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The Effect of Capital Requirements on Bank Lending to Small and Medium-Sized Enterprises

Graduate School

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Abstract

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This thesis examines the effect of strengthened capital requirements on the supply-side of bank lending to Small and Medium-Sized Enterprises (SMEs) in Europe. The thesis further assesses the effect of capital buffers on lending to SMEs in addition to examining how different bank lending practices are affected by stricter capital requirements. SMEs are of particular importance to policymakers since they heavily depend on bank financing and are an important part of the European economy. Using data from 10 different countries and 70 banks in Europe from 2008 to 2015, we estimate our model using a System Generalized Method of Moments. We find that a 1 percentage point increase in the Tier 1 ratio will result in a decrease of 1.24 percentage point of lending to SMEs. Furthermore, we find that transaction-based banks are more adversely affected than relationship-based banks by increased capital requirements, and we find a negative relationship between the capital buffers and lending to SMEs.

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1. Introduction

This thesis examines the effect of strengthened capital requirements on bank lending to Small- and Medium-Sized Enterprises (SMEs) in Europe. It is frequently argued that the recent financial crisis highlights the importance of a regulated banking sector. VanHoose (2007) argues that the effects of strengthened capital requirements on bank behavior are ambiguous. Proponents of increased regulation emphasize the needs for safer and more capitalized banks (BCBS 2010; Admati et al. 2013; Angelini et al. 2015), whereas others express concern for adverse effects on the economy (Allen et al, 2012; Francis & Osborne 2009; Brun et al. 2013; Mésonnier & Monks 2015). Faced with the option to either decrease assets or increase equity to meet the new capital requirements, Wehinger (2012) and Aiyar and Jain-Chandra (2012) claim that banks are deleveraging rather than raising new capital. Since bank lending is an important source of financing for SMEs (Berger & Udell 1998; Bolton & Frexias 2000; Vera & Onji 2010; López-Gracia & Sogorb-Mira 2008; Moro et al. 2012) and are an important part of the European economy (European Union 2017), it is imperative to understand the true effects of increased capital regulation on bank behavior and the consequences for the most bank dependent firms. Furthermore, papers have found adverse effects of increased capital requirements on bank lending (Kashyap et al. 2010; Bridges et al. 2014), and particularly lending to SMEs (Saurina & Trucharte 2004; Humblot 2014).

The primary objective of this thesis is to investigate the impact of increased capital requirements, known as the Basel III framework, on bank lending to SMEs in Europe. We focus on the supply-side of bank lending by examining the lending volume of 70 banks in 10 countries from 2008 to 2015 and analyzing if the supply of lending to SMEs have changed due to the increased capital requirements. Furthermore, we investigate whether relationship-based banks are affected to a larger extent than transaction-based banks, and if less capitalized banks are more affected from the regulatory changes than better capitalized banks. As part of our research, we hypothesize that (i) increased regulatory capital has a negative impact on SME bank lending, (ii) relationship-based banks are more adversely affected by capital requirements than transaction-based banks, and (iii) lower capital buffers have a negative impact on credit growth. We contribute to the existing literature by quantifying the impact of increased capital

requirements on bank lending to SMEs in Europe. Previous research has focused on a particular country, but to the best of our knowledge, no research on capital requirement has been done on this scale. Our results are also of practical importance to policy makers, to fully understand the impact of strengthened capital requirement on SME bank lending.

To assess the relationship between lending and capital requirements we rely on the system Generalized Method of Moments (GMM) approach. This allows us to control for endogeneity issues and to deal with the fact that our dataset includes a smaller time span and a larger number of observations. Through our estimations, we find a negative relationship between additional regulatory capital and SME lending, confirming our first hypothesis. According to our findings, a one percentage point increase in Tier 1 ratio will result in a decrease of lending to SMEs by 1.24%. Our results are in line with the theoretical framework developed by Thakor (1996), that increased capital requirements will decrease lending when banks are forced to hold more capital as it imposes additional costs. Secondly, we find that transaction-based banks are more adversely affected by additional regulatory capital than relationship-based bank. Thus, our results are not in line with the theoretical argumentation of Berger and Udell (2002) that relationship-based banks should be more adversely affected by increased capital requirements, as they rely on soft information. Lastly, to the contrary of our hypothesis, we find that a higher capital buffer results in a larger decrease in lending to SMEs. We find no evidence that a lower capital buffer results in a greater decrease in SME lending; hence, we cannot confirm the capital buffer theory or the bank lending channel theory, rather our results are rather in line with the argumentation of Gropp and Heider (2010) that capital requirements are of second-order importance to banks regarding the choice of capital structure.

