

# **Banking in Emerging Europe: A bank level balance sheet view<sup>1</sup>**

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## **Abstract**

Using a novel bank-level dataset we document key developments in banking sector of countries from central, eastern and south-eastern Europe (CESEE) during 2004-2011. We conclude that banks behaved prudently prior to the Great Recession, given that expansion of their balance sheets was coupled with strengthening of their capital. We show that profitability of banks was important determinant of their capitalisation (i.e. equity-to-assets ratio). We find that that non-core funding was a persistent feature on balance sheets of banks active in CESEE and that a part of the non-core funding build-up could be explained by the expansion of banks' loan portfolio. This paper contributes to the literature on credit developments in CESEE countries by applying methodological concepts found in papers on bank balance sheet management.

**Keywords:** banks; central, eastern and south-eastern Europe (CESEE); target capital model; non-core funding.

**JEL Classification:** F36, G20, G21

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<sup>1</sup> This paper should not be reported as representing the views of the European Central Bank (ECB). The views expressed are those of the authors and do not necessarily reflect those of the ECB.

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## **Non-technical summary**

Banking in central, eastern and south-eastern Europe (CESEE) underwent significant changes over the last decade. A dynamic credit growth, financed largely by capital inflows, which fuelled domestic demand boom and inflated asset prices in several countries ended abruptly as the global financial and economic crisis hit the region. A sudden stop of capital flows and a lost access to funding sources of banks – either in a form of direct borrowing from their parent banks residing in Western Europe, or their access to wholesale markets – shook up the stability of banking system in CESEE countries. As the credit boom turned into a bust and inflated asset prices fell rapidly in some countries, banks witnessed deterioration in quality of their loan portfolios. This deterioration was further intensified by plummeting economic activity at home and abroad and increasing unemployment. Macroeconomic adjustment is still on-going in some countries from CESEE amid continuously contracting, or anaemic lending activity by banks.

Using a novel bank-level dataset, we study key developments in banking sector of CESEE countries during a larger part of the last decade. In general we focus on the liability side of bank's balance sheet, analysing how banks managed their capitalisation (i.e. equity-to-assets) and their non-core funding (i.e. funding excluding customer deposits) before the Great Recession and afterwards. We estimate a partial adjustment target capital model proposed by Hancock and Wilcox (1993, 1994) using a bank-level data from 18 countries from the CESEE region – covering EU member states and countries outside the EU – over the period 2004-2011.

On CESEE banks' capitalisation, we show that income generated by the asset side of balance sheet is important determinant of bank's capital and this finding is robust to different specification of profitability measures. In other words, we prove that banks in CESEE retained their earnings and strengthened their capitalisation, instead of distributing profits to their shareholders. Interestingly, the riskiness of loan portfolio does not seem to affect bank's capitalisation. This changes, when we estimate our benchmark model for different sub-samples. When differentiating countries by their EU membership, we find that capitalisation of banks operating in EU countries tend to respond to the riskiness of their balance sheet positively, while no relationship could be detected for banks in non-EU countries. In line with the literature, we conclude that bank's capitalisation is negatively related to growth of loans.

On CESEE banks' non-core funding, we find that the speed of adjustment is slow and thus we conclude that non-core funding was a persistent feature on banks' balance sheet. This also signals that alternative sources of funding for banks are costly to obtain, what could be particularly restrictive in a situation of global and system-wide shocks (e.g. Lehman collapse). We show that bank's ability to attract customer deposits as well as income generation capacity of its balance sheet are negatively related to non-core funding, pointing out to their substitutability. We conclude that a part of the non-core funding build-up could be explained by the expansion of loan portfolio.

## **I. Introduction**

Economic developments in central, eastern and south-eastern Europe (CESEE) were shaped by a sequence of events, which could be summarized as follows. First, large capital inflows into the region helped to fuel a domestic demand-driven economic boom. Benefiting from these ‘convergence-play’ induced capital flows, many countries recorded a dynamic growth of loans, booming residential housing prices and growing internal and external macroeconomic imbalances. Second, the global financial and economic crisis hit the region hard and via multiple channels, including significantly reduced capital flows (in some specific cases their reversal) and a negative trade shock. In several countries, the adjustment of macroeconomic imbalances is still on-going.

Turning to banks active in the CESEE region, which are largely controlled by banking groups from Western Europe<sup>4</sup>, one can identify several shocks that affected them lately. These include much lower capital flows compared with the pre-crisis period. This was specifically evident for so-called debt-creating capital flows, including for instance a direct lending across the border to non-financial sector and capital flows within the international banking groups. Moreover, a sharp adjustment of economic activity connected with job losses worsened the quality of banks’ loan portfolio and weakened their capital position. More recently, banks were affected by the outbreak of sovereign debt crisis in some euro area countries as well as by the risk of parent banks’ deleveraging.

In this paper we study key developments in banking sector of CESEE countries during a larger part of the last decade using a novel bank-level dataset. We focus on the liability side of bank’s balance sheet, analysing how banks managed their capitalisation (i.e. equity-to-assets) and their non-core funding (i.e. funding excluding customer deposits).

The paper is structured as follows. Section II reviews the available literature on credit developments in the CESEE region, bank balance sheet management, as well as recent literature on the impact of the global financial crisis on banks. Section III offers some stylized facts on the banking systems in the region and section IV briefly discusses the dataset and our econometric approach. Section V reviews our empirical findings and section VI concludes.

## **II. Review of literature**

The process of economic convergence and financial deepening were main arguments used to justify the pace of credit growth in the CESEE region during the earlier part of the last decade. These arguments received attention in early-2000s, when articles<sup>5</sup>

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<sup>4</sup> We refer here to EU-15 countries in general. The EU-15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

<sup>5</sup> See Cottarelli et al. (2005), Backé et al. (2006) and Backé and Wójcik (2008). Hilbers et al. (2005), elaborating on the risks stemming from a rapid credit growth, offer an overview of macro-prudential and supervisory measures to manage these risks.

estimating the equilibrium pace of financial deepening during the post-transition period concluded that no clear evidence of excesses could be detected. Nevertheless, a call for caution for the policy-makers was often stressed. Amid a steady acceleration of loan growth across the CESEE region, the assessment had been changed, suggesting that the loan growth could be excessive<sup>6</sup>. More recent studies<sup>7</sup> acknowledge that there was indeed a credit boom in the most of CESEE countries prior to the global financial and economic crisis, highlighting the role of large capital inflows in general, and the parent banks' lending, direct cross-border lending, and domestic policies in particular.

