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SŁAWOMIR JUSZCZYK[*], ADAM ZAJĄC[**], ŁUKASZ MLECZKO[***], BARTOSZ KUBLIK[****]

[*]Warsaw University of Life Sciences – SGGW, Poland,
[**]Cardinal Stefan Wyszyński University, Poland,
[***]Alior Bank S.A., Poland,
[****]Cooperative Bank Ostrów Mazowiecka, Poland

FARM LOANING IN POLAND DURING THE COVID-19 PANDEMIC

Key words: farms, number of loans, demand for loans, COVID-19 pandemic, Poland

ABSTRACT. The study attempts to identify changes in the farm credit market in Poland during the Covid-19 pandemic. The research used the data of the Central Statistical Office and the Credit Information Bureau for the years 2017-2020. In the course of the research, three econometric models were constructed, explaining the number of loans to farms as well as the number of farmers' credit inquiries, illustrating the interest in external capital of farms during the pandemic. The program Statistica 13.3 was used. An analysis of the normality of the distribution was performed using the Shapiro-Wilk test. The Pearson correlation method was used to establish the existence of a correlation relationship between the variables. In order to construct the predictive models, the correlation calculus and the forward step regression calculus were used. The analysis covered all loans granted on a monthly basis in 2017-2020. In total, in this period, banks granted 245,607 loans to individual farmers and their volume amounted to nearly PLN 24 billion. In the course of the research it was found, inter alia, that the set of explanatory variables in the models may be a premise to introduce improvements in the lending policy of banks servicing agriculture in the form of tightening or liberalizing credit requirements. The research results can also be used by banks to plan future sales targets and interest income from these loans.

INTRODUCTION

Modernized farms are generally characterized by a greater need for credit, moreover, agribusiness enterprises, including farms, operating in the conditions of a market economy and a competitive environment, similarly to economic entities from other sectors, must modernize their activities and conduct investments adjusting production to market requirements [Grzegorzewska 2013].

In scientific studies it can be found that the activity of farms is financed mainly by equity [Zawadzka 2012, Juszczyk, Balina 2017]. However, the share of this capital in financing agricultural activities depends, among others, on the amount of disposable income earned and the propensity to resign from current consumer spending [Kulawik 2003]. Despite the fact that a farm has the capacity to generate a financial surplus, its size is often insufficient for current and investment needs. In such cases, it is necessary to use external financing sources, and the share of own financing in the structure of financing sources usually decreases along with the increase in the size of the farm [Kata 2011].

Decisions on the selection of the optimal financing structure for their activities must be made by individual farmers taking into account the specificity of agriculture, which includes, among others, generally long production cycles, as a result of which there are large discrepancies between the period of incurring inputs and the period of obtaining a return on investment [Wasilewski, Felczak 2013]. Another variable that farmers must take into account are fluctuations in the market situation, which affect the volume of demand and the achieved financial flows [Kata 2012].

The most frequently used external source of financing agricultural activity in Poland is a bank loan [Rosa 2014]. Such a choice may result, inter alia, from the lack of tax benefits due to financial costs, as is the case with enterprises [Felczak 2015]. In addition, individual farms usually have less opportunities than other economic entities to obtain capital from other sources, which is manifested by the inability to obtain it on capital markets [Bierlen at al. 1998]. The research conducted so far has established, inter alia, that well-indebted farms are characterized not only by higher return on equity, but also by higher financial efficiency of their own work [Józwiak 1999, Czerwińska-Kayzer, Poczta 2001].

RESEARCH MATERIAL AND METHODS

The aim of the research was to identify the relationship between major changes in macroeconomic factors and:

– the number of loans to farms in Poland (Y_1) and
– reported demand for agricultural credit, measured by the number of credit inquiries (Y_2).

Variables Y_1 illustrate the size of the effective demand for loans to farmers, while the Y_2 variable can be interpreted as a potential demand for loans from farmers. Explanatory variables are selected measures of macroeconomic activity of the economy, which are presented in Table 1. Potential explanatory variables are marked from X_1 to X_{19}, while the explained variables are Y_1 and Y_2.

