

Jilkova, Petra; Stranska, Pavla Kotatkova

Working Paper

Multiple linear regression analyses of the performance and profitability of the Czech banking sector

Institute of Economic Research Working Papers, No. 41/2017

Provided in Cooperation with:

Institute of Economic Research (IER), Toruń (Poland)

Suggested Citation: Jilkova, Petra; Stranska, Pavla Kotatkova (2017) : Multiple linear regression analyses of the performance and profitability of the Czech banking sector, Institute of Economic Research Working Papers, No. 41/2017, Institute of Economic Research (IER), Toruń

This Version is available at:

<https://hdl.handle.net/10419/219864>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/3.0/>



Institute of Economic Research Working Papers

No. 41/2017

**MULTIPLE LINEAR REGRESSION ANALYSES OF
THE PERFORMANCE AND PROFITABILITY OF
THE CZECH BANKING SECTOR**

Petra Jílková, Pavla Kořátková Stránská

Article prepared and submitted for:

**9th International Conference on Applied Economics
Contemporary Issues in Economy, Institute of Economic
Research, Polish Economic Society Branch in Toruń, Faculty of
Economic Sciences and Management, Nicolaus Copernicus
University, Toruń, Poland, 22-23 June 2017**

Toruń, Poland 2017

© Copyright: Creative Commons Attribution 3.0 License

Petra Jílková¹ and Pavla Koťátková Stránská²

¹petra.jilkova@cvut.cz

²pavla.kotatkova.stranska@cvut.cz

MIAS School of Business nebo Masaryk Institute of Advanced Studies

Czech Technical University in Prague, Kolejní 2637/2a

160 00 Prague 6, Czech Republic

Multiple linear regression analyses of the performance and profitability of the Czech banking sector

JEL Classification: *G21; M31; C38; O16*

Keywords: *bank; financial sector; linear regression analyses; performance; profitability*

Abstract

Research background: The global financial crisis started in the USA and extended to the European market in 2009 – 2010 and caused significant problems in the banking sector. Czech banks were not significantly affected and recorded a profit in many cases and there was no need for government intervention.

Purpose of the article: The purpose of this paper is to analyze the effect of the economic situation of the Czech Republic on the performance and profitability of the banking market through selected determinants. Constructing a linear regression model predicts the values of the dependent variable from the variability of the values of the independent variables.

Methodology/methods: In particular, the final report focusses on measuring the performance and profitability of the banking sector using the method of “Multiple linear regression”. The basis for multiple linear regression model is to estimate the effect of each independent variable X_i to the dependent variable Y . The force of the impact, determine the regression coefficients β_i , also determining which independent variables have the greatest and the smallest effect on the dispersion of the dependent variables. In other words, how much of the variance of the dependent variable is explained by selected independent variables. In addition, a literature review and analysis of secondary are based on data published on or before 1. February 2017.

Findings: This paper clarifies the structure of the Czech banking sector and it is focused on the performance and profitability in the defined time period and how it compares with the selected banking sector and indicators in other countries. On account of data availability for all the years examined, only selected banks were included.

Introduction

The banking sector plays a fundamental role in the economic growth of the selected countries in this paper and gained even more importance due to the global economic crisis in 2009. The Czech banking system is highly stable, fairly competitive and profitable enough for banks with international capital.

The purpose of this research is twofold. Firstly, we examine selected indicators of the banking sector in the Czech Republic; 2004 - 2015. We use the dataset of Czech banks, which covered about 90 % of the Czech banking sector. The Czech sector has developed similarly to the banking sectors of other Central European transition countries. Secondly, constructing a multiple-linear regression model, we predicts the values of the dependent variable from the variability of the values of the independent variables. We would like to verify how bank profitability, a dependent variable (ROA- return on assets, ROE- return on equity), can be influenced by independent variables. Based on the literature review, we have set the parameters for the independent variables for our research. We have two models investigate using a multiple linear regression model, which allows you to examine the effect of the independent variables on the dependent variable value ROA, ROE. Independent variables are:

- CA (Capital Adequacy);
- IMR (Interest Margin Rate);
- GDP (Gross Domestic Product) per capital.
- ROA (Return on Assets);
- BS (Balance Sheet Total);
- Inflation rate;
- IR (interest Rates) CNB.

