

# HAVE MORE PROFITABLE BANKS A MORE OR A LESS RISKY LENDING POLICY? EMPIRICAL EVIDENCE FROM CEE COUNTRIES

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## Abstract

This paper investigates the short and long-run relationship between credit risk and two bank profitability indicators ROA and ROE in Central and Eastern European countries during the period from 2000 to 2010. Results from previous research mostly confirm the negative relationship between profitability and credit risk by considering the current or one year lagged value of profitability. Certain crisis indicates that more profitable banks before the crisis became more risky during the time of crisis. These results motivate us to upgrade the model of credit risk by including earlier values of profitability. Results indicate that two or three years are necessary for growth of profitability to increase credit risk. However, the long-run relationship between foreign banks' profitability and credit risk is positive, for both indicators. For the domestic bank, the long-run effect of ROA on credit risk is positive, while for ROE this relationship is negative.

**Keywords:** credit risk, profitability, foreign bank, CEE countries

**JEL Classification:** C23, G32, G21, P34

## 1. Introduction

The financial crisis, which broke out in 2008, increased interest in research of credit risk in Central and Eastern European (CEE) countries. Before the crisis, the ratio of Non-Performing Loans (NPLs) in CEE countries continuously decreased. Therefore, researchers investigated determinants of credit growth, profitability differences in doing business between domestic and foreign banks. However, with the outbreak of crisis, the ratio of NPLs rapidly increased.

Researchers started investigating macroeconomic and bank specific determinants of NPLs. Recent research, which considers profitability, uses current value or only the first lag of profitability. Negative and statistically significant influence of profitability is confirmed. On the other hand, Martynova *et al.* (2015) developed a mathematical model and proved that it is possible that more profitable banks are more risky. They found support for their idea in the fact that the highly profitable banks before the crisis experienced large losses during crisis. Their theoretical assumptions provide support to the detailed investigation into the relationship between profitability and credit risk in CEE countries.

At the time before the crisis, banks in CEE countries achieved higher yields than in remaining European countries. On the other hand, by the outbreak of the crisis, the level of NPLs in CEE countries was higher than in other EU countries (Tanaskovic and Jandric,

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2015). Therefore, it is possible that banks managers during good times underestimated credit risk and accepted risky projects to reach higher returns. With time, that risk would probably have materialized, but the financial crisis accelerated the process.

Given the high ratio of foreign banks in CEE countries, this paper additionally investigates the role of bank ownership in the relationship between profitability and credit risk. On the one hand, due to the theory that foreign banks have better management skills and know how in risk management, it is expected that that more profitable foreign banks will have a smaller ratio of NPLs than domestic banks. On the other hand, Mihaljek (2008) in his theoretical paper expressed suspicion that foreign banks can increase credit risk in CEE countries to reach expected high *ROE* target.

Therefore, this paper contributes to the literature of credit risk in two ways. First, it investigates in detail the influence of profitability on credit risk by including the previous value of profitability and calculates the long-run relationship. Second, it investigates the difference in the influence of profitability on credit risk between domestic and foreign banks in CEE countries.

The rest of the paper is organized as follows. Section 2 contains a discussion of theoretical and empirical literature of credit risk and profitability. Section 3 presents data, variables and methodology. Section 4 presents empirical results and an economic interpretation of results. Section 5 provides conclusions and policy implications.

## **2. Theoretical and Empirical Background on Profitability and Credit Risk**

The relationship between lagged values of profitability and risk can be described through two opposite hypotheses. The first hypothesis implies a negative relationship between past earnings and NPLs. Louzis *et al.* (2012) called this hypothesis the “Bad Management II” hypothesis. This may be justified if past profitability is considered as a proxy for quality management. Therefore, it is expected that more profitable banks have better managers who meet targets and they do not accept risky projects.

On the other hand, it is possible that bank profitability is positively related to future increases in NPLs. Louzis *et al.* (2012) defined as the “Procyclical Credit Policy” hypothesis.

It can be explained that management may attempt to manipulate current earnings resorting to liberal credit policy. In this manner, a bank may attempt to convince the market of its profitability by inflating current earnings at the expense of future problem loans.

Recent research into credit risk in CEE countries is primarily focussed on macro-economic determinants of NPLs (Jakubík and Reininger, 2013; Skarica, 2014; Tanaskovic and Jandric, 2015). Empirical research showed that GDP growth, interest rate, unemployment and exchange rate as the most important indicators of credit risk.

Much research, apart from key macroeconomic indicators, includes bank specific characteristics and/or bank industry specifics as determinants of credit risk (Agoraki *et al.*, 2011; Maechler *et al.*, 2007; Klein, 2013; Drakos *et al.*, 2016). From this research, it is evident that bank specifics as profitability, size and capital are important determinants of credit risk in CEE countries. Only some research indicates credit to GDP, concentration and ratio of foreign bank as important bank industry specifics.

