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Basel III and Monetary Policy

Investigating Capital Requirements and the Bank Lending Channel: A Nordic Study

Henric Nicklasson
Oskar Jansson

2020

Master's Programme in Finance
Department of Economics
Lund University School of Economics and Management

Supervisor: Anders Vilhelmsson

Abstract

Headlined by Basel III - banking regulation has been the target of extensive revisions and remodeling in the wake of the Global Financial Crisis. The same period has, in many countries, also been characterized by unprecedented accommodative monetary policy. Since banks serve as a critical transmitter of both policies, regulatory and monetary alike, their implications on bank lending merit further investigation. This paper empirically explores the transmission of capital requirements and monetary policy - as well as their interaction - on bank lending, by employing a dynamic Least Square Dummy Variable (LSDV) model on quarterly bank-level data of 17 banks in the Nordic region of Sweden, Norway, Denmark, and Finland (the *Nordic-4)* covering the period from 2013:Q1 to 2019:Q4.

Our results suggest no significant bank lending channel in the region, and though our results favor an irrelevance of capital requirements in accordance with the Modigliani-Miller Theorem in most settings, the theorem appears to fail amongst small banks where a significant negative effect on consumer lending is found. Our study further contributes to the existing literature by providing additional robustness to earlier findings that the effect of capital requirements on lending is primarily prevalent amongst small banks, amidst which it further suggests that there might be a significant interaction between the two policies. Bank-specific heterogeneity in the response, along such dimensions as size, could have unintended implications on the banking system if not properly identified and considered. Especially with the rise of more homogenous regulatory treatments with the increased macroprudential focus in Basel III.

Keywords: Basel III, Capital Requirements, Monetary Policy Transmission, Bank Lending

Acknowledgements

This thesis was written as a part of the Master's Programme in Finance at Lund University School of Economics and Management (LUSEM), Sweden. In this section, we would like to express our sincerest appreciation towards all people who have supported us during the writing process - which this time happened to coincide with the global pandemic of COVID-19.

First and foremost, we would like to highlight our thesis supervisor, Anders Vilhelmsson, who has provided us with guidance, ideas and inspiration throughout this period. His continuous assistance and flexible approach have facilitated our work forward and improved the overall quality of the final version of this paper.

Special thanks should be directed to our families and friends for the support and encouragement during this semester.

Henric Nicklasson & Oskar Jansson

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List of Abbreviations

Abbreviation	*Definition*
Basel III	Third Basel Accord
BCBS	Basel Committee on Banking Supervision
CET1	Common Equity Tier 1
CCoB	Capital Conservation Buffer
CCyB	Countercyclical Capital Buffer
ECB	European Central Bank
EU	European Union
ERM II	Exchange Rate Mechanism II
HQLA	High Quality Liquid Asset
IRB	Internal Ratings Based
LCR	Liquidity Coverage Ratio
LSDV	Least Square Dummy Variable
MM	Modigliani-Miller
NSFR	Net Stable Funding Ratio
RWA	Risk-Weighted Assets

1 Introduction

The 2007-2008 Global Financial Crisis and the recession that followed, shed a bright light on the many shortcomings of the contemporary financial system and its legislations. Though the culprits were many, a consensus seems to have arisen that the primary offender was that of the banking systems (Acharya & Richardson, 2009; Kashyap, Rajan & Stein, 2008; Li, Xiong, Chen & Wang, 2017). These bearing pillars of modern-day complex financial systems proved to comprise systemic costs that they did not themselves fully bear. It was made evident that the legislators and their regulatory policies had not kept pace with recent financial developments, and it was clear that new revised regulation was necessary. In response, the Basel Committee on Banking Supervision (BCBS) presented the third configuration of the Basel standards (Basel III) (BIS, 2017). First published in December 2010, it aims to, through both microprudential and macroprudential measures - where additional focus under the third accord arguably has been devoted to the latter - to provide regulators with tools to address systemic risks towards a stable, safe and sound financial system (European Commission, 2013).

Regulators and supervisors, tasked with the upkeep of a sound and effective financial system, are however not the only ones exerting their influence on the banking system. The central bankers, tasked with macroeconomic stability, also recognize the importance of banks as financial intermediaries in achieving their task (Cecchetti & Li, 2008). The monetary policy in the wake of the financial crisis and the time of the implementation of Basel III has and is being characterized as unprecedentedly accommodative with several countries taking up zero and even negative interest rate regimes. Some might argue that a period of such need for economic stimulus hardly is a good time for the implementation of these regulations of more contractionary nature. The banking system thus stands as a critical transmitter and medium for both policies, monetary and regulatory alike (Imbierowicz, Löffler & Vogel, 2019). An existing body of research has, with various aims, examined the two policies - capital regulation and monetary policy - by studying them separately. However, little consensus seems to have been reached regarding their interaction (Aiyar, Calomiris & Wieladek, 2016; Imbierowicz, Löffler & Vogel, 2019; Xiong, 2013). This paper seeks to contribute to this area by studying the two policies' impact on bank lending. Hence, though monetary policy aims to affect the real economy through several distinct channels, we narrow our focus to its effect on bank lending, i.e. the bank lending channel; Thus, the purpose of this study is to untangle some of the

ambiguity surrounding the two policies' effects and interactions in regard to bank lending and try to establish robust relationships, as to help prevent possible perverse and unintended outcomes.

With this aim, we investigate the relationship in the Nordic region of Sweden, Norway, Denmark, and Finland (hereafter the *Nordic-4*). Though these Nordic countries not seldom are viewed as very similar in most regards, they all differ in one crucial aspect of relevance in the context of this paper, and of which this study wishes to bring further insight - their monetary policy. The heterogeneity in this aspect stems from the following circumstances; Whilst Finland has completely surrendered their monetary policy to the supranational European Central Bank (ECB) via its adaptation of the Euro, Norway stands in stark contrast not being part of the European Union (EU) at all. Sweden and Denmark, while also members of the EU, are yet to adopt the Euro and thus still retain some monetary policy independence. Sweden, arguably more so than Denmark, as Denmark while still having its currency, have the Danish krone pegged to the Euro. As such, our sample covers a wide spectrum of monetary policy settings, making our results more generalizable.

Hence, this study seeks to achieve its purpose of contributing to the understanding of the effect and the interaction of prudential capital requirements and the bank lending channel, by looking for relationships that are prevalent across different countries and a variety of monetary settings, rather than focus on a single country solely. This thesis's main research questions serve as benchmarks in terms of empirical research, data collection, and the method applied. This paper seeks to contribute to the existing literature by answering the following research questions:

- *How does capital requirements affect bank lending?*
- *Is there a bank lending channel in the Nordic-4?*
- *Are there any interactions between the stricter capital requirements regulation of Basel III and the potential bank lending channel of monetary policy?*

The paper makes use of quarterly bank-level data collected for a total of 17 Swedish, Norwegian, Danish, and Finnish banks ranging from 2013:Q1 to 2019:Q4, a period predominantly characterized by increases in capital requirements and loose monetary policy. We employ a dynamic LSDV model across all specifications and the results are as follows: For capital requirements, our findings suggest that they primarily affect small banks amongst which we find a significant negative effect on consumer loans. The results might further suggest that

the increased requirements cause loan shifting between sectors as banks reshuffle their loan portfolios towards loans that bear lower risk weights. As for a bank lending channel, our results favor its proposed irrelevance by Romer and Romer (1990). Finally, the interaction of the two policies appears significant amongst small banks where increased capital requirements are suggested to have had an amplifying effect on expansionary monetary policy, which has been the most prevalent one in the sample, but an attenuating effect on contractionary monetary policy. However, given the lack of a significant lending channel, the interaction does not appear very robust. We do, however, suggest that it merits further research.

The remainder of the paper is organized as follows: The next section provides the literature and theoretical review. It includes the background and development of the Basel regulatory framework, following a review of relevant previous research concerning monetary policy transmission, capital regulation, and their interaction. Section 3 describes the method applied and data used, covering both the data collection process and the models employed. Section 4 then serves to present and discuss the empirical findings. Finally, Section 5 concludes.

2 Literature/Theoretical Review

This section aims to present the literature and theoretical review, covering the background and development of the Basel regulatory framework, followed by a brief description of the banking sectors and the prevailing monetary policy regimes in the Nordic-4. Finally, the related literature and previous empirical findings for our study are provided, starting with the relevant transmission channels of monetary policy, followed by capital regulation, and lastly, their interaction.

2.1 The Basel Regulatory Framework

2.1.1 Background

Partly as a response to the financial market turmoil associated with the collapse of the Bretton Woods system in the early 1970s, the central bank governors of the Group of Ten countries, known as the G10, initiated the Committee on Banking Regulations and Supervisory Practices in 1974. Today referred to as the Basel Committee of Banking Supervision (BCBS), the committee has expanded its membership to be represented by 28 jurisdictions but has in practice an impact in virtually all countries where banks with international presence exist (BIS, 2014a). Now, almost half a century since its initiation, the original aim of its existence remains, i.e. to increase the stability of the financial system through improved worldwide supervision and enhance the understanding of main supervisory issues, approaches and techniques. In this role, it brings together central bankers and financial authorities around the world, and its standards set is proposed to be regarded as minimum standards.

As the BCBS itself does not enjoy any formal supranational authority, its proposed prudential rules have no legally binding role. Thus, it depends on the commitment of its members to follow and implement the proposed guidelines and standards, which aims to be tailored and adopted through domestic regulations to fit a specific national system (BIS, 2014a). The Basel committee has formulated three sets of regulations, namely the Basel I, Basel II and Basel III accords.

2.1.2 Basel I - The First Basel Accord

Issued in 1988 in the aftermath of the debt crisis in Latin America, the first accord (Basel I) formulated the first uniform capital adequacy requirements for internationally-active banks. As whilst banking activities had become increasingly global, banking regulations had yet mainly remained local (Balthazar, 2006). In particular, Basel I introduced two main ideas. First, it provided a new definition of bank capital and classified capital as either Tier 1 or Tier 2 capital based on its risk characteristics. This classification served to provide the basis for calculating banks' capital ratios and thus rank their capital adequacy. Tier 1 capital comprises conventional sources of funding for the bank, primarily consisting of common stock and retained earnings, and is, in this regard, considered the highest-ranking of capital. On the other hand, Tier 2 capital is regarded as more supplementary in its nature, e.g. subordinated debt (Yeh, Twaddle & Frith, 2005).

