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FARM SIZE AND TECHNICAL EFFICIENCY OF THE AGRICULTURAL SECTOR IN THE EUROPEAN UNION (EU-27)

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Abstract

The majority of studies of agricultural productivity support the view that there is a relationship between productivity and farm size. How the size of a farm is related to its efficiency is a constant problem in agricultural economics research. It also has important implications for agricultural development policy. For developed countries, including the countries of the European Union, numerous studies show that, with the increase in the size of farms, their efficiency usually increases. Moreover, there is a constant decrease in the number of farms and the concentration of land and labor. For this reason, the problem of the influence of the economic size of a farm is included in the scope of the research related to the analysis of the relationship between the farm size and its efficiency. The purpose of the paper was to investigate the relative technical efficiency of the agricultural sector in the European Union (EU-27) using the Data Envelopment Analysis (DEA).It was found that with the increase in economic size, the technical efficiency of the researched farms improved.Attention was paid to the possibility of reducing labor inputs, mainly in farms of economic size classes ES1-ES4. No need to reduce the level of capital expenditure has been demonstrated. This emphasizes the growing importance of the substitution of labor with capital.

Keywords: *farm size, technical efficiency, Data Envelopment Analysis (DEA), Malmquist Index, EU Member States*

INTRODUCTION

The efficiency of management in agriculture and in other sectors of the economy is of fundamental importance. Despite the fact that in the recent years the importance of the efficiency paradigm has undergone transformation from a typically practical approach related to production efficiency, through a financial approach focusing on ratio analysis towards a multidimensionalassessment considering financial, economic, social and environmental aspects. However, among economist there is an agreement regarding the fact that the economic development requires refinement of efficiency of business entities, and ensuring efficiency in a multidimensional approach cannot be achieved without improving efficiency in technical, economic, and financial terms. The efficiency of management in agriculture is one of the main factors explaining the differences in the development of farms and their competitiveness [3, 31, 33]. For this reason, the analysis of the factors determining the efficiency of farming in the agriculture is in the focus of attention of farmers as well as other stakeholders striving to develop and modernize the agricultural sector. Due to the importance and role of agriculture in maintaining food security, the issue of agricultural farms efficiency is of particular interest to politicians and citizens of every country. Research on agricultural efficiency acknowledges the relationship between farming efficiency and the size of the farm [1, 2, 5, 18, 19, 22, 23, 26, 27, 55, 58].The impact of farm size on its efficiency is a constantly discussed issue in agricultural economics research. This is important from the point of view of creating agricultural development policy mechanisms.In the case of low-income countries or developing countries, where most agricultural farms are small, not exceeding 5 ha of agricultural land, it is pointed out that smaller agricultural farms are more effective than larger ones [4, 14, 46]. In contrast, in the case of developed countries where the level of technological advancement is higher, research shows that as the scale of production increases, the efficiency of farming improves

[6, 7, 12, 17, 37, 41, 46,57], and even growing disproportions are observed [32]. However, it should be borne in mind that striving for an unlimited increase in the size of the farm may result in negative external effects [28, 38]. The relationship between farm size and efficiency was explained by the presence of economies of scale and transaction costs [11, 17, 21, 58, 59].

Due to the constant high importance of management efficiency in agriculture and the need to constantly analyze the factors determining the economic efficiency of farms, the article deals with the issue of assessing management efficiency on farms of various economic size classes.

MATERIALS AND METHODS

In the assessment of the efficiency of the researched agricultural farms the Data Envelopment Analysis (DEA) method was used. The DEA is based on mathematical programming method that determines the effectiveness of objects described by vectors of inputs and outputs. It is possible within the scope of the DEA method to determine among objects the ones that are effective, but also for the ineffective ones obtaining information on necessary changes in the technology that will lead to the improvement of efficiency. This method is commonly used to assess theproductivity of enterprises in many areas of the economy, including agriculture[9, 10, 25, 40, 45, 49, 51, 54]. It is particularly useful when considering a production technology that produces more than one product from more than one input. Therefore, the challenge in measuring productivity is the appropriate aggregation of inputs and outputs of the production process. The result obtained in this way is called the Total Factor Productivity (TFP). The analysis of the efficiency of agricultural farms using the DEA method was carried out using the following set of inputs and outputs:

- inputs

x1 – total assets(SE436) [EURO],

x2 – total labor input (SE010) [AWU],

x3 –total utilized agricultural area (SE025) [ha],

- outputs

y1 – total output (SE131) [EURO].

