

Risks in Bank Crediting of Agricultural Enterprises

Scientific problem. For a long time in the formation of financial and credit support agricultural enterprises play a crucial role for banks crediting. However, the development of credit relations of agricultural enterprises with commercial banks is hampered by high risk with dual nature of formation.

On the one hand, the domestic banking system operates in a risky environment and uses relatively expensive capital, which leads to high interest rates and collateral requirements, short credit term, the lack of credit insurance and guarantee. On the other hand, unfavorable conditions of agricultural enterprises functioning reduces the profitability and deteriorates financial position, limits the ability to withstand the negative effects of natural factors, increases the impact of seasonal and cyclical fluctuations and risks of industrial activity.

Analysis of recent researches and publications. Outlined problems are presented in a wide range of domestic and foreign research scientists. Various aspects of bank crediting to agricultural enterprises were elucidated by such scientists as Dem'yanenko M.Ja., Gudz O. Ye., Stetsyuk P.A. [1], Nepochatenko O.O. [5]. The matters relating to risk management in commercial banks, including the management of individual and systemic risk in bank lending were covered in papers of Vitlinsky V.V. [4], Kyshakevych B.Yu. [2], Kovalov A.P. [3], Yablokov A. [6].

Among foreign scientific and methodic literature it should be especially noted the publication of a group of scientists of Bank for International Settlements, including L. Allen and A. Saunders [7], J.D. Amato and C.H. Furline [8], and researches of F.P. Miller and A.F. Vandome [10], M. Glantz and J. Mun [13], K. Komorad [15].

At the same time contemporary bank crediting is very dynamic, and the negative impact of risk factors is increasing. All these facts raise the need to find new and improved methods to minimize the risks of bank crediting to agricultural enterprises, which lead to the choice of theme and objective of the research.

The objective of the article is to improve the theoretical and methodological aspects to determine the risk of agricultural enterprises' bank crediting. Achieving the goal requires analysis of the nature of credit risk, determining factors of the risk in bank crediting to agricultural enterprises and its modeling.

Statement of the main results of the study. In modern economic literature there are many approaches to determine credit risk. It is associated with the risk, the probability of occurrence of certain events or the size of possible losses. First of all, credit risk should be viewed as an economic category. Vitlinsky V.V. notes that this category reflects the economic relations associated with uncertainty and conflict, burdened with possible threats and unused possibilities [4]. At the same time, the most common are the views, where the credit risk is interpreted as the negative effects of the credit transaction and the loss of potential creditor's profit or both, profit and assets, as well as a default by the borrower to the creditor, non-payment credit or interests. That is the risk of insolvency to fulfill obligations under the credit agreement, risk of default, reflects the essence of credit risk in accordance with the provisions of the Basel Committee on Banking Supervision and Regulation [9, 14].

The determination of credit risk with using the theory of probability and mathematical statistics is widespread, especially among foreign scientists [7-11, 13, 14, 15]. This approach allows to estimate both the probability of the potential amount of losses and to consider several scenarios for further developments. Methods

for determining the credit risk, that are recommended by the Basel Committee on Banking Supervision and Regulation, is also based on the probability theory and mathematical statistics [9, 13, 14]. So, methods based on the determination of the probability of borrower's default, which helps to determine expected amount of loss would be more suitable for adaptation to realities of credit activity in Ukraine.

At the same time, we should distinguish between the types of credit risk, depending on their level of concentration, the risk of the credit portfolio and individual credit transaction. The latter is usually identified with the individual credit risk, the main causes of which are industrial and commercial, financial, managerial and ethical characteristics of the borrower; compliance to the credit product, and characteristics of the collateral or guarantees. In minimization of such credit risk the important role is played by general estimation and credit-worthiness of the borrower, the project (which will be financed through a credit), proposed pledge or guarantees, insurance, structuring and documentation of credit transactions and further monitoring. Thus, the primary role is played by analytical methods, while the basis to determine the risk parameters must be the credit rating of the potential borrower.

Under the terms of the "International convergence of capital measurement and capital standards: a new approach" recommended by the Basel Committee on Banking Supervision and Regulation, better known as Basel II, the credit rating of the borrower is a tool for flexible risk management used by the lender to determine the measure of risk and capital adequacy [2, 6, 10, 11, 15]. The banks can use both, internal ratings assigned by their own methods, and external determined by independent agencies. However, in any case, the principle of correspondence between the rating and the degree of financial risk, represented as the probability of default, have to be respected [6, p. 235].

Thus, default does not mean bankruptcy in the general sense, but the deviation from the terms of the credit agreement, any violation concerning the terms, amount of payments of credit body or interest. The decisive factor in

the probability of default for each credit transaction is the borrower's reliability, the measure of which is the credit rating or credit index. A variety of methods and methodological approaches to their definition are widely covered in the national and foreign scientific literature [1-3, 5-8, 9, 11-13, 15].

