

Laidroo, Laivi; Männasoo, Kadri

Article

Perils of excessive credit growth: evidence from 11 new EU member states

Baltic Journal of Economics

Provided in Cooperation with:

Baltic International Centre for Economic Policy Studies (BICEPS), Riga

Suggested Citation: Laidroo, Laivi; Männasoo, Kadri (2014) : Perils of excessive credit growth: evidence from 11 new EU member states, Baltic Journal of Economics, ISSN 2334-4385, Taylor & Francis, London, Vol. 14, Iss. 1-2, pp. 17-34,
<https://doi.org/10.1080/1406099X.2014.942541>

This Version is available at:

<https://hdl.handle.net/10419/180070>

Standard-Nutzungsbedingungen:

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

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

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

Terms of use:

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

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

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



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

Perils of excessive credit growth: evidence from 11 new EU member states

Laivi Laidroo & Kadri Männasoo

To cite this article: Laivi Laidroo & Kadri Männasoo (2014) Perils of excessive credit growth: evidence from 11 new EU member states, *Baltic Journal of Economics*, 14:1-2, 17-34, DOI: [10.1080/1406099X.2014.942541](https://doi.org/10.1080/1406099X.2014.942541)

To link to this article: <https://doi.org/10.1080/1406099X.2014.942541>



© 2014 The author(s). Published by Routledge.



Published online: 20 Aug 2014.



Submit your article to this journal [↗](#)



Article views: 910



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 5 View citing articles [↗](#)

Perils of excessive credit growth: evidence from 11 new EU member states

Laivi Laidroo* and Kadri Männasoo

Department of Finance and Economics, Tallinn University of Technology, Tallinn, Estonia

(Received 22 November 2013; accepted 8 April 2014)

We investigate the association between banks' credit expansion and loan loss reserves on a panel of banks from 11 new EU member countries from Central and Eastern Europe during 2004–2010. Unused committed credit lines capture the decline in banks' risk aversion being associated with a supply shift. As the existence of loan commitments may lead to overlending, we expect that banks with a higher share of unused committed credit lines are more prone to subsequent increase in loan loss reserves. The system and difference GMM estimations as well as pooled OLS and panel fixed effects estimations confirm that an excessive credit supply, reflected in overextension of committed credit lines, predicts increase in bank loan loss reserves two years ahead while controlling for bank asset returns, real growth in loan portfolio, country GDP, inflation and EBRD banking sector reform index. This stresses the importance of credit lines monitoring by regulatory and supervisory authorities for timely recognition of credit overextension episodes. The negative association between loan loss reserves and real GDP growth was affirmed.

Keywords: banks; Central and Eastern Europe; committed credit lines; credit growth; credit quality

JEL classification codes: G21

1. Introduction

The recent financial turmoil has reminded us of the perils of excessive lending on the economy. The financial accelerator models (Bernanke & Gertler, 1989; Bernanke, Gertler, & Gilchrist, 1999; Kiyotaki & Moore, 1997) have elaborated the mechanism. However, for the bank the greatest problems related to lending arise when misperception and inappropriate response to risks occur (Borio, Furfine, & Lowe, 2001). These tendencies may lead to the accumulation of credit risk if accompanied by overextended credit supply, i.e. granting loans in amounts which may exceed customers' ability to repay them. Whenever macroeconomic conditions deteriorate and customer defaults increase, this credit risk will be charged in the form of loan loss provisions putting pressure on the bank's capital.

Since the deterioration in credit quality may lead to bank failures, a significant amount of research utilizing bank-level data focuses on the associations between loan loss measures and macro and bank-specific variables on developed and emerging markets (see Appendix Table A1). However, despite the fact that Central and Eastern European (CEE) countries' economies and

*Corresponding author. Laivi Laidroo, Tallinn University of Technology, Tallinn, Estonia. Email: laivi.laidroo@ttu.ee

banking sectors have been subject to strong swings during the last decade, the number of studies on that region's credit quality has remained modest. Bikker and Metzmakers (2005) focused amongst others on loan loss provisions in Czech Republic and Hungary. Frait and Komárková (2009) targeted only Czech Republic. Shehzad, de Haan, and Scholtens (2010) investigated the ownership structure's impact on non-performing loans in a sample of 50 countries including 11 CEE countries. Therefore, our objective is to investigate the association between unused committed credit lines, real loan growth and loan loss reserves (LLR) in banks from 11 CEE countries during 2004–2010. According to Keeton (1999) loan growth leads to higher future loan losses only in cases where there is a supply shift. If the supply or demand-driven loan growth is not separated, it may lead to ambiguity in the reported association between loan losses and real loan growth. Previous literature has utilized different loan demand proxies (Gambacorta, 2008), simultaneous equations (Sóvágó, 2011) or stochastic frontier analysis (Fungáčová, Herrala, & Weill, 2011; Fungáčová, Herrala, & Weill, 2013) to overcome this limitation. However, this paper focuses on an alternative possibility by introducing unused committed credit lines as an indicator of overextended credit supply. Unused committed credit lines capture the decline in banks' risk aversion being associated with a supply shift. As according to Thakor (2005) the existence of loan commitments leads to overlending, we expect that banks with a higher share of unused committed credit lines are more prone to subsequent increase in loan loss reserves. Anticipating credit risk accumulation during expansions (Borio et al., 2001), we also expect real loan growth to be associated with an increase in loan loss reserves.

To the knowledge of the authors, this paper represents a first attempt to test empirically the relationship between loan commitments and loan loss reserves put forward in Thakor (2005). The new EU member countries from Central and Eastern Europe have experienced a dramatic shift towards capital and credit market liberalization during the EU accession process. Despite remarkable improvements in legislation and governance, high levels of credit growth have brought along serious credit risk issues in the region (see for the evidence provided in previous country-level studies: e.g. Backé, Égert, & Zumer, 2007; Cottarelli, Dell'Ariccia, & Vladkova-Hollar, 2005; Coudert & Pouvelle, 2010; Guo & Stepanyan, 2011; Grešl & Seidler, 2012). The latter mostly agree that the growth in private sector credit to GDP ratio before the 2008 crisis was excessive¹ in Latvia, Lithuania, Estonia, Bulgaria and Romania. Some doubts existed also about the sustainability of credit growth in Croatia, Hungary and Slovenia. When comparing the real growth in private sector credit growth in the selected 11 CEE countries with that of Western European ones, it appears that during 2004–2008 in CEE the annual credit growth was on average 24.5% compared to 9.1% in Western Europe. However, when comparing the growth in average country-level non-performing loans during 2004–2008 and 2009–2010, the average increase in CEE countries' non-performing loans ratio was 6.1 percentage points compared to only 1.9 percentage points in Western Europe. Such a rapid pre-crisis credit growth followed by significant deterioration of credit quality indicates that compared to more stable credit environments of developed economies, CEE countries provide a more suitable context for testing the set of hypotheses. The shortness of credit history and low experience in credit risk assessment has been a perfect platform for information asymmetries and agency problems to emerge.

We observe the period of 2004–2010 in 11 new EU member countries from the CEE region employing the bank-level data from BankScope database. BankScope provides a good coverage of selected banking markets.² As previously noted, there are a limited number of bank-level studies on credit quality issues in the CEE region. Even in the context of other bank-related themes, the number of cross-country papers remains modest (e.g. Aydin, 2008; Barth, Nolle, Phumiwasana, & Yago, 2003; Bonin, Hasan, & Wachtel, 2005; de Haas and van Lelyveld, 2004, 2006, 2008; Laidroo, 2014a, 2014b; Laidroo and Ööbik, 2014; Männasoo & Mayes,

2009; Matousek & Sarantis, 2008; Weill & Godlewski, 2009). The short time series, poor availability and quality of the data have been the common reasons to refrain from the analysis of CEE countries. We have addressed these concerns by selecting a more recent time period including the ups and downs of the economic and credit cycle while making use of better data availability. We also employ a thorough data preparation process by eliminating inconsistencies, consolidating the existing information and filling in the data gaps for banks with more significant market share by using the banks' public reports.

Our study reveals that overextension of committed credit lines proves to be a two years ahead warning indicator of excessive credit supply and subsequent increase in loan loss reserves. This evidence might provide valuable insights for regulatory and supervisory authorities as the use of unused committed credit lines measure may enable more timely recognition of credit overextension episodes compared to real loan growth measure alone. The negative association between loan loss reserves and real GDP growth was affirmed.

