METHODOLOGICAL OPPORTUNITIES OF RATING MODELS FOR BANKS

Alexander Karminsky *Vladimir Sosyurko*

University – Higher School of Economics, Moscow, Russia

Abstract. *This article demonstrates some aspects of rating modeling for banks using the econometric approach. We evaluate credit ratings examinig the bank data at long period of time including the last financial crisis. Special attention is devoted to preparing the database, choosing the explanatory variables, analyzing the forecasting power and stability of the models. We analyze peculiarities of rating models for banks from different markets and regions (developed, CEE, BRIC, CIS and others), as well as differences in methodologies of the largest international rating agencies. Our econometric research uses data for banks from 86 countries for the 1995-2009 time period.*

Keywords: *credit rating, bank, financial risk, econometric model.*

1. Introduction

Ratings are playing the significant role in current financial systems, establishing an independent estimation of credit risk for various companies. More and more banks, corporations and local authorities join the rating system, and by now most entities use rating in their everyday activity. At the same time the number of banks and companies with ratings is not large.

In this paper we develop econometric models which predict long-term foreign currency credit ratings of banks using only freely accessible public information. It allows us to study factors that have an influence on the process of rating formation, to compare rating estimations among different ratings agencies and to analyze predictive power of the examined models.

We assess the basic financial and macroeconomic indicators that have the greatest effect on bank credit ratings of the three largest international agencies: Moody's Investors Service (Moody's), Standard and Poor's (S&P) and Fitch Ratings (Fitch). We create ordered choice (ordered probit) econometric models using the bank data from different countries for the 1995-2009 time period to study these indicators thoroughly.

2. Credit ratings in banking sector

The credit rating is an opinion of rating agency about the ability and willingness of an issuer, such as a bank, corporation or country, to meet its financial obligations in full and on time. This opinion is expressed in the discrete ordered rating scale, which defines group according to the credit risk of the issuer. In this paper we examine long-term credit ratings in a foreign currency that have horizon over 5 years by construction. Presence of the lag between financial data and rating is connected with time necessary for agencies to analyze creditworthiness of a company and prepare all reports as it described in [1].

It is impossible to speak truly about a bank financial condition, leaning only against the financial reporting. Along with the analysis of financial indicators, the assessment of a bank should include examination of all information concerning its activity. Credit ratings are the result of transformation of the great volume of information into public opinion concerning risk group which the issuer concerns. The basic purpose of any rating agency is to be an information intermediary.

The review of methods and principles of rating formation for international agencies has shown that rating level is depended on a wide set of financial and non-financial parameters that are difficult to formalize, see [2]. Altman and Rijken in their paper [3] benchmark credit ratings of non-financial US organizations and besides financial indicators they use size (total liabilities normalized by the total value of the US equity market) and age (number of years from the first assignment of a rating) of the companies as explanatory variables, which have a positive impact on ratings. We also use rating models for the analysis of stability of ratings which agencies declare as the methodology focused on enough big time horizon (more than 5 years). Such approach (through-the-cycle) has a prudent migration policy and don't reflect company's short-term fluctuations. The through-the-cycle methodology is designed to achieve an optimal balance between rating timeliness and rating stability.

Book [1] describes various schemes and methods of construction of rating models on the basis of the data from rating agencies, as well as default probability models and expert evaluations. Authors examine rating models for Russian banks for the first time, also they involve macroeconomic environment to the models and conduct comparative analysis of various methods of rating forecasting. Some of these methods are used in our research.

Rating process has a great importance for all participants of financial markets (issuers, investors, financial intermediaries and regulating authorities). As we have mentioned international rating agencies consider a wide set of both financial and non-financial parameters before assigning a rating. In spite of the fact that rating agencies frequently publish their rating methodologies, the detailed information remains closed. High level of closeness is explained by confidential relations between rating agencies and issuers and by competitiveness of rating business. Thus, precise parameters that determine credit ratings are not known, and we turn to econometric research, particularly to rating modeling.

Rating models can be of interest for financial market intermediaries (banks), since they help to identify risks on the basis of IRB approach that is recommended by Basel agreement [4], and for banking regulatory authorities for monitoring the condition of a banking system. Therefore in this paper we investigate possibility and methods of constructing rating models, significance values of all factors influencing ratings, and also a predictive power of such models.

