Banking System Adjustment to Regulatory Capital Requirements

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Abstract

The main objective of this paper is to explore the adjustment of bank business activities to new regulatory capital requests using panel data analyses of the European banking system. The research hypothesis assumes that the increase in capital requirements affects the banks' balance sheet adjustment and bank lending to the non-financial sector. The banks can maintain the higher regulatory capital ratio by increasing the volume of share capital or by decreasing the risk-weighted assets and bank lending activities. The high equity premium upon a new equity issue due to asymmetric information about the bank's net worth discourages the current shareholder to issue additional capital, which has resulted in bank lending constraints and has increased non-risk bank assets. Banks' response to new capital requirements can announce a long-term negative impact to real

economy and bank depending borrowers. The model of empirical analysis of the banking sector adjustment to new capital requirements will be demonstrated on the sample of publicly listed banking firms in the European Union in the period 2000–2016 using dynamic panel-data estimation with the Generalized Method of Moments (GMM) in one-step.

Keywords: dynamic panel, bank capital, bank lending, risk-weight assets

JEL classification: C33, D53, F65, G21

1 Introduction

Under the Basel III regulatory framework (BIS, 2010), banks have been faced with new capital requirements in the content of capital structure and the regulatory capital ratio. The European Parliament and the Council have introduced prudential constraints, with respect to the Basel III capital standard, to the European Union (EU) banking system (European Parliament and Council Regulation No. 575/2013 of 26 June 2013). The basic argument for new capital requirements is that the higher equity ratio promotes banks' financial stability by reducing the probability of distress of a banking firm and by reducing bank incentives in taking a risk position and increasing the buffer against bank loses. The most important consequence of additional capital requirements should be the downsizing of banking risks and an increase of banking system stability during the financial crisis periods. Some authors have researched the relations between higher capital requirements and bank risk assets. The empirical results have shown that higher capital increases bank stability and reduces the risk profile of banking assets (Baker & Wurgler, 2014). Klomp and de Haan find that capital regulation reduces asset risk based on the bank data from OECD (Klomp & de Haan, 2012) and emerging and developing countries (Klomp & de Haan, 2015). Other empirical results from different banking systems have shown that better capitalized banks are more resistant to lending supply in the period of financial

market shocks, which improves the banking and economic stability (Kapan & Minoiu, 2013). Beltratti and Stulz (2012) show that higher bank capital reduces the fragility of banking firms and increases the bank's ability to absorb the effects of financial crisis. During the last financial crisis and the significant increase in capital requirements, the banking firms met a new capital requirement with the reduction of risk-weighted asset (mostly in downsizing of lending activities) or the rise of the regulatory capital volume (some banks with regulatory capital ratio near or lower the minimum threshold)[1]. Some authors have found that an additional rise in capital requirements reduces total lending from 3.5 percent (Bridges et al., 2014) up to 7.2 percent (Aiyar, Colomiris, & Wieladek, 2014). Mésonnier and Monks (2015) analyzed the systematically important banks' effect of enforcement on increasing core capital in a 1.2 percent reduction of credit growth. The empirical evidence has shown that most banks have not funded the additional capital requirements by raising the equity. External equity financing is always costly because of the significant asymmetric information about the bank net value (Asal, 2015). Acharya and Steffen (2014) have concluded that most banks manipulated with risk models to underestimate risk and minimize capital requirements. Potential investors may consider equity originating in terms of overvalued current shares in case where a problem of adverse selection exists. Hanson, Kashyap, and Stein (2011) have found that raising capital requirements produces a positive impact on marginal costs of banking firms' equity. Recent financial crisis has confirmed negative investors' sentiment to banking shares. The share prices of the banking firms have not prevailed in the pre-crisis period and shareholders are unmotivated for a new issue due to the capital splitting risk. This is the reason why—by increasing equity—banks orient themselves toward the accumulation of retained earnings (Cohen, 2013). The main purpose of this paper is to model the behavior of banking firms during the announcement and implementation of new capital requirements in the period of ongoing financial and banking crisis. As far as banking stability and activities are concerned,

1 Banks with a high ratio of non-performing loans and with low regulatory capital ratio increased equity mostly by capitalization of present owners or the debt-to-equity swap (e.g. Banca Monte dei Paschi di Siena increased its capital by EUR 3.8 billion, while UniCredit increased its capital by EUR 13 billion in Italy's biggest public offering).

prudential regulators are faced with a risk of downsized lending to customers, securities volume, and interbank assets.

2 Empirical Research

The basis of the empirical research is the analysis of the banking firm adoption to the new regulatory capital requirements. With respect to complying with the new capital structure and regulatory capital ratio requirements, the main research hypotheses have been developed:

- Banking firms will decrease risk-weighted assets by mostly reducing the lending activities.
- Banking firms in the period of the financial crisis are not ready to increase the equity because of the significant capital costs and negative investment sentiment to the banking shares.

The analysis will be done on the representative sample of the European Union's systematically important banks.

