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MSc Thesis in Finance

Interbank Confidence and Credit Growth

Analysis of the bank lending channel in the Nordics and Baltics as well as the eurozone

Abstract. Changes in a central bank's monetary policy are proven to affect credit growth for corporations and households. However, the exact transmission mechanism is still widely debated. This paper adds to the studies on the bank lending channel and focuses on cross-sectional differences among banks and the distributional effects of monetary policy on credit growth. In combination with traditional bank-specific factors, which ought to capture the bank lending channel, we add a measure of the interbank confidence to analyse banks' credit growth in the Nordic and Baltic States during the period of 2002-2010. We find weak support for the idea that the bank-specific variables help to capture the bank lending channel in the Nordic and Baltic States. Also, we find that TED spread volatility, which is a proxy for interbank confidence, is a significant determinant of credit growth in the sample region. We argue that this effect is of economic significance. Finally, in contrast to our findings for the Nordic and Baltic countries, but in line with previous research, additional analysis indicates the presence of distributional effects on credit growth in a sample of eurozone banks.

Keywords: monetary policy, bank lending channel, credit growth, interbank confidence.
JEL Classification: E44, E52

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Technical abbreviations

Bank-specific factors

CAP	Total Equity over Total Assets
DEP	Total Customer Deposits over Total Interest-bearing Liabilities
EDF	Expected Default Frequency
LIQ	Liquidity
LLP	Loan-loss Provisions over Gross loans
SIZE	Logarithm of Total Assets
STF	Short-term funding over Total Interest-bearing Liabilities

Other abbreviations

2SLS	Two-step Least Squares
AB	Arellano and Bond estimator
ABS	Asset-backed securities
BB	Blundell and Bond estimator
Bps	Basis points
CB	Central Bank
ECB	European Central Bank
EQT	Country-specific stock market index returns
GMM	Generalized Method of Moments
MBS	Mortgage-backed securities
NSM	Non-standard monetary policy measures
TED	(spread) Difference between the interbank and T-bill interest rates
OLS	Ordinary-Least Squares

Country abbreviations

The Nordics

DK	Denmark
FI	Finland
SE	Sweden
NO	Norway

The Baltics

EE	Estonia
LV	Latvia
LT	Lithuania

The eurozone

AT	Austria
BE	Belgium
DE	Germany
ES	Spain
FR	France
GR	Greece
IE	Ireland
IT	Italy
LU	Luxembourg
NL	Netherlands
PT	Portugal

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1 Introduction

The amount of loans channelled into the economy has been proven to encourage economic growth[1]. In most countries, lending activity is directed by central banks that conduct monetary policy. Nevertheless, by and large, commercial banks are the main providers of external financing for households and corporations. Therefore, in order to understand precisely how monetary policy transmits into credit growth, one needs to study the monetary policy transmission mechanism. The monetary policy transmission mechanism has been explained through (1) the balance-sheet and (2) bank lending channels. The former explains credit growth via financing decisions of non-financial corporations and households (demand-side effect), whereas the latter focuses on financial institutions and their ability to supply credit to the economy (supply-side).

Since the publication of Bernanke and Blinder (1988), the mainstream view of the bank lending channel has assumed that changes in policy rate (monetary shocks) have a direct impact on deposits, which in turn determine credit growth (Disyatat[2], 2008). But it is also important to realise that banks with unalike characteristics adjust the credit supply differently, given a monetary policy shock. Here the distributional effects of monetary policy come into play. It has been widely accepted that small, undercapitalized, and illiquid banks play an important role in the monetary policy transmission mechanism as the credit growth of these banks reacts more to monetary policy shocks (Altunbas el al., 2002).

The recent decade brought substantial changes in banks' business model through securitisation, market funding, and a higher proportion of non-interest-bearing revenues (Wilson et al., 2010). As a result, the debate over the bank lending channel has been extended to include not only Size, Liquidity and Capitalisation factors, but also additional variables (such as Deposits, Short-Term Funding, and Expected Default Frequency). Gambacorta and Ibanez (2011) show that banks with more short-term funding, more exposure to securitisation, and less supervision decreased credit growth during the crisis more than other banks. Besides, the recent crisis in 2007-2008 showed that the banking sector's risk characteristics are important for banks to get market funding and shelter changes in money market circumstances (Altunbas et al., 2010). This view (called bank risk-taking channel) suggests shifting the focus

[1] For comprehensive overview, please see Levine (2005).

[2] But Disyatat (2008) argues that change in deposits is not elastic enough (with respect to policy rate shocks) to explain the variation in credit growth. Deposits are linked closely to economic activity and market rates work as a better proxy for the opportunity costs of holding deposits as opposed to policy rates.

from changes in bank balance sheet composition towards endogenous variation in the external finance premium, which should reflect the health of banks (Disyatat, 2011).

The motivation for our thesis is three-fold. (1) The bank lending channel in the Nordic and Baltic States has not been covered as extensively as in the US and the eurozone. We observe that the banking sector in the Nordic and Baltic States is more homogenous than the one in eurozone and could have a different monetary policy transmission mechanism. As a result, we also aim to compare the bank lending channel in the Nordic and Baltic countries with the one in the eurozone. (2) Following rising interest in market-related effects on monetary policy transmission, we focus on TED spread volatility (which proxies for interbank market confidence) and its importance for the bank lending channel. (3) Finally, the 2007-2008 crisis drew more attention towards the effectiveness of the monetary policy in combination with the macro-prudential regulation. Some studies show that the cooperation of macro-prudential authorities (financial supervisors, accounting standards regulators) and central banks bring benefits during both regular times and financial turmoil (Angelini et al., 2011). Therefore, we hope to contribute to this line of research by assessing how important it is for the regulators to monitor interbank confidence.

Our thesis builds on previous research regarding the bank lending channel and incorporates new ideas within the field, some of which are discussed by Gambacorta and Ibanez (2011) and Altunbas et al., (2010). For a conceptual depiction of our research framework, please refer to Appendix D, Figure 7. First of all, we extend the set of bank-specific factors when testing the distributional effects of the bank lending channel. In combination with traditional bank-specific determinants (Size, Liquidity, and Capitalisation), we also include Short-term Funding, Deposits, and Loan-loss Provisions. We find that traditional bank-specific factors are not determinants of the bank lending channel in the Nordic and Baltic countries, but we find some support for this theory if all six variables are used. In contrast, the analysis of eurozone banks demonstrates the importance of bank-specific characteristics for monetary policy transmission. The eurozone results are in line with the existing empirical evidence in the same region (Altunbas et al., 2010). Moreover, we include TED spread volatility, which proxies for counterparty risk in the banking sector. We find that this variable helps to explain the bank lending channel in the Nordic and Baltic countries, but is not significant in the sample of eurozone banks. Yet we find that TED spread volatility is an important determinant of credit growth in periphery eurozone countries: Greece, Ireland, Portugal, and Spain. Although we believe that our findings are more relevant for monetary policy authorities, we expect that our analysis is of interest for both academics and practitioners interested in the distributional effects of monetary policy.

The remainder of this paper is structured as follows: Section 2 includes a literature review and discussion of our contribution to the literature follows in Section 3. Section 4 outlines our hypotheses and Section 5 – data description. Then we proceed with a description of our econometric model in Section 6 and an interpretation of the results in Section 7. Section 8 includes policy implications and Section 9 outlines limitations and suggestions for further research. Finally, concluding remarks are presented in Section 10.

2 Literature review

Interest in the credit transmission mechanism has developed over the years bringing new ideas and more in-depth analysis. Initial studies focused on lending from a borrower's (non-financial institution) perspective, investigating the "money view", where a single interest rate determined the aggregate level of loans in the economy. Later researchers introduced the "lending channel" with different interest rates in general equilibrium models to account for imperfect substitutability among deposits and nonreservable liabilities. Only in the 1990s was the "lending channel" further broken down into the balance-sheet channel and bank lending channel, which focus on financial intermediaries' reactions to central banks' policy rate shocks.

2.1 From the money channel to the bank lending channel

The importance of financial intermediation has been investigated since the early 1930s, right after the Great Depression. At that time, researchers focused on the effects of the transmission mechanism on the real economy[3] through the money channel (IS-LM model) of the transmission mechanism, which simplified the mechanism into the three main components: money, bonds, and a single interest rate. Bonds and loans on the asset side of banks' balance sheets were seen as perfect substitutes, both of which have a negative relation with an interest rate. The money channel assumes that monetary contraction reduces banks' reservable deposits, which in turn pushes banks to decrease the asset side of a balance sheet (Gambacorta, 2005). Hence, a single interest rate was thought to capture all returns, whether government bonds, bank loans or real capital (Kashyap and Stein, 1995).

The single interest rate assumption was perceived as a shortcoming in later research[4], which introduced general equilibrium models with different interest rates, implying imperfect

[3] For a comprehensive review, please see Gertler (1988).
[4] Brainard, 1964; Tobin and Brainard, 1963; Tobin, 1970; Brunner and Meltzer, 1963, 1972, 1988.

substitutability in a three-asset world with money, publicly issued loans, and intermediated "loans" (Kashyap and Stein, 1995). As opposed to the "money view", this approach is called the "lending view".

Bernanke and Blinder (1988) posited three key conditions for the "lending" channel (also called the "lending view") of monetary transmission to hold as a distinct view: (1) intermediated loans and open-market bonds are not perfect substitutes (an argument against the Modigliani-Miller capital structure invariance proposition[5]); (2) imperfect substitutability between deposits and market financing must hold; (3) price frictions of adjustments to balance sheets must hold. If conditions (1) and (2) do not hold[6], we are back to the pure "money view", where loans are perceived as perfect substitutes for bonds. Bernanke and Blinder (1988) conclude that imperfect substitutability between bonds and loans (the asset side of a balance sheet) leads to the amplification of monetary policy shocks as compared to the traditional IS-LM channel (the "money view"), which explains the effectiveness of monetary policy through the liability side of the bank's balance sheet[7]. The key finding in their paper is that monetary policy can affect lending not only through the bond-market rate, but also through a spread between rates on loans and bonds. Hence, monetary tightening shrinks deposits, which reduces lending as banks cannot tap into an uninsured liabilities market without facing frictions.

In the 1990s the "lending view" was disentangled into the balance-sheet channel and bank lending channel (Bernanke and Gertler, 1995). The former dwells on the notion that a borrower's short-term financing and collateral values determine credit growth (demand-side effect), whereas the bank lending channel draws attention to financial intermediaries, which face information asymmetries affecting costs of borrowing and lending for banks (supply-side effect). Bernanke and Blinder (1992) employed the federal fund rate as an indicator of the monetary policy stance on aggregated data and found that it is more informative than monetary aggregates. Besides, researchers concluded that monetary policy works through both "money" and "lending" channels; hence, a central bank is able to directly affect the level of deposits through the money multiplier mechanism. This conclusion was reaffirmed by Kashyap and Stein, 1995; Stein, 1998; Walsh, 2003; Kishan and Opiela, 2000; Ehrmann et al., 2003.

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5 Romer and Romer (1990) argue that banks see reservable and non-reservable deposits as perfect substitutes.
6 For discussion of the micro foundations and reasoning behind these assumptions, see Kashyap and Stein (1993).
7 When a central bank reduces reserves in the banking system, the stock of money falls, which leads to a contraction in loans.

2.2 Studies on the bank lending channel

The key hypothesis under the bank lending channel states that the monetary policy transmission mechanism works through bank credit (Gambacorta, 2005). The cornerstone research of Bernanke and Blinder (1988) stated that an increase in a policy rate decreases banks' reserves, consequently leaving less capital to be lent. This and subsequent research papers on bank lending rely on a common assumption about the sequence of transmission: the policy rate affects the level of deposits (either directly or through a yield on deposits), which in turn forces banks to adjust the funding mix, including the loan supply (Disyatat, 2011).

Although the significance and magnitude of bank-specific characteristics differ from country to country, literature on aggregate data agrees that size, liquidity and capitalisation factors play an important role in the bank lending channel. Interaction terms between the monetary policy stance and these bank-specific factors have positive signs as larger, more liquid, and better-capitalized banks are expected to weather credit growth against the shocks of external finance availability (Altunbas et al., 2010; Kishan and Opiela, 2000; Gambacorta and Mistrulli, 2004). This implies that small, less capitalized, and illiquid banks react more strongly to a monetary policy shock in terms of credit growth. Therefore, these banks tend to decrease credit growth more during increasing monetary policy rates, and increase credit growth more during times of monetary easing.

2.2.1 The bank lending channel in the US

Kashyap and Stein (1995) found that small banks (below the 95th percentile with respect to Total Assets) are more sensitive to federal fund rate changes, because these banks are more constrained to attract non-deposit financing as opposed to large banks[8]. But the effect may come also from the demand side as small banks usually grant loans to small corporations that face procyclical demand (Berger and Udell, 1994). Ashcraft (2003) concludes that small banks lend to small firms and large banks use off-balance-sheet items to finance large firms. This makes it difficult to distinguish the bank lending channel from the balance-sheet channel.

Kashyap and Stein (2000) further elaborated on the size effect including the liquidity measures and concluded that small and less liquid (with respect to Securities over Total Assets) banks adjust their lending more rapidly given a monetary policy rate change.

As far as capitalisation is concerned, Bernanke and Lown (1991), Berger and Udell (1994) as well as Kishan and Opiela (2000) conclude that banks with weaker capital ratios have

[8] For example, small banks have to issue short-term paper at discount due to lower creditworthiness and smaller amounts.

greater lending reactions. In comparison to these studies, where the researchers employ panel data, others (i.e. Hancock at al., 1995; Gambacorta and Mistrulli, 2004) use a dynamic framework (i.e. vector autoregression) and reach the same conclusion. In terms of capitalisation specification, some studies in this field use actual capital-to-asset ratio (i.e. Bernanke and Lown, 1991), whereas other researchers (like Hancock et al., 1995) apply deviations of capital relative to target levels, which may lead to a model misspecification (Berrospide and Edge, 2010). Nevertheless, researchers coherently agree that the lending of poorly capitalized banks is more sensitive to monetary policy shocks than the lending of well-capitalized financial institutions.

Kishan and Opiela (2006) prove the asymmetry of credit growth with respect to contractionary/expansionary monetary policy shocks. They find that small low-capitalisation banks cut lending more compared to high-capitalisation banks during times of an increasing policy rate; however, during monetary easing (a decreasing Federal Reserve policy rate environment) small high-capitalisation banks' credit growth outpaces the credit growth of low-capitalisation banks. This signals that small undercapitalised banks play a vital role in economic recovery and regulators should ensure the sufficient capitalisation of such banks (Kishan and Opiela, 2006).

2.2.2 The bank lending channel in Europe

The US and European economies can be characterized by similar economic cycles and the effect of random policy rate shocks on their economies is also similar (Peersman and Smets, 2003). Hence, Smets and Wouters (2003) conclude that monetary policy transmission mechanisms can be comparable, too. Nevertheless, there are significant differences in terms of the competitive and regulatory landscape: for instance, European non-financial companies are more exposed to bank lending as opposed to market lending (Ehrmann et al., 2003), and state-ownership in the banking sector is more pronounced in Europe than in the US (La Porta et al., 2000). These differences may lead to different results for European and US banks. For instance, in Europe (1) size has a negative effect (contrary to the results for the US market), which indicates that information frictions are less of an issue for small banks in Europe (Ehrmann et al., 2003); (2) there is considerable heterogeneity among European countries with respect to the importance of bank-specific characteristics in the bank lending channel.

For both micro and aggregate data, France and Spain show a more rapid change in lending due to shocks in the monetary policy as compared to Germany and Italy (Ehrmann et al., 2003). A bank's size ought to explain variability in credit growth given monetary shocks in

Spain (Ehrmann et al., 2003), but it is rejected as a useful indicator in France, Germany, and Italy. The irrelevancy of size effect in Italy is confirmed by Gambacorta (2005). This may be due to closer customer relations that allow banks to smooth out the higher cost of funding. Besides, liquidity is found to be a highly significant determinant of bank lending in France, Germany, and Italy, whereas the results are less robust for Spain (Gambacorta, 2005; Ehrmann et al., 2001).

Size, liquidity and capitalisation are significant determinants in the Netherlands (De Haan, 2001), in Portugal the lending channel is affected only by capitalisation (Farinha and Marques, 2001), in Greece by size and liquidity (Brissimis et al., 2001), and in Finland liquidity plays only a marginal role (Topi and Vilmunen, 2001).

Matousek and Sarantis (2009) investigate the bank lending channel in Central and Eastern European countries[9] over the period of 1994-2003. They conclude that overall size and liquidity appear to have a significant role in determining banks' responses to changes in the monetary policy stance. For the Baltic countries, the paper shows that these two factors have positive signs (as expected) and are robust irrespective of specification.

In general, as compared to the US, the diminished importance of size and capitalisation effects among European banks is related to less severe informational asymmetries: government involvement, banking networks, and a low number of bank failures during the period under review (Ehrmann et al., 2001). These factors reduce information frictions and yield different results as compared to the US banks.

Among studies on European countries, we have not been able to find comprehensive literature covering the Nordic and Baltic States as a separate region. There are several studies (i.e. Angeloni et al., 2003; Gambacorta and Ibanez, 2011) which include some of the Nordic countries in their analysis but do not draw separate conclusions in relation to this region. Therefore, this fosters our curiosity to check the bank lending channel for the Nordic and Baltic States.

2.2.3 From "originate-to-hold" to "originate-to-distribute"

The above-mentioned studies investigate traditional banks, but since the 1990s deregulation and technological development have led to diversification in the product base, increased risk management complexity, and the wider geographical exposure of banks (Wilson et al., 2010). Hence, the "originate-to-hold" business model has been outpaced by the "originate-to-

[9] The Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic and Slovenia.

distribute" model, where banks rely more on wholesale funding (contrary to deposit-based funding) and securitisation (Boot and Thakor, 2010). Consequently, this changed the dynamics of monetary transition as the market perception upon bank's assets and borrowing capacity became more relevant (Bernanke, 2008). For instance, Cetorelli and Goldberg (2008) notice that monetary policy shocks are less relevant due to more banks' business being undertaken in foreign markets.

Ivashina and Scharfstein (2010) investigate US banks with relation to wholesale funding: banks which had a smaller deposits-to-assets ratio, cut the lending more during the crisis. The authors also analyse counterparty risk in the US syndicated loans market and conclude that banks which had co-syndicated loans with Lehman Brothers cut their lending more. Essentially, more deposits on banks' balance sheets imply a more stable source of funding and such banks cut their lending less than those which use credit lines (Ivashina and Scharfstein, 2010). In addition, Cornett et al. (2011) conclude that banks with more deposits and more equity issued more loans during the 2007-2009 crisis as compared to those which relied on wholesale debt funding. Also, this study takes into account the left-hand side of the balance sheet: the more asset-backed securities (ABS) (including mortgage-backed securities (MBS)) a bank had, the more liquid assets it held during the crisis reducing the capacity to issue new loans. This contradicts the idea posited by Altunbas et al. (2009a) that securitisation reduces funding needs and allows the transfer of credit risk to the market, consequently reducing regulatory requirements on capital, which in turn should foster the issuance of new loans.

Gambacorta and Ibanez (2011) study bank lending during the crisis (which they define as 2007-2010) and non-conventional bank-specific factors. They find that the average credit growth of banks with weak core capital positions, higher dependence on market funding, and non-interest sources of income decreased more during crisis as compared to other banks. According to them, traditional bank-specific factors (size, liquidity, capitalisation) are not enough to fully capture the functioning of the new bank lending channel dimensions, which emerged due to financial innovation and changes in the business model of banks. They show that banks with more short-term funding, more exposure to securitisation, and facing less supervision cut credit growth during the crisis more than other banks. Finally, Gambacorta and Ibanez (2011) find that prolonged periods of low interest rates elevate lending, which brings us to the investigation of the risk-taking channel – the new stream within the bank lending channel research field.

2.2.4 New research stream: the risk-taking channel

Extended periods of low interest rates are associated with excessive risk-taking by banks (Adrian and Shin, 2008). In our sample, such periods prevailed in 2004-2005 and 2008-2009; therefore, we believe it is important to touch upon the risk-taking channel.

The bank risk-taking channel suggests moving the focus from changes in the bank balance sheet composition towards endogenous variation in the external finance premium, which should reflect the health of banks (Disyatat, 2011). The risk-taking channel takes the bank lending channel at its base and adds the assumption that the transmission mechanism of monetary policy has a direct effect on banks' funding conditions and management incentives (Altunbas et al., 2009b; Borio and Zhu, 2008). Therefore, monetary policy may affect the risk-taking behaviour of banks and other financial intermediaries via asset prices and collateral values (Jiménez et al., 2009). For instance, banks tend to take on more leverage during extended periods of low interest rates and, consequently, shrink balance sheets during the monetary contraction, which leads to pro-cyclical credit growth and deterioration of financial stability (Adrian and Shin, 2008; Altunbas et al., 2009). Besides, extended periods of a low interest rate environment change banks' valuation and perception of risk and intensify their search for yield, which works as a by-product of facilitating economic growth through the lower cost of borrowing (Altunbas et al., 2010).

Altunbas et al. (2010) argue that traditional bank-specific factors (size, liquidity, capitalisation) may not capture the willingness to adjust credit growth with respect to the monetary policy stance given an "originate-to-distribute" business model. According to them, (1) securitisation reduced the size of on-balance-sheet items; (2) innovation in liquidity management reduced the need to hold liquid securities; (3) a closer link to markets has reduced the informative power of capital ratios. Therefore, on top of the three traditional bank-specific characteristics, Altunbas et al. (2010) add Loan-Loss Provisions (LLP), as an ex-post measure of credit risk, and Expected Default Frequency (EDF), which is explained as a forward-looking measure of credit risk[10]. They find that the interaction term between EDF and the monetary policy measure has a negative sign, which indicates that low-risk banks can better cope with monetary policy shocks and adjust their credit growth less as compared to high-risk banks.