The remainder of this paper is structured as follows: Section 2 introduces Background of SMEs and the capital regulations. Section 3 introduce existing literature on capital requirements and bank behavior. Section 4 introduces the theoretical framework and presents out hypotheses. In section 5 we include a discussion of our model, variables and econometric approach. In section 6 we present our findings and a brief discussion of the results. Finally, section 7 summarize the paper and concludes our findings.

2. Background

In 2008, the Basel Committee for Banking Supervision (BCBS) announced new reforms, Basel III, to strengthen the resilience of the global banking sector. The framework was implemented in 2013 and will be fully realized by 2019 (BCBS 2011b). The reformed framework declares an increase of existing capital requirements and an introduction of liquidity regulations. Concerning the capital requirement, the minimum Tier 1 capital ratio will be gradually increased from 4% to 6% and the Common Equity Tier 1 will increase from 2% to 4.5%. In addition, some banks are considered more important to the stability of the financial system, and are defined as global systemically important banks (G-SIBs) (BCBS 2011b). These banks are evaluated according to size, interconnectedness, substitutes or financial institution infrastructure, cross-jurisdictional activity, and complexity, and will require an additional loss absorbency, ranging from 1% to 3.5% of risk-weighted assets that should consist of Common Equity Tier 1. This additional capital requirement will be introduced in 2016 and fully implemented by the end of 2018.
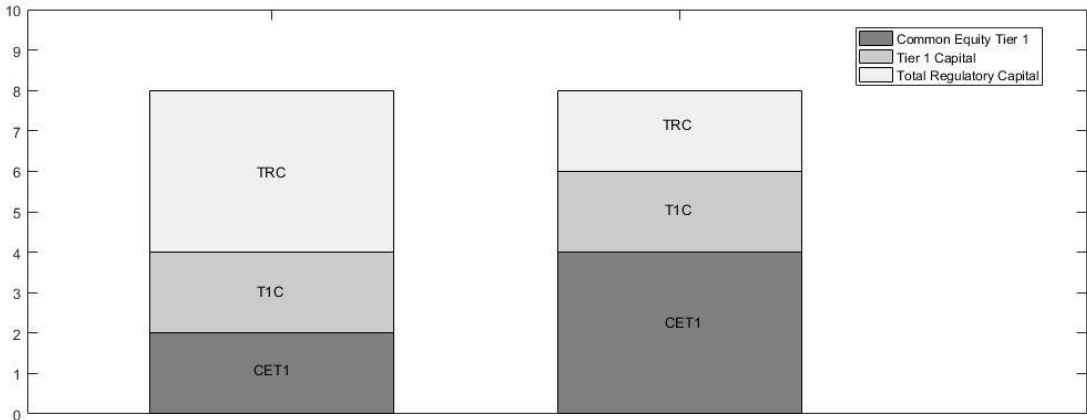
Figure 1. Capital Requirements of Basel II and Basel III

The main purpose of these regulatory changes is to reduce the risk that negative events will spread from the financial sector to the real economy, by increasing the banking sector's capacity to withstand shocks arising from financial and economic stress (BCBS 2011a). Furthermore, the framework also focuses on improving risk management and risk governance practices, in addition to increasing the disclosure and transparency of the banking sector. Increased capital

requirements are expected to have adverse short-term effects on loan supply as banks adjust to new regulations, necessitating regular assessments by regulators to ensure that the benefits outweigh the costs of increased regulation. The overall effects of the Basel III accord are ambiguous. Although the advocates of the framework argue that it reduces the effects and probability of a financial crisis (Santos 2000; BCBS 2010), others argue that the consequences are higher credit costs and decrease lending volumes (Francis & Osborne 2009; Allen et al. 2012; Brun et al. 2013; Mésonnier & Monks 2015). Berger and Udell (1998), Saurina and Trucharte (2004) and Humblot (2014) further argues that the SMEs, which are characterized by higher information asymmetries than other firms, are likely to suffer more from these consequences as these firms are highly dependent on bank loans as the main source of financing.

