DETERMINANTS OF THE USE OF SUBSIDIES FOR THE DEVELOPMENT OF RURAL AREAS BY SMALL AGRICULTURAL HOLDINGS: CASE OF POLAND

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Abstract. The study analysed factors influencing farmers' decisions on the use of subsidies for rural development in small farms in Poland. The study included technical, economic and social features of 1,485 farms with an area of up to 10 ha of UAA participating in the FADN system in 2016. Applying an econometric probit model, variables were identified that should be taken into account when developing rural development policy aimed at increasing the likelihood of using subsidies in farms and thus fostering the achievement of the CAP objectives. The study showed that four variables were significant of eleven analysed. They presented a good fit into the model, as evidenced by the used measures for assessing the quality of the model (coefficient R^2_{calc} and ROC curve). It was found that the decision to use subsidies for rural development in small farms in Poland depends on the farmer's level of education, the quality of the land, the area of arable land and the efficiency of agricultural activity. The chance of using subsidies unrelated to production in small farms grows with increasing area of arable land. On the other hand, the chance of using subsidies for rural development decreases with the increase in the farmer's level of education, better soil quality and increased agricultural productivity. The presented research shows that the characteristics of farmers (education), technical characteristics of farms (soil quality, agricultural area) and the agricultural system (agricultural productivity) are important aspects that should be taken into account in the creation of a new conceptual framework for rural development policy to intensify use of subsidies by farmers from small farms. A comprehensive approach to agricultural development programs, including a whole range of factors that influence farmers' decisions on the use of subsidies for rural development will bring tangible results in the form of significant and sustainable development.

Key words: subsidies, rural development, small farms, logit model.

JEL code: Q18, Q12, R58.

Introduction

Small farms, as the history of economic development indicates, even in a highly technically developed agriculture remain a key player in food production and job creation in rural areas (Czyzewski A., Stepień S., 2013). They also play an important role in the delivery of public goods, social services and environmental services, while contributing to soil conservation, watershed services, biodiversity, and carbon sequestration, as well as poverty reduction and food security (FAO, 2004). Small farms are an important element of European rural areas. However, without a properly targeted agricultural policy and an active promotion the development of small farms, it will be difficult for them to survive in the current reality. The recent debates on the shape of the CAP after 2020 clearly indicate that this policy should be more flexible. Member States are to be given more discretion as to how distribute their allocations under the CAP. This will allow them to develop customized programs responding to the problems of farmers and wider rural communities in the most effective way (European Commission, 2017). Most small farms without public support have no chance of surviving on an increasingly demanding and competitive market. To increase their income, they must either go to high-value agricultural production or increase the share of income from non-agricultural sources (Gulati A., Delgado M. N. C., Bora S., 2005). This is possible, inter alia, thanks to the support of agriculture under the second pillar of the CAP. Farmers have the option of

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applying for non-production subsidies targeted at supporting rural development. These subsidies include, among others, agri-environmental subsidies, subsidies for areas with unfavourable conditions for agricultural production, agricultural advisory services, subsidies to improve the quality of agricultural products, training, afforestation and maintaining the ecological balance of the forest environment. So far, a number of studies have been carried out relating to the issue of subsidies in agriculture. The research issues addressed included allocation of subsidies in agriculture, impact of subsidies on production and economic results of agricultural holdings, environment, rural community, development of rural areas, as well as identification of factors determining their use (Lakner S., 2009; Fan B., 2011; Rizov M. et al., 2013; Mary S., 2013; Kazukauskas A., Newman C., Sauer J., 2014; Li J., Xu Y., 2015; Cimpoeis L., 2015; Pechrova M., 2015; Balezentis T., De Witte K., 2015; Sun W., Zhai Y., 2016; Ferto I., Zoltana B., Varga A., 2016; Kravcakova V., Kotulic, 2016; Capitanio F. et al., 2016; Soliwoda M., 2017; Wieliczko B., Kurdys-Kujawska A., Herda-Kopanska J., 2017; Wieliczko B., Kurdys-Kujawska A., Sompolska-Rzechula A., 2018; Kurdys-Kujawska A., Sompolska-Rzechula A., 2018; Li J., 2018; Lemanowicz M., 2018; Lakner S., 2018). It seems, however, that the problem of factors determining farmers' decisions on the use of subsidies not related to production has not yet been sufficiently examined. There are many programs in Poland supporting small farms. The question of who benefits from them is worth answering. A better understanding of the factors that determine farmers' decisions regarding the use of non-production subsidies is key to creating effective farmer support programs. Considering the importance of this topic, the main goal of this research study is to identify and assess factors affecting farmers' decisions on the use of subsidies for rural development in small farms in Poland.