Moreover, Disyatat (2011) argues that more market-funding reliance makes banks more sensitive to monetary shocks. He suggests shifting the thinking from quantitative and

[10] It is worth noting that the most risky banks in Europe (EDF value at the fourth quartile) are on average smaller, have more liquid assets and are less capitalized, which goes in line with the traditional theory.

compositional changes in banks' balance sheets towards the external finance premium, which is driven by banks' financial health. In the traditional bank lending channel, monetary policy tightening decreases liquidity for banks, but the risk-taking channel assumes that increasing monetary policy rates have a disproportionate impact on the price of funding liquidity (Disyatat, 2011). Carpenter and Demiralp (2010) support this view and conclude that the traditional bank lending channel is not enough to explain credit growth as market funding allows one to choose the optimal mix of liabilities to issue new loans and the cost of this is passed on to the final consumer (real economy), who adjusts demand for credit given new prices.

Hence, we see that the risk-taking channel has drawn attention in explaining the transmission mechanism of monetary policy. As the empirical support for these studies is only picking up, we stick closely to the traditional bank lending channel, but also incorporate the idea that besides the monetary policy stance and bank-specific factors, one should take into account interbank market factors to be able to explain the transmission mechanism of monetary policy and credit growth.

3 Our contribution to the literature

The literature review provides us with the following indications: (1) the traditional bank lending channel is no longer sufficient to explain credit growth due to significant changes in banks' geographical and product scope as well as funding possibilities; (2) differences in the regulatory landscape and competitive environment among European and US banks cannot assure the same conclusions for different markets; (3) the 2007-2008 crisis allows one to test theoretical concepts to prove the relevance of the risk-taking channel on credit growth.

As we have noticed, the debate about financing risk-premium has been gaining momentum following the 2007-2008 crisis. Our thesis sheds light on the topic of the risk-taking channel through more tangible proxies of risk. We extend the traditional credit growth model to include proxies for market confidence, namely a broad market confidence measure (country stock index) and a counterparty risk proxy in the banking sector (TED spread volatility).

Also, we expand the selection of bank-specific characteristics by adding Short-Term Funding (*STF*), Deposits (*DEP*) and Loan-Loss Provisions (*LLP*) in our regressions. *STF* and *DEP* were shown to explain the bank lending channel during the 2007-2010 crisis in a sample of the European Union[11] and the US by Gambacorta and Ibanez (2011). Since our time span includes these years and also takes Sweden, Denmark, and Finland as part of the Nordic and Baltic State sample, we include these variables expecting to capture credit growth with more precision. We also include an *LLP* measure following Altunbas et al. (2010), who state that *LLP* proxy for riskiness of a credit portfolio.

To the best of our knowledge, the bank lending channel in the Nordic and Baltic States has not been covered as extensively as in the US and eurozone markets. Angeloni et al. (2003) include the UK, Sweden, Japan, and the US as a control group while measuring the transmission mechanism of monetary policy in the eurozone (including Finland), but do not discuss implications which would be specific to the Nordic or Baltic region. The same applies to Gambacorta and Ibanez (2011), who include Sweden and Finland together with 13 other European Union countries while investigating the bank lending channel during the crisis.

As far as the Baltic States are concerned, Köhler el al. (2006)[12] investigate the Baltic market in 1997-2004 using domestic and euro money market rates as a proxy for monetary policy rates[13]. They find that the euro money market rate is a better determinant of credit growth than the domestic one, which turns out to be insignificant in their regressions. This is most likely related to the fact that households and corporations had outstanding loans mainly in euros and with floating rates. Moreover, Köhler el al. (2006) find that liquidity is the key factor in explaining distributional effects of the monetary policy[14]. This means that less liquid banks in the Baltic States decrease credit growth more if central banks increase monetary policy rates.

4 Our hypotheses

If there were no information asymmetries and other market frictions, banks, irrespective of their characteristics, would adjust credit growth equally given a monetary policy shock. Nonetheless, literature on the bank lending channel has widely accepted three key bank characteristics (size, liquidity and capitalisation), which capture the distributional effects of a

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[11] Austria, Belgium, Denmark, Germany, Greece, Finland, France, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, the United Kingdom.

[12] Discussion paper.

[13] We believe that for the period of 1997-2004 the money market rate was close to the repo rate (the proxy for the monetary policy rate in our regressions), but for our study we prefer the repo rate as we want to disentangle the monetary policy effect from interbank market effects.

[14] Which is measured by the interaction term of the monetary policy rate and the liquidity indicator.

monetary stance. These factors explain distributional effects among banks with different characteristics. Hence, our first hypothesis is as follows:

H1: Traditional bank-specific characteristics (size, liquidity and capitalisation) are significant determinants of the bank lending channel.

This captures the idea that information asymmetries of financial intermediaries exist, which affects the costs of borrowing and lending for banks. We expect to fail to reject this hypothesis if the majority of banks in the sample operated through a traditional "originate-to-hold" business model, with low exposure to foreign operations and short-term funding. Yet individual lenders' exposure to interbank markets has grown over time. If on average this trend had a significant impact on credit growth, we would expect to reject our first hypothesis. As our dataset includes a broad base of commercial banks, savings banks and mortgage institutions, it is hard, if not impossible, to make a well-educated guess about a rejection/failure to reject this hypothesis a priory.

Nevertheless, there is a growing amount of literature which states that traditional bank-specific factors (size, liquidity and capitalisation) are not enough to capture the bank lending channel. Financial globalisation has created a more favourable environment for banks to borrow abroad, whereas the extended period of low interest rates in most of the developed world resulted in increased reliance on short-term funding (Altunbas et al., 2010).

H2: In combination with traditional characteristics (size, liquidity and capitalisation), other bank-specific factors (short-term funding, deposits, and loan-loss provisions) are significant determinants of the bank lending channel.

Here we address the link between monetary policy and the credit growth of the average bank after controlling for both traditional and newly identified bank-specific characteristics. Over the last decade, developments in the banking industry have gradually changed the revenue model and capital composition of many banks. Hence, our second hypothesis relates to research which includes other bank-specific characteristics in the bank lending channel. We believe we would reject this hypothesis if in addition to bank-specific characteristics there were other significant determinants of the bank lending channel. This is related to the growing amount of research which focuses on the fairly new idea of the risk-taking channel. It states that a bank's ability to get funding in the external or interbank market at least partly depends on the level of confidence that investors and counterparties have with respect to the bank as well as the general market (Disyatat, 2011). Therefore, we proceed with the following hypothesis:

H3: In combination with bank-specific characteristics, TED spread volatility is a significant determinant of the bank lending channel.

Higher dependency on short-term and external funding has increased banks' interrelatedness with the market. However, it is not exactly clear how a change in market confidence affects credit growth. Hence, our last hypothesis focuses on whether market confidence is a statistically and economically significant factor in explaining credit growth patterns across banks.

5 Data

Since we are interested in credit growth coming through the bank lending channel, we would like to observe as much variation as possible in terms of monetary policy and bank specific characteristics, yet we would also like to have a limited disparity in control variables such as legal system and regulation. Nordic countries offer an interesting dataset as historically there are a lot of economic and cultural similarities among them. The same applies for the Baltic States, which have a similar institutional setting.

Moreover, the countries of interest have different exchange rate mechanisms[15]. Also, the banking sector in the Nordic and Baltic countries is well developed, but characterized by the dominance of a few large banks and a number of small institutions. We believe that both factors could help to capture the market and bank-specific effects on credit growth with better precision. Still, the total number of banks in the region is small and the amount of previous research is limited compared to Europe more broadly. Therefore, we intend to expand our dataset to include banks in the eurozone to compare the results with the Nordic and Baltic countries and with other research. In addition, there are more globally active banks in the eurozone than in the Nordics, which could lead to additional findings with respect to changes in the business model.

The main Nordic and Baltic State dataset includes seven countries: Sweden, Norway, Finland, Denmark, Estonia, Latvia, and Lithuania. In the eurozone we have Austria, Belgium, France, Germany, Greece, Ireland, Italy, Luxemburg, the Netherlands, Portugal, and Spain. For analysis we take the longest available annual time series, which covers the period of 2002-

[15] Sweden and Norway have a floating exchange rate. Finland has had the euro since its inception (1999). Since the same year, Denmark has had a fixed exchange rate with a 1% band. The same mechanism has been applied in Latvia since 2005. Lithuania has had a currency board since 2004. Estonia had a fix from 2004 until 2011, when it joined the eurozone.

2010. We believe nine years of data is sufficient to cover at least one economic cycle[16] and observe enough variation in banks' loan composition. Bank-specific information is obtained from the Orbis database; market-related information (i.e. interest rates, GDP) is retrieved from DataStream.

5.1 The banking market landscape in the countries under review

In this section we briefly present distinctive features of the Nordic and Baltic States banking sector[17], which are (1) lower the total assets of the banking sector to the country's GDP ratio; (2) a higher loan-to-deposit ratio, (3) higher market concentration as compared to the eurozone countries (Appendix B, Table 5).

First of all, total assets to GDP ratio in the Nordic and Baltic States stood at 265%, whereas this figure was 384% for the eurozone countries. Sweden has the largest banking sector (381%), which is due to significant dependence on foreign operations. Lithuanian banks' total assets do not exceed the GDP figure (93%), which may be due to higher public ownership (Köhler el al., 2006). In the eurozone, due to considerable dependence on foreign operations, Luxembourg's total assets exceeded the local GDP figure 20 times. Ireland was "far" behind with a 7.6 times larger banking sector than the actual GDP value, which was also due to the international business model applied by not-so-local banks (Ueda, 2012).

The second distinctive feature of the Nordic and Baltic States is the Loans-to-Deposits ratio, which was two times higher (at 2.4) than among the eurozone countries (1.2). The "front-runners" here are Sweden and Denmark (which also have the largest banking sector relative to their GDP in the Nordic and Baltic region, i.e. more than 380%) with a Loans-to-Deposits ratio reaching 2.4 and 2.9 respectively. The ratio for Finland and the Baltic States was around 1.5, yet higher than the eurozone average.

Finally, the Nordic and Baltic States have more concentrated banking markets as proxied by the total assets of the 5 largest banks. Finland has the most concentrated banking sector among Nordic countries as this figure stood at 83%. This figure is only exceeded by Estonia (93%) as compared to 81% in Lithuania and 69% in Latvia. In the eurozone the ratio varies from 25% in Germany to 93% in Austria. On a weighted average basis, Nordic and Baltic banking market concentration was 64%, whereas that of the eurozone was 47%.

We believe that this indicates less market competition in the Nordic and Baltic States, which implies lower incentives to take on more risk. In more competitive markets, boom years

[16] We find some studies, which state even shorter business cycles (i.e. Camacho et al., 2008).

[17] For readers less familiar with the Nordic and Baltic States banking sector, please see Appendix E for a non-formal overview of key developments in the Nordic and Baltic banking sector over the period under review.

lead to excessive bank lending which results in higher losses during an economic downturn (Rotheli 2010; Jimener and Saurina, 2006).

A brief market landscape overview indicates that Nordic and Baltic banks are more conservative in terms of lower Total Assets over GDP ratio and less market competition. But a high Loans-to-Deposits ratio shows that banks expose themselves to market funding and they leverage their deposit base. This indicates that besides the traditional bank-specific characteristics ($SIZE$, LIQ and CAP) other variables, such as STF, DEP and LLP may play an important role in capturing the bank lending channel (this is related to our second hypothesis).

We also consider the parent-subsidiary relationship which is of particular importance in the Baltic States. Using information from the Orbis database we identify subsidiaries as opposed to parent or stand-alone companies. We retrieve the sort code for the parent company of each financial institution: if the sort code of the ultimate owner is non-existent in the dataset, we consider the bank to be a stand-alone company; if the code matches, we identify the bank as a subsidiary. In our dataset, out of a total of 3184 data points for the Nordic and Baltic sample on gross loans, 371 are identified as belonging to subsidiaries, which account for about 20% of total lending during the period under review.

During monetary tightening, parent banks tend to provide liquidity to subsidiaries. For instance, Ehrmann and Worms (2001) show that small banks in Germany receive net inflows from parent institutions during times of an increasing policy rate. We believe such a relation may affect our results, too. In particular, it could decrease the importance of size effect on explaining lending growth given monetary shock (Ehrmann et al., 2001).

We notice that cross-border relations have been a prominent issue since the 2007-2008 crisis, after which it was noticed that parent banks tend to protect local markets, hence foreign subsidiaries face net outflows during difficult times (Ueda, 2012). Unfortunately, our dataset does not contain proper variables that would allow us to incorporate this relationship into our analysis.

5.2 Data preparation

For the description of the main variables, expected signs and reasoning behind the expectations, please see Appendix B, Table 6. We replace negative Equity values and negative Gross Loan values with missing entries. Then, to remove outliers, the conventional procedure would be to drop observations below the 1st and above the 99th percentile. We follow this procedure for $\Delta \ln(Loans)$ and LIQ (Liquid Assets over Total Assets), CAP (Total Equity over Total Assets) and DEP (Total Customer Deposits over Total Interest-bearing Liabilities) and STF (Short-Term Funding over Total Interest-bearing Liabilities). But we are aware that dropping $SIZE$ (log[Total Assets]) above the 99th percentile would exclude the main banking institutions in the Nordic region (i.e. Swedbank, Nordea, Danske bank). Therefore we drop only banks whose $SIZE$ is below the 1st percentile.

Values outside the thresholds are replaced with missing values. We follow this procedure to get rid of outliers – we are not interested in capturing the tails of the distribution, but rather in measuring the average effect of bank-specific characteristics on credit growth.

5.3 Descriptive statistics

For descriptive statistics of our dataset please see Appendix B, Table 7. This section gives us a better understanding of the key features of the banking sector in the Nordic and Baltic countries as well as in the eurozone.

5.3.1 Loan portfolio size, credit growth, interest rates and TED spread volatility

In the Nordic and Baltic States average loans stood at EUR 6 billion, which is close to the eurozone average (EUR 5.3 billion), but the divergence in the eurozone was much higher, which indicates that it may be difficult to control credit growth through a single monetary policy rate. Moreover, different currency regimes in the Nordic and Baltic States lead to variation in the monetary policy rate across countries in this region. We expect that a monetary policy stance should work more effectively for these countries as local authorities can impose ad-hoc solutions for local banks. Furthermore, we prefer annualized TED spread volatility (calculated using monthly values) over TED spread as we think that the former variable is more informative. Volatility increased in 2007 and reached its peak in 2008 for most of the countries – only Denmark and Latvia's TED spread volatility spiked in 2009. We see that these developments capture the years, when the interbank market faced the most troublesome period from 2002-2010.

5.3.1.1 Average loan portfolio and credit growth

The average loan portfolio size of banks in our sample for the Nordic and Baltic States was almost EUR 6 billion. Finland had the biggest loan portfolios (nearly EUR 14 million), followed by Denmark and Sweden (above EUR 8 billion) as well as Norway with EUR 2.7 billion. Loans in the Baltic States averaged at around EUR 1.1 billion. The eurozone loan portfolio size was EUR 5.3 billion in 2002-2010, but differences among countries were much more extreme. We think that such divergence in the eurozone as compared to the Nordic and Baltic States makes it more difficult for the ECB to control credit growth. In relation to banks' size, Germany has a very small loan portfolio size (EUR 2 billion), whereas the Netherlands' average loan portfolio was almost EUR 67 million.

For every bank in our dataset, we take year-end values of Gross Loans outstanding[18]. We select this measure over Net Loans (Gross Loans minus Impairments), because we believe this measure to be more stable and not prone to managerial manipulation of impaired loan levels. Also, interpretation would be less straightforward if a Net Loan measure was used as this variable includes changes in both Gross Loans and Impairments.

Effectively, change in Gross Loans measures change in stock of lending as opposed to the flow of lending. Previous literature[19] indicates that during periods of rising policy rates, banks tend to increase short maturity lending in exchange for cutting long maturity loans. As a result, the flow of loans remains constant, but the stock of loans decreases significantly. Hence, we are conscious that the effect of the policy rate on lending in our study may include shifts in loan maturity, which we do not account for.

Over the period of 2002-2010 the average credit growth rate in the Nordic and Baltic States was 12%. During the period under review, we see that Nordic countries experienced strong credit growth until 2007 (see Appendix A, Figure 1); then the growth slowed down, but remained positive. The pattern of credit growth in the Baltic States (Estonia, Latvia, Lithuania) is "impressive" as higher than 30% growth in 2003-2007 was followed by a sudden drop in 2008 and contraction in 2009. After the countries joined the European Monetary Union (currency boards for Estonia and Lithuania since 2004; a fixed rate with 1% band for Latvia since 2005), they started to overheat and were hit hard by 2007-2008 crisis.

Eurozone countries saw lower credit growth rates (6% on average) over the period under review as compared to the Nordic and Baltic States. Germany faced 2% average growth in credit, although all other countries experienced it above the average. The highest rates are recorded for Greece (18%) and Ireland (13%).

5.3.1.2 Interest rates

To analyse the bank lending channel in the US market, researchers have used the nominal federal funds rate (i.e. Bernanke and Blinder, 1992, Kashyap and Stein, 2000). For European banks, studies include the ECB refinancing rate as an independent variable to measure the effect of central bank policy on bank lending (Angeloni, 2003). Hence, we retrieve end-of-

[18] Our data set contains only bank-specific aggregate amount of business, mortgage and consumer loans. For an analysis of different loans, see Den Haan at al (2007).

[19] Morgan (1998) and Sofianos et al. (1990) compare spot lending to commitments, Black and Rosen (2011) investigate the stock of loans by maturity.

quarter values of repo rates for the Nordic and Baltic States and the ECB repo rate for the eurozone countries. Unfortunately, we are not able to find the overnight repo rate for the Estonian Central Bank; hence, we use the Tallinn interbank one-month middle rate.

In our model we assume that the central bank policy rate is the key tool for affecting credit growth. We believe that a change in the monetary policy rate leads to a change in credit growth within one year (Altunbas, 2002). Therefore, for the period of 2002-2010 we use end-of-quarter values to calculate yearly averages (See Appendix A, Figure 2). In regressions, we include contemporaneous and lagged changes in the yearly average. Effectively this measures the 6-month and 18-month lagged effect of a change in the policy rate on credit growth.

In terms of monetary policy rates in the Nordic and Baltic States, different currency regimes play a vital role. Sweden and Norway have floating exchange rates, which allows local central banks to set monetary policy rates ad-hoc according to problems faced by local banks. Finland adopted the euro at its inception in 1999; hence, Finnish banks adhere to the monetary policy rate set by the European Central Bank.

In 1999, Denmark fixed the Danish krona to the euro, allowing exchange rate fluctuation within a 1% band. Latvians did the same in 2005. This exposes these countries to currency risk, which increased substantially for Latvia in 2007-2008 due to the high risk of devaluation. Estonia and Lithuania introduced currency boards in 2004, which still left these countries with currency risk. In Figure 2 (Appendix A) we see that the monetary policy rate for the Baltic States was substantially higher as compared to Denmark. We think that this indicates that markets priced in much higher currency risk for the Baltic States than for Denmark.

5.3.1.3 TED spread volatility

Besides the effect of central bank policy rates on credit growth, we analyse market confidence and its impact on credit growth. Counterparty risk played a significant role during the 2007-2008 crisis and became one of the key factors in explaining credit growth under severe circumstances (Cornett et al., 2011).

TED spread is defined as the difference between LIBOR and T-bills[20]. Increasing TED spread signals lenders' belief that the risk of default on interbank loans is increasing, which captures the counterparty risk (Cornett et al., 2011). Hence, we believe that this is the best available proxy to measure credit risk in the banking sector as part of our market confidence estimation. We prefer the TED spread variable over the crisis-dummy (employed by Altunbas and Ibanez, 2011), because we want to capture the interbank market confidence

[20] Interest on T-bills is a proxy for the risk-free rate.

effect as opposed to having a dummy which may include other crisis-related effects (i.e. funding or liquidity risk).

Moreover, we believe that taking quarterly averages would neglect the variation of the TED spread within the quarters. Equally, we think that the variation in TED spread is more informative than just the quarter-end values. As for the interbank market rate we take the 3-month offered interbank rate for every country in the Nordic and Baltic sample and the euro 3-month offered interbank rate for the eurozone countries (including Finland). As a proxy for the risk-free rate, we take Overnight Indexed Swap (OIS) for the eurozone countries (including Finland). Unfortunately, such a measure is not available for other Nordic countries and the Baltic States; hence, we substitute it with a proxy for the country's risk-free rate, namely short-term T-bill rates.

As we can see from the Figure 3 (Appendix A), TED spread volatility increased in 2007. Woes in the banking sector continued in 2008, when only Sweden was able to keep TED spread volatility below 1%. Norway and euro markets reached their peak in 2008 with a volatility measure slightly above 2%. Denmark's TED spread volatility continued growing, even reaching 3% in 2009. Meanwhile, in the Baltic States Estonia was able to keep TED spread volatility at around 1%, Lithuania experienced a peak in 2009 at 4%, and Latvia "championed" the market with 9% spread volatility in 2007 and 14% in 2009.

If we had banks' deposits held at central bank (CB) in our dataset, we would also run alternative regression with this measure instead of TED spread volatility. We noticed that according to aggregate data (retrieved from central banks of Nordic countries) the banks' deposits held at the CB increased in 2007-2008, which shows that when banks were more reluctant to lend in the interbank market, they parked their liquid assets at the CB.

