

EFFECTIVENESS OF PRODUCTION POTENTIAL OF FARMS AS A FACTOR DETERMINING THE USE OF SHORT-TERM SOURCES OF FINANCING

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Annotation: Financial decisions of farmers which are reflected in the financing structure of agricultural activities indicate the predominance of equity capital. In the structure of liabilities, however, long-term capital prevails. However, an increase can be noted in financing of agricultural holdings with short-term capital, mainly due to the increased involvement of trade credit. The main objective of the study is to assess the impact of factors related to the farm's production potential and the efficiency of its use on the probability of making a decision to involve short-term capital to finance agricultural production. The study scope covered commercial farms in Poland. The basic data source were the financial results of 12,027 individual farms, which in 2015 conducted agricultural accounting for the needs of the Polish Farm Accountancy Data Network. The logistic regression model was used to determine the factors affecting the financing of agricultural activities with short-term foreign capital. The dependent variable was the probability of using short-term foreign sources of financing by the agricultural holding in Poland in 2015. The obtained results show that factors related to the farm's production potential and the effectiveness of its use have an influence on the decision to finance agricultural activity with short-term foreign capital. The parameters of the constructed model indicate that there is a positive relationship between: the economic size of the farm, the area of agricultural land, the value of assets (minus land, permanent crops and production quotas), investments on the farm and the marketability of production, and the use of short-term financing sources. However, the higher the farm's ability to self-finance operations and create savings, the lower the likelihood that a given entity will decide to involve short-term capital in financing of agricultural production.

Key words: logistic regression, short-term liabilities, agricultural holdings

JEL classification: Q1, Q12, Q14

1. Introduction

Our previous research has shown that the productive potential (area of agricultural land, share of leased land in the area of agricultural land, total labor input and technical work equipment) affects decisions regarding the selection of external sources of financing agricultural activities (Strzelecka, Zawadzka and Kurdyś-Kujawska, 2018). We have also established that in the structure of liabilities of entities from the agricultural sector, long-term liabilities prevail (Zawadzka and Strzelecka, 2018; Zawadzka and Strzelecka, 2014; Strzelecka, Kurdyś-Kujawska and Zawadzka, 2019), which confirms the results of research that are presented in the literature (Mądra, 2010; Felczak and Domańska, 2014). Agricultural activity is associated with a long production cycle, the effects of which depend to a large extent on environmental factors. The long production cycle, in turn, requires sources of financing, obtained both on the financial and commodity markets, hence farmers' activity on the credit market (Zawadzka, 2012). Agricultural holdings make limited use of short-term external capital (including trade credit) for financing of agricultural activity (Zawadzka and Strzelecka, 2018). The research results concerning the use of trade credit by farms in Poland show, on the one

hand, a growing interest in this form of borrowing, and on the other hand, that these entities are more often lenders of commercial credit, than its recipients (Zawadzka and Kurdyś-Kujawska, 2018). It seems interesting, therefore, to establish the factors that affect the use of short-term external capital, including trade credit, by farms. The effect of skillful use of external sources of financing by agricultural holdings may be an increase in labor productivity and income and an improvement of their competitive position on the market (Mądra, 2008). Linking this issue with the effectiveness of using the production potential of farms seems interesting from a scientific point of view. The production potential of agricultural enterprises includes land, labor and capital resources. It conditions, therefore, the development opportunities for agriculture (Poczta and Średzińska, 2007), and thus determines the need of financing production with external funds (Daniłowska, 2007). At the same time, land and capital resources can be the basis for securing a loan. A higher production potential may contribute to increasing the use of external capital in the structure of financing sources of an agricultural enterprise, including short-term sources. The basic objective of the research is to assess the impact of factors related to the farm's production potential and the effectiveness of its use on the probability of making a decision on the involvement of short-term capital to finance agricultural production.