The global financial and economic crisis renewed the interest in better understanding of how banks manage their assets and liabilities, how they respond to shocks, and how the transmission of these shocks is affected by the globalisation of banking. The notion that leverage behaves pro-cyclically was documented by Adrian and Shin (2011), suggesting that banks' equity behaves as a predetermined variable while the asset side moves in sync with the economic cycle. Bruno and Shin (2012) identified that global liquidity following the leverage cycle of global banks is driving banking sector capital flows worldwide. Adverse liquidity shocks affecting banking systems of major developed countries hit emerging market economies, according to Cetorelli and Goldberg (2011), via several channels, including direct cross-border lending to both, banks and non-banks, as well as through the contraction of local lending by foreign banks' affiliates in emerging markets. In addition, Hahm, Shin and Shin (2012) concluded that a large stock of non-core liabilities indicates the erosion of risk premiums and, therefore, could serve as a good indicator of growing vulnerabilities in the banking sector.

The impact of global deleveraging of international banking activities on economic activity still remains one of the central issues for the policy-makers. In the euro area, the need to strengthen banks' capital amid deteriorating quality of their loan portfolio and the fragmentation of funding markets increased the risk of disorderly deleveraging in the second half of 2011. This risk was significantly reduced by the Eurosystem's three-year longer-term refinancing operations in December 2011 and March 2012. These operations have, according to the ECB (2012), eased a need for banks to refinance themselves in the market in the near term. As the macroeconomic adjustment in peripheral euro area countries continues, deleveraging pressures in the euro area remain. Financial interlinkages between the CESEE region and mature economies from the euro area (European Union) received increased attention, as the effects from a sudden stop of capital flows and deleveraging by parent banks, as well as possible policy actions to contain them were extensively analysed<sup>8</sup>.

Growing interconnectedness of banking systems and better availability of bank-level data offered a fertile ground for the analysis of developments within banking groups. The evidence that multinational bank holdings manage credit growth of their

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<sup>6</sup> See Duenwald et al. (2005), Boissay et al. (2006), Backé et al. (2007), and ECB (2008) for selected countries outside the European Union.

<sup>7</sup> See Maechler and Ong (2009) and Bakker and Gulde (2010).

<sup>8</sup> See Árvai, Driessen and Ötoker-Robe (2009), De Haas and Van Lelyveld (2011), ECB (2012). The effect of the European Bank Coordination 'Vienna' Initiative on financial stability in emerging Europe is analysed in De Haas et al. (2012) and Mileva (2013).

subsidiaries through their internal capital markets was documented by De Haas and Van Lelyveld (2010). In addition, their analysis suggests that subsidiaries of financially strong parent banks tend to expand faster while parent banks in general provide support for their subsidiaries in times of a local crisis given that capital management within the banking group rather than macroeconomic linkages matters. However, studying banks' behaviour during the Great Recession, De Haas and Van Lelyveld (2011) conclude that parent banks were not "...a significant source of strength to their subsidiaries" and banks with a higher exposure to parent and wholesale funding had to reduce lending more<sup>9</sup> than domestic banks relying on local deposits. These findings thus suggest that foreign-owned banks<sup>10</sup> could support financial stability in a country, but could also impact financial stability adversely if the shock originates in the home country.

Turning to literature analysing banks' balance sheet management practices<sup>11</sup>, there are two concepts which gained particular popularity. First – a partial adjustment target capital model<sup>12</sup> as proposed by Hancock and Wilcox (1993, 1994), is built around the presumption that banks actively manage their capitalisation by adjusting it each period towards its optimal level. The second concept – a balance sheet growth perspective pioneered by Peek and Rosengreen (1995), assumes that provision of loans by a bank depends on both, the current and the initial level of bank's capitalisation. The former concept was used in several studies analysing the factors affecting banks' capital targets, as for instance in Jokipii and Milne (2008) for European banks; Francis and Osborne (2010) for the UK banks; Berrospide and Edge (2010) for the US banks; and Maurin and Toivanen (2012) for the listed euro area banks.

The impact of regulatory policies on capital of banks and their ability to provide loans to the real economy received attention of many researchers. The implementation of more risk-sensitive minimum capital requirements for banks proposed by the Basel Committee on Banking Supervision in late 1990s under a so-called Basel II, and their potential 'pro-cyclicality' had raised a lot of interest. For instance, a pro-cyclical development of bank's capital buffers<sup>13</sup> was documented in Ayuso, Pérez and Saurina (2004) analysing Spanish commercial and savings banks, while Bikker and Metzmakers (2004), focusing on banks active in OECD countries, concluded that banks' internal capital targets, generally well above the minimum capital requirements, are only moderately pro-cyclical. More recently, Chami and Cosimano (2010) studied the implications of risk-based capital requirements for the conduct of monetary policy, identifying 'bank balance-sheet channel' of monetary policy. The

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<sup>9</sup> This is also confirmed by Ongena, Peydró and van Horen (2012) however the real effect of reduced lending on firms were not confirmed. Popov and Udell (2012) present a strong evidence that firms' access to credit was affected by changes in financial conditions of their banks across emerging Europe during the global financial and economic crisis.

<sup>10</sup> Claessens and van Horen (2012) study the impact and behavior of foreign banks for a large number of countries.

<sup>11</sup> This stream of literature studied factors behind loan contraction in the US economy during 1990-91.

<sup>12</sup> Estrella (2004) proposes a dynamic model of optimal bank capital, which depends *inter alia* on capital adjustment costs, regulatory measures and bank's profitability.

<sup>13</sup> Capital held by a bank in excess of the minimum regulatory capital.

impact of the global financial crisis on banks' lending was analysed in Barajas et al. (2010), concluding that capital rather than liquidity constraints weighed on the ability of large US banks to expand their operations. They also show that bank's demand for capital is a function of loan demand expectations. The impact of new capital requirements introduced under the Basel III framework would according to Cosimano and Hakura (2011) require a higher equity-to-asset ratio and thus would lead to increase in lending rates causing decline in lending.

This paper analyses the management of balance sheet of banks active in the CESEE region, building on earlier studies following, in different variations, a partial adjustment target capital model proposed by Hancock and Wilcox (1993, 1994).

### **III. Stylized facts**

In this section, we briefly present stylized facts about banking sector in selected CESEE countries using data on banks'<sup>14</sup> balance sheets aggregated at a country level. We analyse them from two perspectives. First, applying a geographical perspective, we separate EU member states from the CESEE region from the rest of EU member states<sup>15</sup>, assuming that banks in catching-up economies differ from the banks in more mature economies in terms of structural features of their balance sheets. Second, we analyse banks' balance sheet applying a time perspective, assuming that behaviour of banks in both groups differed prior to the Great Recession and since then.

Starting with a geographical perspective, we conclude that banks in the CESEE region followed a 'traditional' banking model more than their peers in the rest of EU countries. In other words, taking deposits from and granting loans to households and non-financial corporations dominated, in large, their business models. At the same time the leverage ratio, defined here as total assets to equity, was lower compared with the rest of EU countries (see Chart 1; Panels A, B). A lower leverage and the traditional banking model might look, at the first sight, as indications of financially sound banks in the region. This assessment could prove misleading, when taking into account the process of sustainable economic convergence and an adequate pace of financial deepening.