2.1 Data Selection

The survey was conducted on a sample of 35 banking groups operating in the EU for the period 2000–2016, selected by the size of assets. The total share of the observed group of banks, according to the asset size criterion in total assets of the European Monetary Union (EMU) credit institutions, was approximately 78.9 percent at the end of 2016[2]. Therefore, the chosen banking companies are unquestionably taking the position of market makers on a single EU banking market. The total assets of the observed banks amounted to EUR 23,514,793 million, while the total assets of the EMU credit institutions amounted to EUR 29,810,935 million on December 31, 2016. In addition to the size of the

2 A selected sample of banks is shown in the Appendix Table 1.

asset and the significance of a particular group that is defined by experiential knowledge, an additional basic criterion for selecting a particular group in a sample of observations is also the public listing, i.e. the criterion of listed shares of a group of banks in the European Union capital markets for which the Orbis database (Bankscope) is used as an additional check. Namely, the sample of this research was formed based on the data obtained from the Reuters database, referring to the balance sheet of each selected group, as well as on business indicators and individual relevant regulatory capital positions predefined by the Basel III standard. In this way, maximum relevance, impartiality, and objectivity is ensured during statistical processing, presentation, and finally, when relevant judgments are made as a result of previous empirical research. Data and related indicators are taken from the consolidated annual reports of the observed group of banks published in accordance with the International Financial Reporting Standards (IFRS). The issues of merger and acquisitions that are contained in the same consolidated reports for the period 2000–2016 were not considered relevant for the research problem. Large regional and development banks are excluded from the sample under the criterion of public listing as the same do not entirely comply and operate under market criteria although they are subject to the same banking regulation in question.

2.2 Variable Description

The dependent variable of this survey is the growth of Risk-Weighted Assets (RWA). Independent variables are directly or indirectly related to the ability of a banking firm to meet regulatory capital requirements; and the selected ones are:

- **NPL/TL** – The ratio of non-performing loans (potentially risky loans for which the value adjustment was made) and total loans expressed in percentage.
- **D** – Increase of all received deposits of individual banking groups expressed in percentage.

- **FR** – Net fee revenue in percentage.

Indicators of the macroeconomic environment of the observed banking groups are primarily related to the EU area. Although global banking groups have revenue outside the EU as well, their dominant business activities are taking place in the EU economic area. Macro indicators as control variables are[3]:

- **UNPLEU** – The unemployment rate in the EU-28 countries, expressed in percentage.
- **GDP** – The GDP growth of the EU-28 countries, expressed in percentage.

In addition to the abovementioned bank and macroeconomic environment variables, and for the purpose of empirical analysis of the subject research, it has been necessary to define the period of announcement and enforcement of prudential regulations of capital requirements on the basis of which banks' behavior and alignment would be observed. Namely, one of the basic assumptions of this research is that any regulatory modeling of banking business, primarily in the function of securing financial stability, produces direct causal effects on the structure and volume of bank assets. The basic breakdown of the variables has been made for 2010 (announcement of the Basel III standard), as well as for the year 2013 (implementation of the Basel III standard), 2015 (implementation of the Liquidity Cover Ratio – LCR) and 2016 (implementation of the Capital Conservation Buffers), which altogether represent the years of enforcement.

In this way, two other variables of empirical research have been formed:

- **DLA** – Announcement of regulatory measures. The announcement period of regulatory measures—i.e. when the value of the variable is 1—starts in 2010 and lasts until the end of the observed period. For all other years the value of this variable is 0.

3 The observed indicators are downloaded from the common database of the European Central Bank (ECB) as well as from the common statistical database Eurostat.

- **DLE** – Enforcement of regulatory measures. The period of enforcement of the regulatory measures (value of the variable is 1) begins in 2013 and lasts until the end of the observed period. For all other years the value of this variable is 0.

The description of all variables and the expected impact of independent variables are given in Table 1.

Table 1: *The Description of Variables and the Expected Impact of the Independent Variables*

Label	Definition of the variable	Expected impact
RWA	Risk-Weighted Assets (EUR mil.); Level of the banking industry credit activity	Dependent variable
NPL/TL	Level of the credit risk of an individual bank and the quality of the loan portfolio (in %)	-
D	The most stable and highest quality source of credit growth (in %)	+
FR	Indicator of banks' activities that does not include lending and other forms of core business (in %)	-
DLA	Period of regulatory announcement	+/-
DLE	Period of regulatory enforcement	+/-
UNPLEU	Unemployment rate in the EU-28 (in %)	-
GDP	Gross domestic product in the EU-28 (in %)	+

Source: The authors' definition and expectation.

The general characteristics of the variables of the observed sample were determined by descriptive statistics as shown in Table 2. The data processing of the survey data was done by the STATA 14.2 statistical package.

Table 2: *Descriptive Statistics of Sample Variables*

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Banks' business indicators					
RWA	481	204.038	179.258	21.689	1.015.649
NPL/TL	268	19.03	107.14	0.05	1.393.30
D	576	22.57	286.38	-82.50	6.788.60
FR	583	31.84	28.07	-112.10	573.80
Macroeconomic environment					
UNPLEU	595	9.08	0.98	7.00	10.90
GDP	595	1.48	1.82	-4.40	3.90

Source: Authors' calculation.