The analysis used economic data for European Union (EU27) agricultural farms for the years 2013-2022 obtained from the FADN Public Database (Farm Accountancy Data Network) [20]. All result categories are given in accordance with the FADN methodology (symbols of result categories in accordance with the FADN methodology are given in brackets). The inputs and outputs determined in this way were subjected to the productivity analysis. An output-oriented model with constant returns to scale was used to analyze efficiency [16]. Considering n objects that use k inputs and obtain l outputsfrom their use, data on inputs and outputscan be presented in the form of the following matrix of dimension $n\times(k+l)$:

$$\underbrace{\begin{bmatrix} x_{11} & \cdots & x_{1k} \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \\ x_{n1} & \cdots & x_{nk} \end{bmatrix}}_{\text{input}} \underbrace{\begin{matrix} y_{11} & \cdots & y_{1l} \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \\ y_{n1} & \cdots & y_{nl} \end{matrix}}_{\text{output}} \quad (1)$$

To assess the technical efficiency of a certain established facility N ($1 \le N \le n$) the following conditions will be formulated regarding the outputs and then the inputs obtained by object N in relation to other decision-making units. The aim of the model is to proportionally reduce expenditures without reducing the outputs. Mathematically, it comes down to the following notation:

$$\min_{\lambda_1,\ldots,\lambda_n} \theta$$

$$\lambda_1,\ldots,\lambda_n \ge 0$$

$$\left.\begin{matrix} \lambda_1 y_{11} + \cdots + \lambda_n y_{n1} \ge y_{N1} \\ \vdots \\ \lambda_1 y_{1l} + \cdots + \lambda_n y_{nl} \ge y_{Nl} \end{matrix}\right\} \text{the outputs do not decrease} \quad (2)$$

$$\left.\begin{matrix} \lambda_1 x_{11} + \cdots + \lambda_n x_{n1} \le \theta \cdot x_{N1} \\ \vdots \\ \lambda_1 x_{1k} + \cdots + \lambda_n x_{nk} \le \theta \cdot x_{Nk} \end{matrix}\right\} \text{inputs are reduced } \theta \text{ times} \quad (3)$$

The model given above has the following solution:

$$\lambda_i = 0 i \neq N$$
$$\lambda_N = 1$$
$$\theta = 1 \quad (4)$$

If there is no solution such that $\theta \neq 1$, the decision object is considered to be effective. Otherwise, the value $1 – \theta$ shows how much the inputs can be reduced without reducing the outputs. To introduce returns to scale variable into the model, an additional condition is assumed:

$$\lambda_1 + \cdots + \lambda_n = 1 \qquad (5).$$

The distinctive feature of the DEA method is the estimation of the relative efficiency of the enterprise without assuming in advance some form of function linking inputs with the achieved outputs.

As a result of using the DEA method, information is obtained on:

-the level of productivity of each researched unit,

-achievable level of production (reduction of inputs) assuming optimal production possibilities,

-model units that are characterized by the best use of inputs.

Subsequently, an analysis of changes in the efficiency of farms was carried out in individual economic size classes. A non-parametric method was used, based on the Malmquist productivity index. The Malmquist index is a measure of the dynamics of efficiency in two time periods (*tit+1*). It involves a certain synthesis of assessments of the productivity of a given facility in both periods in relation to other units from the periods *tit+1*. The Malmquist index allows the change in total productivity to be broken down into a change in technical efficiency and a change in the frontier of technological possibilities. Färe et al. [16] define the change in the output-based Malmquist productivity index as:

$$m_o(y_{t+1}, x_{t+1}, y_t, x_t) = \left[\frac{d_o^t(x_{t+1}, y_{t+1})}{d_o^t(x_t, y_t)} x \frac{d_o^{t+1}(x_{t+1}, y_{t+1})}{d_o^{t+1}(x_t, y_t)}\right]^{1/2}$$

where: $d_o^t(x_t, y_t)$ - technical efficiency of the entity over the period *t;*

$d_o^t(x_{t+1}, y_{t+1})$ - technical efficiency of the entity for data for the *t + 1* period and technology in period *t*;

$d_o^{t+1}(x_t, y_t)$ - technical efficiency of the entity for data from period *t* and technology in the period *t + 1*;

$d_o^{t+1}(x_{t+1}, y_{t+1})$ - technical efficiency of the entity in the *t + 1* period.