A closer look at changes in the leverage ratio of banking sector in the region<sup>16</sup> reveals some striking patterns. We estimate Kernel density functions of the leverage ratio for nine countries from the region in three periods (see Chart 1, Panel C). These are the following: 'an early-boom period' refers to a probability distribution of the leverage ratio in January 2006, 'a pre-Lehman period' in August 2008, and the latest in June 2012. Some evidence of pro-cyclicality of leverage could be detected from a more compressed shape of the density function for the pre-Lehman period compared to the density function estimated for the early-boom period. A west-ward shift of the central point of the probability density function estimated with the June 2012 data is an even

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<sup>14</sup> Monetary financial institutions (MFIs) are referred here as banks.

<sup>15</sup> The ECB BSI data are available only for EU countries (see Appendix Table 1).

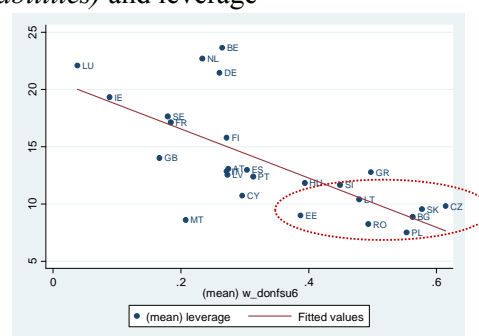
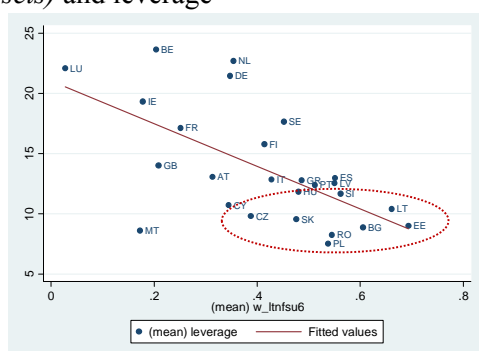
<sup>16</sup> We exclude Estonia from the sample here due to data availability (i.e. data start in January 2008).

more interesting finding. This might indicate that banks in the CESEE region were leveraging too fast during boom years and had to deleverage afterwards.

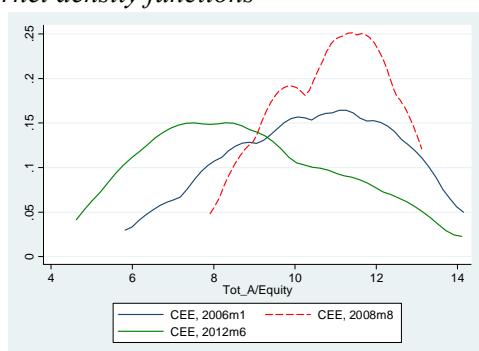
The incidence of non-performing loans in CESEE countries points to some heterogeneity within the region (see Chart 1, Panel D). The presence of two rather distinct groups – which might be linked to excessive credit growth prior to the Great Recession – is more obvious in the CESEE region than in the case of other EU countries.

**Chart 1.** ‘A bird’s eye’ view on the banking sector in CEE EU

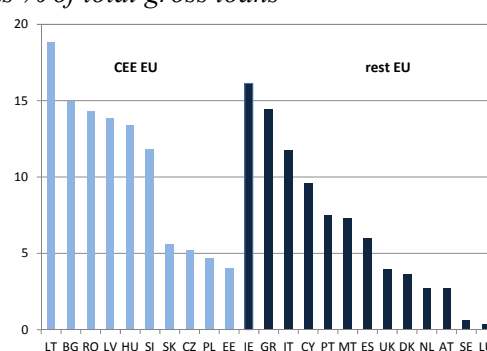
A. Loans to non-MFI sector (*as % of total assets*) and leverage      B. Deposits of non-MFI sector (*as % of total liabilities*) and leverage



C. Leverage  
kernel density functions



D. Non-performing loans  
as % of total gross loans



Note: Charts A and B use averages of selected variables over the period January 2004-July 2012. CEE countries include Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia. Leverage is calculated as total assets to equity. Data for non-performing loans refer to 2011q4, or year 2011 and are not available for Belgium, Finland, France and Germany in the IMF’s FSI.

Source: ECB BSI, IMF’s Financial Soundness Indicators, and authors’ calculations.

Next, we extend our comparative analysis by adding a time perspective. More specifically, we analyse two regions in two broader periods – before the global financial and economic crisis and since then<sup>17</sup>.

Prior to the crisis, banks’ balance sheet across CESEE countries expanded very dynamically compared with the rest of EU member states (see Chart 2, Panel A). It had largely reflected dynamically growing loan portfolio, often justified by the

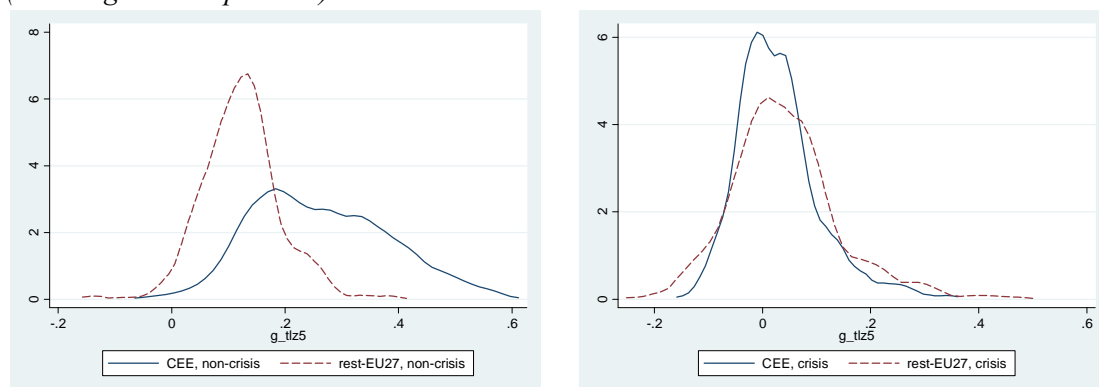
<sup>17</sup> The non-crisis period covers data from January 2004 (or any later first data point) until August 2008. The crisis period covers data from September 2008 until July 2012.

process of financial deepening<sup>18</sup>, a parallel feature to the economic convergence process. In the following period, the expansion of banks' balance sheet in the CESEE region slowed down considerably, or even turned negative, broadly resembling developments in the rest of EU countries.

