https://doi.org/10.61308/AVGV3407

Market Farm Sustainability Assessment of the Central and Eastern European Union Member States

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Citation: Krustev, V. (2023). Market Farm Sustainability Assessment of the Central and Eastern European Union Member States. *Bulgarian Journal of Agricultural Economics and Management*, 68(3), 72-81

Abstract

The main concept of every agricultural policy is aiming to support the farm sustainability beyond the aspects defined in a single definition and a contemporary state policy could not escape from the focus of economic efficiency, social responsibility and/or environmental compatibility.

The European Union regulations are reorganizing the holdings in the entire Community and this reflects crucially on the economic size and furthermore the agricultural sustainability of the farms.

This paper aims to find out how the agricultural holdings are affected and how the connection between farm economic size and sustainability is developed within the three sustainability pillars.

The scientific approach uses an assessment that modifies the Farm Accountancy Data Network set of variables in comparison of predefined criteria used as a sustainability scoring system establishing a sustainability estimation based on affiliation of two independent indexes as a final balanced rating classification.

The results are determined for each economic size class to the benchmarking frame received by a previous research on a EU level which reports the Balkan farms as a part of the EU vulnerable agricultural units.

Key words: agricultural holdings; farm sustainability; economic size

Introduction

The whole farm goods supply chain becomes more sustainable and the expectations if its increase is a reasonable answer of the enlarging customer sensitivities and also the CAP reform efforts in the future (Saitone and Sexton, 2017). In such a context, the expectations of sustainable production affect all the three sustainability aspects – economic, environmental and social. The specification of main farm sustainability estimations including their principles and criteria and distinguishing the proper indicators is widely discussed in the literature (Hodge and Hardi, 1997; OECD, 1994; Atkinson et al., 1997; Radke, 1999; Pretty, 2018; Dessart et al., 2019) during the last decades.

The most papers initiated to sustainability assessment are focused on environmental component. In this study the sustainability is estimated through the main detrimental factors of production, farm intensification rate and the economic viability of a holding based on the production costs. The author that pays attention on the sustainable intensification is the Ethiopian researcher Vine Mutyasira (2017) who tried to find out where is the limit of that intensity and when a farm is exploiting the land, animals and environment too much. He summarizes the sustainability indicators into a comparative sustainability index using Data Envelopment Analysis to receive sustainability scores. He finds that the holding size and the accessibility to farm enlargement are some of the drivers increasing the sustainability at the farm level.

Providing a sustainability increasing and greener farm policy suppose representing an as-

sessment of its previous impact as a part from the content requirements. There are operational requisites for the practical use of sustainability indices for the needs of the policy measures. It would be advisable to build the indices in a way their construction to be easily traceable (Böhringer and Jochem, 2006; Kuik and Gilbert, 1999; Hammond et al., 1995). Ivanov (Ivanov et al., 2023) developed an approach for normalization and accumulating of indicators and created a composite index that take place in the method for constructing the Relative Comparative Assessment index in this paper.

Methodology

The time period was chosen within the framework of the last two already applied medium-term schemes of the Common Agricultural Policy (2007–2013 and 2017–2019).

The sustainability indices are received by combining two independent methods, which use mostly different indicators in creating the three pillars. The both of methods participate in the construction of the Composite Sustainability Indexes.

The holding that take place in this observation form four economic size classes.

Economic Size Classes

Creating the Economic Size Classes involves adapting the European nomenclature, where the modifications are restricted to combining the class IV and V in Class 1 and excluding the one from 100 to 250 thousand EUR Standard Output. Due to not existing any holding in there, the next one takes its place and the number the economic size classes is reduced to four.

Data Envelopment Analysis

Data Envelopment Analysis (DEA) looks for a virtual producer, which might not even exist in the sample as a best production function and gives distances from that production frontier to the other holdings (decision making units – DMUs). Each farm operates as a different production function every individual year to receive its specific index.