A Malmquist index value greater than 1 will indicate an increase in total factor productivity (TFP), less than 1 will indicate a decrease in total productivity, and equal to 1 means no change in productivity.

In the analysis of the efficiency of the researched farms, the two-factor distribution of the Malmquist index proposed by Färe et al. [16] was used, which has the following form:

$$M_O = TE_O x TP_O$$

where: TE_O measures the change in technical efficiency change of an entity between periods *tit+1*, and TP_O determines technological change. To calculate the Malmquist productivity indices, the same set of variables was adopted as in the case of analyzing the efficiency of agricultural farms using the DEA method.

RESULTS AND DISCUSSIONS

By assessing the efficiency of the researched farms diversified in terms of economic size using the DEA method, technical efficiency indicators were obtained (Table 1).If the value is 1, the conclusion can be drawn that there has been no more efficient use of resources in the set of objects examined.On the other hand, if the technical efficiency index is below 1, it means that with a given level of resources, the level of effects can be increased.Our own research shows that technical efficiency improves as economic size increases.With the technical efficiency of farms in economic size classes ES1-ES3 being at a similar level.The technical efficiency index for the largest farms - ES6 - was 1 in all years analyzed.Farms in economic size class ES5 also had significantly higher technical efficiency than other farms in smaller economic size classes.With that said, the efficiency gap between ES5 and ES6 farms was not as large as for farms in the lower economic size classes.It is clear that the smallest farms ES1-ES3 are characterized by similar levels of technical efficiency. The remaining farm classes ES4, ES5 and ES6 form separate farm groups.This indicates a significant disparity between farms in economic size classes ES1-ES3 and the rest.Only economic size ES4 farms achieve higher technical efficiency. The increase in economic size from the ES1 and ES2 classes to the ES3 level did not produce any clear positive effects during the period under review.It is only from the economic size of ES4 that positive effects can be seen.This indicates that a small increase in farm size from a low level does not have a positive effect.It is only when the appropriate scale of production is exceeded that the farmer benefits.Small farms are not in a position to achieve the same level of efficiency as large farms.In the long term, farming with low efficiency will not allow this type of farm to function and grow.Small farms will be 'out of business' and their resources can be absorbed by larger farms, helping to improve efficiency and provide a sustainable basis for agricultural development.The problem for such an agricultural development strategy is the limited allocation of agricultural production factors, especially land [43, 44, 52] , and the environmental and social functions of farms [28]. An important aspect of agricultural policy should be to support the development of small farms through easier access to land (purchase or lease) [8, 39, 47, 50, 53], helping farmers to access credit, marketing, technology [13, 24, 35, 42].

Table 1. Technical efficiency indicators of the surveyed farms for the period 2013-2022

Year	**DMU***					
	ES1	**ES2**	**ES3**	**ES4**	**ES5**	**ES6**
2013	0.353	0.320	0.383	0.472	0.736	1.000
2014	0.387	0,344	0,385	0,468	0,735	1,000
2015	0,376	0,353	0,380	0,476	0,731	1,000
2016	0,358	0,326	0,365	0,455	0,687	1,000
2017	0,386	0,327	0,367	0,461	0,688	1,000
2018	0,289	0,313	0,379	0,485	0,703	1,000
2019	0,284	0,299	0,345	0,442	0,657	1,000
2020	0,283	0,306	0,351	0,449	0,662	1,000
2021	0,315	0,327	0,370	0,475	0,683	1,000
2022	0,325	0,316	0,370	0,480	0,703	1,000
2013-2022	0,353	0,320	0,383	0,472	0,736	1,000

* DMU – Decision Making Unit
Source: Own calculation on the basis of data from FADN.

Promoting diversification in the production of high-value commodities can play an important role in raising the small-holders' income and he development of the rural nonfarm sector [15].

Table 2 shows the relationship of the estimated output targets to those actually achieved with the given inputs.For decision-making units in which the optimal production sizes (outputs) were equal to the actual output sizes, the ratios of reference to actual sizes were equal to 1.A distinctive feature of the approach presented is the use of (estimated) output targets set by decision-making units (DMUs) as benchmarks for performance comparisons.This leads to a comparison of the performance of the optimum target with the actual performance achieved.The actual realized outputs in the decision-making units analyzed do not achieve the target results due to inefficiencies.The research shows that the obtainable production based on given inputs on farms of economic classes ES1 - ES5 in all the years analyzed was higher than the actual production obtained.As economic size increased, these differences decreased.