2. Materials and Methods

The basic source of data were statistics collected as part of a system for collecting and using farm accountancy data (FADN). The test sample included 12,027 individual farms¹², which in 2015 participated in the Polish FADN system. The logistic regression model was used to determine the factors affecting the financing of agricultural activities with short-term foreign capital. It allows to study the impact of many independent variables x_1, \dots, x_k on the dependent variable Y . The response variable was the probability of using short-term foreign sources of financing by the agricultural holding in Poland in 2015. It is a dichotomous variable that accepts two possible values: 0 - no given feature (6,206 cases), 1 - having a given feature (5,821 cases). The selection of variables for estimating the model parameters was made on the basis of current research results on the factors affecting the use of outside capital, including short-term external capital, by agricultural holdings. On the basis of substantial grounds and the available data, the following variables were selected to assess the analyzed phenomenon, relating to the production/manufacturing potential of the farm and the efficiency of its utilization¹³: x_1 - economic size (in terms of standard output in EUR: 1 - very small, 2 - small, 3 - medium-small, 4 - medium-large, 5 - large, 6 - very large), x_2 - total area of agricultural land (ha), x_3 - total workload (own and paid labor) (AWU)¹⁴, x_4 - value of assets excluding value of land, permanent crops and production quotas (PLN thousand), x_5 - livestock density (LU/ha), x_6 - equipment of labor in land (ha/AWU), x_7 - technical equipment of land (thousands of PLN/ha), x_8 - technical equipment of labor (PLN thousand/AWU), x_9 - type of farm (dichotomous variable, 1 - mixed, 2 - specialized), x_{10} - marketability of production (%), x_{11} - gross investment (dichotomous variable, 1 - yes, 0 - no), x_{12} - land productivity (thousand PLN/ha), x_{13} - labor

¹²For the purposes of the study, from the population of individual farms, which in 2015 participated in the Polish FADN system (12,105 farms), units with a arable land less than 1 ha were eliminated. These entities, in terms of production and economic results, differ significantly from average units (Wrzaszcz and Prandecki, 2015).

¹³Variable selection was made on the basis of (Poczta, Średzińska and Standar, 2008; Poczta and Średzińska, 2007; Zawadzka and Strzelecka, 2014; Strzelecka, Zawadzka and Kurdyś-Kujawska, 2018; Zawadzka, Szafraniec-Siluta and Ardan, 2016; Daniłowska, 2007; Orłowska, 2017).

¹⁴AWU (*Annual Work Unit*) - work unit, equivalent to 2,120 working hours a year (Floriańczyk, Osuch and Płonka, 2016).

productivity (thousand PLN/AWU), x_{14} - Family Farm Income/FWU¹⁵ (PLN/FWU), x_{15} - Cash-flow (2) (PLN) - the ability of the holding to self-finance activities and create savings. In the analyzed group of entities, the minimum area of agricultural land was 1 ha, and the maximum area was 703.43 ha. In more than half of farms, the area of agricultural land was 24.44 ha, the value of assets minus land, permanent crops and production quotas was 453.55 thousand PLN, and the family farm income was at the level of 28.07 thousand PLN. In half of the analyzed farms the livestock density was small and amounted to 0.74 LU/ha. This might suggest a focus on crop production in the surveyed farms. The total labor expenditures varied widely and ranged from 0.11 AWU to 29.65 AWU. The index of technical equipment of land in more than half of farms amounted to 35.31 thousand PLN/ha, while the index of technical equipment of labor was 504.10 thousand PLN/AWU. The percentage ratio of the amount of commodity production (intended for sale) on a farm to the amount of its full production ranged from 0.6% to 206.05%. In more than half of farms the commodity index was 87%. The production volume from one hectare of arable land in half of farms accounted for 5.12 thousand PLN. The amount of cash flows, which shows the ability of the farm to self-finance its activities and generate savings, amounted to PLN 53.16 in half of farms. In the analyzed group of farms, the value of cash flows varied. The difference between the minimum and maximum cash flows amounted to PLN 8,758.34. Table 1 presents descriptive statistics of variables that were included in the initial model.