Material and methods

The study used farm data that was available in the Polish Farm Accountancy Data Network (FADN). For the research, 1485 farms classified as very small and small were selected. These are entities in which the area of agricultural land amounts to No more than 10 ha. The owners of farms mostly had basic vocational education in agriculture (38.31 %). At the same time, every fifth farmer had basic vocational non-agricultural education, non-agricultural secondary education or agricultural secondary education. Only 4.71 % of farmers in the sample had basic education. Persons managing small farms were on average 49 years old. The average area of land used was 6.69 ha. In more than half of small farms, agricultural income was equal to or exceeded PLN 15,462 (app. EUR 3.600). A significant part of farms (97.71 %) demonstrated the ability to self-finance their activities and create savings as part of operating activities. To a lesser extent, the surveyed entities used loans or borrowings (15.21 %). In 27.28 % of the surveyed farms, No investments were made. On the other hand, in 34.41 % of farms the value of sold fixed assets was higher than the value of purchased and produced fixed assets. Non-productive subsidies received 53.73 % of the farms covered by the study. In more than half of them, the amount of subsidies received was above PLN 1,534 (app. EUR 360). The value of received subsidies showed very large variation (coefficient of variation of 254 %). The minimum amount of subsidies was PLN 188 (app. EUR 45), while the maximum amount was PLN 100,000 (app. EUR 23.300). To estimate the likelihood of small farmers benefiting from subsidies for rural development, logistic regression was applied¹. In linear regression models, a linear relationship is assumed between the explained variable (Y) and the explanatory variable (X). The

¹ A detailed description of logit modelling along with the assessment of its quality can e.g. in Kurdys-Kujawska A., Sompolska-Rzechula A. (2018), Determinants of Farmers Demand for Subsidized Agricultural Insurance in Poland, Proceedings of the 2018 International Conference "Economic Science for Rural Development 2018", No 47, Jelgava, LLU ESAF, pp. 164-173 DOI 10.22616/ESRD.2018.019.

dependent variable is of a continuous type. However, in the case of logistic regression, it is assumed that the dependent variable is dichotomous or binary, i.e. $Y_i = 0$ or 1 for all $i = 1, \dots, n$. The regression model using the logistic function has the form:

$$p_i = \frac{\exp(\beta_0 + \beta_1 X_i)}{1 + \exp(\beta_0 + \beta_1 X_i)} \quad (1)$$

where: β_0, β_1 are model parameters, X_i independent variables that can be both qualitative and quantitative, p_i is the probability that $Y_i = 1$. After linearization of equation (1), we obtain (Fratczak E., 2018):

$$\frac{p_i}{1 - p_i} = \exp(\beta_0 + \beta_1 X_i) \quad (2)$$

In this case $\frac{p_i}{1 - p_i}$ is called odds, and the log odds function is called logit. The form of the logit-based model is as follows:

$$p'_i = \ln\left(\frac{p_i}{1 - p_i}\right) = \beta_0 + \beta_1 X_i \quad (3)$$

Odds are defined as the ratio of the likelihood of occurring of an event and the probability of an event not occurring. Due to the fact that the logistic function is nonlinear, the direction coefficient β_i represents the change in logic caused by the change of X by one unit. In the context of odds, the interpretation of the directional coefficient is as follows: for X variable having a continuous value $\exp(\beta_i)$ is an increase in odds $Y = 1$ for each unit of growth of X variable; for X variable having the dichotomic value $\exp(\beta_i)$ is an increase in the odds that $Y = 1$, when $X = 1$ in relation to the situation when $X = 0$.

For the study selected were variables, which may influence farmers' decisions to use subsidies for rural development. The model uses a set of explanatory variables and the dependent variable is the receipt of subsidies for rural development (Y). Explanatory variables are: X_1 - farmer's level of education (1- elementary, 2 - non-agricultural basic vocational, 3 - agricultural basic vocational, 4 - non-agricultural secondary, 5 - agricultural secondary, 6 - non-agricultural tertiary, 7 - agricultural tertiary); X_2 - the age of the farmer (in years); X_3 - own work inputs (FWU); X_4 - soil quality index; X_5 - area of agricultural land (ha); X_6 - income from agricultural activity (PLN); X_7 - the ability to self-finance activities and create savings as part of operating activities (yes -1; No - 0); X_8 - total liabilities (yes - 1; 0 - no); X_9 - profitability of production (%); X_{10} - gross investment value (PLN); X_{11} - gross value added (PLN).

Empirical results

The analysis of the results of the estimation of the model parameters of the probability of using subsidies for rural development by small farms in Poland showed a statistical significance of four variables: X_1 - the level of education of the farmer; X_4 - soil quality index; X_5 - area of agricultural land (ha); X_{11} - gross value added (PLN). The empirical results obtained from the estimation of the logit model are presented in Table 1.

Table 1

Evaluation of logit model parameters

Variable	Variable	Parameter valuation	p-value	Odds ratio
	constant	2.053012	-	-
X_1	Farmer's education level	- 0.084644	0.036818	0.9188
X_4	Soil quality index	-3.620743	0.000001	0.0268
X_5	UAA	0.22309	0.000001	1.2499
X_{11}	Gross value added	-0.00002	0.002039	0.9999

Source: authors' calculations

Table 2 present the accuracy of farm classification based on the elaborated model.