The data for the analysis was collected in MS Excel 2016, the statistical analysis was carried out in Statistica 13.3 by Stat Soft. The level of significance was $p < 0.05$. Moreover, the analysis of the normality of the distribution was performed using the Shapiro-Wilk

Table 1. Potential variables adopted in the research

X_1	Price indices of consumer goods and services (previous year = 100)
X_2	X_2 Registered unemployment rate [%]
X_3	Average monthly salary in the national economy [PLN]
X_4	Average monthly nominal pension of individual farmers [PLN]
X_5	Average monthly nominal gross salary in the enterprise sector [PLN]
X_6	Average employment in the enterprise sector [thousand]
X_7	Retail sales of goods (constant prices) divided by sales in the corresponding period of the previous year multiplied by 100 [%]
X_8	Refinancing loan rate [%]
X_9	Rediscount rate [%]
X_{10}	Lombard loan rate [%]
X_{11}	Dynamics of wheat purchase prices (without seed) [%]
X_{13}	Dynamics of cattle purchase prices (excluding calves) [%]
X_{14}	Dynamics of pig purchase prices [%]
X_{15}	Dynamics of milk purchase prices [%]
X_{16}	Total sold production of industry (constant prices), analogous period of the previous year = 100%
X_{17}	Imports of goods (constant prices) [%]
X_{18}	General economic climate in manufacturing index [%]
X_{19}	Registered unemployed persons (as at the end of the year) [thousand]
Y_1	Number of loans granted to individual farmers [pices]
Y_2	Demand for credit measured by the number of credit inquiries from individual farmers [pices]

Source: own study

test. If the assumptions were met, the Pearson correlation method was used to establish the existence of a correlation relationship between the variables. In order to construct predictive models used to estimate the number of credits for agriculture in the following months and years and potential demand for these credits, the correlation account and the forward step regression analysis was performed. The analysis covered all loans granted on a monthly basis in the years 2017-2020, therefore 48 monthly series from the four-year research period were analyzed. During this period, banks granted a total of 245,607 loans for individual farmers and their volume amounted to PLN 23,833 billion. The source of research materials was data from the Credit Information Bureau and the Central Statistical Office in Poland.

The results of the conducted research may be used to estimate by banks and other interested institutions to approximate the impact of individual explanatory variable in subsequent periods on the explained variables. Their changes may be a reason for introducing improvements in the credit policy in the form of tightening or liberalizing credit requirements. The results of the research can also be used by banks to construct predictive models determining the future sales targets of banks.

FINDINGS

Table 2 presents the results of the analysis of variance, which was used to determine whether there is a statistically significant relationship between the variable Y_1 (number of credits) and the independent variables X_1-X_{19}. The research showed a relationship between the variable Y_1, i.e. the number of credits, and the set of predictors from X_1 to X_{19}, which was confirmed at the level of < 0.001. The next stage of the analysis was to clarify which independent variables affect Y_1 and what is the direction of this relationship. Table 3 presents the results of the forward step regression calculus indicative of these predictors.

Table 2. Analysis of variance – dependence of the dependent variable Y_1 on the set of predictors

Effect	Sum of squares	Number of degrees of freedom (df)	Mean square	F-test statistic	*p-value*
Regression	55,278,664.099	8	6,909,833.012	4.943	< 0.001
Rest	54,520,623.180	39	1,397,964.697	-	-
Total	109,799,287.278	-	-	-	-

Source: own research

In table 3 some values with an asterisk in the footnote indicate a low statistical value, and therefore indicate only the preliminary nature of some results and the need for further, more detailed inquiries on the subject matter. It should be noted that if the test probability (*p-value*) is lower than the critical significance level, usually 0.05, then in terms of probability it only entitles to ad hoc treatment as if the null hypothesis had been rejected. It is worth noting that the *p-value* is only a parameter of a statistical sample and does not fully express the probability of an alternative hypothesis. Moreover, it may not express the practical significance of the phenomenon studied, as a low value can be obtained even with small intergroup differences, if the sample size is very large, as in these studies. It can even be added that in economic life there are no perfectly zero effects, therefore in each pair of variables there are at least slight covariates. Thus the measure of the practical significance of the results seems to be the size of the effect, with the adopted

Table 3. Forward step regression analysis and the influence of the set of predictors on the number of credits for individual farmers (Y_1)