Table 1. Descriptive statistics of independent variables adopted for the model

Variable	Average	Median	Minimum	Maximum	Range	SD	CV	Skewness
x_2	36.05	24.44	1.00	703.43	702.43	41.21	114.32	5.15
x_3	1.93	1.81	0.11	29.65	29.54	1.18	60.87	7.49
x_4	658.21	453.55	5.00	12,061.04	12,056.04	687.81	104.50	3.93
x_5	1.39	0.74	0.00	1,135.00	1,135.00	10.55	758.16	103.13
x_6	20.01	14.47	0.04	283.00	282.96	19.08	95.37	3.25
x_7	43.71	35.31	0.00	5,172.34	5,172.34	90.34	206.68	31.93
x_8	675.82	504.10	0.00	7,573.39	7,573.39	598.14	88.51	2.89
x_{10}	84.67	87.64	0.60	206.05	205.45	14.29	16.88	-1.14
x_{12}	9.84	5.12	-1.45	4,304.27	4305.73	60.47	614.75	41.60
x_{13}	112.67	77.42	-49.74	1,851.17	1900.90	115.80	102.78	3.62
x_{14}	48,470.54	28,072.31	-33,5624.25	12,457,894.33	12,793,518.58	144,967.93	299.08	55.05
x_{15}	76.90	53.16	-2,880.50	5,877.83	8758.34	148.85	193.58	7.73
Discrete variable								
x_1	Average	Number of farms in each economic size class						
		0	1	2	3	4	5	6
	3.21	239	3,311	3,780	3,164	1,503	30	239
Dichotomous variables								
x_9	Average	Number of mixed farms			Number of specialized farms			
	0.67	3,964			8,063			
x_{11}	Average	Occurrences 1			Occurrences 2			
	0.59	7,036			4,991			

Source: Own study based on FADN data, 2019

In order to find the best combination of factors significantly affecting the financing of agricultural activity with short-term external capital, the backwards elimination method was

¹⁵FWU (Family Work Unit) - equivalent to 2,120 working hours a year (Floriańczyk, Osuch and Płonka, 2016).

applied. Assessment of the significance of individual model parameters was made using z^2 Wald Test. The assessment of the degree of fit of the logistic regression model to the empirical data was carried out using the Cox-Snell R^2 , Nagelkerke's R^2 and Count R^2 . To assess the goodness of fit of the obtained model, the AUC - Area Under Curve value was used. The quality of the logistic regression model was also evaluated using ROC (Receiver Operating Characteristic Curves).

3. Results and Discussion

Based on the adopted research assumptions, using the backwards elimination method, subsequent predictors were eliminated from the initial model and the change in the value of the criteria adopted to assess the quality of the model was made. Finally, six independent variables were included in the final model. Results of the final model, evaluating the impact of manufacturing potential and the efficiency of its use on the use of short-term capital to finance agricultural production on farms in Poland are presented in Table 2.

Table 2. Results of the estimation of model parameters

Variable	Variable parameter	Standard error	z^2 Wald test	Significance level	Odds ratio
x_1 – economic size	0.458	0.033	193.707	<0.001	1.581
x_2 – arable land area	0.018	0.001	191.887	<0.001	1.018
x_4 - value of assets excluding value of land, permanent crops and production quotas	0.001	0.0001	195.085	<0.001	1.001
x_{10} - marketability	0.013	0.002	69.753	<0.001	1.013
x_{11} - gross investment	0.254	0.044	33.554	<0.001	1.289
x_{15} - Cash flow (2)	-0.003	0.000	175.239	<0.001	0.997
<i>Intercept</i>	-3.612	0.149	590.966	<0.001	0.027
AIC = 13,409.70					
Cox-Snell R^2 = 0.2356; Nagelkerke's R^2 = 0.3142; count R^2 = 0.7101					
AUC = 0.790 LR = 3,223.01 (df=6; p<0.01)					