Research Methodology

Through the multiple-linear regression model will be investigated once the dependency between the dependent variable and at least two independent variables. In the case of a multiple regression analysis based on the values of the dependent variable are looking for from a linear combination of two or more independent variables. The resulting function is registered using a formula that is similar to the formula for the function of the simple linear regression, and that:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon_i, \text{ or } Y = \beta_0 + \sum_{i=1}^n \beta_i X_i + \varepsilon_i$$

where Y is dependent variable, $\beta_0, \beta_i \ i = 1, \dots, n$ are the regression coefficients (or partial regression coefficients), $X_i \ i = 1, \dots, n$ are independent variables and ε_i is random folder $i = 1, \dots, n$.

The coefficients of the regression functions are determined by least squares.

Before doing the regression analysis, it is necessary to fulfill the specified requirements. Assumptions of multiple regression analysis are set according (VAUSS, 2002, p. 343–344). The assumption of normality is next to the graphical assessment recommends that you verify the tests by one of normality on significance level 0.05, such as Kolmogorov-Smirnov test, Shapiro-Wilk test.

Literature review

We will study the literature review focused on the determinants of bank performance and profitability in the last decade. We set a set of bank characteristics, macroeconomic and regulatory indicators as well as financial structure variables in order to explain bank profitability. This paper examines the effect of defined independent variables (bank-specific, macroeconomic, and industry-related) on the profitability of the banking industry in the Czech Republic. In the literature, bank profitability is typically measured by the ROA (return on assets) and ROE (return on equity). It is usually expressed as a function of internal and external determinants.

Internal determinants are influenced by specific banks' decisions and policies, which can be changed by banks; Molyneux (1993, p. 17). External determinants of bank profitability are influenced by events outside the banks, industry-related and macroeconomic variables that reflect the economic and legal environment where the financial institution operates. Later, the internal and external determinants were considered together and authors tried to describe the relationship between banking structure, performance, concentration or market share (Short, 1979, p. 209-219; Bourke, 1989, p. 65-79), and Molyneux (1993).

Ho and Saunders (1981, p. 581-600) described how banking profitability is based on interest margins and interest rates. This paper was supported by a lot of in-depth studies describing the main relationship between lenders and borrowers and based on the idea that interest margin is influenced by two main components, the degree of competition in the different mar-

kets and client credibility (McShane and Sharpe, 1985, p. 115-136; Angbazo, 1997, p. 55-87). In the model of Maudos and de Guevara (2004, p. 2259-2281) the bank is viewed *“as a risk-averse dealer in the credit market and the interest margins is influenced by a phase of economic growth and the environment of macroeconomic stability in which financial markets have shown low volatility”*.

Hoggarth et.al. (2002, p. 825-855) explained that GDP variable is not statistically significant in explaining profitability and takes into account private and corporate default possibility. An opposite opinion was put forth by Bikker and Hu (2012, p. 55), writing that gross domestic product (GDP) is one of the very important profitability determinants. Staikouras and Wood (2011, p. 3-6) wrote *“variations in bank profitability can be strongly explained by the level of inflation rate. An important indirect influence on commercial banks lies in the impact of inflation on their customers and the consequent changes in the demand for different kinds of financial services”* and expected that the effects of inflation can be substantial and undermines the stability of the financial system and the ability of the regulator to control the solvency of financial intermediaries.

A number of authors have described that bank profitability is influenced by a balance sheet total indicator, Černohorský and Prokop (2016), using macroeconomic factors like taxation rate as well as banking-specific and institutional factors. Capital and reserves structures are very important for the banks as well. It should be mentioned that capital and reserves are usually significantly higher than minimum capital requirements for almost all banks.

The most valuable for this paper is the Bank of Greece Research, Determinants of Bank Profitability in the South Eastern European Region. This study examine the profitability behaviour of bank sector related on macroeconomic, industry-related and bank-specific determinants, using an unbalanced panel dataset of South Eastern European (SEE) credit institutions over the period 1998-2002; Athanasoglou, Delis and Staikouras (2006).