Table 2

Accuracy of the logit model classification

Classification of holdings based on the logit model	Actual classification of the farm		Overall accuracy of the classification
	$y_i = 1$	$y_i = 0$	
$\hat{y}_i = 1$	627	204	74.47 %
$\hat{y}_i = 0$	171	483	
Sensitivity, specificity	78.75 %	70.31 %	

Source: authors' calculations

The assessment of the quality of the model was based on the value of the coefficient R^2_{calc} (74.47 %) and the ROC curve (Figure 1). The results indicate that the classification based on the model is much better than random. The results of the Hosmer-Lemeshow test indicate that there are No significant differences between the empirical and theoretical numbers that result from the estimated logistic regression models. The model has a high ability to detect objects that do not have a given feature, i.e. the use of subsidies for rural development, as evidenced by high sensitivity values (78.75 %) and model specificity (70.31 %).

Source: authors' calculations

Fig. 1. The ROC curve for model

The area under the ROC curve equals 0.82 and is significantly larger than 0.5 (at a significance level greater than 0.000001).

In the model, the negative, statistically significant impact on the dependent variable is exercised by: farmer's level of education, soil quality index and gross value added. This means that the higher the farmers' level of education, the higher the soil quality index and the higher the gross value added, the less likely they are to use subsidies for rural development by small farms in Poland. However,

the area of agricultural land has a positive, statistically significant impact on the dependent variable. This means that the larger the area of agricultural land, the higher the probability of using subsidies not related to production.

Discussion

The research results bring new insights into the considerations concerning the identification of factors affecting the probability of using subsidies directed to rural development unrelated to production by small farms in Poland.

Assuming the invariability of the other factors included in the model, first in relation to the farmer's education, the results indicate that the level of education determines decisions related to making use of subsidies by small farms. With the increase of the farmer's level of education by one category, the chance of benefiting from subsidies for rural development decreases by 8.11 %. Better educated farmers with higher qualifications are more likely to look for better paid work outside agriculture. The possibility of shifting labour resources and off-farm employment make them less interested in undertaking activities for the development of a farm. On the other hand, farmers with lower education, without appropriate qualifications, training and skills may have difficulties in seeking work outside agriculture. The possibility of using these subsidies allows them to adapt the farm to changing market demands, improve the quality of agricultural products, or, as in the case of LFA subsidies, compensate for lower incomes. Thus, subsidies may weaken non-agricultural activity of small farm owners.

Secondly, small farms with higher soil valuation rates are less likely to benefit from non-production subsidies. An increase in the soil quality index by one unit means that the chance of using these subsidies by small farms is down by 97.32 %. Higher production value of soil encourages small farm owners to make full use of its natural resources, which contributes to increasing agricultural income. In addition, these results confirm that subsidies for the development of rural areas, in particular subsidies for farms located in less favoured areas are an important tool for compensating for the losses in agricultural incomes and may also condition their further functioning.

Thirdly, the efficiency of agricultural activity is also an important determinant of subsidizing the development of small farms. At the same time, as the results indicate, the chance to use non-production subsidies will remain almost unchanged, with the increase of gross value added by PLN 1,000. This means that irrespective of economic performance, which is a reflection of production efficiency, small farms are willing to use subsidies to improve the overall performance of the farm, including the increase in agricultural productivity.

Fourthly, the increase in the area of agricultural land by 1 ha enhances by 25 % the chances of using subsidies unrelated to production. The lack of suitable land acreage may force farmers to undertake work outside of the farm. The area owned is mainly used for cultivation only for the needs of the farmer's household. This may suggest a lower inclination of farmers from farms with a smaller area to undertake activities for the development of their farm.

Conclusions

The study presents the results of a research on the identification and assessment of factors affecting farmers' decisions on the use of subsidies for rural development in small farms in Poland. Based on literature studies and the availability of data, explanatory variables were selected. The study included eleven variables related to technical, economic and social characteristics of small farms. Based on the conducted research, it can be concluded that the level of farmer's education,

soil quality and gross value added reflected in the effectiveness of agricultural farms have a significant negative impact on the use of non-production subsidies by small farm owners. The chance of using subsidies unrelated to production by small farms in Poland decreases by 8.11 % with an increase of the farmer's level of education by one category, and will decrease by 97.32 % with a growth in the soil quality index by one. On the other hand, it remains almost unchanged, with the increase of gross value added by PLN 1,000. In turn, the area of agricultural land has a significant positive impact is the use of subsidies in small farms. Increasing the area of agricultural land by 1 ha raises by 25 % the chance of using non-production subsidies.

The obtained results have a cognitive and an application-oriented character. They help to enhance the knowledge of the factors determining the decisions of small farms on the use of non-production subsidies. They can be a contribution to further research on subsidizing agriculture and they can also be used by public institutions responsible for promoting and formulating rural development policy.

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