2.1 Small and Medium-Sized Enterprises in Europe

Because there are funding programs in the European Union (EU) that aim to promote SMEs, there are strict definitions of a SME. According to the European Commission, the definition of a SME is a firm with less than 250 employees (The Commission of the European Communities 2003). In addition, they should not have a turnover above €50 million or a balance sheet total above €43 million. SMEs are further divided in three different categories depending on the size. Micro is defined as firms which employs less than 10 employees, small firms employ 10 to 49 employees, medium-sized firms employ 50 to 249 employees, and any firm with 250 or more employees are defined as large companies.
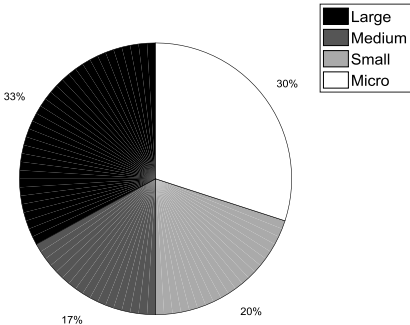

Figure 2. Share of Employment in Each Segment (European Union 2017)

In the EU, SMEs play an important role for the economy, both in terms of share of employment and value added. Approximately 99.8% of all firms in the EU are defined as a SMEs and employ 66.8% of all workers in 2015 (European Union 2017). According to data from 2015, SMEs contributed with €3.9 trillion in value to the EU zone, accounting for approximately 60% of the total economic activity. Since the financial crisis of 2008, the value added by SMEs have increased steadily as well as the number of active firms. A part of this growth can be attributed to the underlying economic growth of Europe. However, since 2008 there has been a decrease in the number of employees in the SME sector in the EU, and not until 2014 did the growth in employment increase (European Union 2016). In an attempt to support funding to SMEs, the European Investment Bank (EIB) and the European Investment Fund (EIF), provide support through various actions. The EIB encourages bank lending to SMEs by offering guarantees that reduces the risk on SME loans. In addition, the European Investment Fund (EIF), in which the EIB is the major shareholder, focus on equity investments in both venture capital and growth capital. Together, the EIB and EIF are focusing on responding efficiently to the market needs in SME financing in Europe. During 2015 the EIB Group provided €28.4 billion of support to SMEs and cooperated with almost 1000 financial intermediaries. Additionally, the EIB Group supported the business activities of roughly 240 000 SMEs that employed more than 4.1 million people. These initiatives can be a counterweight to the negative consequences that SMEs are facing due to changes in the economic activity or changes in the regulatory framework to meet the demand for financing. As part of supporting SME financing, the EIB Group has together with the European Commission also established initiatives such as the European Fund for Strategic Investments (EFSI), InnovFin – EU finance for Innovators, and Competitiveness of Enterprises and SMEs (COSME).

2.2 Debt Financing for SMEs

It is important to consider the SMEs' demand for loans to assess the consequences of capital requirements on the supply of lending to SMEs. Debt financing is the most common choice of financing for SMEs (Berger & Udell 1998; Bolton & Frexias 2000; López-Gracia & Sogorb-Mira 2008; Vera & Onji 2010; Moro et al. 2012) and the capital structure of SMEs differs from larger firms (López-Gracia & Sogorb-Mira 2008; Mac An Bhaird 2010). Moro et al. (2012) argues that the question of capital structure should not be viewed as equity verses debt but rather