In almost all the mentioned research profitability indicators show negative and statistically significant influence on credit risk. All this research considers current or one year lagged value of profitability. Consequently, it can be concluded that, in CEE countries, the relationship between profitability and NPLs follow the “Bad Management II” hypothesis.

Research, which includes members of the European Union countries with or without CEE countries did not confirm “Bad Management II” hypothesis so strongly. Results vary according to the group of countries and the indicator used. For example, Makri *et al.* (2014) used current and lagged value of profitability (*ROA* and *ROE* indicators) in credit risk model for 14 Eurozone countries. They did not obtain a significant relationship between *ROA* indicator and NPLs, while the *ROE* indicator showed statistical significance for the current value. Also, Witowski and Luca (2016) investigated the relationship between capital, risk and profitability in seven European countries. The relationship between profitability and bank risk varies according to the country. Louzis *et al.* (2012) investigated macroeconomic and bank-specific determinants of NPLs in Greece. Except for the short-run relationship between credit risk and their determinants a long-run relationship was also calculated. They found that the *ROE* indicator was statistically significant and negatively related to mortgages and consumer NPLs, while it was insignificant for the business NPLs.

The above mentioned research, apart from Louzis *et al.* (2012), also considers current value or one-year lag of profitability. However, it is insufficient period to discover possible positive relationship between NPLs and past earnings. Therefore, it is evident that is necessary to include more lags of profitability in the credit risk model to disclose the real relationship between profitability and credit risk.

The only study that seriously considered the positive relationship between profitability and credit risk is the paper by Martynova *et al.* (2015). They observed that high profitable respectable banks before crisis have high losses in crisis. Therefore, they attempt to reconcile theory and evidence by formulating a mathematical model of credit risk. They mathematically proved the proposition that banks with a more profitable core business may have higher risk taking incentives. Their model supports “Procyclical Credit Policy”.

Their theory can be fully implemented in CEE countries. The rate of return before crisis in CEE countries was larger than in other countries. Therefore, it can be expected that managers of banks in CEE countries accept higher risk projects to achieve higher returns in times before crisis. Additional support for relaxing credit policy was strong economic growth at this time.

According to Mihaljek (2008), this behaviour can be more pronounced for the foreign bank subsidiaries in CEE countries. Before the crisis, he outlined several reasons why foreign banks can increase risk in CEE countries. Risk could trigger problems in an emerging economy host market or parent bank home market. Škrabic Perić (2012) provide evidence of the importance of the home macroeconomic environment and parent bank characteristics on the credit risk of the foreign bank. Therefore, this paper is focussed on problems in the host market. One reason could be the high profitability target in CEE countries. To achieve target profitability, managers underestimate credit risk and overestimate profitability rate or relax lending standards. Therefore, they are motivated to increase lending regardless

of potential risk to achieve target profitability and earn extra bonus for excellent business results. Additionally, they are working on fixed-term contact.

Considering this assumption, it is necessary to investigate the difference in the influence of more than one previous profitability rate on the recent ratio of NPLs between domestic and foreign banks. To our knowledge, only Drakos *et al.* (2016) considered the difference in the relationship between bank profitability and risk taking with regard to ownership, but they used only one lag. Results varied when including different indicators of bank risk (risk-weighted assets and z-score) by sign and significance. Additionally, differences between domestic and foreign banks were statistically significant in just a few specifications.

From their research, it can be concluded that the difference in the relationship between profitability and credit risk exist. To clarify this difference, we will include additional lags of interaction terms of profitability and ownership in the model.

### 3. Data

The data set consists of commercial banks for 16 CEE countries<sup>1</sup> in the period 2000–2010. Data for banks were obtained from Bankscope, while macroeconomic data were obtained from the World Bank Database and the European Central Bank Statistical Data Warehouse. Bank ownership data are collected from several sources: EBRD statistics, banks' web page, national banks' statistics and reports. Also, Havrylchyk and Jurzyk (2011) gave us information about their ownership data set.

The basic model of credit risk consists of three groups of variables: bank specific variables, bank industry specific and macroeconomic variables. As a measure of bank Credit Risk (*CRISK*) the ratio of NPLs and gross loans is used as a dependent variable.

