HIGHER SCHOOL OF INSURANCE AND FINANCE

VUZF SOFIA

Department of Finance

ABSTRACT

of the scientific dissertation on the topic:

ECONOMIC EFFICIENCY OF FARMS IN POLAND DEPENDING ON ECONOMIC SIZE

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Bożena KUSZ

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1. JUSTIFICATION OF THE TOPIC SELECTION

In economics, the category of efficiency is of fundamental importance. At its core, it addresses the challange of managing scarce resources and optimizing their use for the production of goods and services. Over the last few decades, the paradigm of efficiency has evolved from a predominantly practical approach to a financial one, focusing on indicator analysis, and more recently, to a multidimensional assessment that considers various aspects of economic entities' operations and their environmental impact. However, economists agree that economic development requires improving the efficiency of economic entities, and ensuring efficiency in a multidimensional approach cannot be achieved without improving efficiency in economic and financial terms.

The efficiency of agricultural management is a key factor explaining differences in farm development, competitiveness, changes in agricultural structure, and its role in national economic growth. For this reason, the factors that explain and determine differences in farm efficiency are at the center of interest for farmers and other stakeholders seeking to improve the financial performance and development opportunities of the agricultural sector. Due to the importance and role of agriculture in ensuring food security, the issue of farm efficiency is of particular interest to politicians and citizens in all countries.

Research on farm efficiency focuses on the relationship between farm efficiency and farm size, a long-standing issue in agricultural economics. In the case of low-income or developing countries, where the majority of farms are small, with less than 5 ha of land, it is pointed out that smaller farms perform better per ha than larger farms. This may be due to a lack of access to more efficient and modern agricultural production technologies, which limits the ability of large farms to improve efficiency. This advantage of small farms reverses with technological changes. In the case of high-income developed

countries, where farms are much larger, research shows that as farm size increases, so does farm efficiency.

For developed countries, including those in the European Union and those in the former Soviet bloc, numerous studies show that as farm size increases, land and labor productivity and income per worker tend to increase. In addition, there is a steady decrease in the number of farms and a reduction in the employment of the workforce, as well as an increase in land concentration. For this reason, the issue of the impact of the economic size of a farm on its economic situation and management efficiency is still relevant not only from a scientific point of view, but also from the point of view of agricultural policy shaping various paths of development of agriculture and farms.

The implication of the positive relationship between management efficiency and farm size is the need to change the agrarian structure of agriculture, especially in low-income countries. This means the need to increase the size of farms through consolidation, which causes a reduction in the number of farms and limiting employment in agriculture, but also the need to implement modern, efficient agricultural production technologies. Such a strategy for the development of agriculture requires appropriate agricultural policy instruments that allow for the modernization of agriculture, but also for minimizing the social costs associated with the loss of agricultural jobs and the marginalization of rural areas.

Agriculture is subject to constant changes of varying intensity. The factors causing these changes are both external and internal. These include, first and foremost, the state of the national economy, the development of non-agricultural sectors, the labor market, domestic and foreign demand for food, consumer requirements, demographic conditions, price relations of production factors, price relations in agriculture, access to new technological solutions, the level of income in agriculture and many other factors. In Poland, one of the most

important drivers of change in agriculture in recent years has been the institutional framework of the European Union's Common Agricultural Policy, which has covered Polish farms and agricultural markets since 2004. On the other hand, the inclusion of Polish agriculture in area subsidies may also reinforce an unfavorable agrarian structure, as smaller farm owners are reluctant to sell their land and thus lose their subsidy income. The processes of agricultural modernization observed in Western European countries since the 1960s have not taken place in Poland, which is why the agricultural structure in Poland is still not modern.

In 2020, there were over 1.3 million farms in Poland and compared to 2010, there was a decrease of 12.7% in the number of farms (table W.1) according to the last agricultural census in Poland, carried out in November 2020. The agricultural landscape is dominated by small farms (less than 20 hectares), which accounted for 88.8% of all farms in 2020, down from 91.8% in 2010. This high proportion of small farms is considered a significant structural weakness in Polish agriculture and a main factor of low management efficiency.

The conducted research aims to better understand the differences between farms in the level of their management efficiency and the factors determining the efficiency of using land, labor and capital resources. Increasing production scale and farm size through economies of scale is expected to enhance technical efficiency and improve economic performance. Growing competitiveness will require small family farms to expand production scale while maintaining sustainable practices and achieving productivity levels comparable to larger farms. Research on the determinants of management efficiency is also helpful in designing appropriate agricultural policy instruments that allow for the efficient restructuring and modernization of agriculture, in particular of agriculture suffering from structural deficiencies.