Table 2. Comparison of reference quantities with actual output quantities - effects: y1 - total output (SE131) for the decision-making units in the surveyed farms for the period 2004-2020 (actual volumes=1)

Year	DMU					
	ES1	ES2	ES3	ES4	ES5	ES6
2013	2.84	3.13	2.61	2.12	1.36	1.00
2014	2.59	2.90	2.60	2.14	1.36	1.00
2015	2.66	2.83	2.63	2.10	1.37	1.00
2016	2.80	3.06	2.74	2.20	1.46	1.00
2017	2.59	3.06	2.73	2.17	1.45	1.00
2018	3.46	3.19	2.64	2.06	1.42	1.00
2019	3.53	3.34	2.90	2.26	1.52	1.00
2020	3.53	3.27	2.85	2.23	1.51	1.00
2021	3.18	3.06	2.70	2.11	1.46	1.00
2022	3.08	3.16	2.70	2.08	1.42	1.00

Source: Own calculation on the basis of data from FADN.

Table 3 presents an analysis of the relationship between estimated input values and actual input values.For decision-making units in which the optimum input sizes (inputs) were equal to the actual input sizes, the ratios of reference to actual were equal to 1.All values below 1 indicated a possible level of input reduction with given effects.The data indicate a possible level of reduction mainly in labor inputs (x2), but primaryin the smallest farms ES1-ES4.The analysis carried out does not indicate a need to reduce capital (x1) and land resources (especially on ES1-ES3 farms).The findings highlight the importance of the relations between production factors.

Table 3. Comparison of reference quantities with actual input quantities - inputs: x1 - total assets (SE436), x2 - total labor input (SE010), x3 - total utilized agricultural area (SE025) for the decision-making units in the surveyed farms for the years 2004-2020 (actual quantities=1)

Year	Inputs	DMU					
		ES1	ES2	ES3	ES4	ES5	ES6
2013	x1	1.00	0.96	1.00	1.00	0.93	1.00
	x2	0.15	0.38	0.60	0.79	1.00	1.00
	x3	0.97	1.00	1.00	0.90	0.85	1.00
2014	x1	1.00	0.92	0.96	1.00	0.94	1.00
	x2	0.13	0.37	0.59	0.80	1.00	1.00
	x3	0.91	1.00	1.00	0.92	0.87	1.00
2015	x1	1.00	0.94	1.00	1.00	0.97	1.00
	x2	0.12	0.36	0.59	0.77	1.00	1.00
	x3	0.87	1.00	0.97	0.88	0.81	1.00
2016	x1	1.00	0.96	1.00	1.00	0.99	1.00
	x2	0.13	0.37	0.59	0.77	1.00	1.00
	x3	0.87	1.00	0.99	0.86	0.81	1.00
2017	x1	1.00	1.00	0.97	1.00	1.00	1.00
	x2	0.13	0.37	0.59	0.74	1.00	1.00
	x3	0.85	0.99	1.00	0.84	0.82	1.00
2018	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.17	0.38	0.57	0.69	0.96	1.00
	x3	0.88	0.93	0.90	0.76	0.75	1.00
2019	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.17	0.39	0.59	0.71	0.96	1.00
	x3	0.88	0.98	0.91	0.76	0.77	1.00
2020	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.17	0.38	0.60	0.73	0.99	1.00
	x3	0.88	0.93	0.89	0.75	0.75	1.00
2021	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.17	0.37	0.58	0.72	0.99	1.00
	x3	0.90	0.91	0.89	0.75	0.75	1.00
2022	x1	1.00	1.00	1.00	1.00	1.00	1.00
	x2	0.14	0.31	0.52	0.67	0.92	1.00
	x3	0.70	0.81	0.81	0.70	0.69	1.00

Source: Own calculation on the basis of data from FADN

Under conditions of dynamically changing prices of production factors and especially the increasing cost of labor compared to other factors of production, it is becoming necessary to substitute labor with capital[29, 30, 34, 36, 48, 56].