The dynamic analysis of the dependent variables of our research was made as the calculation of the average value for all the banking groups at the level of each observed year (Table 3). Although the number of observations is not the same at the level of the whole sample, which could somehow reduce the credibility of the approximation through the calculation of the average annual value, in this way, we still have enough data to obtain a simpler insight into the dynamics of the observed portfolio of banks as well as the movement of the credit assets in a unit of time.

Table 3: *Average Value of the Dependent Variable of the Sample at the Level of the Total Portfolio of Observed Groups of Banks, in EUR Million*[4]

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Avrg_TRWA	119.010	134.504	126.351	133.242	152.032	179.624	203.977	227.175	253.310

Year	2009	2010	2011	2012	2013	2014	2015	2016
Avrg_TRWA	250.858	245.642	235.492	205.367	244.571	229.577	235.809	223.266

Source: Authors' calculation.

4 The dynamics of the average value of all banking groups' assets and return on equity are shown in the Appendix Figure 1.

The dynamics of the average value of credit assets of the banking groups' portfolio recorded a strong growth to about EUR 253,000 million in 2008, after which sharp downfall adjustments were recorded. Significant recovery occurs later in 2013 by returning approximately to 2010 levels, while the further downward trend ends with a value close to the level of 2007 (even slightly lower).

In addition to the basic analysis of the dynamics of the dependent variables, it was necessary to evaluate whether there are differences in the arithmetic means of the banking group variables before and after the announcement of regulatory changes as well as before and after the enforcement of the regulatory measures, using a two-way t-test.

Table 4: *Results of the Two-Way T-Test of Differences in Arithmetic Means of the Observed Sample Variables for the Announcement Period and the Enforcement of Regulatory Measures*

Variable		Period	Obs.	Mean	Std. Dev.	p-value
DLA	RWA	0 1	272 209	182786.1 231696	154988.4 203709.6	0.0029***
	NPL/TL	0 1	110 158	6.644818 27.65759	28.78671 136.982	0.1144
	D	0 1	332 244	13.9512 34.30205	23.0772 439.426	0.3998
	FR	0 1	340 243	32.90735 30.34074	33.15854 18.72135	0.2767
DLE	RWA	0 1	358 123	194251.8 232521.5	167777.9 207257.8	0.0410**
	NPL/TL	0 1	163 105	18.4516 19.93543	119.5017 84.99505	0.9121
	D	0 1	436 140	29.29954 1.620714	328.8826 13.20348	0.3202
	FR	0 1	443 140	31.43273 33.11857	31.3516 13.06444	0.5360

Notes: * denotes significance at 10 percent; ** denotes significance at 5 percent; *** denotes significance at 1 percent.
Source: Authors' calculation.

The dependent variable of the observed bank sample shows the statistical significance of differences in arithmetic means before and after the announcement of regulatory measures as well as before and after the enforcement of regulatory

measures. The obtained results are expected and confirm the basic assumptions of the research on the significance of the selected variables and the expected influence of regulation on the banking industry. Unlike the dependent variables, the independent deposit growth variable (D)—before and after the establishment of the new regulatory framework—did not show statistical significance of differences in arithmetic means. Although deposits after the announcement of regulatory measures have increased by 34.3 percent on average, significant corrections in average growth came after the enforcement of the measures, i.e. only 1.6 percent.

Following the announcement of new, more stringent capital requirements implementation, there is a significant average increase of non-performing loans in total loans (NPL / TL) of 27.6 percent, although with a lack of statistical significance. By the enforcement of the new regulatory environment, the expected increase in the share of non-performing loans in total loans (NPL / TL) continued, but also with the absence of statistical significance. Finally, it is logical to expect a more stringent regulatory regime of creditworthiness and reduced lending to small- and medium-sized companies with larger risk weights by the banking firms as well as further regulatory compliance with the relative reduction in the share of assets with credit risk.

The independent variable of average net income from fees and provisions (FR) recorded an average decline after the announcement of the regulatory measure, from 32.9 percent to 30.3 percent, and a slightly higher than average increase of +1.7 percent after the enforcement of the measure.

Before the formation of the final model, it was necessary to check the correlation between the selected variables. According to the present knowledge, a multicollinearity test in panel models does not exists, while coefficients between pairs of potential independent variables are used in empirical issues related to multicollinearity testing.

Table 5: *Correlation Matrix: Impact on Risk-Weighted Assets*

	RWA	NPL/TL	D	FR
RWA	1			
NPL/TL	-0.0995	1		
D	0.3443***	-0.0014	1	
FR	-0.0661	0.0106	-0.0317	1

Notes: * denotes significance at 10 percent; ** denotes significance at 5 percent; *** denotes significance at 1 percent.
Source: Authors' calculation.

