PANEL STUDY OF LOAN LOSS PROVISIONS

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1. Introduction

Using loan loss provisions to "smooth" the financial performance of commercial banks is not an unfamiliar phenomenon. The motives of commercial banks for the management of this process are diverse. It is believed that the main reasons can be divided into three groups: achievement of the regulatory requirements to bank capital adequacy, creation of hidden reserves and control of the financial performance, etc. [1, p.42]. Balancing between the objective need and making an attempt to manipulate accounting data the transactors form rules and trends typical of a particular sector or industry. These rules and trends are disclosed and characterized using specific econometric techniques. The enrichment of the structure of data of the activities of the commercial banks and the improvement of the econometric methods requires also development of the techniques for their study. A goal of this article is the development of econometric techniques for evaluation of the impact of selected factors on loan loss provisions.

2. Overview of the literature

A number of empirical studies using various econometric techniques, factors, models, evaluation methods, etc., were used to clarify the impact of loan loss provisions on the management of the financial result. They include classical studies of the management of financial performance of American banks [2, p.4], studies with extended scope of the factors of commercial banks [3, p.10] and others. The first econometric study of the impairment of loans in Bulgaria was conducted for the period 2005–2008 [4, p.259]. The latest study of the management of the financial performance of commercial banks with improved econometric technique was carried out for the period 2007–2010 [5, p.295].

The study of loan loss provisions utilizes classical regression techniques consisting of use of linear models, estimation through the simple method of the least squares and dummy binary variables. For example, J. Zhou and K. Chen use a classical linear regression model with 17 variables, including 3 dummy variables [3, p.26]. 989 observations were used for the period 2000–2001 to assess the regression model. "Bank Compustat" is used as a source of statistical information. In their study F. Filipova et al. also applied a linear regression model with 10 factors including 3 dummy variables [4, p.286]. 35 observations for the period 2005–2008 were used to assess the regression model. The annual financial statements of commercial banks were used as a source of statistical information. The replica of the above study is based on a similar model divided into three parts in order to achieve statistical reliability [5, p.305]. 58 observations for the period 2007–2010 were used for the evaluation. The annual financial statements of commercial banks were used as a source of information.

What is common between the used econometric techniques is the classical regression analysis. A linear multifactor model is used for the investigation of the relationship between loan loss provisions and the determining factors. The simple method of the least squares is used to evaluate the parameters. The studies differ in the selection of factors, the selection of the dummy variables, etc. It should be noted that the studies generally use a matrix of data having the nature of panel data. This creates preconditions for violation of the conditions for application of the regression analysis. Therefore, the recent research in this area tends to diversify and refine the econometric techniques used to study the management of financial performance [6, p.119].

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3. Panel approach

Panel data are used to evaluate the parameters of the discussed models as an effort to obtain more reliable estimates. This is achieved by multiple increase of the number of observations. The application of simple regression without taking into account the panel structure of the data leads to evaluation of parameters which are supposed to remain unchanged over time and are the same for all units of the panel. These assumptions are not always sufficiently justified. They need to be tested before using a simple linear regression with a panel data structure. In panel models this assumption does not apply to all parameters but only to the parameters before factor variables or before some of them. This condition must be also checked by an appropriate statistical test.

The most commonly used linear panel models are divided into two basic types: fixed-effects regression and random-effects regression. The main difference between them is the assumption of non-correlation of unobservable effects and factor variables in the random-effects regression model. After evaluation of the fixed-effects regression model, apart from the other diagnostic tests typical of linear regression models, there is also an investigation of the statistical significance of individual fixed effects [7, p.13]. This involves examination of the homogeneity of the free member and is based on the F-test. In the linear panel model with random effects, apart from the other diagnostic tests, use is made also of the LM test of Breusch and Pagan for random effects [7, p.59]. It tests whether the value of the dispersion of unobserved individual effects is zero. In addition, the test of Hausman should also be applied in order to select between a fixed-effects model and a random-effects model [8, p.288].