This was followed by an assessment of changes in farming efficiency using the Malmquist Index.The results are presented in Tables 4-12 for the individual years of the analysis period and in Table 13 for the averages for the period 2013-2022.In 2014, average farm productivity increased by 3.3% compared to 2013 (Table 4).With the exception of class ES3, all the farm classes surveyed recorded an increase in the Malmquist index in 2014.A decomposition of the Malmquist index into two components shows that economic size classes ES2 and ES3 experienced a decrease in technological progress, while the others experienced an increase.In contrast, the technical efficiency of farms in the economic size classes ES1 - ES3 has increased, while it has decreased in ES4 and ES5 and remained unchanged in ES6 farms.

Table 4. Change in Malmquist index in 2014/2013

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	1.096	1.019	1.117
ES2	1.078	0.972	1.047
ES3	1.006	0.983	0.988
ES4	0.992	1.040	1.031
ES5	0.999	1.013	1.012
ES6	1.000	1.005	1.005
Average	1.028	1.005	1.033

Source: Own calculation on the basis of data from FADN.

In the year 2015, average farm productivity decreased by 2.9% compared to 2014 (Table 5), with both technical efficiency and technical capacity decreasing.

Table 5. Change in the Malmquist index in 2015/2014

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.972	0.931	0.905
ES2	1.025	1.011	1.036
ES3	0.986	0.977	0.964
ES4	1.018	0.931	0.948
ES5	0.994	0.945	0.939
ES6	1.000	0.971	0.971
Average	0.999	0.961	0.971

Source: Own calculation on the basis of data from FADN.

Only ES2 farms showed an increase in the Malmquist index.Similarly, a decrease in the Malmquist index of 1.8% was also recorded in 2016 (Table 6).The exception was the ES6 farms.The decline in productivity was due to a decline in technical efficiency.

In 2017, the situation of agricultural farms was more favorable. An increase in the Malmquist index was recorded in all economic size classes (Table 7).This increase has been achieved both through improvements in technical efficiency (the exception being ES6 farms, where no change has been recorded) and through technological progress.

Table 6. Change in the Malmquist index in 2016/2015

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.952	1.016	0.967
ES2	0.925	1.030	0.953
ES3	0.962	1.020	0.982
ES4	0.955	1.016	0.970
ES5	0.939	1.051	0.987
ES6	1.000	1.036	1.036
Average	0.955	1.028	0.982

Source: Own calculation on the basis of data from FADN

Table 7. Change in Malmquist index in 2017/2016

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	1.078	1.024	1.104
ES2	1.001	1.036	1.037
ES3	1.003	1.032	1.035
ES4	1.013	1.024	1.037
ES5	1.002	1.042	1.045
ES6	1.000	1.039	1.039
Average	1.016	1.033	1.049

Source: Own calculation on the basis of data from FADN.

In 2018, there was a 6% decline in the Malmquist index. While this varied between farm groups (Table 8), the largest decrease was recorded in ES1 farms.

Table 8. Change in Malmquist index in 2018/2017

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.750	0.966	0.724
ES2	0.959	0.969	0.929
ES3	1.033	0.982	1.014
ES4	1.053	0.966	1.018
ES5	1.021	0.966	0.987
ES6	1.000	1.004	1.004
Average	0.963	0.975	0.940

Source: Own calculation on the basis of data from FADN.

A 1.8% increase in the Malmquist index was recorded in 2019 (Table 9), this was due to an increase in the level of technological progress, while technical efficiency decreased. All classes of economic size of farms were characterized by an increase in technological progress and a decrease in technical efficiency (except for ES6 farms, where this indicator did not change).

Table 9. Change in Malmquist index in 2019/2018

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.981	1.073	1.053
ES2	0.954	1.073	1.024
ES3	0.911	1.073	0.978
ES4	0.910	1.073	0.977
ES5	0.935	1.073	1.004
ES6	1.000	1.079	1.079
Year	0.948	1.074	1.018

Source: Own calculation on the basis of data from FADN.

The opposite situation occurred in 2020. All farm groups experienced a decline in productivity, but mainly due to a decrease in the level of technological progress (Table 10).

Table 10. Change in Malmquist index in 2020/2019

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.998	0.970	0.968
ES2	1.023	0.970	0.993
ES3	1.018	0.970	0.987
ES4	1.016	0.970	0.985
ES5	1.007	0.971	0.978
ES6	1.000	0.990	0.990
Average	1.010	0.973	0.983

Source: Own calculation on the basis of data from FADN.

