"Forecasting of the state of the credit market in Ukraine"

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Forecasting of the state of the credit market in Ukraine

Abstract

The article highlights the forecasting of development of the credit market in Ukraine on the basis of regression analysis and based on a number of macroeconomic factors. It provides a matrix of coefficients for pair correlations for the calculation of the volume of loans given by banks and non-bank financial institutions, foreign economic agents and inter-economic actors. It gives partial regression models for determining the volume of loans according to the market's segments. It carries out the forecasting of the credit market and the volumes of loans given by its segments.

Keywords: credit market of Ukraine, forecasting, regression analysis, pair correlation.
Jel Classification: G21, G23, E51.

Introduction

The development of the country's credit market is influenced by a number of social and economic processes that have an ambiguous impact on its structure and performance. The study of the parameters of influence of a certain factor on the functioning of the credit market makes it possible to predict the trajectory of its further movement. There are many scientific approaches to identifyingcause-and-effect relationships between the processes and factors that determine them. On their basis it is possible to offera mathematical model for the development of lending.

1. The purpose of the article.

To investigate the influence of socioeconomic factors on the development of the credit market in Ukraine, to forecast its main indicators for the period 2016-2019, to build an integrated model for the developmentof the credit market in Ukraine.

2. The main results of the study.

The variability in the economic environment of the state leads to the permanent search of models predicting the components of the economic system of the country in general and its credit market in particular. In Ukraine,the study ofperspective ways for the development of financial sector in general and the credit market in particular is embodied in the "Comprehensive program for the development of the financial sector of Ukraine till 2020" [1] and in the Strategy of the banking system's development 2016-2020: "A synergy of the development of banks and industrialization of the economy" [2]. Annual forecasts of the credit market's developmentare also

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presented by rating agencies.

To quantify the relationships between the credit market and the factors that influence its development we use a multiple (multivariate) correlation and regression analysis, which involves the determination of the depth of relationship between signs, the construction of multi-factor regression models, the studyof significance of both the parameters of the built models and the models in general.

Correlation and regression analysis is based on the building of a regression model and involves the following stages: formation of a system of all possible factors affecting the credit market; selection of the necessary factors; analysis of factors; justification of the method and construction of the multifactor regression model; assessment of the parameters ofthe regression model; checking the adequacyof the constructed model; calculation of the main characteristics of the model; analysis of the obtained results [3].

The studyof the formation and the functioning of the credit market in Ukraine has made it possible to form a system of factors that we consider crucial for its development, namely: GDP (million Hryvnias), x_1; rate of inflation (%), x_2; unemployment level (%), x_3; public debt and public debt guaranteed by the state (billion Hryvnias), x_4; average salary (UAH a month), x_5; foreign direct investments (million US dollars), x_6; discount rate of the National Bank of Ukraine (NBU) (%),x_7; exchange rate (Hryvnias for 100 US dollars), x_8; exports (million US dollars), x_9; imports (million US dollars), x_{10}.

To build a regression model for the development of the credit market it is necessary to determine a formalized form of the relationship between the dependent variable Y and several independent variables $X_1, X_2,…,X_n$. We will analyze the impact of independent variables - the distinguished macroeconomic factors (indicators) on a number of dependent variables that determine the development of the credit market: the number of banks, the volumes of the loan portfolios of banks, the volumes of loans

provided to the economy by non-banking financial institutions, international lenders and business entities.

The building of a regression model begins with the selection of independent variables and is carried out in conjunction with the second stage – the selection of the form of communication (regression equation). The main problem during the selection of independent factors is their possible multicollinearity, that is, the presence of close relationships between some of these factors. This relationship is measured by the correlation coefficient and calculated by using the formula (1):

$$r_{xy} = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2 \cdot \frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})^2}}, \quad (1)$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}, \ \bar{y} = \frac{\sum_{i=1}^{n} y_i}{n} \quad (2)$$

where r_{xy} is a coefficient of correlation between the variables x and y;

n - the number of observations;

x_i, y_i − i-th actual values of the variables x and y;

$\bar{x}$, $\bar{y}$ −average variables x and y (formula (2)).