Many articles in the economic and agricultural literature have analyzed the relationship between efficiency/productivity and the farm size. Despite this, such research should be continued for two basic reasons: the extreme relevance of the issue and any change in economic, social or broadly understood institutional conditions require continuous analysis and updating of the determinants of farm efficiency in agriculture.

2. SUBJECT AND OBJECT OF RESEARCH

Due to the still great importance of management efficiency in agriculture and the need to conduct ongoing analysis of factors determining the economic efficiency of farms, the subject of the research in this paper is the assessment of efficiency and analysis of its determinants in farms. The literature on the subject indicates that the economic size of the farm is of great importance in shaping the economic results and management efficiency in agriculture. For this reason, farms of different economic sizes are the subject of the research. The paper adopts the classification of farms according to economic size, which is commonly used in the countries of the European Union. The analysis of the differentiation of the efficiency of farms according to their economic size is related to the fact that in Poland there is a predominant number of small farms. The defective agricultural structure in Poland is considered to be one of the main factors limiting the management efficiency and development possibilities of farms.

3. OBJECTIVE AND SCOPE OF THE WORK

The aim of the work is to analyze the level of efficiency of farms in Poland and the factors determining it in farms of different economic size classes.

The scope of the work includes the following areas:

1. systematization of the theoretical layer in the field of management efficiency in agriculture,

2. systematization of theoretical knowledge in the field of determinants of management efficiency in agriculture,

3. characterization and analysis of changes in the economic and financial results and organization of the studied farms distinguished by economic size,

4. characterization of the organization of the studied farms distinguished by economic size,

5. characterization and analysis of changes in management efficiency in the studied farms using partial indicators,

6. analysis of endogenous conditions of the economic efficiency of the studied farms,

7. analysis of technical efficiency using data envelopment analysis (DEA).

4. RESEARCH HYPOTHESES

The following hypotheses were presented in the paper:

H.1. the efficiency of farming improves with the increase in the economic size of farms.

H.2. the disproportion in farming efficiency between farms of different economic size classes increases over time.

H.3. due to the increasing costs of labor in relation to other factors of production (land and capital), improving farming efficiency requires substituting labor with capital.

5. RESEARCH METHODOLOGY

The literature on the subject pays particular attention to the factors that determine the efficiency of farming. Three basic areas are most often mentioned: 1. macroeconomic area, 2. technical area, 3. microeconomic area. The work focused on two areas: technical and microeconomic, which are endogenous, internal conditions that are largely dependent on the farmer. It was

assumed that the area related to macroeconomic factors is located in the environment of the farm, creates the same conditions for the functioning of all farms, and only the farmer's managerial skills allow for adaptation to these conditions. This adaptation concerns factors related to the functioning of farms, in terms of production technology, organization of production and farm, mutual relations of production factors, etc. It is assumed that under relatively constant macroeconomic conditions and a constant level of available production technologies, it is the factors from the technical and microeconomic areas that determine the economic results obtained by farms and the level of management efficiency.

In this work, the analysis of the efficiency of farms was performed using partial indicators according to the following formula:

$$Ef = \frac{E}{N} \qquad (1)$$

where:

Ef – efficiency,

E – effect,

N – input.

The analysis of the economic efficiency of farms was carried out for two main groups of indicators:

1. production factor efficiency,

2. production factor profitability.

All indicators were calculated using result categories in accordance with the FADN (Farm Accountancy Data Network) methodology.

The following economic categories were used as effects in the efficiency equation (1) (the symbols used in the FADN methodology are given in brackets):

1. total production (SE131) [EURO],

2. net value added (SE415) [EURO],

3. family farm income (SE420) [EURO].

In turn, the following economic categories were used as inputs in the efficiency equation (1) (the symbols used in the FADN methodology are given in brackets):

1. agricultural area (SE025) [ha],

2. total labor inputs (SE010) [AWU – annual work units],

3. own labor inputs (SE015) [FWU – family work unit],

4. capital [EURO]:

4.1. cost approach Kc1, which is the sum of intermediate consumption (SE275), depreciation (SE360), rents (SE375) and interest (SE380);

4.2. cost approach Kc2, which is the sum of intermediate consumption (SE275) and depreciation (SE360);

4.3. resource approach, which takes into account:

4.3.A. total assets (SE436);

4.3.B. fixed assets (SE441) less the value of land, permanent crops and production quotas (SE446), due to the impossibility of separating the value of land itself, the value of permanent crops and production quotas was also taken into account. However, the value of permanent crops and production quotas does not constitute a large share in the structure of assets, so it can be assumed with great probability that this variable mainly consists of the value of land;

4.3.C. equity (SE501).