DEA`s virtual producer is received by combining the most efficient DMUs of the sample (2007–2019) so there is a possibility several units to present the greatest results (Berg, 2010). Every other score computed by the program is presented as a coefficient according to the distance from the best indicators combination between 0 – 1. In order to use the tool reliably in combining simultaneously 15 indicators (Table 2), the "Benefit-of-the-doubt" approach was applied. The indicators used in the sustainability modelling were exposed as outputs while the input of the production system was ignored (Cherchye et al., 2006). The optimization is made by using one as input. In addition, five indicators were used as outputs for the pillar assessment in the same order. The agricultural sustainability is estimated by assuming input oriented and set to constant returns to scale (CRS) DEA model. The sustainability evaluations are received by technical efficiency results computed for each average Member-State farm taken from the representative FADN annual observation, which are actually presenting the performance and structure of a national agricultural economy.

The specification of the DEA indices is consisted in adding more outputs (or inputs) and so the efficiency computation becomes more complex. (Charnes et al., 1978). This is the reason

Table 1. Formation of the Economic Size Classes

Class 1			**Class 2**				**Class 3**		**Class 4**	
Up to 25 000 EUR SO			Up to 50 000 EUR SO				Up to 100 000		More than 100 000 EUR SO	
Romania	Slovenia	Croatia	Poland	Lithuania	Bulgaria	Latvia	Hungary	Estonia	Czechia	Slovakia
10	22	23	27	28	39	40	53	88	252	403

Source: EC, FADN.

why the 15-DEA sustainability scores are higher than any pillar assessment.

Relative Comparative Assessment

The Relative Comparative Assessment (RCA) uses a normalization formula to accumulate the indicators in an index for every sustainability dimension. That accumulation averages the normalized indicators in each pillar. The final sustainability index is obtained as an arithmetic mean of all the three pillars, which gives to every indicator equal weight in a pillar estimation. The final sustainability assessment is calculated in a same way in order to complete the observation in a clear and traceable approach.

Table 2. Table of Indicators

Indicator No:	RCA Indicator:	Ref. Value:	*DEA indicator:*	Ind. Type:
1	Labour Productivity = Total gross output/ Total labour input	**EU average**	*Total labour input*	More is better
2	Production Diversification = 1 - [(Max Output - Avg Output) + (Avg Output - Min Output)]/Total Output)	**EU average**	*Total livestock output / Livestock Units*	More is better
3	Profitability = Farm Net Income/(Total Inputs - Farm use)	**EU average**	*Total Utilised Agricultural Area*	More is better
4	Capital productivity = Total gross output/Average farm capital	**EU average**	*Total assets*	More is better
5	Economic Resilience = (Total Output - Total Subsidies)/(Other direct inputs + Depreciations + Total External Factors) (Bachev et al., 2017)	**EU average**	*Total gross output*	More is better
6	Income per Family Member = Family Farm Income/Family Working Units	**EU average**	*Family Farm Income/ Family Work Units*	More is better
7	Farmhouse Consumption per Family Member = Farmhouse consumption/Unpaid labour input	**EU average**	*Farmhouse consumption*	More is better
8	Worker`s Remuneration = Wages paid/Paid labour input	**EU average**	*Wages paid/ Paid labour input*	More is better
9	Own Land = 1 - (Rented Area/Total Utilised Agricultural Area)	**EU average**	*Gross Farm Income**	More is better
10	Farm Made Production Factors = Farm use/Total Utilised Agricultural Area + Total Livestock Units	**EU average**	*Farm use*	More is better
11	Stocking density	**EU average**	Stocking density	***Less is better***
12	Fertilizers per Area Unit = 1 - (Fertilisers/ Intensified area*) * = Arable Land + Permanent Crops	**EU average**	Fertilisers	***Less is better***
13	Crop Protection per Area A=Unit = 1 - (Crop protection/Intensified area*)	**EU average**	Crop protection	***Less is better***
14	Crop Rotation = Protein crops / (Cereals + Energy crops + Potatoes + Sugar beet + Oil-seed crops + Industrial crops + Vegetables & flowers)	**EU average**	Protein crops/Total output crops & crop production	*More is better*
15	Energy Intensity = 1 - (Energy/Total Utilised Agricultural Area)	**EU average**	Energy	***Less is better***

Source: FADN.