Table 6: *Correlation Matrix: Macroeconomic Environment and Dummy Variables of Regulatory Measures*

	DLA	DLE	UNPLEU	GDP
DLA	1			
DLE	0.6630***	1		
UNPLEU	-0.0652	-0.3623***	1	
GDP	-0.0643	0.0130	-0.7566***	1

Notes: * denotes significance at 10 percent; ** denotes significance at 5 percent; *** denotes significance at 1 percent.
Source: Authors' calculation.

Based on the correlation matrix results in Table 5, it can be concluded that there are no pairs of variables which could cause multicollinearity with the simultaneous inclusion in the model if we consider that there is no coefficient that exceeded the value of 0.5. The results from Table 6 suggest a significant correlation between the dummy variables, which is expected and will not be separately considered. In the same way, the expected multicollinearity problem can be seen by the simultaneous inclusion of the unemployment variable and gross domestic product in the empirical models. Although the relationship between these two macro variables is logical and expected, the model estimates will be made by substituting them alternately.

After the descriptive statistics—the t-test of the differences in the arithmetic mean of the selected empirical research variables and the correlation matrix results—it is necessary to define the model of influence of the prudential regulation of capital requirements on bank credit assets.

2.3 Research Model

Although the econometric analysis is improving and becoming more accurate, empirical research has shown that the data being analyzed have simultaneous temporal and spatial components. Such data containing the temporal and spatial components of some variables are called panel data.

According to Verbeek (2004), the main advantage of panel data, compared to time series or cross-sectional assemblies, is that they allow the identification of certain parameters or questions without the need to limit the assumptions. Many economic models suggest that current behavior depends on past behavior (persistence, habit forming, partial adaptation etc.), so that in many cases we want to evaluate a dynamic model on an individual level. The ability to do that is unique to panel data.

Panel data allows for an analysis of changes at an individual level and, accordingly, one of the main advantages of panel analysis is the ability to model individual dynamics. The panel analysis also highlights the control of heterogeneity at the individual level and the difference between the observed units is assumed as well. Models that do not have this feature can have negative implications in the context of estimating bias (Wooldridge, 2002). Various authors argue that panel models possess greater variability, estimating efficiency, lower possibility of multicollinearity, and greater degrees of freedom. Panel data analysis retrieves maximum information from a limited number of observations over a given period and maximizes the number of degrees of freedom. In this way, a higher efficiency of model parameters with less restrictive assumptions is assured. Advantage is also reflected in reducing the size of econometric problems that are present in

classical econometric research. Škrabić Perić (2012) points to the advantages of panel analysis in that it enables the definition and testing of more complicated econometric models and that it also reduces the multicollinearity problem. Namely, if two variables of the same observation unit are strongly correlated, but this correlation is not expressed between other observation units, this correlation loses its significance.

On the other hand, panel data model constraints arise when basic assumptions of panel analysis are disturbed, such as distortions in measurement, time-series dependence, short observation period within the time series, availability problem or lack of panel data at certain time periods. Some of the econometric problems inherent in time-scale data—heteroscedasticity and time-series autocorrelation—should also be noted. According to the availability of data, we differentiate between the balanced panel data (each data unit in each period for all variables has the necessary data available) and the unbalanced panel data (if any observation unit lacks data for a variable in a given period).

For the purposes of this study, panel analysis was performed using a static and dynamic panel, as well as using a dynamic panel with a GMM estimator. For each static and dynamic panel, fixed effects – *Fe* and random effects – *Re* analyses were also performed, while a dynamic panel with a GMM estimator was performed with one or two steps (the Arellano-Bond dynamic panel-data estimation GMM-type; one-step/two-step). Considering that the observed variables of this empirical research are of dynamic nature, the static panel models are not appropriate for estimating the same variables due to the absence of autocorrelation, i.e. the dependence of the present value of a variable on its previous value (Škrabić Perić, 2012). Therefore, dynamic panel models have been selected for further analysis and the basic model for the selected variables can be written as follows:

$$y_{i,t} = \mu + \gamma \cdot y_{i,t\text{-}1} + \beta_1 \cdot x_{i,t1} + \beta_2 \cdot x_{i,t2} + ... + \beta_k \cdot x_{i,tK} + \alpha_i + \varepsilon_{i,t}, \; i = 1,....N, \; t = 1,...T, \quad (1)$$

where i is the unit, t is time, μ is a constant member, γ a parameter of a dependent variable with a lag, β_1, β_2,..., β_K are parameters of exogenous variables, $x_{i,t}$ are independent variables, α_i is a specific error for a $i\text{-}_{th}$ bank, and ε_i i represents the error of relation of the $i\text{-}_{th}$ bank.

The number of observation units (bank groups) exceeds the number of observation periods that meet the requirement for the Arellano-Bond estimator. Due to the presence of the standard error bias for the GMM estimator in two steps, additional panel model analysis made the choice of a dynamic panel with a GMM estimator in one step. The analysis also found that the number of instruments does not exceed the number of cross-sections, so the properties of the GMM estimator system are not compromised. To keep the number of instruments under control, a one-step dependent variable is used as an instrument.