In the analysis of the factors determining the economic efficiency of the surveyed farms, the following indicators of factor productivity and profitability were taken as dependent variables:

Y.1. land efficiency – the ratio of total production (SE131) to the area of agricultural land (SE025) [EURO/ha],

Y.2. labor efficiency – the ratio of total production (SE131) to total labor inputs (SE010) [EURO/AWU],

Y.3. capital productivity in cost terms Kc1 – the ratio of total production (SE131) to capital Kc1 [multiplicity],

Y.4. capital productivity in cost terms Kc2 – the ratio of total production (SE131) to capital Kc2 [multiplicity],

Y.5. total asset productivity – the ratio of total production (SE131) to total assets (SE436) [multiplicity],

Y.6. productivity of fixed assets - the ratio of total production (SE131) to fixed assets (SE441) less the value of land, permanent crops and production quotas (SE446) [multiplicity],

Y.7. equity productivity - ratio of total production (SE131) to equity (SE501) [multiplicity],

Y.8. land profitability - ratio of family farm income (SE420) to agricultural land area (SE025) [EURO/ha],

Y.9. total labor profitability - ratio of net value added (SE415) to total labor input (SE010) [EURO/AWU],

Y.10. own labor profitability - ratio of family farm income (SE420) to own labor input (SE015) [EURO/FWU],

Y.11. cost-based capital profitability Kc1-ratio of family farm income (SE420) to capital Kc1 [%],

Y.12. cost-based capital profitability Kc2-ratio of family farm income (SE420) to capital Kc2 [%],

Y.13. return on total assets-the ratio of family farm income (SE420) to total assets (SE436) [%],

Y.14. return on fixed assets-the ratio of family farm income (SE420) to fixed assets (SE441) less the value of land, permanent crops and production quotas (SE446) [%],

Y.15. return on equity - the ratio of family farm income (SE420) to equity (SE501) [%].

The set of potential explanatory variables belonging to the determinants of the economic efficiency of farms included the following groups of variables:

X.1. economic size of farms (SE005) expressed in the value of Standard Output (SO) [EURO].

X.2. relations of production factors:

X.2.1. technical equipment of land - the ratio of fixed assets (SE441) reduced by the value of land, permanent crops and production quotas (SE446) to the area of agricultural land (SE025) [EURO/ha],

X.2.2. technical equipment of labor - the ratio of fixed assets (SE441) reduced by the value of land, permanent crops and production quotas (SE446) to total labor inputs (SE010) [EURO/AWU],

X.2.3. land to labor ratio - the area of agricultural land (SE025) to total labor inputs (SE010) [ha/AWU]

X.3. technology and organization of production – this area was characterized by the ratio of total production to direct costs (SE132=SE131/SE281) [multiplicity]. This indicator illustrates not only the efficiency of the applied production technology, but it is also related to the way in which the farm is

managed, its organization, the management of production processes, market relations concerning the prices of agricultural inputs and the prices of sold products.

X.4. cost structure management:

X.4.1. share of external production factor costs (labor, land, capital) (SE365) in total costs (SE270) [%],

X.4.2. ratio of general economic costs (SE336) to direct costs (SE281) [%].

X.5. use of subsidies – subsidy rate calculated as the ratio of the total amount of subsidies for operating activities (SE605) to the total production value (SE131) [%].

X.6. financial leverage and asset structure:

X.6.1. fixed assets to fixed capital ratio [%],

X.6.2. total debt ratio [%],

X.6.3. long-term debt ratio [%],

X.6.4. share of current assets (SE465) in total assets (SE436) [%],

X.6.5. ratio of net working capital to total assets [%].

X.7. Financial liquidity:

X.7.1. Current liquidity ratio,

X.7.2. Accelerated liquidity ratio.