The ranking and normalization formula applied to assess the indicator (Table 2) scores to fit between zero and one:

$$\textbf{Indicator Value} = \frac{\textbf{FADN Value}}{\boldsymbol{AVG} + \textbf{St Dev}} * (0{,}5 + 0{,}5 * CV^2)$$

Coefficient of Variation (CV) = Standard Deviation (St Dev) / Average (AVG)

The perspective view through the prism of standard deviation and average values of each indicator, the construction of an index insists on a cut of the sequence spikes. Aiming to avoid extreme peaks, there are single values several times higher or lower than the second in the row.

Each single normalized result has the following restrictions:

A. value <0 = 0 **B.** value >1 = 1.

The combination of these two different approaches gives a higher priority and weight to the Data Envelopment Analysis. This is because of the spreading of sustainability coefficients as a distance from the highest (1) whereas the Relative Comparative assessment uses the center of the scale (0.5) to distribute the coefficients as higher or lower through the prism of standard deviation and arithmetic average.

Composite Sustainability Indexes

The Composite Sustainability (or Pillar`s) Indexes are created by finding the average value of both assessment methods:

$$\textbf{Sustainability (Pillar) Assessment} = \frac{\textbf{DEA Index} + \textbf{RCA Index}}{\textbf{2}}$$

Beyond the limitations of this methodology (the different statistical criteria in the methods), there in another approach to be presented covering the same results according to the references.

Results

The smallest market oriented farms are those in Romania. They represent IV economic size class from the EC nomenclature and the First

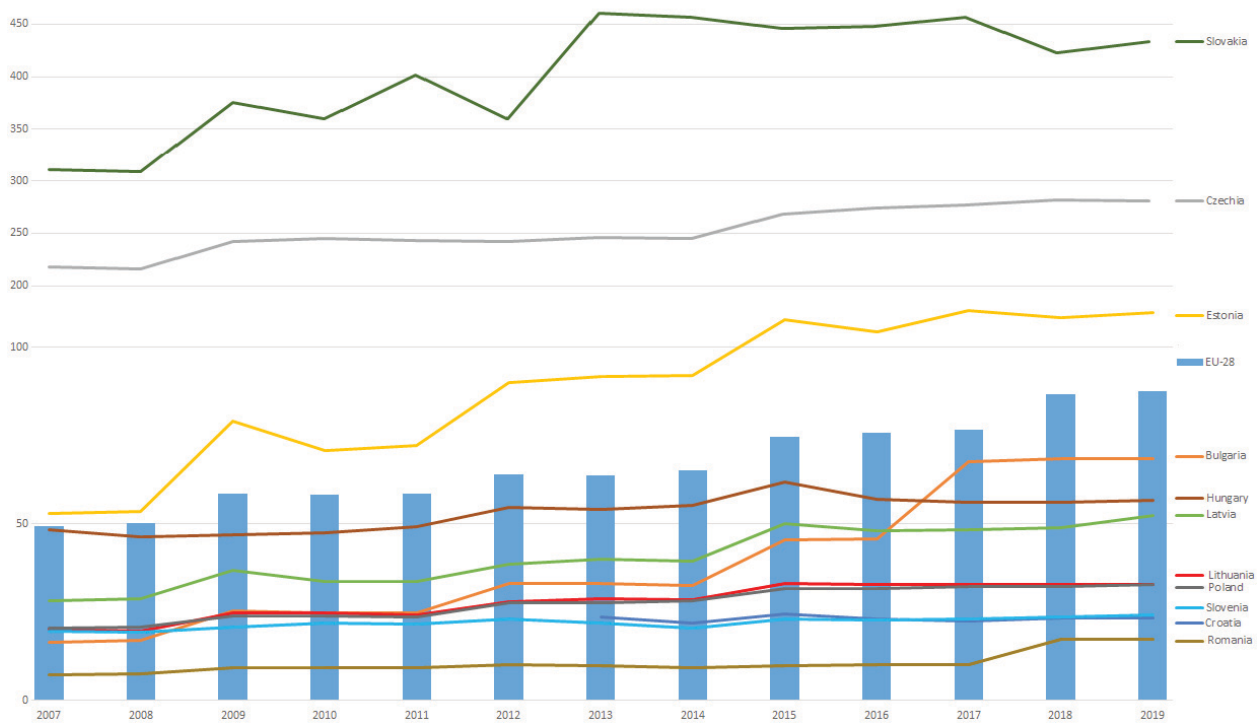

Fig. 1. Market Farms Economic Size Evolution

Source: EC, FADN.