Finally, Arellano-Bond's one-step estimator with the use of robust standard error will be used for testing the research hypothesis. Due to the use of a number of variables in the proposed model, the same variables could not be included in the model at the same time. In the function of verifying the hypothesis, the basic model had to be expanded by introducing the dummy variable of the announcement and enforcement of regulatory measures. By using the robust standard error in a model for which the Sargan test cannot be used, the validity of the models is estimated on the basis of the autocorrelation test of the first differences of the second-order residuals.

2.4 Results and Discussion

In order to test the hypothesis of our research, the basic model can be written via equation 2 (**MODEL1**) and equation 3 (**MODEL2**) by using different control variables:

$$\Delta LogRWA_{it} = \mu + \gamma \cdot \Delta LogRWA_{i,t\text{-}1} + \beta_1 \cdot \Delta NPL/TL_{it\,1} + \beta_2 \cdot D_{it\,2} + \beta_3 \cdot \Delta FR_{it\,3} \quad (2)$$
$$+ \beta_4 \cdot GDP_{it\,4} + \alpha_i + \varepsilon_{it},$$
$$i = 1,....N\,,\ t = 1,...,T.$$

$$\Delta LogRWA_{it} = \mu + \gamma \cdot \Delta LogRWA_{i,t\text{-}1} + \beta_1 \cdot \Delta NPL/TL_{it\,1} + \beta_2 \cdot D_{it\,2} + \beta_3 \cdot \Delta FR_{it\,3} \quad (3)$$
$$+ \beta_4 \cdot \Delta UNPLEU_{it\,4} + \alpha_i + \varepsilon_{it}\,,$$
$$i = 1,....N\,,\ t = 1,...,T.$$

Table 7 presents the results of model estimate of the influence of regulatory requirements on banks' credit activity. All models satisfy the test of second-order autocorrelation of the first residuals AR (2), i.e. on the 5 percent significance level, the test does not reject the null hypothesis that there is no second-order correlation of the first residual differences, indicating thereby that there is no autocorrelation between the residuals in the model. It can be concluded that the models are well-specified.

Table 7: *The Results of the Panel Analysis Impact of the Increase of Regulatory Capital Requirements on Banks' Credit Activity*

Variable	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6
Banks' business indicators						
$\Delta LogRWA_{i,t-1}$	-0.6238044*** *(0.1332071)*	-0.5810222*** *(0.1338068)*	-0.6347797*** *(0.1323302)*	-0.6121126*** *(0.1327897)*	-0.6106689*** *(0.1258199)*	-0.5566764*** *(0.1246413)*
$\Delta NPL/TL_{it}$	-0.0004184*** *(0.0000598)*	-0.000459*** *(0.0000665)*	-0.0004062*** *(0.0000611)*	-0.0004298*** *(0.0000659)*	-0.000386*** *(0.0000774)*	-0.0004341*** *(0.0000844)*
D_{it}	0.0011691*** *(0.0004084)*	0.0011791*** *(0.0004151)*	0.0013183*** *(0.0004191)*	0.0013325*** *(0.0004202)*	0.0012344*** *(0.000428)*	0.0012761*** *(0.000438)*
ΔFR_{it}	-0.0010747* *(0.0006284)*	-0.0010268* *(0.0005998)*	-0.0011441* *(0.0006489)*	-0.0011202* *(0.0006357)*	-0.0011206* *(0.000598)*	-0.0010798* *(0.0005557)*
Announcement of regulatory measures						
DLA_{it}			0.0296932*** *(0.007066)*	0.0311888*** *(0.0076308)*		
Implementation of regulatory measures						
DLE_{it}					0.0185681** *(0.0080287)*	0.0255599*** *(0.0084864)*
Macroeconomic environment						
$\Delta UNPLEU_{it}$		0.0016121 *(0.0034224)*		0.0015295 *(0.003271)*		0.0063702** *(0.0032834)*
GDP_{it}	0.0025951* *(0.001521)*		0.0013006 *(0.0014358)*		0.0019535 *(0.0014758)*	
μ	-0.016886*** *(0.0043075)*	-0.0135159 *** *(0.0042549)*	-0.0349529*** *(0.0064771)*	-0.0341967*** *(0.0067906)*	-0.0240771*** *(0.006323)*	-0.0241174*** *(0.0067681)*
Number of observations	132	132	132	132	132	132
Number of groups	25	25	25	25	25	25
AR(1) test	0.0377	0.0427	0.0261	0.0280	0.0428	0.0539
AR(2) test	0.1172	0.1029	0.2046	0.2005	0.0954	0.0675

Notes: * denotes significance at 10 percent; ** denotes significance at 5 percent; *** denotes significance at 1 percent.

Source: Authors' calculation.

