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## **NON-PERFORMING LOANS: ANALYSIS AND REGULATION**

### **1. INTRODUCTION**

The governments of many countries faced with the problem of minimization of part of non-performing loans in the loans portfolio of the banking system. The quality of credit risk management of the banking system is characterized by the share of non-performing loans to total loans. According to the IMF methodology non-performing loans are loans whose payment period expired more than 90 days or more and loans which in the last 90 days of the agreement were capitalized, refinanced, prolonged, and also loans whose payments are less than 90 days overdue but there are strong doubts that it will be implemented [*Financial Soundness Indicators...*]. A considerable volume of non-performing loans brakes investment inflowing in the economy that negatively influences rates and scales of public recreation. The non-performing loans also come forward as a destabilizing factor of the financial firmness of the country making it vulnerable to the external and internal threats. Taking it into account, there is a necessity to find out what factors the size of part of non-performing loans depends on and what regulation mechanism must be for the nonperforming loans systematically to diminish with the simultaneous increase of the volumes of crediting for overcoming of the recession.

The works of many domestic and foreign scientists, in particular O. Baranovskyy, R. Bek, N. Borkivets, R. Espinoza, J. Glen, A. Hamerle, O. Lavrushyn, R. Nabok, P. Nikiforov, M. Nkusu, V. Mishchenko, A. Moroz, A. Prasad, L. Prymostka, N. Sheludko, H. Scheule, P. Yakubik were devoted to the study of reasons of appearance of nonperforming loans, methods of their return, ways of minimization and diagnostics of a loans portfolio. Relying on scientific research and studies of practice of regulation of the nonperforming loans on loans operations by the governments of foreign countries it is necessary

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to deepen existent works with the help of application of mathematical tools and outline the possible methods of regulation of the nonperforming loans.

The aim of writing the article is to research features of governmental regulation of bank sector of developing countries and its influence on the volumes of nonperforming loans of banks and also establishing cause-effect connections of effective index – the part of inactive loans in the loans portfolio of banks of Ukraine and independent variables with the use of cross-correlation-regressive analysis, the formation of structural suggestions in relation to regulation of non-performing loans of banks.

## 2. MATERIALS AND METHODS

The banking systems of many countries are tested on firmness under the conditions of financial crisis. Countries that develop are especially vulnerable to the unfavorable financial environment. China, Poland, Russia and Ukraine belong to this group of countries. Each of these countries has approached differently to overcome problems in the economy and the efficiency of implementing fiscal policy is also different.

The best dynamics of development of efficiency of regulation of the banking system was shown by China. It is worth noticing that during a period of 2004–2007, banking systems of Ukraine and China by basic financial indicators as return on equity (%); return on assets (%); the proportion of equity in total assets (%); the adequacy of regulating capital (%); the share of non-performing loans to total loans (%); the share of coverage by insurance reserves of non-performing loans (or problem debt) (%), are identified as banking systems with the lowest level of efficiency.

However, exposing the relative indexes of financial indicators to the analysis, it is possible to observe tendencies in relation to the improvement of positions of the banking systems of Ukraine and China (share of non-performing loans had been reducing: in Ukraine in 2004 formed – 30%, in 2005 – 19,6%, in 2006 – 17,8%, in China: in 2004 – 13,2%, in 2005 – 8,6%, in 2006 – 7,1%, and share of coverage by insurance backlogs of non-performing loans of loans were increased: in Ukraine in 2004 formed – 21,1%, in 2005 – 25,0%, in 2006 p. – 23,1%, in China: in 2004 – 14,2%, in 2005 – 24,8%, in 2006 – 34,3%) (table 1).

Despite the bank practice of the majority of investigated countries for which consistently during 2004–2008 the financial indexes of efficiency of governmental regulation had a tendency of getting worse, China showed a positive trend. The share of non-performing loans of loan operations went down from 13,2% to 2,4% between 2004–2008; the share of coverage by insurance backlogs of non-performing loans of loan operations grew from 14,2% to 116,4%; return on equity increased from 13,7% to 17,1%, return on assets grew from 0,5% to

1,0%, sufficiency of regulatory capital increased from (-4,7%) to 12,0% [*Global Financial Stability Report...*]. In 2009 the share of non-performing loans to total loans of banks of China fell to the lowest level and amounted to 1.6% (for the acceptable level of 3.5%) and the share of coverage by insurance reserves of non-performing loans reached a record value and amounted to 155% [*Global Financial Stability Report...*]. Therefore, China's banking system has been resilient to the negative impact of unfavorable economic conditions.