Time series (months) N = 48	Standardized coefficient		Non-standardized coefficient		t-Student statistics	*p-value*
	Beta	standard error	b	standard error		
Constant	-	-	86,773.319	39,807.510	2.180	0.035
X_1 Price indices of consumer goods and services (previous year = 100)	-0.557	0.246	-989.734	437.601	-2.262	0.029
X_4 Average monthly nominal pension of individual farmers [PLN]	0.522	0.261	10.972	5.487	2.000	0.053*
X_7 Retail sales of goods (constant prices) divided by sales in the corresponding period of the previous year multiplied by 100 [%]	-0.405	0.262	-107.367	69.558	-1.544	0.131*
X_{11} Dynamics of wheat prices (without seed) [%]	0.204	0.150	24.237	17.818	1.360	0.182*
X_{13} Dynamics of cattle prices (excluding calves) [%]	0.543	0.183	181.413	61.220	2.963	0.005
X_{14} Dynamics of pig prices [%]	0.764	0.196	52.935	13.569	3.901	< 0.001
X_{16} Total sold production of industry (constant prices), analogous period of the previous year = 100%	-0.400	0.218	-95.481	52.037	-1.835	0.074*
X_{18} General economic climate in manufacturing index [%]	0.926	0.234	114.610	29.000	3.952	< 0.001

* lower importance

Source: own research

confidence interval. Taking the above into account, in the course of the research it was found, inter alia, that the variable X_{18} entered the model, i.e. general economic climate in manufacturing index [%] ($p < 0.001$), X_{14} i.e. dynamics of pig prices [%] ($p < 0.001$), X_{13} i.e. dynamics of cattle prices (excluding calves) [%] ($p = 0.005$) and X_1 i.e. price indices of consumer goods and services (previous year = 100) ($p = 0.029$). The analysis also showed the impact of the X_{16} variable at the limit of significance, i.e. total sold production of industry (constant prices), analogous period of the previous year = 100% ($p = 0.074$), X_{11} i.e. dynamics of wheat prices (without seed) [%] ($p = 0.182$), X_7 i.e. retail sales of goods (constant prices) divided by sales in the corresponding period of the previous year multiplied by 100 [%] ($p = 0.131$) and X_4 – average monthly nominal pension of individual farmers [PLN] ($p = 0.053$). In the course of the research it was found that the increase in the general economic situation index (X_{18}) by 1 percentage point (p.p.) compared to the previous year was associated with an increase in the number of loans granted to individual farmers (Y_1) by nearly 115 per month. The improving economic situation resulted in an increase in the demand for agri-food products, which in turn enhanced to investments in farms. In the event of a change by one p.p. the variables X_{13} and X_{14} – dynamics of cattle prices (excluding calves) [%] and dynamics of pig prices [%] resulted in a change in the number of loans granted by nearly 53 and over 181 units per month, respectively. Thus it can be assumed that the growing purchase prices of agricultural products increase the income of individual farmers and thus improve their financial situation. Therefore their creditworthiness increases and the possibility of making investments with the use of external capital increases. The fact that the impact of purchase prices of cattle and pigs on the number of loans granted per month is significant may mean that a group of farmers engaged in this type of production can to a large extent finance their activities with a bank loan. In the case of the X_1 variable, i.e. the price indices of consumer goods and services its increase by 1 p.p. caused a decrease in the number of loans to farms in Poland by nearly 990 per month. Such a situation could be the result of a decrease in disposable income of farms due to an increase in the prices of basic consumer goods, and thus was associated with reduced creditworthiness of farms.

Table 4. Influence of the predictor set on the dependent variable Y_1 (number of credits for agriculture)

Statistics	Value
Correlation Coefficient (Multiple R)	0.710
Multiple R^2	0.503
Adjusted R^2	0.402

Source: own research

Then it was determined to what extent the predictor team explained the variability of Y_1 i.e. the number of credits for agriculture. Table 4 shows the statistic in this area.

As a result of the multiple regression analysis concerning the influence of the set of predictors on the number of credits for agriculture, the correlation coefficient was at the level of 0.710. Thus, a significant correlation was found between Y_1 and the set of independent variables

in the model. The multiple determination coefficient was adjusted based on the size of the group and it was finally found that the variability of the predictors in the model explains at least 40.2% of the variability in the number of credits for agriculture on a monthly basis.