Economic situation of the Czech Republic and selected independent variable

The financial system of the Czech Republic is characterized by the dominant role of the banking sector, which is one of the most stable markets in the Central and Eastern European region, with a high degree of client loyalty. There are three “big” banks (ČS, ČSOB and KB) with 70% of the market share. (ČNB, 2017)

Gross Domestic Product of the Czech Republic at market prices increased by 2,5% in 2016 compared to the last year, and it is less than the figure of

4,5% published in 2015. A sharp change is not predicted for 2017 (2,6%) or for 2018 (2,4%). This very positive development is caused by a macroeconomic situation and a combination of monetary conditions followed by a huge growth in investment activity (both state and private), steady growth in household consumption and successful foreign trade. The sole source of risk for the Czech economy is a potential deterioration of economic activity in other advanced countries (especially the Euro currency area, specifically Germany). We can say that the increase of GDP significantly improved unemployment in the Czech Republic. This indicator fell to 4,0 % in 2016, one of the lowest rates in the EU. (ČNB, 2017)

Negative price shocks have contributed to low inflation rates in recent years. Inflation rate (measure by HICP) was 0.7 % in 2016, higher than in 2015 (0,3%), and it is expected the move back towards 2% inflation target of the Czech National Bank's. *“The scenario of stronger growth in rates, which might have a negative effect on borrowers' ability to repay, would thus be a consequence of an adverse external shock rather than domestic developments.”*(ČNB, 2017)

In the current low-inflation environment, total bank loans to the private sector rose by 5.8% and total deposits by 7.0% year on year in 2016. The long term interest rates was at 0.4% in 2016, interest rates on new loans to households, and building society loans were at 3.91%. The interest rate on loans for house purchase were 2.24% and mortgage loans were at 3.41%. The low interest rates on the new mortgage loans provided by banks could caused that the sensitivity of households to a potential rise in loan interest rates not accompanied by growth in their income. ČSÚ (2017)

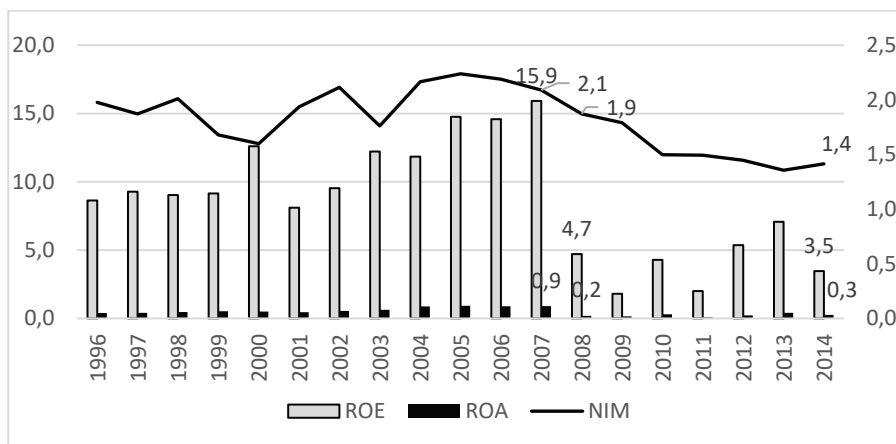
Figure 1. Macroeconomic Indicators in Czech Republic in years 2008 - 2018 (2017, 2018 is prediction)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
GDP (growth in %)	3,1	-4,5	2,5	1,8	-0,8	-0,5	2,7	4,5	2,5	2,6	2,4
Consumption on Household (growth in %)	2,9	-0,7	1,0	0,3	-1,2	0,5	1,8	3	2,7	2,4	2,4
Average Inflation Rate (%)	6,3	1	1,5	1,9	3,3	1,4	0,4	0,3	0,7	2	1,6
Emploment (growth in %)	1,6	-1,4	-1	-0,3	0,4	1	0,8	1,4	1,8	0,3	0,3
Unemployment Rate (avg. ln %)	4,4	6,7	7,3	6,7	7	7	6,1	5,1	4	3,9	3,9
Convergency Interest Rates (% p.a.)	4,3	3,98	3,89	3,7	1,92	2,2	0,67	0,49	0,53	0,6	1,1

Source: ČSÚ (2017)

The financial crisis (2008 – 2010) was started by the fall of investment bank Lehman Brothers in September 2008. This crisis touched financial and banking sectors all over the world. The Figure 2 shows the fact, how financial crisis 2008/2009 affected banking sector in the Czech Republic. In Figure 2 is analyzed banks' performance and profitability due to the development of Annual Profit Indicators for Euro Area during and before the crisis. Three ratios were used to represent bank profitability measures.