Second, Basel I stipulated that the proper level of banks' capital base was to be determined in relation to the risks of that specific bank. In essence, the risks were considered to be attributed to the asset side of the balance sheet, and correspondingly, the minimum capital requirement was defined as a portion of the risk-adjusted assets held (Yeh, Twaddle & Frith, 2005). In order to make risk-adjustments of the assets, different risk-weights were assigned to different assets. As such, assets considered riskier, e.g. corporate loans, were given higher weights, whereas assets with less risk, e.g. assets with exposure to the government, were assigned relatively lower weights. Under Basel I, the minimum capital requirement was defined as the sum of Tier 1 and Tier 2 capital expressed as a percentage of the total risk-weighted assets (RWA). Banks were obliged to hold at least 50 percent of its capital base as Tier 1, and a minimum total ratio of 8 percent of its RWA as a minimum (Yeh, Twaddle & Frith, 2005).

2.1.3 Basel II - The Second Basel Accord

Though built on the first capital restrictions of Basel I, the second accord of the Basel framework (Basel II) was released in 2004 to revise the standards formulated by its precursor and provide a more consistent framework (Balthazar, 2006). With the wide use among banks of risk mitigation instruments and other methods to manage and measure risk, discrepancies arose between the Basel framework and some banks actual risk reported and opened up for financial innovation. In essence, Basel II recognized that banks faced risks more multifaceted than previously defined, and thus aimed to more explicitly link capital requirements with these risks (Yeh, Twaddle and Frith, 2005). Accordingly, a notable revision of Basel II is that it

admitted that financial institutions indeed might differ in a significant manner. Hence, this accord made it possible for financial institutions to adopt different approaches to calculate RWA and the capital requirements, e.g. depending on their advancement level. Thus, banks were encouraged to establish more sophisticated risk management processes with a closer relationship between actual risks and the capital required for such risks. As credit risk represents a significant share of the risks faced by banks, it serves as a critical ingredient for regulatory capital requirements. Basel II provided two different approaches for the computation of risk-weights: The Standardised approach and the Internal Ratings-Based (IRB) approach (Lind, 2005).

The IRB approach implied that some banks, subject to approval by financial supervisory authorities, adopted so-called internal models in the computation of their RWA. The idea was that this would lead to a more significant link between the capital requirements and the actual risks associated. However, this approach turned out to instead be somewhat counterintuitive, where banks could easily "game the system". This flexibility incentivized banks to understate their risks through, e.g. manipulation of the risk-weighted capital, use of derivatives, and concentration of risk exposure in assets considered less risky (Pakravan, 2014). Further, while the minimum capital requirement of 8 percent was to remain unchanged also under Basel II, additional elements were added. Arguably most central, the Basel Committee introduced the "three pillars" concept of which the second framework is based. The three mutually reinforcing pillars contain minimum capital rules encompassing the level and type of capital that banks are required to hold, the supervisory review process of financial institutions and their capital needs, and market discipline that concerns information disclosure (Balthazar, 2006). An updated version of the three pillars under the revised standards of the third accord (Basel III) is summarized in Table 1 below, followed by a more detailed description of the content of each pillar.

2.1.4 Basel III - The Third Basel Accord

Though the Basel III package indeed was under development before the eruption of the global financial crisis, the changes made were mostly a response to the many deficiencies in global regulatory and supervisory frameworks that were made evident during the crisis. Hence, the third installment was developed on the grounds of the inappropriate measures of earlier reform packages and extends the pre-crisis framework with a rather significant range of innovations. Thus, Basel III is described as being more solid in avoiding the build-up of systemic collapses

and better equip the banking sector with the capability to uphold the real economy over economic cycles (BIS, 2017). While the regulation under Basel III still builds on the foundation of the three pillars, it implies a gradual tightening of capital requirements, both regarding the quantity and quality of banks' capital holdings. As the financial crisis revealed, many banks did not have sufficient levels of high-quality capital in the earlier phase of the crisis, which made them vulnerable when conditions in the marketplace changed (BIS, 2011).

Moreover, inconsistencies between different jurisdictions related to how capital ratios were defined caused confusion and difficulties for market participants to examine and compare the quality of capital if banks happened to fall under different jurisdictions (BIS, 2011). Released in 2010 and implemented since 2013, the updated framework implies tighter capital requirements, leverage requirements, countercyclical measures, more stringent requirements for systemically important banks, and introduces requirements on liquid asset holdings (BIS, 2017).

As earlier touched upon, the third accord continues to consist of the three pillars already established. However, the structure is revised and strengthened in line with the rather comprehensive set of reforms from the previous accords. Table 1 below and the subsequent part serves to provide an overview of the content and purpose of the pillars under Basel III.

Table 1: Summary of the Basel III Pillars

Pillar	Aim	Description
Pillar 1: *Minimum capital and liquidity requirements*	Certain requirements that ensure banks have adequate capital and liquidity levels to withstand losses and runs on funding	Minimum requirements for capital, leverage, and liquidity. Also additional requirements for systemically important banks
Pillar 2: *Supervisory Review Process*	Allow supervisors to work with individual banks to assess risks unrelated to Pillar I, e.g. internal controls and qualitative issues	Guidelines on qualitative issues, e.g. corporate governance, stress testing, model validation, risk data aggregation, and reporting
Pillar 3: *Market Discipline*	Provide the market with sufficient information to allow market prices to reflect and influence risk-taking	Standardized templates for public disclosure of key risk metrics to market participants

(Adapted from Gomes, King & Lai, 2017, p .37)

2.1.4.1. Pillar 1: Minimum Capital and Liquidity Requirements

The first pillar arguably represents the core of the Basel Committee's regulatory framework, formulating the calculations of capital requirements for credit, market, and operational risk. Under Basel III, a new stricter definition of regulatory capital is introduced. It provides a classification system with a certain set of criteria which all are to be fulfilled for each of the below three different capital categories:

(1) Common Equity Tier 1 (CET1) capital - represents "going-concern" capital.
(2) Additional Tier 1 capital - also serves as "going-concern" capital.
(3) Tier 2 capital - classified as "gone-concern" capital (BIS, 2019a).

Tier 1 capital consists of the sum of CET1 and additional Tier 1 capital, and the total regulatory capital is then the sum of Tier 1 and Tier 2 capital, where CET1 represents the highest quality of capital with ultimate loss-absorbance capacities. The capital requirements under Pillar 1 include a minimum CET1 of 4.5 percent, a minimum Tier 1 capital ratio of 6 percent, and a minimum total capital (Tier 1 + Tier 2) ratio of 8 percent, where each minimum requirement, as earlier noted, is expressed as a percentage of RWA (BIS, 2019b).

In addition, the package of new sets of reforms under Basel III includes the introduction of new capital buffers, specifically aimed to mitigate system-wide risks within the financial system through so-called macroprudential measures. As such, the Capital Conservation Buffer (CCoB) and Countercyclical Buffer (CCyB) entered the regulatory field and are additional attempts to dampen the effect of procyclicality within the financial system. Also, macroprudential elements introduced more stringent measures subject to implementation for Systemically Important Financial Institutions (SIFIs) (BIS, 2019c). The Capital Conservation Buffer (CCoB) aims to conserve the capital of banks and ensure the existence of available capital that can be drawn upon in times of stress. The CCoB is to be met with an additional amount of CET1 capital and is thus required on top of the established 4.5 percent requirement (BIS, 2019c). CCyB then serves as an extension of the CCoB and is based on the idea that banks should build up a capital buffer during good times and in periods of high lending growth. Compared to CCoB, it is subject to the discretion of national jurisdictions to account for variations in the financial climate between countries. The institution-specific CCyB is likewise required to be met with CET1 capital, but varies between 0 and 2.5 percent of banks' RWA, and is updated on a regular basis based on current economic conditions (BIS, 2019c).

As presented in Table 2 below, Basel III foresees a gradual transition and a step-by-step implementation of its stricter capital regulation. However, the regulations might be, and commonly is, implemented at a national level earlier than the phase-in arrangements outlined by the Basel Committee.

Table 2: Capital Requirements - Phase-in Arrangements (Basel III)*

	2013	2014	2015	2016	2017	2018	2019
Minimum Common Equity Capital Ratio (CET1)	3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital Conservation Buffer (CCoB)				0.625%	1.25%	1.875%	2.5%
Minimum CET1 + CCoB	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
Minimum Tier 1 Capital	4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum Total Capital		8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Minimum Total Capital + CCoB		8.0%	8.0%	8.625%	9.25%	9.875%	10.5%

*All dates are as of 1 January
(Adapted from BIS, 2011, p .69)

Aiming to complement the previously presented risk-based requirements, Basel III also introduces a credible supplementary measure in the form of a non-risk leverage ratio. One of the highlighted underlying drivers for the financial crisis was revealed to be the buildup of excessive leverage in the banking system. Whilst many banks managed to show seemingly stable capital ratios, they were still showing unsustainable leverage levels. With high leverage in essentially the entire financial sector, and when banks in the height of the crisis had no choice but reduced their leverage, a vicious circle was created followed by sharp drops in the availability of credit in the real economy (BIS, 2014b). The non-risk based ratio is expressed as a percentage and comprises both on- and off-balance sheet items where banks are required to meet a leverage ratio of three percent as a minimum (BIS, 2019d).

An additional aspect brought into light during the financial crisis was the cost of the absence of liquidity standards. As a result, the enhanced prudential liquidity reform package was developed to promote the resilience of banks' liquidity risks and to absorb adverse shocks in the economy. Thus, the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR), two different liquidity restrictions, were proposed, both pursuing different but complementary objectives (BIS, 2013). Whereas the LCR aims to promote short-term resilience of banks' liquidity risks, the goal of the NSFR is rather to promote structural

resilience in the long term. The LCR requires banks to maintain an adequate level of high-quality assets (HQLA) that easily can be converted in cash and enable banks to survive during a 30-day period while experiencing a high degree of liquidity stress.

Through LCR, defined as the bank's stock of HQLA divided by the net cash outflows over such a time period, banks are required to adhere to a minimum LCR ratio of 100 percent (BIS, 2014b). The NSFR is defined as the ratio of the amount of stable funding available relative to the required amount of that funding. In line with LCR, Basel III sets a minimum NFSR of at least 100 percent (BIS, 2014c).

