ANALYSIS OF THE BANKING CRISES BY THE PANEL LOGIT MODEL WITH THE APPLICATION TO BELARUSSIAN BANKING SYSTEM

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Abstract

This paper is devoted to the problem of forecasting of the banking crisis on the base of logit model of binary choise for panel data. The model based on the data for 60 countries,including Belarus, is constructed. The possibility of using of this model in the system of early warning is assessed.

1 Introduction

Stability of the banking system gets special significance in a transition economies with emerging banking systems, which has some special features. Firstly, there is a very strong interference of the government in the banking sector, secondly, administrative methods of management has an influence on the banking sector, for example restriction of an interest rate makes banks unable to carry out the optimal risk-management policy. The problem of forecasting of the banking crises is very important for belarussian banking system either [4]. For achieving this aim different approaches which are based on the econometric models are used, e.g. logit models of binary choise for panel data [2,3,5]. The aim of this researches is the evaluation of the possibility to use this approach for analysis of the stability of the belarussian banking sector within the frame of the early warning systems.

2 Description of the econometric model

The probability of a banking crisis is estimating by using a multivariate logit model on the base of annual panel data. Let $P(i,t)$ is a dependent variable that takes the value of one when a banking crises occurs in country i at time t, and a value of zero otherwise; β is a vector of unknown coefficients and $F(\cdot)$ is the logit probability distribution function. The probability that a crisis will occur in a country i at time t is logit function of a vector of an explanatory variable $x(i,t)$. The choise of explanatory variables is determinated by economic theory with taking into account special features of the modeling banking systems. Then the model can be written in the next way:

$$Prob\{P(i,t)=1\} = F(x(i,t)'\beta), \quad i=\overline{1,N}, t=\overline{1,T},$$

where N - number of countries, T - number of years,

$$F(u) = \frac{e^u}{1+e^u}, \quad u \in \mathbf{R}^1.$$

Following Demerguc-Kunt [2] we use next initial list of variables: rate of growth of real GDP (X1), rate of change of the US$ exchange rate (X2), nominal interest rate minus the contemporaneous rate of inflation (X3), rate of change o the GDP deflator (X4), ratio of central government budget surplus to GDP (X5), ratio of M2 to foreign exchange reserves of the central bank (X6), ratio of domestic credit to the private sector to GDP (X7), ratio of bank liquid reserves to bank assets (X8), rate of growth of real domestic credit (X9), real GDP per capita (X10), index of an economic freedom (X11).

Using X1 we can identify macroeconomical shocks, which disrupt stability of the banking system by growing of non-performing loans. X2 defines presence of the currency risk in the banking sector. X4 shows the presence of the macroeconomic shocks. X6 takes into account the risk of taking banking crises by sudden outflow of capital. X7 shows the progress of the process of the liberalization in the country. X8 identifies the level of liquidity of assets. X9 shows the progress of the process of the liberalization in the country. X10 has a plus correlation with activities of the government. X11 shows the level of bureaucratization, quality of the legislation.

3 Results of the model construction

We use panel data for 60 countries, including Belarus, for 1991-2005 years. For model's parameters estimation we used the maximum likehood method, realised in Eviews 5.0, supposing that log-likehood function:

$$\ln L = \sum_{t=1}^{15} \sum_{i=1}^{60} [P(i,t) \ln F(x(i,t)'\beta) + (1 - P(i,t)) \ln (1 - F(x(i,t)'\beta))]. \qquad (1)$$

The results of model estimation shown that variables X3, X4, X5 and X9 are not statistically significant. But the model is adequate in whole. After excluding this variables from the model, the results haven't significant changes. These results are presented in table 1.

Let us present the results of economic analysis of the constructed model.

In Demerguc-Kunt [2] there is the next approach of calculating percent of predicted crisis and non-crisis situations: if estimating probability is jumped up, then dependent variable takes value one. After this transformation of dependent variable percent of predicted crisis and non-crisis situations are calculating.

In Manasoo [5] there is the next approach of calculating percentage of predicted crisis and non-crisis situations: the threshold value for each country is an expert evaluation, and if estimating probability exceeds this threshold value, then the dependent variable takes value one. After this transformation of dependent variable percent of predicted crisis and non-crisis situations are calculating individually for each country.

We use the following approach of calculating percentage of predicted crisis and non-crisis situations. All countries were grouped into 5 groups, and one threshold value was found for each group in such way to maximize percent of predicted crisis and not crisis situations. Almost all developed countries are included in the first three groups. The thresholds values are determinated, special for each group. If the estimating value of banking crisis exceeded threshold value, then in this year dependent variable took the value of one, and took zero value otherwise. After these transformations, we obtained the following results: 84% of predicted crisis, and $85 - 90\%$ of predicted non-crisis situations.

One more result of this researches is discovery the most important explanatory variables on the example of Republic of Belarus. First of all, let redefine variables: rate of growth of real GDP (X1), rate of change of the US$ exchange rate (X2), ratio of M2 to foreign exchange reserves of the central bank (X3), ratio of domestic credit to the private sector to GDP (X4), ratio of bank liquid reserves to bank assets (X5), real GDP per capita (X6), index of an economic freedom (X7). These results are presented in the table 2.

"Negative scenario 2006" means, that we take values of the variables in 2006, which characterize negative situation in the country. For example 10% decrease of real GDP, or 50% growth of US$ rate of exchange. "Change of probability" shows how the

Table 1: Results of model estimation

Variable	**Coefficient**	**Std.Error**	**z − Statistic**	**Prob.**
X1	-2.971543	0.829034	-3.584345	0.0003
X2	0.103371	0.056197	1.839452	0.0658
X6	0.000772	0.000405	1.904057	0.0569
X7	-0.716372	0.358144	-2.000235	0.0455
X8	-3.608708	2.018001	-1.788259	0.0737
X10	-3.56E-05	1.40E-05	-2.544840	0.0109
X11	0.033445	0.014220	2.351988	0.0187

Table 2: Importance of the explanotory variables

Explanatory variable	Real data 2006	Negative scenario 2006	Difference	Change of probability
X1	1.1	0.9	0.2	0.060028139
X2	1.05	1.5	-0.45	0.005918704
X3	5.7027366	15	-9.2972634	0.000930485
X4	0.2405271	0.2	0.0405271	0.003811195
X5	0.1238281	0.06	0.0638281	0.032998747
X6	3333.957	3000	333.957	0.001838989
X7	46	46	0	0

variable influence on the probability of the crisis. We use the next method to evaluate this influence: the real data for 2006 are taken, and the probability of the crisis is estimating, then the set of data for negative scenario changes the real data and we find change of probability of crisis. Let $M^{(0)}$ is real data of 2006, $M^{(1)}$ is a negative scenario 2006. On first step we calculate probability of a crisis for $M^{(0)}$ and $M^{(1)}$. After this we use the iteration formulas:

$$M_j(i) = M_{j-1}(i) \quad i \neq j, \quad M_j(j) = M^{(1)}(j), \quad i = 1, .., 7,$$

$$M_0 = M^{(0)}, \quad M_7 = M^{(1)}, \quad j = 1, .., 7.$$

It is appeared that the most important variables in sense of "Change of probability" are rate of growth of real GDP, ratio of bank liquid reserves to bank assets.

4 Conclusion

The logit model of binary choise for panel data is constructed. Statistical and economic adequancy of this model are assessed. The achieved results allow to use such kind of model in the early warning systems.

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