Figure 2. Annual Profit Indicators for Euro Area (1996 - 2014, %)



Source: FRED (2017)

The impact of the crisis is investigated by using ROA (return on assets), ROE (return on equity) and NIM (Net Interest Margin Indicator). ROE and ROA are two of the most important profit indicators for evaluating how effectively a company's management team is managing the capital that shareholders entrust to them.

The results showed that the financial crisis had a negative impact on the bank profitability in the Euro Area. The most recent studies, where authors examined the profitability during crisis periods, consider a similar combination of bank-specific, industry-specific, and macroeconomic factors in both pre-crisis and post-crisis time periods; Dietrich and Wanzenried (2011).

The long-standing environment of low interest rates reduces banks' traditional interest income and the decrease in the NIM value after 2009 results from this fact. In these days there are client deposit rates already close to

0% and the year-on-year decline in interest rates on client deposits (by 0.15 pp to 0.47%) and client loans (by 0.38 pp to 4.2%) continues in 2016/2017 in the Czech Republic.

Multiple Linear Regression Analyses of the Performance and Profitability of the Czech Banking Sector

MODEL I. Addition indicator ROA (Return on Assets) on CA (Capital Adequacy), IMR (Interest Margin Rate) and GDP (Gross Domestic Product) per capital was investigated using a multiple linear regression model, which allows you to examine the effect of the independent variables on the dependent variable value.

MODEL II. Addition indicator ROE (Return on Equity) on ROA (Return on Assets), BS (Balance Sheet Total), Inflation rate and IR (interest Margin) CNB was investigated using a multiple linear regression model, which allows you to examine the effect of the independent variables on the dependent variable value.

The result will also be the quantification of the relationship with subsequent verification provided for the null hypothesis of statistical significance through appropriately selected statistical test. This step is included in the regression diagnostics, which we will evaluate the multiple-linear regression model, fully assembled.

From the above, it is therefore fixed the null hypothesis H_0 : the selected indicator is not statistically significant on the chosen level of significance, as well as the null hypothesis H_0 : assembled model is statistically insignificant.

Figure 3. Result of MODEL I., II.

Result of MODEL I.

Dependent variable: ROA				
	Coefficient	ERROR	t-stat	p-value
CA	2,31620	0,581579	-3,983	0,0073 *
IMR	0,0271602	0,0463970	0,5854	0,5796
GDP(per capital)	-0,0220668	0,0181735	-1,214	0,2703

Coefficient of determination	0,661559
Modifi.coefficient of determination	0,485931
P-value (Anova)	0,085904

Result of MODEL II.

Dependent variable: ROE				
	Coefficient	ERROR	t-stat	p-value

ROA	0,570387	0,169254	-3,370	0,0199	*
BS	0,0953903	0,0368753	2,587	0,0490	*
Inflation rate	-0,00684273	0,0137740	-0,4968	0,6404	
IR CNB	-3,02793	1,38946	-2,179	0,0812	*

Coefficient of determination	0,506049
Modifi.coefficient of determination	0,110887
P-value (Anova)	0,65904

Source: own calculations based on MODEL I., II.

The parameters in bold type in above of text were indicated as statistically significant in terms of testing statistical significance at a level of 0.05. Statistical significance was not confirmed for the other parameters; this is most likely caused by the length of the time series or an inappropriately selected function type, i.e., the selected linear function was not the most appropriate. The equations with statistical significance demonstrated for most parameters showed the value of the index of determination fluctuating at an average of 30%, which points to a higher definite level of correlation. For the equations with unconfirmed statistical significance, the index of determination's value remains in single digit percentage.

Conclusions

This paragraph should provide a brief summary of the topic of this paper and offer the possible directions of future research. This paper has examined the literature review dealing with internal and external determinants of bank performance and profitability. In addition many of the results confirm findings from former papers on bank profitability and this paper also investigates the impact of financial crisis 2008/2009 to annual profit indicators for Euro Area. The results showed that the financial crisis had a negative impact on the bank profitability in the Euro Area and on macroeconomic indicators in the Czech Republic.

The purpose of this research is twofold. Firstly, we examine selected indicators of the banking sector in the Czech Republic; 2004 - 2015. We use the dataset of Czech banks, which covered about 90 % of the Czech banking sector.

Secondly, constructing a multiple-linear regression model, we predicts the values of the dependent variable from the variability of the values of the independent variables. This model is done for the Czech Republic (2004 – 2015).