5.3.2 Bank-specific characteristics

In our regressions we include three traditional bank-specific characteristics, namely Size ($SIZE$), Liquidity (LIQ) and Capitalisation (CAP), as well as two factors applied by Gambacorta and Ibanez (2011) – Short-Term Funding (STF) and Deposits (DEP), and Loan-Loss Provisions (LLP) used by Altunbas et al. (2010). Over the period under review, the Nordic and Baltic States held less liquid assets, had higher capitalisation ratios, more deposits and less of short-term funding (please see Appendix B, Table 7). At first glance one might think that Nordic and Baltic banks are "more traditional" as compared to eurozone banks. But we are aware that Nordic banks are dependent on foreign operations and the Baltic State banks have experienced considerable credit growth prior to the 2007-2008 crisis. This makes it difficult to make straightforward conclusions; therefore, we expect to find more while running the regression analysis.

5.3.2.1 Size

On average, the size factor (in regressions we use the logarithm of Total Assets) is similar in all Nordic and Baltic countries (except Finland, where this factor is considerably higher). As for the eurozone, banks in Ireland show an exceptionally high value of total assets. We suspect this may be due to heavy exposure to foreign markets (Ueda, 2012).

5.3.2.2 Liquidity

As for liquidity, we take the ratio of Liquid Assets over Total Assets (LIQ). Nordic and Baltic countries held a relatively smaller amount of liquid assets (13%) as compared to eurozone banks (18%). Swedish banks held only 6% of liquid assets, whereas for the Baltic States the ratio varied from 23% in Lithuania to 32% in Estonia and Latvia. We think this may be related to the perception of risk over the period under review: due to higher lending rates in the Baltic States, banks in these countries had to keep more liquid assets on their balance sheets to cover short-term liabilities. Among the eurozone countries, Luxembourg's banks held the most liquid assets (49%), which we believe may be related to heavy exposure to cross-border operations.

5.3.2.3 Capitalisation

The Capitalisation ratio (Total Equity to Total Assets) in the Nordic and Baltic States stood above the eurozone with 11% and 8% on average. Norwegian and Danish banks were among the best-capitalised with 13% of the CAP ratio. Only Estonia exceeded this figure with 14% of the Capitalisation ratio. In the eurozone, the Capitalisation ratio of Germany, Ireland and Luxembourg's banks stood at 7% on average.

Please note that the standard capital-to-asset ratio used here might not be the best measure of the riskiness of bank portfolios, which would be captured more effectively by a measure of Tier 1 capital over capital weighted by risk (Gambacorta and Mistrulli, 2004). According to Hüfner (2010) this could help to explain the low Equity-to-Assets ratio for Germany, where spread between Equity to Assets and Equity to Risk-Weighted Assets is relatively high. Hence, low risk attached to banks' assets allows a sustainably high leverage. Other studies also employ an Expected Default Frequency (EDF) measure as a substitute for the capitalisation factor (i.e. Altunbas et al., 2010). Unfortunately, we are not able to employ any of these measures, because the former measure is reported for only a small number of banks in our dataset, and the latter is available only for listed banks. Therefore, we stick to the

Equity over Total Assets ratio (CAP), although we keep in mind that this may be an overly broad measure of the capitalisation.

Moreover, Basel III regulations are an important issue as new requirements for banks' capital has to be phased in over the years 2013-2019, which is expected to constrain banks' credit supply in combination with increased borrowing costs for corporations and households (Cosimano and Hakura, 2011). We believe this topic requires extensive analysis and is not directly related to our research question; hence, we do not elaborate on this point[21].

5.3.2.4 Deposits

As far as the deposit base is concerned, Nordic and Baltic banks had a higher ratio of DEP (Deposits over Total Interest-bearing Liabilities) (74%) compared to the eurozone countries (68%). Norwegian banks have the highest ratio (88%), which may be due to the large number of small saving banks. The country with the second largest DEP ratio in our sample is Germany (75%), which also has a large number of savings banks. Irish banks had less than half of their borrowings in deposits (38%), which explains the strong tilt towards the "originate-to-distribute" banking model (Ueda, 2012).

5.3.2.5 Short-term funding

During the period under review, Nordic and Baltic banks were less exposed to Short-Term Funding (Short-Term Funding over Total Interest-bearing Liabilities, STF) as compared to the eurozone banks with an STF ratio of 15% and 18% respectively (see Appendix A, Figure 4). Among Nordic banks, Norway had the lowest exposure to Short-Term Funding (11%), which combined with a high ratio of DEP constitutes 99% of Total Interest-bearing Liabilities. On the other hand, Finland had a rather high STF ratio of 21%, but a low level of deposits (51%), which leads to 28% of interest-bearing funding coming from bond markets. In the eurozone, Italy had a very low STF ratio (7%), which leads to heavy exposure to bond markets (34%). In contrast, Germany combines high levels of deposits (75%) with a sufficient amount of STF at 18%, which in combination covers 93% of Total Interest-bearing Liabilities.

5.3.2.6 Loan-Loss Provisions

We also include a proxy for riskiness of the bank credit portfolio following Altunbas et al. (2010). In their research, Expected Default Frequency (EDF) and Loan-Loss Provisions (LLP) show the same effect on credit growth: if perceived riskiness of the credit portfolio increases (either through EDF or LLP) banks tend to decrease credit growth. Although the final result is

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21 For a comprehensive study of Basel III's effects on credit supply and borrowing rates, please see Cosimano and Hakura (2011).

similar, the path is somewhat different. EDF is a forward-looking variable, which includes the market's perception of a bank and its capacity to issue uninsured debt (Altunbas et al., 2010); hence, higher perceived risk indicates lesser ability to absorb future losses, which affects credit growth negatively. On the other hand, higher LLP leads to lower profits and capital, which restricts banks in issuing new loans. Although this measure stems from accounting and not from the market, we select LLP over EDF as our sample comprises of many unlisted banks for which we are not able to retrieve market-related data.

As for Loan-loss Provisions (LLP), Sweden, Norway and Finland had very low Provisions (below 0.3% as a share of Gross Loans) (see Appendix A, Figure 5). The figure for Denmark was around 1%. The Baltic banking sector had the highest Loan-Loss Provisions (exceeding 1.1%) as compared to other countries in our sample. In the eurozone, only Greece stood at the same level as Latvia (1.1%); other countries' Provisions did not exceed 1% – the Netherlands and Belgium had the lowest ratio of 0.3%. Everything else held constant, we expect Loan-Loss Provisions to affect credit growth negatively, because an increase in the former reduces profits and capital, hence reducing a bank's ability to issue new loans (Altunbas et al., 2010).

Foos et al. (2010) find that excessive loan growth[22] leads to higher Loan-Loss Provisions (LLP) in 3 subsequent years due to relaxed credit standards, which in turn reduce a bank's solvency and increases its risk during a credit boom. We believe that after considerable credit growth in 2003-2007, a related increase in LLP should have been factored into our sample.

6 Econometric model

6.1 Economic Intuition and Assumptions

We analyse the determinants of credit growth to corporations and households. Our model views banks as intermediaries between borrowers (end users of lent capital) and the central bank (the sole regulator of the cost of capital). In the hypotheses, we posit that credit growth depends on three key aspects and the interplay between them: the monetary policy rate of the central bank, market confidence and bank-specific characteristics. We depict our framework in Figure 7 (Appendix D). From a traditional macroeconomic perspective, the policy rate directly determines the cost of borrowing for the lender and is viewed as a key mechanism for

[22] Defined as the difference between an individual bank's loan growth and the median loan growth of banks from the same country and year.

controlling credit growth (Bernanke and Gertler, 1995). The other two aspects, market confidence and bank-specific characteristics, could be viewed not only as determinants of the cost of funding for a bank, but also as factors which shape the magnitude of bank's reaction to a change in monetary policy rate (Disyatat, 2011). In this paper we focus on the two latter effects and build the econometric model accordingly.

As discussed earlier there is empirical evidence of the existence of the bank lending channel. Bank-specific characteristics, particularly Size, Liquidity and Capitalisation are found to be important determinants of credit growth (Matousek and Sarantis, 2009). These three main accounting-based measures broadly define business, liquidity and solvency risks respectively. To expand the traditional analysis we also aim to capture the bank-specific effects of funding and interest rate risks on credit growth. As a result, our model incorporates a ratio of Deposits to Total Interest-bearing Liabilities (DEP) and a variable measuring banks' reliance on Short-Term Funding STF (as a portion of Total Interest-bearing Liabilities). These two factors were identified as possible indicators for the banking problems during the recent financial crisis (Gambacorta and Ibanez, 2011). Certainly, different bank risks are not mutually exclusive and individual variables represent several effects at the same time. Yet extending the set of independent bank-specific variables helps us to better evaluate reasons for the credit growth.

By interacting bank-specific variables with the changes in the monetary policy rate we capture the distributional effects of monetary policy on credit growth. Our research is focused on average firm-level data and this has an important implication for the model. As we do not test the aggregate effects of monetary policy shocks on the total amount of lending in the economy, country-wide variables are not interacted with the policy rate.

With the third hypothesis (*In combination with bank-specific characteristics, TED spread volatility is a significant determinant of the bank lending channel.*) we test if the bank lending channel is also shaped by changes in interbank confidence. For consistency it is important to clearly define the concept of market confidence and its relation to lending (for graphical representation see Appendix D, Figure 8). In general, we view market confidence as investors' willingness to invest or provide capital for a risky asset. This is a supply-side-based view where we disregard the shifts in demand for capital caused by changes in confidence. Further, market confidence is divided into three levels from (1) broad market confidence to (2) interbank confidence to (3) bank-specific confidence. We assume that an increased risk at any level will result in decreased confidence and vice versa, which implies that investors are rational decision makers. We also hypothesize that changes in different levels of confidence will have varying effects on credit growth. Then, it is essential to understand that each level of confidence is interrelated. This relationship will be addressed when choosing variables and interpreting the results.

For each level of confidence we pick a separate proxy, which we believe to be the most accurate measure within that level. Changes in the broadest market confidence, for example, could be explained by the returns in the equity market. Positive past returns in the stock market lead to relatively greater supply of capital through decreased risk aversion (Bernanke and Kuttner, 2003). Also, during a market upturn, volatility declines consequently releasing risk budgets, which encourages risk-taking (Danielsson et al., 2004).

Furthermore, recent research on the financial crisis has identified TED spread as a good measure for counterparty risk in the banking sector (Cornett et al., 2011). We believe that this indicator provides insight into investors' confidence explicitly towards the financial sector. Employing a TED-spread-related variable in our model should disentangle the effects on credit growth steaming from market-wide and banking-sector confidence. The latter is the focus of our research.

The third level of market confidence is defined as bank-specific and driven by idiosyncratic risk. A common practice in academic literature and often among practitioners is to use an Expected Default Frequency (EDF) measure to evaluate the future credit risk of an individual bank. Unfortunately, our dataset includes many non-listed banks, which have no EDF estimate. Instead, we believe that the accounting-based measure of Loan Loss Provisions (LLP) controls for the effects on credit growth arising from idiosyncratic risks (Altunbas et al., 2010). By disentangling market confidence into three levels we build a model with the aim of analysing interbank confidence effects on credit growth.

Overall, the model is based on the hypotheses that monetary policy rates, interbank confidence and bank-specific characteristics determine credit growth to businesses and households. Each aspect is tested with a group of variables which are believed to be the best proxies for the underlying effects.

6.2 Main specification

Our data is characterized by a large number of banks N, and a short time series T. In addition, credit growth by definition is autoregressive over time and including lagged value of lending as an independent variable brings an endogeneity bias into the model. Furthermore, bank-specific variables could also suffer from endogeneity, because the causal relationship could work both ways. To address this problem academics have developed dynamic panel estimation models. One of the most popular techniques is the Arellano and Bond (1991) differenced Generalised Method of Moments (GMM) estimator. Later it was improved by Blundell and Bond (1998), who derived a GMM system. In academic literature this technique is often used in researching bank lending on datasets consisting of yearly firm-level observations.

However, this estimator is criticised for the complex process employed as a consequence of "overidentification" of instrumented variables (see the discussion in Section 6.4). Therefore, despite the popularity of the GMM estimator in the bank lending channel literature, we also perform corresponding OLS regressions to compare the results with those from the GMM model.

The initial specification is based on the traditional research focusing on the frictions in the bank lending channel. We test the monetary policy effect on credit growth with respect to Size, Liquidity and Capitalisation of an individual bank. At this point we test our H1 (*Traditional bank-specific characteristics (size, liquidity and capitalisation) are significant determinants of the bank lending channel*).

$$\Delta \ln(Loans)_{i,t} = o_i + \Delta \ln(Loans)_{i,t-1} + \sum_{j=0}^{1} \beta_i \Delta i_{PR,k,t-j} + \rho \mathrm{H}_{i,t-1} + \eta \Delta i_{PR,k,t} * \mathrm{H}_{i,t-1} + TD_t + CD_k + \varepsilon_{i,t} \quad (1)$$

Here $i = 1, \ldots, N$ and N is number of banks; $k = 1, \ldots, 7$ and k is country; $t = 1, \ldots, T$ and T is the final year. The dependent variable $\Delta \ln(Loans)$ measures the change in credit supply. It is first differenced to obtain a stationary data series for individual banks. Δi_{PR} is the change in the policy rate, which varies across countries. Studies note that monetary policy shock translates into credit growth within one year (Altunbas et al., 2010). Since effective change in the monetary policy rate (Δi_{PR}) in our study is lagged 6 months, we also add one lag, which effectively captures interest rate changes one and a half year ago. In addition, we assume that policy rate is effectively set through exogenous variation via open market operations[23].

Vector H initially includes the three main bank-specific characteristics at $t-1$: $SIZE$ (log of Total Assets); LIQ is the bank's liquidity position (Liquid Assets over Total Assets); CAP is capitalisation (Total Equity to Total Assets). Measures of the amount of Short-Term Funding and Deposits are not included in the vector for regression (1). $\Delta i_{PR} * \mathrm{H}$ represents interaction terms between the change in policy rate at t and all the bank-specific variables in

[23] For a discussion of practical concerns regarding implementations of the policy rate, please see Disyatat (2008).

vector H at $t-1$. All the bank-specific variables and interaction terms are demeaned respective to the relevant type. This procedure enables us to have regression coefficients, which demonstrate the average effect of the related bank characteristic on credit growth.

TD_t and CD_k are time and country dummies respectively. TD_t addresses macroeconomic shocks that have a common effect on all individual banks, whereas CD_k eliminates institutional and cultural differences between the banking systems in the sample countries. Moreover, we use time-fixed effects to control for the country-specific loan demand shifts over time. In good years, when the economy is booming, the demand for credit will rise together with the shifts in other factors. Alternatively, it is possible to use nominal GDP growth to control for the same effects, as shown by Bernanke and Gertler (1989). Time and country dummies are applied in all regressions for the Nordic countries, but time-fixed effects are excluded for the eurozone sample as monetary policy is invariant across the eurozone countries. To control for the business cycle instead we include a lagged value of nominal GDP growth in each country. Furthermore, for the GMM estimation it is recommended that one includes time dummies to reduce correlation across individual banks.

Three additional bank-specific ratios measuring the amount of Short-Term Funding (STF), Deposits (DEP) and Loan-Loss Provisions (LLP) as well as respective interaction terms are added into regression (1) to test our second hypothesis (*H2: In combination with traditional characteristics (size, liquidity and capitalisation), other bank-specific factors (short-term funding, deposits, and loan-loss provisions) are significant determinants of the bank lending channel.*).

$$\Delta \ln(Loans)_{i,t} = o_i + \Delta \ln(Loans)_{i,t-1} + \sum_{j=0}^{1} \beta_i \Delta i_{PR,k,t-j} + \psi LLP_{i,t-1} + \phi \Delta i_{PR,k,t} * LLP_{i,t-1} + \rho \mathrm{H}_{i,t-1} + \eta \Delta i_{PR,k,t} * \mathrm{H}_{i,t-1} + TD_t + CD_k + \varepsilon_{i,t} \quad (2)$$

Here $i = 1, \dots, N$ and N is number of banks; $k = 1, \dots, 7$ and k is country; $t = 1, \dots, T$ and T is the final year. Vector H now also includes the Short-Term Funding ratio STF (Short-term Funding over Total Interest-bearing Liabilities) and the Deposits ratio DEP (Total Customers' Deposits over Total Interest-bearing Liabilities).

LLP is the ratio of Loan-Loss Provisions over Gross Loans. It is a bank-specific variable which approximates the riskiness of the credit portfolio of each institution. $\Delta i_{PR} * LLP$ is the interaction term between the change in the monetary policy rate in period t and LLP at $t-1$. Both the stand-alone LLP variable and the interaction term are distinguished from other bank-specific characteristics as those that ex post inform the market about the credit riskiness of the bank.

We proceed to build the baseline model to test the third hypothesis (*H3: In combination with bank-specific characteristics, TED spread volatility is a significant determinant of the bank lending channel.*) and include the measures of changes in broad market confidence (equity index returns) and interbank confidence (TED spread volatility).

$$\Delta \ln(Loans)_{i,t} = o_i + \Delta \ln(Loans)_{i,t-1} + \sum_{j=0}^{1} \beta_i \Delta i_{PR,k,t-j} + \pi_i \Delta EQT_{k,t-1} + \omega_i TED_{k,t-1} + \psi LLP_{i,t-1} + \phi \Delta i_{PR,k,t} * LLP_{i,t-1} + \rho \mathrm{H}_{i,t-1} + \eta \Delta i_{PR,k,t} * \mathrm{H}_{i,t-1} + TD_t + CD_k + \varepsilon_{i,t} \quad (3)$$

Here $i = 1, \dots, N$ and N is number of banks; $k = 1, \dots, 7$ and k is country; $t = 1, \dots, T$ and T is the final year. ΔEQT is the change in annualized stock market index return in each country. TED is the volatility of the spread between the 3-months interbank rate and the 3-month T-bill rate. Both variables are country specific and lagged by one period. TED is the variable of the most interest to us as it determines change in the stress level in the banking system.

We use a two-step GMM procedure to get efficient estimates. Standard errors are adjusted for heteroskedasticity. For the sample of eurozone banks, in baseline regressions (1), (2) and (3) we substitute time-fixed effects with the nominal GDP growth in every country to avoid multicollinearity.

6.3 Testing hypotheses

In order to test our first two hypotheses regarding the existence of the bank lending channel, step-by-step we analyse coefficients at interaction terms in vector η and coefficient ϕ at LLP. The key focus here is the effectiveness of monetary policy rate changes on shifts in credit growth. For the third hypothesis we look at coefficients π and ω. Furthermore, estimates at bank-specific variables are considered to provide additional information for the discussion.

Regression (1) covers variables representing Size ($SIZE$), Liquidity (LIQ) and Capitalisation (CAP). Based on previous empirical evidence we expect to find that on average larger, more liquid and better capitalized banks will be able to better withstand a shock in the monetary policy rate. The effects stemming from the Size and Capitalisation of the bank are considered as a friction in the bank lending channel, because everything else held equal, the Size and Capitalisation should not matter for the transmission of monetary policy. Alternatively, bigger banks should be able to substitute to other sources of financing without significant costs and more liquid banks could draw on their liquidity resources to extend lending in times of monetary tightening.

More formally H1 (*Traditional bank-specific characteristics (size, liquidity and capitalisation) are significant determinants of the bank lending channel.*) is tested using a joint test. We build an equation which tests if all interaction terms are simultaneously equal to 0:

$$H_0: \eta_{SIZE} = \eta_{LIQ} = \eta_{CAP} = 0 \tag{4}$$

$$F = (R\hat{\beta})'\left(R\Sigma_{\hat{\beta}}R'\right)^{-1}(R\hat{\beta}) \sim \mathrm{X}^2(k) \tag{5}$$

Where $R\hat{\beta}$ is a matrix, effectively defining the null hypothesis, R is the adjusted identity matrix used to calculate variance, $\Sigma_{\hat{\beta}}$ is the inverse variance-covariance matrix of the estimators. F test statistics follow Chi-squared distribution with k degrees of freedom equal to the number of restrictions being tested – in this case three. We expect to reject this null and observe significance in individual coefficients at $SIZE$, LIQ and CAP. Rejecting the null hypothesis would support our first hypothesis and confirm that Size, Liquidity and Capitalisation are determinants of the bank lending channel.

Regression (2) includes all bank-specific variables of interest. We follow the same procedure to evaluate if banks' amount of Short-Term Funding, Deposits and Loan-Loss Provisions are shaping the distribution of credit following the changes in monetary policy.

Interaction term ϕ between LLP and change in monetary policy rate is expected to be negative ($\phi < 0$). Banks that increase Loan-Loss Provisions inform the market about the deteriorating quality of the underlying loan portfolio. Larger losses should lead to the worsening financial health of an institution. In turn this would increase the cost of capital and negatively affect a bank's ability to resist the adverse changes in the monetary policy rate.

Banks with more deposit financing are assumed to have better access to funding and should be less vulnerable to changes in the monetary policy rate. Alternatively, it is not exactly clear what effect on credit distribution monetary policy shocks would have for the banks that have more Short-Term Funding. From one perspective, heavier reliance on Short-Term Funding could pose refinancing risks if the liquidity in the external market dries up (Gambacorta and Ibanez, 2011). This eventually could lead to banks' stronger reaction to a shock in the monetary policy rate. On the other hand, we think that the banks which have liabilities of shorter maturity could benefit more quickly from decreasing interest rates and expand their lending.

