ANALYSIS OF FINANCIAL STABILITY OF THE BELARUSIAN ECONOMY BASED ON MICRODATA AND EXPERT INFORMATION

V.I. Malugin[1], A.Yu. Novopoltsev[1], N.V. Hryn[2]

[1]*Belarusian State University, Minsk, BELARUS*
[2]*Yanka Kupala State University, Grodno, BELARUS*
e-mail: malugin@bsu.by, novopsacha@gmail.com, lebnat@tut.by

Abstract

In the practice of a central bank, prudential indicators based on aggregated macroeconomic and financial data [1] are used to analyze financial stability of the banking system. There is an evidence that it's may be not enough to use aggregated macroeconomic and financial data to identify situations of growing systemic risks threatening economic and financial stability [2]. Obviously, the financial stability of the banking sector and the economy as a whole essentially depends on the financial state (creditworthiness) of certain categories of enterprises, as well as the level of credit risk for various sectors of the economy. For this reason, firm-level data is going to be more appealing for central banks. It's reported that, in contrast to aggregated economic and financial data, microdata allow for more flexible and differential analysis. This makes the statistical indicators of solvency and financial stability based on microdata a useful complementary tool for analysis of actual economic and financial processes.
Keywords: data science, financial stability, microdata, expert information

1 Issues of traditional methodology

In international practice microdata and macroeconomic indicators are used in various applications related to the estimation of statistical credit risk models and probability of default at the macro level and for individual companies. Depending on data and indicators used, the following set of models may be applied [3]: 1) models based on balance sheet data of companies; 2) models based on microdata and stock market statistics; 3) models based on macroeconomic and stock market indicators; 4) credit scoring models; 5) hybrid models that allow using both microdata and macroeconomic indicators.

In [3] some of the models listed above are estimated on Belarusian data, and the issues related to their application are reported. The most critical issues related to practical application of the models proposed are the following: 1) lack of a mechanism for formation stock prices that comes from insufficient development of the financial market; 2) lack of credit ratings for the majority of Belarusian companies.

All this does not allow applying models based on indicators of a stock market and credit ratings. Another obstacle for the effective application of the models proposed is a priori endogenous-exogenous structure dictated by the developed economies. Problems can arise from taking into account the properties of the Belarusian economy,

as well as possible changes in the economic policy, for example, a gradual reduction in issuing new loans for state programs. In this regard, the most promising type of model for assessing the financial stability of the Belarusian economy is one based on balance sheets microdata, as well as hybrid models incorporating macroeconomic and prudential indicators.

The process of construction models based on microdata, however, is associated with a number of specific issues. As noted above, microdata allow for more flexible and differentiated analysis. Differentiated analysis of solvency involves the partitioning of the set of companies from a particular sector of the economy into classes corresponding to different levels of credit risk. In this case, the most important issue is to identify correctly the class corresponding to the state of default. To distinguish the companies in the default, statistics on the defaults derived for the model estimation period is necessary. The first issue related to models based on financial statements of companies is the lack of actual statistics on the defaults. That makes it difficult to unambiguously formalize the definition of default and forces the researchers to replace actual statistics with some proxies such as unprofitable companies frequency that cannot always be justified [3].

To solve this problem from the point of international experience, it is recommended to use the data of the Credit Register of the National Bank of the Republic of Belarus. The data are compiled on a daily basis and include the credit histories of the majority of companies. In particular, it is may be used for construction of statistical indicators of credit risk based on widely used criteria of default. An example of such indicator is an estimate of probability of default as relative frequency of accounts with past due payments. In the Basel framework default is defined as: "90 days past due on debt or interest payment by a contract" [4].

The application of generally accepted criteria of default on microdata requires estimation of creditworthiness for different categories of companies. For example, large state-owned enterprises (SOE) have soft budget constraints with their positive (high probability of financial support by government) and negative consequences (strengthening the relationship between the insolvency risk of enterprises, credit risk for banks and fiscal risks for the government) [3]. As SOE constitute a large part of the real sector of the economy, these features like "soft budget constraints", which are not taken into account, may significantly bias the estimates of credit risk measures derived according to international standards. Therefore, along with the generally accepted default criteria, it is recommended to use alternative "expert" criteria taking into account the specific features of credit risk assessment process in the Belarusian economy. To illustrate that, Figure 1 shows line plots of expert indicators of financial stability estimated on a sample of companies in each quarter: an average integral statistical credit rating based on cluster analysis (ind_rating, right scale) is compared with one indicator that is purely statistical combination of some expert criteria (ind_best) and another one estimated by IMF methodology (ind_imf) [7]. Obviously, both indicators have similar dynamics to statistical rating, but IMF indicator differs in larger extent after the crisis period of the 2016 year that shows that expert information may help to introduce some corrections to statistical methodology.