Economic Size Class in this study. Changes in economic size have been significant in that country, which saw an impressive 145% rise in average economic size, but farms remain the smallest in the EU. In order not to be a single representative

In the class three more units were added. Slovenian do not have such an increase – only a 22%, and in Croatia the movement of the size varies within very short limits and is insignificant.

The Second Class have an economic size (ES) in the range of 25–50 thousand euros SO. The farm economic size is based on its average of the entire observed time period. This is the medium-small class of market farms in the present paper. The increase in the economic size of Bulgarian farms is the most noticeable (more than 300%) in the EU in the observed period and this corresponds to a sharply decreasing number of entrepreneurs in the sector. Poland, Lithuania and Latvia also saw an increase in farm size of more than 50%.

The class of the big sized agricultural units also shows a substantial increase of economic size. The exception is appearing in Hungary – a minor change, while those in Estonia have doubled the available area and/or animals and/or their productivity.

There is no presentative from Central and Eastern Europe in the class from 100 to 250 thousand EUR Standard Output, while the biggest farms are these in Czech Republic and Slovakia which form the Fourth Class where the growth of farms is relatively small within 40%, but besides that percentage the increase equals between 50 000 and 100 000 EUR Standard Output.

Economic Sustainability

Most of the Central and Eastern European Member States of EU could not gain a sufficient economic increase. Their participation in the European Union is surrounded by challenges involving loss of rural population and agricultural entrepreneurs because of the required market orientation of donated agricultural entities.

The 2007–2013 program period brings economic difficulties to all of the Eastern holding. In 2008–2009 their curves dropped down due to the new CAP requirement which leads to economic size rise covered by a significant decrease in the farm population (about 25% or 123 thousand entrepreneurs formally left the business in Bulgaria in a short period, before 2009).

Most of the holdings recovered the economic level until the 2011–2013 and even succeeded to improve their sustainability. Lithuanian, Bulgarian and Romanian holdings could not pass through that stress with short momentary exceptions. In the other hand, between the two Balkan countries appears opposing graphs in the period from 2010 to 2015. When Romanian level is getting lower, The Bulgarian one is rising (2012), but both represent a huge difference between their state management in CAP implementation.

Not surprisingly, the corporate farmers with the largest production scales also demonstrate the highest economic performance. Of these megastructures, only the Czech Republic economic sustainability is not significantly above the average during the predominant part of the observation, but its curve tends to follow that of the EU, and despite certain fluctuations, it shows a moderate increase in the measurement of the pillar. The second program period performance realized above the reference score of economic sustainability. The only farms economically performing better are these from Slovakia. Their production scale and in particular the capital productivity supports the highest results.

The production scale seems to be also the reason for Estonian agricultural producers to perform above the EU average. Their economic size increased up the limit of 100 000 EUR SO in 2015. After a very short, delay the economic sustainability increased sharply by 28% due to an improved labour productivity.

The bigger part of Eastern European agricultural units stays far below the economic performance of the EU–28.

The agricultural units in Hungary, Poland and Latvia have a wider production portfolio (diversification) which leads their curves very close to the permanently increasing rate of the Community.