focus on short and long term debt for SMEs. Small businesses are generally associated with more risk, more asymmetric information and higher transaction costs derived from agency problems. If the debt market is available for firms, equity financing poses a higher dilution cost and debt financing is then the optimal choice (Bolton & Frexias 2000) and according to Petersen and Rajan (1994) it is especially true for start-ups. However, SMEs have financial restrictions over larger firms as the access to public markets are limited. Issuing debt on the bond market is considered less expensive than bank loans, and those who lack access to the market are more willing to apply for bank loans (Li 2016). Recently, financing through crowdfunding is becoming more popular as an alternative to bank loans when the bond market is not accessible. In addition, SMEs tend to receive more internal financing from people within the firm and relatives of the owners. External financing tends to come from private equity and private debt markets. However, we must consider the fact that capital structure is a function of the firm size and age. As a firm matures, the reliance of public debt financing ad public equity financing increase, as the markets become more accessible (Berger & Udell 1998; La Rocca et al. 2011). There is empirical evidence that there exists a financial growth life cycle model of firms. As a firm grows, internal equity from retained earnings and the use of short term-debt are preferred and used more frequently.

It is estimated that 50% of all SMEs depend on bank loans (European Union 2016) and 27% of all SMEs applied for bank loans in 2016. According to the Survey of Access to Finance for Enterprises (SAFE), although issues related to customer acquisition and finding the right labor are key challenges for SMEs, about 10% of all SMEs in the EU claim that access to finance is the most pressing issue. The survey concludes that smaller firms perceive this as a more common issue, in contrast to larger firms that do not have the same problem. The same trend is observed in the acceptance rate of loans, were the average deny rate is 7% while smaller firms have a deny rate of 12%. However, these numbers do vary greatly between the member states of the EU. In Greece 31% of all SMEs claim that access to finance is the greatest challenge, while in Austria and Germany the number is 8%. The overall trend in the access to finance in the EU is positive. According to the survey, loans are becoming more accessible and the terms have improved in the last three years. The trailing 12-month lending flow from 2007 until 2016

is presented in Figure 3. There is an initial drop related to the financial crisis and has since then stabilized.
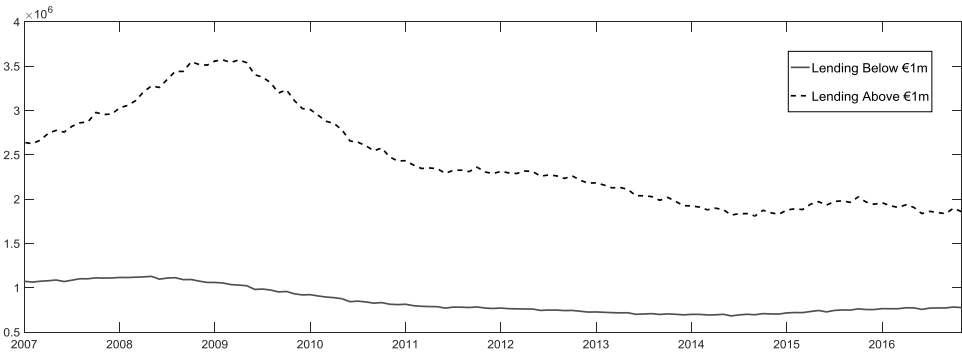

Figure 3. Lending Flow in EU (Trailing 12 months). Source: ECB Statistical Data Warehouse

Additionally, survey data from the European Commission (2016) confirms the opinion that bank loans are an important source of financing for SMEs, where 18% of the European SMEs used bank loans during April to September in 2016. According to the report, the most common sources of financing for SMEs were the following: credit line or overdraft (37%), leasing or hire-purchase (23%), trade credit (19%) and bank loans (18%). The results also indicate that there are significant variations between countries and the source of financing; e.g. France and Belgium demonstrate bank loan rates over 25%, whereas Hungary and Estonia are below 10%. Additionally, firm-specific characteristics also appeared to influence the source of financing, as equity financing was more common than bank lending among start-ups.

2.3 SME Supporting Factor in the Regulatory Framework

The European Banking Authority (EBA) further supports the argument that SMEs access to bank loans are adversely affected by the Basel III reforms. In an attempt to support SME lending, the European Commission initiated the SME Supporting Factor (SF) in Article 501 of Capital Requirements Regulation (CRR), which decreases capital requirements for exposures to SMEs by the factor 0.7619; thus, a capital discount of approximately 24% on SME exposure. As a response to the concerns regarding the supply of lending to SMEs (Berger & Udell 1998; Saurina & Trucharte 2004; Humblot 2014), the purpose of the SF is to offset the negative effect of the Basel framework, by freeing up regulatory capital to improve lending conditions for

SMEs. Dietsch et al. (2016) showed that in two of the largest economies in Europe, France and Germany, the SME SF is able to reduce the negative effect that Basel III has on SME lending. Mayordomo & Rodriguez-Moreno (2016) further argues that medium-sized firms will benefit more from the SF than micro-firms.