X.8. Farm's ability to self-finance its operations and create savings,

X.8.1. Cash flow (1) (SE526) [EURO] – shows the farm's ability to self-finance its operations and create savings within its operating activities. Cash flow (1) is calculated as follows: Sales of products + Other revenues + Sales of

animals – Total costs – Costs of purchasing animals + Balance of subsidies and taxes on operating activities + Balance of subsidies and taxes on investments.

X.8.2. Cash flow (2) (SE530) [EURO] – shows the farm's ability to self-finance its operations and create savings. Cash flow (2) is calculated as follows: Cash flow (1) + Sales of fixed assets - Purchases and investments in fixed assets + Balance of liabilities at the end of the year – Balance of liabilities at the beginning of the year.

X.9. investment effort – calculated as the ratio of gross investment (SE516) to the sum of depreciation (SE360) and income from the family farm (SE420). Variables that can be substantively justified were selected for the study. Then, Pearson correlation coefficients were calculated for independent variables in order to eliminate variables that were correlated with each other. Finally, through substantive analysis, the following dependent variables were removed from the constructed econometric models explaining the partial indicators of the efficiency of the management of the studied farms: X6.1, X7.1, X6.5, X6.3, X8.1, X4.1.

A multiple regression model was used to analyze the factors determining the partial efficiency indicators (Y.1 – Y.15), which had the following form:

$$y_i = \beta_0 + \sum_{j=1}^{k} \beta_j x_j + \varepsilon_i \qquad (2)$$

where: yi– i-th observation on the explained variable (i = 1, 2,…,n), xij – i-th observation on the j-th explanatory variable belonging to the set of explanatory variables, β0, βj, , – structural parameters of the regression equation, εi – random component. The backward stepwise regression procedure was used to estimate the models.

In the assessment of the efficiency of the examined farms, in addition to partial indicators, the Data Envelopment Analysis (DEA) method was also used. The DEA method is a mathematical programming-based method for

determining the efficiency of objects described by input and output vectors. Within the DEA method, it is possible to identify the efficient objects in a set of objects and, for inefficient objects, to obtain information on the necessary technological changes that will lead to improved efficiency. This method is one of the most commonly used non-parametric methods of measuring technical efficiency.

A non-parametric method based on the Malmquist productivity index was used to assess changes in the efficiency of farms in individual economic size classes. The Malmquist index is a measure of the dynamics of efficiency in two time periods (t and t+1). It consists in a certain synthesis of the productivity assessments of a given object in both periods relative to other units from the periods t and t+1. The Malmquist index allows the change in total productivity to be split into a change in technical efficiency and a change in the technical possibilities frontier. The output-based Malmquist productivity index was calculated according to the following equation:

$$m_o(y_{t+1}, x_{t+1}, y_t, x_t) = \left[\frac{d_o^t(x_{t+1},y_{t+1})}{d_o^t(x_t,y_t)} x \frac{d_o^{t+1}(x_{t+1},y_{t+1})}{d_o^{t+1}(x_t,y_t)}\right]^{1/2} (3)$$

where: $do\ t\ (xt\ ,\ yt)$ – technical efficiency of the entity in period t; $do\ t\ (xt{+}1,\ yt{+}1)$ - — technical efficiency of the entity for data from period t + 1 and technology in period t; $do\ t{+}1\ (xt\ ,\ yt\ )$ - technical efficiency of the entity for data from period t and technology in period t + 1; $do\ t{+}1\ (xt{+}1,\ yt{+}1)$ - — technical efficiency of the entity in period t + 1.

A Malmquist index value greater than 1 will indicate an increase in total factor productivity (TFP), a value 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 studied farms, a two-factor distribution of the Malmquist index was used, which has the following form:

$$M_O = TE_O x TP_O \quad (4)$$

where:

TE_O – measures the change in the technical efficiency of a unit between periods t and t+1, and

TP_O - determines technical (technological) progress.

The following set of variables was used to calculate the Malmquist productivity indices for the period 2004-2020:

- inputs

x_{o1} – total assets (SE436) [EURO],

x_{o2} – agricultural area (SE025) [ha],

x_{o3} – number of full-time employees (SE010) [AWU],

- effects

y_o – total production value (SE131) [EURO].

Next, the DEA method was used to assess the relative efficiency of farms in individual economic size classes. The analysis of farm efficiency using the DEA method was carried out using a set of inputs and outputs identical to those in the case of the Malmquist index. The inputs and outputs defined in this way were subjected to productivity analysis. A model oriented towards maximizing effects with constant scale effects was used to analyze efficiency.