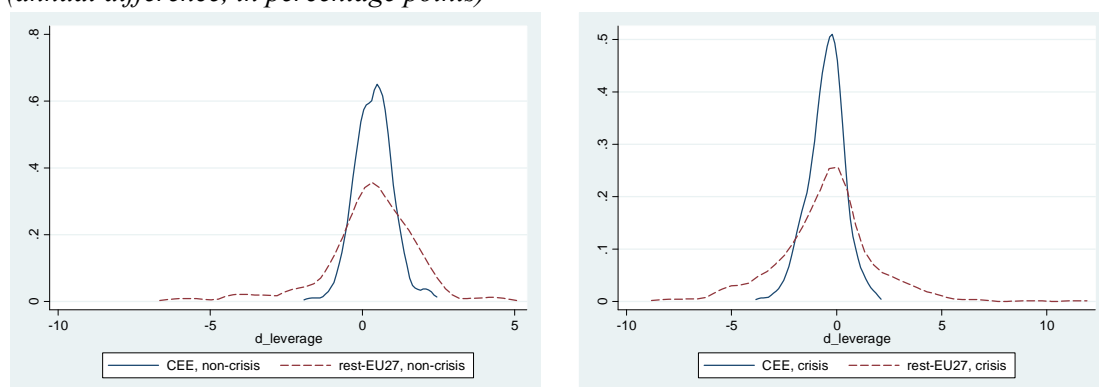
At the same time, the probability distributions of changes in the leverage ratio – indicating the speed of banks' leveraging – are more compressed for CESEE countries in both periods (see Chart 2, Panel B). This does not provide support to our previous statement on the excessive pace of leveraging, but rather suggests that banks were increasing their equity alongside their dynamically growing balance sheets<sup>19</sup>. Interestingly, heterogeneity across CESEE countries observed in the case of the balance sheet growth cannot be detected in the case of leverage.

**Chart 2.** Development of banks' total assets and leverage ratio in two regions across time

Panel A. Banks' total assets  
(annual growth in per cent)



Panel B. Banks' leverage ratio  
(annual difference, in percentage points)



Note: All charts show univariate Kernel density function for selected variables.  
Source: ECB BSI, authors' calculations.

<sup>18</sup> See Cottarelli et al. (2005), Backé et al. (2006), Boissay et al. (2006), and Backé et al. (2007).

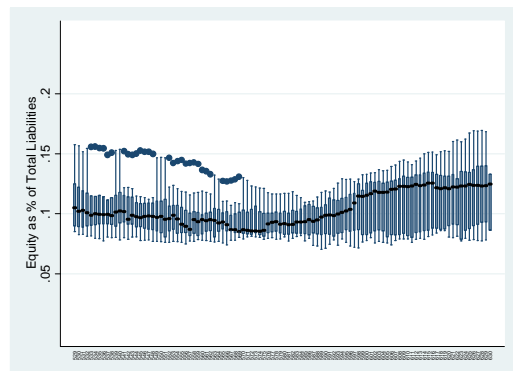
<sup>19</sup> Some tentative signs of pro-cyclical behavior of leverage, as documented Adrian and Shin (2011), are visible for both regions. More specifically, the estimated density functions of changes in the leverage ratio are skewed towards positive values prior to the crisis and towards negative values in the following period.



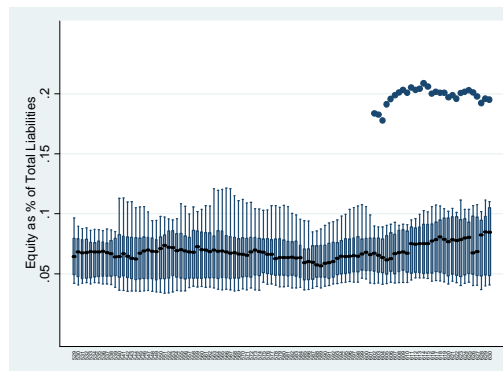
Banking sector in CESEE countries was, on average, better capitalised than the banking sector in the rest of EU countries, and its capitalisation was further strengthened over time (see Chart 3). Our previous finding, namely that banks in CESEE countries increased their capital alongside the expansion of their balance sheets during the boom years, is confirmed here by a relatively flat profile of the equity to total liabilities ratio. It should be noted, that a higher level of bank's capitalisation per se is not sufficient to shelter country's banking sector from global shocks, as demonstrated by the impact of Lehman failure on global banking.

**Chart 3.** Banks' equity  
(as % of total liabilities)

A. in CEE EU countries



B. in rest EU27 countries

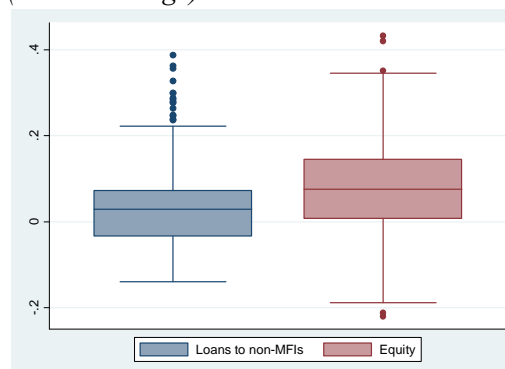


Note: Box plots are shown, incl. median, 25<sup>th</sup> and 75<sup>th</sup> percentile. Time axis starts in 2004m1 and ends in 2012m6. Source: ECB BSI and authors' calculations.

Strengthening of banks' capitalisation observed in CESEE resulted from both, increasing equity and a relatively slower increase of their loan portfolio (Chart 4). Banks in several countries had actually scaled down their loan portfolio as non-performing loans were written off their balance sheets and new lending was rare, or non-existent.

Summing up, banks in CESEE pursued a 'traditional banking model', based on accepting deposits from and granting loans to non-MFI private sector, and were less leveraged compared with the rest of EU member states. A closer look at the rapid expansion of banks' balance sheet – which was essentially reflecting the expansion of loans to non-MFI private sector – seemed to be coupled with a parallel strengthening of banks' equity. After the global financial and economic crisis hit the world economy, banks in CESEE strengthened their capitalisation further and this was achieved by both, an increase in equity and a less dynamic growth of, or eventually contracting loan portfolio. So far, we were using aggregated data on banks' balance sheet, which might be useful to tell a general story for the CESEE region using a simple comparative analysis. However, these data are not sufficient to analyse management of

**Chart 4.** Loans to private sector and equity during the crisis period in CESEE  
(annual change)



Note: The crisis period refers to 2008m9-2012m6. Box plots are shown, including median, 25<sup>th</sup> and 75<sup>th</sup> percentile. Source: ECB BSI and authors' calculations.

banks' balance sheet in detail. Therefore, next we turn to a richer bank-level data set, which allows us to track management of bank's balance sheet more closely.

#### IV. Data and estimation strategy

Our dataset is built on bank-level data from Bankscope. We take a slightly broader view on the CESEE region, as in addition to 10 EU member states from the region, we also include 8 countries, which are not members of the EU (see Appendix Table 2). These countries – some of them are EU candidate or prospective EU candidate countries – share in our view common features with EU member states from CESEE. More specifically, their banking systems are to a large extent controlled by banking groups from Western Europe, some of them experienced a credit-fuelled economic boom, and all of them could be considered as catching-up economies.