The SME SF was introduced in 2014, and hence only affect the last two periods of our sample. One can therefore expect that the effect of the SME SF may be limited. Since 2010, the SME lending has decreased but since the SME supporting factor was introduced, the EU observed an increase in SME lending (ESBG 2015). Because the limited effect of SME SF in our dataset, we have not included it in our model, but we want to emphasize that it may be an offsetting factor in our results.

3. Literature review

3.1 Capital Requirements and Bank Behavior

In an assessment conducted by BCBS (2010), the average annual probability of a banking crisis is approximately 4% to 5%. Lowering the annual probability of one percentage point is expected to give a yearly benefit of 0.2% or 0.6% of output, depending on whether the crisis will have a temporary or permanent effect on real economic activity. Additionally, the new requirements are also expected to decrease the severity of a potential banking crisis, although the statistical relationship is week because of the limited amount of observations, i.e. the number of banking crises. These results are supported by Berger and Bouwman (2013) who investigate the performances of US banks between 1984 and 2010, and find that higher capital improves survival probabilities during banking crises. They further state that the result is economically reasonable since capital functions as the main cushion against negative events. Several other articles have also found results which indicate that strengthened capital and liquidity requirements reduces the probability of a crisis. Barrell et al. (2009) investigates the UK banking sector and estimate that a one percentage point increase in the capital ratio will lower the likelihood of a banking crisis in the UK during 2007 to 2008 by roughly 5% to 6%.

Although the new capital regulations are introduced to enhance the resilience in the banking sector, the negative aspects of increased regulation must also be considered. In 2010, the BCBS and the Financial Stability Board established the Macroeconomic Assessment Group (MAG), with the purpose of estimating the macroeconomic impact of the new reforms. Their conclusion is that a one percentage point increase in the target ratio of tangible common equity to risk-weighted assets might decrease annual growth rates by an average of 0.04 percentage points during a four to five-year period, before growth rates will recover towards the baseline trend (MAG 2010). However, the negative impact on annual GDP growth may be larger if banks either meet the new requirements ahead of the proposed timetable, or increase their capital above the required levels set by the framework. On the other hand, MAG (2010) also states that the impact may be smaller than estimated since banks already had started to improve their capital levels, which would reduce the need for further capital accumulation. The effect on the real economy will also depend on what strategy the banks adopt to fulfill the capital requirements. For example, if banks are able to reduce overall costs or chose to hold safer assets, the estimated increase in loan rates or decrease in loan volumes might be less severe, leading to smaller negative effects on annual growth rates.

The view that capital requirements might lead to a contraction of bank lending is also supported by Mésonnier and Monks (2015). In their study of banks in the euro area, they find that banks which needed to increase their Tier 1 capital by one percent had an annual loan growth that was 1.2 percentage points lower than other banks that did not need to increase their capital ratios. The negative impact of increased regulation is also supported by Aiyar et al. (2014) and their study on UK banks, which supports the view that lending growth is adversely affected by increases in capital requirements. Furthermore, Cosimano and Hakura (2011) argue that increasing the equity-to-asset ratio by 1.3 percentage points to satisfy the Basel III requirements, will decrease banks long-run loan volumes by 4.6% in countries that experienced the financial crisis, and by 14.8% in countries that did not experience the crisis. The fact that countries that did not experience the financial crisis will be effected to a larger extent is explained by country-specific differences, such as banks net cost of raising new equity and the interest elasticity of loan demand.