As a result of scientific sources' analysis we consider appropriate use of parametric methods which give the possibility to identify risk with certain parameters, including the probability of default by means of linear and logistic regression or neural network system. However, as Yablokov A. and Komorad K. proved in their works, methodological approaches based on regression can provide accuracy of prediction the same, or even higher, as the neural network system, but are much simpler in development and application [6, 15].

Thus, the further improvement of the methods of quantitative estimation and analysis of agricultural enterprises' credit risk can be done by the development of economic and mathematical model predicting the probability of default by the borrower (Fig. 1).

It is advisable to identify such basic factors of agricultural enterprises' credit risk: credit rating, the ratio of credit amount and the borrower's equity, interest rate and term of the credit.

According to a previously proposed methodological approach, the credit rating of agricultural enterprises are defined as the integral index based on factors prerequisites, intensification and efficiency of production, and financial conditions, each of them is characterized by a number of indicators according to accounting and statements [12]. For the mathematical processing of the data such methods as relative values, normalization and standardization of the values, mean values (including geometric mean), integral method and such method of rating as distance from the origin can be applied. Such approach allows taking into account specifics of the agricultural economic activity and its impact on individual credit risk formation.

The initial information for credit risk determination model development is the statistics of typical agricultural enterprises of Mykolayiv region in 2001 – 2013. In general, the sampling has 42 observations. Investigated enterprises

involved credits for up to 36 months, but the most frequently – for one year. Interest rate fluctuated within a 15 – 28%, the most frequently – 21%. However, such level of payment is excessive in many cases, since the av-

erage rate on loans to 8.12 percentage points higher than the average return on assets.

It suggests that credit risk of agricultural enterprises is greatly caused by too high interest rates for them, and the reduction of interests would lead to risk decreasing too.