Considering n objects that consume k inputs and obtain l effects using them, the data on inputs and effects can be presented in the form of the following matrix of dimension $\times (k + l)$:

$$\underbrace{\begin{bmatrix} x_{11} & \dots & x_{1k} \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \\ x_{n1} & \dots & x_{nk} \end{bmatrix}}_{\text{nakłakł}} \underbrace{\begin{bmatrix} y_{11} & \dots & y_{1l} \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \\ y_{n1} & \dots & y_{nl} \end{bmatrix}}_{\text{efekty}} \qquad (5)$$

In order to assess the technical efficiency of a certain fixed object N ($1 \leq N \leq n$), the following conditions will be formulated concerning the effects and then the inputs obtained by object N in relation to the remaining decision-making units. The aim of the model is to proportionally reduce the inputs without reducing the effects. Mathematically, this can be reduced to the following notation:

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

$$\lambda_1,\dots,\lambda_n \geq 0$$

$$\left.\begin{array}{c} \lambda_1 y_{11} + \dots + \lambda_n y_{n1} \geq y_{N1} \\ \vdots \\ \lambda_1 y_{1l} + \dots + \lambda_n y_{nl} \geq y_{Nl} \end{array}\right\} \text{ effects do not decrease} \qquad (6)$$

$$\left.\begin{array}{c} \lambda_1 x_{11} + \dots + \lambda_n x_{n1} \leq \theta \cdot x_{N1} \\ \vdots \\ \lambda_1 x_{1k} + \dots + \lambda_n x_{nk} \leq \theta \cdot x_{Nk} \end{array}\right\} \text{ expenditure decreases by } \theta \text{ times} \qquad (7)$$

The above model has the following solution:

$$\begin{array}{l} \lambda_i = 0 \quad i \neq N \\ \lambda_N = 1 \\ \theta = 1 \end{array} \qquad (8)$$

If there is no solution such that $\theta \neq 1$ decision object is considered efficient. Otherwise, the value $1-\theta$ shows how much the inputs can be reduced without reducing the effects.

To introduce variable scale effects into the model, an additional condition is assumed:

$$\lambda_1 + \ldots + \lambda_n = 1 \qquad (9).$$

The DEA method is distinguished by the estimation of the relative efficiency of an enterprise without assuming a certain form of function linking inputs to the obtained effects.

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

- the productivity level of each unit examined,

- achievable level of production (reduction in inputs) assuming that optimum production capacity is achieved,

- benchmark units with the best use of inputs.

6. STRUCTURE OF THE PAPER

The structure of the paper results from the adopted research problem and is closely related to the main objective of the paper and the scope of the paper. The paper consists of the following main parts: 1. introduction; 2. objective, research hypotheses and research methodology; 3. theoretical part including review of literature on agricultural efficiency; 4. empirical part including results of own research. The paper concludes with a summary and conclusions and a bibliography. A detailed plan of the work is presented below:

Introduction

1. Objective, subject and research methodology

1.1. Objective and research hypotheses

1.2. Research methodology

2. Theoretical and practical aspects of efficiency in agriculture

2.1. Definition of the concept of management efficiency

7. BRIEF CHARACTERISTICS OF THE CHAPTERS OF THE WORK

The **introduction** to the paper presents an introduction to the research issue and the rationale for the research conducted. **Chapter one** presents the aim and scope of the study, formulates the research hypotheses and presents the research methodology.

The second chapter, based on a literature review, offers a general overview of issues related to farming efficiency in agriculture. Attention is drawn to the multiplicity of approaches to understanding this concept of the nature of efficiency, resulting from the different ideological foundations appropriate to different trends in economic theory. Efficiency can be considered from a broad perspective, encompassing multiple dimensions—economic, social, and environmental—as well as dynamic and static approaches. This results in the need for a multi-aspect assessment of the effects of the activities of economic entities but also taking into account many factors determining its level in the analysis of efficiency. A review of selected definitions of "efficiency" is presented, which show a diverse approach to this issue.

However, the most common problem in the definitions presented is the relationship between the effects obtained and the inputs involved, the problem of the most optimal allocation of resources between different applications in the sense of the Vilfredo Pareto optimum, and the ability of the firm to adapt to the changing environment. The further part of the chapter also emphasizes the need to disaggregate the concept of overall efficiency, particularly when assessing farm efficiency, by considering both technical and economic factors. Additionally, methods for measuring efficiency in agriculture are presented, addressing both measurable and non-measurable goals, as well as various types of efficiency relevant to farm evaluation. The chapter concludes with an overview of the primary sources of efficiency improvement for farms, including

both exogenous and endogenous factors, while considering contemporary agricultural functions and sustainable development principles.