The second hypothesis (*H2: In combination with traditional characteristics (size, liquidity and capitalisation), other bank-specific factors (short-term funding, deposits, and loan-loss provisions) are significant* *determinants of the bank lending channel.*) is more formally tested by forming an alternative null which states that all six interaction terms are simultaneously equal to 0:

$$H_0: \eta_{SIZE} = \eta_{LIQ} = \eta_{CAP} = \eta_{STF} = \eta_{DEP} = \phi = 0 \quad (6)$$

The test statistics are calculated using the Wald procedure and $p - value$ is found based on a Chi-squared distribution with 6 degrees of freedom. To check the second hypothesis we expect to reject this null and observe significance in individual coefficients at LLP, STF and DEP. Moreover, rejection of the first hypothesis would provide stronger support for the second hypothesis, if tests for the latter are significant.

The third hypothesis (*H3: In combination with bank-specific characteristics, TED spread volatility is a significant determinant of the bank lending channel.*) is evaluated by looking at coefficients π and ω in regression (3). We expect that lagged value of country-wide stock index EQT will have a positive effect on credit growth $(\pi > 0)$ as positive market returns should reduce risk aversion and release risk budgets, consequently increasing credit growth (Bernanke and Kuttner, 2003; Danielsson et al, 2004).

Moreover, we expect the lagged value of TED spread volatility to have a negative relation with credit growth ($\omega < 0$). Increasing volatility in the TED is related to decreasing interbank confidence. Consequently, in such an environment banks should face higher funding costs, which may lead to slower future growth of credit for corporations and households.

A more formal test for $H3$ includes market-wide variables:

$$H_0: \pi = \omega = 0 \quad (7)$$

Here, test statistics from the Wald procedure follow Chi-squared distribution with two degrees of freedom. Failure to reject H_0 would mean that the tested independent variables simultaneously do not have any impact on credit growth. If this was the case, we would fail to find support for our first hypothesis. This would indicate that EQT and TED measures, which all proxy for market-wide confidence, would not explain changes in credit growth.

6.4 The Arellano and Bond GMM estimator

A GMM estimator relaxes the requirement for the independent variables to be strictly exogenous and allows endogeneity in the model. This is relevant in our case as there are three main issues. First, a dependent variable (credit growth) is characterized by autoregressive features. Second, lending activity and the state of the banking sector may affect monetary policy decisions (Gambacorta and Ibanez, 2011). Third, unobserved bank-specific effects could be present in the model. Arellano and Bond (1991) (AB) and Blundell and Bond (1998) (BB) developed a special type of GMM estimator to address these econometric problems. It ensures efficiency and consistency given that the model is not subject to serial correlation of residuals in the order of two and that instruments are valid. The latter condition is tested with the Sargan test (Sargan, 1958).

The intuition behind the AB estimator is best explained as a special type of linear 2-Step Least Squares (2SLS) estimator. 2SLS is designed to deal with endogeneity problems in the underlying OLS regression by instrumenting the key independent variables. Furthermore, 2SLS can be implemented through two distinct OLS regressions. Nevertheless, in 2SLS one needs to pick instrument variables such that they would not be correlated with the errors (satisfy the exclusion restriction) and be significant instruments. Trying to satisfy these conditions may lead to having more instrument variables than explanatory variables. Then the system of equations will have no solution as there are more equations than the unknowns.

The GMM estimator overcomes this problem of overidentification by trying to individually satisfy moment conditions, instead of solving the equations all at once. Furthermore, the AB estimator controls for correlations and variations in instruments and weights them according to the level of additional information they bring.

GMM procedure uses lagged values of variables as instruments. However, there are some differences in how AB and BB estimators pick instrument variables. The initial AB procedure uses lagged first differences of the regressors as instruments. Later, BB made an observation that first differences of instrument variables are uncorrelated with the fixed effects. This helped to expand the AB procedure by incorporating additional instruments, namely lagged levels of endogenous regressors. The result was a system GMM estimator which simultaneously solves two systems of equations. Instrumenting variables with lagged levels offers the most benefits in the datasets with a short time period, because of additional observations. Accordingly, we decided to use the updated AB estimator in our analysis.

Despite the fact that the GMM estimator accounts for possible endogeneity, it is vital to specify independent variables according to their relation with the error term. This requires distinguishing between exogenous, predetermined or endogenous variables. In a more formal way, regressors are strictly exogenous if there is no correlation between any idiosyncratic shock $\varepsilon_{i,s}$ (where $s = 1, \ldots, T$) and independent variable $x_{i,t}$ (where $t = 1, \ldots, T$), hence:

$$E(x_{i,t}\varepsilon_{i,s}) = 0 \; \forall \; s, t \tag{8}$$

Contrarily, predetermined regressors are correlated with past shocks:

$$E(x_{i,t}\varepsilon_{i,t+j}) = 0, j \geq 0 \tag{9}$$

$$E(x_{i,t}\varepsilon_{i,t-s}) \neq 0, s \geq 1 \tag{10}$$

Finally, if the regressor is thought to be correlated with past and present error term $\varepsilon_{i,s}$, it is defined as an endogenous variable.

$SIZE$, LIQ, CAP and other bank-specific variables are considered endogenous in nature. For example, bank Size depends on past and future credit growth. However, one-period-lagged values of the same variables are by construction predetermined. Therefore, following our model, for GMM we define the bank-specific characteristics as predetermined variables. All the predetermined variables are instrumented by the respective lags from $T-1$ to $T-3$.

We choose to add only one lag of the dependent variable in our model, since we believe it is enough to control for the autoregressive features of credit growth. The lag of the dependent variable is automatically defined as an endogenous regressor. Variables measuring policy rate, market-wide confidence and interaction terms are also considered to be endogenous. Credit growth at banks is expected to have a straightforward impact on monetary policy. Further, for the eurozone sample we replace time-fixed effects with the measure of lagged nominal GDP growth which is also considered to be endogenous. Credit growth depends on changes in GDP and vice versa. All endogenous variables are instrumented by the respective lags from $T-2$ to $T-3$.

Systemic risk factors (a change in TED spread volatility and past equity index returns) are determined to be exogenous. It is highly unlikely that credit growth at individual banks could have an impact on the market-wide factors. Interaction terms at the bank-specific variables are considered to be exogenous as well. By construction, credit growth is not expected to affect the mechanism of how different banks react to monetary policy shocks.

A rule of thumb for the BB procedure is that the number of instruments should be less than the variable groups in the sample. Otherwise, the estimator could overfit the instrumented variables and fail to remove endogeneity from the regression. We limit the use of lags as instruments to two per variable, because we believe there is less economic sense in having further lags as instruments. Moreover, due to the relatively small sample size in the Nordic and Baltic countries we need to keep track of the total number of instruments. We run test regressions where we do not limit the number of instruments to check for possible misspecifications and find no significant differences. Furthermore, we build a simple 2SLS model where we use lagged variables as instruments and compare the results with the GMM model for consistency. Again, the results are similar to those from the GMM model. Finally, even though our baseline models are run with a GMM estimator, it is a good exercise to compare the results with OLS regressions. There is a trade-off between the biasedness of the OLS coefficients and the wrong rejection of a hypothesis, because of the higher standard deviation of GMM estimates. OLS is a random estimator which can provide biased coefficients, because of endogeneity, but should have better statistical power. Oppositely, estimates from the GMM procedure are expected to be closer to the true population value, but have higher dispersion. As argued by Roodman (2009), AB and BB estimates are superior to OLS in dynamic panel datasets.

6.5 Robustness tests of the model

We perform two types of robustness checks. First, we look at various additional variables and relationships that could affect our baseline regressions. Then, we substitute the local monetary policy rate with the ECB rate for countries with fixed currency regimes among the Nordic and Baltic countries. As a next exercise we substitute the monetary policy rate with the interbank market rate. Finally, we exchange TED spread volatility with the change in TED spread level.

6.5.1 Additional variables

6.5.1.1 Business type

Financial institutions are different in terms of business model, capital structure and means of value-added which allows the clustering of MFIs into commercial banks, savings banks, mortgage banks, investment banks etc. In our sample we focus on three key types of banks that are the most common in the Nordic countries: commercial banks, savings banks and mortgage institutions.

In Table 8 (Appendix B), one can see that descriptive statistics of different types of banks are not homogenous within and across regions: (1) the average loan of the Banks and Mortgage Institutions in the Nordic and Baltic sample is almost twice as large as in the eurozone; (2) Savings Banks provide relatively small loans and for the Nordics and Baltics this figure is half as large as for the eurozone countries; (3) Banks have the highest liquidity ratios (19%), but the divergence from other groups is stronger for the Nordic and Baltic States (about 11 basis points lower than for Banks) as compared to the eurozone (5 bps less than for Banks); (4) the deposit base is highest for Saving Banks – 81% in the Nordic and Baltic States and 70% in the eurozone.

Hence, to support the tests of the main hypotheses we believe it is important to check whether there are specific trends in credit growth within each business category. We test this by introducing two dummy variables (with respect to Saving Banks and Mortgage Institutions) into the baseline model. It is expected that credit growth will be higher for mortgage institutions and commercial banks when compared to saving banks, which have a more conservative business model as observed from the summary statistics.

6.5.1.2 Parent-subsidiary relationship

In case of substantial equity cross-holdings, the lending decision and ability at subsidiary banks are expected to be influenced by their parent companies (Houston et al., 1997). The holding bank could exert power pursuing specific goals or the effects on lending could arise from outside factors that are related to the state of the parent. For example, a subsidiary of a larger bank would find it harder to get financing if the holding company experienced financial distress (Houston et al., 1997). The effect could also go the other way round. Furthermore, Ashcraft (2003) finds that if the market is dominated by stand-alone banks, the response of lending to a monetary policy shock is more severe. Subsidiaries can more easily get financing from their parent companies in times of monetary tightening and continue lending.

In our model we try to account for the parent-subsidiary relationship by inserting a dummy variable for the banks that are not stand-alone companies. We only consider effective links between the banking institutions and do not account for the situations where the banking institution is owned, say, by an industrial company.

We also aim to analyse the impacts of changes in monetary policy and market sentiment towards credit growth at subsidiary banks. Therefore, we introduce interaction terms between the subsidiary dummy Sub and changes in policy rate and TED. We expect to see a positive coefficient at this interaction term, because subsidiary banks should be able to draw on their parent companies to support lending during times of monetary tightening.

A broader perspective on parent-subsidiary relationship could be explained by cross-border business ties (Ueda, 2012). Change in the amount of credit at foreign subsidiaries is particularly important during stressful periods in capital markets. Unfortunately, we do not have enough data to fully test such effects. However, our sample of Nordic and Baltic banks provides some idea of cross-country lending behaviour, because most of the banks in the Baltic States are owned by Scandinavian financial institutions. By testing the parent-subsidiary relationship in the Nordic sample we also partially check how policy rate changes and the market situation affect credit growth at foreign subsidiaries.

6.5.1.3 Non-standard monetary policy measures

Monetary policy is defined by a change in the overnight repo rate Δi_{PR}, as we believe this is the main tool that a central bank has to implement its monetary policy. Yet other specific measures were also taken by the central banks to encourage lending during the 2007-2008 crisis. We address this issue by adding a control variable for a Non-standard monetary policy measures NSM which measures the change in size of the central bank's balance sheet normalized by GDP (following the methodology of Curdia and Woodford, 2010) (see Appendix A, Figure 6). We believe that more aggressive monetary easing policies resulted in more active asset purchases and thus, expansion of the central bank's balance sheet.

We expect to find a positive relation between change in *NSM* and credit growth. For instance, Gertler and Karadi (2011) conclude that expansion of Federal Reserve credit intermediation reduced the effect of the balance sheet constraints of financial intermediaries during the 2007-2008 crisis. Also, the size of central banks' balance sheets grew extensively during the crisis; therefore, this measure in our regressions embraces only the crisis period. On the other hand, Curdia and Woodford (2010) argue that expansion of the balance sheets of central banks is effective only during a crisis and works as an additional tool for policy rates.

From a traditional macroeconomic perspective, one might think that bank reserve requirements should also alter bank lending and have to be included in our model. On the other hand, bank reserves tend to be inelastic to policy rate changes as banks hold reserves to meet regulatory requirements as well as to have a buffer against uncertainty in cash flows (Borio and Disyatat, 2009; Disyatat, 2008). On the other hand, higher reserve requirements lead to higher "economic tax" on banks, which is passed on to customers (Disyatat, 2008). This may lead to a decrease in credit growth due to demand-side effects; yet Disyatat (2008) argues that the same effect could be reached through a higher monetary policy rate. Moreover, Sweden, Norway and Denmark do not apply any reserve requirements (Gray, 2011). Hence, we do not include reserve requirements or reserves held by banks in our regressions.

6.5.2 Other proxies

6.5.2.1 The ECB rate for countries with fixed exchange-rate

Another test we perform is to replace the domestic policy rate with the one imposed by the ECB for the countries that have fixed exchange-rate mechanisms (Denmark, Estonia, Latvia, Lithuania). As noted by Köhler el al. (2006), credit growth in the Baltic States is better explained by the euro market rate, because there are many outstanding loans in EUR with floating interest rates. Therefore, we expect our robustness check will allow us to better understand the monetary policy transmission mechanism in the Nordic and Baltic sample.

6.5.2.2 The interbank market rate

The goal of the policy rate in our model is to correctly represent the basic mechanism of shifts in the financing costs for the banks. Therefore, in the baseline regressions we employ the central bank's repo rate. However, in some academic literature on bank lending short-term interbank interest rates are used as a proxy for monetary policy (Altunbas, 2010; Gambacorta and Ibanez, 2011). Therefore, as a robustness check we include interbank rates instead of the central bank's repo rate. The main idea is to understand if TED remains a significant determinant of credit growth, since by definition TED spread volatility moves in line with the interbank interest rate.

6.5.2.3 TED measure

In the main specification of the model we use TED spread volatility as a determinant for interbank confidence. We choose TED spread volatility over level, because we believe the former is a more pronounced reflection of the changes in the conditions in the banking sector. Being able to capture the magnitude and persistence of the moves in confidence is very important, since we work with yearly data. Nonetheless, we perform a robustness check by plugging in the difference of the TED spread into the model for consistency reasons.

7 Results

The presentation of results first focuses on the sample of the Nordic and Baltic countries and the baseline regressions. We structure the analysis around the main hypotheses, initially looking at monetary policy shocks and bank-specific characteristics and then checking the impacts of the changes in interbank confidence on credit growth. Later we cover the eurozone banks and compare the findings. Finally, we perform additional tests to evaluate the robustness of the key results.

7.1 The Nordic and Baltic States

7.1.1 Monetary policy shocks and credit growth

The results for the sample of Nordic and Baltic banks are reported in Appendix B, Table 9. Here we discuss regressions (NOR1) and (NOR2) which are estimated using the BB GMM procedure. Coefficients at the interaction terms are of key interest, because they show whether bank-specific characteristics matter in policy transmission to credit growth.

As expected we observe a negative and strongly significant relationship between the change in the central bank's policy rate ($\Delta i_{PR,k,t}$) and credit growth in both regressions. This demonstrates that the basic mechanism of monetary policy holds in the economy. The lagged change in policy rate ($\Delta i_{PR,k,t-1}$) has a positive though insignificant coefficient at a 5% confidence level. The surprising positive relationship could reflect the lending boom in 2003-2007 despite tightening of monetary policy in the sample countries and decreasing supply of loans during 2007-2008, when central banks flooded banks with liquidity (see Appendix A, Figure 6). As the effective lag of the policy rate measure is one and a half years, it is no surprise that this variable captures some of these trends.

In regression (NOR1) the coefficient at interaction term with Size ($\Delta i_{PR} * SIZE$) is positive and significant at a 5% level. This indicates that credit growth at larger banks is less reactive to monetary policy shocks. Further, coefficients at Liquidity ($\Delta i_{PR} * LIQ$) and Capitalisation ($\Delta i_{PR} * CAP$) are not statistically different from zero. We fail to reject the joint null that estimates at all three interaction terms are equal to zero (see Table 1 below).

Therefore, the three traditional bank-specific measures are not enough to explain the bank lending channel in the Nordic and Baltic countries. We reject our first hypothesis and continue analysis of the regression (NOR2).

Table 1. Decision rules (the Nordic and Baltic States)

Table No.	H_0 test	Description	χ^2	Df	P-value	Decision
(NOR1), Table 9, Appendix B.	$H_0: \eta_{SIZE} = \eta_{LIQ} = \eta_{CAP} = 0$	$\Delta i_{PR,k,t}$ interacted with $SIZE$, LIQ and CAP are jointly statistically equal to zero	5.87	3	0.12	Fail to reject
(NOR2), Table 9, Appendix B.	$H_0: \eta_{SIZE} = \eta_{LIQ} = \eta_{CAP} = \eta_{STF} = \eta_{DEP} = \phi = 0$	$\Delta i_{PR,k,t}$ interacted with $SIZE$, LIQ, CAP, STF, DEP and LLP are jointly statistically equal to zero	14.77	6	0.02	Reject
(NOR3), Table 9, Appendix B.	$H_0: \pi = \omega = 0$	EQT and TED are jointly statistically equal to zero	32.38	2	0.00	Reject

Here we present statistical tests for the three null hypotheses that coefficients are jointly equal to zero. Table No. refers to the relevant regression for the test. H_0 test specifies the exact equation of the null. We also report Chi-squared (χ^2) statistics, degrees of freedom (Df), P-values and our decision regarding null hypotheses.

We find coefficients at interaction variables of the Deposit ratio ($\Delta i_{PR} * DEP$) and the Short-Term Funding ratio ($\Delta i_{PR} * STF$) to be positive though insignificant. This means that the banks which respectively rely more heavily on market funding or short-term funding do not react differently to the monetary policy shocks than those that are less market dependent. This does not support our second hypothesis, because we would expect to have a significant relationship here. Furthermore, it is surprising to see that the coefficient at $\Delta i_{PR} * LLP$ interaction term is positive, even if insignificant. We posited that banks which had more Loan-

Loss Provisions should be more severely affected by positive monetary policy shocks and consequently reduce lending growth.

Interaction estimates at Liquidity ($\Delta i_{PR} * LIQ$) and Capitalisation ($\Delta i_{PR} * CAP$) ratios are both positive in regression (NOR2). The liquidity coefficient is significant at a 5% level. This provides evidence that on average more liquid banks are better positioned to withstand monetary policy shocks and in case of an interest rate increase will reduce their lending less than the less liquid banks. Positive coefficients for the bank-specific interaction variables are in line with the findings of Altunbas et al. (2010) on eurozone banks. We are also encouraged by the fact that the Sargan and Arrelano-Bond tests show that the model is well specified and does not suffer from autocorrelation problems.

It is also interesting to look at the bank-specific control variables, which add some further insight regarding our second hypothesis. In Nordic and Baltic countries, banks with more Deposits relative to Total Assets (DEP) on average have increased their loans more quickly than banks with fewer deposits. A lower ratio of Deposits to Total Assets demonstrates that the bank uses more wholesale funding to supply loans. In difficult times, when it is harder to get market funding, such institutions will have to cut lending more than those with more Deposits. Looking at the effects of Loan-Loss Provisions (LLP), we can state that the quality of previously issued loans is a significant determinant of future credit growth. The regression results show that a one percentage point increase in provisions for credit losses on average decreases credit growth by 3.2%. Aside from DEP and LLP, coefficients at other bank-specific variables are insignificant.

The coefficient at the lag of the dependent variable $\Delta \ln(Loans)_{t-1}$ is positive and significant as expected and demonstrates the autoregressive features of the credit growth measure. This is one of the reasons why it is necessary to account for endogeneity in our model. In addition we observe few switches in coefficient signs between the OLS regressions and GMM. We believe such changes could be caused by the endogeneity bias which is corrected by the BB procedure. Yet for validity reasons, we are pleased to see little variation in the signs of coefficients between the two estimators.

The second hypothesis (*H2: In combination with traditional characteristics (size, liquidity and capitalisation), other bank-specific factors (short-term funding, deposits, and loan-loss provisions) are significant determinants of the bank lending channel.*) is formally tested by formulating the joint null that all coefficients at the interaction terms are simultaneously equal to 0. We reject this null at a 5% level (p-value = 0.02). Thus, the baseline model (NOR2) provides weak evidence of the existence of distributional effects in the bank lending channel in the Nordic and Baltic countries. From one perspective, liquidity appears to be a significant determinant of how the effects of monetary policy will impact credit distribution and the signs of other interaction terms are economically reasonable. On the other hand, statistical tests are on the margin of the support of our second hypothesis.

7.1.2 Market confidence and credit growth

We look at regression (NOR3) (Appendix B, Table 9) for the analysis of market confidence's impact on credit growth. Both variables of interest which measure systematic risk in the banking sector (TED) and the economy (EQT) are significant at a 5% level. The coefficient at the lag of TED spread volatility (TED) is significant and negative. This means that a rise in the volatility of the spread between interbank interest rates and the risk-free rate does negatively affect credit growth to corporations and households in the Nordic and Baltic countries. In other words, increased stress in the banking sector would eventually lead to credit growth. Although the exact mechanism is not clear, we think higher TED spread volatility demonstrates an increase in the systematic risk and raises the cost of funding for individual banks. As a result, banks will tend to cut credit to corporations and households.

More support for the third hypothesis comes from the coefficient at the control variable EQT. It shows that good past performance of the equity market has a positive correlation with changes in lending. However, we cannot say if this variable is deterministic, because equity market returns could measure many different effects. To illustrate, share prices depend on the expected amount of future cash flows, which could change for many different reasons. Moreover, equity returns are often positively correlated with future GDP growth, which increases demand for loans. As a result, a causal link is not exactly clear. On the other hand, moves in financial markets are found to be correlated with the level of risk aversion among investors (Bernanke and Kuttner, 2003). Hence, higher past equity returns could increase investors' confidence in capital markets and lower funding costs for the banks. In turn, access to cheaper market financing has been shown to promote lending (Cirrarelli et al., 2010).