In contrast, in 2021 (Table 11) and 2022 (Table 12) the situation has improved significantly and an increase in the Malmquist index has been recorded.

Table 11. Change in Malmquist index in 2021/2020

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	1.112	1.040	1.157
ES2	1.069	1.040	1.111
ES3	1.054	1.040	1.096
ES4	1.058	1.040	1.100
ES5	1.033	1.057	1.092
ES6	1.000	1.064	1.064
Average	1.054	1.047	1.103

Source: Own calculation on the basis of data from FADN.

Table 12. Change in Malmquist index in 2022/2021

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	1.032	1.098	1.133
ES2	0.967	1.098	1.062
ES3	1.000	1.098	1.098
ES4	1.012	1.098	1.111
ES5	1.029	1.146	1.180
ES6	1.000	1.198	1.198
Average	1.006	1.122	1.129

Source: Own calculation on the basis of data from FADN.

This is due to both technological progress and changes in technical efficiency (except for ES2 in 2022).

Table 13. Change in Malmquist index from 2013 to 2022

DMU	Technical efficiency change	Technological change	Malmquist Index
ES1	0.991	1.014	1.005
ES2	0.999	1.021	1.020
ES3	0.996	1.019	1.015
ES4	1.002	1.016	1.018
ES5	0.995	1.028	1.023
ES6	1.000	1.041	1.041
Average	0.997	1.023	1.020

Source: Own calculation on the basis of data from FADN.

In addition to the analysis for individual years, an analysis of the Malmquist index for the whole period is also presented, where the average values for 2013-2022 are used (Table 13).In all farm groups the Malmquist index was above one. It was also found that the largest ES5 and ES6 farms had the largest increase in the Malmquist index, while ES1 farms had only a 0.5% increase in the Malmquist index.This indicates a growing disparity between the smallest farms (ES1) and the rest of the farm group, especially ES6 farms. The decomposition of the Malmquist index into two components shows that, in all farms economic size classes, technological progress increased, while technical efficiency decreased (except for ES6 farms, where no change was recorded, and ES4 where a minimal increase of 0.2% was recorded).These data make it possible to analyze the impact of technical efficiency changes and technological change on the change in productivity of individual facilities.The reason for the changes in the total productivity index was a change in the production (technological) capacity rather than a change in the way the farms used their assets within the available technology.The efficiency gap lies in the mix of available factors of production.

CONCLUSIONS

Improving the efficiency of farms is one of the essential conditions for strengthening their competitive position and economic strength.The paper assesses the economic efficiency at the microeconomic level on agricultural farms of different economic sizes.The study used the non-parametric DEA method to estimate changes in farm efficiency over time and to assess the relative efficiency of farms in each economic size class.

As a result of the research work, the following statements can be made:

(1)As the economic size increased, the technical efficiency of the surveyed farms improved. A clear efficiency gap was observed between farms in economic size classes ES5 and ES6, and ES4 as well as another group of farms in economic size classes ES1-ES2. This is an indication that a significant increase in production scale is necessary for a significant improvement in farm efficiency. A minor increase does not lead to a clear improvement in management efficiency. The benefits in terms of greater efficiency are only realized when the appropriate production scale is exceeded.

(2)For a given level of production, the analysis also indicated a possible reduction in inputs.Attention was drawn to the potential for labor input reduction, mainly on farms in economic size classes ES1-ES4.There has been no evidence that a reduction in the level of capital expenditure is necessary.This indicates the growing importance of capital substitution for labor.These trends are indicative of a process of "pushing" labor out of agriculture and allows labor costs to be reduced. Furthermore, assuming that the 'freed' labor resources from the farm can be used in non-agricultural activities, this should have a positive impact on the disposable income of the farmer's family.Therefore, agricultural, and rural development policies should implement instruments to activate farmers to seek non-agricultural sources of income.The economic development of the country is also important for this process of substitution of labor with capital.In particular, the low level of unemployment allows labor to be 'pulled out' of agriculture.

(3)All economic size classes recorded an increase in technical efficiency (Malmquist index) during the period under review.The smallest improvements in efficiency were recorded in the ES1 farms, and the largest in the ES6 farms.This indicates a growing disparity between farms of different economic sizes.

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