Almost all variables for **MODEL1** and **MODEL2** are statistically significant and with the expected signs. Coefficients of the dependent variable from the previous period are statistically significant and contribute to the decrease of the dependent variable of the current period, which is in line with the expectations and basic assumptions of empirical research. Independent variables of the increasing share of non-performing loans in total loans and the growth in net income for fees and provisions negatively affect the growth of banks' credit assets. Namely, the choice of the credit strategy of the banks' management structures and credit risk perception directly affect the increase in the share of non-performing loans in the structure of banking assets. The deterioration of the regular repayment of approved loans leads to an increase in the provision for problem loans, which directly affects the internal fund reallocation within a bank firm. Insufficient or inefficient diversification of banking assets leads to the materialization of credit risk and the increase in the value adjustment of the credit placements, i.e. the reduction of their fair value. The increased credit risk and the consequent negative impact on regulatory compliance lead to an increase in investment in risk-free assets and an increase in the activities of banks that do not include lending and other forms of the core banking business (e.g., transactional banking, brokerage services, and other forms of financial services). An increase in revenue from the so-called non-credit activities (fees, provisions etc.) influences the decrease of the value of the risk-weighted assets as a whole.

The positive sign of the coefficient of deposit growth variables indicates a relative increase in the share of deposits in the total sources of funding for the increase of banks' credit assets. Better quality of deposit coverage, i.e. lowering the risk weighting of the credit assets, makes it easier to meet regulatory requirements as a whole.

The control variable of the macroeconomic environment of GDP growth shows statistical significance and the expected sign, i.e. the increase in GDP is, among other things, the result of the increase in the banking industry credit assets.

The introduction of the unemployment rate as the control variable in the basic **MODEL2** did not show any statistical significance when compared to GDP.

In the next step, the basic model has been extended by introducing the variable of regulatory announcement (**DLA**), as well as by introducing a variable of regulatory measure enforcement (**DLE**). In accordance with the pre-defined models, testing will also be done according to defined changes in control variables of banks' macro-business operations.

An extended model can be written using the equation (**MODEL3**):

$$\Delta LogRWA_{it} = \mu + \gamma \cdot \Delta LogRWA_{i,t-1} + \beta_1 \cdot \Delta NPL/TL_{it\,1} + \beta_2 \cdot D_{it\,2} + \beta_3 \cdot \Delta FR_{it\,3} \quad (4)$$
$$+ \beta_4 \cdot DLA_{it\,4} + \beta_5 \cdot GDP_{it\,5} + \alpha_i + \varepsilon_{it},$$
$$i = 1,....N,\ t = 1,...,T,$$

i.e. by using the unemployment rate control variable in the equation (**MODEL4**):

$$\Delta LogRWA_{it} = \mu + \gamma \cdot \Delta LogRWA_{i,t-1} + \beta_1 \cdot \Delta NPL/TL_{it\,1} + \beta_2 \cdot D_{it\,2} + \beta_3 \cdot \Delta FR_{it\,3} \quad (5)$$
$$+ \beta_4 \cdot DLA_{it\,4} + \beta_5 \cdot \Delta UNPLEU_{it\,5} + \alpha_i + \varepsilon_{it},$$
$$i = 1,....N,\ t = 1,...,T.$$

Coefficients of banks' business indicators presented as the non-performing loans growth rates, as well as an increase in net income for fees and provisions are of the same negative sign and are statistically significant as in previous models, while the growth of the deposit is of the counter sign and contributes to the reduction of the risk of credit assets. Furthermore, the value of β_4 coefficient of the **DLA** variable, upon which the test is performed in both observed models, is positive and statistically significant, i.e. it is evident from both models that

the introduction of the regulatory variable of announcement positively affects the risk-weighted assets. Namely, the results of **MODEL3** and **MODEL4** show that already with the announcement of the regulatory measures, the banking group started to adapt to new capital requirements. By reducing the risk of credit assets—particularly due to a lack of financing of the small- and medium-sized companies (SMEs) and more risky projects—the banking firm has the influence on compliance with regulatory requirements without changing the equity or the ownership structure. However, the lack of significance of the domestic product growth rate in relation to the credit assets growth suggests that there is no serious credit activity of the banking industry in the function of boosting the credit cycle and domestic product growth following the announcement of regulatory measures. The control macro variable of the unemployment rate is also not statistically significant.

The introduction of regulatory enforcement variable into models (**DLE**) has been statistically significant and can be expressed by the equation (**MODEL5**):

$$\Delta LogRWA_{it} = \mu + \gamma \cdot \Delta LogRWA_{i,t\text{-}1} + \beta_1 \cdot \Delta NPL/TL_{it\,1} + \beta_2 \cdot D_{it\,2} + \beta_3 \cdot \Delta FR_{it\,3} \quad (6)$$
$$+ \beta_4 \cdot DLE_{it\,4} + \beta_5 \cdot GDP_{it\,5} + \alpha_i + \varepsilon_{it},$$
$$i = 1,....N,\ t = 1,...,T,$$

i.e. by using the unemployment rate control variable in the equation (**MODEL6**):

$$\Delta LogRWA_{it} = \mu + \gamma \cdot \Delta LogRWA_{i,t\text{-}1} + \beta_1 \cdot \Delta NPL/TL_{it\,1} + \beta_2 \cdot D_{it\,2} + \beta_3 \cdot \Delta FR_{\mathrm{it}\,3} \quad (7)$$
$$+ \beta_4 \cdot DLE_{it\,4} + \beta_5 \cdot \Delta UNPLEU_{it\,5} + \alpha_i + \varepsilon_{it},$$
$$i = 1,....N,\ t = 1,...,T.$$