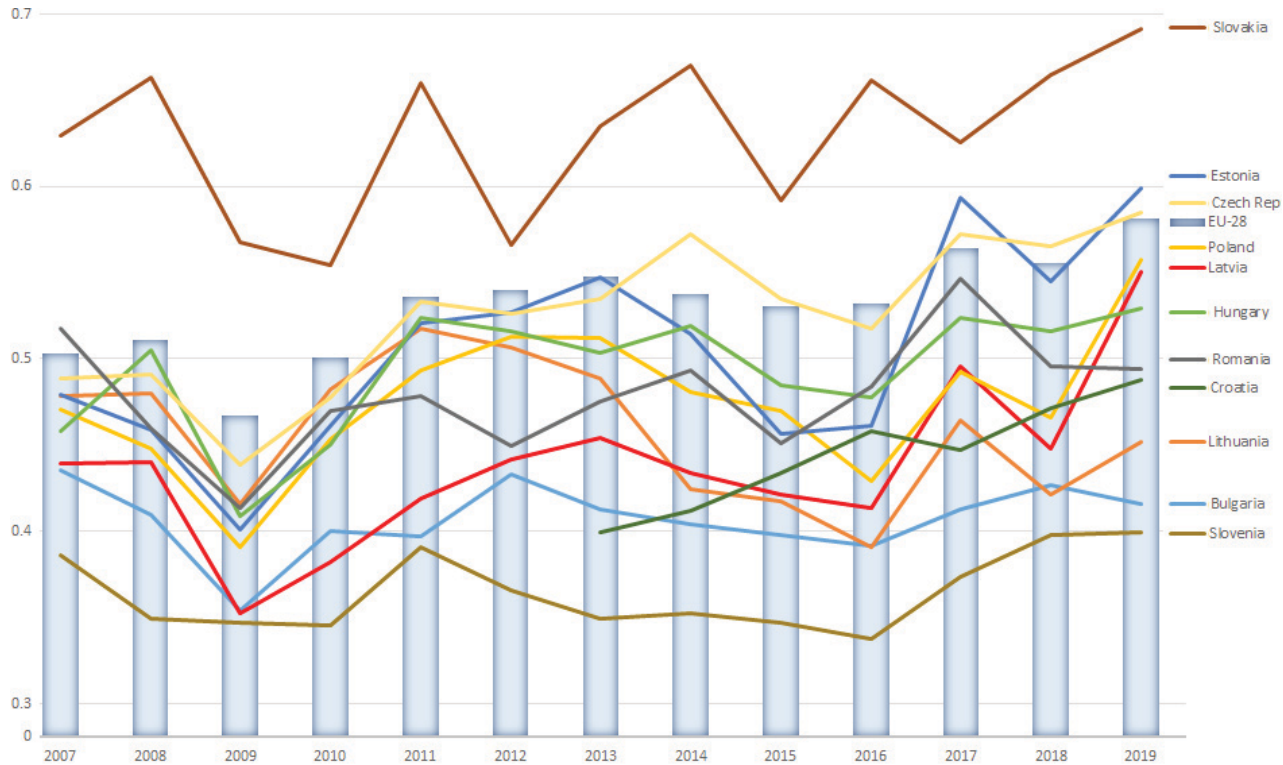

Fig. 2. Economic Sustainability Index

Source: Own calculations, based on FADN.

Powered by the profitability, Croatian trend is positive and permanently rising, while the Slovenian has its peaks but remains at the lowest EU level.

Social Sustainability

The most of the holdings represent better social performance of their social sustainability. However, this dimension has an inflation dependence and if the purchase power parity was a topic of this study, it might be uncovered.

The results show how small farms are also unconvincing in a social aspect and their curves are located (far) below the European average despite the smallest from Slovenia and Croatian are very close to the reference. The social indicators of the Romanian holdings go through peaks and drops, but the trend is not so positive and the farmers have the lowest levels after Bulgaria's which made an insufficient corresponding to the inflation rate increase. Close to them without considerable differences in the social conditions in Lithuania and Poland. Their peaks are much distanced form the constantly growing level of EU–28. In Hungary (and to some extend Latvia) appears a significant spread but still below the benchmark. Estonian level become very close to the evolving EU–28 dimension, constantly pushed by the founding and Scandinavian states.

Slovakia and Czechia have the only farms that could reveal a social performance, which is higher than EU level which fundaments on the increasing income for both entrepreneurs and hired personnel.

The social distinction between the old and new Member States countries to enlarge besides the advertised cohesion efforts and CAP tools.

Ecological Sustainability

The environmental practices in agriculture of the new Member States are greater than the standards established by the EU founding states.