We constructed our dataset as follows. First, we downloaded the annual balance sheet and profit and loss statement data for all banks active in the CESEE region over period 2004-2011. Second, we set the minimum time span of available bank-level data to four consecutive years (i.e. 2007-2010). Third, we dropped banks in liquidation and special development (state-owned) banks from our sample. Fourth, in order to correct for outliers in our dataset, we excluded all banks which have loan-to-deposit ratio above 50.

We end up with an unbalanced panel of 309 banks in 18 countries. On average, we have slightly more than 17 banks per country<sup>20</sup>.

**Table 1.** Our dataset based on bank-level data

	<i>EU</i>	<i>non-EU</i>	Total
<i>Subsidiaries</i>	96	86	182
<i>Other banks</i>	58	69	127
<b>Total</b>	154	155	<b>309</b>

Note: Number of banks could vary for different models.

Source: Bankscope and authors' calculations.

Using bank-level data, we model equity-to-asset and non-core funding ratios. We estimate all models in a dynamic panel setting using the system GMM estimator à la Arellano and Bover (1995) and Blundell and Bond (1998) with two-step corrected cluster-robust standard errors (Windmeijer, 2005). This econometric approach is chosen given the properties of our bank-level dataset. We operate with a relatively short panel<sup>21</sup> which could be subject to the “dynamic panel bias” (Nickel, 1981). Moreover, we use some explanatory variables that are not strictly exogenous and at the same time appropriate instruments are not easily available. Using the system GMM estimator helps to tackle these issues and provides consistent estimates, so long as there is no second order auto-correlation in the residuals and the model is validly

<sup>20</sup> The lowest number of banks is 7 (for Montenegro) and the highest number of banks is 42 (for Ukraine). For further details on our dataset, please see Appendix Table 3. Due to frequent omissions in the original Bankscope dataset we re-calculated all variables used in the regressions in order to ensure their consistency across countries and time and we also implemented linear cross-checks.

<sup>21</sup> Number of time periods for 309 banks varies from 4 to 8 years.

instrumented (Roodman, 2009). For each model we report number of instruments used in the estimation, as well as the Arellano-Bond autocorrelation and the Sargan specification tests.

## V. Empirical Results

In this section we discuss first the results of the partial adjustment target capital model and we continue with the results of the non-core funding model.

### A. Partial adjustment target capital model

In the stylized facts section we showed that banks in selected CESEE countries were – at country level – well capitalised. By estimating the partial adjustment target capital model we analyse factors affecting bank’s internal capital targets. A bank facing a difference between its actual and targeted level of capital may adjust its capital, but could also actively manage its assets and liabilities in order to achieve its internal target of capital (Hancock and Wilcox (1993, 1994)<sup>22</sup>).

We model bank’s internal capital targets as a function of the adjustment costs ( $\beta$ ), controlling for the capacity of bank’s balance sheet to generate income, the riskiness of balance sheet, its structural features, and economic cycle (see Equation 1). Our model specification resembles the models used in Ayuso et al. (2004) and Jokipii and Milne (2008).

$$K/A_{i,t} = c + \beta * (K/A_{i,t-1}) + \sum_{n=1}^N \gamma_n * X_{n,i,t} + D_t + \varepsilon_{i,t} \quad (1)$$

where  $K/A_{i,t}$  is the equity-to-assets ratio<sup>23</sup>,  $X_{n,i,t}$  is a vector of  $N$  bank-specific variables,  $D_t$  includes dummy variables, and  $\varepsilon_{i,t}$  is the error term. The costs of adjustment are captured by coefficient  $\beta$ , and throughout the paper we interpret it as  $(1-\beta)$ , corresponding to the speed of adjustment. Bank-specific explanatory variables include different proxies for profitability (e.g. return on assets, net interest margin), riskiness of the bank’s loan portfolio (i.e. reserves for non-performing loans), its size and business model (proxied by the share of loans in total assets). We also account for economic cycle by including, interchangeably, growth of loans and real GDP growth. Dummy variables<sup>24</sup> track bank’s ownership and the global financial and economic crisis.

In our sample we found that the speed of adjustment of capital is moderately slow (see Table 2, Columns 1-5). While broadly comparable to findings by Maurin and Toivanen (2012) for the listed euro area banks, our estimate of the speed of

<sup>22</sup> The adjustment of bank’s balance sheet is not instantaneous due to presence of adjustment costs. See Estrella (2004) for a discussion on the costs affecting bank’s capital.

<sup>23</sup> Rather than focusing on the minimum regulatory capital, which could vary across countries and time, we use its broader definition.

<sup>24</sup> Year dummies are included in order to control for common shocks and to treat any serial correlation that might be present in the data. See Roodman (2009) for a detailed discussion on this.

adjustment is much higher compared to the one found in Bikker and Metzmakers (2004)<sup>25</sup> for banks in OECD countries. Using different proxies for profitability, we found that income generation capacity of balance sheet affects bank's capitalisation positively and it is consistently significant across alternative specifications. This supports stylized facts, namely that banks in CESEE countries were increasing capital alongside the expanding balance sheets and we conclude that banks did so by retained earnings.

**Table 2**

Variables	Equity-to-Asset Ratio				
	(1)	(2)	(3)	(4)	(5)
Equity-to-Asset Ratio (lag)	0.626*** [0.07]	0.640*** [0.10]	0.624*** [0.08]	0.665*** [0.13]	0.622*** [0.07]
NPL reserves (as % gross loans)	0.101 [0.06]	0.067 [0.07]	0.065 [0.07]	0.083 [0.06]	0.097 [0.07]
Loans (% of total assets)	0.034 [0.03]	0.048* [0.03]	0.045* [0.02]	0.054** [0.03]	0.035 [0.03]
Return on Assets	0.320*** [0.09]	-	-	0.296*** [0.08]	0.333*** [0.10]
Return on Equity	-	0.006* [0.00]	-	-	-
Net Interest Margin	-	-	0.382** [0.16]	-	-
Gross Loans (annual growth)	-	-	-	-0.019*** [0.01]	-
real GDP Growth	-	-	-	-	-0.033 [0.03]
Bank's Size	-0.032*** [0.01]	-0.030*** [0.01]	-0.024*** [0.01]	-0.031*** [0.01]	-0.033*** [0.01]
Subsidiaries (dummy)	0.071 [0.05]	0.086 [0.05]	0.073 [0.05]	0.062 [0.05]	0.072 [0.05]
Crisis (dummy)	-0.001 [0.00]	-0.002 [0.00]	-0.002 [0.00]	-0.005 [0.01]	-0.003 [0.00]
Constant	-0.144*** [0.05]	-0.152*** [0.05]	-0.136*** [0.05]	-0.146*** [0.05]	-0.147*** [0.05]
Nr. of observations	1945	1945	1945	1940	1945
Nr. of banks	308	308	308	308	308
Nr. of Instruments	54	49	49	50	55
AB (2) test (p-value)	0.74	0.50	0.41	0.99	0.74
Sargan test (p-value)	0.15	0.19	0.25	0.50	0.16

Note: System GMM partial adjustment target capital model results using a two-step procedure. Robust standard errors are reported in brackets and significance levels of 1% (\*\*\*), 5% (\*\*) and 10% (\*) are shown. All regressions include year dummies. In all models, the share of non-performing loans is treated as endogenous variable.