Coefficients of a bank's business indicator are of the same sign and are statistically significant as in previous models. The value of β_4 coefficient of variable regulatory enforcement (**DLE**), based on which the test is performed in both observed models, is positive and statistically significant. It is evident from the model that the introduction of regulatory measures enforcement variables as well as the announcement variable has a positive impact on risk-weighted assets. Namely, by implementing the regulatory measures of the capital requirements increase, the management structures of banking firms continue to adapt banking assets toward new requirements. Credit risk reduction by a relative drop in the share of non-performing loans in total loans and the deposit base increase as the source of financing opened up the space for increasing the credit assets of the lower risk weight. Furthermore, a relative increase in credit assets through better coverage of the potential materialization of credit risks ultimately leads to easier compliance with the banks' regulatory requirements.

Coefficient and the absence of significance of the GDP macro variable by regulatory measures enforcement confirms the lack of banking sector's significant credit activity while expanding the model with the variable of unemployment rate, the same variable that has become statistically significant. In accordance with the underlying assumptions of empirical research and the analysis of the obtained results, it can be concluded that there is a significant correlation between the relative reduction of exposure to more risky sectors of the economy and an increase in the unemployment rate. Namely, the realization of credit demand for SMEs in bank-centric economies becomes more difficult by declining real economic activity. Banking firms forced to meet regulatory requirements are turning to finance large and less risky companies, leaving little room for small- and medium-sized enterprises for quality restructuring and financing of development projects. Since the stated macro-variables are in interdependence, the result is not surprising.

Based on the results of the estimated models, the direction and the statistical significance of the observed variables, it can be concluded that regulatory

measures of increasing capital requirements have negative effects on banks' credit activities.

3 Concluding Remarks

The intensity of financial crisis and its impact on financial system functionality caused by prudential regulations has been more forceful than ever in history. The main focus of financial authorities lies in the long-term stabilization of financial markets. Reactivity of financial institutions under the prudential constrains is hard to predict. The adjustment of financial institutions is directly linked to the strength of the financial system, the role of the lender of the last resort, and the real sector, the consumer of financial services. Long-term instability of interbank market and negative sentiment to the equity of banking firms, supported by a decrease in real financial sector investments, are the conditions for the implementation of new capital requirements and necessary prudential measures. Regulatory authorities are faced with the risk of financial institutions adapting to new capital requirements by squeezing risk-weighted assets mostly by decreasing the loan portfolio. The announcement and the implementation of new capital requirements coincides with and is enforced by the culmination of financial crisis, with a significant impact on borrowing and lending activities and with an increase of loan portfolio credit risk. The analytical model confirms negative relations between risk-weighted assets of sampled banks and the volume of non-performing loans. Even with the reallocation of financial funds from financial markets to the banking sector at the beginning of financial crisis, the relative volume of deposit in the long run is in positive relations with lending activities due to the ability of the banking sector to create endogenous money. Therefore, the model demonstrates negative relations between fee income and risk-weighted assets, which indicates transition of banking firms toward new products and services and a move out of traditional lending and trading activities. Prudential authorities were ready to take over the risk of regulatory measures to squeeze credit activity on customers who have significant negative impact on

economic growth and development. It is obvious that the banking sector will adapt to new capital requirements that are oriented toward limiting bank assets growth, decreasing the opportunities of banking firms in speculative activities on financial markets, and bringing the banking system back to the traditional client-oriented business model. The stability of the banking sector is the primary objective of regulatory authorities.

The additional capital buffers are necessary in the long-term stability of the European banking sector, with a special approach to systematically important banks. The negative consequence of regulatory pressure is that risk banking activities will be allocated from prudential regulations into other financial institutions. The unregulated shadow banking can increase the costs of adverse selection because banks can transfer the risk to financial institutions that are out of excessive capital pressure (Plantin, 2014).

The practical contribution of this research can certainly be seen through its potential users. The complexity of the model presentation of banking sector behavior in changed regulatory conditions can contribute to a better understanding of the same problem by the creators of the regulatory policies and regulators themselves. With the expectation of further regulatory alignment in favor of preserving the financial stability as a whole and in order to understand the reaction of the banking industry toward a simple measure of increasing capital requirements, the results of this research are certainly directed to public investors and management structures as well.

The biggest and most important limitation of the survey is the unavailability of the listing prices of shares of the banking firms. For the same reason, it was not possible to include the real market value of the banking sector in the model calculation. It would be worthwhile to further model the movement of banks' market underlying value in terms of changing regulatory conditions as a logical continuation of research. Additionally, it would be particularly interesting to observe the changed ownership structure after the wave of state aid with the aim

of stabilizing the banking market has settled. The research did not provide any supporting evidence of direct and indirect strengthening of state influence in the management structures of banks due to the complexity of the problem.