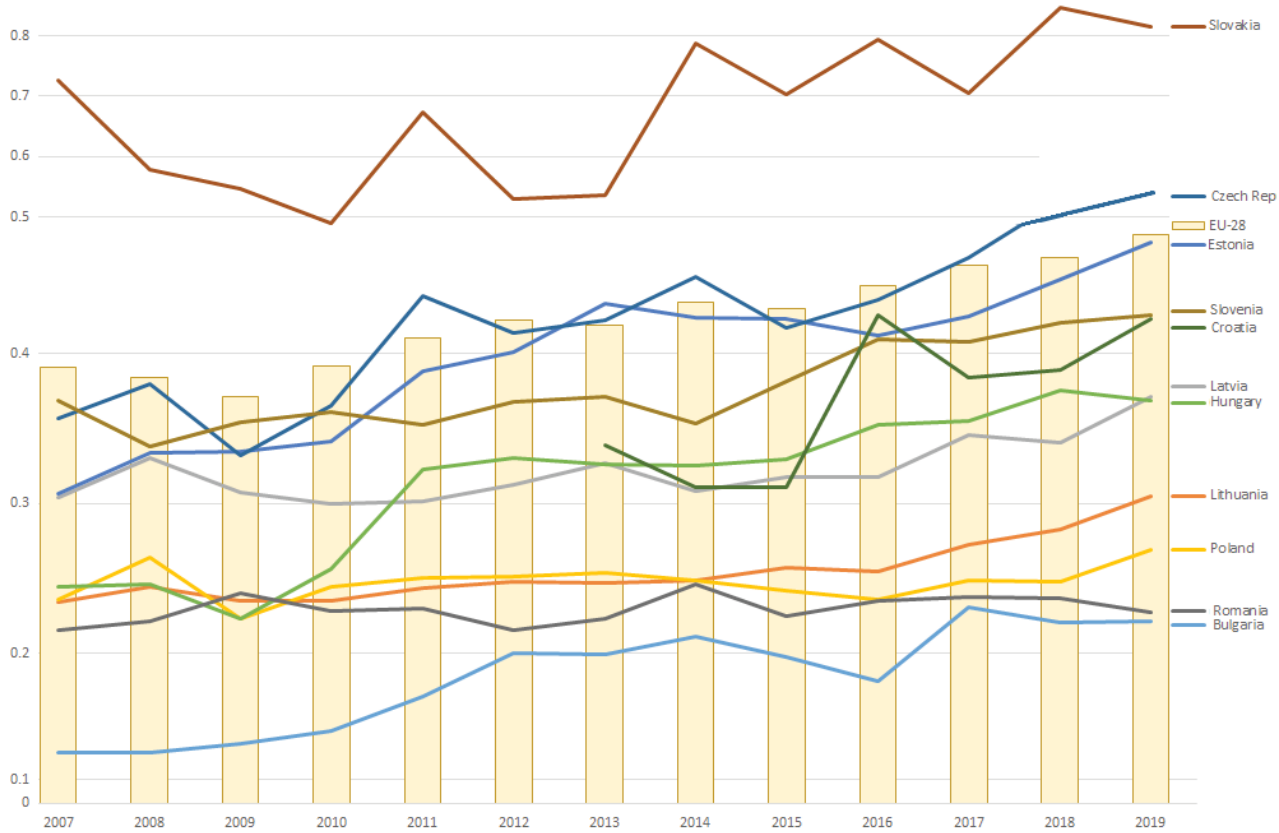

Fig. 3. Social Sustainability Index

Source: Own calculations, based on FADN.