The first group regards bank specific variables. *SIZE* is measured by natural logarithm of total assets and expected sign of variable is positive or negative (+/–). Negative sign is more expected. Large banks are usually considered as a safer bank because they cooperate with large companies and states. They are also more attractive for clients and they can choose more transparent and safe clients. On the other hand, *size* can have a positive influence on credit risk. Bigger banks can increase risky lending because they expect government protection in case of bank failure (“too big to fail”). In previous research for CEE countries results are mixed. Agoraki *et al.* (2011) found negative and statistically significant influence of size on credit risk, while Drakos *et al.* (2016) found a positive influence. *LIQUIDITY* is measured by liquid assets to total assets and expected sign of variable is positive (+). In situations of high bank liquidity, the manager is motivated to increase lending by relaxing the credit standards. *CAPITAL* is measured by equity to assets and the expected sign can be positive or negative (+/–). The bank managers with a low level of capital can increase risky lending because of moral hazard. On the other hand, managers of good capitalized banks can be subject to pressure to ensure the return of capital so they can also increase risky lending.

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1 Albania, Bosnia and Herzegovina, Bulgaria, Hungary, Croatia, the Czech Republic, Estonia, Latvia, Lithuania, Macedonia, Montenegro Poland, Romania, Serbia, Slovakia and Slovenia

Considering the fact that profitability is variable of interest, two most popular profitability indicators are used: Return on Average Assets (*ROA*) and Return on Average Equity (*ROE*). The expected sign is positive or negative (+/-). Previous research mostly found a negative relationship between profitability and credit risk in CEE countries and confirmed “Bad Management II” hypothesis. Therefore, it is expected that coefficient of current value or first lag of profitability will be negative. On the other hand, respecting the assumptions of Martynova *et al.* (2015) and Mihaljek (2008), a positive relationship between second and third lag of profitability and credit risk can be expected, especially for foreign bank subsidiaries. Considering the above mentioned the long-run relationship between profitability and credit risk can be positive or negative. *OWNERSHIP* is the dummy variable of bank ownership for banks *i* in the period *t*<sup>2</sup>.

The second group of variables are industry specific indicators. *Herfindahl-Hirshman Index (HHI)* is used as a measure of competition in banking systems. According to the existing literature for CEE counties, both directions are possible (+/-). Agoraki *et al.* (2011) confirm that banks with higher market power are associated with a lower level of credit risk. On the other hand, Škrabic Peric (2012) found a positive relationship between HHI index and credit risk, while Cifter (2015) did not provide a clear relationship between concentration and credit risk in CEE countries. The level of *Financial Development (FINDEV)* is measured as a ratio of domestic credit to private sector by banks to GDP. The expected sign for CEE countries is positive (+). The growth of credit to GDP was a consequence of rapid credit growth and it can be followed by loosening lending standards (Jakubik and Reininger, 2013).

The third group of *variables* consists of the macroeconomic indicators in CEE countries. *GDP growth* is taken as a measure for economic activity and the expected sign is negative (-). As a measure of *INTEREST RATE* in the country, the average lending interest is taken<sup>3</sup>. The expected sign for this variable is positive (+). *INFLATION* is measured by the Consumer Price Index (2005=100). The expected sign for this variable is positive (+). *EXCHANGE RATE* is measured by official exchange rate of local currency to the U.S. dollar and the expected sign is positive (+). Recent studies of credit risk indicate exchange rate as significant determinant of credit risk because of the high level of FX loans (Tanaskovic and Jandric, 2015; Beck *et al.*, 2015).

## 4. Model and Methodology

Considering the results of mentioned empirical research, current value of profitability is included in model. To avoid possible problems of endogeneity both profitability indicators and all other bank characteristics variables are treated as endogenous. Taking into account,

2 In the sample, a bank is categorized as foreign in year *t* if participation in the bank’s capital by foreign investors exceeds 50%.

3 Average lending interest rate is chosen because it is directly correlated with NPLs. If any other interest rate is chosen, results are not changed significantly because the coefficient of correlation between average lending rate and interbank money market interest rate is 0.84.

that some time is necessary for changes in the bank industry and the macroeconomic environment affects credit risk, all these variables are lagged by a one year. The model can be expressed by Equation 1.

$$\begin{aligned} CRISK_{it} = & \mu + \gamma CRISK_{i,t-1} + \beta_1 SIZE_{it} + \beta_2 LIQUIDITY_{it} + \\ & + \beta_3 CAPITAL_{it} + \beta_4 ROA(E)_{it} + \\ & + \beta_7 HHI_{i,t-1} + \beta_8 FINDEV_{i,t-1} + \beta_9 INFLATION_{i,t-1} + \beta_{10} GDPG_{i,t-1} + \\ & + \beta_{11} INTERESTRATE_{i,t-1} + \beta_{12} EXCHANGERATE_{i,t-1} + \alpha_i + \varepsilon_{it}, \end{aligned} \quad (1)$$

$i = 1, \dots, N, t = 1, \dots, T.$

All variables are noted as in the Data section.  $\alpha_i$  is specific error for each bank and  $\varepsilon_{it}$  is the remaining part of the error term.  $N$  is the number of banks and  $T$  is the number of time periods.  $\beta_1 - \beta_4$  and  $\beta_7 - \beta_{12}$  are parameters.