4. Econometric model

This study is based on earlier studies of loan loss provisions conducted using classical regression techniques [4, pp.259–298; 5, pp.295–309]. The panel study includes the commercial banks which are licensed by the Bulgarian National Bank, operate on the territory of Bulgaria and have published complete annual statements for the period 2007–2010. After adjusting the statistical data the number of the studied banks decreased to 19 from the initial 30. The final panel sample consists of 76 observations over a period of four years. The following panel model was applied to assess the effect of the individual factors on the loan loss provisions:

$$LLP_{it} = a_0 + в_1 BSIZE_{it} + в_2 BIG4_{it} + в_3 CAR_{it} + в_4 \Delta LP_{it} + в_5 LWO_{it} + в_6 NPL_{it} + в_7 SIZE_{it} + в_8 EBTP_{it} + в_9 DUMMYFOWN + в_{10} DUMMYLISTED + e_{it} \quad (1)$$

where LLP $_{it}$ – Loan loss provisions/total loans;

BSIZE $_{it}$ – Number of board members;

BIG4 $_{it}$ – Dummy variable: 1 – if auditor is any of the four big auditing companies; 0 – if the auditor is different from the four big auditing companies;

CAR $_{it}$ – Capital adequacy ratio;

ΔLP $_{it}$ – Change in loan portfolios (thousand BGN);

LWO $_{it}$ – Write-offs loans/ total assets;

NPL $_{it}$ – Non-performing loans/total loans;

SIZE $_{it}$ – Log of total assets;

EBTP $_{it}$ – Earnings before taxes and loan loss provision/total assets;

DUMMY FOWN – Dummy variable: 1 – if it is a foreign bank with majority ownership; 0 – if it is a Bulgarian bank with majority ownership;

DUMMY LISTED – Dummy variable: 1 – if it is a public bank which is listed on the Bulgarian Stock Exchange; 0 – if it is not.

ε_{it} – stochastic component;

α_0, β_1, β_2, β_3, β_4, β_5, β_6, β_7, β_8, β_9, β_{10} – parameters of the model;

i – serial number of the bank;

t – serial year.

5. Empirical results

The admissibility of pooling together the data from a simple regression and a panel model with dummy variables of time was checked on the basis of model (1) and the F-criterion of Chow [7, p.57]. The results are presented in Tab. 1.

Tab. 1. Chow's F-test of the poolability of the panel data

Years included in the panel	P-value
2007–2010	0,000*
	0,000**
2007–2009	0,021*
	0,136**
2007–2008	0,725*
	0,528**
2008–2010	0,001*
	0,002**
2008–2009	0,118*
	0,509**
2009–2010	0,010*
	0,007**

* simple regression
** panel fixed-effects regression

It was found that for all variants of the panel, including 2010, it was impossible to pool the data. Other variants of the panel are admissible. An important conclusion can be made on the basis of these results that the correlation modeled by (1) has changed significantly in 2010 compared to the previous period. This is interpreted as a change and a reconsideration of the arguments and motives used by the bank management with regard to the management of the financial performance in 2010 as a result of the coming financial crisis.

Model (1) is considered in three variants of panel models. The first panel model (M1) is assessed for the period 2007–2009 with fixed and random effects and includes 8 basic factors:

$$LLP_{it} = a_0 + \beta_1 BSIZE_{it} + \beta_2 BIG4_{it} + \beta_3 CAR_{it} + \beta_4 \Delta LP_{it} + \beta_5 LWO_{it} + \beta_6 NPL_{it} + \beta_7 SIZE_{it} + \beta_8 EBTP_{it} + e_{it} \quad (2)$$

The second panel model (M2) is assessed for the period 2007–2009 with fixed and random effects and includes 8 basic factors plus dummy variable "DUMMY FOWN". The latter reflects the effect of foreign majority ownership:

$$LLP_{it} = a_0 + \beta_1 BSIZE_{it} + \beta_2 BIG4_{it} + \beta_3 CAR_{it} + \beta_4 \Delta LP_{it} + \beta_5 LWO_{it} + \beta_6 NPL_{it} + \beta_7 SIZE_{it} + \beta_8 EBTP_{it} + \beta_9 DUMMYFOWN + e_{it} \quad (3)$$

The third panel model (M3) is assessed for the period 2007–2009 with fixed and random effects and includes 8 basic factors plus dummy variable "DUMMY LISTED". The latter reflects the effect of the listing of the bank on the Bulgarian Stock Exchange:

$$LLP_{it} = a_0 + \beta_1 BSIZE_{it} + \beta_2 BIG4_{it} + \beta_3 CAR_{it} + \beta_4 \Delta LP_{it} + \beta_5 LWO_{it} + \beta_6 NPL_{it} + \beta_7 SIZE_{it} + \beta_8 EBTP_{it} + \beta_{10} DUMMYLISTED + e_{it} \quad (4)$$

The panel models were evaluated with Stata 10.0. The selection between fixed-effects panel models and random-effects panel models was performed with the Hausman test. The results are presented in Tab. 2.