Angelini et al. (2015) study the long-term economic costs of the Basel III reforms and find that an increase in the capital ratio will have a linear impact on output, where a one percentage point increase will decrease, on average, the steady-state output by 0.09%. Comparable results were found by Barrell et al. (2009) who states that the increased capital requirement is a cost to the banks, leading to increased lending margins. The increase in borrowing costs will thus have a negative effect on GDP, decreasing the long-run output by up to 0.08%. Nevertheless, according to a calibrated model on US banking data by De Nicoló et al. (2012, 2014), banks may respond differently depending on the size of the increase in required capital. When capital requirements are between 1% and 2%, banks are expected to meet the requirements by increasing their lending and, consequently, retained earnings. Also, it was estimated that an increase in capital requirements between 2% to 3% would lead to a 15% increase in lending. However, when the required capital is larger than 3%, banks are supposed to begin decreasing their lending, because it becomes too expensive to accumulate equity through increasing retained earnings According to a recent study by De Nicoló et al. (2015) on 89 countries between 1998 and 2011, a 2% increase in capital requirements was estimated to decrease annual growth of GDP by 0.48% to 0.88%. They further argue that both the short-term and long-term adverse impact on loan growth from increased capital requirements are significant.

Although regulators argue that an increased regulatory framework as a consequence of Basel III will have a positive net benefit on the economy, it is difficult to predict how banks will respond to increased regulation. The BCBS (2010) states that the long-term benefits are lower risk of financial crisis and reduced fluctuations in economic output, although the short-term effects during the transitional phase as banks adopt to the new Basel III framework are more unclear. One possible response to the increase in capital requirements might be that banks increase their equity financing and reduce long-term debt, and that any higher cost of funding is retained by increasing loan rates. However, banks could also offset the higher funding cost through increased non-interest income, decreased deposit rates, or reduced operating expenses. Banks' response to increased capital requirements might also depend on the state of the economy. A paper by Jackson et al. (1999) empirically investigates how banks in the G-10 responded to the introduction of the 1988 Basle Accord, and suggests that banks use the most cost effective measures when responding to capital requirements. For instance, in a booming

economy it might be convenient for banks to either raise new capital or retain earnings, whereas it might be more cost effective to decrease loan supply in an economic trough. This finding thus proposes that bank lending will be adversely affected when it is costly for banks to raise new capital.

3.2 Impact on SME Financing

Vera and Onji (2010) state that debt financing is SMEs main source of financing, and as Berger and Udell (1998) argues it is of special importance at an early stage of the firm life. Many authors emphasize that this may pose a problem for SMEs as the availability of credit is limited (Angelkort & Stuwe 2011) and there is a concern among researchers that the new Basel requirements will have a relatively larger impact on SMEs' availability to bank financing, altering its capital structure. Allen et al. (2012) raises the concern that smaller companies might have a harder time to receive financing if banks will restrict credit to meet the new requirements. As smaller companies are riskier and have less access to alternative sources of funding, their financing is much more dependent on bank lending than for larger firms. This problem is also raised by Angelkort and Stuwe (2011), who states that the new requirements could threaten SME financing because banks might increase lending rates or seek borrowers with lower credit risk. Furthermore, the concern of SME financing is also expressed by Humblot (2014) that investigates possible effects of the Basel III framework on SMEs' in France. In the article, the author concludes that the new requirements can have a negative impact on SMEs' access to bank credit, where especially short-term credit and the smallest firms are likely to be adversely affected.

4. Theoretical Framework

The Modigliani-Miller (MM) theorem on capital structure (Modigliani & Miller 1958) argues that the cost of capital of a firm is independent of capital structure, given a perfect market structure. Hence, an introduction of capital requirements forcing banks to alter their capital ratio should not have any effect on the firm value. Given market imperfections such as taxation and bankruptcy penalties, Kraus and Litzenberger (1973) argues that it will in fact matter. Although some literature still claims the MM theorem to be valid, empirical evidence seems to argue