Table 1

Financial indicators of the banking systems, %

Country	2004	2005	2006	2007	2008	2009
The share of non-performing loans to total loans, %						
Poland	14,9	11,0	7,4	5,2	4,4	7,0
Russia	3,3	2,6	2,4	2,5	3,8	9,6
Ukraine	30,0	19,6	17,8	13,2	17,4	33,8
China	13,2	8,6	7,1	6,2	2,4	1,6
The share of coverage by insurance reserves of nonperforming loans, %						
Poland	61,3	61,6	57,8	59,3	61,3	50,2
Russia	148,5	176,9	170,8	144,0	118,4	94,8
Ukraine	21,1	25,0	23,1	26,3	29,6	32,3
China	14,2	24,8	34,3	39,2	116,4	155,0
Return on assets, %						
Poland	1,4	1,6	1,7	1,7	1,6	1,2
Russia	2,9	3,2	3,3	3,0	1,8	0,7
Ukraine	1,1	1,3	1,6	1,5	1,0	-4,4
China	0,5	0,6	0,9	0,9	1,0	1,1

Source: *Global Financial Stability Report...*

By deploying financial crisis China has managed to create a proper system of stability of the banking sector, which allowed it to not only survive during the crisis, but also significantly improve financial performance indicators.

The Commission of regulation of the banking system of China plays a crucial role in the development of the banking system of China. After its appearance in 2003, the reform of the banking system of China had a more dynamic development. During reformation the Commission paid attention to the next aspects: strengthening efficiency of banking supervision, making the conditions for the balanced and stable development of the banking system of country, assistance to introduction of financial innovations, providing quality services and increase social responsibility. The commission set a cruel control for banks

in relation to inhibition by them base coefficients of financial stability, practice of corporate management and risk management.

The feature of reformation of the banking system of China is also the reason that it is a part of national reforms and its implementation comes true gradually. The systematic realization of reformation of the banking system of China prepared local banks to the competition with foreign banks, that is why financial crises were faced by the banks of China as powerful financial institutions with a sufficient capital, an effective corporate management and a fixed mechanism of risks management.

Due to the input of the strict conservative regulation of bank business, the realization of rational politics of reformation of the banking system of country, by results the economic analysis China reached the greatest level of efficiency of governmental regulation of the banking system with a tendency to its further retention.

In particular, good success at regulation of banking was shown by Polish government. Due to the proper supervision of the government, Polish bankers applied the risky methods of financing and conduct of banking activity far less than their colleagues from the other countries relying mostly on a deposit base. The Polish banks far more careful came to crediting an especially mortgage, due to which they were not grasped by problems typical for many foreign banks. Thus, during period from 2004 to 2008 the share of non-performing loans to total loans of Polish banks decreased from 14.9% to 4.4% and return on assets during all these years exceeded the threshold of profitability, which is set at 1% (in 2004 was – 1.4%, in 2005 – 1.6%, in 2006 – 1.7% in 2007 – 1.7%, in 2008 – 1.6%, in 2009 – 1.2% [*Global Financial Stability Report...*]). This situation is made possible through the efforts of authorities who have prepared and implemented in a series of legal documents (among others it is the so-called regulative package) that additionally supported and strengthened the financial system of the country. Corresponding measures from providing financial stability were also used by National bank of Poland [Mirzayan].

Undoubtedly, the degree of development of economy of country influences closely development and stability of the banking system. The stable economic growth of Poland became the consequence of forming strong foundation of economy, that was created due to realization of the considerable state converting inside the country for the last twenty years. The consistent reformation, mostly was related to preparation of the country to the membership in European Union, brought the balanced structure of economy to the state. In particular, relatively insignificant dependence of Poland from foreign markets (an export presents less than 40% of Polish GDP) during simultaneously large enough consumption at the internal market made the economy of the country resistant to the changes of the state of affairs of foreign markets. Considerable internal demand, and especially an individual consumption increased by reduction of taxes and

indexation of pensions and social payments, were able to compensate enough the falling of external demand. Although in 2009 the efficiency of banking sector went down slightly, international rating agencies gave a positive forecast in relation to further development of the Polish economy.