If $r_{xy} > 0,8$, the variables x and y are considered multicollinear with only one of them left for further analysis [4, p. 189]. During the deviation of the variables we should focus on their economic content, trying to retain the most important and significant of them. At the same time we assess the correlation of independent and dependent variables, leaving the variables the coefficient of correlation of which with the dependent variable is higher than 0.4. For the convenience of such an operation we build a matrix of pairwise correlation coefficients of all the variables thatshows which variables need to be ignored.

Therefore, we evaluate the multicollinearity of the above-mentioned factors. In this case, the matrix of correlation of macroeconomic indicators would be of the 10×10 dimension (Table 1).

Table 1. Matrix of correlation of coefficients'pairs

Indicator	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
x_1	1									
x_2	-0.296	1								
x_3	-0.435	-0.250	1							
x_4	0.881	-0.120	-0.280	1						
x_5	0.997	-0.299	-0.441	0.887	1					
x_6	0.994	-0.280	-0.433	0.899	0.994	1				
x_7	-0.555	0.710	0.043	-0.357	-0.559	-0.508	1			
x_8	0.845	-0.482	-0.036	0.747	0.850	0.840	-0.702	1		
x_9	0.940	-0.312	-0.509	0.688	0.926	0.909	-0.601	0.751	1	
x_{10}	0.908	-0.296	-0.528	0.623	0.889	0.876	-0.561	0.695	0.992	1

The analysis of coefficients' correlation shows that there is a close relationship between some of the analyzed indicators: correlation coefficient was higher than 0.8.

As shown in Table. 1, such indicator as GDP is closely correlated with public debt and public debt guaranteed by the state (x_4), average salaryx_5), foreign direct investments (x_6), exchange rates ($x_8$8), exports (x_9) and imports (x_{10}0).

Of these indicators we retain GDP, because we believe that the volume of GDP has the highest impact on the functioning and development of the state's credit market. As for the other factors, we have not discovered a close correlation with other indicators. The coefficients of correlation of the inflation indicator (x_2) with other factors do not exceed 0.8. Therefore it is advisable to retain it for further research. A similar situation is observed for such factors as unemployment level ($x_3$3) and discount rate of the National Bank of Ukraine (x_7). Thus, by analyzing the matrix of correlation of the ten identified and analyzed indicators we have selected four of them for further research, namely: GDP (GDP), inflation (I), unemployment rate (B), discount rate of the National Bank of Ukraine (S).

As the leading indicators characterizing the state of the credit market include the number of banks and the volume of loans given by the market's lenders, the next phase of the study should determine the closeness of relationship between the resulting and factor variables, that is,the dependence of the number of banks (KB), the volume of loan portfolios of banks (VP), the volume of loans given by nonbank financial institutions (VN), the volume of international loans (VM), and the volume of inter-economic loans (VG), on the selected factors.

First of all, we build a correlation matrix for the resulting variable − the number of banks (*KB*), which is presented in Table 2.

Table 2. The matrix of coefficients of pair correlation to the number of banks

Indicator	KB	P	I	B	S
KB	1				
P	-0.600	1			
I	0.634	-0.296	1		
B	-0.237	-0.435	-0.250	1	
S	0.768	-0.555	0.710	0.043	1

Based on the obtained correlation matrix we build a multifactor regression model of the number of banks:

$$KB = -0.0000088 \cdot P + 0.372 \cdot I + 0.367 \cdot S + 149,133 \, (3),$$

where *P* is the volume of Ukraine's GDP in the current year, billion Hryvnias;

I – rate of inflation,%;

B–level of unemployment,%

S– discount rate of the National Bank of Ukraine, %.

The obtained regression model (3) shows that the number of banks is influenced by macroeconomic situation in the country, becausefor this model the determining coefficients are the indicators of GDP and inflation rates. The presence of discount rate in the model also indicates a significant impact of the monetary policy of the National Bank of Ukraineon the activity of banks on the credit market of Ukraine.

The obtained regression statistics show that the constructed regression model meets all adequacy tests and is appropriate for forecasting.

We will analyze the impact of the studied factors on the credit activity of domestic banks, namely, on the total amount of loans granted by banks to the economy of Ukraine. The selection of indicators for the analysis should be based on the correlation matrix presented in Table3.