2.1.4.2. Pillar 2: Supervisory Review Process

While Pillar 1 indeed concerns the core risks faced by banks, including the outlining of the minimum capital required, Pillar 2 likewise serves as a vital component of the Basel framework. The second pillar recognizes the importance of efficient risk management practices, or lack thereof, concerning banks' capital adequacy and encouraging banks to assess their capital adequacy and, based on such assessments, take appropriate actions (BIS, 2019e). Thus, the supervisory review process goes beyond ensuring that banks hold the capital required in Pillar I and recognizes the responsibility a bank's management bears to design solid internal capital assessment processes and the formulation of capital targets. Furthermore, such assessments made by banks are subject to review by supervisors to evaluate the appropriateness of banks' judgments given their actual risk profiles, where supervisors may intervene when necessary. Through the supervisory review process, this interaction intends to foster an active capital adequacy dialogue between the bank and the regulator, and correspondingly ensure that excessive risks or deficiencies identified can be adequately addressed (BIS, 2019e).

2.1.4.3. Pillar 3: Market Discipline

Similar to Pillar 2, Pillar 3 aims to compliment the capital rules outlined in Pillar 1. In essence, Pillar 3 was established to encourage the market discipline of the banking sector by formulating a set of regulatory disclosure requirements. It aims to incentivize banks to operate in a sound, safe, and efficient way (BIS, 2015). A higher level of transparency and consistency in this matter further helps to reduce the information asymmetry in the marketplace, and facilitates the comparability of different financial institutions, both within and between different jurisdictions. In a similar vein, establishing standardized measures and rules of the disclosure enables market participants with greater access to relevant information concerning banks' risk

exposure and capital adequacy. It thus enhances the trust and confidence in banks and the financial system as a whole (BIS, 2015).

2.2 Nordic-4

In 2013, the International Monetary Fund (IMF) published the Nordic Regional Report. The report highlights, *inter alia*, the region's high degree of concentration and interconnectedness and documents that the six largest banks (i.e. Handelsbanken, SEB, Swedbank, Danske Bank, DNB, and Nordea), together represent 90.4 percent of the Nordic banking sector. In addition, the same banks' assets amount to approximately 185 percent of the total Nordic-4 GDP (International Monetary Fund, 2013). However, while a range of favorable features is shared among these countries - e.g. high employment, low income inequality, and stable public finances - several identical risks are also pinpointed, such as rising house prices and indebted households. Due to the close economic and financial ties within the region, which include banks with clear cross-border linkages with common exposures, the potential of spillovers of economic shocks is accordingly relatively high (International Monetary Fund, 2013).

As already touched upon in the introductory section, despite prominent similarities, the *Nordic-4* comprises four different monetary strategies, as perhaps is most clearly shown through their stance towards the euro. According to the Riksbank, which serves an independent position in Sweden as the country's central bank, the Swedish monetary policy aims to maintain price stability. As such, they try to keep inflation low and stable, where the current inflation target is set equal to 2 percent (Riksbank, 2019). To achieve its objectives, the primary tool for the Riksbank to conduct its monetary policy is the repo rate (Riksbank, online). Similarly, Norges Bank is responsible for the Norweigan monetary policy, representing also an inflation-targeting regime that uses its main monetary policy instrument, i.e. the policy rate, to manage price and financial stability (Norges Bank, 2020). The EU member Denmark, through Denmarks Nationalbank, is likewise concerned with price stability and, thus, maintaining low and stable inflation. However, it stands in contrast to its neighboring countries in terms of its opt-out from the eurozone, but at the same time keeping its currency tightly pegged to the euro through the so-called European Exchange Rate Mechanism II (ERM II) (Denmarks Nationalbank, 2017). Finally, Finland serves both as a member of the EU and has adopted the euro as its currency. Hence, Finland belongs to the Eurosystem, where the Bank of Finland,

together with the ECB and other central banks within the euro area, participates. As a result, the strategies of the Bank of Finland are related to not only the aims of its own but also those of the eurozone (Bank of Finland, n.d.a). The eurozone's core objective is, however, in a similar fashion concerned with price stability, thus maintaining the euro's purchasing power. With this aim, the main tool towards this is the ECB's key interest rates (Bank of Finland, n.d.b).

Altogether, three of the *Nordic-4* countries are members of the EU, but with Finland representing the only country that has adopted the euro. Although neither in the eurozone, nor an EU member, Norway has been subject to the implementation of the EU capital adequacy rules into its national legislation due to the European Economic Area (EEA) agreement. As for the implementation of the Basel regulations, in an EU context, the Basel III framework is translated through the so-called CRD IV/CRR package that comprises the Capital Requirements Regulation (CRR) and Capital Regulation Directive (CRD) (International Monetary Fund, 2015). The rules and regulations adopted through the CRD IV/CRR framework seek to promote harmonized supervised practices within the EU/EEA and strengthen the resilience of banks in the EU, applied from 1 January 2014 and onwards with a gradual tightening of capital regulations (European Commission, 2013). However, just as the Basel Committee members can choose to implement the directives in varying pace, countries in the EU/EEA reserve the same right and as such the implementation also in the *Nordic-4* has not been uniform.

2.3 Related Literature

2.3.1 Monetary Policy Transmission

Though there are several channels through which monetary policy might have real effects on the economy, this study focuses on the bank lending channel. The concept of the bank lending channel was first put forth by Bernanke and Blinder (1988), by extending the standard IS-LM model of aggregate demand into a static model incorporating the credit view to the framework, it predicts a reduction in lending following a hike in interest rate. Kashyap and Stein (1993) dissected the underlying assertions of the bank lending channel into two parts, namely that 1.) the supply of bank lending is affected by open market operations, and 2.) that these shifts in the supply affect both the structure and magnitude of aggregate output in the economy. In the spirit of the Lucas critique, the authors further delve into the underlying micro foundation

necessary for this reasoning to hold. By quoting a large body of earlier underlying research, they stress that while sufficiently dealing with financial intermediation and contracting, some stones remain unturned and require further research and modeling. They do, however, conclude that the empirical evidence supports the bank lending channel's existence.

Later, Stein (1998), by looking at liability management and bank assets through an adverse selection model, similarly generated a bank lending channel as well, though this time, micro-founded. The model further deals with some of the critique presented in Romer and Romer (1990), one of the most prominent papers opposing the significance of a bank lending channel. This as the type of Modigiliani-Miller (MM) logic on which the critique relies, is shown to fail if there's asymmetric information about bank assets value, as adverse selection then generates a lemon premium in the market for risky bank liabilities, which in turn is likely to make the market for them imperfect. Further dissection and countering of the Romer and Romer (1990) critique can be found in Kashyap and Stein (1995, 2000).

As for the region investigated, empirical evidence covering the bank lending channel in the *Nordic-4* is rather sparse. An example of an investigation in a Swedish context is the paper by Westerlund (2003), who documents empirical support for the bank lending channel of monetary policy based on a panel of bank balance sheet data covering the period 1998 to 2003. Havro and Vale (2011) further provide empirical results favoring a bank lending channel of monetary policy in Norway while studying Norwegian banks during 2001 to 2010. Their findings particularly reveal that banks with sound capitalization tend to be less responsive to shocks in the money market rate. Moreover, Drejer, Koch, Rasmussen, Spange and Sørensen (2011) sought to investigate the impact of changes in monetary policy interest rates in a Danish perspective using an unbalanced panel data set in total comprising 29 of the largest banks in Denmark from 2000 to 2010. According to their findings, the transmission of monetary policy mainly occurs through the interest rate channel. In contrast, the credit channel (including the bank lending channel) seems to be less pronounced in the Danish economy. The ECB Working Paper by Topi and Vilmunen (2001) sought to explore the transmission of monetary policy in Finland by adopting a panel comprising Finnish banking data ranging from 1995 to 2000. All in all, based on their approach, the authors find (at most) weak supporting evidence for the existence of the bank lending channel of monetary policy in the country during the investigated period.

2.3.2 Capital Regulation

Though the Basel regulations, from its first till its latest installment, put significant focus and weight on the risk-based capital requirements here investigated, such importance is not commonly seen attached to it traditionally neither theoretically nor empirically. The basis for an often perceived irrelevance of it, exemplified in the quote of Benjamin M. Friedman - "Traditionally, most economists have regarded the fact that banks hold capital as at best a macroeconomic irrelevance and at worst a pedagogical inconvenience," cited in Bernanke, Lown and Friedman (1991, p. 240), takes its grounding in the Modigliani-Miller (MM) theorem. It posits that there should be no reason for the price or quantity of credit to be affected by changes in capital ratios, as its second proposition concludes a company's funding cost unaffected by the composition of its liabilities (Bridges, Gregory, Nielsen, Pezzini, Radia & Spaltro, 2014). In other words, capital requirements should not affect the funding cost of lending and ought, therefore, not affect its price nor quantity. The proposition takes its grounding in a friction-free world with perfect capital markets. In contrast, the market for bank equity is exposed to many potential frictions that could cause capital requirements to have real effects. Bridges et al. (2014) point at information asymmetries, debt overhang, and the textbook example of tax-deductibility of debt interest rate payments.

The implication of such frictions as those above mentioned, most central in the context of capital requirements, is costly equity rather than modestly cheap, as suggested in MM. Costly equity, paired with binding capital buffers, is the prerequisite for capital requirements to have an independent effect on lending (Aiyar, Calomiris & Wieladek, 2016). As such, our study implicitly tests for such frictions, or failures, of the MM theorem. As for the direction of the effect, Thakor (1996) develops a formal model for testing the effects of risk-based capital requirements such as those outlined in the Basel regulation and suggests an increase in capital requirements to reduce aggregate lending.

Moreover, the empirical body of research on the interplay between capital requirements and lending behavior can be broadly divided into two kinds, those on actual capital resources and those on capital requirements, where the former have been used as a proxy for the latter given data limitations. Our study falls in the latter category, thanks to improved reporting standards and legislations such as those advocated in Pillar 3 of the Basel framework, having made it possible. However, given these restrictions in the past, earlier studies have tended to focus on the UK, for which bank-specific time-varying regulatory capital requirements have been used and the data made available since the implementation of Basel I in the late 1980s.

Francis and Osborne (2009) and Bridges et al. (2014) are two such studies, studying UK data during 1996-2007 and 1990-2011, respectively. Both studies confirm a reduction in lending, as Thakor (1996) suggested, following a hike in capital requirements. The later study by Bridges et al. (2014) also identifies differences in the effect of lending on different sectors of the economy, a heterogeneity we try to consider in this study as well.