The regulation of the banking system of Russia during 2004–2009 has a stably average level of efficiency with an exception of 2005, with this index reaching the highest value. In 2005, the Russian economy when an export assisted the considerable increase of income part of budget, that influenced the increase of social payments and development of solvent demand. The resource base of the Russian banks was mostly formed due to profit of exporters. The passive resources of bank sector during 2004–2007 grew by about 40% annually [Navoy 2009: 29]. Directions of investment of monetary resources were limited, however the Russian exporters gave an advantage to bringing in resources from western banks and placing of the eurobonds at the international market. But the Russian banks were forced to send the money to an acquisition of shares of large exporters and placing of bonds of clients. Crediting was made in insignificant volumes for financing of the working capital of enterprises.

This explains a slight share of non-performing loans to total loans of Russian banks, particularly in the period since 2004 by 2009 it was within the permissible level (in 2004 – 3.3%, in 2005 – 2.6%, in 2006 – 2.4%, in 2007 – 2.5% , in 2008 – 3.8%). To minimize credit risk Russian banks fully formed insurance reserves to cover losses on non-performing loans, therefore, the share of coverage by insurance reserves of non-performing loans in 2004 was 148.5%, in 2005 – 176.9%, in 2006 – 170.8%, in 2007 – 144.0%, in 2008 – 118.4% [*Global Financial Stability Report...*]. During this period, return on assets was also at a high level (in 2004 – 2.9%, in 2005 – 3.2%, in 2006 – 3.3%, in 2007 – 3.0 % , in 2008 – 1.8%) [*Global Financial Stability Report...*]. In 2006 the Russian banks began the active crediting of physical persons. The rapid increase of portfolio of the consumer crediting without the proper estimation of borrowers promoted the credit risks of the banking system. The blanks in regulation of risks of the consumer crediting entailed the decline of level of efficiency to middle on a selected scale. In 2009 the share of non-performing loans to total loans of banks increased to 9.4%, the share of coverage by insurance reserves of nonperforming loans dropped to 94.8% and the return on assets decreased to 0.7% [*Global Financial Stability Report...*].

Thus, the Russian banking system came in 2009 with deep structural disproportions, caused by the increase of bad quality portfolio of the consumer crediting and instability of passive base dependent on export earnings, keeping the segmentation and low liquidity of interbank loans of market. Only rapid reaction of governmental power represented by central bank of Russian Federation and government of Russia allowed saving the middle level of efficiency of regulation of the banking system during 2008–2009.

To level the negative tendencies in banking by governmental power of Russia the considerable volumes of financial support were given to the bank and real sectors of economy, a money-and-credit mechanism was optimized. In particular, a central bank applied such measures for regulation of liquidity level as a decline of bank rate and norms of the obligatory backup; an expansion of pawnshop list of securities on the agreements of REPO; an increase of terms of the pawnshop crediting to 30 days and three months; an increase of size of correcting coefficients at the calculation of cost of providing; a decline of requirements due to the rating of enterprises whose assets are set off as providing; a weakening of rules for extra charge of backlogs for coverage of possible losses for loans operations, a grant blank credits to the banks for the term of 6 months; crediting of banks under providing of credit portfolios and bills; an indemnification of losses at the interbank market during the recall of licenses from banks, a grant of the subordinated credit to Sberbank of Russia in amount of 500 milliards rubles, an allocation of 50 milliards of US dollars as sponsorship of banks [Morgunov 2010: 41].

Thus, the governmental authorities of Russian Federation succeeded in retaining stability of the banking system however disproportions in the structure of economy and considerable dependence on foreign markets make the banking system of Russia very sensible to the external and internal threats. That is why, on condition of absence of transformation in the economy of Russia, efficiency of governmental regulation of bank sector will go down, as well as indexes of its stability.