Table 3. The matrix coefficients of pair correlation to calculate the volume of loans granted by banks

	VP	P	I	B	S
VP	1				
P	0.970	1			
I	-0.264	-0.296	1		
B	-0.430	-0.435	-0.250	1	
S	-0.471	-0.555	0.710	0.043	1

Multifactor regression model of the volume of loan portfolios of banks in Ukraine looks like this:

$$VP = 0.694 \, ЧР + 2469.335 \, ЧВ + 1830.764 \, ЧS - 190592.701 \quad (4),$$

This regression modelincludes the parameters characterizing the dependence of the volume of loan portfolios of domestic banks on the macroeconomic situation in the country and on the well-being of the population.

The analysis of coefficients of multiple correlation (*R*) and determination (R^2) made it possible to make a conclusion about the adequacy of the built regression models with standard error 8,748.

To forecast the development of the segment of lending of non-bank financial institutionswe analyze the dependence of the volume of loans granted by non-bank financial institutions on pre-selected factors that are crucial for the functioning of the credit market and for this particular segment.

The correlation matrix presented in Table. 4 shows that the regression model should include only one of the analyzed indicators − GDP. Since the coefficients of correlation between unemployment, inflation, discount rate of the National Bank of Ukraine and the resulting variable are too low, these indicatorsshould not be included in the model.

Table 4. Matrix coefficients of pair correlation to calculate the volume of
loans to non-bank financial institutions

Indicator	VN	P	I	B	S
VN	1				
P	0.952	1			
I	-0.166	-0.198	1		
B	-0.058	0.063	-0.546	1	
S	0.024	-0.065	0.848	-0.447	1

Regression model of the volume of loans granted by non-bank financial institutions looks like this:

$$VN = 0.026 \cdot P - 12053.427 \qquad (5)$$

Thus, the obtained regression model (5) demonstrates that decisive for the segment of lending by non-bank financial institutions and the volume of loans granted by them, is the macroeconomic situation in the country, namely– the amount of GDP.

Since the coefficient of multiple correlation (R) equals 0,95 and the coefficient of determination (R^2) is 0,91, the built regression model meets all adequacy tests and is appropriate for forecasting.

We will assess the closeness of relationships between the volume of inter-economic credits (VG) and the chosen indicators. To do this we will build a correlation matrix presented in Table5.

Table 5. Matrix of correlation coefficients pairs for calculation of inter - economic credits

indicator	VG	P	I	B	S
VG	1				
P	0.97	1			
I	-0.14	-0.20	1		
B	0.10	0.06	-0.55	1	
S	0.07	-0.06	0.85	-0.45	1

The built correlation matrix shows that the regression model should include only one of the analyzed indicators, namely GDP.

Regression model of the volume of inter-economic loans looks like this:

$$VG = 0.35 \cdot P + 44862.73$$
(6).

Thus, the volume of inter-economic loans is influenced only by the state of the national economy, which is determined by the volume of GDP. Other factors that affect the functioning of the credit

market in general, do not affect the volume of inter-economic lending.

Since the coefficient of multiple correlation (R) equals 0,97 , and the coefficient of determination (R^2) is 0,94 , the built regression modelmeets all adequacy tests and is appropriate for forecasting.

We will assess the closeness of the amount of loansgiven by foreign economic agents depending on our chosen indicators. The correlation matrix presented in Table 6 indicates that the regression model should include only one of the analyzed indicators, namelythe GDP.

Table 6. Matrix of coefficients of pair correlation to calculate the
volume of loans given by foreign economic agents

Indicator	VM	P	I	B	S
VM	1				
P	0.90	1			
I	-0.30	-0.20	1		
B	0.05	0.06	-0.55	1	
S	-0.07	-0.06	0.85	-0.45	1

Regression model of the volume of loans of foreign economic agents looks like this:

$$VM = 0.05 \cdot P - 982.44$$
(7).

The coefficient of multiple correlation (R) equals 0,9 , and the coefficient of determination (R^2) –

0,8. This indicates that the built regression modelmeets all adequacy tests and is appropriate for forecasting.

To assess the trends in the development of the credit market of Ukraine we make the forecastof fac-

torial signs (determined factors) by using Brown's method.