This paper is divided as follows. Section 2 discusses credit quality measures. The third section introduces theoretical and empirical evidence on the credit quality determinants. Section 4 presents the empirical model and provides an overview of data and methodology. Section 5 contains discussion and analysis of results. Section 6 concludes.

2. Measuring banks' credit quality

Credit quality is crucial for bank's financial strength. It can be observed either through the flow variable or stock variable. Flow variable is presented in the income statement and is hereafter referred to as loan loss provision. Stock variable is presented on the bank's balance sheet and is hereafter referred to as the loan loss reserves (LLR). There exist two forces which determine the size of provisions and loan loss reserves: specific and general provisions.

Specific provisions represent already identified loan impairments. They are generally backward-looking, determined according to the accounting rules and are sometimes also referred to as non-discretionary provisions because bank managers have little control over their disclosure decision (Whalen, 1994). Such losses are taken into account after certain events have occurred and this component of loan loss provisions explains how banks' provisioning practices may exacerbate business cycles. During a recession specific provisions increase (due to increasing customer defaults) putting pressure on the bank's capital and reducing its desire to lend. The causes for such behaviour may lie not only in the deteriorating economic conditions during a recession, but in the credit risk that was accumulated during an economic boom and which materialized during a recession. The reasons for such accumulation of risks may relate to the misperception and inappropriate responses to risk by market participants over time (Borio et al., 2001). Misperception of risk may relate to the 'disaster myopia' which refers to underestimation of risk and probability of a disaster during long periods in which no disaster has occurred (Guttentag & Herring, 1984). A similar idea has been incorporated into the 'institutional memory hypothesis' which states that the deterioration in the ability of bank loan officers to recognize potential loan problems may lead to an easing of credit standards as time passes since the last significant experience with problem loans (Berger & Udell, 2004). Inappropriate responses to risk could occur as a result of herding behaviour, i.e. people will be doing what others are doing rather than using their own information (Banerjee, 1992). For example herding in bank credit policies could lead to different banks granting loans to similar sectors (Rajan, 1994). Often these tendencies are reinforced with incentive problems (for example designing bonus schemes of credit officers that neglect credit risk considerations). Depending on the phase of the business cycle, such developments can lead to lending booms and contractions, which in turn could lead to significant fluctuations in loan loss provisions and from there through to significant changes in loan loss reserves.

Although there have been some attempts to reduce such fluctuations through the introduction of dynamic provisioning³ for example in Spain in the mid-2000s (de Lis, Martínez Pagés, & Saurina, 2001), these have remained a few exceptions.

General provisions represent possible loan losses and as their determination requires managerial judgement, these are also sometimes referred to as discretionary provisions. Their size may be influenced by earnings management, capital management, signalling or tax considerations. Earnings management hypothesis states that managers may use general provisions to smooth banks' earnings, i.e. banks increase provisions on good years and decrease provisions on bad years to keep earnings stable (Greenawalt & Sinkey, 1988; Fudenberg & Tirole, 1995). Capital management hypothesis is based on the idea that the structure of the bank's provisions (portion of general and specific provisions from total provisions) could be used to manage the bank's capital ratio.⁴ Signalling could occur if the bank's managers use provisions to signal the financial strength of the bank (Beaver, Eger, Ryan, & Wolfson, 1989). General provisions may also depend on tax considerations, because if provisions are tax deductible, it creates incentives for provisioning (Bikker & Metzmakers, 2005).

Similarly to the distinction of specific and general provisions, the empirical research on banks' credit quality can be split into two strands. The first strand focuses mainly on the impact of business cycles or macroeconomic environment on banks' loan loss provisions, loan loss reserves or non-performing loans. These studies employ either aggregated data of one country (including Solttila & Vihriälä, 1994; Arpa, Giulini, Ittner, & Pauer, 2001), aggregated country-level data of a group of countries (including Albertazzi & Gambacorta, 2009, 2010; Bikker & Hu, 2002; Pesola, 2011) or bank-level data of one country or region (for an overview see Appendix Table A1). The static or dynamic panel regression models used in these studies usually include measures capturing the business cycle, institutional context and several bank-specific control variables and in many cases one of these is loan growth. The second strand of literature tests specifically one or several of the above-mentioned hypotheses concerning discretionary provisions (for example Ahmed, Takeda, & Thomas, 1999; Bhat, 1996; Collins, Shackelford, & Wahlen, 1995; Kwak, Lee, & Mande, 2009; Leventis, Dimitropoulos, & Anandarajan, 2012). These papers put less emphasis on the business cycle impact.

This paper follows the first strand of empirical literature utilizing bank-level data. Unlike previous studies it pays attention to the association between loan loss reserves and unused committed credit lines while controlling for bank real loan growth and assets returns along with country GDP, inflation and European Bank for Reconstruction and Development (EBRD) banking sector reform index.

3. Determinants of banks' credit quality

According to Keeton (1999) loan growth leads to higher future loan losses only in cases where there is a supply shift, i.e. loan interests and credit standards are lowered, lending soars and latent credit risks accumulate. The association between lagged loan growth and provisions turns negative whenever the loan growth relates to borrowers' demand shift and improved creditworthiness or an increase in returns on investment (productivity shift) (Keeton, 1999). Namely, if demand increases, lending initially increases, but then banks increase interest rates and tighten credit standards leading to lower credit risk. If borrowers' productivity increases, their demand for credit increases, but as their ability to repay loans increases, banks relax collateral requirements or accept borrowers with poorer credit histories. However, despite the impact of loosened credit standards, the cost of incremental credit risk is likely to be outweighed by the increase in borrowers' creditworthiness due to the productivity shock.

Previous banking literature has utilized different approaches for distinguishing loan demand and supply. In the context of monetary policy transmissions it is usually assumed that certain bank-specific characteristics influence only loan supply. Recently Gambacorta (2008) proxied loan demand with movements in permanent and transitory GDP,⁵ inflation and the money market rate. Sóvágó (2011) used a simultaneous equations approach employing bank lending survey data. Fungáčová et al. (2011, 2013) employed stochastic frontier analysis to estimate credit supply changes. Alternative possibility is to consider committed credit lines which represent insurance for companies against quantity credit rationing during an economic downturn (Thakor, 2005).

Thakor's (2005) theoretical model shows that banks' discretion of whether to honour borrowing requests under commitments generates reputational concerns. This can lead to an equilibrium in which loan commitments serve their role in increasing credit supply relative to the spot credit market during an economic downturn. However, they produce the inefficiency of excessive credit supply when the real interest rate is low and the economy is doing well. This indicates that when the economy is in a good state, the existence of loan commitments leads to an oversupply of credit, i.e. loan commitments may enforce information asymmetries related to moral hazard and adverse selection. Campello, Graham, and Harvey (2010) identified that credit constrained firms drew more heavily on lines of credit in order to frontload funds in fear of restricted access to credit in the future. This means that banks with a greater relative portion of loan commitment exposures during booms are susceptible to higher credit risk. In the context of Keeton (1999) it refers to a possibility that the unused committed credit lines could be a proxy for credit standards. Therefore, if the share of unused committed credit lines to total loans increases, then loan supply dominates demand, latent credit risk expands and is likely to be revealed in future loan loss provisions. Accordingly, we expect an increase in unused committed credit lines to be associated with an increase in credit risk realization. To the knowledge of the authors this hypothesis has not been tested in a similar empirical set-up before.

Most of the previous bank-level research has employed loan growth as an indicator of latent credit risk to be unfolded with a time lag of several years. However, it is difficult to foresee the time span before credit risk is revealed. The realization of credit risk depends on the phase of the business cycle and of the time that has passed from the last 'bust' of the bank's loan portfolio. Corresponding to this ambiguity, previous empirical evidence on the association between loan growth and credit quality remains contradictory. In the same period's context positive association between loan growth and loan loss provisions has been reported in Bikker and Metzmakers (2005) and Fonseca and González (2008), but the opposite result has been reported in Cavallo and Majnoni (2001) and Leaven and Majnoni (2003). Disparities in results may relate to different specifications, but also to restrictions set on the observations in the latter two studies which may have had significant impact on the reported results. In an inter-temporal context a negative association has been reported for one-period lagged loan growth in Craig, Davis, and Pascual (2006) and both current period and one-period lagged loan growth in Quagliariello (2007). Salas and Saurina (2002) supported positive association between non-performing loans and loan growth lagged by three years (for two- and four-year lags the association was not significant). This means that one limitation of previous studies is the varying prediction horizon.