When we talk about Ukraine, financial indicators during 2004–2007 were considerably worse comparing to the banking systems of analyzed countries, in particular, in part of management of credit risks of the banking system. Tendencies were however traced to the improvement of certain indexes: the share of non-performing loans to total loans decreased: in 2004 – 30%, in 2005 – 19,6%, in 2006 – 17.8%, in 2007 – 13.2, the share of coverage by insurance reserves of nonperforming loans: in 2004 – 21.1%, in 2005 – 25,0%, in 2006 – 23.1%, in 2007 – 26.3%, return on assets was on the appropriate level in 2004 – 1.1%, 2005 – 1.3%, in 2006 – 1.6%, in 2007 – 1.5% [*Global Financial Stability Report...*]. Till September 2008 the banking sector of Ukraine was developing dynamically: the rates of increase of bank assets presented: in 2005 – 159,2%; in 2006 – 159,1%; in 2007 – 176,2%; in 2008 – 154,7%, rates of increase of credit operations accordingly amounted: in 2005 – 161,2%; in 2006 – 171,7%; in 2007 – 180,9%; in 2008 – 163,2% [Official web-site of the National Bank of Ukraine]. It was assisted by the high rates of GDP increase (in 2005 – 102,7%; in 2006 p. – 107,3%; in 2007 – 107,9%;), considerable pace of increase of real salary (in 2005 – 120,3%; in 2006 – 118,3%; in 2007 – 112,5%;) [Official web-site of the National Bank of Ukraine], positive balance of payments balance, considerable inflow of foreign

investments, in particular, and in a bank sector (the share of foreign capital in the share capitals of banks in 2004 presented – 9,6%, in 2005 – 19,5%; in 2006 – 27,6%; in 2007 – 35,0%) [Official web-site of the National Bank of Ukraine]. However, the absence of structural reforms in the country, an inefficient structure of payments balance, an inconsistency of fiscal and monetary policy, political collisions, a liberalization of the economic regulation were unable to form reliable foundation of firmness of economy of the country to external financial indignations. An increase of credit risks, a lack of formation of backlogs for possible losses on loan operations, an inconsistency of bank assets and liabilities because of their volumes, terms and profitability led to Ukraine entering the crisis of liquidity of the banking system in autumn, 2008. The effectiveness of government regulation of the banking system declined sharply. This is supported by financial statistics: the share of non-performing loans to total loans started growing in 2008 it amounted to – 17.4%, in 2009 – 33.8%, the share of coverage by insurance reserves of nonperforming loans was at a low level in 2008 – 29.6, in 2009 – 32.3%, return on assets decreased in 2008 was 1.1%, and in 2009 became negative figure and was (–4.4%) [*Global Financial Stability Report...*]. An efficiency of the banking system went down to the lowest level what is kept till these days.

An important problem in this period, which cannot solve the state bank regulator during the period under review is a high proportion of non-performing loans to total loans in the banking system of Ukraine. Therefore there is a need to find out what factors depend on the extent of share of non-performing loans and what should be the regulatory mechanism to make this share decreased steadily in order to achieve an adequate level of financial stability of the banking sector. It leads to examining causation study the effective rate of the independent variables using correlation and regression analysis.

To carry out correlation and regression analysis we have selected output indicator  $\gamma$  – the proportion of non-performing loans in the total loan portfolio of the banking system. Selection of this indicator for correlation and regression analysis caused by the fact that it reflects the vulnerability the domestic banking system on the risks of lending activities, which is crucial at providing vital activity of the banking institution.

At the first stage for carrying out the regression analysis of effective variable we have chosen the factors that have the greatest impact on it. Based on a logical approach and by calculating the matrix of pair wise correlations between selected factors (their normalized values) as well as between each factor and effective (dependent) variables were selected factors that have the highest value of correlation coefficient with the effective variable. So we build the dependence between selected factors and effective variable ( $\gamma$ ) which were chosen as dependent variables (see table 2).

Table 2

The set of indicators to be used at regression model to determine the degree of influence of independent variables on the dependent one – the share of non-performing loans to total loans of the banking system of Ukraine (%)

Period	The share of non-performing loans	The level of coverage by insurance reserves	The weighted average interest rate on loans	The pace of credit growth
Years	$\gamma$	$\chi_1$	$\chi_2$	$\chi_3$
01.01.2006	19,60	25,00	14,60	161,20
01.01.2007	17,80	23,10	14,10	171,70
01.01.2008	13,20	26,30	13,50	180,90
01.01.2009	17,40	29,60	16,00	163,20
01.01.2010	33,80	32,30	18,30	94,30
01.01.2011	37,40	35,40	14,80	101,00

Source: *Global Financial Stability Report...*; Official web-site of the National Bank of Ukraine.