To statistically summarize the third hypothesis (*H3: In combination with bank-specific characteristics, TED spread volatility is a significant determinant of the bank lending channel.*) we perform a formal joint test of coefficients at TED and EQT. We strongly reject a null hypothesis that both coefficients are simultaneously equal to 0 (p-value = 0.000). Based on this exercise we state that we fail to reject our third hypothesis. Market confidence, measured by TED spread volatility (TED) and equity index (EQT) performance, is an important determinant of equilibrium credit growth in the Nordic and Baltic countries. Moreover, we are more motivated by this conclusion as the key confidence variables remain significant and do not change signs throughout OLS and BB GMM estimation.

Table 2. Economic magnitude (the Nordic and Baltic States)

Variable	Exp. sign	Coef.	Sign. Level	p25	p75	Diff	+1 p.p. effect on $\Delta ln(Loans)$
$\Delta i_{PR,k,t}$	-	-9.569	1%	n/a	n/a	n/a	-9.57
$\Delta i_{PR,k,t-1}$	-	1.366	Not Sign.	n/a	n/a	n/a	1.37
$TED_{k,t-1}$	-	-2.222	1%	n/a	n/a	n/a	-2.22
$EQT_{k,t-1}$	+	0.175	5%	n/a	n/a	n/a	0.18
$\Delta i_{PR,k,t} * SIZE_{i,t-1}$	+	0.292	5%	-0.011	0.019	0.030	0.88
$\Delta i_{PR,k,t} * LIQ_{i,t-1}$	+	8.272	1%	0.000	0.001	0.001	0.78
$\Delta i_{PR,k,t} * CAP_{i,t-1}$	+	9.461	Not Sign.	0.000	0.000	0.001	0.58
$\Delta i_{PR,k,t} * STF_{i,t-1}$	+/-	2.453	Not Sign.	0.000	0.001	0.001	0.31
$\Delta i_{PR,k,t} * DEP_{i,t-1}$	+	2.171	Not Sign.	-0.001	0.002	0.003	0.75
$\Delta i_{PR,k,t} * LLP_{i,t-1}$	-	99.080	10%	0.000	0.000	0.000	0.44

The economic magnitude of key variables with respect to $\Delta \ln(Loans)_{i,t}$ is presented. Expected signs (Exp. sign) indicate our prior expectations on directional effects of the variable. Coefficients (Coef.) and significance levels (Sign. level) as reported in the regression (NOR3). The 25th percentile (p25) and 75th percentile (p75) are reported. We calculate the difference between these cut-off points (Diff) to evaluate the difference in credit growth between the banks in the top and bottom points. The last column shows an estimated magnitude of the economic effect in percentage points (p. p.), given a 1 percentage point (p. p.) rise in the respective variable. For the coefficients at contemporaneous and lagged monetary policy rate ($\Delta i_{PR,k,t}$, $\Delta i_{PR,k,t-1}$), TED spread volatility ($TED_{k,t-1}$) and country-specific stock market returns ($EQT_{k,t-1}$) the interpretation of the effect is straightforward. For the coefficients at the interaction term of monetary policy shock ($\Delta i_{PR,k,t}$) and bank-specific characteristics ($SIZE$, LIQ, CAP, STF, DEP, LLP), the last column shows the difference of credit growth (in p. p.) between the 25th percentile and 75th percentile of respective variable, given a 1 p. p. increase in the monetary policy rate.

Table 2 above provides a brief summary of the coefficients of main interest in regression (NOR3), which is reported in Appendix B, Table 9. Here we also evaluate whether frictions in the bank lending channel are of economic significance. For that reason we calculate the difference in average credit growth between the top 25% and the bottom 25% of banks, caused by a 1 p. p. increase in the policy rate. The ranking is done for each variable depending on the coefficient being evaluated. We find that banks in the top 25th percentile, based on Size and Liquidity, on average will have 0.9 p. p. and 0.8 p. p. greater credit growth respectively than the banks in the bottom 25th percentile, after a 1 p. p. increase in the policy rate. The average credit growth in the Nordic and Baltic countries in the sample period was 12%; therefore, Size and Liquidity of an individual bank are factors of economic significance for the monetary policy setters. Nevertheless, a 1 p. p. change in monetary policy rate ($\Delta i_{PR,t}$) and TED spread volatility (TED) on average has a more pronounced effect on credit growth than the bank-specific variables.

Overall, the findings from the baseline models indicate a weak link between the bank-specific characteristics and how monetary policy affects the distribution of credit in the Nordic and Baltic States. We demonstrate further that greater stress in the banking sector, measured by TED spread volatility (TED), on average will have a negative effect on credit growth. In contrast to existing empirical evidence on the eurozone (Altunbas et al., 2010), we find that the bank lending channel in the Nordic and Baltic countries is driven by interbank confidence.

We are aware that the Nordic and Baltic market is rather concentrated; therefore, the reaction of the biggest lenders to a monetary policy stance adds up to a significant aggregate credit growth effect. Hence, we run the same regressions for banks with loans at the 50th percentile and above. We do not find any substantial differences[24] and only a couple of points are worth noting. A 1 p. p. change in the monetary policy rate leads to a 5.3 p. p. decrease in credit growth, which is of a smaller magnitude as compared to the whole sample. Also, the magnitude of the coefficient at TED spread volatility (TED) stays the same for the sample of the main loan providers. Therefore, we see that monetary policy rate change has less of an impact for the banks with the biggest loan portfolios, but the counter-party risk proxy is still of the same importance.

7.2 The eurozone

Most of the empirical evidence on the bank lending channel in Europe comes from the eurozone countries and does not cover the period of the 2007-2008 financial crisis. Therefore, we extend our analysis to eurozone banks (results are presented in Appendix B, Table 10 regressions (EUR1)-(EUR3)). First, we test if bank-specific characteristics impact how monetary policy is transmitted into credit growth. Then, we analyse what implications on credit growth interbank confidence has in the eurozone.

The results for the eurozone are somewhat contradictory to our findings in the Nordic and Baltic countries. The first two regressions (EUR1) and (EUR2) indicate that an increase in the current policy rate ($\Delta i_{PR,t}$) on average leads to higher credit growth over the following six months. Though as expected, the lag of policy rate change ($\Delta i_{PR,t-1}$) has a negative coefficient. In general, we find that it takes more than a year for a rise in the ECB policy rate to decrease credit growth in eurozone banks. Different banking systems and economic developments across the sample countries could be the reason for the discrepancies in the monetary mechanism's direct link with credit growth. Contrarily, policy rate changes in the Nordic countries could more quickly reach the bank's balance sheets.

[24] The results are not reported as they convey essentially the same message.

Table 3 below presents the tests of the joint null hypotheses which we conduct to evaluate our three main hypotheses. We strongly reject the first null that coefficients at the interaction terms with Size ($\Delta i_{PR} * SIZE$), Liquidity ($\Delta i_{PR} * LIQ$) and Capitalisation ($\Delta i_{PR} * CAP$) are all equal to 0 in regression (EUR1). Further, in line with the previous research on eurozone banks by Altunbas et al. (2010) and Gambacorta and Ibanez (2011) we observe that all three key coefficients are positive. Estimates at Size and Capitalisation are strongly significant. This suggests that credit growth at larger and better capitalized banks is more prone to adverse changes in the policy rate. Thus, we reject our first hypothesis in a sample of eurozone banks. We find evidence for the existence of frictions in the bank lending channel in the eurozone.

Regression (EUR2) mainly confirms the findings stemming from regression (EUR1). An exception is the surprising negative and significant coefficient at the Liquidity interaction term ($\Delta i_{PR} * LIQ$). Banks with more liquid assets will reduce their credit supply relatively more than less liquid banks in case of monetary tightening. Such a link could hold if, for example, in the eurozone, riskier banks held more liquidity on their balance sheets.

Table 3. Decision rules (the eurozone)

Table No.	H_0 test	Description	χ^2	Df	P-value	Decision
(EUR1), Table 10, Appendix B.	$H_0: \eta_{SIZE} = \eta_{LIQ} = \eta_{CAP} = 0$	$\Delta i_{PR,t}$ interacted with $SIZE$, LIQ and CAP are jointly statistically equal to zero	54.32	3	0.00	Reject
(EUR2), Table 10, Appendix B.	$H_0: \eta_{SIZE} = \eta_{LIQ} = \eta_{CAP} = \eta_{STF} = \eta_{DEP} = \phi = 0$	$\Delta i_{PR,t}$ interacted with $SIZE$, LIQ, CAP, STF, DEP and LLP are jointly statistically equal to zero	81.69	6	0.00	Reject
(EUR3), Table 10, Appendix B.	$H_0: \pi = \omega = 0$	EQT and TED are jointly statistically equal to zero	5.2	2	0.07	Fail to reject

Here we present statistical tests for the three null hypotheses that coefficients are jointly equal to zero. Table No. refers to the relevant regression for the test. H_0 test specifies the exact equation of the null. We also report Chi-square (χ^2) statistics, degrees of freedom (Df), P-value and our decision regarding null hypotheses.

Though we find stronger evidence for the existence of the bank lending channel in the euro-zone than in the Nordic and Baltic countries the economic significance of the bank-specific variables are lower (Table 4 below). This could partly be explained by the lower average credit growth (6%) in the sample of the eurozone banks. Another reason for the lesser magnitude of the effects is the less evident difference in bank-specific characteristics among banks in the top 25th percentile and bottom 25th percentile.

Table 4. Economic magnitude (the eurozone)

Variable	Exp. sign	Coef.	Sign. level	p25	p75	Diff	+1 p. p. effect on $\Delta ln(loans)$
$\Delta i_{PR,t}$	-	1.416	1%	n/a	n/a	n/a	1.42
$\Delta i_{PR,t-1}$	-	-1.572	1%	n/a	n/a	n/a	-1.57
$TED_{k,t-1}$	-	0.675	5%	n/a	n/a	n/a	0.68
$EQT_{k,t-1}$	+	-0.017	Not Sign.	n/a	n/a	n/a	-0.02
$\Delta i_{PR,t} * SIZE_{i,t-1}$	+	0.328	1%	-0.003	0.003	0.005	0.17
$\Delta i_{PR,t} * LIQ_{i,t-1}$	+	-2.810	1%	0.000	0.000	0.000	-0.12
$\Delta i_{PR,t} * CAP_{i,t-1}$	+	6.834	5%	0.000	0.000	0.000	0.09
$\Delta i_{PR,t} * STF_{i,t-1}$	+/-	-0.740	Not Sign.	0.000	0.000	0.000	-0.03
$\Delta i_{PR,t} * DEP_{i,t-1}$	+	-0.949	Not Sign.	0.000	0.000	0.001	-0.06
$\Delta i_{PR,t} * LLP_{i,t-1}$	-	-6.167	Not Sign.	0.000	0.000	0.000	-0.01

The economic magnitude of key variables with respect to $\Delta \ln(Loans)_{i,t}$ is presented. Expected signs (Exp. sign) indicate our prior expectations on directional effects of the variable. Coefficients (Coef.) and significance levels (Sign. level) as reported in the regression (EUR3). The 25th percentile (p25) and 75th percentile (p75) are reported. We calculate the difference between these cut-off points (Diff) to evaluate the difference in credit growth between the banks in the top and bottom points. The last column shows an estimated magnitude of the economic effect in percentage points (p. p.), given a 1 percentage point (p. p.) rise in the respective variable. For the coefficients at contemporaneous and lagged monetary policy rate ($\Delta i_{PR,t}, \Delta i_{PR,t-1}$), TED spread volatility ($TED_{k,t-1}$) and country-specific stock market returns ($EQT_{k,t-1}$) the interpretation of the effect is straightforward. For the coefficients at the interaction term of monetary policy shock ($\Delta i_{PR,t}$) and bank-specific characteristics ($SIZE, LIQ, CAP, STF, DEP, LLP$), the last column shows the difference of credit growth (in p. p.) between the 25th percentile and 75th percentile of respective variable, given a 1 p. p. increase in the monetary policy rate.

Finally, considering the results from regression (EUR3) we fail to reject the joint null that change in TED spread volatility (TED) and equity index returns have an impact on credit growth. Moreover, the TED measure has a positive and significant sign which is opposite to our expectations. This leads to the rejection of the third hypothesis (*H3: In combination with bank-specific characteristics, TED spread volatility is a significant determinant of the bank lending channel.)* for the eurozone banks.

Although we fail to demonstrate the effects of market confidence on credit growth in the eurozone, we still question this conclusion. Tests for the validity of the model reveal that there is autocorrelation in the second order residuals in the main GMM equations. In addition, the Sargan test indicates that the instruments used in the regression are possibly invalid. We try to address these issues by picking different instruments and decreasing the number of predetermined variables. Unfortunately, none of the measures that were taken help us to pass the required validity test. Finally, we run 2SLS regression, instrumenting endogenous variables with their lagged levels, but again we do obtain similar results to the ones in the GMM estimation.

In order to understand the causes for rejecting the third hypothesis, we look at how credit supply reacts to changes in TED spread volatility at banks which are located in periphery countries of the eurozone. These are Greece, Ireland, Portugal and Spain (GIPS), countries whose banks were severely hit by the financial crisis. We introduce a new variable which interacts past changes in TED with the dummy variable distinguishing periphery eurozone countries. The findings are presented in Appendix B, Table 11. Interestingly, we find a significant and negative correlation between the new interaction term ($GIPS_i * TED_{k,t-1}$) and credit growth. On average, a change in TED spread volatility affects credit growth unequally in the core eurozone when compared to the periphery. On average, a 1 p. p. increase in TED spread volatility decreases credit growth by 4.7 p. p. in GIPS countries as compared to the core eurozone. Such an increase in TED spread volatility was observed in 2007; whereas in 2008 the volatility rose further by around 1 p. p. Hence, we believe realisations of such a high TED spread volatility are of economic significance and possible in the future, too. Therefore, we conclude that increased counterparty risk in the banking sector has an economically significant higher negative impact on credit growth in the peripheral eurozone countries.

To sum up the discussion of the eurozone results, we fail to reject our first two hypotheses and find support that bank-specific variables ($SIZE$, LIQ, CAP, DEP, STF and LLP) are significant determinants of the bank lending channel in the eurozone. Furthermore, interbank confidence appears to be an insignificant factor for credit growth in the eurozone. However, we show that a change in TED spread volatility (TED) will have a more pronounced effect on credit growth to banks in the periphery countries than in the core eurozone.

7.2.1 Comparison of findings for the Nordics, Baltics and the Eurozone

We find that bank-specific characteristics are not strong determinants of how monetary policy is transmitted into credit growth in the Nordic and Baltic States. Instead, credit growth is negatively affected by an increase in market confidence in the banking sector, as measured by TED spread volatility. Alternatively, in the sample of eurozone banks, we confirm the presence of the bank lending channel, where traditional bank-specific characteristics such as Size, Liquidity and Capitalisation shape the monetary policy transmission mechanism. Moreover, interbank confidence is not a significant factor for banks' credit growth in core eurozone countries, but appears to be negatively related to credit growth in Greece, Ireland, Portugal and Spain.

Several factors could contribute to the differences in the results. First, the sample of the Nordic and Baltic countries is much smaller, though more homogenous in terms of banking institutions. Rigorous instrumentation by the GMM estimator could have decreased the significance of the coefficients and led us to reject the first two hypotheses. This idea is also supported by the fact that the signs of the key coefficients at the interaction terms of Size and Capitalisation are the same for both regions. Second, Nordic financial markets are dominated by a small number of very large banks which provide the great majority of credit to the economy. It is likely that monetary policy in Nordic and Baltic countries is focused on managing lending at these key institutions. As a result, the existence of frictions in the bank lending channel is harder to identify.

Interestingly, in both samples none of the variables measuring banks' dependence on wholesale funding (measured by DEP) and Short-Term Funding (STF) are significant. We do not find support that greater dependence on less stable funding would cause banks to react differently to a monetary policy shock in terms of credit growth. Yet more precise proxies of dependence on market funding could show different results.

7.3 Robustness checks

We perform two types of robustness checks. First, we look at various additional variables and relationships that could affect our baseline regressions (Appendix C, Table 12). Then, we substitute key independent variables in other proxies (Appendix C, Table 13).

7.3.1 Additional variables

Additional variables are dummy variables to control for Saving Banks ($Saving$) and Mortgage Institutions ($Mortg$); the interaction term between monetary policy rates and the dummy variable if the organisation is a Subsidiary or not ($\Delta i_{PR} * Sub$); change in Total Assets of the central bank normalised by the country's GDP, which proxies for Non-standard monetary policy measures (NSM). For the results output, please see Appendix C, Table 12.

7.3.1.1 Business type

No significant deviations in credit growth are observed for different types of banking institutions in the Nordic and Baltic countries (Appendix C, Table 12 regression (NORTYPE)). This may come as a surprise as one may expect growth in lending at mortgage institutions to vary from change in lending at commercial banks. However, we measure the effects on the average bank in the category; therefore, it may be the case that large discrepancies from the mean are not captured by the model. Furthermore, we find that credit growth at saving banks in the eurozone was significantly smaller than at other financial institutions (Appendix C, Table 12, regression (EURTYPE)). We think that this effect could come from the large number of German savings banks in the eurozone sample.

7.3.1.2 Parent-subsidiary relationship

Interestingly, another robustness test demonstrates that subsidiary banks tend to reduce credit less after a monetary shock than independent banks (Appendix C, Table 12). This effect is strongly significant in both samples: Nordic (NORSUB) regression and the eurozone (EURSUB) regression. Moreover, for the Nordic and Baltic countries we could interpret the parent-subsidiary relationship on a cross-country level, because the majority of banks in the Baltic States are owned by Nordic parents. Hence, in contrast to general beliefs during the financial crisis, we could argue that actually, subsidiary banks in the Baltic States did not decrease their credit as much as they could have. In other words, parent Scandinavian banks helped their subsidiaries to weather the monetary and economic shocks.

7.3.1.3 Non-standard monetary policy measures

Controlling for Non-standard monetary policy measures (proxied by Total Assets of central banks normalised by country GDP) that central banks took during the crisis to facilitate lending and boost market confidence does not alter the regression results (Appendix C, Table 12 regression (NORNSM)). Additionally, we see that non-standard measure NSM had a significant positive effect on credit growth in the Nordic and Baltic countries, whereas the impact was insignificant at a 5% level in the eurozone. This indicates that Nordic and Baltic banks were better able (as compared to the eurozone) to fight the drop in credit growth rates during the 2007-2008 crisis through additional liquidity to the banking sector.

7.3.2 Other proxies

As for other proxies, we first address the fact that some of the countries in the Nordic and Baltic sample have their currencies pegged to the euro. We substitute the central bank's policy rate with the one provided by the ECB for Denmark and the Baltic States. Then, another test replaces the monetary policy rate with the interbank market rate. Finally, the level of the TED spread is used instead of TED spread volatility. Appendix C, Table 13 contains the results.

7.3.2.1 The ECB rate for countries with fixed exchange rate

Denmark, Estonia, Latvia and Lithuania have fixed exchange rate mechanisms. Consequently, their monetary policy is expected to closely follow the one conducted by the ECB. In our initial model, for the Nordics and Baltics we use the monetary policy rates of the individual central banks in each country, except Finland. Hence, it is a natural step to check whether the results are robust if we take the ECB's repo rate as the monetary policy indicator for the countries with pegged currencies. Appendix C, Table 13 regression (NORFIX) presents the findings from this exercise. We see that the results are in line with the previous findings and support our analysis. As there is no convention regarding which proxy to use, we therefore believe that having the repo rate and TED spread volatility allows us to better disentangle the monetary shock and interbank confidence effects (as compared to the interbank rate and TED spread volatility, the effects of which may overlap).

7.3.2.2 The interbank market rate

Interbank interest rates have been extensively used as a proxy for a central bank's monetary policy when studying bank lending. Instead, in our research we use the repo rate for the same purpose of measuring changes in monetary policy. Therefore, to have a better comparison with other studies we replace the central bank's policy rate with the 3-month interbank rate (Appendix C, Table 13 regression (NORINT)). This exercise has no significant effect on the regression coefficients for the sample of Nordic and Baltic countries. However, for the eurozone banks we observe that $\Delta i_{PR,t}$, which in the main model had a surprisingly positive and significant coefficient, now becomes insignificant. This indicates that contrary to the central banks' policy rates in the Nordics and Baltics, changes in the ECB's refinancing rate are not that closely related to the moves in 3-month EURIBOR.

7.3.2.3 TED spread level

We replace TED spread volatility with the TED spread level and re-estimate the baseline regressions (Appendix C, Table 13 regression (NORTED)). The results for the eurozone countries are not different as coefficient at TED remains insignificant. However, for the Nordic and Baltic countries we observe different results. The coefficient at the level measure of interbank confidence is insignificant, which does not support our previous findings. We believe this occurs because the TED spread is a fast moving indicator and taking yearly observations does not capture these aspects. Instead, we believe the volatility of the spread is a better proxy for the magnitude of changes in counterparty risk in the banking sector.

7.3.3 Comparison of robustness checks for the Nordics, Baltics and eurozone

Loan-Loss Provisions (LLP) is the only significant bank-specific control variable for both samples. This indicates that worse quality of the loan portfolio in the past correlates with lower credit growth in the following period. LLP is the only bank-specific variable which in our model measures credit risk within a bank. Hence, we claim that a rise in a bank's idiosyncratic risk will eventually lead to lower credit growth. Furthermore, DEP (ratio of Deposits to Total Assets) is a significant control variable for the Nordic and Baltic banks and gives some idea of the importance of stable funding. Banks that can attract more deposits on average are also likely to provide more credit.