Source: Authors' calculations.

Interestingly, the riskiness of bank's balance sheet does not seem to affect bank's capitalisation in our sample as we found positive, but insignificant impact of reserves for non-performing loans (NPL). This might indicate that creation of the reserves by banks was sufficient. Banks with a higher share of loans in their assets tend to be

<sup>25</sup> One should acknowledge different time periods analysed in these papers. Our paper uses data more comparable to Maurin and Toivanen (2012), while Bikker and Metzmakers (2004) use data from 1990s.

better capitalised compared with banks holding more securities on their balance sheets. This finding in our view points to a prudent behaviour of banks following a ‘traditional banking’ business model in the CESEE region.

Bank’s size matters for its capitalisation, as we found that larger banks are less capitalised compared with other banks in the same country. This might be related to a more advanced risk management techniques used by larger banks as well as to benefits stemming from economies of scale and scope.<sup>26</sup> Our finding that larger banks tend to have lower capital ratios in CESEE countries is in line with the available literature, including *inter alia* Flannery and Rangan (2008) for the large US banks and Brewer et al. (2008) for the globally operating banks, while Berrospide and Edge (2010) find a positive effect of bank’s size on its capital for the bank holding companies in the US.

Using the annual growth of gross loans<sup>27</sup> as an approximation of loan demand, our model gives us a negative coefficient, suggesting that capitalisation of banks in CESEE countries is negatively related to the demand cycle. Similar findings were documented in Bikker and Metzmakers (2004) estimating capital ratio for banks operating in OECD countries, and in Ayuso et al. (2004) and Jokipii and Milne (2008) estimating capital buffers for Spanish banks and European banks respectively. Alternatively, we used country’s real GDP growth, which turned negative, but not significant.

The main results of our benchmark model (Table 2, column 4) hold also when we split our sample by the membership of a country in the European Union (see Table 3). Interestingly, the speed of adjustment towards internal capital targets is faster in case of banks operating in EU countries compared with banks active outside the EU. In addition, EU banks tend to adjust their capital in response to the riskiness of their balance sheet (approximated by NPL reserves), while this factor seem not to matter for non-EU banks. Moreover, subsidiaries tend to be better capitalised compared with domestic banks and the global financial and economic crisis weighed on banks’ capitalisation in EU countries.

In addition, we tested our benchmark model using capital buffer – calculated as a difference between the actual capital and the minimum regulatory capital – as an alternative dependent variable. The results, which are consistent with the results of our benchmark model, are reported in the Appendix (see Appendix Table 4).

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<sup>26</sup> In words of Panzar and Willig (1981, pp.268): “Whenever the costs of providing the services of the sharable input to two or more product lines are subadditive [...] the multiproduct cost function exhibits economies of scope”.

<sup>27</sup> We estimated a model, where growth of loans is treated as endogenous variable and the results of the benchmark model hold. The results of this model are not reported in the paper and are available upon request.

**Table 3**

Variables	Equity-to-Asset Ratio		
	Full Sample	EU Banks	non-EU Banks
Equity-to-Asset Ratio (lag)	0.665*** [0.13]	0.488** [0.23]	0.693*** [0.16]
NPL reserves (as % gross loans)	0.083 [0.06]	0.177** [0.08]	0.062 [0.10]
Loans (% of total assets)	0.054** [0.03]	0.077*** [0.02]	0.042 [0.03]
Return on Assets	0.296*** [0.08]	0.285** [0.14]	0.312*** [0.11]
Gross Loans (annual growth)	-0.019*** [0.01]	-0.023*** [0.01]	-0.025*** [0.01]
Bank's Size	-0.031*** [0.01]	-0.039*** [0.01]	-0.029** [0.01]
Subsidiaries (dummy)	0.062 [0.05]	0.086* [0.04]	0.024 [0.07]
Crisis (dummy)	-0.005 [0.01]	-0.009* [0.00]	-0.001 [0.01]
Constant	-0.146*** [0.05]	-0.190*** [0.05]	-0.107 [0.07]
Nr. of observations	1940	997	943
Nr. of banks	308	154	154
Nr. of Instruments	50	50	50
AB (2) test (p-value)	0.99	0.80	1.00
Sargan test (p-value)	0.50	0.42	0.33

Note: System GMM partial adjustment target capital model results using a two-step procedure. Robust standard errors are reported in brackets and significance levels of 1% (\*\*\*), 5% (\*\*) and 10% (\*) are shown. All regressions include year dummies. In all models, share of non-performing loans is treated as endogenous variable.

Source: Authors' calculations.

## B. Non-core funding model

The global financial and economic crisis, the collapse of repo markets in the US and worldwide, as well as the recent fragmentation of financial markets in Europe following the outbreak of sovereign debt crisis in some euro area countries highlighted the risks related to high dependence of banks on non-core funding. Hahm, Shin and Shin (2012) concluded that a large stock of non-core liabilities in banking sector reflects the erosion of risk premiums and, therefore, it signals vulnerability to a crisis. In CESEE countries, particularly for the banks which are controlled by parent banks residing in Western Europe, their high reliance on both, the wholesale funding and funding provided by parent banks, was often discussed among policy-makers. Therefore a better understanding of how banks manage their non-core funding and what implications it may have for their balance sheets is in our view important.

Applying intuition from the partial adjustment target capital model, we estimate non-core funding<sup>28</sup> model, assuming that a bank, similarly to its capital, sets its internal target for non-core funding taking into account developments on its balance sheet.

<sup>28</sup> We use two definition of non-core funding. Our preferred model uses dependent variable defined as bank's funding sources less all customer deposits (i.e. non-deposit funding). In the Appendix we report

Our non-core funding model is specified as follows:

$$W/A_{i,t} = c + \beta * (W/A_{i,t-1}) + \sum_{n=1}^N \gamma_n * X_{n,i,t} + D_t + \varepsilon_{i,t} \quad (2)$$

Where  $W/A_{i,t}$  is the share of non-core funding in total liabilities,  $W/A_{i,t-1}$  is the lagged value of the share of non-core funding in total liabilities,  $X_{n,i,t}$  is a vector of  $N$  bank-specific control variables,  $D_t$  refer to dummy variable and  $\varepsilon_{i,t}$  is the error term. As for the partial adjustment target capital model, we interpret a coefficient for the lagged value of dependent variable as the speed of adjustment ( $1-\beta$ ) towards a (internally) targeted level of non-core funding.