Using the software we performed the calculation of regression models for the three dependent variables. In more details we focus on the analysis of the results of the investigated effective variable  $\gamma$  – share of non-performing loans in total loans of the banking system. The results of the work with the model for searching the coefficients of regression, examining their relevance and significance of the overall model are shown in table 3.

Table 3

Statistic of research model of the share of non-performing loans in total lending operations of the banking system of Ukraine

Coefficients	Value of coefficients	Standart error	$t$ -statistics	Fishers criterion, $F$	Coefficient of multiple correlation, $R$	Coefficient of determination, $R^2$
$b_0$	89,57614	29,87532	2,998333	27,72627	0,995522	0,991064
$b_1$	-0,00886	0,780404	-0,01136			
$b_2$	-1,35922	0,764154	-1,77873			
$b_3$	-0,30838	0,058458	-5,2752			
$b_4$	-0,17333	1,593703	-0,10876			

Source: calculated by the author using the STATISTICA program.

As a result of calculations we get a multifactor linear regression model:

$$y = 89,57614 - 0,00886 \chi_1 - 1,35922 \chi_2 - 0,30838 \chi_3 - 0,17333 \chi_4.$$

The parameter  $b_0=89,57614$  defines the level of the dependent indication provided that all factors equal to zero. Parameters  $b_0, b_1, b_2, b_3, b_4$ , – partial regression coefficients. Each measures the impact of the variable on the condition that all the others remain unchanged are constants. For example, the increase factor  $\chi_1$  (level of coverage by insurance reserves of non-performing loans on credit operations) the unit value of the share of bad debts will decrease by 0,00886, with increasing factor  $\chi_2$  (weighted average rate on loans) the unit value of the share of non-performing loans will decrease by 1,35922, and with the increase of a factor  $\chi_3$  (growth rate of credit operations) the unit value of the share of non-performing loans will decrease by 0,30838. As the calculated ratios all investigated factors have a significant inverse effect on the dependent variable. The influence of other components is mediated through these components that correlate with them. Multiple correlation coefficient  $R = 0,995522$ , and the coefficient of determination  $R^2 = 0,991064$ , indicating the adequacy of the model (the model explains roughly 99% change in the share of non-performing loans in total of credit operations due to changes in: the level of insurance reserves covering problem loans, the weighted average interest rate on credits and loans growth).

To assess the reliability of the correlation characteristics Fisher's criterion  $F$  was used. If  $F$  factual  $>$   $F$  theoretical, then, with a reasonable degree of probability the existence of influence of studied factors can be argued. For our calculation  $Ff(27,72627) > Ft(0,141374)$ . Thus, the assumption of the existence of the relationship of dependent and independent variables is confirmed.

To eliminate the autocorrelation and implementation of economic forecasting, we have introduced a variable  $t$  in the regression equation where it plays the role of the time factor, and calculated for it the appropriate option of regression.

It is clear that such an economic forecast makes sense in the short period over which we can assume that the characteristics of the investigated fact will not significantly change. By using the obtained regression equation we will define the exponents of the share of non-performing loans to total loans of the banking system as of January 1, 2012 and as of January 1, 2013.

$$y_{01.01.2012} = 89,57614 - 0,00886 \times 35,40 - 1,35922 \times 14,80 - 0,30838 \times \\ \times 101,00 - 0,17333 \times 7 = 36,78635.$$

$$y_{01.01.2013} = 89,57614 - 0,00886 \times 35,40 - 1,35922 \times 14,80 - 0,30838 \times \\ \times 101,00 - 0,17333 \times 8 = 36,61302.$$

Collected data show that the share of nonperforming loans in the total loan portfolio of the banking system as of January 1, 2012 amounted to 36.8%, as of January 1, 2013 – 36.6%, which is slightly less than in 2010 – 37.4%. Complementing regression analysis with logical, it should be noted that independent factor variables significantly fluctuated during 2009–2010, under the influence of systemic financial crisis. In particular, most of this is reflected in the rate of growth of assets in the system of national banks (see table 2). Thus, over the period of 2005–2010, the average growth rate of loans was 145.05%, and as of January 1, 2011 only – 101,0%. Such an essential difference between the independent variable  $\chi_3$  as of January 1, 2011 the average value generates considerable uncertainty in the forecast regarding the reliability of the obtained result determined by numeric value. However, obtained due to conducted calculations a future downward trend in the share of non-performing loans in total of credit operations in the banking system in 2011–2012 certified regression equation is objective.