More recently, there is also the study by Jiménez, Ongena, Peydró and Saurina (2017), who more specifically examine capital requirements as a countercyclical policy tool by using a unique dataset of Spanish banks. They conclude that countercyclical policy tools such as the countercyclical buffer, indeed exhibit a mitigating effect on business cycles. The results suggest that these capital buffers cause a reduction in lending when the economy is booming, but increases the availability of credit during bad times, and argue that bank procyclicality arguably is preferable to costly monetary policy measures in times of crisis. In the more general case, there is the paper by The Macroeconomic Assessment Group (2010) that looks at a total of 96 models for 16 individual countries as well as the euro area, to conclude similarly that capital requirements have a negative effect on lending flows, albeit through model forecasting rather than by solely looking at the historical data.

2.3.3 Monetary Policy and Capital Regulation - Interaction

In the light of the gradual tightening of capital requirements and the extension of the regulatory toolkit at hand for supervisors as discussed extensively in Section 2.1, research on the subject has grown and proliferated since Friedman's quote in 1991. One such strand of research is the interaction between both aforementioned influences on lending, capital requirements regulation and monetary policy. As noted by Aiyar, Calomiris and Wieladek (2016), the standard view of the bank lending channel suggests important interaction between the two, whilst as documented by Cecchetti and Li (2008), the goals of the central bankers, for whom macroeconomic stability is often primarily judged by price stability and employment, and the goals of the regulators, can sometimes be conflicting. The regulators might want to limit it to avoid excessive risk-taking. In contrast, the central bankers might seek to stimulate and increase lending, a clash that further highlights the need for research in the area to avoid potential perverse or destabilizing interactions.

Though theory suggests a reduction in lending given a rise in either capital requirements or monetary policy rate, their potential interaction is more ambiguous in nature. For example, one of the first formal theories of their interaction, presented in Thakor (1996), suggests that in

the presence of risk-based capital requirement, a reduction in interest rate does no longer unambiguously increase lending, instead, the perverse effect of reduced lending can ensue. This as the effect becomes dependent on the term structure of interest rate rather than the rate itself. As such, the perverse effect is achieved if the reduced (increased) short-term interest rate increases (reduces) the term spread, as it will increase (reduce) the probability of the borrower being denied credit in the model. As such, he suggests a more dynamic interaction than solely an attenuating effect on monetary policy if a large fraction of banks are operating near (or below) the constraint of their capital requirements, already earlier argued by both Bernanke, Lown and Friedman (1991), and Kashyap and Stein (1993). Their argued attenuating effect is due to the banks then not being able to extend loans that carry reserver requirements without raising additional equity, which is bound to be costly if the more senior risky non-reservable liabilities are taken to be so, which is a prerequisite for the lending channel in the first place. However, also the opposite, an amplification of the bank lending channel can be found later theorized amongst banks operating at low levels of capital by Van den Heuvel (2002). This through bringing about a reduction in the adverse selection and moral hazard issues in the market for non-reservable bank liabilities.

Similarly, Aiyar, Calomiris and Wieladek (2016) argue a strengthened bank lending channel due to capital requirement increases, again through the market for non-reservable bank liabilities. This time, a more general interaction finds its way through how increased capital requirements, and its implied limit on leverage, causes non-depository debt to be harder for banks to access, and the sparsity of which the effectiveness of the bank lending channel directly relies upon, as shown by Bernanke and Gertler (1995). As such, there appear several distinct ways the capital requirement regulation changes brought about with Basel III could interact with monetary policy. An interaction that is not only likely to differ in magnitude, but also in sign. The multifaceted nature of the interactions necessitates empirical studies to help penetrate the ambiguity displayed above, and establish which, if any, interaction actually is prominent. The empirical strand appears however, as of yet, unsuccessful in bringing any definite answers. Whilst Aiyar, Calomiris and Wieladek (2016) conducted a study to explore the interplay in a UK context and documented that both tighter capital requirements and monetary policy cause a reduction of banks' lending, they found little evidence regarding the interaction. Takáts and Temesvary (2019), however, explored the interaction between the monetary policy of major international currencies issuers (EUR, USD, and JPY) vis-á-vis macroprudential policy and document notable interactions between monetary policy related to currency of cross-border

bank lending and macroprudential policy. While the authors found that a tightening of macroprudential policy dampens the lending influence of monetary policy, they correspondingly stress that easing of macroprudential policy instead tends to intensify the lending impact of monetary policy.

On a different - yet related - note, Xiong (2013) finds evidence of asymmetries between expansionary and contractionary monetary policy amongst low- and high-capitalized banks. They, in a Chinese context, suggest that well-capitalized banks' lending tends to a greater extent be influenced by expansionary policies. In contrast, less-capitalized banks rather seem to modify their lending behavior in response to monetary policy that is contractionary in nature. The paper further suggests capital requirements to have had an attenuating effect on expansionary policy, but conversely an amplifying one on contractionary policy.

The paper perhaps most closely related to ours is that of Imbierowicz, Löffler and Vogel (2019), who examine the transmission of bank capital requirement changes and monetary policy separately and explore their interaction by studying bank lending and lending rates in the euro area. By focusing on the German banking system, and while finding a negative relationship between monetary policy and bank lending, they regarding the effect of capital requirement changes notice a difference in the effect between weakly and strongly capitalized banks. Only weakly capitalized banks see a decrease in lending as a response to a capital requirement increase, while the strongly capitalized banks remain unaffected. As for their interaction effect, the authors suggest that increased capital requirements to dampen the effect of monetary policy and further stressed that a mutual consideration of both policies is crucial. Though our studies differ in many regards, we identify two principal aspects that we extend to their study. First, by considering banks in a set of countries, rather than a single one, we are hopefully able to provide more general and robust results. Second, we consider both consumer and commercial lending, as well as their aggregate, as opposed to the rather narrow non-financial corporate loans solely considered in theirs. Amongst other things, this should allow us to identify potential loan shifting between sectors better and distinguish them from real lending reductions.

3 Methodology

This section aims to provide a detailed description of the data used and the model applied, including motivations for the choices made and the variables included.

3.1 Data

3.1.1 Sample Selection

Our data comprises quarterly bank-level data and macro data in the Nordic region during a seven-year period, ranging from the first quarter of 2013 to the last quarter of 2019. Data prior to 2013 was excluded due to difficulties to accurately collect it, as the first transitional rules of capital regulation and definition of capital under Basel III (integrated through the CRD/CRR regulatory framework in *Nordic-4*) had not yet entered into banks' reporting, at least not on a sufficient scale. A total of 17 banks are included in the sample, five of which are Swedish, four are Danish, five are Norwegian, and three are Finnish. A complete list of all banks included in the study is depicted in Appendix 1, where each bank is grouped based on its specific country of origin. Importantly, as Nordea in October 2018 relocated its headquarters from Sweden to Finland, the bank is accordingly treated as Swedish bank until the third quarter of 2018 and is in subsequent quarters regarded as a Finnish bank, and a dummy variable accompanies the transition.

The banks were selected after sorting banks from a given country based on their gross lending, with the aim to include a significant portion of each country's total lending. The major concerns of the sample selection relate to data availability, where the arguably low sample size of 17 banks gathers support from the considerably large and highly concentrated banking sector in the Nordics (see Section 2.2), where e.g. the regions' six largest banks, that as earlier mentioned account for roughly 90% of the sector according to International Monetary Fund (2013), are all included in the sample.

We use quarterly data for our empirical analyses since it represents the highest frequency for which the bank-specific variables used are published. Using the highest frequency increases the sample size and, by extension, our tests' statistical power. It is further argued to be the appropriate frequency when seeking to measure the short-term effect of

monetary policy changes on bank lending (Gambacorta & Marques-Ibanez, 2011). The bank-level data is throughout represented by consolidated group-level data, i.e. collected on a consolidated basis, rather than unconsolidated one, due to the fact that decisions and strategies regarding bank lending and bank capital being likely to both be taken at the group level (Bridges et al. 2014).

3.1.2 Bank-Level Data

The bank-specific data was manually acquired from the banks' various reports published on their Investor Relations page. There are two bank-specific variables of primary interest. First, our dependent variable, represented by the q-on-q change in the log of total loans for the two loan sectors investigated, i.e. consumer and commercial loans respectively, as well as their aggregate. All these are below plotted in Figure 1 - Panel A-C, where we can note that they appear to display sufficient variation for multivariate analysis, and that commercial loans display more variation than consumer loans that appear more stable. The second variable of main interest is the bank-specific capital requirements, expressed as a percentage of total risk-weighted assets (RWA). As discussed in Section 2.1.4, beyond the minimum requirement set, banks have gradually been required to satisfy certain additional buffer requirements, varying from institution to institution. The capital requirement for a given bank thus comprises the minimum capital requirement and, where applicable, additional buffers in terms of the capital conservation buffer (CCoB), countercyclical buffer (CCyB), and other capital buffers required for systemically important financial institutions (SIFIs) (see Section 2.1.4.1). In addition, requirements concerning the risk assessment and supervisory review process related to Pillar 2 are considered (see Section 2.1.4.2). Our analysis concerns the cumulative change over four quarters in *total* regulatory capital requirements, i.e. the change in the sum of these, that further can be noted in Figure 1 - Panel D, and which also appear to produce sufficient variation to allow for multivariate analysis.

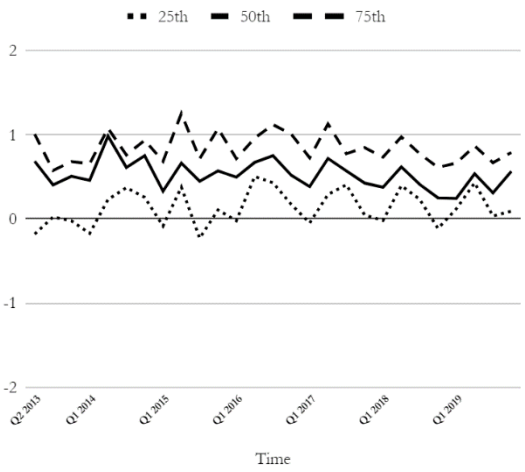
There are further two additional bank-specific variables included in the study, size and excess capital, which make up our set of micro control-variables. These were selected due to their strong grounding in prior research where bank response to both capital requirements and monetary policy, has been shown to vary depending upon them (see e.g. Bridges et al. 2014; Imbierowicz, Löffler & Vogel, 2019; Westerlund, 2003; Xiong, 2013). Size is defined as the log of each bank's total assets. Its influence is primarily derived from how it is theorized to serve as a proxy for information frictions and problems, such that it is harder for smaller banks

to restructure their loans and other assets to such external shocks that both monetary and regulatory changes pose (Topi & Vilmunen 2001). Excess capital, also commonly referred to as capital buffer in related literature, is here defined as a specific bank's actual quarterly total capital ratio (i.e. CET1 + Additional Tier 1 + Tier 2 capital) minus its total capital requirements for a given quarter. The variable aims to capture the degree of "financial slack", whereby a higher ratio would imply that the bank is less constrained by regulatory changes (Imbierowicz, Löffler & Vogel, 2019). In regard to monetary policy, less capitalized banks are suggested less likely to respond to changes due to it being more likely to hurt their business (Xiong, 2013). Additional information pertaining to the source, definition, and descriptive statistics of the bank-specific variables used can be found in Table 3 and 4, Section 3.1.4.