The use of loan growth as a predictor of credit risk raises also a question whether the focus should be on general loan growth or on abnormal (excessive) loan growth. There exists a quite extensive strand of empirical literature utilizing country-level data which have focused on whether the country-level growth in private sector credit to GDP is excessive (e.g. Backé et al., 2007; Cottarelli et al., 2005; Coudert & Pouvelle, 2010; Grešl & Seidler, 2012; Guo & Stepanyan, 2011). These papers define excessive credit growth as its deviation from its long-term trend. The methodologies employed vary from the Hodrick-Prescott filter and 'speed

limits' to various econometric techniques used to explain the equilibrium level of credit/GDP ratio by some fundamental macroeconomic variables. As most of these approaches require long time series, these cannot be easily applied in the context of bank-level data.

Abnormal loan growth measures in bank-level studies have been recently used by Hess, Grimes, and Holmes (2009) and Foos, Norden, and Weber (2010). Foos et al. (2010) find weak support for negative association between loan loss provisions and one-period lagged abnormal loan growth,⁶ the association turned positive when abnormal loan growth was lagged two to four periods. In Hess et al. (2009) the association between provisions and the same and the following year's abnormal loan growth was insignificant, but in the case of two, three or four lags of abnormal loan growth, there appeared a statistically significant positive association in a dominant part of the estimations. Although abnormal loan growth is expected to have a stronger correlation with credit risk than general loan growth, its use is limited by the definition of 'normal' loan growth. In previous papers 'normal' loan growth of each bank has been proxied with the host country banking sector average loan growth. This creates three problems. First, it is assumed that the market's loan growth is always normal. This may not be true in the case of lending booms when annual loan growth deviates from its long-term trend. Under these circumstances ignoring the above trend growth of the banking market generates a downward bias in the bank-level abnormal growth measure. As a result the association between an individual bank's abnormal loan growth and provisions will appear weaker. Disregarding the systematic component of abnormal loan growth, but accounting for the realization of systematic risk as part of actual loan impairment underestimates the correlation. Second, it neglects bank-specific differences in loan growth rates. The growth rates of newly established or smaller banks may consistently outperform the market. As a result the association between abnormal growth rates and credit impairment may be underestimated for larger and overestimated for smaller or newly established banks. Still, the greatest increase in credit risk should occur if the bank's loan growth exceeds its steady state. Third, in transition countries the market's and/or bank's trend-line long-term growth is hard to determine, since the short history of modern banking and extreme growth rates observed in the beginning of the transition period pose serious constraints in finding a reliable measure.

This paper attempts to overcome the limitations of ordinary and abnormal loan growth measures by adding a variable – based on unused committed credit lines – thereby distinguishing between loan supply and demand shifts. According to Thakor's (2005) model, the excessive use of committed credit lines is an indicator of credit supply shift which could be associated with increased credit risk for the bank. We hypothesize that banks with a higher share of unused committed credit lines are more prone to subsequent increase in loan loss reserves. Hence, we measure latent credit risk by two variables. The first is defined as a difference from country-year average unused committed credit lines to total loans (*RCCL*) measured in standard deviations.⁷ It could be considered an early-warning indicator of increasing credit risk, which should have a positive association with loan loss reserves. The second is the ordinary real loan growth rate (*L*) capturing the overall trend in the credit portfolio. Loan loss reserves are expected to be positively associated with loan growth. Given the low-frequency annual observations and the shortness of time-period we employ three lags of both variables.

Many previous studies include, in addition to loan growth, several other bank-specific control variables including profitability measures for testing the earnings management hypothesis, capital ratios for testing the capital management hypothesis or have controlled for bank size, liquidity and/or ownership. Although the support for earnings management hypothesis (banks' provisions are positively associated with earnings) has been quite overwhelming (Bikker & Metzmakers, 2005; Bouvatier and Lepetit, 2008; Cavallo & Majnoni, 2001; Fonseca and González, 2008; Frait and Komárková, 2009; Hess et al., 2009; Leaven & Majnoni, 2003; Quagliariello, 2007),

the expected and actual signs of other control variables' coefficients have remained ambiguous. Considering that different bank-specific variables are highly correlated and the main focus of this paper is on the association between loan growth and loan loss reserves, only profitability ratio was included as an additional bank-level control variable.⁸

Credit quality is dependent on the macroeconomic environment being reflected in business cycle variables such as real GDP growth and inflation. If credit risk accumulation occurs during an economic boom (Borio et al., 2001), and provisions remain dependent on customer defaults accounted for after certain events (Whalen, 1994), provisions and loan loss reserves are expected to be negatively associated with GDP growth. The association is likely to exist also for small lags in the business cycle variable. A number of previous papers support negative association with GDP growth (Arpa et al., 2001; Bikker & Hu, 2002; Bikker and Metzmakers, 2005; Bouvatier & Lepetit, 2008; Craig et al., 2006; Fonseca & González, 2008; Frait & Komárková, 2009; Gerlach, Peng, & Shu, 2005; Leaven & Majnoni, 2003; Pain 2003; Quagliariello, 2007; Salas & Saurina, 2002). Alternatively stock market or real estate price indices might be considered for capturing the macroenvironmental fluctuations, but due to lower relevance⁹ these are not considered in this paper.

4. Empirical analysis

4.1. The empirical model

The empirical model is set up as follows. We use two alternative credit quality ratios: loan loss reserves to total loans (*LLRI*) and loan loss reserves to total assets (*LLR2*). Discussion on the choice of these variables is provided in section 4.2. We are testing five alternative model specifications: pooled ordinary least squares (OLS), panel fixed effects (FE), difference Generalized Method of Moments (GMM) and system GMM with full instrument set and system GMM with collapsed instrument set. Beyond the lagged dependent variable we control for a number of bank-level and country-level variables. The baseline model entails up to three lags for unused committed credit line to gross loans measure and real loan growth measure. Other control variables including bank return on assets (*ROA*), country real GDP growth (*GDP*), inflation (*CPI* – Consumer Price Index) and bank reform index (*BRI*) enter the model with the first and second lag. For a robustness test the model is also estimated with two lags of *RCCL* and *L*, without any considerable changes in parameter values and significance levels (results are available from authors upon request).

$$LLR_{ikt} = f\left(LLR_{ikt-1}; \sum_{j=0}^3 RCCL_{ikt-j}; \sum_{j=0}^3 L_{ikt-j}; \sum_{j=0}^2 ROA_{ikt-j}; \sum_{j=0}^2 GDP_{ikt-j}; \sum_{j=0}^2 CPI_{ikt-j}; \sum_{j=0}^2 BRI_{ikt-j}\right) \quad (1)$$

Where:

LLR_{ikt} – loan loss reserves ratio of bank i from country k on year t .

$RCCL_{ikt-j}$ – unused committed credit lines to gross loans ratio of bank i from country k on year $t-j$, where $j=0,1,2 \dots$ measured in standard deviations from country-year average ratio of unused committed credit lines to gross loans.

L_{ikt-j} – loan growth variable of bank i from country k on year $t-j$ where $j=0,1,2 \dots$.

GDP_{kt-j} – real GDP growth of country k on year $t-j$ where $j=0,1,2 \dots$.

CPI_{kt-j} – CPI growth of country k on year $t-j$ where $j=0,1,2 \dots$.

BRI_{kt-j} – EBRD banking sector reform index of country k on year $t-j$ where $j=0,1,2 \dots$.