Figure 1: Comparative analysis of aggregated indicators of financial stability

2 Developed methodology and software

To assess the financial stability of the economy using microdata on a regular basis, it is necessary to take into account the features of the Belarusian economy and possible risk factors, as well as to develop methodology, modeling tools and software for calculating economic and financial indicators, and applying for that statistical, machine learning, and big data techniques.

As a part of this study, methodological, model and software tools intended to build statistical indicators of the creditworthiness of the real sector of the economy and the financial stability of the banking sector based on the financial statements of companies and available expert information. To build these indicators, we used representative sample of enterprises from the real sector of the economy that are mainly SOE and generate a large part of revenues and profits in Belarusian economy.

Unlike earlier studies [5, 6], in this research we also utilized available expert information in a form of economically reasonable criteria used in real practice to assess financial state of the Belarusian enterprises based on their balance sheets statements.

Statistical indicators of creditworthiness at the micro and macro levels include the following: statistical credit ratings of companies corresponding to the credit risk groups (from 1 to 4); average credit rating for an economic activity; average credit rating for the whole sample of companies which represent integral indicator of the creditworthiness for the economy as a whole [6]. For a given set of expert criteria of default and the proposed integral criteria, which take into account expert information, statistical indicators of financial stability are calculated as estimates of the probability of default. The proposed statistical methodology is implemented using statistical and machine learning algorithms in Python programming language.

A joint econometric analysis of prudential and financial stability indicators of the banking sector and the indicators based on microdata shows their significant correla-

tions, both at the level of the main industries, as well as at the level of the real sector of the economy. In particular, the leading nature of the integral indicator of the creditworthiness of the economy is revealed in relation to the capital adequacy ratio. An estimate of the probability of default for the dominant integral criterion (covers over 50% of enterprises that are vulnerable according to at least one expert criteria proposed) also demonstrates the leading dynamics with respect to the problem debt share from borrowers (at the level of the banking sector). The discovered relations are important for validation of the proposed statistical indicators and their further practical application. The advanced features of the proposed statistical indicators allow them to be used as exogenous variables in more complex econometric models on extended data sets. In case of fast retrieval of initial data, it can be used as independent indicators for the vulnerabilities diagnostics of the banking sector with an aim of early warning of systemic risks that threaten economic and financial stability.

References

[1] Pashkevich A.V., Vlasenko M.N. (2017). Instruments of macroprudential policy: European experience, perspectives for Belarus. National Bank of Belarus. Bank Bulletin. No. **12**, pp. 11-18. (in Russian)

[2] Bank for International Settlements (2017). Uses of central balance sheet data offices' information. *IFC-ECCBSO-CBRT Conference on "Uses of Central Balance Sheet Data Offices information"*. Ozdere–Izmir, Turkey, 26 September 2016.

[3] Vlasenko M.N., Tkachev A.I. (2017). Estimation of probability of default for the enterprises of a real sector of economy. National Bank of Belarus. Bank Bulletin. No. **1**, pp. 18-26. (in Russian)

[4] Bank for International Settlements (2005).Basel II: Revised international capital framework.

[5] Malugin V., Hryn N., Novopoltsev A. (2014). Statistical analysis and econometric modelling of the creditworthiness of non-financial companies. *International Journal of Computational Economics and Econometrics*. Vol. **4 (1/2)**, pp. 130-147.

[6] Malugin V.I., Novopoltsev A.Yu., Hryn N.V., Milevsky P.S. (2018). Statistical analysis of creditworthiness of real sector of Belarusian economy with microdata *Bank Bulletin. – A special issue "Bank Research"*. No. **14**. (in Russian)

[7] Information portal of International Monetary Fund. Mode of Access: https://www.imf.org/. Date of Access: 20.10.2018.