To explore differences in influence of profitability on credit risk between foreign and domestic bank, interaction term between profitability and ownership<sup>4</sup> is included in Equation 2.

$$\begin{aligned} CRISK_{it} = & \mu + \gamma CRISK_{i,t-1} + \beta_1 SIZE_{it} + \beta_2 LIQUIDITY_{it} + \\ & + \beta_3 CAPITAL_{it} + \beta_4 ROA(E)_{it} + \delta fROA(E)_{it} + \\ & + \beta_7 HHI_{i,t-1} + \beta_8 FINDEV_{i,t-1} + \beta_9 INFLATION_{i,t-1} + \beta_{10} GDPG_{i,t-1} + \\ & + \beta_{11} INTERESTRATE_{i,t-1} + \beta_{12} EXCHANGERATE_{i,t-1} + \alpha_i + \varepsilon_{it}, \end{aligned} \quad (2)$$

$i = 1, \dots, N, t = 1, \dots, T.$

All notations are equal as in Equation 1 and  $\delta$  is parameter of interaction term between profitability and ownership. However, our criticism of most previous papers is that they consider the current value or first lag of profitability. In the order to correct this weakness, in the next step, the model of credit risk is expanded with previous values of profitability<sup>5</sup>. The extended model can be expressed by equation:

$$\begin{aligned} CRISK_{it} = & \mu + \gamma CRISK_{i,t-1} + \beta_1 SIZE_{it} + \beta_2 LIQUIDITY_{it} + \\ & + \beta_3 CAPITAL_{it} + \sum_{j=1}^3 \beta_{3+j} ROA(E)_{i,t-j} + \\ & + \beta_7 HHI_{i,t-1} + \beta_8 FINDEV_{i,t-1} + \beta_9 INFLATION_{i,t-1} + \beta_{10} GDPG_{i,t-1} + \\ & + \beta_{11} INTERESTRATE_{i,t-1} + \beta_{12} EXCHANGERATE_{i,t-1} + \alpha_i + \varepsilon_{it}, \end{aligned} \quad (3)$$

$i = 1, \dots, N, t = 1, \dots, T.$

4 Variable ownership is not included in the model as a separate variable. In this paper, we are not interested, whether foreign banks are more or less risky than domestic banks, but we are trying to discover differences in the influence of profitability on the credit risk in regard to bank ownership.

5 Three lags of profitability are included because we believe that it is enough time to investigate relationship between profitability and credit risk. Additional lags are not considered because of short time period of data set. By including additional lags additional observations are lost.

All notations are equal as in Equation 1 and  $\beta_4 - \beta_6$  are parameters of first, second and third lag of profitability. To explore the difference in influence of profitability on credit risk between foreign and domestic banks, lagged values of interaction term between profitability and ownership also included in Equation 2 and the following equation is formed:

$$\begin{aligned} CRISK_{it} = & \mu + \gamma CRISK_{i,t-1} + \beta_1 SIZE_{it} + \beta_2 LIQUIDITY_{it} + \\ & + \beta_3 CAPITAL_{it} + \sum_{j=1}^3 \beta_{3+j} ROA(E)_{i,t-j} + \sum_{j=1}^3 \delta_j fROA(E)_{i,t-j} + \\ & + \beta_7 HHI_{i,t-1} + \beta_8 FINDEV_{i,t-1} + \beta_9 INFLATION_{i,t-1} + \beta_{10} GDPG_{i,t-1} + \\ & + \beta_{11} INTERESTRATE_{i,t-1} + \beta_{12} EXCHANGERATE_{i,t-1} + \alpha_i + \varepsilon_{it}, \end{aligned} \quad (4)$$

$i = 1, \dots, N, \quad t = 1, \dots, T.$

All notations are equal as for Equation 3 and  $\delta_1, \delta_2, \delta_3$  are parameters of first, second and third lag of interaction terms between profitability and credit risk.