4.2. Data and methodology

This paper focuses on 11 CEE countries which had joined the European Union by August 2013 including: Bulgaria; Czech Republic; Estonia; Croatia; Hungary; Lithuania; Latvia; Poland; Romania; Slovenia; and Slovakia. The annual bank-level data were retrieved from BankScope, banks' total assets by countries from OECD Banking Statistics database and central banks' web-pages. The GDP growth and inflation figures were taken from IMF IFS statistics. The dataset covers all commercial banks contained in the database during 2004–2010 for these 11 CEE countries. As the number of banks in the sample varied due to merges, bankruptcies or new starters, an unbalanced panel was formed to avoid survivorship bias. The unconsolidated statements were used, because these enabled us to avoid double-counting the statistics that relate to the operations of the same bank in its home country and enabled us to exclude the influence of its foreign operations. Each bank's financials were selected for each year separately based on the following criteria. First, annual unconsolidated financial data following International Financial Reporting Standards (IFRS) was used whenever available, if not, the preference was given to unconsolidated statements following local Generally Accepted Accounting Principles (GAAP). Second, annual report data were included only if they included 12 months' results and the financial year ended on 31 December or 1 January. The dataset obtained for each country was compared with the banking sector assets for the same year.¹⁰ The final dataset includes 125 banks. In models including ordinary real loan growth the banking sector coverage per country per year is 53% to 100% and on average 80%.¹¹ In models employing unused committed credit lines the coverage per country per year is poorer at 44% to 100% and on average 70%. To eliminate the impact of mergers and acquisitions, bank-years with loan growth greater than 200% were eliminated. The *RCCL* measures with values above 150% were also excluded.

Table 1. Descriptive statistics.

Variable name and description values in percentages	Baseline Model, 3 lags Obs = 417				Alternative Model, 2 lags Obs = 543			
	mean	st dev	min	max	mean	st dev	min	max
<i>LLR1</i> – loan loss reserves to total loans	4.822	4.268	0.259	37.916	5.512	4.124	0.086	37.916
<i>LLR2</i> – loan loss reserves to total assets	3.297	3.589	0.123	43.817	3.014	3.351	0.021	43.817
<i>RCCL</i> – unused committed credit lines to total loans	15.968	14.325	0.272	104.964	17.459	16.509	0.081	139.922
<i>L</i> – real loan growth	10.873	25.393	–43.931	197.671	14.518	26.220	–43.931	197.671
<i>GDP</i> – real GDP growth	0.315	6.299	–17.955	10.522	1.567	6.332	–17.955	12.233
<i>CPI</i> – Consumer Price Index	4.408	3.530	–1.224	15.252	4.334	3.256	–1.224	15.252
<i>BRI</i> – EBRD Bank Reform Index [range from 1 to 4.33]	3.753	0.251	3.300	4.000	3.746	0.256	3.000	4.000
<i>IMP1</i> – loan loss provisions to total assets	1.244	1.808	–1.520	16.646	1.057	1.666	–1.520	16.646
<i>IMP2</i> – loan loss provisions to total loans	1.823	2.425	–2.761	22.796	1.574	2.282	–2.761	22.796
<i>ROA</i> – pre-impairment operating profit to average total assets	1.767	1.542	–11.690	9.531	1.782	1.511	–11.690	10.889

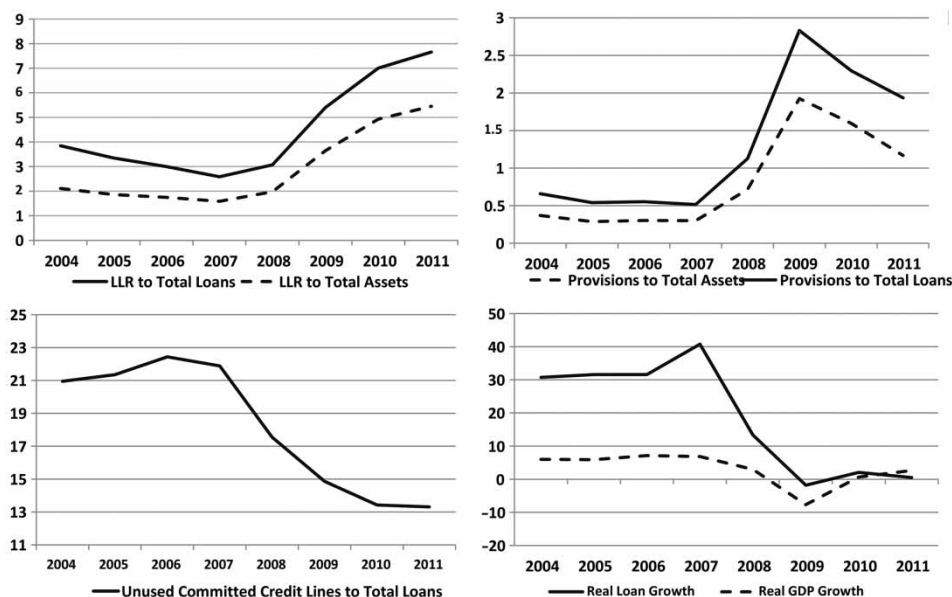


Figure 1. Trends in key variables (all values in %).

In empirical tests the number of banks is lower as for some variables the data were not available for all banks on all years (partly due to the use of lagged explanatory variables). Table 1 presents definitions of all variables included in the analysis and their descriptive statistics.

Figure 1 illustrates the dynamics of key variables over the study period of 2004–2010. Although traditionally loan loss provisions in the income statement are considered more timely measures for capturing credit quality changes, in the case of CEE banks the swings in credit quality are better observed from the loan loss reserves (*LLR*) on the balance sheet.¹² One of the reasons relates to regulatory and institutional revisions in loan loss provisioning rules and policies, which according to the Worldbank surveys¹³ have in some countries changed over time. Some improvements and trends towards harmonization of CEE banking sector regulations have been also observed during 2004–2010 based on the EBRD index of banking sector reform.¹⁴

The differences could also be partially related to poorer data quality of income statement loan loss provisions.¹⁵ To reduce the impact of these biases, we have chosen the loan loss reserves ratio as the baseline measure for the empirical analysis. The unused committed credit lines variable demonstrates a small hike over 2005–2006 with a subsequent drop since 2007. The strongest dynamics is demonstrated by the real loan growth variable with an average growth above 30% in 2005–2007 and a significant drop afterwards. The real GDP growth shows a similar pattern at a considerably lower magnitude.

We estimate the models with *RCCL* and real loan growth employing multiple model specifications including pooled ordinary least squares (OLS), bank-level fixed effects ordinary least squares (OLS FE) and the dynamic Arellano and Bond (1991) difference GMM (Generalized Method of Moments) as well as the two-step system GMM estimator of Arellano and Bover (1995) and Blundell and Bond (1998) with extended and collapsed instrument set. The GMM estimator accounts for panels with short time-dimension (*T*), but a large number of subjects (*N*), i.e. the short panels with $N \gg T$. A linear functional relationship is assumed between the dependent and explanatory variables, whereas the variable of interest can depend on its own past realizations enabling for a dynamic estimation. All explanatory variables except the yearly dummies enter the baseline GMM

estimations¹⁶ as endogenous instrumented with all their past lags. Bank-level fixed effects are accounted for as well as the heteroscedasticity and autocorrelation within the banks, but not across them. The reported standard errors employ the Windmeijer (2005) correction avoiding the downward bias in finite samples. Also the GMM estimates with ‘collapsed’ instruments are reported as suggested by Roodman (2009) in order to avoid instrument proliferation leading to overfit of endogenous variables. Since our panel data include gaps we maximize the estimation sample by using orthogonal deviations instead of first differences. Year dummies are included to reduce possible correlation across individuals’ idiosyncratic disturbances and these dummies are treated as exogenous variables in GMM estimations. Although the system GMM requires ‘the steady state’ assumption throughout the analysed period we use it as baseline estimation. We observe the post-EU accession period mostly and expect that countries have reached a fair level of maturity after 15–20 years from turnaround. This presumption is also supported by the EBRD banking reform index, with an average close to 4¹⁷ over the observation period. Nevertheless we have validated our results by using difference GMM, which confirmed our baseline results.