otherwise (Mac An Bhaird, 2010; La Rocca et al. 2011). As discussed by Myers (1984), a company may target an optimal debt-equity mix which maximizes its firm value by exploiting interest tax shields (i.e. the static tradeoff theory), or prefer the type of financing that minimizes the asymmetric information problem (i.e. the pecking order theory). Equity poses the most severe asymmetric information, debt has minor adverse selection while internal funds avoids the issue of asymmetric information. According to the pecking order theory (Myers 1984) a firm's financing decision is determined by the size of the firm. In general, as a first source of financing a firm choses internal financing until these resources are exhausted, were the firm then turns to external debt. There are benefits of debt financing from a tax perspective, given that interest payments generally are tax deductible (DeAngelo & Masulis 1980). However, there might be severe issues arising during financial distress (Kraus & Litzenberger 1973). Considering the high cost of issuing new equity, in terms of dilution, the general rule is to issue safe securities before risky securities (Myers & Majluf 1984). From a theoretical perspective, the presence of large amounts of debt may cause suboptimal decisions due to issues related to debt overhang (Myers 1977). Hence, a shorter maturity date of the debt can resolve these issues and also signal high quality assets of the firm (Flannery 1986) and for this reason are preferred over longer maturities. In line with more recent literature that invalidates the MM theorem, changes in capital structure, e.g. caused by increased capital requirements, may alter firm value.

4.1 Capital Structure of Banks

Given the existence of market imperfections, the findings of Modigliani-Miller's (1958) theorem on capital structure has been modified to understand the capital structure of banks. In relation to non-financial companies, banks are faced with a different regulatory framework, such as capital requirements and liquidity requirements which in turn will affect the capital structure decisions. In addition, the complexity and the structure of a bank and its balance sheet leads to issues related to asymmetric information for outside investors, making issuing new equity even more costly. Hence, banks may prefer debt financing. Diamond and Rajan (2000) argues that the capital structure of a bank is a trade-off between several factors. The structure will affect liquidity and credit creation but also its stability. Froot and Stein (1998) claims that equity financing is costly for two main reasons. In the short-term, it is very costly to raise funds. Secondly, it is costly to hold a stock of equity capital as a buffer, even if it is accumulated

through retained earnings. On the other hand, a highly leveraged bank may face issues during financial distress. During the financial crisis, Berger and Bouwman (2013) concluded from empirical research that additional capital will increase the performance of banks during economic downturn in addition to increasing its survival probability. Diamond and Rajan (2000) further argues that if an optimal level exists that maximize lending, although altering the capital structure through regulations may make the bank safer, it will also decrease lending capabilities as the bank deviates from optimal levels and in turn increase the cost of capital of the bank.

According to Gropp and Heider (2010), capital ratios differ between the largest banks in the US and the EU. Banks tend to have an established capital structure that is not general, but specific to that bank. Depending on the type of the type of customers the bank has and their demand for liquidity, the optimal structure may vary. Other properties of the banks, such as capital buffers, maturity mismatch in the balance sheet and the risk profile of the bank, will have an effect on how banks alter their capital structures due too economic or policy shocks. In context of the Basel framework, to avoid the risk of falling below the minimum requirements, banks tend to maintain a stable capital buffer above the minimum requirements.

4.2 Capital Requirements and Lending

Increased capital requirements might affect bank lending through various mechanisms. The reaction to new regulatory framework and introduction of stricter capital ratios can be handled in several different ways. As Cohen and Scatigna (2016) states, a bank may choose to increase its retention rate or profits, e.g. by increased lending spreads. By issuing new equity, a bank may also improve its ratio but, as previously discussed, it may not be favorable from a value perspective. As a second alternative, a bank may choose to change its exposure to less risker assets through either a lower credit growth of new loans or through a reallocation of assets towards less risky assets.

Depending on the adopted strategy, the consequences differ for the shareholders of the bank but also for the economy as a whole. A possible reduction in the lending volume will have a larger impact on the most bank-depend firms, namely SMEs (Berger & Udell 1998; Saurina &

Trucharte 2004; Humblot 2014). The decision to either reduce lending or raise more capital boils down to the question of cost efficiency and shareholder value maximization (Hyun & Rhee 2011; Jackson et al. 1999). Issuing new equity is costly in relation to debt financing and during economic downturns, it is even more costly to raise new capital and hence the optimal decision is to reduce lending. As discussed by Kashyap et al. (2010) and Aiyar et al. (2014), due to capital requirements, banks are forced to equity financing, which banks tend to compensate by increasing the accumulation of retained earnings and shrinking lending volume. Myers and Majluf (1984) further argue that, because asymmetric information and the signaling effect of issuing new equity poses an even greater cost, issuing new equity is not a favorable option, in line with the pecking order theory. As a response to additional capital regulations, banks chose to reduce risk-weighted assets rather than issuing new equity. This argument is further supported by Brun et al. (2013). The authors states that total lending is a constant multiple of existing equity that constrains the lending capacities of banks. The authors conclude that banks are cautious to increase capital in the short-term, and suggest that increased capital requirements cause banks to deleverage and reduce their lending.