During the analysis it is supposed to find answers to the following questions:

- Which financial indicators of banks have influence on their credit ratings?
- Which macroeconomic indicators are meaningful for bank credit rating?
- What time lag is necessary for rating agencies to perform the analysis of bank creditworthiness and assign a credit rating?
- Is there any dependence of bank ratings on their affiliation to group of countries (developed, emerging markets, CEE, etc.)?
- Do credit ratings of international agencies differ much and are the estimated models for all three agencies similar?

3. Econometric analysis

3.1. Theoretical aspects of rating models

Credit ratings are quantitative ordered variables; therefore we use econometric models of a multiple choice (ordered probit models) to study ratings. Here we describe theoretical aspect of such models. There is an ordered dependent variable y_i with numerical values 1, 2, 3 … k (in our case – agency-rating grades). Let there is also be an unobservable (latent) variable y_i^*, specified by the equation:

$$y_i^* = x_i'\beta + \varepsilon_i, \qquad (1)$$

where x_i is a set of explanatory variables for bank-year observation i. All errors ε_i are independent and have a normal function of distribution $F(z)$. Here y_i is related to y_i^* as follows:

$$\begin{cases} y_i = 1 \ \ if \ \ y_i^* \le c_1, \\ y_i = r \ \ if \ \ c_{r-1} \le y_i^* \le c_r, \ 2 \le r \le k-1, \\ y_i = k \ \ if \ \ y_i^* \ge c_{k-1}, \end{cases} \qquad (2)$$

where c_r and c_{r-1} are the lower and upper boundaries for the y_i^* to obtain rating grade r. Assuming equations (1) and (2) to be true, the probability that y_i equals r is specified by:

$$\begin{cases} P(y_i = 0) = F(c_1 - x_i'\beta), \\ P(y_i = r) = F(c_{r-1} - x_i'\beta) - F(c_r - x_i'\beta), \ 2 \le r \le k-1, \\ P(y_i = k) = 1 - F(c_{k-1} - x_i'\beta). \end{cases}$$

All unknown parameters are estimated with a maximum likelihood procedure. Also the generalized Huber–White standard errors are computed, thus relaxing the homoscedasticity assumption and the assumption of independency among observations of the same bank.

As a numeric scale for ratings we have chosen a "mixed scale" with narrow tails used in paper [5], since it improves statistical forecast properties of the models and keeps all explanatory variables significant. Thus, high and low ratings are consolidated into groups, and all middle-class ratings are represented by exact rating grades. Totally there are 12 values in this scale (k=12). It should be noticed that smaller numbers correspond to higher ratings, therefore variables with negative β coefficients in our models have positive influence on ratings, and on the contrary.

3.2. Sample

Financial data and credit ratings of banks have been obtained from Bloomberg database, therefore most of banks have one or more trading securities, and their financial reporting is constituted under the IFRS. Macroeconomic indicators of bank countries of domicile are taken from the GMID (Global Market Information Database). All financial indicators we have used in research are annual.

Final sample consists of 5629 observations including data for 551 banks from 86 countries during 1995-2009. Each observation is defined by bank and year and comprises number of financial indicators, as for a bank, and country to which it belongs. Credit ratings of banks are included in observations with time lag. The majority of observations apply to banks from USA

(622), Japan (526), France (189), Italy (188), Turkey (164), India (154) and Russia (145) (see Figure 1). Developing countries are represented by 30% of all observations and developed countries include 50% of the sample.

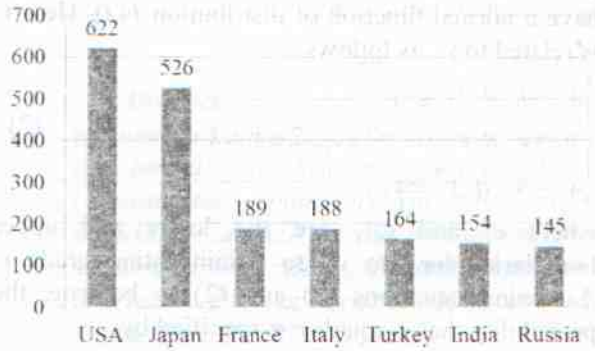

Figure 1. Number of observations by countries

Developing countries are represented by 30% of all observations and developed countries include 50% of the sample.

3.3. Analysis of the model variables

Final set of variables and properties of rating models are presented in Table 1.

As expected positive influence on agency-ratings has been shown by the size of a bank (natural logarithm of total book value of assets) and capital ratio, since they are being important bank indicators according to [4]. Squared values of mentioned parameters have been insignificant for most models. Involving total risk-based capital ratio as explanatory variable considerably improved statistical properties of rating models except for Fitch agency. The retained earnings to assets ratio has also shown a positive influence on ratings because this parameter ensures bank financial strength.