We found that the speed of adjustment of non-core funding to banks' internal targets is very slow (see Table 4). In other words, non-core funding was a persistent feature of the bank's balance sheet across CESEE. This signals that alternative sources of funding for banks are not easy to get, what could be particularly restrictive in case of global and system-wide shocks (e.g. Lehman collapse).

Non-core funding is positively related to loan growth<sup>29</sup>, suggesting that banks with higher loan growth had a higher (target) for non-core funding. Therefore, we conclude that some part of the non-core funding build-up on balance sheet could be explained by the expansion of bank's loan portfolio. This is in line with anecdotal evidence on banks' practices, suggesting that other sources of funding than deposits played an increasingly important role in financing loan growth in the CESEE region prior to the Great Recession.

In addition to non-core funding, banks could finance the expansion of their balance sheet by two other sources. First, banks could retain earnings and raise equity. Second, banks could compete with other banks for customer deposits. By controlling for both, we found a negative and consistently significant relationship between growth of deposits and non-core funding. From our proxies for the internally available funding, only the net interest margin variable is significant.

The structure of the asset side of bank's balance sheet seem to matter as well, as banks for which granting loans is the core business depend less on non-core funding. Conversely, banks with a higher share of securities tend to have higher share non-core funding, which could be justified given that securities are more liquid compared to loans and therefore could be adjusted relatively quickly.

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results for alternative dependent variable defined as non-deposit short-term funding (see Appendix Table 5).

<sup>29</sup> In this model, we treat growth of loans as endogenous variable.

**Table 4**

Variables	Non-Core Funding				
	( 1 )	( 2 )	( 3 )	( 4 )	( 5 )
Non-core Funding (lag)	0.917*** [0.07]	0.921*** [0.07]	0.912*** [0.06]	0.877*** [0.06]	0.927*** [0.11]
Gross Loans (annual growth)	0.094*** [0.03]	0.091*** [0.03]	0.093*** [0.03]	0.082*** [0.03]	0.093** [0.04]
Customer Deposits (annual growth)	-0.049** [0.02]	-0.045** [0.02]	-0.046** [0.02]	-0.040*** [0.01]	-0.050** [0.02]
Net Interest Margin	-0.607** [0.24]	-	-	-0.587*** [0.21]	-0.596** [0.24]
Return on Assets	-	0.088 [0.13]	-	-	-
Return on Equity	-	-	-0.002 [0.00]	-	-
Loans (% of total assets)	-0.145 [0.09]	-0.172* [0.09]	-0.168* [0.09]	-	-0.160* [0.10]
Securities (% of total assets)	-	-	-	0.130** [0.06]	-
Bank's Size	0.005 [0.01]	0.008 [0.01]	0.009 [0.01]	0.006 [0.01]	0.007 [0.02]
Subsidiaries (dummy)	0.001 [0.05]	0.015 [0.05]	0.011 [0.05]	0.007 [0.05]	0.001 [0.06]
Crisis (dummy)	0.000 [0.01]	0.005 [0.01]	0.015 [0.01]	0.002 [0.01]	0.010 [0.01]
EU member (dummy)	-	-	-	-	0.001 [0.06]
Constant	0.130** [0.06]	0.118** [0.06]	0.120** [0.06]	0.039 [0.05]	0.140* [0.08]
Nr. of observations	1914	1914	1914	1862	1914
Nr. of banks	306	306	306	304	306
Nr. of Instruments	50	50	50	50	50
AB (2) test (p-value)	0.98	0.99	0.97	0.68	0.92
Sargan test (p-value)	0.72	0.65	0.61	0.67	0.71

Note: System GMM results using a two-step procedure. Robust standard errors are reported in brackets and significance levels of 1% (\*\*\*), 5% (\*\*) and 10% (\*) are shown. All regressions include year dummies. In all models, growth of loans is treated as an endogenous variable.

Source: Authors' calculations.

We found no significant differences neither between banks operating in EU countries and outside the EU, nor for subsidiaries and domestically owned banks. For an alternative specification of dependent variable – non-deposit short-term funding (see Appendix Table 5) – our main results hold. In contrast to the benchmark model, we found a positive and significant relationship of bank's size and its non-deposit short-term funding.

## VI. Conclusions

Using a novel bank-level dataset we studied key developments in banking sector of the CESEE region using a bank-level data from 18 countries – EU member states and countries outside the EU – during 2004-2011.

Estimating the partial adjustment target capital model proposed by Hancock and Wilcox (1993, 1994) in a dynamic panel setting using the system GMM estimator, we analysed how banks managed their capitalisation (i.e. equity-to-assets) and their non-core funding (i.e. funding excluding customer deposits).



On CESEE banks' capitalisation, we show that income generated by the asset side of balance sheet is important determinant of bank's capital and this finding is robust to different specification of profitability measures. In other words, we prove that banks in CESEE retained their earnings and strengthened their capitalisation, instead of distributing profits to their shareholders. Interestingly, the riskiness of loan portfolio does not seem to affect bank's capitalisation. This changes, when we estimate our benchmark model for different sub-samples. When differentiating countries by their EU membership, we find that capitalisation of banks operating in EU countries tend to respond to the riskiness of their balance sheet positively, while no relationship could be detected for banks in non-EU countries. In line with the literature, we conclude that bank's capitalisation is negatively related to growth of loans.

On CESEE banks' non-core funding, we find that the speed of adjustment is slow and thus we conclude that non-core funding was a persistent feature on banks' balance sheet. This also signals that alternative sources of funding for banks are costly to obtain, what could be particularly restrictive in a situation of global and system-wide shocks (e.g. Lehman collapse). We show that bank's ability to attract customer deposits as well as income generation capacity of its balance sheet are negatively related to non-core funding, pointing out to their substitutability. We conclude that a part of the non-core funding build-up could be explained by the expansion of loan portfolio.

This paper contributes to the literature on credit developments in CESEE countries by applying methodological concepts found in papers on bank balance sheet management.

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## Appendix

**Appendix Table 1.** BSI dataset - country coverage (EU Member States)

Central and Eastern Europe (CEE)		rest EU-27	
<i>Bulgaria</i>	<i>Lithuania</i>	<i>Austria</i>	<i>Greece</i>
<i>Czech Republic</i>	<i>Poland</i>	<i>Belgium</i>	<i>Ireland</i>
<i>Estonia</i>	<i>Romania</i>	<i>Cyprus</i>	<i>Italy</i>
<i>Hungary</i>	<i>Slovenia</i>	<i>Germany</i>	<i>Luxembourg</i>
<i>Latvia</i>	<i>Slovakia</i>	<i>Spain</i>	<i>Malta</i>
		<i>Finland</i>	<i>the Netherlands</i>
		<i>France</i>	<i>Portugal</i>
		<i>United Kingdom</i>	<i>Sweden</i>

Note: Denmark is excluded due to data issues.

Source: ECB BSI.