Few additional observations are drawn from the data that apply to the eurozone and Nordic banks. We observe that credit growth at subsidiary banks in the eurozone are less reactive to monetary policy shocks. It should come as no surprise that parent banks are willing to help their subsidiaries in worse times while probably putting stricter controls on credit supply during good times. Furthermore, while there is no difference in credit growth at different types of banks in the Nordic region, credit growth at saving banks in the eurozone tend to be slower when compared to commercial banks and mortgage institutions. Finally, Non-standard monetary policy measures taken by central banks during the crisis seem to be more effective in the Nordic and Baltic States while no significance is found for the eurozone banks.

Summing up, two datasets have some similarities on how bank-specific characteristics shape the monetary policy transmission mechanism. Nevertheless, the existence of the bank lending channel is more evident in the eurozone countries. Market confidence is an important determinant of credit growth in the Nordic and Baltic banks as well as in the periphery countries of the eurozone.

8 Macroeconomic implications

After discussion of the results, we proceed with the macroeconomic implications of our findings. Here, the focus is on the Nordic and Baltic States, the region of main interest for this paper.

The key implication of the results is that the bank-specific characteristics provide limited information for the monetary policy makers when controlling credit growth. Instead, the significant effect of TED spread volatility on the credit growth indicates that the central banks in the Nordic and Baltic countries should monitor interbank confidence more closely as opposed to the bank-specific factors.

Due to high concentration in the Nordic and Baltic banking sector, central banks and policy makers tend to put more emphasis on the main banking groups. Our study shows that on average the same bank lending determinants apply for the main credit providers as compared to the whole banking sector. The only difference is that the monetary policy rate has a lesser economic impact on the credit growth of the main loan providers as compared to small ones. This shows that the main banking institutions in the Nordic and Baltic States are less affected by monetary policy. In addition, we find that (1) the main lenders are more dependent on interbank market conditions; (2) it is hard, if not impossible, to maintain stable credit growth during times of market turmoil. The 2007-2008 crisis revealed that the banking sector, which over the years had become more dependent on wholesale funding, decreased credit supply substantially. Our research shows that these effects were driven by a drop in interbank market confidence even after controlling for the demand effects of credit growth and bank-specific characteristics. Therefore, we believe that central banks should emphasize macro-prudential regulation more, which should maintain the soundness and stability of the interbank market and consequently the banking sector as a whole.

Aside from this, our study shows that additional liquidity provided by central banks in the form of Non-standard monetary policy measures helped to mitigate a drop in credit growth during the period of 2007-2008. Therefore, we believe that in case of extreme situations additional monetary policy measures are useful and should be applied.

On the other hand, we are not able to check for the long-term effect of these extraordinary measures. We think that this may encourage banks to take more risks, as they know that central banks will step in during market turmoil. This insight leads us back to the macro-prudence issue: if central banks were able to monitor and align banks' risk incentives, maybe we would not observe such a strong drop in interbank market confidence in 2007-2008, which resulted in a credit growth drop in the Nordic and Baltic countries. We take the position that wholesale funding per se is not something that banks should avoid. We believe that more emphasis on interbank monitoring should be imposed in order to be able to mitigate interbank market challenges in a timely manner.

Although we find commonalities across the banking sector in the Nordic and Baltic countries, there is great divergence within the sector. As the market includes various types of banks (Commercial Banks, Saving Banks, Mortgage Institutions), which have different bank-specific characteristics, it is difficult to measure the average distributional effect of a monetary policy shock. Hence, it is hard for the local central banks to conduct straightforward monetary policy expecting to have the same effect on every individual bank.

Among the individual bank-specific characteristics, we find DEP and LLP to be significant. The former ratio implies that Nordic and Baltic banks rely on deposits to issue new loans. Alternatively, LLP significance indicates that an increase in past Loan-Loss Provisions constrains credit growth through reduction in profitability and capital. In relation to the study by Foos et al. (2010) which finds that excessive lending growth is followed by an increase in LLP in 3 subsequent years, we think that excessive lending growth should be monitored more closely by central banks or financial regulators in order to smooth out the earning growth of banks and ensure stability in the banking sector.

9 Limitations and suggestions for further research

Our study measures the average effect of a monetary policy stance. For macroeconomic implications, we mitigate this problem somewhat while looking at a sample with banks which have the highest loan portfolios (50th percentile and above). But measuring the aggregate effect would add additional insights regarding the effect on the economy as a whole.

Moreover, we are only able to access yearly data on bank-specific information. The 2007-2008 crisis showed that the interbank market situation as well as the balance-sheet composition of central banks and financial intermediaries can change rapidly. Hence, we expect that quarterly observations would allow one to capture the bank lending channel in the Nordic and Baltic States with more precision, especially in relation to the 2007-2008 crisis period.

Also, other interbank confidence proxies could be tested. For instance, a change in banks' deposits held at central banks could be incorporated, which would also proxy for interbank confidence. Moreover, the risk metric of an individual bank could be a more effective bank-specific factor than the Loan-Loss Provisions currently applied. For instance, Foos et al. (2010) employ an average capitalisation ratio and return on assets (ROA) measure normalised by 5-year standard deviation of ROA, which works as a bank stability measure. Unfortunately, we are not able to calculate this measure as we do not have a time span that is long enough. Furthermore, other capitalisation ratios could be applied. For instance, Tier 1 capital over risk-weighted assets would measure capitalisation in relation to implied risks of assets backed by this capital.

Finally, the cross-country relationship could be investigated in more detail. At the time of writing this paper, market participants' focus has shifted to Western bank subsidiaries in Central and Eastern Europe, which faced capital withdrawals by struggling parent banks. Our paper provides some insight into the cross-border parent-subsidiary relationship, though more research could be done in this field.

10 Conclusion

We find that bank-specific characteristics are not strong determinants of the monetary policy transmission mechanism in the Nordic and Baltic countries. Instead, credit growth is negatively affected by a decrease in interbank confidence, as measured by TED spread volatility. If only the banks with the largest loan portfolios are considered (50th percentile and above), the economic magnitude of TED spread volatility turns out to be higher, whereas the importance of a monetary policy shock on credit growth diminishes. Hence, we conclude that the main lenders are more exposed to shocks in interbank confidence and less reactive to a monetary policy stance in comparison to smaller market players. We argue that changes in interbank confidence have an economically significant effect on credit growth.

Moreover, the parent-subsidiary relationship plays an important role in the region as subsidiary banks are better able to shelter adverse changes in the policy rate. Furthermore, we find that Non-standard monetary policy measures (proxied by growth in size of a central bank's balance sheet) helped to mitigate the drop in credit growth during the 2007-2008 crisis.

Alternatively, in the sample of the eurozone banks we confirm the presence of the bank lending channel, where traditional bank-specific characteristics such as Size, Liquidity and Capitalisation shape the monetary policy transmission mechanism. This is in line with the previous empirical evidence on the bank lending channel in Europe (Altunbas et al., 2010; Gambacorta and Ibanez, 2011). Moreover, interbank confidence is not a significant determinant of banks' credit growth in core eurozone countries, but appears to be negatively related to credit growth in Greece, Ireland, Portugal and Spain. Finally, Non-standard monetary policy measures for the eurozone banks were not as effective as for the Nordic and Baltic States in 2007-2008.

We demonstrate that in the Nordic and Baltic countries the level of interbank confidence is a significant factor when controlling credit growth in the banking sector. Ensuring stability in the interbank markets is expected to facilitate the credit growth. Therefore, we believe that the monetary policy setters and market supervision authorities in the Nordic and Baltic countries should closely monitor the developments in the interbank markets.

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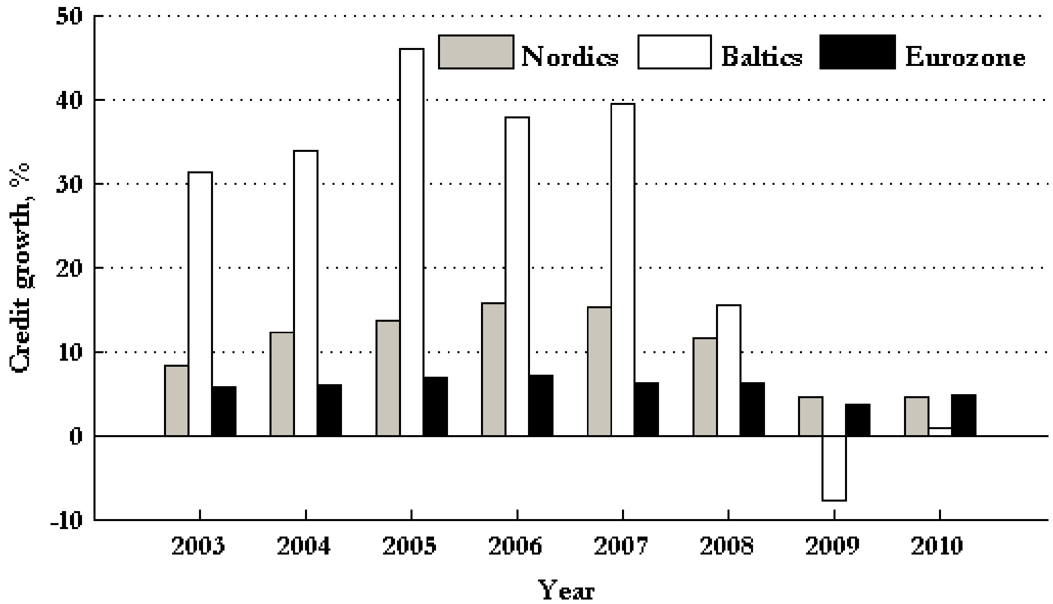
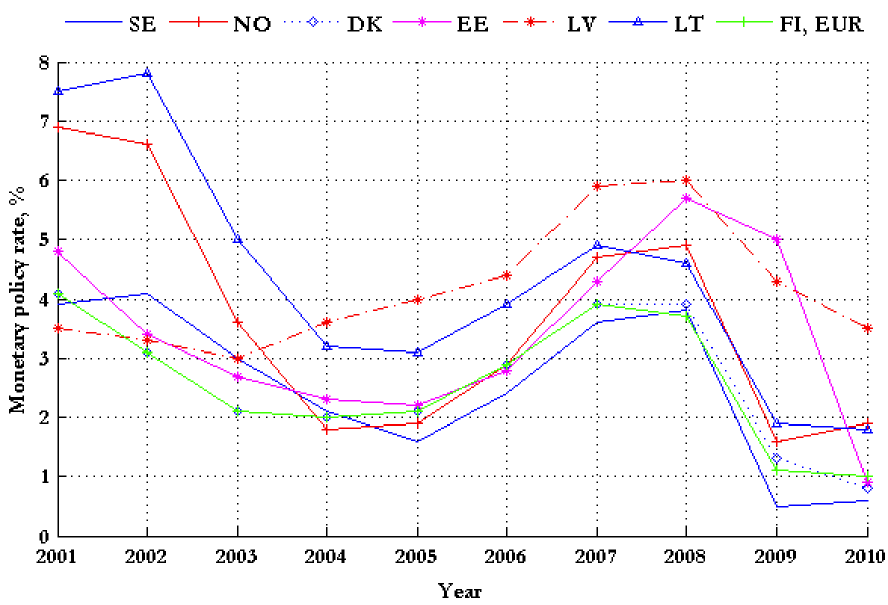
Appendix A. Key figures

Figure 1. Credit growth, %



The average credit growth is depicted for the banks in the Nordics (grey bar), Baltics (white bar) and the eurozone (black bar) in percentage points over the period of 2003-2010.

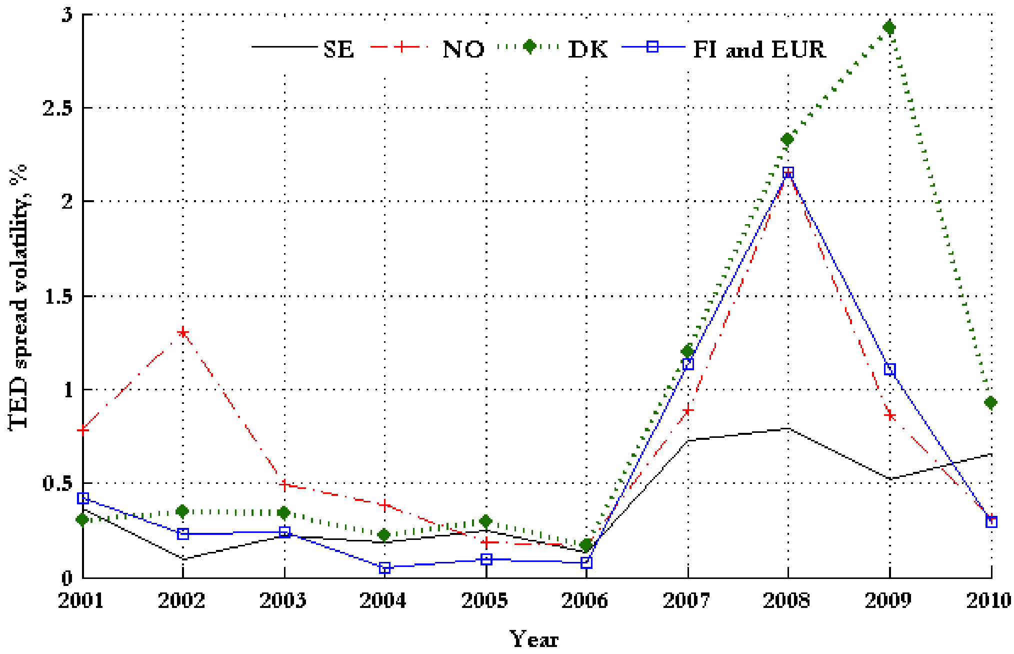
Figure 2. Monetary policy rates, %



Monetary policy rates are depicted for Sweden (SE), Norway (NO), Denmark (DK), Finland (FI), Estonia (EE), Latvia (LV), Lithuania (LT) and the eurozone (EUR) in % over the period of 2001-2010. Policy rates of Finland and the eurozone coincide as Finland had euro during the period under review.

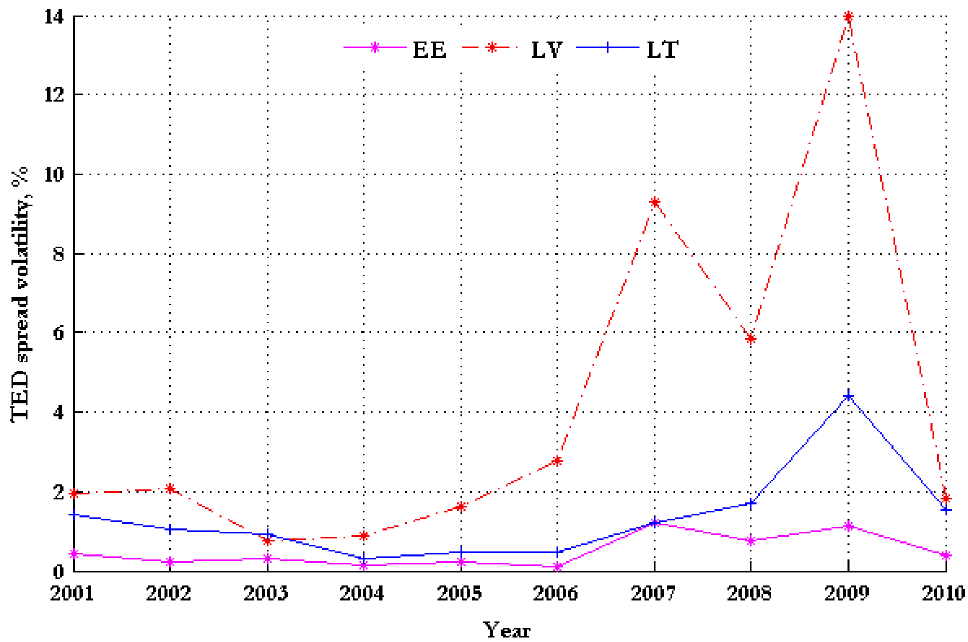
Figure 3. TED spread volatility, %

a) The Nordic states and eurozone



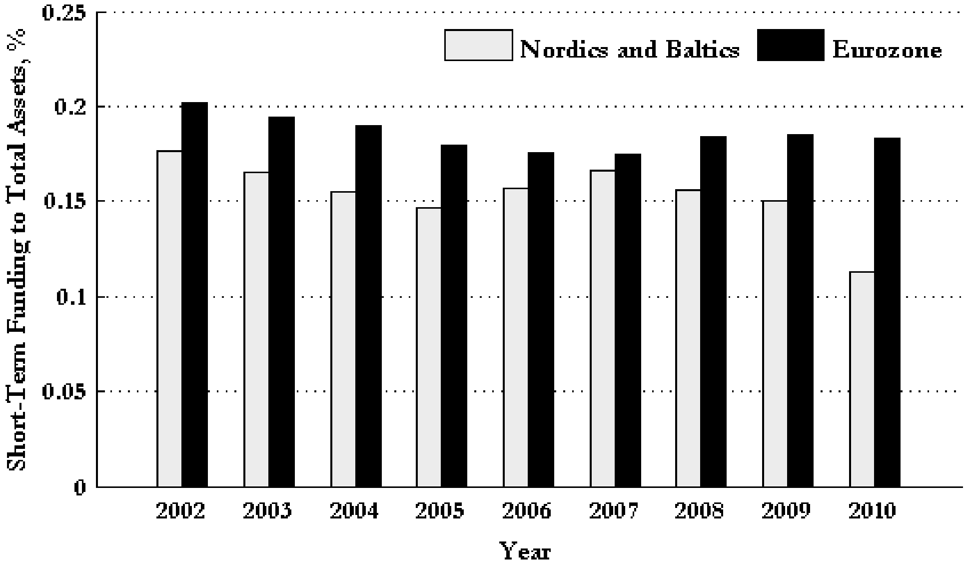
TED spread volatility is depicted for Sweden (SE), Norway (NO), Denmark (DK), Finland (FI) and the eurozone (EUR) in % over the period of 2001-2010. TED spread is the difference between the interbank market rate and a proxy for risk-free rate. TED spread volatility is calculated on the annual basis from the monthly TED spread observations.

b) The Baltic States



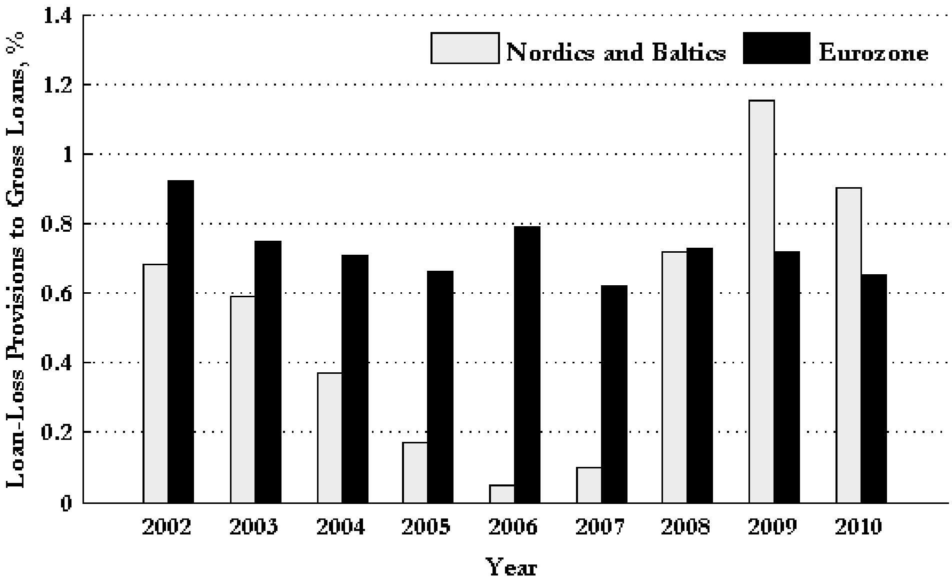
TED spread volatility is depicted for Estonia (EE), Latvia (LV) and Lithuania (LT) in % over the period of 2001-2010. The TED spread is the difference between the interbank market rate and a proxy for risk-free rate. TED spread volatility is calculated on the annual basis from the monthly TED spread observations.