To check objectivity of predicted results of model by comparing actual data parameter of share of non-performing loans is somewhat difficult since 2011 the National Bank of Ukraine made a calculation of non-performing loans in other methodologies, which was already included not four groups of adversely classified assets, but only two of the four existing respectively the share of non-performing loans declined sharply and amounted to 14.73% (01.01.2012), and as the IV quarter of 2012 – 13.8% [*Indicators of financial stability*]. When analyzing the statistical data of the central bank, we also observe a tendency to decrease non-performing loans of banks of Ukraine (IV quarter of 2012 was amended in order to classify assets by category of quality, according to which non-performing loans include only two of the riskiest assets of the five possible).

In addition, it should be noted that according to the theory of correlation-regression analysis of economic forecasting to give credence to results, when the closer the value of the approximation error  $R^2$  to one. According to our calculations  $R^2 = 0,991064$ . That is, the coefficient of determination of the model  $R^2$  indicates its high adequacy.

### 3. CONCLUSIONS

Thus, carried out research revealed a tight correlation relationship between the share of non-performing loans in total of credit operations of domestic banks and the level of covering by insurance reserves of non-performing loans, the weighted average interest rate on credits and loans growth.

Parameters of equation clearly define significant inverse effect of independent variables on the dependent. This leads to the conclusion that with increasing of the level of covering by insurance reserves of invalid loans and the average interest rate on loans the share of non-performing loans is reduced. For this reason, the formation of reserves by standard and non-standard credit debt should be made in full scope with the establishment of strict control by the banking regulator to the rules on the formation and keeping those reserves in the appropriate accounts. However, banks should revise pricing mechanisms for credit resources. In particular, instead of creating compensation for the risk of loan default in price of credit should be improved mechanisms for assessing the creditworthiness of customers and adequate analysis of credit risk in the early stages of credit should be implemented. Reducing the average interest rate on credit resources while increasing quality requirements for credit risk assessment can broaden the scope of crediting that will reduce excess liquidity will positively affect growth rate of credit to the economy and substantially affect the decline in the share of non-performing loans in the loan portfolio of banks. Besides, a high rate of adequacy of the model ( $R^2$ ) allows to use the model to predict future tendencies of change of the share of non-performing loans in total bank loans. Thus, the analysis showed that the efficiency of government regulation of the banking system must be improved through a major reform of the real and financial sectors. In this case in the near future state regulators of banking systems to minimize the amount problem debt should focus on controlling the formation of insurance reserves by banks for possible credit risks in full scope, and make incentives to reduce the cost of bank loans with the continuous supervision of the adequacy of the application of techniques for analyzing the creditworthiness of borrowers and diversification of the credit portfolio.

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### NON-PERFORMING LOANS: ANALYSIS AND REGULATION

The analysis of the level of non-performing loans and the volumes of forming the insurance reserves for them with a time lag of 6 years (2004–2009) in developing countries (China, Poland, Russia, Ukraine) was made. The estimation of efficiency of regulatory processes to combat non-performing loans of the banking sector which were applied by these countries was provided. The correlation-regression model of establishing cause-effect relationship between effective index – the share of non-performing loans in the loan portfolio of the banking system and the independent variables was developed and tested. The recommendations on the mechanisms to minimize the amount of non-performing loans were given.

### NIECZYNNE KREDYTY: ANALIZA I REGULACJA

Zrealizowano analizę poziomu nieczynnych kredytów i objętości kształtowania ubezpieczeniowych rezerw za nimi z czasowym logem 6 lat (2004–2009) w krajach, co rozwija (Chiny, Polska, Rosja, Ukraina) się. Nadano ocenę efektywności regulacyjnych procesów co do walki z problematycznym zadłużeniem bankowego sektora, które były stosowane przez dane kraje. Opracowano i zaaprobowano korelacja-regresyjny model ustalenia przyczynowo-skutkowego związku między efektywnym wskaźnikiem – częścią nieczynnych kredytów w portfelu kredytowym bankowego systemu i niezależnymi zmiennymi. Nadano rekomendacje co do mechanizmów minimalizacji objętości nieczynnych kredytów.