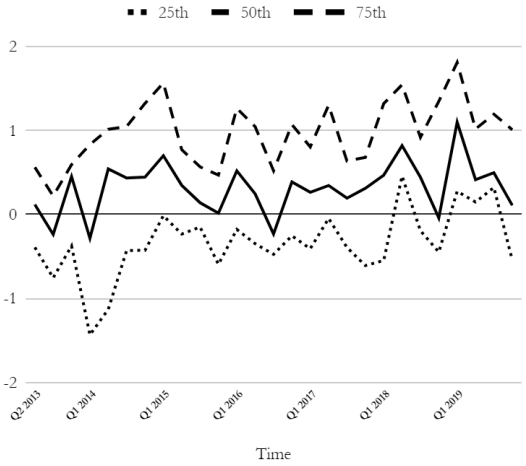
Figure 1: Changes in Loans and Capital Requirements (Panel A-D)

The figure displays the quarterly changes in consumer loans (Panel A), commercial loans (Panel B), total loans (Panel C), as well as the cumulative change over four quarters for total capital requirements (Panel D). All series have their 25th, 50th, and 75th percentiles plotted.

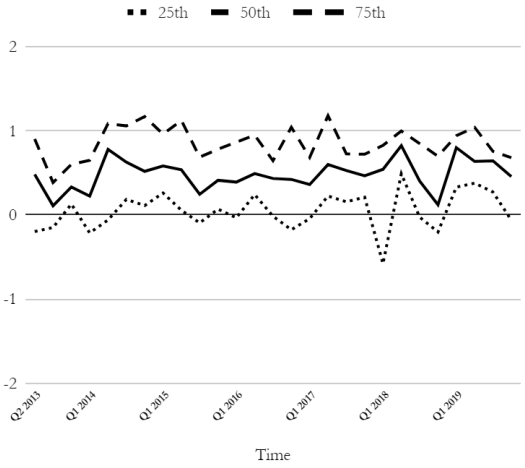
Panel A: Changes in Consumer Loans



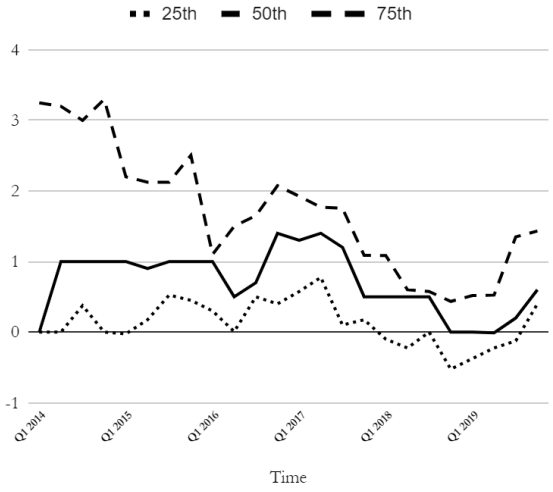
Panel B: Changes in Commercial Loans



Panel C: Changes in Total Loans



Panel D: Changes in Capital Requirements



3.1.3 Macro Data

The primary macro variable of interest is the monetary policy proxy, for which prior literature gives two primary suggestions (Westerlund, 2003). Either to take a model-based approach, as done by Bernanke and Mihov (1998), as they with a VAR methodology look at the residuals of a central bank reaction function. Alternatively, to look at changes in the short-term interest rate under central bank control, as done with the federal funds rate by Bernanke and Blinder (1992). The approach taken here relates to the latter, as we make use of three-month interbank rates (IBOR) for the four countries through STIBOR, CIBOR, NIBOR, and EURIBOR. Problematization can be found in how a simple interest rate approach is found inconsistent by Bernanke and Mihov (1998), in comparison to their model-based approach. We, however, find this approach thoroughly grounded in prior research both into capital requirements interaction with monetary policy through Imbierowicz, Löffler and Vogel (2019), the bank lending channel through Kashyap and Stein (1995), as well within the region of interest through Westerlund (2003) for Sweden, Havro and Vale (2011) for Norway, Drejer et al. (2011) for Denmark, and Topi and Vilmunen (2001) for Finland, all looking into the bank lending channel and making use of the earlier mentioned three-month interbank rates.

A further set of four macro variables are used in the study, i.e. credit to GDP gap, term spread, Business Confidence Index (BCI), and output gap. These are all used as macro control variables, aiming to represent the time-varying macroeconomic and demand-driven changes in bank lending. They are closely related to the ones used by Imbierowicz, Löffler and Vogel (2019) with two exceptions; they use the German IFO business climate index rather than BCI. They further also include an economic policy uncertainty index, which was excluded in our analysis as it is not published for all countries of the *Nordic-4.* Further information pertaining to the source, definition, and descriptive statistics of the macro variables used, can be found in Table 3 and 4, Section 3.1.4.

3.1.4 Descriptive Statistics

Table 3: Descriptive Statistics - Dependent and Independent Variables

This table reports the descriptive statistics for the variables used, showing the mean, standard deviation, 10th and 90th percentile, covering the period Q1 2013 to Q4 2019. The variables are further defined in Table 4.

Descriptive Statistics

Variable	Mean	Standard Deviation	10th Percentile	90th Percentile
Dependent Variables				
Δ Consumer Lending (q-on-q)	0.4964	1.0084	-0.3250	1.3065
Δ Commercial Lending (q-on-q)	0.3854	1.3602	-1.0660	1.8348
Δ Total Lending (q-on-q)	0.4633	0.8345	-0.4900	1.3166
Independent Variables				
Capital Requirements	14.9827	3.3136	10.5200	19.0000
Δ Capital Requirements	0.2244	0.8126	-0.1590	1.0000
Excess Capital	4.7442	3.7643	1.0000	9.8700
Bank Size	5.4713	0.8405	3.9997	6.4656
Monetary Policy	-0.0779	0.2685	-0.4436	0.2172
Credit to GDP gap	-6.8583	12.5700	-28.4000	10.2000
Term Spread	0.8414	0.4109	0.3200	1.3200
BCI	1.0033	0.0114	0.9871	1.0195
Output gap	-0.8730	1.3723	-2.3340	0.7960

Table 4: Descriptive Statistics - Variable Definitions

This table serves to provide an overview and shortly describes the variables included. Furthermore, for each of the variables, the data source is provided.

Variable definitions

Variable	Definition	Data Source
Dependent Variables		
Δ Consumer Lending (%, q-on-q)	Loans to consumers, % change (q-on-q).	Investor Relations*
Δ Commercial Lending (%, q-on-q)	Loans to the commercial sector, % change (q-on-q).	Investor Relations*
Δ Total Lending (%, q-on-q)	Total loans, % change (q-on-q).	Investor Relations*
Independent Variables		
Capital Requirements (% of RWA)	Total capital requirements, % of risk weighted assets	Investor Relations*
Δ Capital Requirements (%)	The cumulative change over four quarters in total capital requirements,	Investor Relations*
Excess Capital (% of RWA)	Total capital ratio (CET1 + Tier 1 +Tier 2), less total capital requirements.	Investor Relations*
Bank Size (ln real assets)	Log of each bank's total assets	Investor Relations*
Monetary Policy (%)	The cumulative change over four quarters in the 3-month interbank rate in each country.	Riksbank.se Statistics
Credit to GDP gap (%)	The deviation of credit to GDP from its long-term trend in each country.	Bank of International Settlements
Term Spread (%)	Spread between money market rate and 10-year government bond interest rate in each country.	Riksbank.se Statistics
BCI	Business confidence index in each country.	OECD.stat
Output gap (%)	The deviation of actual output from potential output in each country.	OECD.stat

*Bank-specific reports found on their respective investor relations pages.

3.2 Model Specification

3.2.1 Bank Capital Requirements and Lending

To investigate the possible relationship between changes in bank capital requirements and changes in bank lending, we employ the following dynamic panel equation for each loan sector.

$$\Delta Loan_{it} = \beta \Delta ca\text{pre}q_{i,t-k} + \beta Micro_{i,t-1} + \beta \sum_{j=1}^{l} \Delta Loan_{it-j} + f_i + f_{ct} + \varepsilon_{it} \qquad (1)$$

The dependent variable, $\Delta Loan_{it}$, represents the quarterly percentage change in outstanding loans for bank i at time t. The main explanatory variable of interest, capital requirements, is represented by $\Delta ca\text{pre}q_{i,t-k}$, with k=4. As such, we investigate the response in loan growth to the cumulative changes in capital requirements over the previous year, similarly to Imbierowicz, Löffler and Vogel (2019). The model also includes our set of micro control variables, namely size and excess capital, and lagged dependent variables represented by $\sum_{j=1}^{l} \Delta Loan_{it-j}$, with l=2. Both bank fixed effects and country-specific time fixed effects are included through f_i and f_{ct}, and the error term is represented by ε_{it}.

3.2.2 The Bank Lending Channel

To additionally investigate the prevalence of the bank lending channel in our sample, we add a monetary policy proxy and replace the country-specific time fixed effects with common time fixed effects, as well as a set of macro control-variables specific for each country. Thus, we try to estimate changes in loan growth for each sector with the following dynamic panel equation.

$$\Delta Loan_{it} = \beta \Delta ca\text{pre}q_{i,t-k} + \beta \Delta MP_{i,t-m} + \beta Micro_{i,t-1} + \beta Macro_{i,t} + \beta \sum_{j=1}^{l} \Delta Loan_{it-j} + f_i + f_t + \varepsilon_{it} \qquad (2)$$

The monetary policy variable $\Delta MP_{i,t-m}$serves as our exogenous monetary policy proxy, represented by each country's 3-month interbank rate. Similarly, as with the capital requirements, m=4, hence we are again studying the effect of the cumulative change over the previous year on bank lending growth, similarly to Imbierowicz, Löffler and Vogel (2019). The $Macro_{i,t}$variable represents a set of country-specific macro variables as we are no longer

able to include our country-specific time fixed effects f_{ct}, as they would absorb the monetary policy changes since they are the same for all banks in each country. However, we are able to replace them with common time fixed effects, f_t, as each country leads a different monetary policy, helping us to still mop up some of the shocks that hit the whole region. Though, of course, less efficiently than the country-specific time fixed effects, given the countries heterogeneity, and where for example Norway should be expected to be more severely hit by an oil price shock than the rest of the sample.