Finally, we can say that in the first model is evident that ROA has a statistically significant effect pointer CA, and that the decline in indicators CA leads to a decline in ROA and vice versa. Other indicators were verified as statistically insignificant. The second model is evident that ROE has statistically significant impact indicators ROA, BS and IR CNB. Effect indicators ROA and BS is a direct indicator of IR CNB is indirect. Inflation rate indicator has been verified statistically insignificant.

The possible directions of future research will be the fact that “The Czech National Bank has decided to continue intervening against the Czech crown to keep the exchange rate at around 27 crowns per euro in the second half of 2017.” (ČNB, 2017) and how this fact change the macroeconomic environment in the Czech Republic in a short and long-term period.

References

Angbazo, L. (1997): “Commercial bank net interest margins, default risk, interest-rate risk and off-balance sheet banking”, *Journal of Banking and Finance* 21, 55-87.

Athanasoglou, P., Delis, M. and Staikouras, Ch. (2006). Determinants of bank profitability in the South Eastern European region. 2006.

Bikker, J. A.; Hu, H. (2012) Cyclical patterns in profits, provisioning and lending of banks and procyclicality of the new Basel capital requirements. *PSL Quarterly Review*, 2012, p. 55.

Bourke, P. (1989). Concentration and other determinants of bank profitability in Europe, North America and Australia. *Journal of Banking and Finance* 13: 65-79.

ČNB (2017). Financial Stability Report 2015/2016 [online]. ČNB, 2017. [cit. 2017-01-28]. Available at : http://www.cnb.cz/en/financial_stability/fs_reports/.

Černohorský, J., Prokop, V. (2015). The Relationship of Concentration and Profitability in Banking Markets,” in *Proc. 15th International Conf. on Finance and Banking*, Praha, 2015.

ČSÚ (2017). Macroeconomic Indicators in Czech Republic in years 2008 – 2018. ČSÚ, 2017. [cit. 2017-03-20]. Available at : https://www.czso.cz/csu/czso/hmu_cr.

Demirgüç-kunt, A., Huizinga, H. and Claessens, St. (1998). How does foreign entry affect the domestic banking market. 1998.

Dietrich, A. and Wanzenried, G. (2011). Determinants of Bank Profitability Before and During the Crisis: Evidence from Switzerland. Available at: <http://www>

.ecb.int/pub/pdf/other/eubankingsectorstabilityen.pdf.
10.1016/j.intfin.2010.11.002.

DOI:

FRED (2017). ROA, ROE, NIM Indicators. Federal Reserve Economic Data, 2017. [cit. 2017-03-20]. Available at : <https://fred.stlouisfed.org/>.

Ho, T. and Saunders, A. (1981): “The determinants of banks interest margins: theory and empirical evidence”. *Journal of Financial and Quantitative Analysis*, vol. XVI, No. 4, 581-600. DOI: 10.2307/2330377.

Hoggarth, G.; Reis, R. and Saporta, V. (2002) Costs of banking system instability: some empirical evidence. *Journal of Banking & Finance*, 2002, 26.5: 825-855.

Maudos, J. and De Guevara, J. F. (2004) Factors explaining the interest margin in the banking sectors of the European Union. *Journal of Banking & Finance*, 28.9: 2259-2281. DOI: 10.1016/j.jbankfin.2003.09.004.

McShane, R.W. and Sharpe, I.G. (1985): “A time series/cross section analysis of the determinants of Australian Trading bank loan/deposit interest margins: 1962-1981”. *Journal of Banking and Finance* 9, 115-136. DOI:10.1016/0378-4266(85)90065-2.

Molyneux, P. (1993). Market structure and profitability in European banking. Institute of European Finance, University College of North Wales, Research Paper 9. 17.

Short, B. (1979). The relation between commercial bank profit rates and banking concentration in Canada, Western Europe, and Japan. *Journal of Banking and Finance* 3, 209-219. DOI: 10.1016/0378-4266(79)90016-5.

Schipper IV, John E. (2013). The Determinants of Bank Profitability Through The Global Financial Crisis: Evidence from Slovakia and Poland.

Staikouras, Christos K.; WOOD, Geoffrey E. (2011). The determinants of European bank profitability. *International Business & Economics Research Journal (IBER)*, 2011, 3.6. DOI: 10.19030/iber.v3i6.3699.

Vauss, D. (2002). *Analyzing Social Science Data*. London: SAGE, 343–344.