Figure 4. Short-Term Funding ratio (STF), %



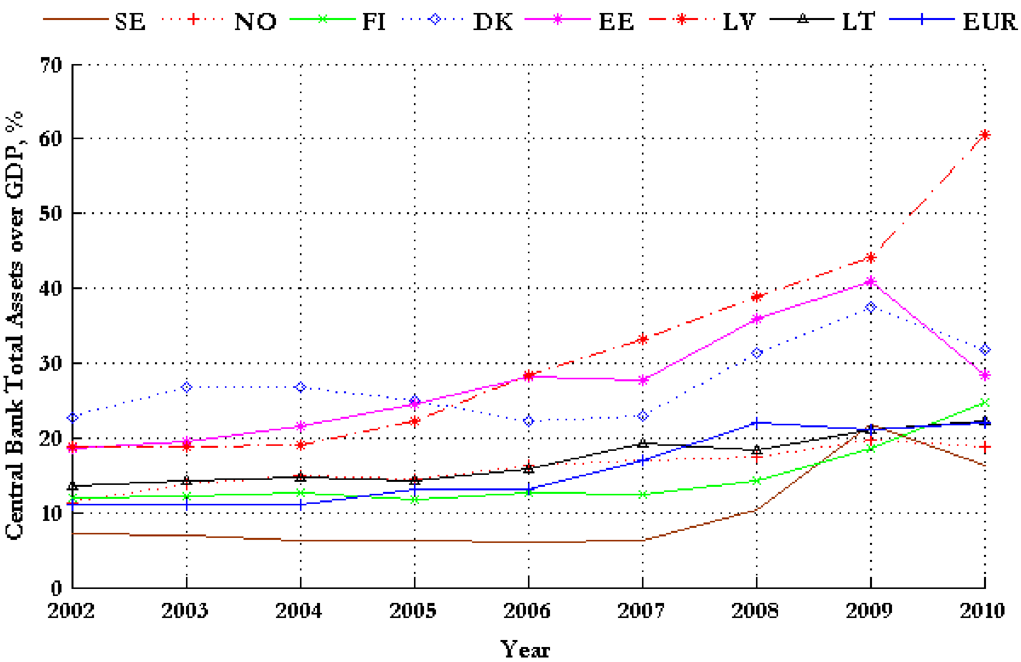
The average ratio of Short-Term Funding (STF) is depicted for the Nordic and Baltic States (grey bar) and the eurozone (black bar) in % over the period of 2002-2010. STF is calculated as the ratio of Short-term funding to Total Interest-bearing Liabilities for each individual bank.

Figure 5. Loan-Loss Provision (LLP), %



The average amount of Loan-Loss Provisions (LLP) are depicted for the Nordic and Baltic States (grey bar) and the eurozone (black bar) in % over the period of 2002-2010. LLP is calculated as the ratio of Loan-Loss Provisions to Gross Loans for each individual bank.

Figure 6. Non-standard monetary policy measures, %



The ratio of central banks' Total Assets over country GDP is depicted for Sweden (SE), Norway (NO), Finland (FI), Denmark (DK), Estonia (EE), Latvia (LV), Lithuania (LT) and the eurozone (EUR) in % over the period of 2002-2010. Please note that the ratio for Latvia reached 60% in 2010, due to (1) usage of IMF and EU credit facility in foreign currency and (2) 10% GDP contraction year-on-year.

Appendix B. Summary statistics and regression output

Table 5. The banking market landscape by country

Country	Total Assets	Lending	Loans-to-Deposits	Top 5	Country	Total Assets	Lending	Loans-to-Deposits	Top 5
DK	912.4 *3.90*	623.9 *83%*	2.9	64%	EE	30.7 *2.15*	23.1 *1%*	1.5	93%
FI	192.4 *1.07*	192.4 *47%*	1.4	83%	LV	29.1 *1.62*	23.3 *30%*	1.5	69%
SE	1,398.5 *3.81*	836.6 *N/A*	2.4	61%	LT	25.6 *0.93*	20.5 *17%*	1.5	81%
NO	465.5 *1.49*	335.3 *N/A*	N/A	N/A	**Nordic/Baltic**	**3,054.2** ***2.65***	**2,055.1** ***N/A***	**2.4**	**64%**
AT	1,130.9 *3.95*	797.0 *74%*	1.3	93%	IE	1,179.5 *7.56*	595.9 *51%*	1.5	59%
BE	1,150.7 *3.25*	704.8 *53%*	0.7	77%	IT	2,764.8 *1.79*	1,922.3 *91%*	1.5	34%
DE	7,896.8 *3.19*	4,061.9 *93%*	1.0	25%	LU	820.5 *20.37*	551.3 *6%*	0.7	28%
ES	3,807.8 *3.62*	2,696.8 *91%*	1.1	43%	NL	2,707.4 *4.60*	1,928.7 *91%*	1.2	85%
FR	6,385.0 *3.31*	3,601.7 *97%*	1.3	47%	PT	531.7 *3.08*	389.8 *77%*	1.3	70%
GR	493.1 *2.14*	362.4 *76%*	0.8	69%	**Eurozone**	**28,868.0** ***3.84***	**17,612.6** ***86%***	**1.2**	**47%**

Figures are presented in million EUR. Total Assets and Lending is shown for the year 2010, Loans-to-Deposits and Total Assets of the top 5 banks for the year 2009. Figures in italics represent ratio over country GDP (under Total Assets) and share of lending provided by local banks (under Lending). Last column shows share of the top 5 largest financial institutions in terms of Total Assets.
Sources: ECB, Datastream, national statistical pages.

Table 6. Description of key variables

Variable	Description	Exp. sign	Reasoning
$\Delta \ln(Loans)_{i,t}$	Dependent variable. Calculated using year-end values of Gross Loans.		
$\Delta \ln(Loans)_{i,t-1}$	Lagged value of the dependent variable.	+	An increase in the past lending should be positively correlated with the change in lending today.
$\Delta i_{PR,k,t}$	Monetary policy rate (repo rate) calculated using quarter-end values.	-	An increase in the monetary policy rate should lead to lower growth rate of credit.
$\Delta i_{PR,k,t-1}$	Lagged value of the monetary policy rate.	-	Previous period increase in the monetary policy rate should lead to a lower credit growth in the contemporaneous period.
$TED_{k,t-1}$	Annualized TED spread volatility calculated from monthly difference between interbank market rate and risk-free rate proxy.	-	An increase in TED spread volatility (proxy for interbank confidence) should decrease lending rates.
$EQT_{k,t-1}$	Stock market returns calculated using year-end index values.	+	Positive stock market returns should alter risk-aversion and release risk budgets in turn fostering credit growth.
$SIZE_{i,t-1}$	Logarithm of Total Assets.	+	Larger banks should have higher lending rates.
$LIQ_{i,t-1}$	Liquid Assets to Total Assets.	+	More liquid banks should be able to create more new loans.
$CAP_{i,t-1}$	Total Equity to Total Assets.	+	Better capitalised banks should have higher rates of credit growth.
$STF_{i,t-1}$	Short-Term Funding to Total Interest-bearing Liabilities.	+/-	Higher dependence on market conditions makes it hard to predict the effect.
$DEP_{i,t-1}$	Total Customer Deposits to Total Interest-bearing Liabilities.	+	Higher deposit base should allow issuing more loans.
$LLP_{i,t-1}$	Loan-Loss Provisions to Gross Loans.	-	An increase in LLP should restrict issuance of loans through lower profitability and less capital.
$\Delta i_{PR,k,t} * SIZE_{i,t-1}$	Interaction term of the change in the monetary policy rate and *SIZE*.	+	Larger banks should be less affected by monetary policy shock.
$\Delta i_{PR,k,t} * LIQ_{i,t-1}$	Interaction term of the change in the monetary policy rate and *LIQ*.	+	More liquid banks should be less reactive to monetary policy shocks.
$\Delta i_{PR,k,t} * CAP_{i,t-1}$	Interaction term of the change in the monetary policy rate and *CAP*.	+	Better capitalised banks should react less to monetary policy stance.
$\Delta i_{PR,k,t} * STF_{i,t-1}$	Interaction term of the change in the monetary policy rate and *STF*.	+/-	Higher dependence on market conditions makes it hard to predict the effect.
$\Delta i_{PR,k,t} * DEP_{i,t-1}$	Interaction term of the change in the monetary policy rate and *DEP*.	+	A higher deposit base should shelter bank from monetary policy stance.
$\Delta i_{PR,k,t} * LLP_{i,t-1}$	Interaction term of the change in the monetary policy rate and *LLP*.	-	Monetary policy shock should affect banks with a higher LLP ratio more.
ΔNSM_i	Non-standard monetary policy measure calculated as a change in central bank's Total Assets over country's GDP using quarter-end values.	+	Extraordinary central bank measures should mitigate negative effects in the banking sector and maintain growth rates of credit.
$GIPS_i$	Dummy variable. Value of 1 if country where bank operates is Greece, Ireland, Portugal or Spain, 0 otherwise.	+/-	Credit growth in the banks in the periphery countries depend on many factors and the exact relationship is not clear.
$GIPS_i * TED_{k,t-1}$	Interaction term between the *GIPS* and *TED* variables.	+/-	Due to various driving forces of the interbank market, it is hard to predict what effect may TED spread volatility have on credit growth in periphery as compared to other eurozone countries.
$Saving_i$	Dummy variable. Value of 1 if bank is categorised as Savings Banks, 0 otherwise.	-	Credit growth at saving banks is expected to be lower than at the commercial banks.
$Mortg_i$	Dummy variable Value of 1 if bank is categorised as Mortgage Institution, 0 otherwise.	+	Credit growth at mortgage institutions is expected to be higher than at the commercial banks.
Sub_i	Dummy variable. Value of 1 if bank is categorised as Subsidiary, 0 otherwise.	+	Subsidiary banks are expected to demonstrate higher credit growth.

The description of key variables, expected sign and reasoning behind the expectation are outlined.

Table 7. Key statistics of dataset by country

Country	N	Total assets	Total loans	Ave. loan	g(Loans)	$SIZE$	LIQ	CAP	DEP	STF	LLP
DK	103	1,148,438	809,003	8,142	10%	6.4	15%	13%	73%	17%	1.0%
FI	15	443,099	195,275	13,911	16%	8.5	18%	7%	51%	21%	0.2%
SE	80	1,126,663	795,765	8,027	10%	6.3	6%	9%	68%	12%	0.2%
NO	125	434,029	306,544	2,715	10%	6.0	11%	13%	88%	11%	0.3%
EE	6	27,414	22,520	1,373	18%	5.6	32%	14%	66%	20%	1.2%
LV	17	25,512	19,653	873	24%	6.4	32%	10%	70%	20%	1.2%
LT	9	23,268	17,916	1,415	27%	6.8	23%	10%	61%	31%	1.1%
	355	**3,228,423**	**2,166,676**	**5,988**	**12%**	**6.3**	**13%**	**11%**	**74%**	**15%**	**0.6%**
AT	229	1,423,154	800,197	2,785	6%	6.4	23%	9%	67%	20%	0.8%
BE	38	2,213,241	1,105,207	25,772	8%	7.8	21%	8%	63%	22%	0.3%
DE	1,549	7,305,877	3,123,264	1,934	2%	6.4	15%	7%	75%	18%	0.8%
ES	135	3,716,072	2,472,901	16,066	10%	7.4	15%	9%	70%	17%	0.6%
FR	208	11,400,000	4,361,000	17,698	8%	8.0	23%	10%	48%	41%	0.4%
GR	18	455,169	313,938	12,804	18%	8.7	19%	9%	72%	19%	1.1%
IE	14	866,301	503,298	34,591	13%	10.2	27%	7%	38%	37%	0.7%
IT	564	3,396,309	2,354,436	3,163	12%	6.1	18%	12%	59%	7%	0.6%
LU	59	752,934	294,764	3,248	7%	8.0	49%	6%	56%	32%	0.4%
NL	34	4,364,303	2,406,210	66,671	10%	8.9	22%	7%	56%	19%	0.3%
PT	30	541,829	375,966	11,598	11%	8.3	21%	10%	43%	33%	0.8%
	2,878	**35,012,035**	**18,111,181**	**5,343**	**6%**	**6.6**	**18%**	**8%**	**68%**	**18%**	**0.7%**

The number of banks, Total assets, Total loans are presented for the year 2009 in million EUR. Average loan (in million EUR) and other average values of bank-specific variables are for period 2002-2010. g(Loans) shows average growth rate of loans. $SIZE$ is log of Total Assets. LIQ is the ratio of Liquid Assets to Total Assets. CAP is the ratio of Total Equity to Total Assets. DEP is the ratio of Total Customers' Deposits to Total Interest-bearing Liabilities. STF is the ratio of Short-Term Funding to Total Interest-bearing Liabilities. LLP is the ratio of Loan-Loss Provisions to Gross Loans.

Table 8. Key characteristics of banks by type

	Bank type	Ave. Loan	g(Loans)	$SIZE$	LIQ	CAP	DEP	STF	LLP
Nordic and Baltic States	Banks	10,019	15%	6.9	19%	11%	67%	21%	0.8%
	Saving Banks	1,337	10%	5.6	9%	12%	81%	10%	0.4%
	Mortgage	19,624	11%	8.9	7%	8%	23%	25%	0.1%
	AVERAGE	**5,988**	**12%**	**6.3**	**13%**	**11%**	**74%**	**15%**	**0.6%**
Eurozone countries	Banks	5,906	7%	6.3	19%	9%	68%	17%	0.7%
	Saving Banks	2,724	3%	7.3	14%	6%	70%	21%	0.8%
	Mortgage	10,860	4%	8.4	15%	7%	40%	28%	0.3%
	AVERAGE	**5,343**	**6%**	**6.6**	**18%**	**8%**	**68%**	**18%**	**0.7%**

Orbis database provides a trade description tag for every bank. Using this information, we group financial institutions into 3 clusters: (1) Banks (Bank Holdings & Holding Companies, Commercial Banks, Cooperative Banks) (2) Saving Banks and (3) Mortgage Institutions. Average loan (in billion EUR) and other average values of bank-specific variables are for the period of 2002-2010. g(Loans) shows average growth rate of loans. $SIZE$ is log of Total Assets. LIQ is the ratio of Liquid Assets to Total Assets. CAP is the ratio of Total Equity to Total Asset. DEP is the ratio of Total Customers' Deposits to Total Interest-bearing Liabilities. STF is the ratio of Short-Term Funding to Total Interest-bearing Liabilities. LLP is the ratio of Loan-Loss Provisions to Gross Loans.

Table 9. Results of the main regression for the Nordics and Baltics

Regressions (NOR1)-(NOR3) are GMM estimator regression, (NOR4)-(NOR6) OLS. Dependent variable: $\Delta \ln(Loans)_{i,t}$. Independent variables are change in monetary policy rate ($\Delta i_{PR,k,t-j}$), monetary policy rate interaction terms with banks specific factors ($SIZE$, LIQ, CAP, STF, DEP, LLP), TED spread volatility ($TED_{k,t-1}$), Country Stock Index ($EQT_{k,t-1}$). Stand-alone bank-specific factors are included as control variables. The GMM estimator includes lagged credit growth ($\Delta \ln(Loans)_{i,t-1}$). Values in parenthesis show robust standard errors. Significance is *** p<0.01, ** p<0.05, * p<0.1.

	GMM			OLS		
$\Delta \ln(Loans)_{i,t}$	(NOR1)	(NOR2)	(NOR3)	(NOR4)	(NOR5)	(NOR6)
$\Delta i_{PR,k,t}$	-2.370**	-4.912***	-9.569***	-2.633***	-4.253***	-7.364***
	(0.969)	(1.380)	(1.765)	(0.911)	(1.053)	(1.135)
$\Delta i_{PR,k,t-1}$	0.472	-0.0206	1.366	-0.0562	0.691	1.986**
	(0.648)	(0.970)	(1.055)	(0.594)	(0.727)	(0.831)
$\Delta i_{PR,k,t} * SIZE_{i,t-1}$	0.253**	0.205*	0.292**	0.323***	0.128	0.217**
	(0.109)	(0.119)	(0.124)	(0.0862)	(0.0977)	(0.0978)
$\Delta i_{PR,k,t} * LIQ_{i,t-1}$	-0.965	6.841**	8.272***	0.240	2.704	3.647
	(3.461)	(2.876)	(2.824)	(2.546)	(3.002)	(3.079)
$\Delta i_{PR,k,t} * CAP_{i,t-1}$	-1.811	8.181	9.461	8.591*	0.560	4.266
	(3.838)	(7.009)	(7.399)	(4.955)	(6.098)	(6.122)
$\Delta i_{PR,k,t} * STF_{i,t-1}$		0.784	2.453		4.256*	5.257**
		(2.991)	(2.763)		(2.349)	(2.231)
$\Delta i_{PR,k,t} * DEP_{i,t-1}$		0.898	2.171		1.151	2.081
		(1.826)	(1.864)		(1.395)	(1.380)
$\Delta i_{PR,k,t} * LLP_{i,t-1}$		44.93	99.08*		78.34*	105.2**
		(62.55)	(56.34)		(45.42)	(45.07)
$TED_{k,t-1}$			-2.222***			-1.289***
			(0.511)			(0.467)
$EQT_{k,t-1}$			0.175**			0.149***
			(0.0701)			(0.0421)
$SIZE_{i,t-1}$	-0.0158	0.00321	0.00796	0.000542	0.00134	0.00181
	(0.0142)	(0.0136)	(0.0134)	(0.00174)	(0.00326)	(0.00317)
$LIQ_{i,t-1}$	0.255**	0.210*	0.104	0.0915**	0.108**	0.0905**
	(0.123)	(0.110)	(0.110)	(0.0363)	(0.0454)	(0.0454)
$CAP_{i,t-1}$	0.816***	-0.168	-0.285	0.0261	0.0800	0.0750
	(0.316)	(0.335)	(0.332)	(0.0930)	(0.109)	(0.112)
$STF_{i,t-1}$		0.252	0.245		0.0514	0.0595
		(0.154)	(0.158)		(0.0381)	(0.0370)
$DEP_{i,t-1}$		0.553***	0.590***		0.0626	0.0700*
		(0.154)	(0.152)		(0.0393)	(0.0379)
$LLP_{i,t-1}$		-3.194**	-1.841*		-1.888**	-1.217*
		(1.269)	(1.072)		(0.743)	(0.737)
$\Delta \ln(Loans)_{i,t-1}$	0.408***	0.252***	0.185***	0.381***	0.273***	0.243***
	(0.0436)	(0.0475)	(0.0413)	(0.0351)	(0.0392)	(0.0377)
Constant	0.0427**	-0.0779*	-0.0804	0.00323	0.0705***	-0.000419
	(0.0210)	(0.0436)	(0.0578)	(0.0160)	(0.0206)	(0.0283)
Observations	2,037	1,280	1,280	2,037	1,280	1,280
Adj. R-squared				0.359	0.423	0.445
Number of instruments	139	208	210			
Number of ID	367	271	271			
Sargan test (p-value)	0.0001	0.1169	0.0957			
AB test MA(1) (p-value)	0.0000	0.0000	0.0000			
AB test MA(2) (p-value)	0.0639	0.9478	0.6648			

Table 10. Results of the main regression for the eurozone

Regressions (EUR1)-(EUR3) are GMM estimator regressions, (EUR4)-(EUR6) OLS. Dependent variable: $\Delta \ln(Loans)_{i,t}$. Independent variables are change in monetary policy rate ($\Delta i_{PR,t-j}$), monetary policy rate interaction terms with banks specific factors ($SIZE$, LIQ, CAP, STF, DEP, LLP), TED spread volatility ($TED_{k,t-1}$), Country Stock Index ($EQT_{k,t-1}$). Stand-alone bank-specific factors are included as control variables. The GMM estimator includes lagged credit growth ($\Delta \ln(Loans)_{i,t-1}$), and change in GDP ($\Delta \ln(GDPN)_{k,t-1}$). Values in parenthesis show robust standard errors. Significance is *** p<0.01, ** p<0.05, * p<0.1.

	GMM			OLS		
$\Delta \ln(Loans)_{i,t}$	(EUR1)	(EUR2)	(EUR3)	(EUR4)	(EUR5)	(EUR6)
$\Delta i_{PR,t}$	0.837*** (0.0903)	0.632*** (0.0894)	1.416*** (0.383)	0.843*** (0.0790)	0.752*** (0.0950)	1.697*** (0.376)
$\Delta i_{PR,t-1}$	-0.912*** (0.283)	-0.999*** (0.308)	-1.572*** (0.399)	-1.666*** (0.229)	-1.716*** (0.233)	-2.195*** (0.316)
$\Delta i_{PR,t} * SIZE_{i,t-1}$	0.389*** (0.0531)	0.328*** (0.0619)	0.328*** (0.0636)	0.467*** (0.0428)	0.410*** (0.0522)	0.404*** (0.0523)
$\Delta i_{PR,t} * LIQ_{i,t-1}$	1.047 (0.983)	-2.752*** (1.048)	-2.810*** (1.049)	0.229 (1.003)	-0.750 (1.226)	-0.801 (1.224)
$\Delta i_{PR,t} * CAP_{i,t-1}$	15.26*** (3.427)	6.485** (3.152)	6.834** (3.189)	12.19*** (2.525)	8.659*** (3.265)	8.595*** (3.274)
$\Delta i_{PR,t} * STF_{i,t-1}$		-0.757 (0.650)	-0.740 (0.654)		-0.766 (0.733)	-0.735 (0.733)
$\Delta i_{PR,t} * DEP_{i,t-1}$		-0.934 (0.630)	-0.949 (0.632)		-1.236** (0.573)	-1.190** (0.574)
$\Delta i_{PR,t} * LLP_{i,t-1}$		-8.305 (14.82)	-6.167 (14.96)		-31.97** (14.14)	-31.87** (14.10)
$TED_{k,t-1}$			0.675** (0.276)			1.136*** (0.296)
$EQT_{k,t-1}$			-0.0173 (0.0115)			-0.0124 (0.0112)
$SIZE_{i,t-1}$	-0.0114** (0.00549)	-0.00154 (0.00508)	-0.00135 (0.00530)	0.00283*** (0.000648)	0.00283*** (0.000734)	0.00286*** (0.000735)
$LIQ_{i,t-1}$	0.115*** (0.0381)	0.0678** (0.0319)	0.0638* (0.0335)	0.0500*** (0.0108)	0.0411*** (0.0123)	0.0397*** (0.0123)
$CAP_{i,t-1}$	-0.141 (0.258)	-0.0449 (0.188)	-0.0918 (0.187)	0.0233 (0.0403)	0.0360 (0.0449)	0.0360 (0.0450)
$STF_{i,t-1}$		0.149** (0.0743)	0.153** (0.0721)		0.0340*** (0.0121)	0.0343*** (0.0121)
$DEP_{i,t-1}$		0.0938 (0.0652)	0.0994 (0.0659)		0.0231** (0.00991)	0.0234** (0.00993)
$LLP_{i,t-1}$		-1.564*** (0.259)	-1.565*** (0.257)		-0.905*** (0.166)	-0.888*** (0.166)
$\Delta \ln(Loans)_{i,t-1}$	0.187*** (0.0199)	0.151*** (0.0197)	0.145*** (0.0200)	0.209*** (0.0137)	0.197*** (0.0145)	0.196*** (0.0146)
$\Delta \ln(GDPN)_{k,t-1}$	0.343*** (0.120)	0.393*** (0.132)	0.604*** (0.156)	0.746*** (0.1000)	0.757*** (0.100)	0.943*** (0.124)
Constant	0.0562** (0.0254)	0.0358* (0.0199)	0.0262 (0.0192)	0.0205*** (0.00478)	0.0202*** (0.00478)	0.00882 (0.00589)
Observations	17,424	15,293	15,293	17,424	15,293	15,293
Adj. R-squared				0.186	0.208	0.209
Number of instruments	120	179	181			
Number of ID	2,968	2,728	2,728			
Sargan test (p-value)	0.0000	0.0000	0.0000			
AB test MA(1) (p-value)	0.0000	0.0000	0.0000			
AB test MA(2) (p-value)	0.0042	0.0032	0.0044			

Table 11. GIPS countries

Regressions (EUR3) and (GIPS) are GMM estimator regressions for the eurozone. (EUR3) is reported as in Table 10. (GIPS) regression includes a dummy variable $GIPS_i$, which takes value of 1 if country where bank operates is Greece, Ireland, Portugal or Spain, 0 otherwise. Dependent variable: $\Delta\ln(Loans)_{i,t}$. Independent variables are change in monetary policy rate ($\Delta i_{PR,t-j}$), monetary policy rate interaction terms with banks specific factors ($SIZE$, LIQ, CAP, STF, DEP, LLP), TED spread volatility ($TED_{k,t-1}$), Country Stock Index ($EQT_{k,t-1}$). Stand-alone bank-specific factors are included as control variables, but not reported. Lagged credit growth ($\Delta\ln(Loans)_{i,t-1}$), and change in GDP ($\Delta\ln(GDPN)_{k,t-1}$) for the eurozone are included. Values in parenthesis show robust standard errors. Significance is *** p<0.01, ** p<0.05, * p<0.1.