**Appendix Table 2.** Bankscope dataset - country coverage (CESEE countries)

EU countries		non-EU countries	
<i>Bulgaria</i>	<i>Lithuania</i>	<i>Albania</i>	<i>Montenegro</i>
<i>Czech Republic</i>	<i>Poland</i>	<i>Bosna and Hercegovina</i>	<i>FYR Macedonia</i>
<i>Estonia</i>	<i>Romania</i>	<i>Croatia</i>	<i>Serbia</i>
<i>Hungary</i>	<i>Slovenia</i>	<i>Moldova</i>	<i>Ukraine</i>
<i>Latvia</i>	<i>Slovakia</i>		

Source: Bankscope and authors' calculations.

**Appendix Table 3.** Bankscope dataset – summary statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Equity-to-Asset Ratio	2255	0.138	0.099	-0.030	1
Equity Buffer	2255	0.044	0.098	-0.127	0.900
Non-Core Funding (% of total liabilities)	2226	0.235	0.197	0	0.889
Non-Core Short-Term Funding (% of total liabilities)	2226	0.160	0.180	0	0.887
NPL Reserves (% of gross loans)	2253	0.054	0.066	-0.002	0.935
Loans (% of total assets)	2255	0.581	0.166	0	0.981
Securities (% of total assets)	2188	0.125	0.130	0	0.796
Customer Deposits (annual growth)	1918	0.278	0.890	-0.934	24.92
Gross Loans (annual growth)	2143	0.311	0.545	-1	6.732
Return on Assets	2253	0.007	0.033	-0.467	0.265
Net Interest Margin	2252	0.046	0.032	-0.410	0.394
Return on Equity	2253	0.038	0.836	-36.064	3.622
Real GDP Growth	2255	0.032	0.053	-0.180	0.122
Bank's size (i.e. share in total assets in country sample, logs)	2255	-3.754	1.446	-8.538	-0.024
Crisis (i.e. value 1 for 2009-2011, nil otherwise)	2255	0.379	0.485	0	1
EU member (dummy)	2255	0.512	0.500	0	1
Subsidiaries (dummy)	2255	0.590	0.492	0	1

Source: Bankscope and authors' calculations.

**Appendix Table 4**

Variables	Equity Buffer				Eq-to-A
	( 1 )	( 2 )	( 3 )	( 4 )	( 4* )
Equity Buffer (lag)	0.649*** [0.07]	0.661*** [0.06]	0.641*** [0.07]	0.679*** [0.08]	0.665*** [0.13]
NPL reserves (as % gross loans)	0.103 [0.06]	0.066 [0.07]	0.067 [0.07]	0.083 [0.06]	0.083 [0.06]
Loans (% of total assets)	0.027 [0.02]	0.045** [0.02]	0.045** [0.02]	0.053** [0.02]	0.054** [0.03]
Return on Assets	0.339*** [0.10]	-	-	0.304*** [0.08]	0.296*** [0.08]
Return on Equity	-	0.007* [0.00]	-	-	-
Net Interest Margin	-	-	0.395** [0.16]	-	-
Gross Loans (annual growth)	-	-	-	-0.019*** [0.00]	-0.019*** [0.01]
Bank's Size	-0.030*** [0.01]	-0.029*** [0.01]	-0.022*** [0.01]	-0.029*** [0.01]	-0.031*** [0.01]
Subsidiaries (dummy)	0.062 [0.05]	0.082 [0.05]	0.065 [0.05]	0.057 [0.04]	0.062 [0.05]
Crisis (dummy)	-0.001 [0.00]	-0.001 [0.00]	-0.002 [0.00]	-0.002 [0.01]	-0.005 [0.01]
Constant	-0.172*** [0.06]	-0.179*** [0.05]	-0.163*** [0.05]	-0.168*** [0.05]	-0.146*** [0.05]
Nr. of observations	1945	1945	1945	1940	1940
Nr. of banks	308	308	308	308	308
Nr. of Instruments	49	49	49	50	50
AB (2) test (p-value)	0.72	0.48	0.39	1.00	0.99
Sargan test (p-value)	0.11	0.26	0.30	0.63	0.50

Notes: System GMM partial adjustment target capital model results using a two-step procedure. Robust standard errors are reported in brackets and significance levels of 1% (\*\*\*), 5% (\*\*) and 10% (\*) are shown. All regressions include year dummies. In all models, share of non-performing loans is treated as endogenous variable. Capital buffer is calculated as a difference between actual capital ratio and the regulatory minimum capital.

Source: Authors' calculations.

**Appendix Table 5**

Variables	Non-Core Short-Term Funding				
	( 1 )	( 2 )	( 3 )	( 4 )	( 5 )
Non-Core Short-Term Funding (lag)	0.848*** [0.08]	0.856*** [0.08]	0.856*** [0.08]	0.799*** [0.07]	0.808*** [0.12]
Gross Loans (annual growth)	0.046* [0.03]	0.055** [0.03]	0.056** [0.03]	0.046** [0.02]	0.044* [0.02]
Customer Deposits (annual growth)	-0.035 [0.02]	-0.038* [0.02]	-0.038* [0.02]	-0.030** [0.01]	-0.033* [0.02]
Net Interest Margin	-0.624*** [0.19]	-	-	-0.569*** [0.18]	-0.588*** [0.18]
Return on Assets	-	0.003 [0.10]	-	-	-
Return on Equity	-	-	-0.001 [0.00]	-	-
Loans (% of total assets)	-0.105 [0.08]	-0.122 [0.08]	-0.123 [0.08]	-	-0.093 [0.08]
Securities (% of total assets)	-	-	-	0.051 [0.04]	-
Bank's Size	0.035** [0.01]	0.043*** [0.02]	0.043*** [0.02]	0.036*** [0.01]	0.042*** [0.02]
Subsidiaries (dummy)	0.049 [0.06]	0.048 [0.06]	0.047 [0.06]	0.056 [0.06]	0.068 [0.08]
Crisis (dummy)	0.001 [0.01]	0.006 [0.01]	0.000 [0.01]	-0.003 [0.01]	-0.002 [0.01]
EU member (dummy)	-	-	-	-	-0.036 [0.08]
Constant	0.199*** [0.06]	0.209*** [0.06]	0.211*** [0.06]	0.137*** [0.05]	0.232*** [0.07]
Nr. of observations	1914	1914	1914	1862	1914
Nr. of banks	306	306	306	304	306
Nr. of Instruments	50	50	50	50	50
AB (2) test (p-value)	0.44	0.64	0.64	0.39	0.44
Sargan test (p-value)	0.68	0.71	0.70	0.65	0.63

Notes: System GMM results using a two-step procedure. Robust standard errors are reported in brackets and significance levels of 1% (\*\*\*), 5% (\*\*) and 10% (\*) are shown. All regressions include year dummies. In all models, growth of loans is treated as endogenous variable.

Source: Authors' calculations.