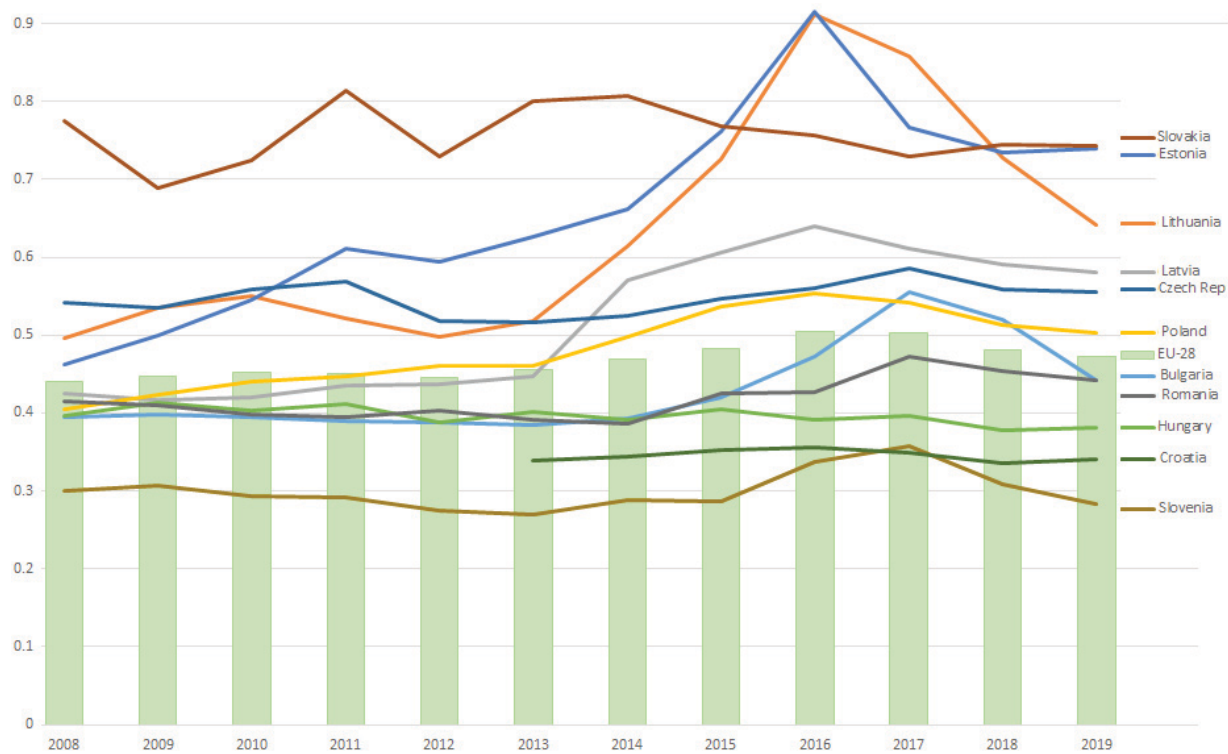

Fig. 4. Ecological Sustainability Index

Source: Own calculations, based on FADN.

The highest environmental standards are being kept by Baltic trio, Czechia and Slovakia. After the first program period, Polish farms also passed true the EU average. Most of the investigated indicators have sufficient and improving levels. This might be due to the production economics optimizing the negative effects of over fertilizing the crops and the other detrimental inputs in order to minimize the costs and to optimize their impact. The ecological sustainability drivers of Baltic countries are locked in the correct crop rotation. The vast including of protein crops improves the soil vitality and fertility. This also might step on CAP stimulation like this in Bulgarian where farms used to be purposefully subsidized (2014–2019).

On the other side Hungary have no increase in the areas covered by nitro fixing plants and this is the reason of their standstill. This is applicable also for the smallest holdings. Slovenian farmers spend more on energy and plant protection products. This is topical also for the fertilizers, which is so common for the agricultural units in Croatia and Poland.

Composite Sustainability

The Composite Sustainability Index reveals the scale efficiency power. This study could not explain which level is sustainable or not, but the comparative method summarizes the relative sustainability values and exposes the smallholdings as not enough economically resilient. In the other hand, they have to choose a priority: to be more socially responsible or ecologically compatible, because the both are not under their control nor all the three of the pillars.

The most sustainable holdings based on the all three pillar indicators belong to the "non-reformed" Slovakian holdings. This is very common to the Czech Republic, which indices float around the EU average.

The Baltic countries have very competitive Ecological Pillar, which pushes their Composite Sustainability Index to a more successful level. However, only Estonia represent a socially sustainable structure at a Community level.

The Balkan farms place at the bottom of the chart. They struggle the reform losing many farm units and their only not suffering pillar is the ecological, excluding Croatia and Slovenia which social pillar is closer to the reference. This in term means that these small-scale enterprises have to choose how to prioritize the sustainability goals and give the large corporate farm structure sustainability relative advantages, which may enforce the regional depopulation if European Commission insists on incorporating the agricultural business in the near future.