5. Results and discussion

The estimations are presented in Table 2. Multiple model specifications were employed to verify the robustness of the results including pooled ordinary least squares (OLS), fixed effects panel regression (FE), system GMM with full instrument set (GMM1), GMM with collapsed instrument set (GMM2) and difference GMM (Diff GMM). The sample size of 417 bank-year observations is relatively limited given the number of endogeneous (three) and pre-determined (four) variables in the regression. This poses problems for sample-size demanding GMM estimations.¹⁸ Nevertheless the *RCCL* measure at lag two turns out to be statistically significant at least at the 10% level throughout all estimations. The coefficient ranges from 0.07 to 0.1 suggesting that the unused committed credit lines ratio two standard deviations above the country-year average results in a 14–20% increase in loan loss reserves. This is a sizeable economic effect. The other lags of unused committed credit lines produce insignificant coefficients, which stresses the importance of the time-dynamic effect in how the latent risks materialize. Two-year lag between extended credit line and the credit risk to manifest is reasonable, since loan losses can materialize only with a time lag, which however cannot be too long.

The loan growth term in contrast fails to predict increase in credit risk. The lagged terms of loan growth variable are mostly insignificant. The only significant coefficients at first and second lag in the fixed effects model have negative signs. In line with Cavallo and Majnoni (2001) and Leaven and Majnoni (2003), but contradicting the results of Bikker and Metzemarkers (2005) and Fonseca and González (2008) the real loan growth exhibits a highly significant negative contemporaneous coefficient, however, with a rather modest size.

The lagged autoregressive loan loss reserves term (see Table 2) is consistently positive and significant throughout different model specifications with coefficients ranging between 0.5 and 0.7. This is an expected result since the credit risk tends to cumulate and aggravate in time.

The variables including return on assets, EBRD banking sector reform index¹⁹ and CPI do not produce significant results neither with their contemporaneous nor lagged terms. Only the contemporaneous real GDP growth captures significant effect on bank loan loss reserves. The negative coefficient of real GDP growth is highly intuitive, suggesting that improved economic environment supports bank balance sheets and reduces credit risk. This result is in line with expectations and findings reported in previous studies (e.g. Bouvatier & Lepetit, 2008; Quagliariello, 2007). This points to the banks’ tendency to provision during bad times leading to the amplification of business cycles as noted in financial accelerator models (e.g. Bernanke & Gertler, 1989). For each per cent of real GDP growth the loan loss reserves will drop about 0.04%.

Table 2. Determinants of loan loss reserves to total loans (*LLRI*).

Variable	OLS		OLS FE		System GMM1		System GMM2		Diff GMM	
<i>Constant</i>	1.606	***	0.228		2.687	***	2.875	**		
	(0.340)		(2.160)		(0.550)		(1.367)			
<i>LLRI_{t-1}</i>	0.701	***	0.451	***	0.597	***	0.701	***	0.588	***
	(0.033)		(0.049)		(0.061)		(0.088)		(0.068)	
<i>RCCL_t</i>	-0.062	*	-0.026		-0.032		0.056		-0.044	
	(0.036)		(0.042)		(0.063)		(0.180)		(0.069)	
<i>RCCL_{t-1}</i>	0.009		0.059		-0.021		-0.020		0.055	
	(0.044)		(0.045)		(0.058)		(0.138)		(0.075)	
<i>RCCL_{t-2}</i>	0.097	**	0.081	**	0.067	*	0.105	*	0.086	*
	(0.045)		(0.039)		(0.040)		(0.060)		(0.049)	
<i>RCCL_{t-3}</i>	-0.053		0.026		-0.049		-0.035		0.016	
	(0.041)		(0.044)		(0.039)		(0.077)		(0.055)	
<i>L_t</i>	-0.008	***	-0.006	***	-0.009	***	-0.012	***	-0.006	***
	(0.001)		(0.002)		(0.002)		(0.004)		(0.002)	
<i>L_{t-1}</i>	-0.001		-0.002	**	-0.001		0.001		0.000	
	(0.001)		(0.001)		(0.001)		(0.002)		(0.001)	
<i>L_{t-2}</i>	0.000		-0.002	**	-0.001		-0.001		-0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
<i>L_{t-3}</i>	0.000		0.000		0.000		0.000		0.000	
	(0.000)		(0.001)		(0.001)		(0.001)		(0.000)	
<i>ROA_t</i>	-0.013		-0.014		-0.052		-0.133		-0.060	
	(0.015)		(0.020)		(0.033)		(0.084)		(0.049)	
<i>ROA_{t-1}</i>	-0.005		-0.018		-0.043		0.077		0.014	
	(0.016)		(0.026)		(0.036)		(0.068)		(0.053)	
<i>BRI_t</i>	-0.443		-0.424		-0.475		-0.570		-0.436	
	(0.270)		(0.368)		(0.297)		(0.834)		(0.349)	
<i>BRI_{t-1}</i>	0.178		0.642		0.012		0.007		0.817	
	(0.266)		(0.530)		(0.292)		(0.735)		(0.508)	
<i>CPI_t</i>	0.008		-0.006		0.008		0.012		-0.011	
	(0.012)		(0.013)		(0.012)		(0.022)		(0.015)	
<i>CPI_{t-1}</i>	0.027	**	-0.001		0.014		0.025		0.001	
	(0.011)		(0.014)		(0.014)		(0.019)		(0.012)	
<i>GDP_t</i>	-0.032	***	-0.036	***	-0.037	***	-0.042	***	-0.038	***
	(0.008)		(0.008)		(0.009)		(0.014)		(0.010)	
<i>GDP_{t-1}</i>	-0.007		-0.021	**	-0.008		0.002		-0.009	
	(0.006)		(0.009)		(0.008)		(0.012)		(0.014)	
Year dummies	yes		yes		yes		yes		yes	
Obs.	417		417		417		417		296	
Banks			125		125		125		113	
Instruments					139		55		97	
Adj. R2	0.832		0.837							
Hansen statistic					110.6		49.17	**	83.06	
AR (1)					-2.91	***	-3.26	***	-3.02	***
AR (2)					-0.59		0.13		0.51	
F statistic	84.8	***	117.4	***	90.2	***	62.5	***	125.2	***

Notes: For definitions of variables see Table 1. OLS – model estimated using ordinary least squares. OLS FE – model estimated using ordinary least squares fixed effects. System GMM1 – model estimated with two-step system GMM with full set of instruments (Arellano & Bover, 1995; Blundell & Bond, 1998). System GMM2 – model estimated with two-step system GMM using collapsed instruments (Roodman, 2009). Diff GMM – model estimated with difference GMM (Arellano & Bond, 1991). Robust standard errors in parentheses. Statistical significance: *** $p < .01$; ** $p < .05$; * $p < .10$.

Given the highly cyclical growth patterns in the CEE region economies with a standard deviation of 5% in real GDP growth the coefficient suggests a rather small economic effect. One standard deviation increase in real GDP reduces loan loss reserves by 0.2%.

The alternative measures on loan loss reserves, one being a ratio to total loans and the other being the ratio to total assets (for results with the latter see [Appendix Table A2](#)), both provide highly similar results, proving that the estimations remain robust to slight differences in target variable definition.

Overall, the results indicate that the significant positive effect of *RCCL* measure on loan loss reserves remains robust to varying model specifications and lag structures. Keeton (1999) stresses that credit risk increases whenever there is a shift in credit supply. Thakor (2005) claims that the increase in the portion of committed credit lines is a signal of higher credit risk. We contribute by setting up the empirical test on the relationship between *RCCL* and *LLR* ratio, whereas controlling for the impact of real growth in lending, bank return on assets and country *GDP*, *CPI* and EBRD banking sector reform index. Although our conclusions remain limited with respect to missing insight on the factors driving the changes in *RCCL* such as credit lines maturity-structure, loan types, portfolio concentration, etc., our study does provide insights about indicators which enable more timely detection of loan overextension situations and might help regulatory and supervisory authorities to take pre-emptive actions.

6. Conclusions

We investigated the association between banks' credit expansion and loan loss reserves on a panel of banks from 11 new EU member countries from Central and Eastern Europe during 2004–2010. As implied by Thakor (2005), we expected that banks with a higher share of unused committed credit lines would be more prone to subsequent increase in loan loss reserves.

Our results revealed a significant and robust positive association between a two-year lagged ratio of unused committed credit lines to two alternative definitions of loan loss reserves ratios (*LLR* to total assets – *LLR1* and *LLR* to total loans – *LLR2*). This exemplifies that the declining risk aversion of banks reflected in increased ratio of unused committed credit lines to assets is revealed at a medium horizon. The coefficients remained insignificant at shorter and longer lags. In line with some of the previous research the real loan growth assumed significant and negative contemporaneous effect with respect to loan loss reserves ratio. This indicates the regularity that high loan growth episodes associate with positive market sentiment and low-risk environment. However, the real loan growth variable did not possess any predictive value in signalling credit risk accumulation.