The abovementioned limitations should certainly be taken into account for future research, particularly for research on the structure of non-risky assets and their correlation with the capital market. Namely, the phenomenon of banking firms in risk transfer to other market players is particularly apparent after the last global financial crisis (risk shifting). The abandonment of the socialization paradigm concerning the costs of banking failures changes the nature of the conflict between social actors. Regulatory authorities, on behalf of taxpayers, become more sensitive to the management structures' behavior, which could assist in the return toward traditional sources of evolutionary growth and development of the banking sector as a whole.

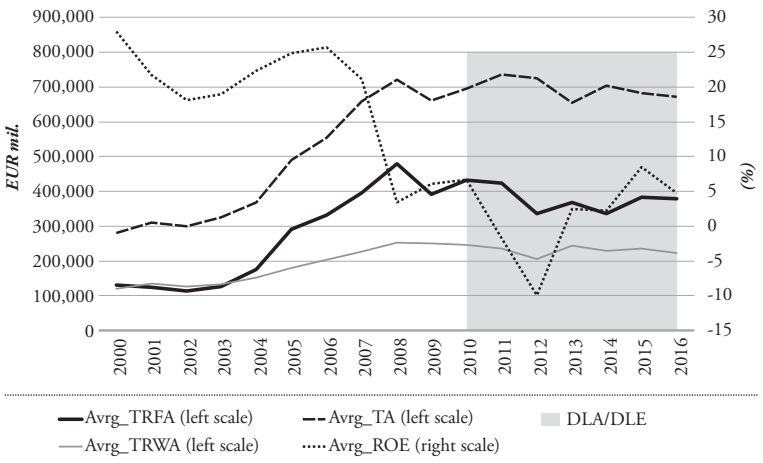
Appendix

Appendix Table 1: *A Selected Sample of Banks, in EUR million, on December 31, 2016*

Bank name	Country	Assets	Capital	ROE (%)	Capital adequacy (%)
Allied Irish Banks, PLC	Ireland	95.622	13.148	13,30	17,60
Banca Monte dei Paschi di Siena, SpA	Italy	153.179	6.425	-40,30	10,40
Banco BPM, SpA	Italy	117.411	7.575	-28,60	16,17
Banco Popular Español, SA	Spain	147.686	10.835	-41,90	12,64
Banco de Sabadell, SA	Spain	212.508	13.033	7,90	13,80
Banco Santander, SA	Spain	1.339.125	90.938	12,0	14,68
Bank of Ireland Group, PLC	Ireland	123.129	9.401	11,10	16,40
Bank VTB, PAO	Russia	195.415	21.746	4,60	14,60
Barclays, PLC	UK	1.423.475	76.122	5,20	19,60
Banco Bilbao Vizcaya Argentaria, SA	Spain	731.856	47.364	13,50	15,10
BNP Paribas, SA	France	2.076.959	100.665	11,40	14,20
CaixaBank, SA	Spain	347.927	23.526	6,30	16,20
Commerzbank, AG	Germany	480.450	28.560	2,20	15,30
Crédit Agricole, SA	France	1.524.232	58.276	6,00	18,60
Danske Bank, A/S	Denmark	469.104	20.505	16,80	21,80
Deutsche Bank, AG	Germany	1.590.546	64.503	-1,20	16,60
Dexia, SA	Belgium	212.771	4.147	7,10	16,80
DNB ASA	Norway	292.200	22.734	11,80	19,50
Erste Group Bank, AG	Austria	208.227	12.460	16,60	18,20
HSBC Holdings, PLC	UK	2.259.087	166.827	3,90	20,10
ING Group, NV	Netherlands	845.081	49.793	12,10	19,68
Intesa Sanpaolo, SpA	Italy	725.100	48.911	6,70	17,00
KBC Group, NV	Belgium	275.200	17.357	18,60	20,00
Lloyds Banking Group, PLC	UK	959.593	56.763	8,90	18,40
Nationwide Building Society	UK	258.373	12.976	11,90	36,10
Nordea Bank, AB	Sweden	615.659	32.409	14,60	24,70
Royal Bank of Scotland, PLC	UK	937.138	57.038	-8,00	19,20
Sberbank of Russia, PAO	Russia	393.897	43.757	26,10	15,70
Skandinaviska Enskilda Banken, AB	Sweden	273.698	14.723	10,50	24,80
Société Générale	France	1.382.241	61.953	10,40	17,90
Standard Chartered, PLC	UK	615.133	45.978	0,80	21,30
Svenska Handelsbanken, AB	Sweden	274.422	14.243	15,60	31,40
Swedbank, AB	Sweden	224.983	13.526	18,80	31,80
UBS Group, AG	Switzerland	873.833	50.111	7,50	23,18
UniCredit, SpA	Italy	859.533	39.336	-25,20	11,66

Source: Reuters.

Appendix Figure 1: *The Dynamics of the Average Value of Bank Assets and the Return on Equity of Banks*



Notes: *Avrg_TA* – total average assets; *Avrg_TRFA* – total average risk-free assets; *Avrg_TRWA* – total average risk/credit assets; *Avrg_ROE* – total average return on equity; *DLA/DLE* – time period of announcement / enforcement of regulatory requirements.

Sources: Reuters and authors' calculation.

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