Brown's method is a combination of causal and non-causal model.In other words, it is a combined model, which is very convenient, because forecasting with the help of correlation-regression model without the use of non-causal model is impossible. The essence of this method is in the use of a weighted moving average.That is, while forecasting the time series with the help of Brown's me-

thod greater weight is given to the recent observations, which is very useful in predicting economic processes, especially in crisis periods. For example, during the forecastingwith the classical method of moving averages with equal weights, the crisis will causea significant decline in the forecasting of its dynamics, even with the economy'sstable recovery [5].

The obtained projected values of factor signs are presented in Table7.

Table 7. Projected values influencing the development of the credit market of Ukraine

Year	GDP	Inflation	Unemployment level	Discount rate of NBU
2015	1649240	124,078	7,81667	7,83416
2016	1731750	123,256	7,93333	8,39785
2017	1814260	122,433	8,05	9,15022
2018	1896770	121,611	8,16667	10,0912

Based on the data of Table 7 we forecast the dynamics of development of the credit market in the period 2016-2019 by substituting the projected values of

Table 7 into the built regression models (3–7). The obtained projected values of the keyindicators of credit market of Ukraine are presented in Table8.

Table 8. Forecast of key indicators of the credit market in
Ukraine in 2016-2019 (*atthe beginningofthe period*)

Year	*KB*, units	VP, million Hryvnias	VN, million Hryvnias	VG, million Hryvnias	VM, million Hryvnias
2016	183	1 045 532	31 574,2	622 936,5	82 052,8
2017	182	1 104 427	33 756,8	651 857	86 206,9
2018	181	1 163 668	35 939,5	680 777,5	90 361,1
2019	180	1 222 909	38 122,1	709 698	94 515,3

By making the calculation of the projected indicators characterizing the state of development of the credit market we can state that during the period 2016-2019 there will be a growing trend in all segments of the credit market of Ukraine.

In particular, the projected growth of the volume of bank credit portfolios at the beginning of 2019 (1 222 909 million Hryvnias) compared with the beginning of 2015 (1 006 358 million Hryvnias) [6] is expected to be 121,5%, or 216,551 million Hryvnias. Despite the projected decline in the volume of loansgiven by non-bank financial institutions in 2016 compared to 2015 – by31 574, 2 million Hryvnias [7, 8], or by 30,7%, at the beginning of 2019 one predicts the growth in the volume of lendingby non-bank financial institutions up to 38 122,1million Hryvnias. However, this indicator is still lower thatat the beginning of 2015.

The projected volume of inter-economic loans at the beginning of 2016 will decrease compared with the beginning of 2015 by96 404,5million Hryvnias – to622 936,5million Hryvnias. [9]. However, by the beginning of 2019 the volume of inter-economic lending will increase to 709 698 million Hryvnias, or by 1,14 times till the beginning of 2016 due to the unfavorable state of the economy.

The development of the segment lending by foreign economic agents has also a projected growing trend. At the beginning of 2019 the total volume of loans from abroad is expected to reach94 515,3million Hryvnias, which will exceed the volume at the beginning of 2015 by 29 292,3million Hryvnias [10] or by 144,9%.