We conclude that the credit impairment models should be augmented with the unused committed credit lines term next to the ordinary real loan growth variable to get an improved and timelier estimate of expected increase in loan loss reserves. Seemingly the committed credit lines' shorter maturity structure and ability to capture credit supply shift instead of a demand driven loan growth improves the credit risk prediction. A better insight into the structure of loan commitments would deserve attention in future research, in order to gain a deeper understanding on credit risk drivers.

Our study confirmed negative association between contemporaneous GDP growth and loan loss reserves, however, with a rather modest size effect. The banks' return on assets, EBRD banking sector reform index and CPI, however, did not produce any significant results.

Overall, the results remained robust to multiple model specifications, different lag and instrument structures and use of alternative definitions of the target variable. The limitations of the study concern a relatively short time-period subject to institutional and regulatory changes, which may have impact on our results. However, we have included the EBRD banking sector reform index

and yearly dummies to capture this transitional effect. The CEE context witnesses certain aspects, including the short credit history and low credit risk management experience, which might inhibit the results to be explicitly transferable to banks operating in mature markets. Although the information asymmetry phenomenon is more pronounced in emerging markets, it is present to a varying extent in all credit markets. Still, future research investigating the role of unused committed credit lines in developed countries is needed to verify the conclusions of this paper.

In addition, this paper showed that a positive macroeconomic environment as measured by real GDP growth helps to keep control on credit risk, however, the size of the effect remained modest. Future research into the structure and content of committed credit lines would enable a deeper understanding on the formation and accumulation of credit risk and support regulatory and supervisory authorities in early recognition and response to the loan overextension episodes.

Acknowledgements

The authors are grateful for the financial support provided by the Estonian Ministry of Education and Research via projects SF0140059s12 and B617A. The research of Kadri Männasoo has been supported by Estonian Research Council grant project PUT315. The financing institutions had no involvement in the design and content of the research paper.

Notes

1. The abovementioned papers consider the deviations of credit growth from its long-term trend, i.e. financial deepening is accounted for.
2. In the case of CEE countries the models employing only real loan growth variable cover on average 80% of the banking markets and with unused committed credit lines on average 70%. For example in the case of Western European markets the BankScope's data coverage in terms of total country's banking market fluctuates heavily ranging from 20% to 100%. Similar numbers have been reported also in previous literature (e.g. Foos et al., 2010), meaning that such tests could be conducted on carefully selected groups of countries or on a country basis.
3. Dynamic provisioning refers to forward-looking loan loss provisioning, indicating that banks increase loan loss provisions during booms, to be better prepared for possible downturn, and decrease loan loss provisions during downturns.
4. According to Basel II the Tier I capital should exceed 4% of risk-weighted assets and Tier II capital 8% of risk-weighted assets and cannot exceed Tier I capital. While specific provisions have an impact on both ratios, general provisions do not have an impact on Tier II capital under a standardized approach as long as the loan loss reserves are below 1.25% of the risk-weighted assets (<http://www.bis.org/bcbs/>).
5. Permanent and transitory GDP were proposed by Melitz and Pardue (1973) with permanent GDP having positive and transitory GDP negative association with lending growth.
6. Foos et al. (2010) define abnormal loan growth as the difference between bank *i*'s loan growth rate and the growth rate of each country's aggregate loan amount, as reported in OECD Banking Statistics and central bank statistics. A similar measure is also used in Hess et al. (2009).
7. Equivalent to conventional z-score measure, with mean equal to country-year average RCCL.
8. The authors tried to control also for equity ratio and ownership, however, the increase in instrument count and high correlations between the variables did not enable us to produce reliable estimates in specifications including many lags of loan variables.
9. Many of the CEE countries in our sample have rather thin capital and stock markets, whereas the indices of real estate prices have very short time series.
10. This process involved also a consistency check for the same bank's data across years and if some commercial banks with significant market share were missing from the dataset, their numbers were added using official unconsolidated annual reports disclosed on banks' websites. A total of 19 banks' data was corrected/added in this process and for 11 of them consolidated numbers were used (as no unconsolidated data were available, but the banks' market share in respective country was above 10%).
11. Average banking sector coverage remains below 90% as the BankScope database does not include branches of foreign banks and smaller banks. Also the total banking assets number in Bulgaria,

- Poland and Romania includes savings banks and cooperative banks which are not included in the sample of this paper due to their significantly different activity profile compared to commercial banks.
12. The balance sheet credit quality measures have been also used in Shehzad et al. (2010), Bikker and Metzmakers (2005) and Salas and Saurina (2002).
 13. Data available at <http://go.worldbank.org/WFIEF81AP0>.
 14. Data available at <http://www.ebrd.com/pages/research/economics/data/macro.html>.
 15. The loan loss provision variable did exhibit a high number of observations with a negative value reflecting periods of net loan recovery, which would have been problematic to account for in an empirical analysis (such observations are included in Table 1 and Figure 1).
 16. The GMM estimations are most reliable, since the inclusion of a lagged dependent variable may bias the pooled and FE estimators.
 17. The banking sector reform index score '4' denotes significant movement of banking laws and regulations towards Bank of International Settlements (BIS) standards; well-functioning banking competition and effective prudential supervision; significant term lending to private enterprises; substantial financial deepening.
 18. The Hansen test rejects the validity of the instrument set for system GMM with collapsed instrument set. The Hansen test for difference GMM and system GMM with full instrument set however supports the null hypothesis of validity of the instrument set.
 19. The relatively low variation in the EBRD banking sector reform index in post-EU accession period might be the reason for the missing effect.

Notes on contributors

Laivi Laidroo is a Senior Research Scientist at the Tallinn University of Technology. Her recent research interests have moved towards financial intermediaries and their role in amplification of the business cycles in the CEE region.

Kadri Männasoo is a Professor of Statistics at the Tallinn University of Technology. Her recent research agenda relates mainly to companies' investment patterns, including R&D investments, and their implications to long-term growth.

References

- Ahmed, A. S., Takeda, C., & Thomas, S. (1999). Bank loan loss provisions: A reexamination of capital management, earnings management and signaling effects. *Journal of Accounting and Economics*, 28(1), 1–25. doi:10.1016/S0165-4101(99)00017-8
- Albertazzi, U., & Gambacorta, L. (2009). Bank profitability and the business cycle. *Journal of Financial Stability*, 5(4), 393–409.
- Albertazzi, U., & Gambacorta, L. (2010). Bank profitability and taxation. *Journal of Banking and Finance*, 34(11), 2801–2810.
- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58, 277–297.
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variables estimation of error components models. *Journal of Econometrics*, 68(1), 29–51.
- Arpa, M., Giuliani, I., Ittner, A., & Pauer, F. (2001). The Influence of Macroeconomic Developments on Austrian Banks: Implications for Banking Supervision. BIS Papers No. 1, 91–116.
- Aydin, B. (2008). Banking Structure and Credit Growth in Central and Eastern European Countries. IMF Working Paper No. 215.
- Backé, P., Egert, B., & Zumer, Z. (2007). Private-sector credit in central and Eastern Europe: New (Over) shooting stars?. *Comparative Economic Studies*, 49, 201–231.
- Banerjee, A. V. (1992). A simple model of Herd behavior. *Quarterly Journal of Economics*, 107(3), 797–817.
- Barth, J. R., Nolle, D. E., Phumiwasana, T., & Yago, G. (2003). A crosscountry analysis of the bank supervisory framework and bank performance. *Financial Markets, Institutions and Instruments*, 12(2), 67–120.
- Beaver, W., Eger, C., Ryan, S., & Wolfson, M. (1989). Financial reporting, supplemental disclosures, and back share prices. *Journal of Accounting Research*, 27(2), 157–178.
- Berger, A. N., & Udell, G. F. (2004). The institutional memory hypothesis and the procyclicality of bank lending behaviour. *Journal of Financial Intermediation*, 13(4), 458–495.