Source: Own study based on FADN data, 2019

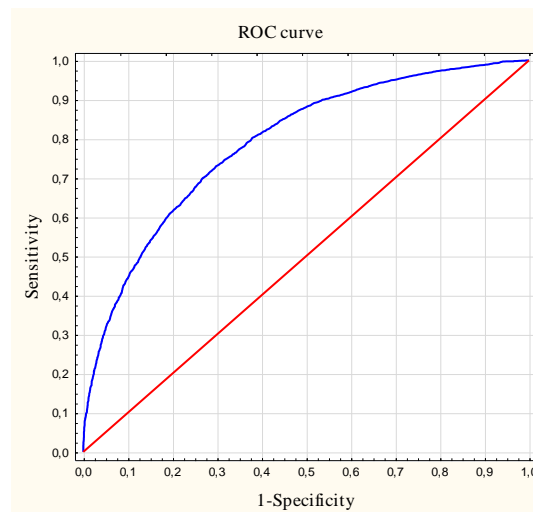
The estimated final model determining the impact of production potential and production and economic results on the probability of using short-term outside sources of financing by agricultural holdings in Poland has the following form:

$$Prob(Y=1) = A(0.458x_1 + 0.018x_2 + 0.001x_4 + 0.013x_{10} + 0.254x_{11} - 0.003x_{15} - 3.612) \quad (1)$$

where: $A(x) = \frac{e^x}{1+e^x}$ distribution function of logistic distribution

The model is statically significant at the 1% significance level. Based on the model, 71.01% of cases were correctly classified (*count* R^2 = 0.7101). The quality assessment of the constructed model was based on *Cox-Snell* R^2 (0.2356), *Nagelkerke's* R^2 (0.3142), as well as using the ROC curve, which is presented in Figure 1.

Figure 1. ROC curve for the model



Source: Own study based on FADN data, 2019

The area under the ROC curve (AUC) is 0.79, which indicates a good quality of the constructed model (field larger than 0.5).

The results indicate that in the model, the following factors have a statistically positive effect on the dependent variable: x_1 - economic size, x_2 - area of agricultural land, x_4 - assets excluding land, permanent crops and production quotas, x_{10} - marketability and x_{11} - gross investments. This means that the larger the economic size of agricultural holding, area of agricultural land, assets minus land, permanent crops and production quotas, marketability and gross investments, the higher the likelihood of using short-term outside sources of financing by agricultural holdings in Poland. On the other hand, a negative, statistically significant impact on the dependent variable had variable x_{15} - the ability of the farm to self-finance activities and create savings. Thus, the increase in the size of cash flows showing the farm's ability to self-finance operations and generate savings reduces the likelihood of farmers being ready to use short-term outside sources of financing. Assuming the invariability of the other factors included in the final model (*ceteris paribus*), in relation to the economic size of the farm, the results indicate that the economic size determines the use of short-term outside sources of financing. With the increase of the economic size by one class, the chance of using short-term foreign sources of financing increases by 58%. Agricultural holdings with a larger area of agricultural land have a larger chance to take advantage of short-term external financing. An increase in the area of agricultural land by 1ha means that the chance to finance with short-term external sources increases by 0.18%. The value of assets minus land, permanent crops and production quotas also determines the use of short-term outside sources of financing. The chance of their use will remain almost unchanged if current assets are increased by 1 thousand PLN. A 1% increase in the marketability of production increases the chance of using short-term foreign sources of financing by 0.13%. Implementation of investments in an agricultural holding increases the use of short-term foreign sources of financing by 28%. Along with the increase of the farm's ability to self-finance operations and create savings, the chance to use short-term outside sources of financing decreases by 0.3%.

4. Conclusion

The obtained results show that the factors related to the production potential of the farm and the efficiency of its use have an impact on the decision to finance agricultural activity with short-term external capital. The parameters of the constructed model indicate that there is a positive relationship between: the economic size of the farm, the area of agricultural land, the value of assets (minus land, permanent crops and production quotas), investments on the farm and marketability of production, and the use of short-term external sources of financing. However, the higher the farm's ability to self-finance operations and create savings, the lower the likelihood that a given entity will decide on the involvement of short-term capital in financing agricultural production. It would be interesting to investigate what sources of short-term financing are used by farmers, as well as to indicate, using qualitative studies, the factors determining decisions on the structure of short-term financing. This will be the subject of our further studies.

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