Value of loan loss provisions reflect credit risk and non-returns from customers, as consequence, possibility of bank default because of failure to meet obligations; therefore this factor has a negative influence on ratings. Also it shows bank appetite to risk which is not welcomed by rating agencies. Negative effect is also provided by high borrowings (long-term debt to assets ratio), since rating agencies carefully follow the level of debt repayment. The increase in interest expenses to interest income ratio characterizes the low efficiency of bank' primary activity (intermediary in a money-market), that also is negatively evaluated by rating agencies.

Cash and near cash items to total liabilities ratio is used as a proxy of current liquidity but has a negative influence on ratings. Probably, it is connected with non-linear dependency (function is U-shaped), and the fact that high level of low-profitable assets reduces the financial strength of the bank.

Country distinctions are characterized by several macroeconomic variables.

Corruption Perception Index (CPI) measures the perceived level of public-sector corruption and has been published by Transparency International organization since 1995. The less it is, the higher corruption level is in the country, and, as expected, the lower agency-rating estimations for banks are. In all models this factor has shown high significance (less than 1%). Thus, corruption is one of the major criteria showing external environment conditions created for banks. Variable also has a correlation with real GDP per capita which has shown a smaller explanatory power in our models. Dependence has appeared with the same sign – bigger gross domestic product value of the country corresponds to higher bank credit ratings there.

Exports to import ratio positively influences credit ratings of banks and speaks about favorable economic circumstances in a country. It also has a strong correlation with the current account balance to GDP ratio and weak correlation with the inflation rate. We have chosen inflation to be added in final models.

Annual rate of inflation instinctively has a negative influence on agency-ratings, since there are higher financial risks in countries with high inflation. Usually it is characterized by increased level of failures to deliver and perform obligations properly and general problems for financial assets accessibility.

In order to investigate other country distinctions we have added dummy variables to reflect relations of banks to different groups of countries and regions. Such dummies include developed countries, CIS, BRIC, emerging markets, etc. (1 – "belongs", 0 – "doesn't belong"). Base models for each of three agencies (without dummy variables) are presented in Table 1. We examine the influence of bank affiliation by including dummies to base models. The result of modeling is presented in Table 2.

We can see the negative signs of the explanatory dummies of affiliation with developing markets, which is quite logical, should also be brought to attention. It speaks of higher rating "ceiling" for the developed countries that show better economic environments.

The difference of evaluations of Russian in comparison with banks of developed market should also be noted (for reasons that include the level of corruption and political risk). Actually, this indicates the potential growth for bank ratings in CIS countries.

Credit ratings of banks located in Central and Eastern Europe countries are higher than in emerging markets, BRIC and CIS. CEE is characterized by fast transition to capital markets and the big aspiration to enter EU. Their level of ratings is similar to developed countries.

3.4. Evaluation of the time lag

As we have noticed earlier, ratings have a long time of actualization, and it should be considered when constructing econometric models. Our analysis of such delay between financial data and ratings confirms the given aspect. We have examined rating models with various time lags for ratings from 0 to 2 years (with 3 months step). Lag estimation has been performed by calculating and choosing from better statistical parameters of our models: pseudo R^2 and accuracy of forecasting of a rating. The last criterion includes two values: the percent of an exact rating prediction ($\Delta=0$) and percent of a prediction with an error no more the one second gradation of a numeric scale ($|\Delta|\leq 0.5$). Here Δ is the difference between predicted and actual values of ratings (in the numerical scale of grades).

Time lag has been shown to be around 0.5–1.5 years with 1-year extremum which is extraordinary flat. It means that 1-year time lag doesn't give much advantage on predictive power of models. It speaks of the fact that agencies rate banks with various delays, in dependence of many factors, such as the size and structure of a bank, country of domicile, phase of economic business cycle, individual relations between rating agency and bank and other peculiarities. Therefore we assume the recommended time lag between financial data and ratings should be equal to one year as we have initially chosen for our models.

3.5. Statistical properties of rating models

Distribution of a standard error of models is also investigated. The analysis has shown that there is a small negative asymmetry with longer left tails of distribution (see Figure 2), i.e. ratings predicted by econometric models are higher than actual agency estimations (our models overestimate ratings). For S&P and Fitch rating agencies coefficients of skewness are equal to -0.256 and -0.241. For Moody's rating agency displacement is more essential and equals to -0.550. Thus, ratings of all received models are less conservative, than actual. Probably this is caused by prevalence of banks from developed countries with high ratings in our sample which has a great influence on estimated models.