- Bernanke, B., Gertler, M., & Gilchrist, S. (1999). The Financial Accelerator in a Quantitative Business Cycle Framework. In J. Taylor & M. Woodford (Eds.), *Handbook of Macroeconomics*, vol. 1c (pp. 1341–1393). North-Holland.
- Bernanke, B. S., & Gertler, M. (1989). Agency costs, collateral, and business fluctuations. *American Economic Review*, 79(1), 14–31.
- Bhat, V. N. (1996). Banks and income smoothing: An empirical analysis. *Applied Financial Economics*, 6(6), 505–510.
- Bikker, J. A., & Hu, H. (2002). Cyclical Patterns in Profits, Provisioning and Lending of Banks. DNB Staff Reports No. 86.
- Bikker, J. A., & Metzmakers, P. A. J. (2005). Bank provisioning behaviour and procyclicality. *Journal of International Financial Markets, Institutions and Money*, 15(2), 141–157.
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115–143.
- Bonin, J. P., Hasan, I., & Wachtel, P. (2005). Bank performance, efficiency and ownership in transition countries. *Journal of Banking and Finance*, 29(1), 31–53.
- Borio, C., Furfine, C., & Lowe, P. (2001). Procyclicality of the Financial System and Financial Stability: Issues and Policy Options. BIS Working Papers No. 1.
- Bouvatier, V., & Lepetit, L. (2008). Banks' procyclical behavior: Does provisioning matter? *Journal of International Financial Markets, Institutions and Money*, 18(5), 513–526.
- Campello, M., Graham, J. R., & Harvey, C. R. (2010). The real effects of financial constraints: Evidence from a financial crisis. *Journal of Financial Economics*, 97, 470–487.
- Cavallo, M., & Majnoni, G. (2001). Do Banks Provision for Bad Loans in Good Times? Empirical Evidence and Policy Implications. World Bank Policy Research Working Paper No. 2619.
- Collins, J. H., Shackelford, D. A., & Wahlen, J. M. (1995). Bank differences in the coordination of regulatory capital, earnings, and taxes. *Journal of Accounting Research*, 33(2), 263–291.
- Cottarelli, C., Dell'Ariccia, G., & Vladkova-Hollar, I. (2005). Early birds, late risers and sleeping beauties: Bank credit growth to the private sector in central and Eastern Europe and in the balkans. *Journal of Banking & Finance*, 29(1), 83–104.
- Coudert, V., & Pouvelle, C. (2010). Assessing the sustainability of credit growth: The case of central and Eastern European countries. *European Journal of Comparative Economics*, 7(1), 87–120.
- Craig, R. S., Davis, E. P., & Pascual, A. G. (2006). Sources of Pro-cyclicality in East Asian Financial Systems. Brunel University, Economics and Finance Discussion Papers No. 06-02.
- Fonseca, A. R., & González, F. (2008). Cross-country determinants of bank income smoothing by managing loan-loss provisions. *Journal of Banking and Finance*, 32(3), 217–228.
- Foos, D., Norden, L., & Weber, M. (2010). Loan growth and riskiness of banks. *Journal of Banking and Finance*, 34(13), 2929–2940.
- Frait, J., & Komárková, Z. (2009). Instruments for curbing fluctuations in lending over the business cycle. *CNB Financial Stability Report 2008/2009*, 72–81.
- Fudenberg, D., & Tirole, J. (1995). A theory of income and dividend smoothing based on incumbency rents. *Journal of Political Economy*, 103(1), 75–93.
- Fungáčová, Z., Herrala, R., & Weill, L. (2011). The Influence of Bank Ownership on Credit Supply: Evidence from the Recent Financial Crisis. BOFIT Discussion Papers No. 34.
- Fungáčová, Z., Herrala, R., & Weill, L. (2013). The influence of bank ownership on credit supply: Evidence from the recent financial crisis. *Emerging Markets Review*, 15(2), 136–147.
- Gambacorta, L. (2008). How do banks set interest rates?. *European Economic Review*, 52(5), 792–819.
- Gerlach, S., Peng, W., & Shu, C. (2005). Macroeconomic Conditions and Banking Performance in Hong Kong SAR: A Panel Data Study. BIS Papers No. 22, 481–497.
- Greenawalt, M. B., & Sinkey, J. F. Jr. (1988). Bank loan-loss provisions and the income-smoothing hypothesis: An empirical analysis 1976–1984. *Journal of Financial Services Research*, 1(4), 301–318.
- Grešl, A., & Seidler, J. (2012). Excessive credit growth and countercyclical capital buffers in basel III: An empirical evidence from central and East European countries. *Economic Studies & Analyses*, 6(2), 91–107.
- Guo, K., & Stepanyan, V. (2011). Determinants of Bank Credit in Emerging Market Economies. IMF Working Paper No. 51.
- Guttentag, J., & Herring, R. (1984). Credit rationing and financial disorder. *Journal of Finance*, 39(5), 1359–1382.
- de Haas, R., & van Lelyveld, I. (2004). Foreign bank penetration and private sector credit in central and Eastern Europe. *Journal of Emerging Market Finance*, 3(2), 125–151.

- de Haas, R., & van Lelyveld, I. (2006). Foreign banks and credit stability in central and Eastern Europe. A panel data analysis. *Journal of Banking and Finance*, 30(7), 1927–1952.
- de Haas, R., & van Lelyveld, I. (2008). Internal Capital Markets and Lending by Multinational Bank Subsidiaries. EBRD Working Paper No. 105.
- Hess, K., Grimes, A., & Holmes, M. (2009). Credit losses in Australasian banking. *Economic Record*, 85(279), 331–343.
- Iannotta, G., Nocera, G., & Sironi, A. (2007). Ownership structure, risk and performance in the European banking industry. *Journal of Banking and Finance*, 31(7), 2127–2149.
- Keeton, W. R. (1999). Does faster loan growth lead to higher loan losses?. *Federal Reserve Bank of Kansas City Economic Review*, QII, 57–75.
- Kiyotaki, N., & Moore, J. (1997). Credit cycles. *Journal of Political Economy*, 105(2), 211–248.
- Kwak, W., Lee, H.-Y., & Mande, V. (2009). Institutional ownership and income smoothing by Japanese banks through loan loss provisions. *Review of Pacific Basin Financial Markets and Policies*, 12(2), 219–243.
- Laidroo, L. (2014a). Lending Growth and Cyclicity in Central and Eastern European Banks. TUTECON Working Paper No. WP-2014/4.
- Laidroo, L. (2014b). Bank ownership and lending – Does bank ownership matter? *Emerging Markets Finance and Trade*, forthcoming.
- Laidroo, L., & Ööbik, U. (2014). Banks' CSR disclosures – Headquarters versus subsidiaries. *Baltic Journal of Management*, 7(1), 47–70.
- Leaven, L., & Majnoni, G. (2003). Loan loss provisioning and economic slowdowns: Too much, too late? *Journal of Financial Intermediation*, 12(2), 178–197.
- Leventis, S., Dimitropoulos, P., & Anandarajan, A. (2012). Signalling by banks using loan loss provisions: The case of the European union. *Journal of Economic Studies*, 39(5), 604–618.
- de Lis, F. S., Martínez Pagés, J., & Saurina, J. (2001). Credit Growth, Problem Loans and Credit Risk Provisioning in Spain. BIS Papers No. 1, 331–353.
- Matousek, R., & Sarantis, N. (2009). The bank lending channel and monetary transmission in central and Eastern European countries. *Journal of Comparative Economics*, 37(2), 321–334.
- Männasoo, K., & Mayes, D. G. (2009). Explaining bank distress in Eastern European transition economies. *Journal of Banking and Finance*, 33(2), 244–253.
- Melitz, J., & Pardue, M. (1973). The demand and supply of commercial bank loans. *Journal of Money, Credit and Banking*, 5(2), 669–692.
- Pain, D. (2003). The Provisioning Experience of the Major UK Banks: A Small Panel Investigation. Bank of England Working Paper No. 177.
- Pesola, J. (2011). Joint effect of financial fragility and macroeconomic shocks on bank loan losses: Evidence from Europe. *Journal of Banking and Finance*, 35(11), 3134–3144.
- Quagliariello, M. (2007). Banks' riskiness over the business cycle: A panel analysis on Italian intermediaries. *Applied Financial Economics*, 17(2), 119–138.
- Rajan, R. G. (1994). Why bank credit policies fluctuate: A theory and some evidence. *Quarterly Journal of Economics*, 109(2), 399–441.
- Roodman, D. M. (2009). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, 71(1), 135–158.
- Salas, V., & Saurina, J. (2002). Credit risk in two institutional regimes: Spanish commercial and savings banks. *Journal of Financial Services Research*, 22(3), 203–224.
- Shehzad, C. T., de Haan, J., & Scholtens, B. (2010). The impact of bank ownership concentration on impaired loans and capital adequacy. *Journal of Banking and Finance*, 34(2), 399–408.
- Soltila, H., & Vihriälä, V. (1994). Finnish Banks' Problem Assets: Result of Unfortunate Asset Structure or Too Rapid Growth?. Bank of Finland Research Discussion Papers No. 23.
- Sóvágó, S. (2011). Identifying Supply and Demand in the Hungarian Corporate Loan Market. MNB Occasional Papers No. 94, 3–24.
- Thakor, A. V. (2005). Do loan commitments cause overlending. *Journal of Money, Credit and Banking*, 37(6), 1067–1099.
- Weill, L., & Godlewski, C. J. (2009). Collateral and adverse selection in transition countries. *Eastern European Economics*, 47(1), 29–40.
- Whalen, J. M. (1994). The nature of information in commercial bank loan loss disclosures. *Accounting Review*, 69(3), 455–478.
- Windmeijer, G. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, 126(1), 25–51.