To estimate proposed Equations 1–4, it is necessary to choose one panel data estimator. In all equations, the lagged value of dependent variable is included, and therefore one of the dynamic panel data estimators will be employed. In this study, the system GMM estimator proposed by Arellano and Bover (1995) and upgraded by Blundell and Bond (1998) will be used. This estimator simultaneously estimates the equation in level and the equation in first differences. Our data set contains a large number of banks and relatively small number of time periods. Therefore its use is justified. Additionally, it allows that independent variables are treated as endogenous. Instead of these endogenous variables, it uses instrumental variables in the estimation process (lagged values of variable for equation in the first differences and lagged differenced value for equation in the level). This possibility is very important for our model because it is possible that all used bank specific variables are endogenous. Two-step version of used estimator is robust to heteroscedasticity and it is more efficient than one-step version of estimator<sup>6</sup>. Validity of model specification is checked by two diagnostic tests. The Sargan test checks validity of used instruments. Rejection of null hypothesis suggests that in the model there is no problem of endogeneity. The test for the second order serial correlation AR (2) is performed on differenced residuals. Rejection of null hypothesis indicates that there is no autocorrelation of first order between residuals in level.

## 5. Empirical Results

Table 1 reports results from Equations 1 in Columns 1 and 2, while results from Equation 2 are presented in Columns 3 and 4.

<sup>6</sup> However, standard errors of two-step estimator underestimated standard error in small samples, but Windmeijer (2005) corrected formula for two-step variance and made it concurrent to one-step estimator.



**Table 1 | Results of Estimation of Credit Risk Model with Current Values of Profitability Indicators**

Variable	(1)	(2)	(3)	(4)
<b>CRISK</b> <sub><i>i,t-1</i></sub>	0.560*** a(0.0176)	0.499*** (0.0197)	0.518*** (0.0127)	0.514*** (0.0127)
<b>LIQUIDITY</b> <sub><i>it</i></sub>	0.0903*** (0.0172)	0.113*** (0.0165)	0.0908*** (0.0108)	0.0764*** (0.00746)
<b>CAPITAL</b> <sub><i>it</i></sub>	-0.244*** (0.0181)	-0.148*** (0.0261)	-0.177*** (0.00791)	-0.208*** (0.0155)
<b>SIZE</b> <sub><i>it</i></sub>	-0.853*** (0.135)	-0.227* (0.117)	0.0161 (0.0802)	-0.0979 (0.0823)
<b>INTEREST RATE</b> <sub><i>i,t-1</i></sub>	0.151*** (0.0308)	0.205*** (0.0236)	0.269*** (0.0225)	0.238*** (0.0186)
<b>GDP G</b> <sub><i>i,t-1</i></sub>	-0.0399* (0.0232)	-0.0678*** (0.0214)	-0.0669*** (0.0181)	-0.0703*** (0.0182)
<b>HHI</b> <sub><i>i,t-1</i></sub>	7.054** (3.553)	-0.183 (4.269)	12.02*** (2.493)	4.769 (3.261)
<b>INFLATION</b> <sub><i>i,t-1</i></sub>	0.166*** (0.0190)	0.120*** (0.0164)	0.127*** (0.0134)	0.118*** (0.00900)
<b>FINDEV</b> <sub><i>i,t-1</i></sub>	0.103*** (0.0123)	0.0944*** (0.0129)	0.108*** (0.00978)	0.0850*** (0.00972)
<b>EXCHANGE RATE</b> <sub><i>i,t-1</i></sub>	0.0295*** (0.00365)	0.0195*** (0.00235)	0.0169*** (0.00206)	0.0195*** (0.00124)
<b>ROA</b> <sub><i>it</i></sub>	-0.765*** (0.0492)	- -	-0.211*** (0.0195)	- -
<b>ROE</b> <sub><i>it</i></sub>	- -	-0.121*** (0.0117)	- -	-0.0545*** (0.00577)
<b>fROA</b> <sub><i>it</i></sub>	- -	- -	-1.315*** (0.136)	- -
<b>fROE</b> <sub><i>it</i></sub>	- -	- -	- -	-0.0943*** (0.00794)
<b>cons</b>	-15.38*** (2.265)	-14.60*** (1.890)	-19.36*** (1.560)	-14.20*** (1.105)
<b>N</b>	801	801	800	801
<b>Sargan test (p-value)</b>	0.2265	0.2140	0.2721	0.2186
<b>AR2 test (p-value)</b>	0.2987	0.2092	0.3078	0.1705

Notes: aStandard errors in parentheses, \*, \*\*, \*\*\* indicate significance at 10%, 5% and 1%.

Source: authors' calculations



Most of the used bank specific variables have statistically significant and expected influence. Results indicate that *liquidity* of bank is statistically significant with positive sign. *Capital* has negative sign. Only, *size* changes sign and statistical significance through different specifications. From the bank industry specific variables, *financial development* shows positive and statistically significant influence, while *HHI* is not statistically significant in two of four specifications. All macroeconomics variables are statistically significant with expected sign.