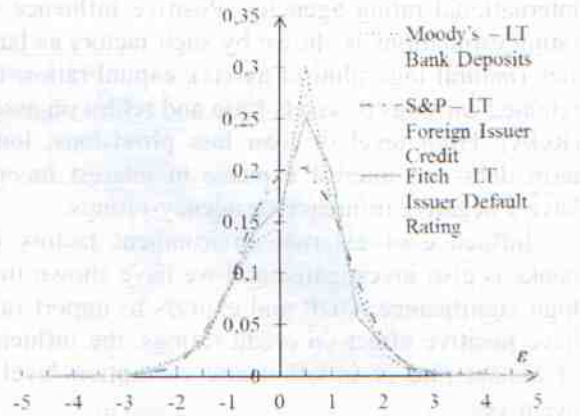

Figure 2. *Error distribution of rating models*

The percent of exact predictions lies within the range of 40-44% depending on a rating agency. Forecasting of ratings with an error of no more than one gradation of numerical rating scale is about 90-91%, and within two grades – is more than 99%.

3.6. Comparative analysis of rating agencies

To compare credit ratings of agencies among themselves, observations for all of three agencies have been united in one pulled sample. Analysis has been made by introducing to our rating model dummies for every pair of agencies as dependent parameters. These dummies show affiliation of rating with one of the agency. Such transformation allows getting a large sample, as number of banks with credit ratings of several agencies is considerably small. Our models also consider financial condition of banks (we have kept all financial explanatory variables used in previous models), so it helps to take into account characteristics of different banks.

The results have shown that the most conservative rating agency is S&P, its level of rating estimations is lower than of other agencies. If we include Moody's and Fitch dummies into model for our pulled sample, β coefficients are equal to 0.45 for Moody's, and 0.32 for Fitch rating agency dummy correspondingly. Thus, Moody's ratings on average are higher than Fitch ratings. The significance of all parameters has been remained at high level.

Obtained results can be used for credit rating comparison of Moody's Investors Service, Standard & Poor's and Fitch Ratings agencies. They are also important for agency-rating forecasts, especially when ratings of one or two other agencies are known.

4. Conclusion

In this research we have examined the influence of financial indicators on banks credit ratings of

international rating agencies. Positive influence on rating estimations is shown by such factors as bank size (natural logarithm of assets), capital ratios, the retained earnings to assets ratio and return on assets (ROA). High level of loan loss provisions, long-term debt and interest expense in interest income have a negative influence on agency-ratings.

Influence of external environment factors for banks is also investigated and we have shown their high significance. GDP and exports to import ratio have positive effect on credit ratings, the influence of annual rate of inflation and corruption level is negative.

Affiliation of banks to developed countries and CEE means higher credit ratings, rather than emerging markets. Even with allowance for macroeconomic parameters developing countries have rating ceilings that speaks of weak economic environment and high geopolitical risks.

Investigation of predictive power of rating models gave the following results. The percent of exact predictions was on the level of 40-44%. Forecast with an error of no more than one gradation was around of 90-91%.

We also recommend considering a 1-year time lag for ratings that is used in models. Rating models can be used for a remote forecast of credit ratings on the basis of open information. Therefore participants of financial markets and regulating authorities can predict original agency-rating estimations, and also evaluate credit organizations that doesn't have assigned ratings.

Comparison of credit ratings for three rating agencies has shown that S&P is the most conservative rating agency in banking sector. It assigns lower ratings all other conditions are the same. Moody's credit ratings are the highest and Fitch have an average level of rating estimations.

Further research of methods and new approaches of rating formation should be conducted to increase predictive power of rating models. Among such approaches we consider the analysis of panel data, introduction of new financial indicators to the model and estimation of non-linear dependences, analysis of sensitivity of banks to the market, dependency on the bank type (saving, investment, etc.), influence of ownership structure (state, private, foreign) and other.

References:

[1] Karminsky, A., Perestsky, A. and Petrov, A. (2005) *Ratings in economy: methodology and practice* (In Russian). Finance and Statistics Publishing House.

[2] Altman, E., Saunders, A. (1998) *Credit risk measurement: Developments over the last 20 years.* Journal of Banking & Finance, 21, pp. 1721-1742.

[3] Altman, E., Rijken, H. (2004) *How rating agencies achieve rating stability.* Journal of Banking & Finance, 28, pp. 2679-2714.