Tab. 2. χ^2 Hausman test for model selection

Panel model	χ^2	P-value
M1	10.34	0.11
M2	13.92	0.04
M3	14.18	0.02

It was found that with significance level of α=0,05 the Hausman test is unconvincing with regard to model M1. In this case the LM test of Breusch and Pagan (P-value=0,03) was used which provides grounds for preferring the fixed-effects panel model. The alternative hypothesis is accepted in the study of models M2 and M3 through the Hausman test. Therefore, the fixed-effects panel models are preferred again. The main results from the evaluation of the three panel models are presented in the following table.

Tab. 3. Evaluations of fixed-effects panel models

Variables	Model M1		Model M2		Model M3	
	β	P value	β	P value	β	P value
Intercept	-.025	0.791	-.039	-.228	-.025	0.791
LWO it	**1.762**	**0.000**	**1.848**	**0.000**	**1.762**	**0.000**
NPL it	.024	0.589	.024	0.579	.024	0.589
SIZE it	.005	0.399	.005	0.396	.005	0.399
EBTP it	**.933**	**0.001**	**1.125**	**0.000**	**.933**	**0.001**
BSIZE	-.006	0.228	-.004	0.449	-.006	0.228
ΔLP	-2.33e-09	0.506	-2.08e-09	0.542	-2.33e-09	0.506
CAR it	6.04e-06	0.995	-1.92e-06	0.999	6.04e-06	0.995
DUMMY FOWN	–	–	-.016	0.114	–	–

The assessed models are adequate. For model M1 F (7,31)=6,32 and P<0,000, for model M2 F(8,30)=6,15 and P<0,000 and for model M3 F(7,31)=6,32 and P<0,000. The F-test of significance of individual fixed effects was applied to each of these models and it confirms their statistical significance (for model M1 F(18,31)=2,14, p-value=0,03, for model M2 F(18, 30)=2,40, p-value=0,02 and for model M3 F(18,31)=2,03 and p-value=0,04). In all three models the variable "BIG4" is removed due to co-linearity. The variable "DUMMY LISTED" is removed from model M3 due to co-linearity. As a result model M3 is reduced to model M1.

It was found that the statistically significant regression ratios (with accepted level of significance α=0,05) in the assessed panel models are those measuring the influence of the relative share of write-offs and the relative share of profit before taxation. Therefore, the relative share of write-offs and the relative share of profit before taxation have statistically significant influence on the relative share of impaired non-performing loans. An increase of 1,76–1,84% in the impaired non-performing loans corresponds to each percentage point increase in the relative share of write-offs. An increase of 0,93–1,12% in the impaired non-performing loans corresponds to each percentage point increase in the profit before taxation. The positive correlation between the percentage of write-offs and the percentage of impaired non-performing loans should be seen as an attempt of the management to make an adjustment. At the same time, the positive correlation between the share of profits and the share of impaired non-performing loans should be interpreted rather as an attempt, albeit minimal, to smooth the financial performance.

The increase of significant regression ratios after removing the 2010 panel is clearly impressive. This is further proof that significant changes were initiated in 2010 in the bank management policies with regard to financial performance management. There are still insufficient data to assess

the direction of the changes in the ratios between the resultative and the factor variables during the economic crisis itself and after that. However, it can be definitively concluded that the restructuring of the ratios between the impaired non-performing loans and their determining factors is a dynamic process which depends on the cycles of market economy.

6. Conclusion

The refinement of the techniques for investigating the impact of various factors on the financial performance is due to the use of increasingly abundant data of the activities of commercial banks and the new and improved evaluation techniques. One possible solution to support the studies with information is the use of panel data. Panel data allow for studying the static and dynamic aspect of the manifested correlation. At the same time, the use of panel data requires application of more advanced evaluation methods that provide more precise results. They are used to make more accurate conclusions about the management of the financial performance of banks.

Understanding the motives and arguments of bank management with regard to loan loss provisions as a tool for "smoothing" the financial performance would create conditions for control and regulation of this process. In this sense, the empirical study of the status and dynamics of the average correlations between loan loss provisions and their determining factors would be a fair and accurate starting point.

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Summary

The purpose of the study is the development of econometric techniques to assess the impact of various factors on loan loss provisions. The use of panel data structures requires a number of additional studies and use of improved models to achieve accurate results. Therefore fixed-effects panel models are approbated for evaluation of the impact on loan loss provisions.

Key words: financial performance, econometry, panel models.

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