3.2.3 Interaction

Finally, to investigate the possible interaction of the regulatory and monetary policies, we introduce an interaction term between capital requirements and our monetary policy proxy. This results in the following dynamic panel equation.

$$\Delta Loan_{it} = \beta \Delta ca\text{pre}q_{i,t-k} + \beta \Delta MP_{i,t-m} + \beta \Delta MP_{i,t-m} * \Delta ca\text{pre}q_{i,t-k} + \beta Micro_{i,t-1} + \beta Macro_{i,t} + \beta \sum_{j=1}^{l} \Delta Loan_{it-j} + f_i + f_t + \varepsilon_{it} \quad (3)$$

This approach of exploring the possible interaction through an interaction term, such as our $\Delta MP_{i,t-m} * \Delta ca\text{pre}q_{i,t-k}$, is the same approach as taken by Imbierowicz, Löffler and Vogel (2019), and aims as earlier discussed to investigate the theorization that the two policies mutually affect each other's effectiveness and transmission.

3.2.4 Extensions and Robustness

To test the robustness of our results, we try relaxing the bank homogeneity assumptions of our fixed effects model, investigating possible heterogeneity along two bank-specific dimensions, as well as heterogeneity along the monetary policy dimensions. Thus, following Imbierowicz, Löffler and Vogel (2019), accommodative and restrictive monetary policy are allowed to affect lending differently, rather than the symmetric response implicitly assumed before. This is done by splitting our monetary policy variable into a loose as well as a tight one. The former takes the value zero if greater than or equal to zero, but the actual value if less than zero. The latter conversely takes the value zero if less than or equal to zero, and the actual value if greater than, resulting in the dynamic panel equation below.

$$\Delta Loan_{it} = \beta \Delta ca\text{preq}_{i,t-k} + \beta \Delta MP(tight)_{i,t-m} + \beta \Delta MP(loose)_{i,t-m} + \beta \Delta MP(tight)_{i,t-m} * \Delta ca\text{preq}_{i,t-k} + \beta \Delta MP(loose)_{i,t-m} * \Delta ca\text{preq}_{i,t-k} + \beta Micro_{i,t-1} + \beta Macro_{i,t} + \beta \sum_{j=1}^{l} \Delta Loan_{it-j} + f_i + f_t + \varepsilon_{it} \quad (4)$$

As we proceed to also allow for heterogeneity along both bank-specific control variable dimensions, namely size and excess capital, we keep the divided monetary policy variable. This first split along bank size allows for the separation of large and small banks, where for example Bridges et al. (2014) find capital requirements to affect smaller banks lending more. It is further a commonly discussed source of bank heterogeneity in the bank lending channel literature (see e.g. Drejer et al. 2011; Havro & Vale, 2011; Topi & Vilmunen, 2001; Westerlund, 2003). We keep our earlier definition of size as the log of total assets and split the sample so that the eight largest banks make the large bank sample and the remaining nine banks the small sample. Using this split as definition, a dynamic - allowing firms to switch groups - and a static approach become equivalent as the eight largest banks remain the same throughout the sample.

The second split along the excess capital dimension allows for possible heterogeneity in response to the two policies and their interaction depending on how well-capitalized the bank is. Both Imbierowicz, Löffler and Vogel (2019) and Bridges et al. (2014) suggest stronger reactions in bank lending to changes in capital requirements amongst banks with low levels of excess capital. Also, evidence of heterogeneity in the response to monetary policy changes along the dimension can be seen in Xiong (2013). Here a static approach would not be feasible due to significant variation across all banks. Instead, a dynamic 50/50 split is employed similar to the one employed by Imbierowicz, Löffler and Vogel (2019).

3.2.5 Lag Determination

The lags for the dependent variables were determined by testing up to four lags and evaluating the different models through the use of the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Though both criteria tended to favor the same models, preference was given to BIC in cases when they differed slightly, favoring a more parsimonious model. The resulting lag length was two for all three types of loans.

3.2.6 Model Choice and Tests

As prevalent within prior research in the area, fixed effects models are used throughout this paper (see e.g. Aiyar, Calomiris & Wieladek, 2016; Bridges et al. 2014; Imbierowicz, Löffler & Vogel, 2019). The use of fixed effects might lead to a loss of efficiency due to an increased number of parameters to be estimated as opposed to random effects. However, the random effects model relies on the more restrictive assumption of zero correlation between the unobserved omitted variables and the explanatory variables and will produce biased and inconsistent coefficients if the assumption is not upheld. With its more lax assumption, the fixed effects model should, on the other hand, always produce unbiased estimates (Brooks, 2014).

The bank fixed effects employed in all model specifications are to account for unobserved bank-specific heterogeneity, relating to time-invariant bank characteristics such as business model. We further also use time fixed effects in all but our first model (see Equation 1), where country-specific time fixed effects were employed instead. These effects aim to capture both macroeconomic and demand-side influences on bank lending that are common to all banks in each quarter. The country-specific time effects arguably do so better as they account for influences that are particular to each country. However, when the monetary policy is added in the second regression, these country-specific time effects lose their applicability as they would absorb the variable, as it in each time period is the same for all banks in each country. The common time fixed effects are, however, an extension on earlier research that looks only at one country, as we unlike these studies should be able to capture cross-country time effects in the region.

Dynamic fixed effects models lead to a well-known bias as noted by Nerlove (1967, 1971) and expanded upon by Nickel (1981). The bias arises when the number of time periods remains fixed and the number of "individuals" tend to infinity. However, as our sample contains a relatively large number of time periods compared to banks, the dynamic fixed effects approach remains preferable to the more generally unbiased but less efficient Generalised Method of Moments (GMM), as for example employed by Imbierowicz, Löffler and Vogel (2019). This as the dynamic fixed effects bias declines with the number of time periods (Bridges et al. 2014; Kiviet, 1995). However, unlike Bridges et al. (2014), we in some of the regressions use a balanced panel, for which the LSDV corrected (LSDVC) method, derived by Kiviet (1995), is preferred. As we, however, also make use of unbalanced panels, for which

LSDVC is not applicable, we for consistency and due to it being computationally simpler opt to always employ LSDV (Judson & Owen, 1999).

Moreover, we identify clear patterns of heteroscedasticity in the residual plots, which are confirmed with Engle's ARCH tests. The Pesaran tests further suggest the prevalence of cross-sectional dependence as well. To account for both these, clustered-robust standard errors, clustered at the bank level, are used for all model specifications. Though we do detect some multicollinearity, it is restricted to the control variables and should thus not interfere with the significance of any coefficients interpreted. Fisher type unit root tests for panel data rejects the null of any unit root for all loan types, and the computed Wooldridge tests further reject any serial correlation in the residuals.

4 Empirical Findings and Analysis

This section aims to provide a descriptive presentation and analysis of the results and bridge our findings to the previously established research.

4.1 Analysis

4.1.1 Transmission of Capital Requirements

In this first step, we run the regression specified in Section 3.2.1 and the results for each of the three loan types can respectively be seen in Table 5 below. The aim is to solely analyze the relationship between capital requirements and loan growth as it allows for the use of country-specific time fixed effects. These are superior at soaking up the factors common to all banks in any quarter than the latter explicit modelling of them through our set of macro variables. The related results suggest the changes in banks' capital requirements over the previous year to have no significant effects on its lending growth. Studying the coefficients, we even, although insignificant, document a positive coefficient, conversely to the negative effect suggested by Thakor (1996), and which has been further repeatedly confirmed empirically (Aiyar, Calomiris & Wieladek, 2016; Bridges et al. 2014; Francis & Osborne, 2009; Imbierowicz, Löffler & Vogel, 2019). Our results instead support the proposed irrelevance of the requirements in the MM theorem, suggesting no adequate frictions or imperfections in the market for the regulatory changes to affect lending.

Table 5: Model 1 - Capital Requirements

The table shows the results from our LSDV regression, regressing the quarterly loan growth on our control variables. Fisher type unit root test for panel data rejects a unit root and Wooldridge tests reject any serial correlation in the panel data. Statistical significance of results is indicated with *=10% level, **=5% level and ***=1% level. Robust standard errors clustered at the bank level are shown in parenthesis below the coefficients.

Regression (1) – Capital Requirements

Dependent Variable:	ΔConsumer Lending	ΔCommercial Lending	ΔTotal Lending
Capital Requirement	0.036214	0.022952	0.028331
	(0.051700)	(0.042922)	(0.059329)
Lagged Dependent Variables	Yes	Yes	Yes
Bank Control Variable	Yes	Yes	Yes
Macro Control Variables	No	No	No
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	No	No	No
Country Specific Time Fixed Effects	Yes	Yes	Yes
Observations	408	408	408
Number of Banks	17	17	17
R-Squared	0.34462	0.36867	0.33829

4.1.2 Transmission of Monetary Policy

In this section, we proceed to add our monetary policy (MP) proxy variables to additionally investigate the effect it might have on the loan growth of the banks with the use of Equation 2, specified in Section 3.2.2, and the results are depicted below in Table 6. We are unable to identify any significant effects of our monetary policy variable's cumulative changes over the previous year on lending growth. As such, we do not find evidence of a statistically significant bank lending channel across our sample. Our results thus seem to favor the Romer and Romer (1990) critique, suggesting perhaps that banks indeed can switch to non-reservable liabilities rather easily given an interest hike. As for the capital requirements, consumer lending appears particularly robust to using country-specific time fixed effects and explicitly modeling them. Although still insignificantly different from zero, the coefficient does not change much. Whilst both commercial and total lending remain positive, their coefficient triples, and in the case of total lending, even becomes significant at the 10% level. Despite the increase, the coefficients still suggest a rather small effect, where a 1 percent change in capital requirements over the previous year would translate into roughly a 0.06 percent increase in lending, which can be compared to Imbierowicz, Löffler and Vogel (2019) results of a roughly 1-for-1 negative effect.