$\Delta\ln(Loans)_{i,t}$	(EUR3)	(GIPS)
$\Delta i_{PR,t}$	1.416*** (0.383)	1.510*** (0.376)
$\Delta i_{PR,t-1}$	-1.572*** (0.399)	-1.396*** (0.409)
$\Delta i_{PR,t} * SIZE_{i,t-1}$	0.328*** (0.0636)	0.194*** (0.0703)
$\Delta i_{PR,t} * LIQ_{i,t-1}$	-2.810*** (1.049)	-2.014* (1.206)
$\Delta i_{PR,t} * CAP_{i,t-1}$	6.834** (3.189)	4.305 (3.633)
$\Delta i_{PR,t} * STF_{i,t-1}$	-0.740 (0.654)	-0.650 (0.643)
$\Delta i_{PR,t} * DEP_{i,t-1}$	-0.949 (0.632)	-1.371* (0.723)
$\Delta i_{PR,t} * LLP_{i,t-1}$	-6.167 (14.96)	-7.564 (16.66)
$TED_{k,t-1}$	0.675** (0.276)	0.837** (0.331)
$EQT_{k,t-1}$	-0.0173 (0.0115)	-0.0234** (0.0117)
$GIPS_i * TED_{k,t-1}$		-4.668*** (1.423)
$\Delta\ln(Loans)_{i,t-1}$	0.145*** (0.0200)	0.134*** (0.0322)
$\Delta\ln(GDPN)_{k,t-1}$	0.604*** (0.156)	0.510*** (0.176)
Constant	0.0262 (0.0192)	0.0334 (0.0213)
Observations	15,293	15,293
Number of instruments	181	182
Number of ID	2,728	2,728

Appendix C. Results of robustness checks

Table 12. Robustness checks: additional variables

Regressions (NORTYPE), (NORSUB) and (NORNSM) are GMM estimator regressions for the Nordic and Baltic States, (EURTYPE), (EURSUB) and (EURNSM) for the eurozone. Dependent variable: $\Delta \ln(Loans)_{i,t}$. Independent variables are change in monetary policy rate ($\Delta i_{PR,k,t-j}$), monetary policy rate interaction terms with banks specific factors ($SIZE$, LIQ, CAP, STF, DEP, LLP), TED spread volatility ($TED_{k,t-1}$), Country Stock Index ($EQT_{k,t-1}$). In (NORTYPE) and (EURTYPE) we include dummy variables for Saving Banks ($Saving_i$) and Mortgage Institutions ($Mortg_i$), which take value of 1 if a bank belongs to a respective group, 0 otherwise. In (NORSUB) and (EURSUB) a subsidiary dummy (Sub_i) takes value of 1 if a bank is indicated as a subsidiary, 0 otherwise. In (NORNSM) and (EURNSM) a change in Non-standard monetary policy measures (ΔNSM_i) of central banks is included. Stand-alone bank-specific factors are included as control variables, but not reported. Lagged credit growth ($\Delta \ln(Loans)_{i,t-1}$), and change in GDP ($\Delta \ln(GDPN)_{k,t-1}$) for the eurozone are included. Values in parenthesis show robust standard errors. Significance is *** p<0.01, ** p<0.05, * p<0.1.

	The Nordics and Baltics			The eurozone		
$\Delta \ln(Loans)_{i,t}$	(NORTYPE)	(NORSUB)	(NORNSM)	(EURTYPE)	(EURSUB)	(EURNSM)
$\Delta i_{PR,k,t}$	-9.188*** (1.740)	-7.568*** (1.716)	-10.67*** (1.959)	1.185*** (0.423)	1.262*** (0.375)	1.578*** (0.390)
$\Delta i_{PR,k,t-1}$	1.379 (1.025)	1.655* (0.956)	2.060* (1.077)	-1.470*** (0.423)	-1.539*** (0.403)	-1.568*** (0.394)
$\Delta i_{PR,k,t} * SIZE_{i,t-1}$	0.269** (0.128)	0.162 (0.132)	0.349** (0.136)	0.307*** (0.0849)	0.298*** (0.0627)	0.327*** (0.0631)
$\Delta i_{PR,k,t} * LIQ_{i,t-1}$	7.886*** (2.935)	9.822*** (2.683)	8.196*** (2.752)	-2.612** (1.044)	-3.350*** (1.061)	-2.884*** (1.058)
$\Delta i_{PR,k,t} * CAP_{i,t-1}$	9.148 (7.014)	9.786 (7.577)	15.34** (7.723)	6.445** (3.255)	6.818** (3.135)	6.811** (3.156)
$\Delta i_{PR,k,t} * STF_{i,t-1}$	2.458 (2.766)	-0.519 (2.930)	2.412 (2.714)	-0.956 (0.660)	-0.598 (0.638)	-0.689 (0.654)
$\Delta i_{PR,k,t} * DEP_{i,t-1}$	2.186 (1.816)	1.448 (1.845)	2.218 (1.779)	-0.856 (0.872)	-0.605 (0.634)	-0.920 (0.628)
$\Delta i_{PR,k,t} * LLP_{i,t-1}$	86.31 (52.86)	88.24 (57.45)	101.0* (55.64)	-7.043 (15.65)	-7.004 (14.68)	-7.430 (14.89)
$TED_{k,t-1}$	-2.142*** (0.501)	-1.773*** (0.465)	-2.473*** (0.493)	0.460 (0.327)	0.624** (0.274)	1.142*** (0.381)
$EQT_{k,t-1}$	0.172** (0.0671)	0.179*** (0.0646)	0.206*** (0.0713)	-0.0127 (0.0116)	-0.0162 (0.0112)	-0.00769 (0.0123)
$Saving_i$	-0.0534 (0.0412)			-0.0357** (0.0139)		
$Mortg_i$	-0.201 (0.141)			-0.0995* (0.0548)		
Sub_i		0.236*** (0.0811)			-0.0323 (0.0373)	
$\Delta i_{PR,k,t} * Sub_i$		3.465*** (1.133)			1.035** (0.408)	
ΔNSM_i			0.377** (0.160)			-0.144* (0.0784)
$\Delta \ln(Loans)_{i,t-1}$	0.200*** (0.0420)	0.193*** (0.0411)	0.190*** (0.0411)	0.144*** (0.0275)	0.144*** (0.0203)	0.143*** (0.0199)
$\Delta \ln(GDPN)_{k,t-1}$				0.562*** (0.175)	0.590*** (0.158)	0.700*** (0.169)
Constant	-0.204*** (0.0590)	-0.0743 (0.0550)	-0.0662 (0.0552)	0.0698** (0.0304)	0.0303 (0.0194)	0.0175 (0.0196)
Observations	1,280	1,280	1,280	15,293	15,293	15,293
Number of instruments	210	211	211	181.000	182.000	181.000
Number of ID	271	271	271	2,728	2,728	2,728

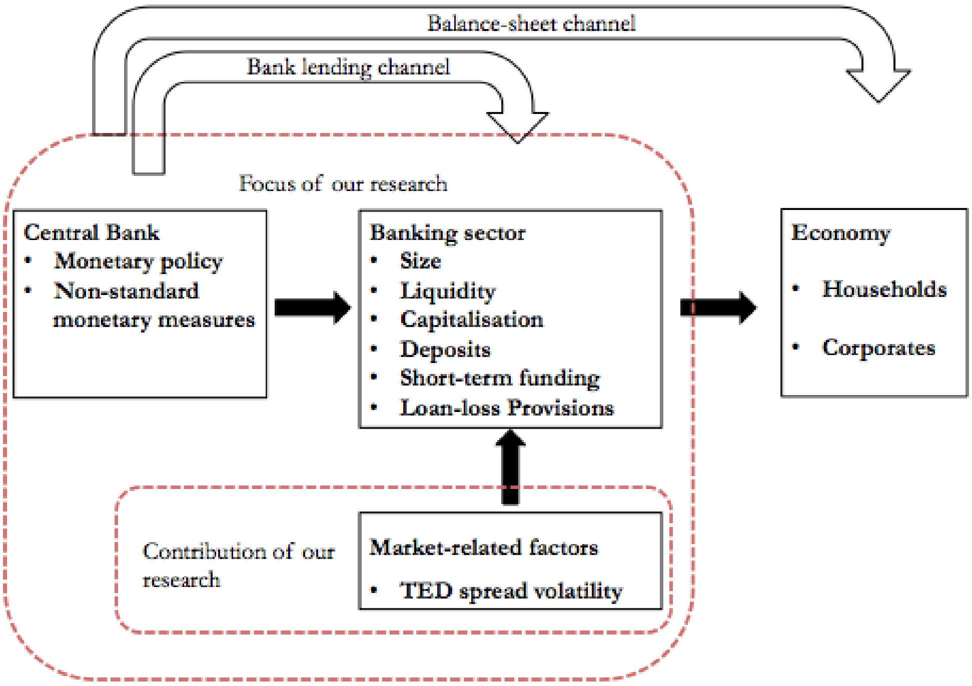
Table 13. Robustness checks: other proxies

Regressions (NORFIX), (NORINT) and (NORTED) are GMM estimator regressions for the Nordic and Baltic States, (EURINT) and (EURTED) for the eurozone. In (NORFIX) local monetary policy rate is substituted with the ECB repo rate for Denmark, Estonia, Latvia, Lithuania. In (NORINT) and (EURINT) monetary policy rate ($\Delta i_{PR,t-j}$) is substituted with an interbank interest rate. In (NORTED) and (EURTED) TED spread volatility ($TED_{k,t-1}$) is substituted with a change in TED spread level. Dependent variable: $\Delta \ln(Loans)_{i,t}$. Other independent variables are change in monetary policy rate interaction terms with banks specific factors ($SIZE$, LIQ, CAP, STF, DEP, LLP), Country Stock Index ($EQT_{k,t-1}$). Stand-alone bank-specific factors are included as control variables, but not reported. Lagged credit growth ($\Delta \ln(Loans)_{i,t-1}$), and change in GDP ($\Delta \ln(GDPN)_{k,t-1}$) for the eurozone are included. Values in parenthesis show robust standard errors. Significance is *** p<0.01, ** p<0.05, * p<0.1.

	The Nordics and Baltics			The eurozone	
$\Delta \ln(Loans)_{i,t}$	(NORFIX)	(NORINT)	(NORTED)	(EURINT)	(EURTED)
$\Delta i_{PR,k,t}$	-10.58***	-4.610***	-7.982***	0.0819	0.766**
	(2.047)	(0.807)	(1.617)	(0.213)	(0.307)
$\Delta i_{PR,k,t-1}$	3.014***	-0.0345	1.420	-0.726***	-1.070***
	(1.047)	(0.857)	(1.049)	(0.260)	(0.378)
$\Delta i_{PR,k,t} * SIZE_{i,t-1}$	0.413***	0.0838	0.276**	0.262***	0.330***
	(0.145)	(0.0913)	(0.118)	(0.0857)	(0.0626)
$\Delta i_{PR,k,t} * LIQ_{i,t-1}$	8.536***	4.787***	9.084***	-1.792	-2.680**
	(3.018)	(1.798)	(2.933)	(1.090)	(1.044)
$\Delta i_{PR,k,t} * CAP_{i,t-1}$	8.863	2.792	11.64	3.640	6.560**
	(7.591)	(5.091)	(7.116)	(2.364)	(3.199)
$\Delta i_{PR,k,t} * STF_{i,t-1}$	4.725	-0.222	3.210	-0.889*	-0.649
	(2.914)	(1.968)	(2.775)	(0.512)	(0.645)
$\Delta i_{PR,k,t} * DEP_{i,t-1}$	3.920**	-0.711	1.958	-1.083*	-0.943
	(1.953)	(0.985)	(1.800)	(0.629)	(0.641)
$\Delta i_{PR,k,t} * LLP_{i,t-1}$	89.30*	23.07	71.72	1.382	-7.778
	(54.17)	(27.33)	(58.21)	(11.08)	(14.81)
$TED_{k,t-1}$	-1.968***	-4.488***	0.296	-0.0646	0.675
	(0.547)	(0.873)	(0.500)	(0.159)	(1.176)
$EQT_{k,t-1}$	0.180**	0.122*	0.237***	0.00879	0.00108
	(0.0710)	(0.0656)	(0.0628)	(0.0116)	(0.0102)
$\Delta \ln(Loans)_{i,t-1}$	0.187***	0.160***	0.211***	0.148***	0.152***
	(0.0430)	(0.0443)	(0.0413)	(0.0332)	(0.0199)
$\Delta \ln(GDPN)_{k,t-1}$				0.382***	0.381***
				(0.144)	(0.139)
Constant	-0.0146	-0.0961*	-0.138***	0.0321	0.0277
	(0.0486)	(0.0556)	(0.0526)	(0.0861)	(0.0185)
Observations	1,280	1,280	1,280	15,315	15,315
Number of instruments	210	210	210	181	181
Number of ID	271	271	271	2,731	2,731
Sargan test (p-value)	0.0944	0.1333	0.0621	0.0000	0.0000
AB test MA(1) (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000
AB test MA(2) (p-value)	0.4999	0.675	0.9069	0.005	0.0031

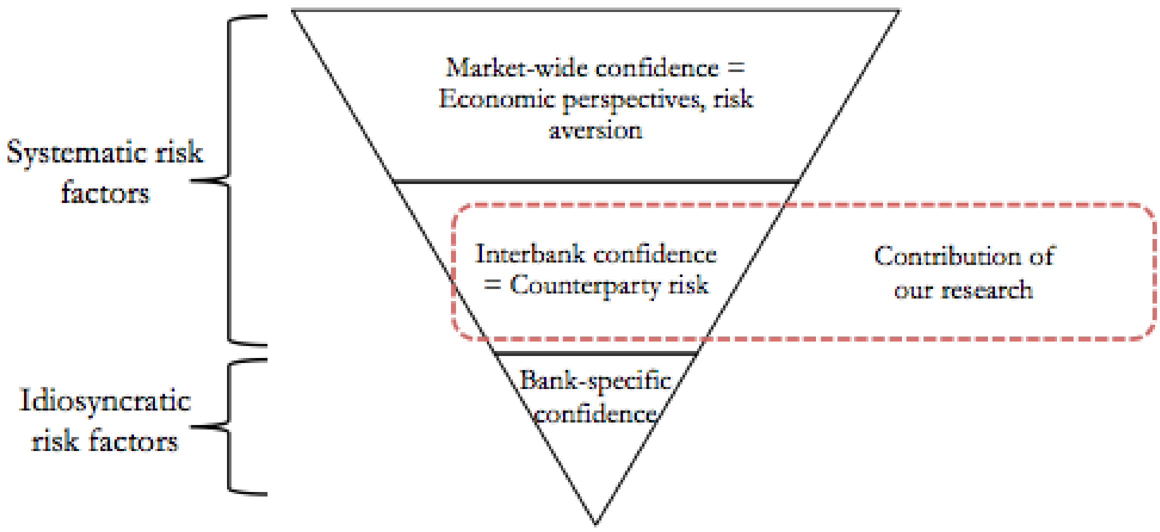
Appendix D. Key frameworks

Figure 7. The framework of our study



The focus and contribution of our research are presented. We investigate the bank lending channel in the Nordic and Baltic States as well as draw conclusions in relation to the eurozone. We rely on widely approved bank-specific factors (Size, Liquidity, Capitalisation) as well as incorporate the newly researched variables (Deposits, Short-Term Funding and Loan-Loss Provisions). The key contribution is the incorporation of TED spread volatility as the proxy for interbank confidence in the bank lending channel.

Figure 8. The framework of confidence



The framework of confidence is depicted. We view broad market confidence as investors' willingness to invest or provide capital to a risky asset. This is the supply-side based view, where we disregard shifts in demand for capital caused by changes in confidence. Furthermore, market confidence is divided into three levels from a broad market perspective to the banking sector and to an individual bank. We assume that increased risk at any level will result in decreased confidence and vice versa. In other words, investors are rational decision makers. We also hypothesize that changes in different scopes of confidence will have varying effects on credit growth.

Appendix E. A general overview of the Nordic and Baltic banking sector

Sweden

In Sweden, loan market is dominated by Nordea, SEB, Handelsbanken and Swedbank (including their subsidiaries), which account for majority of lending in the country. Banks' total assets linked to local operations comprised 250% of GDP in 2010, but after adding foreign operations it accounted for more than 380%, which is twice as much as the eurozone average (Sveriges Riksbank, 2011). This is mainly due to exposure to other Nordic countries and the Baltic States. Swedbank controls more than 40% of lending in Estonia, about 25% in Latvia, and 20% in Lithuania. SEB market shares are 23%, 15% and almost 30% respectively, whereas Nordea has about 10%-15% in every Baltic country (Sveriges Riksbank, 2011).

As of March 2011, almost half of Swedish banks' funding came from deposits; covered bonds comprised 26%, unsecured bonds and certificates – 21%. Market funding of Swedish banks grew from SEK 1,000 billion in 2005 to about SEK 2,700 billion in 2010, where foreign currencies funding (mainly, USD) comprised about 50% of total market funding. (Sveriges Riksbank, 2011).

Norway

Total assets of financial sector accounted for about 230% of GDP (where commercial banks have 120%) in 2010 (Norges Bank, 2010). In the same year, seven largest financial institutions accounted for 70% of total assets and 3 largest – for 55%. In portfolio of households loans, mortgages are dominating; corporates usually take loans for commercial real estate and shipping. Norwegian banks have little exposure to foreign customers as compared to banks in Sweden and Denmark (Norges Bank, 2011). Only DnB NOR has foreign operations of some importance (Steffensen, 2010).

Finland

The finnish banking sector is concentrated and dependent on shocks in foreign markets as two foreign banks (Nordea and OP-Pohjola Group) control a substantial share of the market. Throughout the crisis, domestic commercial banks in Finland remained profitable due to low exposure to the eurozone. Over the period of 2007-2011, funding gap (difference between loans and deposits) was fluctuating around EUR 40 million, which was mainly covered with covered bonds. (Suomen Pankki, 2011).

Denmark

The largest credit institutions in Denmark are Danske Bank and Nordea. Banks' customers funding gap (difference between loans and deposits) has risen sharply prior to the 2007-

2008 crisis due to high credit growth backed-up by issuance of debt instruments, which share in banks' balance sheet rose from 11% in 2003 up to 18% in 2011. Households debt based on variable interest rate has increased from 38% in 2003 to 56% in 2008, which leaves the banking sector more exposed to changes in market rates. (Denmark Central Bank, 2011)

The Baltic States (Estonia, Latvia, Lithuania)

The Baltic market is unique due to its high dependence on Nordic banks (namely, Swedbank, SEB, Nordea, DnB NOR). Over the years, Estonian and Lithuanian banking sectors faced consolidation, but Latvian market remained scattered: sector is still dependent on small niche banks with close links to Russia (Festic et al., 2011). Moreover, Lithuanian banking sector is smaller and less effective than Estonian and Latvian due to high state-ownership and higher risk-aversion of banks (Festic et al., 2011). Researchers are interested in the boom-bust period in the Baltic States, because prior to the 2007-2008 crisis, high credit growth provided by foreign banks' branches and subsidiaries led to deterioration in Loans-to-Deposits ratio, which was followed by increased Loan-Loss Provisions and Impairments (Martin, 2010).