026 in the OMS group, respectively. Latvia emerged as the frontrunner in technical efficiency advancement with a score of 1.077, while Romania depicted the lowest level in this indicator throughout the reviewed period, standing at 0.094.

The findings outlined in Table 2 reveal that only three countries among those scrutinised, specifically France and Malta (+1.1%) and Ireland (+0.3%), achieved TFP progression owing to technical modifications. The remaining nations exhibited a decline in the technological change index (value below 1). The collective average annual technical change index across all countries amounted to 0.979, indicating a technological regression of 2.1% annually across all EU states. Notably, the OMS displayed a superior level of the technical change index, thus mitigating the negative impact on TFP in comparison to the NMS group.

The outcomes of the Malmquist productivity index calculations facilitated year-on-year comparisons, as illustrated in Figure 4. This enabled a meticulous evaluation of the fluctuations in the TFP values for farms belonging to the OMS and NMS country groups across individual years. While the Malmquist productivity index exhibited an overall higher average for the NMS category throughout the entire study period, there were two specific intervals when it dipped below that of the OMS group. These periods were noted in 2016-2015 and 2018-2017. During these time frames, both components of the Malmquist productivity index (Technical-efficiency change and Technical change) for the NMS registered lower values.

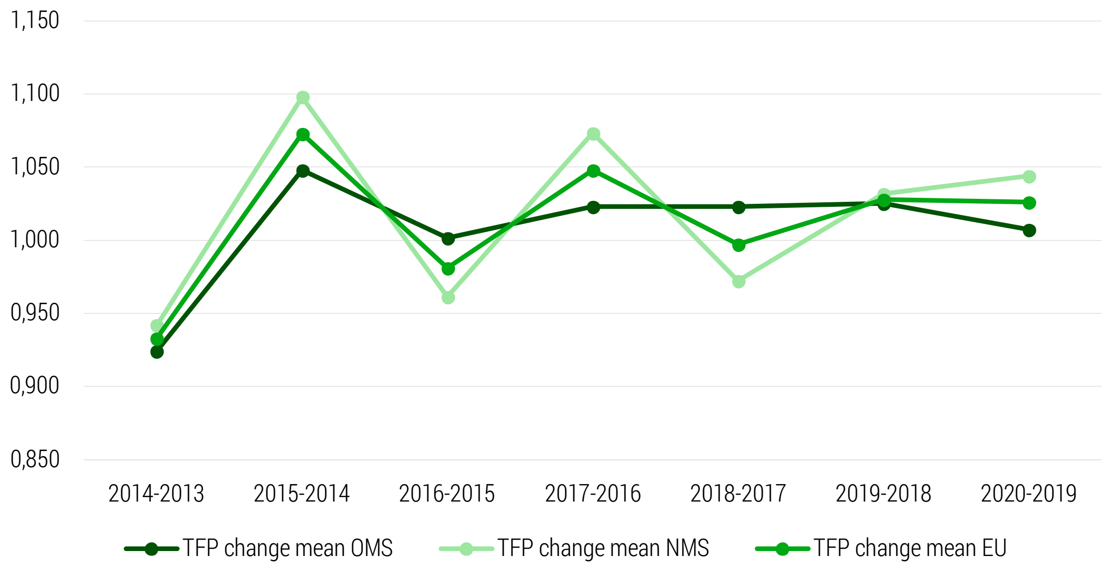

Figure 4. The Malmquist productivity index change for old member states (OMS), new member states (NMS) and all EU countries (EU) from 2013 to 2020

Source: author's work based on www.agridata.ec.europa.eu [16-02-2024].

Conclusions

The observed results of studies confirm most results of earlier studies on agricultural eco-efficiency differences between individual member states of the EU. It can be confirmed that countries such as Denmark, the Netherlands and Italy are eco-efficiency leaders. Their position has not changed recently. Malta is such a leader among countries that acceded to the UE after 2004. Based on surveys described in this article, Greece cannot be classified as an eco-efficiency leader, although it was mentioned as one in several earlier studies. Similar to the study by Pishgar-Komleh et al. (2021), the OMS group turned out to be more eco-efficient than the NMS. However, based on the calculations, a change could be seen in comparison to earlier studies (Fandel & Bartova, 2018): from 2013 to 2020, the eco-efficiency index increased both in OMS and NMS, but NMS showed higher dynamics.