The dynamics of the actual and projected indicators of the volumes of loans by the segments of the credit market of Ukraine during the period 2005-2019 is shown inFig. 1.
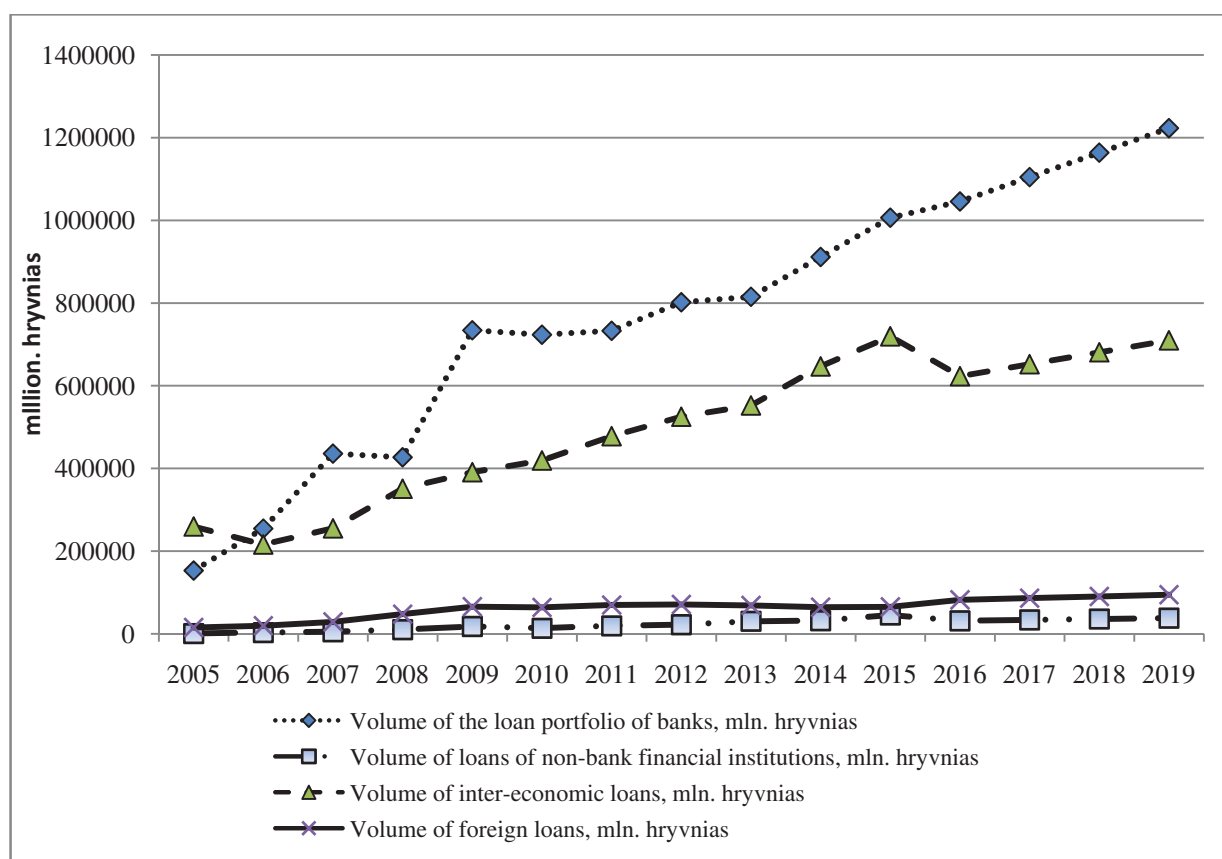
Fig. 1. Dynamics of the actual and forecast indicators in the volume of loans by segments of the credit market of Ukraine during 2005-2019, million UAH

We can conclude that the dynamics of development of the credit market in Ukraine may be steadily increasing in the forecast period of 2016-2019 without the intervention of state regulation, developing only under the influence of factors of macroeconomic environment, which were identified as important. This is confirmed by the general projected trendsin the development of all segments of the credit market determined by using regression models (3–7) shown in Fig. 1.

Based on the built regression models of the volumes of loans (3–7) according to the segments of the credit market, we can forecast the total amount of loans given to the economy of the state through the institutional subjects of the credit market in Ukraine:

$$KP = VP + VN + VG + VM = \left(0,694 \cdot P + 2469,335 \cdot B + 1830.764 \cdot S - 190592,701 \right) + \left(0.026 \cdot P - 12053.427 \right) +$$
$$+ \left(0,35 \cdot P + 44862,73 \right) + \left(0,05 \cdot P - 982,44 \right) = 1.12P + 2469.335B + 1830.764S - 158765.83$$

Thus,

$$KP = 1.12P + 2469.335B + 1830.764S - 158765.83 \qquad (8),$$

where *KP* is the total amount of loans given to the economy of Ukraine in the current year, billionHryvnias.

Therefore, we have obtained the *integrated model of the forecast development of the credit market in Ukraine*, on the basis of regression analysis, the error of which is acceptable to consider the estimatesreliable.

Conclusions

Based on this studyand the projected calculations we can say that the general dynamics of the credit market is expected to be positive despite the current crisis in the national financial sector.

The models predicting the volume of loans given to the segments of the credit market in Ukraineare based on the calculation of coefficients of correlation of the main macroeconomic parameters of the state's socio-economic development. They form the basis of an integrated model for projecting the development of the credit market in Ukraine,making it possible to enhance the validity of scientific approaches to determining the volume of loans given to the economy by certain segments of the credit market.

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