In the next stage of the research, an attempt was made to determine whether there is a statistically significant relationship between the Y_2 variable illustrating the demand for agricultural loans, measured by the number of loan inquiries by individual farmers and the independent variables X_1-X_{19} (Table 5).

Table 5. Analysis of variance and dependence of the Y_2 variable on the set of predictors

Effect	Sum of squares	Number of degrees of freedom (df)	Mean square	F test statistics	*p-value*
Regression	189,439,900.350	5	37,887,980.070	17.553	< 0.001
Rest	90,654,724.630	42	2,158,445.825	-	-
Total	280,094,624.979	-	-		-

Source: own research

The analysis of variance showed a relationship between the number of agricultural loan inquiries (Y_2) and the set of predictors from X_1 to X_{19}, this relationship was confirmed at < 0.001. Therefore, a regression analysis was performed at a later stage to determine which of the predictors are statistically crucial for the variability of the monthly number of agricultural loan inquiries (Table 6).

The model included the variables X_{15} ($p < 0.001$), X_{18} ($p = 0.010$), X_{11} ($p = 0.020$), $_{X6}$ ($p = 0.039$) and X_{16} ($p = 0.004$). Therefore it was established that the increase by one percentage point in variable X_{15}, i.e. the dynamics of milk purchase prices was associated with an increase in the number of credit inquiries by individual farmers on average by 132 per month. It could have been caused by an improvement in the economic situation of some farms engaged in milk production and thus an increase in their willingness to invest with the use of credit. In the case of an increase by 1 p.p. in the variable X_{18}, i.e. the general economic climate in manufacturing index it was associated with an increase in the number of monthly loan inquiries in Poland by 47. The reasons for such a dependence may be related to the increased demand for goods of the agri-food sector and consequently the propensity of individual farmers to develop their business with the use of credit. On the other hand an increase by 1 p.p. in the variable X_{11} (dynamics of wheat prices) was associated with an increase in the monthly number of loan inquiries by an average of more than 5. Therefore it can be assumed that the increase in the income of individual farmers influenced the increase in the tendency to take out loans for farm development purposes. The change by the unit of independent variables X_6 and X_{16} denoting the average employment in the

Table 6. The impact of the set of predictors on the dependent variable Y_2 (monthly number of agricultural loan inquiries)

Time series (months) N=48	Standardized coefficient		Non-standardized coefficient		t-Student statistics	*p-value*
	Beta	standard error	b	standard error		
Constant	-0.414	0.137	-82.301	27.155	-3.031	0.004
X_6 Average employment in the enterprise sector [thousand]	-0.276	0.130	-105.390	49.407	-2.133	0.039
X_{11} Dynamics of wheat prices (without seed) [%]	0.327	0.135	5.323	2.205	2.414	0.020
X_{15} Dynamics of milk purchase prices [%]	0.671	0.125	132.718	24.655	5.383	0.000
X_{16} Total sold production of industry (constant prices), analogous period of the previous year = 100%	-0.414	0.137	-82.301	27.155	-3.031	0.004
X_{18} General economic climate in manufacturing index [%]	0.247	0.092	47.011	17.470	2.691	0.010

Source: own research

Table 7. Influence of the predictor set on the dependent variable Y_2 (potential loan demand – monthly number of agricultural loan inquiries)

Statistics	Value
Correlation Coefficient (Multiple R)	0.822
Multiple R^2	0.676
Adjusted R^2	0.638

Source: own research

enterprise sector [in thousands] and the total sold production of industry in constant prices (analogous period of the previous year = 100%) was associated with a decrease in the monthly number of individual farmers' loan inquiries by 105 and 82 respectively.

Then it was determined to what extent the predictors explained the volatility of potential loan demand, measured by the monthly number of agricultural loan inquiries (Y_2). Table 7 presents the results of the research in this area. The results of the research showed that the correlation coefficient between Y_2 and the set of independent variables of the model was high and amounted to 0.822. The multiple determination coefficient was adjusted based on the size of the group, it was finally found that the model explained at least 63.8% of the variability in the number of monthly loan inquiries from individual farmers in Poland, which generally indicates a satisfactory level of explaining the variability of the number of these loan inquiries.