Appendix

Table A1. Overview of empirical studies on loan loss provisions, loan loss reserves and non-performing loans (NPLs).

Reference	Geographical coverage	Period	Data	Model	Dependent variables used
Cavallo and Majnoni (2001)	World, 36 countries, no CEE countries	1988–1999	Annual	S	Loan loss provisions to total assets
Salas and Saurina (2002)	Spain	1985–1997	Annual	D	Natural logarithm (Ln) of problem loans to total loans year t divided by (1 – problem loans to total loans year t)
Laeven and Majnoni (2003)	45 countries, no CEE countries	1988–1999	Annual	S and D	Level of loan loss provisions year t to total assets year t–1
Pain (2003)	UK	1978–2000	Annual	S and D	Ln of provisions to total loans divided by (1 – provisions to total loans)
Bikker and Metzmakers (2005)	29 OECD countries, incl. 2 CEE countries	1991–2001	Annual	D	Loan loss provisions in year t to average total assets during years t and t–1 Loan loss reserves in year t to total assets in year t
Gerlach et al. (2005)	Hong Kong	1994–2002	Annual	D	NPLs to total loans Net interest income to total assets
Craig et al. (2006)	11 East Asian countries	1996–2003	Annual	S	Real loan growth Interest receipts to assets minus money market rate
Quagliariello (2007)	Italy	1985–2002	Annual	S and D	Loan loss provision to total assets Loan loss provisions to total loans Flow of new bad debt in year t to performing loans in year t–1
Iannotta, Nocera, and Sironi (2007)	15 EU countries, no CEE countries	1999–2004	Annual	S	Operating profit to total earning assets Operating income to total earning assets Operating costs to total earning assets Loan loss provision to total loans Ln of return volatility Ln of insolvency risk
Bouvatier and Lepetit (2008)	15 European countries, no CEE countries	1992–2004	Annual	D	Loan loss provision to total assets Loan growth to average total assets during years t and t–1
Fonseca and González (2008)	World, 40 countries, no CEE	1995–2002	Annual	D	Loan loss provisions year t divided by total assets t–1
Frait and Komárková (2009)	Czech	1997–2008	Quarterly	D	Loan loss provisions in year t to average total assets during years t and t–1
Hess et al. (2009)	Australia and New Zealand	1980–2005	Annual	S	Loan loss provisions to total loans
Shehzad et al. (2010)	50 countries, incl. 11 CEE countries	2005–2007	Annual	S	NPLs to gross loans Capital adequacy ratio

Note: Model presents the specification used and it can be either S – static and/or D – dynamic.

Table A2. Determinants of loan loss reserves to total assets (*LLR2*).

Variable	OLS		OLS FE		System GMM1		System GMM2		Diff GMM	
<i>Constant</i>	1.665	***	0.370		2.818	***	3.150	**		
	(0.345)		(2.216)		(0.631)		(1.263)			
<i>LLR2_{t-1}</i>	0.718	***	0.453	***	0.616	***	0.689	***	0.608	***
	(0.030)		(0.054)		(0.063)		(0.082)		(0.068)	
<i>RCCL_t</i>	-0.065	*	-0.030		-0.017		0.042		-0.023	
	(0.033)		(0.043)		(0.060)		(0.148)		(0.098)	
<i>RCCL_{t-1}</i>	0.002		0.051		-0.022		-0.014		0.003	
	(0.044)		(0.054)		(0.051)		(0.100)		(0.072)	
<i>RCCL_{t-2}</i>	0.105	**	0.088	**	0.088	**	0.113	*	0.080	*
	(0.047)		(0.042)		(0.043)		(0.060)		(0.048)	
<i>RCCL_{t-3}</i>	-0.054		0.037		-0.031		-0.045		0.027	
	(0.041)		(0.045)		(0.044)		(0.070)		(0.056)	
<i>L_t</i>	-0.006	***	-0.005	**	-0.007	***	-0.009	***	-0.004	**
	(0.001)		(0.002)		(0.002)		(0.003)		(0.002)	
<i>L_{t-1}</i>	-0.001		-0.002	*	-0.001		0.000		0.000	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
<i>L_{t-2}</i>	0.000		-0.002		-0.001		-0.001		-0.001	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
<i>L_{t-3}</i>	0.000		0.000		0.000		0.000		0.001	*
	(0.000)		(0.001)		(0.001)		(0.000)		(0.000)	
<i>ROA_t</i>	-0.023		-0.022		-0.069	**	-0.161	**	-0.058	
	(0.016)		(0.020)		(0.033)		(0.080)		(0.046)	
<i>ROA_{t-1}</i>	-0.003		-0.015		-0.035		0.103		0.025	
	(0.017)		(0.033)		(0.035)		(0.070)		(0.039)	
<i>BRI_t</i>	-0.613	**	-0.553		-0.749	***	-0.747		-0.647	
	(0.283)		(0.397)		(0.259)		(0.762)		(0.406)	
<i>BRI_{t-1}</i>	0.297		0.658		0.206		0.077		0.756	
	(0.279)		(0.509)		(0.280)		(0.624)		(0.512)	
<i>CPI_t</i>	0.017		0.004		0.016		0.019		0.004	
	(0.012)		(0.013)		(0.012)		(0.019)		(0.015)	
<i>CPI_{t-1}</i>	0.024	**	0.002		0.011		0.025		0.002	
	(0.012)		(0.015)		(0.013)		(0.021)		(0.014)	
<i>GDP_t</i>	-0.033	***	-0.038	***	-0.037	***	-0.043	***	-0.038	***
	(0.008)		(0.008)		(0.009)		(0.014)		(0.009)	
<i>GDP_{t-1}</i>	-0.004		-0.021	**	-0.005		0.001		-0.008	
	(0.007)		(0.010)		(0.008)		(0.012)		(0.014)	
Year dummies	yes		yes		yes		yes		yes	
Obs.	417		417		417		417		296	
Banks			125		125		125		113	
Instruments					139		55		97	
Adj. R2	0.832		0.828							
Hansen statistic					106.3		42.71		83.04	
AR (1)					-3.10	***	-3.47	***	-3.28	***
AR (2)					0.50		1.09		0.98	
F statistic	90.06	***	82.34	***	68.41	***	64.54	***	64.72	***

Notes: For definitions of variables see Table 1. OLS – model estimated using ordinary least squares. OLS FE – model estimated using ordinary least squares fixed effects. System GMM1 – model estimated with two-step system GMM with full set of instruments (Arellano & Bover, 1995; Blundell & Bond, 1998). System GMM2 – model estimated with two-step system GMM using collapsed instruments (Roodman, 2009). Diff GMM – model estimated with difference GMM (Arellano & Bond, 1991). Robust standard errors in parentheses. Statistical significance: *** $p < .01$; ** $p < .05$; * $p < .10$.