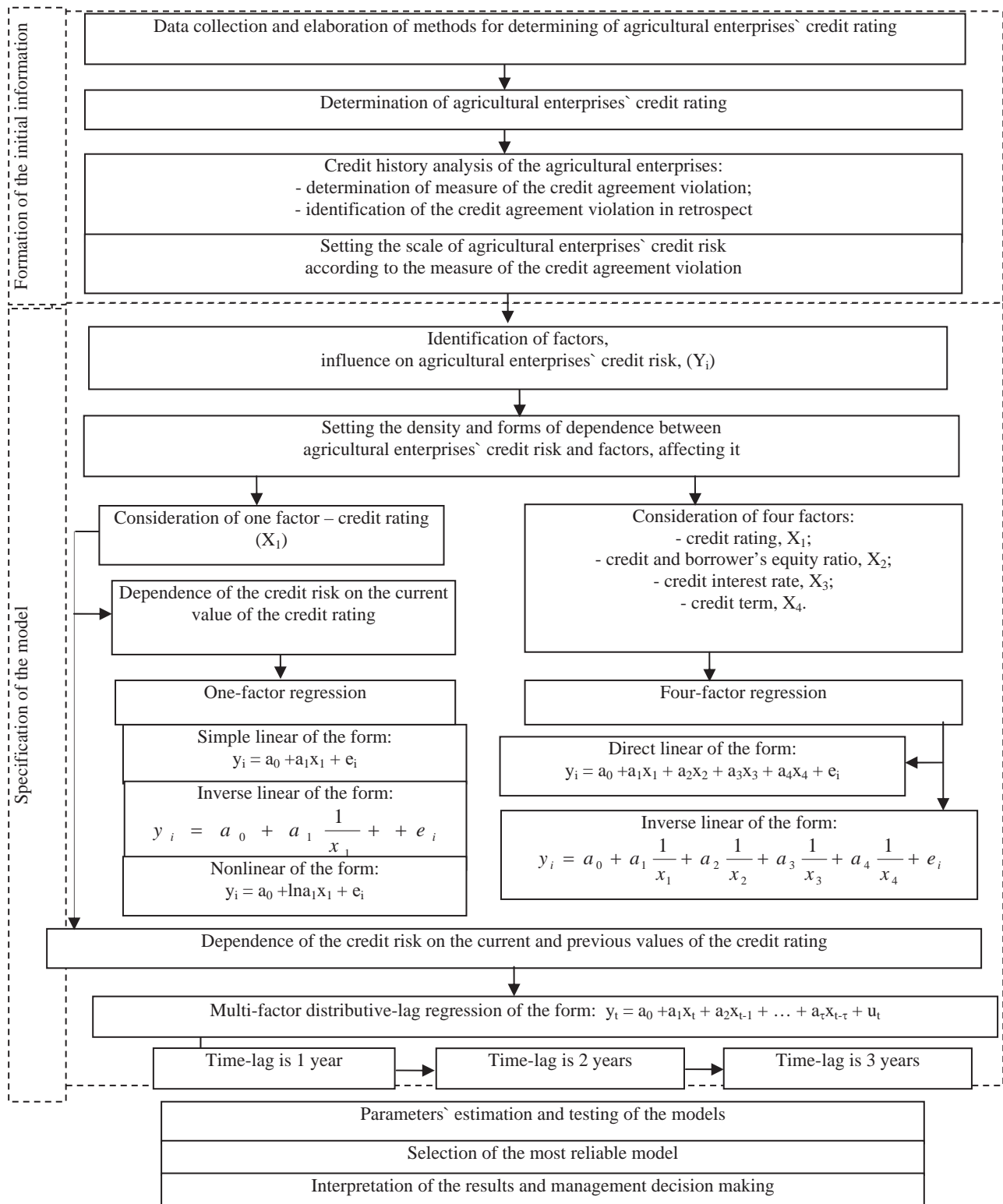


Figure 1. Modeling of agricultural enterprises' credit risk

Source: developed by author

At the same time, more than half of the investigated cases of typical agricultural enterprises' bank crediting were served completely or with minor violations. So, 28.57% of all investigated credits were repaid on time and in full, 23.81% – with minor violations, 19.05% – with significant violations, 16.67% – with very significant violations (breaches payment schedule, approved by credit agreement, both amount and maturity). Only in 5 cases, it is 11.9%, borrowers didn't have ability to pay in full and timely. In each of these cases, such disability was caused by objective reasons, as a result of unpredictable and unforeseen circumstances (abnormal weather conditions that caused the loss of much of the crop, and income as a result). So, credit agreements were prolonged.

In the process of any financial risks analysis, including credit one, the main indicators of the risk level are dispersion, standard deviation and coefficient of variation, which reflect the degree of fluctuation of the investigated features. In our case, breach of the credit agreement is characterized by the following values: dispersion $\sigma^2 = 0,1191$, standard deviation $\sigma = 0,3451$ and the coefficient of variation $V = 86,53\%$. These values indicate that in some cases quantitative credit risk characteristics of agricultural enterprises may significantly deviate from their average values. It confirms the widespread perception of such enterprises as risky borrowers.

Credit risk of agricultural enterprises has stochastic correlation with factors of its formation, investigated by means of correlation pairs. The calculated value of correlation coefficients at -0.6466 is noticeable, on the Cheddok scale, and certifies the presence inverse relation between the credit risk and credit rating. Therefore, the higher credit rating of the borrower is, the higher probability of credit obligations fulfillment without any violations will be. According to the obtained correlation coefficient, the rest of the credit risk factors are directly related with credit risk, but less influential. Therefore, the specification model for credit risk determining can be considered as a factor in one's credit rating, and on all four factors (see Fig. 1).

At the same time, probability of agricultural credit agreement violation may depend on the credit rating not only in the current but also in earlier periods. This dependence may be caused

by cyclical fluctuations of agricultural production, and as a result, their financial and credit support, and credit process in general. At the same time, the effect of cyclical fluctuations in the definition and modeling of credit risk, as the pro-cyclical nature of credit ratings was proved by foreign scientists and highlighted in scientific studies of the Bank for International Settlements [7, 8]. Thus, when the resultant variable depends on the value factor in the current and one or more previous periods, distributive-lagged models should be used.

So, regression models were built according to specifications, presented in Figure 1. The test results demonstrate adequacy of models (by Fisher's test), the significance of the parameters (by Student's t test), absence of multicollinearity (by pair correlation coefficients), autocorrelation (Durbin-Watson's test) and heteroscedasticity (by Spearman's test).

Noteworthy, the highest values of the coefficients of multiple correlation and determination has four-factor inverse linear regression. Since the multiple correlation coefficient $R = 0,809$, the relationship between credit risk and the studied factors are direct and strong, according to the Cheddok scale. The coefficient of determination $R^2 = 0,656$, that is 65,6% of total variance are explained by the regression provided, and at the same variation factors would influence the variation of the resultant variable.

However, for a more reliable choice regression, reflecting the dependence of the agricultural credit risk's variation of its factors' variation, it is advisable to calculate the estimated coefficient of determination, which allows comparing different regression models with different parameters and degrees of freedom. The calculated values of the estimated coefficients of determination for all developed regression models are shown in Table 1. The four-factor inverse linear regression has the highest value of the estimated coefficient of determination of 0,6184. Next to the value of the coefficient of 0,5458 was calculated for distributive-lag model with a time lag of 3 years. The rest of the regression equations have coefficients with a value less than 0,5, so it is insufficient to credit risk estimation and forecasting.