CONCLUSIONS

1. The research was complete and concerned the number of loans to farms in Poland granted by banks in 2017-2020. Additionally, the potential demand for these loans was recognized, measured by the number of monthly loan inquiries from individual farmers. The constructed models at the preliminary stage may be useful ceteris paribus for estimating the adopted dependent variables in the future, i.e. the number of loans to farms and the number of monthly inquiries from individual farmers for credit for production purposes. However, it should be added that some parameters of the first model have a low statistical value. The model concerning the number of requests for agricultural credit (Y_2), illustrating the potential demand for credit from farms, is more useful.
2. At the exploratory stage, the results of the research may be used by banks and other institutions to determine the impact of individual explanatory variables on the explained variables. Their changes may be a reason to introduce certain improvements in the lending policy of banks servicing agriculture in the form of tightening or liberalizing credit requirements. The research results can also be used by banks to effectively plan future sales targets.
3. In the course of the research it was established, inter alia, that there is a correlation between macroeconomic factors and the situation on the market of loans to individual farmers. Particularly important may be the impact of the general economic situation index, the dynamics of the purchase prices of wheat and the dynamics of the purchase prices of milk, as they influenced the change in the real and potential demand for credit on the part of individual farmers.
4. It was found that the economic situation was cyclical in the research period and selected indicators describing its activity changed along with it. The impact of economic changes on the market of loans to individual farmers was confirmed. The obtained research results may be useful for other researchers who want to conduct more detailed analyzes in this area. The results of the research may also be useful for banks in the initial determination of the number of loans granted to farms in Poland, and this, in turn, may be important in estimating the size and volatility of investments in Polish farms.

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KREDYTOWANIE GOSPODARSTW ROLNYCH W POLSCE W OKRESIE PANDEMII COVID-19

Słowa kluczowe: gospodarstwa rolne, liczba kredytów, popyt na kredyt, pandemia COVID-19, Polska

ABSTRAKT

W opracowaniu podjęto próbę rozpoznania zmian na rynku kredytów dla gospodarstw rolnych w Polsce w okresie pandemii Covid-19. W badaniach wykorzystano dane Głównego Urzędu Statystycznego oraz Biura Informacji Kredytowej za lata 2017-2020. W toku badań skonstruowano dwa modele ekonometryczne, objaśniające liczbę kredytów dla gospodarstw rolniczych, a także liczbę zapytań kredytowych rolników, obrazującą zainteresowanie kredytem gospodarstw rolnych w okresie pandemii. Zastosowano program Statistica 13.3. Przeprowadzono analizę normalności rozkładu z wykorzystaniem testu Shapiro-Wilka. W celu skonstruowania modeli predykcyjnych wykorzystano rachunek korelacji oraz rachunek regresji krokowej „w przód". Analizą objęto wszystkie kredyty udzielone w Polsce w układzie miesięcznym w latach 2017-2020. Łącznie w tym okresie banki udzieliły 245 607 kredytów dla rolników indywidualnych, a ich wolumen wyniósł prawie 24 mld PLN. W toku badań ustalono m.in., że zestaw zmiennych objaśniających w modelach może być przesłanką do wprowadzenia określonych udoskonaleń w polityce kredytowej banków obsługujących rolnictwo, w postaci zaostrzenia lub zliberalizowania wymogów kredytowych. Wyniki badań mogą również posłużyć bankom do planowania przyszłych celów sprzedażowych.

AUTHORS

SŁAWOMIR JUSZCZYK, PROF. DR HAB.
ORCID: 0000-0003-3790-6247
Institute of Economics and Finance
Warsaw University of Life Sciences – SGGW
166 Nowoursynowska St., 02-787 Warsaw, Poland
e-mail: slawomir_juszczyk@sggw.edu.pl

ADAM ZAJĄC, PHD
ORCID: 0000-0002-8511-8117
Institute of Economics and Finance
Carinal Stefan Wyszynski Uniwersity
1/3 Woycicki St., 01-938 Warsaw, Poland
e-mail: a.zajac@uksw.edu.pl

BARTOSZ KUBLIK, MSC
ORCID: 0000-0002-1036-6300
Bank Spółdzielczy
32 3 Maja St., 07-300 Ostrów Mazowiecka
Poland
e-mail: b.kublik@bsostrow.com

ŁUKASZ MLECZKO, MSC
ORCID: 0000-0002-4994-3507
Alior Bank S.A.
18B Postępu St., 02-676 Warsaw, Poland
e-mail: lukasz_mleczko@poczta.fm

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