[4] Basel II (2004) *International convergence of capital measurement and capital standards. A revised framework.* Bank for International Settlements, Basel Committee on Banking Supervision.

[5] Peresetsky, A., Karminsky, A. (2008) *Models for Moody's bank ratings.* Bank of Finland, BOFIT Discussion Papers, 17.

Contacts:

Prof.Des. Alexander Karminsky
karminsky a mail.ru

DTS Vladimir Sosyurko
vsosyurko a mail.ru

University – Higher School of Economics,
20 Myasnitskaya Ulitsa, Moscow, 101000,
Russia

Table 1. Rating models with financial indicators only

Variable	Expected influence	S&P – Issuer Credit	Fitch –Issuer Default	Moody's – Bank Deposits	Moody's – BFSR
Ln (Assets)	+	-0.517*** (0.024)	-0.548*** (0.020)	-0.481*** (0.023)	-0.318*** (0.019)
Equity Capital/ Total Assets	+	-2.887*** (0.291)	-2.012*** (0.428)	-2.814*** (0.265)	-1.811*** (0.260)
Total Risk-Based Capital Ratio	+	0.038*** (0.010)	0.008 (0.009)	0.016* (0.009)	-0.014* (0.007)
Loan loss provision/ Total Assets	-	43.641*** (6.020)	39.431*** (6.110)	14.768*** (3.308)	11.472*** (4.205)
Long Term Debt/ Total Assets	-	0.008* (0.005)	0.015** (0.008)	0.024*** (0.004)	0.022*** (0.004)
Interest Expenses/ Interest Income	-	0.288*** (0.046)	0.158** (0.073)	0.331*** (0.068)	0.122** (0.058)
Retained Earnings/ Total Assets	+	-9.148*** (2.548)	-5.247*** (0.826)	-1.193* (0.780)	-2.472*** (0.739)
Cash and Near Cash Items/ Total Liabilities	+	1.442** (0.641)	1.136** (0.486)	1.651*** (0.637)	1.904*** (0.440)
Corruption Perception Index	+	-0.325*** (0.017)	-0.268*** (0.017)	-0.387*** (0.015)	-0.337*** (0.014)
Annual Rate of Inflation, %	-	0.034*** (0.012)	0.050** (0.010)	0.025*** (0.006)	-0.012** (0.006)
Pseudo R^2		**0.265**	**0.242**	**0.277**	**0.183**
Akaike Info Criterion		3.244	3.395	3.239	3.829
Number of Observations		1812	1991	1787	1897

*, **, *** signify 10%, 5% and 1% level of significance, respectively.

Table 2. Rating models for different markets and regions

Variable	Expected influence	S&P –Issuer Credit	Fitch –Issuer Default	Moody's –Bank Deposits	Moody's – BFSR
Base model (no dummies)		-	-	-	-
Pseudo R^2		**0.265**	**0.242**	**0.277**	**0.183**
Russia	-	0.572** (0.572)	0.515*** (0.189)	0.418 ** (0.079)	0.256** (0.111)
OECD	+	-0.152* (0.085)	-0.233*** (0.088)	-0.418 *** (0.079)	-0.013 (0.070)
Pseudo R^2		**0.266**	**0.243**	**0.282**	**0.183**
Developed Countries	+	0.376*** (0.135)	0.417*** (0.114)	0.153 (0.109)	0.206** (0.096)
Emerging Markets	-	0.867*** (0.155)	0.638*** (0.119)	0.833*** (0.109)	0.095 (0.087)
Pseudo R^2		**0.272**	**0.246**	**0.288**	**0.183**
CIS	-	0.604** (0.238)	0.428*** (0.192)	-0.143 (0.152)	0.375*** (0.106)
CEE	+	-0.093 (0.182)	-1.118*** (0.129)	-1.032*** (0.101)	0.199** (0.084)
Developed Countries	+	-0.079 (0.099)	-0.116 (0.094)	-0.467*** (0.081)	0.180** (0.083)
Pseudo R^2		**0.266**	**0.253**	**0.290**	**0.184**
BRIC	-	0.885*** (0.108)	1.017*** (0.102)	0.595*** (0.097)	0.196** (0.085)
CEE	+	0.119 (0.184)	-0.961*** (0.122)	-0.777*** (0.100)	0.173** (0.083)
Pseudo R^2		**0.272**	**0.261**	**0.291**	**0.183**

*, **, *** signify 10%, 5% and 1% level of significance, respectively.