The third chapter presents the characteristics of the studied farms. The equipment of the studied farms with the basic factors of production: land, labor and capital, and their changes over the period analyzed are presented. The relations of production factors are also presented. It is noted that the mutual relations of production factors are the basic condition for the efficiency of the production process. Particular focus is placed on two key relationships: capital-to-labor and labor-to-land ratios. This results from the observed changes in the relations of production factor prices, where in developed countries the relatively most expensive production factor is labor. Consequently, labor is increasingly being replaced by capital. Additionally, developed countries show a trend of decreasing labor-to-land ratios, leading to structural changes in agriculture and an increase in farm sizes. The effect of these processes is structural changes in agriculture resulting in an increase in the size of farms. Next, the organization of production, technical efficiency of production, economic results and cost structure as well as debt and financial liquidity in the studied farms are presented. The economic and financial situation, organization of production and relations of production factors are of fundamental importance in shaping the efficiency of management. The analysis is conducted for farms differentiated by economic size.

Chapter four investigates the factors influencing the economic efficiency of the studied farms. First, an analysis of efficiency was carried out using partial indicators concerning the efficiency and profitability of production factors. This is followed by an examination of the determinants affecting selected partial indicators of economic efficiency. Then, the results of the analysis of changes in the efficiency of the examined farms in the analyzed period were presented. This analysis used the Malmquist index, and the results

of the analysis were presented for individual classes of the economic size of the examined farms. Then, an analysis of the technical efficiency of the examined farms in individual classes of economic size was carried out using the DEA method. These analyses reveal differences in management efficiency among the studied farms across economic size classes, highlighting the significance of economic size in shaping agricultural management efficiency. Chapter four is the core of the paper, directly addressing the research aim and hypotheses.

The main part of the work ends with the chapter titled **"Summary and conclusions".**

8. RESEARCH CONTRIBUTION TO THE DEVELOPMENT OF SCIENTIFIC KNOWLEDGE AND RECOMMENDATIONS FOR STAKEHOLDERS:

The conducted research allowed us to draw attention to the following processes occurring in the area of economics and organization of farms:

1. An intensive process of substitution of labor with capital was found. These trends indicate the existence of a process of "pushing out" labor from agriculture through the substitution of labor with capital, which should have a positive impact on reducing the alternative costs of using the farmer's and his family's own labor and reduce the costs of remuneration of hired workers. Assuming the possibility of using "released" labor resources in non-agricultural activities, this should have a positive impact on the level of disposable income of the farmer's family, thus increasing its accumulation and consumption capabilities. Therefore, agricultural and rural development policies should implement instruments that encourage farmers to seek non-agricultural sources of income. The country's economic development is also important for this process of substituting capital for labor. In particular, the low level of unemployment makes it possible to "extract" labor from agriculture.

2. The growing importance of the balance of subsidies and taxes for operational activity in shaping the income from a family farm was found, which suggests a growing dependence of the income situation in agriculture on public aid. A very high share of the balance of subsidies and taxes for operational activity in shaping the income from a family farm was found in the smallest ES1 and largest ES6 farms. In the case of ES1 farms, this may indicate the social nature of this type of farm, focused to a greater extent on self-supply than production for sale. In turn, ES6 farms may be more sensitive to macroeconomic factors, such as the level of agricultural prices, interest rates, and the level of wages. These farms use hired labor to a greater extent and therefore their nature may be less "family-like" than in other size classes. This would also suggest that a family farm is more resilient to environmental crises.

3. The analysis of the debt and financial liquidity of the surveyed farms indicates that the dominant source of financing was equity capital, which indicates farmers' aversion to financial risk related to debt. The reluctance of farmers to use external sources of financing for business activity may limit the development and modernization processes. Moreover, the imperfections of agricultural financial markets described in the literature, related to limited access to credit for farmers, may intensify the limitations of agricultural development. A higher level of debt was found in larger farms. This may indicate that larger farms have easier access to external sources of financing. This allows larger farms to accumulate capital more easily, which in the future may lead to increasing disproportions between larger and smaller farms. To address these issues, agricultural policy should focus on reducing financial market imperfections and implementing mechanisms that support development and modernization, particularly for smaller farms.