For both indicators the influence of profitability on credit risk is negative and statistically significant in Table 1 Column 1 and 2. Additionally, results in Table 1 Column 3 and 4 indicate bank profitability has negative and a statistically significant influence on NPLs for foreign and domestic banks. However, coefficients of interaction terms between bank profitability and bank ownership ( $fROA_{it}$ ,  $fROE_{it}$ ) have negative sign and they are statistically significant. Therefore, it can be concluded that more profitable foreign banks are more risk averse than domestic bank as in paper of Drakos *et al.* (2016). On the other hand, these results can be explained by the assumption that managers of foreign banks tend to underestimate the credit risk to achieve higher bonus as in Mihaljek (2008). To detect the real relationship between profitability and credit risk, it is necessary to include additional lags of profitability in the model. Additionally, in order to investigate differences between domestic and foreign banks, corresponding lagged value of interaction term between profitability and ownership are included in the model.

By including additional lags of profitability, results of control variables are not changed significantly as can be seen in Table 2. It seems that the model of credit risk is well specified and robust to changes in using different profitability indicators and by introducing additional lags. *Liquidity* has the positive influence of credit risk. Influence of bank *size* becomes negative. It can be concluded that by introducing additional lags of profitability, influence of size on credit risk is clarified. *Capital* has a negative influence and it is statistically significant in all model specification. *Financial development*, *interest rate* and *exchange rate* have a positive and statistically significant influence on credit risk, while GDP growth has a negative influence. HHI index still changes statistical significance and sign. Therefore, it can be concluded that the relationship between concentration and credit risk is not clear.

Moreover, we are interested in the cumulative impact of both profitability indicators on current value of NPLs. Therefore long-run coefficients are calculated and coefficients are given in Table 2. On the basis of estimated results, the long-run effect of profitability is calculated. The long-run coefficient for all banks is calculated by using coefficients from Table 2 Column 1 and 2:

**Table 2 | Results of Credit Risk Model by Including Additional Lags of Profitability Indicator**

	(1)	(2)	(3)	(4)
<b>CRISK</b> <sub><i>i,t-1</i></sub>	0.521*** (0.0198)	0.506*** (0.0191)	0.492*** (0.00864)	0.470*** (0.0101)
<b>LIQUIDITY</b> <sub><i>it</i></sub>	0.0571*** (0.0119)	0.0581*** (0.0122)	0.0635*** (0.00666)	0.0575*** (0.00739)
<b>CAPITAL</b> <sub><i>it</i></sub>	-0.315*** (0.0289)	-0.284*** (0.0257)	-0.306*** (0.0192)	-0.307*** (0.0205)
<b>SIZE</b> <sub><i>it</i></sub>	-1.549*** (0.218)	-1.206*** (0.203)	-1.751*** (0.161)	-1.924*** (0.152)
<b>INTEREST RATE</b> <sub><i>i,t-1</i></sub>	0.287*** (0.0408)	0.225*** (0.0371)	0.314*** (0.0209)	0.199*** (0.0213)
<b>GDP G</b> <sub><i>i,t-1</i></sub>	-0.0486** (0.0241)	-0.0196 (0.0239)	-0.0727*** (0.0183)	-0.0577*** (0.0157)
<b>HHI</b> <sub><i>i,t-1</i></sub>	-0.0691 (6.201)	2.449 (6.257)	-8.638*** (3.172)	-15.74*** (3.757)
<b>INFLATION</b> <sub><i>i,t-1</i></sub>	0.270*** (0.0220)	0.279*** (0.0235)	0.276*** (0.0162)	0.271*** (0.0169)
<b>FINDEV</b> <sub><i>i,t-1</i></sub>	0.0330** (0.0148)	0.0272* (0.0154)	0.0351*** (0.0116)	0.0471*** (0.0106)
<b>EXCHANGE RATE</b> <sub><i>i,t-1</i></sub>	0.0278*** (0.00531)	0.0297*** (0.00519)	0.0288*** (0.00369)	0.0345*** (0.00314)
<b><sup>a</sup> ROA</b> <sub><i>it</i></sub>	-0.111*** (0.0273)	— —	-0.0435*** (0.0168)	— —
<b>ROA</b> <sub><i>i,t-2</i></sub>	0.0122 (0.0340)	— —	-0.0881*** (0.0188)	— —
<b>ROA</b> <sub><i>i,t-3</i></sub>	0.367*** (0.0367)	— —	0.333*** (0.0221)	— —
<b>ROE</b> <sub><i>i,t-1</i></sub>	— —	-0.0191*** (0.00469)	— —	-0.0347*** (0.00354)
<b>ROE</b> <sub><i>i,t-2</i></sub>	— —	-0.0257*** (0.00749)	— —	-0.0720*** (0.00439)
<b>ROE</b> <sub><i>i,t-3</i></sub>	— —	0.0250*** (0.00719)	— —	0.0169*** (0.00465)
<b><sup>b</sup> f ROA</b> <sub><i>i,t-1</i></sub>	— —	— —	-0.324** (0.136)	— —
<b>f ROA</b> <sub><i>i,t-2</i></sub>	— —	— —	0.837*** (0.106)	— —
<b>f ROA</b> <sub><i>i,t-3</i></sub>	— —	— —	0.548*** (0.137)	— —
<b>f ROE</b> <sub><i>i,t-1</i></sub>	— —	— —	— —	0.0151 (0.0126)
<b>f ROE</b> <sub><i>i,t-2</i></sub>	— —	— —	— —	0.140*** (0.0127)
<b>f ROE</b> <sub><i>i,t-3</i></sub>	— —	— —	— —	0.0273** (0.0111)
<b>cons</b>	-17.14*** (2.579)	-19.87*** (2.944)	-16.26*** (1.958)	-12.53*** (2.122)