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The assumptions of eco-efficiency comply with the current direction of CAP. This concept combines a reduction of the negative impact on the natural environment with simultaneously maintaining or increasing production output. The analysis corroborated the hypotheses put forward in this paper. Farms in countries that acceded to the EU before 2004 feature a higher eco-efficiency level, meaning they utilise fewer inputs with an adverse impact on the natural environment. In contrast, farms from the EU member states that joined the EU at the expansion stage after 2004 have gradually reduced the distance, which is reflected by the increased dynamics of the eco-efficiency index in the period under review.

The results were compared with the most similar ones. Staniszewski (2018) also observed that the dynamics of eco-efficiency were faster among the NMS. However, it is found difficult to believe that, 20 years after EU accession, this may be related to the 'base effect' or the impact of the CAP implementation and competition within the common market (Staniszewski, 2018). The analysis conducted in this study, along with the referenced earlier research, suggests that a continued reduction in the disparity in eco-efficiency levels between OMS and NMS systems can be anticipated.

The results of studies show that farms from the NMS group still require additional support. The support should be bi-directional. Firstly, by introducing a relevant training system to support eco-efficiency, providing professional advice and visiting the leading farms. For example, in farms specialising in field crops, enhancing eco-efficiency can also be achieved through changes in farming methods, like using natural predators for pest control and by introducing improved varieties of plants. In this way, the consumption of "polluting" resources can be reduced. Secondly, it should take the form of elevated financial subsidies providing an incentive for ecosystem-friendly agricultural practices and approaches (such as, for instance, organic farming) and making it possible to reduce farming income differences. Adopting this approach to agricultural production will enhance its economic appeal (profitability) and make organic products more accessible and affordable for consumers.

Further surveys concerning agricultural productivity in EU member states based on FADN data should take into account additional variables, however, in this research, only the most appropriate ones were selected from those available. From 2025, the Farm Sustainable Data Network (FSDN) replace FADN. The scope of FSDN will be to cover not only farms' income and business activities but also information on their environmental and social sustainability performance. The new data collection might be in operation in 2026, about the 2025 accounting year.

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Renata KUBIK

EKONOMICZNE I ŚRODOWISKOWE ASPEKTY EFEKTYWNOŚCI ROLNICTWA NOWYCH I STARYCH KRAJÓW CZŁONKOWSKICH UNII EUROPEJSKIEJ – CZY JEST SZANSA NA ZMNIEJSZENIE RÓŻNIC?

STRESZCZENIE: Wspólna Polityka Rolna w aktualnej perspektywie czasowej (2023-2027) zwraca szczególną uwagę na aspekty związane ze środowiskiem naturalnym. Tak ustalone priorytety to ogromna szansa dla krajów przyłączonych do Unii Europejskiej po 2004 roku. Ich rolnictwo charakteryzuje się niskim stopniem uprzemysłowienia, co stwarza możliwość wykorzystania przewag konkurencyjnych przejawiających się m.in. w postaci dobrze zachowanego ekosystemu. Niezmiennie ważny pozostaje aspekt ekonomiczny produkcji rolniczej. Pojęcie ekoefektywności łączy te dwa istotne czynniki. Celem opracowania jest ocena ekoefektywności rolnictwa, jej zróżnicowania i dynamiki pomiędzy dwoma grupami państw członkowskich Unii Europejskiej w latach 2013-2020. Badaniu poddano gospodarstwa towarowe o typie uprawy polowe. W opracowaniu zastosowano metodę DEA oraz obliczono wskaźniki produktywności Malmquista. Przeprowadzona analiza potwierdziła postawione hipotezy. Gospodarstwa rolne w krajach, które przystąpiły do UE przed 2004 rokiem, posiadają wyższy poziom wskaźnika ekoefektywności. Gospodarstwa rolne z krajów członkowskich UE, które przystąpiły w fazie rozszerzenia UE po 2004 roku, stopniowo zmniejszają dystans, co zostało potwierdzone wyższą dynamiką wskaźnika ekoefektywności w badanym okresie.

SŁOWA KLUCZOWE: efektywność, środowisko, rolnictwo, Data Envelopment Analysis, produktywność

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