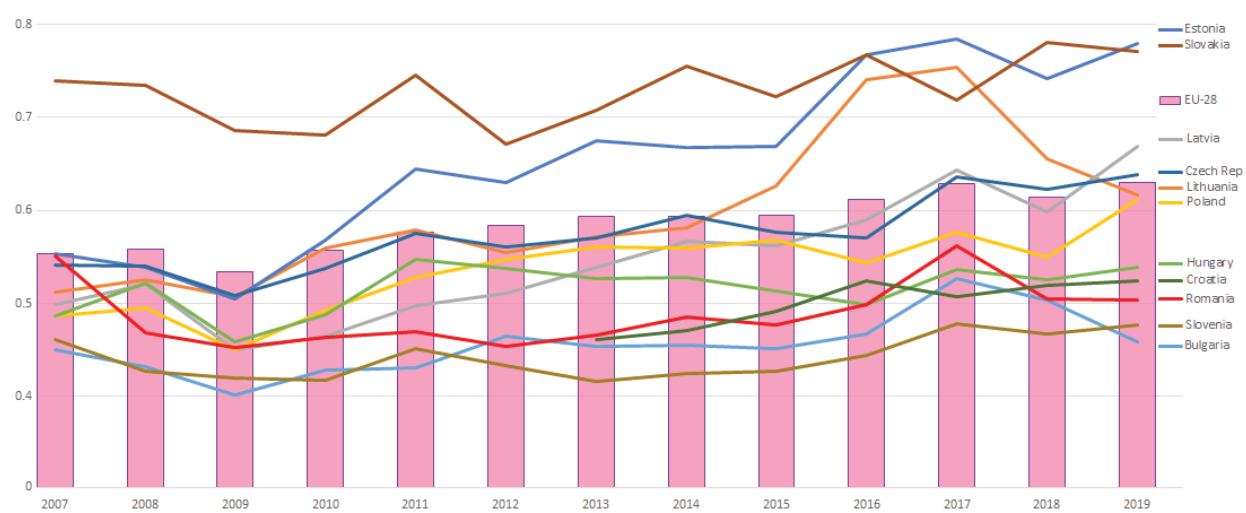

Fig. 5. Composite Sustainability Index
Source: Own calculations, based on FADN.

Conclusions

The farm sustainability of the different Member States economies depends on the degree of intensification, farm economic size, as well as on a large extent on the state CAP management, also known as institutional sustainability or governance.

Slovakia is the most sustainable Central and Eastern European MS. That condition is based on all of the observed years of all of the sustainability pillars. The only exception is locked between 2015–2018 in the ecological dimension where the Baltic MS simultaneously raised the level of their environmental practices. This in term might be a result of CAP encouragement such a this in Bulgaria and all the holdings object of this article (in 2017). The exception is not a big surprise – Slovakia, short (but) increase. These sustainable levels are supported by a big economic size from the very beginning of the observed period.

The second most sustainable holdings are the Estonian`s which are covered by sufficient economic size increase resulting in all the inspected dimensions and is capable for all the Baltic region, including Poland and Czechia.

Croatia and Hungary share a sustainability improvement, which excludes the agro ecology.

Romania, Bulgaria and Slovenia could not gain a significant sustainability boost by CAP.

Social sustainability is directly proportional to economic size, evident from the increase in results of each successive class of holdings. However, that increase is inflation based in Bulgaria and probably there are more MS with such an experience.

The question of increasing the economic size of the units probably correlates with the concept of the founding states of the European Union, and they impose their governing views and interests on the sustainability of large and huge structures would be imposed on territories with solid traditions in agriculture, but struggling to preserve its low-intensive structure with a perspective on the preservation of rural societies, including employment and biodiversity, so alien to the corporate direction of industrialization in agriculture.

Finding a place in the agrarian business is not an easy challenge – a person or a small to medium-sized organization. Visible from the growing economic size, which push up the barriers to entering the business are positioned higher and higher, and they are not about to be underestimated. Maintaining the specific business environment is a difficulty for every state administration precisely because of the increasingly demanding EU, where the goals are getting greener and increasingly cruel to small and medium-sized agricultural entities. Bearing in mind the disappearance of agricultural structures in this already past period, it should be taken into account that the factors contributing to this will be increasingly strengthened in the eventual imposition of the principles of the "Green Deal" and the resulting "shock" consequences for agriculture.

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