Table 2 | (continuation)

<b>Coefficients for foreign banks<sup>a</sup> profitability and long-run coefficients</b>				
<b>'Foreign bank ROA (E)<sub>i,t-1</sub></b>	–	–	–0.3671*** (0.1276)	–0.0195* (0.0103)
<b>Foreign bank ROA (E)<sub>i,t-2</sub></b>	–	–	0.7493*** (0.1003)	0.06777*** (0.0116)
<b>Foreign bank ROA (E)<sub>i,t-3</sub></b>	–	–	0.8811*** (0.1379)	0.0441*** (0.0098)
<b>Long-run effect of profitability<sup>d</sup> (all banks)</b>	0.56023*** (0.1467)	–0.0401 (0.0280)	–	–
<b>Long-run effect of profitability (domestic bank)</b>	–	–	0.3974*** (0.0849)	–0.1695*** (0.0179)
<b>Long-run effect of profitability (foreign bank)</b>	–	–	2.4883*** (0.4077)	0.1743*** (0.0378)
<b>N</b>	633	633	632	633
<b>Sargan test (p-value)</b>	0.3944	0.3260	0.2284	0.2061
<b>AR2 test (p-value)</b>	0.5709	0.5019	0.6903	0.5194

Notes:

<sup>a</sup> ROA (E)<sub>i,t-k</sub>, k = 1, 2, 3 are coefficients for all banks in the Column 1 and 2, while in Column 3 and 4 note coefficients for domestic banks

<sup>b</sup> fROA (E)<sub>i,t-k</sub>, k = 1, 2, 3 coefficients indicate differences between domestic and foreign bank

<sup>c</sup> Foreign bank ROA (E)<sub>i,t-k</sub> = ROA (E)<sub>i,t-k</sub> – fROA (E)<sub>i,t-k</sub>, k = 1, 2, 3 is coefficient for foreign bank

<sup>d</sup> statistical significance of foreign bank coefficients by lags and long run coefficients are calculated by Delta method

<sup>e</sup> Standard errors in parentheses, \*, \*\*, \*\*\* indicate significance at 10%, 5% and 1%.

Source: authors' calculations

$$\beta_{all(domestic)}^{LR} = (ROA(E)_{i,t-1} + ROA(E)_{i,t-2} + ROA(E)_{i,t-3}) / (1 - CRISK_{i,t-1}). \quad (5)$$

The same formula can be performed for domestic banks by using coefficients form Table 2 Column 3 and 4. For foreign banks, the long-run coefficient's equation is:

$$\begin{aligned} \beta_{foreign}^{LR} = & (ROA(E)_{i,t-1} + fROA(E)_{i,t-1} + ROA(E)_{i,t-2} + fROA(E)_{i,t-2} + \\ & + ROA(E)_{i,t-3} + fROA(E)_{i,t-3}) / (1 - CRISK_{i,t-1}), \end{aligned} \quad (6)$$

because the coefficient for foreign banks is the sum of coefficient ROA(E)<sub>i,t-k</sub> and interaction term fROA(E)<sub>i,t-k</sub> for k = 1, 2, 3.

Table 2 Columns 1 and 2 present results for all banks. The results indicate that profitability from the previous year has a negative influence for all banks for both indicators. The second lag of ROA for all banks has a positive, but it is not statistically significant, while second lag of ROE is still negative. On the third lag, coefficients are positive and statistically significant for both indicators. In Table 2 Column 3 and 4, results for both indicators, in regard to bank ownership are presented. On first lag, domestic and foreign bank profitability has a negative influence on credit risk for both indicators. This negative influence is more pronounced for foreign banks, which are in line with results

from Table 1. On the second lag, for domestic banks, the influence of profitability is still negative for both indicators, while for foreign banks it becomes positive. On the third lag, for domestic and foreign banks, influence is positive and statistically significant, but this positive influence is stronger for foreign banks. Obtained results confirm Mihaljek's (2008) suspicion about foreign bank managers and profitability targeting. Results on the first lag indicate that managers underestimate potential risk by low loan loss provision in order to boost profitability. However, results also confirm that, during time, the underestimated risk becomes visible.