Thus, to determine the agricultural enterprises' credit risk, including estimation and

forecasting probability of default, the most appropriate would be the model of four-factor in-

verse linear regression and the distributive-lag model with a time lag of 3 years.

Table 1

Estimated coefficients of determination of investigated regressions

Type the regression	Correla-tion coeff., R	Determi-nation coeff., R ²	Estimated determi-nation coeff., \bar{R}^2
Simple linear regression of the form: $PD_i = 1,005 - 1,129CR_i$	0,6466	0,4181	0,4036
Nonlinear regression of the form: $PD_i = -0,093 - 0,725 \ln CR_i$	0,6926	0,4797	0,4667
Inverse linear regression of the form: $PD_i = -0,396 + 0,384/CR_i$	0,7072	0,5001	0,4876
Distributive-lag regression of the form: $PD_i = 0,999 - 1,424CR_i + 0,376CR_{i-1}$	0,7018	0,4925	0,4643
Distributive-lag regression of the form: $PD_i = 1,089 - 1,578CR_i + 0,539CR_{i-1} - 0,140 CR_{i-2}$	0,7332	0,5376	0,4929
Distributive-lag regression of the form: $PD_i = 1,157 - 1,322CR_i + 0,640CR_{i-1} - 0,598 CR_{i-2} - 0,220 CR_{i-3}$	0,7774	0,6044	0,5458
Four factors direct linear regression of the form: $PD_i = 0,322 - 1,176 CR_i + 0,399 K_i + 2,117 r_i + 0,173 t_i$	0,7186	0,5163	0,4640
Four factors inverse linear regression of the form: $PD_i = 0,634 + 0,385 \frac{1}{CR_i} - 0,003 \frac{1}{K_i} - 0,109 \frac{1}{r_i} - 0,450 \frac{1}{t_i}$	0,8097	0,6557	0,6184

Source: Calculated by the author.

The advantage of the first model is taking into account the borrower's credit rating in current period and the characteristics of the credit (the ratio of credit to borrower's equity, interest rate and term). This approach makes the credit analysis easier and provides higher reliability of credit risk's estimation and forecasting, as the expected losses of this credit transaction. Instead, the second model enables to assess the borrower's reliability based only on its ranking in the current and previous periods. It may be more convenient for the previous express-estimates, even before the establishment of bank credit's conditions, as for leasing, bonds or other types of non-bank credit support.

Conclusions. Provision of the agricultural enterprises' needs in bank credit is inhibited by a high level of risk. In credit risk managing the

significant role is played by analytical methods based on the factors of credit rating and credit parameters.

The methodical approach to determine agricultural enterprises' credit risk is proposed on the base of the correlation and regression analysis methods. It is proposed to use four-factor inverse linear regression model (including the borrower's credit rating in the current period and the characteristics of the loan) or distributive-lag model with a time lag of 3 years based on a credit rating for estimation and forecasting measures of credit agreement violation, as a probability of default and as a main quantitative measure of credit risk. In this case the first can provide higher reliability of credit risk's estimation and forecasting, but the second would be more convenient for express-estimates.

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Оптимізація нормативного регулювання використання аграрних розписок

Постановка проблеми. Сільське господарство є провідним сектором української економіки із значним потенціалом щодо подальшого зростання, яке стимулюватиме динамічний розвиток усіх пов'язаних із ним галузей промисловості, сфер життєдіяльності суспільства. Ключовою проблемою в контексті забезпечення сталого розвитку аграрного сектору національної економіки є формування ресурсної бази виробників із диверсифікацією джерел фінансових та матеріальних ресурсів. У 2012 році Верховною Радою України було прийнято Закон України «Про аграрні розписки» [5], яким регламентовано введення в обіг нового для українських реалій кредитного інструменту – аграрних розписок. В основу нормативних розробок покладено досвід використання сільськогосподарських бонів у Бразилії, які мають широку сферу застосування – від альтернативи банківському кредитуванню до особ-

ливої форми товарного кредиту й високу функціональність – від кредитування під майбутню продукцію до хедж-інструменту та механізму контрактації товарної продукції. 4 вересня 2014 року керівництвом Міністерства аграрної політики та продовольства України і Міністерства юстиції України підписано Наказ «Про запровадження пілотного проекту з відпрацювання технології введення в обіг аграрних розписок» [6], яким започатковується практичне відпрацювання механізму використання аграрних розписок у межах Полтавської області згідно із затвердженим планом заходів. Особлива увага до розписок на різних рівнях галузевого управління, ефективність їх зарубіжного аналогу визначають актуальність статті.

Аналіз останніх досліджень і публікацій. Аграрні розписки та їхні бразильські аналоги – сільськогосподарські бони були предметом досліджень науковців та практиків, серед яких особливо відзначимо В.С. Андрієвського [2], Александре Куросакі [3], Ю.О. Лупенка [4], Фернандо Піменте-

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