4. With increasing economic size, most analyzed indicators of management efficiency showed improvement, underscoring a positive

relationship between economic size and efficiency. The increase in the profitability of one's own work, which determines the level of farmer's satisfaction with the work performed, is of particular importance.

5. Analyzing the determinants of productivity and profitability of production factors, a positive impact of the growth of economic size and technical equipment of labor was found on most of the analyzed partial indicators. This indicates a significant role of substitution of labor with capital. In combination with the positive impact of the growth of economic size, it indicates a path of improving the efficiency of management through the concentration of production and an increase in the technical equipment of labor resources. This process will lead to structural changes in agriculture, consisting in reducing the number of farms and increasing their production and economic potential, as well as "pushing out" the excess labor force from agriculture to nonagricultural sectors. However, these processes should be monitored as they may have negative social effects on rural areas, e.g. depopulation, loss of village vitality.

6. The analysis of management efficiency using the nonparametric DEA method showed that the Malmquist index level increased with the increase in economic size. Decomposition of the Malmquist index into two components showed that in farms of all economic size classes the reason for changes in the total productivity index was the change in production (technological) possibilities, and not the change in the way of using the means possessed by farms within the available technology (except for ES6 farms, where no changes were noted). The efficiency gap lies in the combination of available production factors.

7. The study found that technical efficiency improved with increased economic size. It was also found that the differences in technical efficiency between the studied economic size classes of farms deepened throughout the

research period. This indicates growing disproportions between farms of different economic sizes. This supports the hypothesis that small farms struggle to achieve the same level of efficiency as larger farms. In the long term, conducting agricultural activity at low efficiency will not allow small farms to function and develop.

8. The analysis also indicated a possible reduction in inputs at a given level of production. The data indicate a possible level of reduction in input labor and total asset inputs. However, a much deeper level of reduction in labor inputs was indicated. This emphasizes the need to optimize the equipment of farms with labor and capital resources in relation to the scale of production. This optimization should consequently lead to an improvement in the labor-to-capital ratio. It is worth noting that the models developed for individual years did not suggest the possibility of reducing the involvement of the land factor in the production process. This highlights the importance of land in the development processes of farms. The main barrier to the development of farms may be the lack of access to land, which allows for increasing the area of agricultural land through purchase or lease. In agricultural policy tools, attention should be paid to the possibility of easier land transfer between farms and the strengthening of lease as a form of land disposal.

9. DIRECTIONS OF FURTHER RESEARCH

The considerations presented in the paper show that increasing the scale of production on farms and substituting labor with capital are the right strategy for the development of agriculture. However, the concentration of production may pose threats to the natural environment and the vitality of rural areas. For this reason, further research should concern the identification and quantification of positive and negative external effects of such a strategy. Developing appropriate mechanisms and tools of agricultural policy in the field of

improving the efficiency of management in agriculture and limiting the unfavorable phenomena associated with it is particularly important.

It is also worth paying attention to the role of small farms in further research, especially in the context of providing public goods. The growing disparities in economic efficiency between small and large farms should be emphasized. This will result in a reduction in the number of small farms. This raises further questions for further research: will the resources released from small farms be able to "flow" to larger ones and strengthen them, what effects will the "falling out" of small farms have on the vitality of rural areas, can farms with a significant increase in the scale of production be friendly to the natural environment?

10. LIMITATIONS OF OWN RESEARCH

The limitations of the research conducted were the lack of consideration of qualitative criteria as factors determining management efficiency, such as: age, gender, education and experience of the farmers. These criteria are often mentioned in the literature as factors influencing the adoption of new technological solutions or organizational changes that determine efficiency. These limitations result from the specificity of FADN data and the lack of access to such data. Further research should be conducted using on-farm surveys. This would provide information on the socio-economic characteristics of farmers.

Analyses could also be conducted taking into account not only the economic size of farms but also the directions of production. The direction of production of a farm is also an important factor determining efficiency. It is assumed that such directions of production as poultry production or vegetable production may be characterized by a higher efficiency of using production factors.

Another factor that affects the efficiency of management in agriculture is the intensity of production (the level of expenditure incurred per unit of area).

Farms that produce intensively may also achieve higher efficiency of management. Separating groups of farms with different production intensities would also allow a more detailed analysis of this issue. However, such analyses would require access to individual farm data. The generally available FADN database does not provide such solutions.

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