Long-run coefficients for all banks indicate that *ROA* has a positive impact on NPLs in the long-run Column 1, while for *ROE* the long-run coefficient is not statistically significant Column 2. There are several reasons, which can help to explain these differences in results. Much research has indicated weakness of *ROE* indicator. ECB (2010) considered *ROA* as a more reliable indicator than *ROE* because it is adjusted for the leverage effect. Fišerová *et al.* (2015) confirmed the superiority of *ROA* as a performance indicator for foreign banks in CEE countries. Additionally, Bonin *et al.* (2005) indicated weakness of *ROE* in CEE countries because of large standard deviation.

On the other hand, the non-significant long-run effect of *ROE* indicator can be also a consequence of difference in *ROE* indicator between domestic and foreign banks<sup>7</sup>. These differences can produce a difference in the influence *ROE* on NPLs regard to bank ownership.

Results from Table 2 Column 3 and 4 indicate that long-run relationship between profitability and credit risk for foreign banks is positive for both indicators. These results additionally confirm Mihaljek's (2008) suspicion that foreign banks can increase risk in CEE countries. For a domestic bank, the long-run relationship between *ROA* and credit risk is also positive. For *ROA* indicator, domestic banks also confirm the positive relationship between profitability and credit risk, but it is less pronounced than for foreign banks.

However, the long-run relationship between *ROE* and credit risk is negative for domestic banks. Therefore, results suggest great contradictory behaviour between domestic and foreign banks in the long-run relationship between *ROE* and credit risk. There are several reasons, which can explain this. First in CEE countries, foreign banks keep their capital at a minimum level because they have access to a very large pool of equity funds abroad (Maechler *et al.*, 2007), while domestic banks must have solid capital base to ensure additional source of finance. High *ROE* ratio of foreign banks was due to a larger use of financial leverage rather than the profitable use of assets. The consequence of this behaviour is that in pre-crisis times, foreign banks had statistically significant higher *ROE* than domestic banks. On the other hand, the domestic banks had somewhat higher *ROA* than foreign banks, but the difference was not statistically significant. All these arguments can help to explain differences in results for foreign and domestic banks as differences between *ROA* and *ROE* indicators for domestic banks.

<sup>7</sup> In our sample before crisis foreign banks have statistically higher *ROE* than domestic banks (10.85 *versus* 6.81), while in crisis this difference disappears.

## 6. Conclusion

This paper investigates short and long-run relationship between profitability and credit risk in CEE countries with regard to bank ownership. In recent research, profitability is shown as an important indicator of credit risk. The conclusion of most research is that more profitable banks are less risky. These results are partly the consequence of using current or only one-lag value of the profitability. Regarding the possibility that bank managers underestimate credit risk to achieve higher profitability, this research upgrades the credit risk model with additional lags of profitability indicator.

In the first step, the current value of profitability is included in the model as in most previous studies. Results confirm statistically significant and negative relationship between credit risk and profitability. Results additionally confirm that profitable foreign banks are more risk averse than domestic banks. However, this result can be the consequence of underestimated credit risk to show better business results.

By including additional lags results change significantly. Two years lagged profitability of foreign banks has a positive influence on bank credit risk, while for domestic banks a negative influence remains. Third lag of both profitability indicators has a positive influence on credit risk for domestic and foreign bank. From the results, it is evident that for foreign and domestic banks, growth of profitability for two or three years causes growth of NPLs for both indicators of profitability.

In addition, we compute long-run relationship between profitability and credit risk. For foreign banks, both indicators of profitability show positive influence of credit risk and confirm “Procyclical Credit Policy”, while for a domestic bank results are mixed. Results for *ROA* also confirm a positive long-run relationship. However, coefficient is significantly lower than for foreign banks. *ROE* indicator results indicate a negative long-run relationship with NPLs.

Our results indicate the need to include more than one lag of profitability in credit risk models in CEE countries. Considering only one lag results is unrealistic and can lead to the wrong conclusion. Additionally, results suggest that the traditional view point that more profitable banks are less risky is not acceptable for banks in CEE countries, especially for foreign banks. Therefore, the regulator has to monitor banks with high growth of profit more strictly, especially foreign banks. Also, big multinational banks have to boost control over bank managers in CEE countries and prevent them from underestimating credit risk in order to achieve a large rate of returns.

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