Relatedly, there are posed theories for capital requirements increasing total lending. However, they are suggested to be restricted to banks with very low or negative net worth, as it might help them alleviate the debt-overhang problem (Aiyar, Calomiris & Wieladek, 2016). But as none of the banks in the sample face such settings, the significance of the coefficient might be more likely to be a Type 1 error due to the lack of economic reasoning.

Table 6: Model 2 - Monetary Policy

The table shows the results from our LSDV regression, regressing the quarterly loan growth on our control variables. Fisher type unit root test for panel data rejects a unit root, and Wooldridge tests reject any serial correlation in the panel data. The results' statistical significance is indicated with *=10% level, **=5% level, and ***=1% level. Robust standard errors clustered at the bank level are shown in parenthesis below the coefficients.

Regression (2) – Monetary Policy

Dependent Variable:	ΔConsumer Lending	ΔCommercial Lending	ΔTotal Lending
Capital Requirement	0.034082	0.063260	0.061352*
	(0.038521)	(0.036555)	(0.031856)
Monetary Policy	0.382261	-0.257110	0.151111
	(0.371624)	(0.535750)	(0.257127)
Lagged Dependent Variables	Yes	Yes	Yes
Bank Control Variable	Yes	Yes	Yes
Macro Control Variables	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Country Specific Time Fixed Effects	No	No	No
Observations	408	408	408
Number of Banks	17	17	17
R-Squared	0.15830	0.09310	0.10974

4.1.3 The Interaction of the Two Policies

In this section, the possible interaction of the two policies is investigated, using Equation 3 discussed in Section 3.2.3. This is, as earlier explained, done through an interaction term between the two policies and the results are illustrated below in Table 8. Though we, again, lack any significant results, we can see that both capital requirements and monetary policy appear robust to the inclusion of an interaction, in that they do not change much. These new coefficients take negative signs across all three types of lending. A negative coefficient would, for both contractionary and expansionary monetary policy, suggest that increased capital requirements amplify its effects, whilst reduced ones attenuates it. This reasoning is exemplified in Table 7 below. As the period investigated has been primarily subject to increased capital requirements and an expansionary monetary policy, a negative coefficient would suggest a primarily amplifying effect of regulatory changes on monetary policy. This is contradictory to the findings of Imbierowicz, Löffler and Vogel (2019), though their findings related to monetary policy effect on bank lending interest rates rather than growth. For growth, they, in accordance with our findings and Aiyar, Calomiris and Wieladek (2016), identified no significant interaction. Whilst not confirmed in this study given the insignificant coefficients, an amplifying effect can be found theorized in both Van den Heuvel (2002) and Aiyar, Calomiris and Wieladek (2016). Where perhaps the more likely candidate would be the latter, given the restriction of Van den Heuvel's theory to banks operating at low levels of capital which is not something seen to any extensive scale in the sample.

Table 7: Capital requirements and Monetary Policy Relationship (Negative Interaction Coefficient)

The table seeks to, given a negative interaction term, illustrate the effect of changes in capital requirements and monetary policy on bank lending given the sign of the changes for the policies, respectively.

Monetary Policy			
Capital Requirements		+	−
	+	Loans Decrease $[+ \times + \times - = -]$	Loans Increase $[+ \times - \times - = +]$
	−	Loans Increase $[- \times + \times - = +]$	Loans Decrease $[- \times - \times - = -]$

Table 8: Model 3 - Interaction

The table shows the results from our LSDV regression, regressing the quarterly loan growth on our control variables. Fisher type unit root test for panel data rejects a unit root, and Wooldridge tests reject any serial correlation in the panel data. Statistical significance of results is indicated with *=10% level, **=5% level and ***=1% level. Robust standard errors clustered at the bank level are shown in parenthesis below the coefficients.

Regression (3) – Interaction

Dependent Variable:	ΔConsumer Lending	ΔCommercial Lending	ΔTotal Lending
Capital Requirement	0.023613	0.060457	0.053940
	(0.037850	(0.051737)	(0.035713)
Monetary Policy	0.428194	-0.244492	0.184370
	(0.362167)	(0.574681)	(0.300064)
Capital Req. * MP	-0.050591	-0.013752	-0.036113
	(0.087049)	(0.122293)	(0.090792)
Lagged Dependent Variables	Yes	Yes	Yes
Bank Control Variable	Yes	Yes	Yes
Macro Control Variables	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Country Specific Time Fixed Effects	No	No	No
Observations	408	408	408
Number of Banks	17	17	17
R-Squared	0.15870	0.09311	0.11000

4.2 Extensions and Robustness

4.2.1 Monetary Policy (Tight and Loose)

In this section, we extend the prior model employed in Section 4.1.3 above by splitting our monetary policy variable into a tight and a loose one as described in section 3.2.4. This is done

to allow for non-symmetric response in lending to the two types of policies, for which there is strong prior grounding in research. By extension it further also allows for more heterogeneous interactions. Again, as can be seen in Table 9, the results generally lack significance, but we can note that, in accordance with theory, the tight monetary policy variables have a negative coefficient across all loan types. The loose monetary policy variables, however, take on positive signs, suggesting instead that a lowering of the interest rate would result in a lowering of loan growth. This could suggest that we are unable to separate correlation from causation, as the loose monetary policy is likely to coincide with periods of lower loan growth. However, a further explanation can be found in Thakor's term spread theory (see Section 2.3.3), where a reduction in interest rate could cause a reduction in lending as well if it leads to an increased term spread.

Looking further at the interaction terms, we can see that they indicate asymmetries, taking different signs for the loose and tight policy, however not significantly. Comparing the interactions to Model 3 and basing our discussion again around increased capital requirements as they have been far more prevalent, we can note that it for consumer and total loans exhibits the same amplifying effect on expansionary monetary policy but, in fact, attenuates the effect of contractionary one, whereas the opposite is true for commercial lending. The model does, however, like Model 2 also display a significant capital requirement coefficient, this time for commercial lending rather than total lending, but again positive. Whilst as discussed in the earlier occurrence, it is hard to theorize capital requirements bringing about an increase in total lending in our sample, an increase in a specific loan type could be plausible. As it could then be a case of loan shifting, where increased requirements cause banks to shift loans to sectors with lower risk weights. On a final and more general note, however, the lack of any significance again suggests the lack of any significant bank lending channel in accordance with Romer and Romer (1990), as well as an irrelevance of capital requirements in accordance with the MM theorem.

Table 9: Model 4 - Monetary Policy (Tight and Loose)

The table shows the results from our LSDV regression, regressing the quarterly loan growth on our control variables. Fisher type unit root test for panel data rejects a unit root and Wooldridge tests reject any serial correlation in the panel data. Statistical significance of the results is indicated with *=10% level, **=5% level and ***=1% level. Robust standard errors clustered at the bank level are shown in parenthesis below the coefficients.

Regression (4) – Monetary Policy Tight/Loose

Dependent Variable:	ΔConsumer Lending	ΔCommercial Lending	ΔTotal Lending
Capital Requirement	-0.015779	0.120975**	0.038241
	(0.040261)	(0.053189)	(0.039510)
MP (tight)	-0.031055	-0.504074	-0.402238
	(0.535798)	(0.357789)	(0.397657)
MP (loose)	0.669753	0.030862	0.549680
	(0.433588)	(0.881681)	(0.404385)
Capital Req.* MP (tight)	0.526990	-1.291377	0.034377
	(0.323794)	(0.792785)	(0.404315)
Capital Req.* MP (loose)	-0.126506	0.067345	-0.080286
	(0.103339)	(0.141569)	(0.103282)
Lagged Dependent Variables	Yes	Yes	Yes
Bank Control Variable	Yes	Yes	Yes
Macro Control Variables	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Country Specific Time Fixed Effects	No	No	No
Observations	408	408	408
Number of Banks	17	17	17
R-Squared	0.16280	0.10203	0.11440

4.2.2 Size (Large and Small)

Relaxing our earlier implicit assumption through the use of fixed effects of homogeneity of the coefficients amongst banks, we again run Equation 4 but conditioned on bank size, splitting the sample in two as described in Section 3.2.4. Looking first at capital requirements for the two subsamples in Table 10 below, we can see that there indeed appears to be a difference between large and small banks, where, in accordance with earlier findings, it appears to have a greater effect amongst small banks. Whilst the coefficients remain positive and insignificant across all loan types for large banks, it takes the commonly theorized and empirically found negative coefficients for small banks, again across all loan types. In the case of consumer loans, the coefficient is significant at the 10% level. Bridges et al. (2014) found smaller banks to be the main drivers of the impact of capital requirement changes on lending, theorizing larger, often multinational, banks better equipped to insulate themselves from these types of regulatory changes. Though not significant across all loan types, our results could be argued to support their hypothesis.

Considering the tight monetary policy variable, it appears to indeed exhibit robustness along the size dimension, again taking a negative sign in all cases, and in the case of consumer

loans by large banks, even significantly so at the 10% level. That the effect would be more significant amongst large banks goes against the a priori theorized difference, as larger banks are assumed able to restructure their loans with greater ease in response to a change in the policy. As for the loose monetary policy, it again exhibits more variation amongst loan types but also across the dimension investigated. In the case of consumer loans of small banks, it even suggests the perhaps implausible effect of a one percent decrease in monetary policy rate causing a three percent decrease in lending, significant at the 5% level. Though as earlier mentioned this perverse effect may occur through the policy rates effect on the term spread, such a large coefficient would be quite difficult to motivate and perhaps more likely a case of Type 1 error.

The interaction term for the tight monetary policy takes the same sign in both sub-samples as in the earlier whole. The interaction, however, remains insignificant in all cases but for consumer loans for small banks, where the positive interaction coefficients suggest an attenuating effect of increased capital requirements on contractionary monetary policy. As for the interaction of loose MP, there are some discrepancies in the signs for commercial lending, being positive in two and negative in one, and further remains insignificant across all three specifications. For the consumer and total lending, however, our results indicate a negative relationship throughout all three specifications, though only significantly so (at the 5% level) in the case of small bank consumer lending. This would indicate that increased capital requirements have an amplifying effect on expansionary monetary policy. Thus, our findings amongst small banks are contrary to the findings of Xiong (2013) amongst Chinese banks, that sugget a dampening of the expansionary policy, and a strengthening of contractionary policy.

Table 10: Model 5 - Size (Large and Small)

The table shows the results from our LSDV regression, regressing the quarterly loan growth on our control variables. Fisher type unit root test for panel data rejects a unit root, and Wooldridge tests reject any serial correlation in the panel data. Statistical significance of the results is indicated with *=10% level, **=5% level and ***=1% level. Robust standard errors clustered at the bank level are shown in parenthesis below the coefficients.

Regression (5) – Size (Large)

Dependent Variable:	ΔConsumer Lending	ΔCommercial Lending	ΔTotal Lending
Capital Requirement	0.022535	0.060510	0.039710
	(0.033846)	(0.091475)	(0.054049)
MP (tight)	-0.970044*	-0.860738	-0.955576
	(0.482988)	(1.106148)	(0.737754)
MP (loose)	0.203698	1.427319	0.760332
	(0.114953)	(0.760926)	(0.406646)
Capital Req.* MP (tight)	0.722006	-0.557524	0.298543
	(0.493261)	(1.983083)	(1.104673)
Capital Req.* MP (loose)	-0.019815	-0.080111	-0.038649
	(0.063592)	(0.151703)	(0.084458)
Lagged Dependent Variables	Yes	Yes	Yes
Bank Control Variable	Yes	Yes	Yes
Macro Control Variables	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Country Specific Time Fixed Effects	No	No	No
Observations	192	192	192
Number of Banks	8	8	8
R-Squared	0.32880	0.15570	0.15718

Regression (6) – Size (Small)

Dependent Variable:	ΔConsumer Lending	ΔCommercial Lending	ΔTotal Lending
Capital Requirement	-0.183131*	-0.063626	-0.054696
	(0.089066)	(0.134597)	(0.055323)
MP (tight)	-0.307261	-1.370219	-0.925754
	(0.815818)	(1.259313)	(0.738570)
MP (loose)	3.152660**	-0.227268	1.555163
	(1.175030)	(1.575030)	(0.882989)
Capital Req.* MP (tight)	1.023999*	-1.638353	0.090017
	(0.479453)	(0.892006)	(0.420366)
Capital Req.* MP (loose)	-0.845368**	0.116041	-0.323015
	(0.308499)	(0.345602)	(0.221813)
Lagged Dependent Variables	Yes	Yes	Yes
Bank Control Variable	Yes	Yes	Yes
Macro Control Variables	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Country Specific Time Fixed Effects	No	No	No
Observations	216	216	216
Number of Banks	9	9	9
R-Squared	0.27339	0.25735	0.24464

4.2.3 Excess Capital (High and Low)

Finally, we allow for potential heterogeneity in the response to the different policies and their interaction depending on the banks' excess capital in each period of interest, splitting the sample as described in Section 3.2.4, again running Equation 4 for each sample. Looking first at the capital requirements in Table 11, we again obtain positive insignificant coefficients for the capital requirements, just as in the whole aggregate sample. A theorized stronger negative effect for weakly capitalized banks was thus not found.

Moving on to the monetary policy variables, the coefficients for all loan types remain insignificant also when we condition on excess capital. They do, however, in some cases take on different signs perhaps suggesting the prevalence of at least some degree of heterogeneity along the variable dimension. For the tight monetary policy, we again obtain negative coefficients across all loan types amongst well capitalized banks, just as in the whole sample and in the large and small banks sub-samples in the prior section. For banks with low excess capital we however obtain a positive coefficient for both consumer and total lending. This would be counter to the findings of Xiong (2013) in that he suggests a lower capitalized bank greater influenced by contractionary policy, but it is for those banks that we do not obtain the suggested negative coefficient.

As for the interactions, we again see a negative interaction term with loose monetary policy for consumer loans and total loans, as in all prior specifications. This suggests that increased capital requirements amplify loose MP's effect on both consumer and total loan growth. Though only significantly so in one instance, the similar finding across the different dimensions suggests a certain degree of robustness and might suggest that we are simply unable to attain much significance due to the rather small sample size. Their interaction with the tight monetary policy, as well as the interaction in both cases for commercial lending, appears as earlier, varied and less robust. As such, it is in these cases more difficult to argue for any significant interaction between the policies, identified or not.

Table 11: Model 6 - Excess Capital (High and Low)

The table shows the results from our LSDV regression, regressing the quarterly loan growth on our control variables. Fisher type unit root test for panel data rejects a unit root, and Wooldridge tests reject any serial correlation in the panel data. Statistical significance of the results is indicated with *=10% level, **=5% level and ***=1% level. Robust standard errors clustered at the bank level are shown in parenthesis below the coefficients.

Regression (7) – Excess Capital (High)

Dependent Variable:	ΔConsumer Lending	ΔCommercial Lending	ΔTotal Lending
Capital Requirement	0.006335	0.139563	0.055967
	(0.058171)	(0.108719)	(0.045628)
MP (tight)	-1.057196	-1.156894	-0.537118
	(0.791398	(2.180736)	(0.903653)
MP (loose)	1.205496	-2.450389	-0.273516
	(0.880591)	(1.897114)	(0.959722)
Capital Req.* MP (tight)	-0.008639	-1.075768	-0.151474
	(0.310419)	(0.733699)	(0.471473)
Capital Req.* MP (loose)	-0.233030	0.145283	-0.147191
	(0.173467)	(0.316605)	(0.189257)
Lagged Dependent Variables	Yes	Yes	Yes
Bank Control Variable	Yes	Yes	Yes
Macro Control Variables	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Country Specific Time Fixed Effects	No	No	No
Observations	204	204	204
Number of Banks	13	13	13
R-Squared	0.28655	0.19534	0.22895

Regression (8) – Excess Capital (Low)

Dependent Variable:	ΔConsumer Lending	ΔCommercial Lending	ΔTotal Lending
Capital Requirement	0.020663	0.176827	0.069700
	(0.083834)	(0.185186)	(0.086875)
MP (tight)	0.775084	-0.900352	0.555851
	(1.424275)	(3.744790)	(2.172988)
MP (loose)	-0.056038	0.301057	0.193551
	(0.612332)	(0.798519)	(0.464966)
Capital Req.* MP (tight)	-0.107965	-0.179183	0.023666
	(0.569662)	(1.421329)	(0.779064)
Capital Req.* MP (loose)	-0.059488	0.028502	-0.041829
	(0.167119)	(0.293649)	(0.181179)
Lagged Dependent Variables	Yes	Yes	Yes
Bank Control Variable	Yes	Yes	Yes
Macro Control Variables	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Country Specific Time Fixed Effects	No	No	No
Observations	204	204	204
Number of Banks	12	12	12
R-Squared	0.26327	0.23562	0.22494

5 Conclusion

This paper addresses the transmission of both regulatory and monetary policy, as well as their interaction in a Nordic context, employing a dynamic LSDV model on a panel of banks in the *Nordic-4*. Through the use of a set of countries with various monetary policy regimes, it aims to attain more general and robust insights on the topic than earlier established, and thus help to bring more clarity to the subject.

For capital requirements, our coefficients, unlike prior findings, tended to be positive across most model specifications. While it is difficult to argue capital requirements to be positively related to total lending, a positive coefficient for one of the specific loan types could be a product of loan shifting, where the results indicate a potential flow from consumer lending to commercial lending. A significant negative effect of the increased capital requirements could only be found for small banks consumer lending. For our monetary policy proxy, we find little evidence of a significant bank lending channel in our sample. The tight monetary policy's negative effect, however, appears quite robust and its lack of significance might instead be due to the pooling of several countries, for which the homogeneity assumption of its transmission might be far-fetched. For the interaction, we find significant coefficients for both the loose and the tight policies' interaction with capital requirements for consumer lending amongst small banks. There, it suggests an attenuating effect of increased capital requirements on contractionary monetary policy, whereas it appears to amplify the expansionary one. Given that our sample period primarily has been subject to easing monetary policy, it suggests that it primarily has worked to improve the transmission of monetary policy to small banks. However, outside of this specific lending type, we find little evidence of any significant interaction between the two policies.

Though our results primarily tend in favor of the Modigliani-Miller theorem, it does not appear to hold amongst small banks, where capital requirements' significance on consumer lending indicate frictions, or a failure of the theorem. Looking at our monetary policy proxy, however, it appears to hold also amongst small banks as it lacks significance also there, this follows since the Romer and Romer (1990) critique of the lending channel's significance can be seen as based on MM logic as well.

With this new multi-country approach to the transmission and interaction of monetary policy, and capital requirements, we see two things as central to our purpose and that adds to

the current empirical strand; First, our study provides further robustness to the prior observed tendency of capital requirement changes effect on lending to depend on size, where it is more prevalent amongst small banks. As it is here further suggested to hold across a panel of banks in several countries. Second, there appears to be a significant interaction of the two policies for small banks' loan growth. A significant interaction for loan growth is not attained in neither Imbierowicz, Löffler and Vogel (2019) in the case of the German banking system, that only finds it for interest rates, nor Aiyar, Calomiris, and Wieladek (2016) in the case of the UK, who find no interaction significantly different from zero. As such, our results not only indicate an interaction but further suggest it dependent on bank-specific characteristics.

For future research, we consider further heterogeneity along other bank-specific dimensions as particular interesting, as it appears dependent on bank size. This would be of practical importance to avoid unintended effects that could come about by treating the banking sector as homogenous in the setting of the regulation and monetary policy, as now also the regulatory focus has shifted to a more homogenous treatment with the rise of more macroprudential tools of the Basel III framework. Given that the results also indicate both regulatory and monetary changes to more significantly influence the lending behavior of the smaller banks in our sample, expanding the sample to include more of these might yield further insights. On a final note, we suggest employing other models less restricted to the implicit homogeneity assumption of the LSDV model employed here. Perhaps pooled mean group estimators, as suggested by Pesaran, Shin and Smith (1998) for dynamic heterogeneous panels, might be better suited.

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Appendix

Appendix 1: List of Banks

Country of origin	**Bank**
Sweden	Handelsbanken
Sweden	SEB
Sweden	Swedbank
Sweden	SBAB Bank
Sweden/Finland*	Nordea
Finland	OP Financial Group
Finland	Aktia Pankki Oyj
Finland	Ålandsbanken Abp
Denmark	Danske Bank
Denmark	Jyske Bank
Denmark	Spar Nord Bank
Denmark	Nykredit
Norway	DNB
Norway	SpareBank 1 SR-Bank
Norway	Sparebanken Vest
Norway	SpareBank 1 SMN
Norway	SpareBank 1 Nord-Norge

*Nordea relocated its headquarters from Sweden to Finland, 1 October 2018.