As discussed by Aiyar et al. (2014), additional conditions for a decrease in the lending rate due to an increase in capital requirements are: (i) equity must be relatively costly, (ii) capital requirements must constrain banks' choice of capital ratio, and (iii) there must be alternative sources of financing that can substitute bank lending that borrowers turn to instead. If one of these conditions do not hold, e.g. if market discipline causes banks to keep capital ratios above levels required by bank regulators, then regulatory changes might have less effect on capital ratio decisions and loan supply.

Thakor (1996) argues that as capital requirement increases, the banks' lending costs increase as they are forced to put aside additional capital. If there is competition, banks possibilities to pass on this cost to the borrower is limited and they are forced to accept the additional costs. Other options may therefore seem more attractive and lending becomes less attractive. Government bonds, that requires no capital to be put aside, becomes more attractive and hence we may observe a credit rationing in equilibrium. This argument is further developed by Allen et al. (2012) that claims the demand of government bonds may increase substantially from the

banking sector, causing an overexposure to government bonds that may have far reaching consequences in case of economic turmoil.

As previously discussed, regulations will change bank behavior and an introduction of regulatory framework may cause regulatory arbitrage behavior. Rochet (1992) argues that introducing capital regulations, especially the introduction of risk-weights, will alter the portfolio choices of the bank. Through regulatory arbitrage, banks attempt to choose exposures that are mismatched with their risk weights. Banks then obtain risk weights that does not reflect the true credit risk of that exposure and give banks incentives to choose riskier assets. This creates an inefficient portfolio choice and the consequences of bank taking advantage of regulatory arbitrage depends on how accurate the risk weights are. This does not necessarily mean that lending should decrease, but according to theory, we should observe a change in bank behavior.

We hypothesize that increased capital requirements have a negative impact on aggregate bank lending to SMEs:

Hypothesis I: Increased regulatory capital has a negative impact on SME bank lending.

4.3 Capital Requirements and Relationship-Based Lending

It is important to distinguish relationship-based lending and transaction-based lending in the context of capital requirements. Transaction-based lending, such as financial statement lending, asset-based lending and factoring, are based on hard information while relationship-based lending is based on soft information (Naveretti et al. (2015). The optimal type of lending is dependent on the severity of the asymmetric information of the firm and the existence of hard information. Due to the lack of pledgeable equity in SMEs and the lack of transparency, SMEs are forced to rely on relationship-based lending (Moro et al. 2012). Relationship lending may mitigate these issues as soft information is turned in to hard information as the relationship between the lender and the borrower matures. As Van Caneghem and Van Campenhout (2012) argues, the quality and the available information of the financial statement will affect the leverage of the SME. Hence, lower transparency will lower the accessibility to credit and the

additional risk with lending to SMEs will be reflected in the interest rate, according to Baas and Schrooten (2006).

It is common practice to demand collateral in SME lending, and it is considered to help resolving issues related to asymmetric information. Using loans below €1 million as a proxy for SME lending in Europe, it is clear from Figure 4 that collateral is used to a larger extent in SME lending. However, according to Blazy and Weill (2013), the main driver in the use of collateral is not to resolve asymmetric information, but rather to reduce loan losses. Firms that has a larger credit risk, will be faced with both higher interest rates and higher requirements of collateral, in accordance with the findings of Berger and Udell (1990). Although, from a theoretical perspective collateral may signal quality as argued by Besanko and Thakor (1987) and Chan and Kanatas (1985), but Berger and Udell (1990) argues the opposite as firms with a higher credit risk pledge more collateral, and hence secured loan are often riskier.
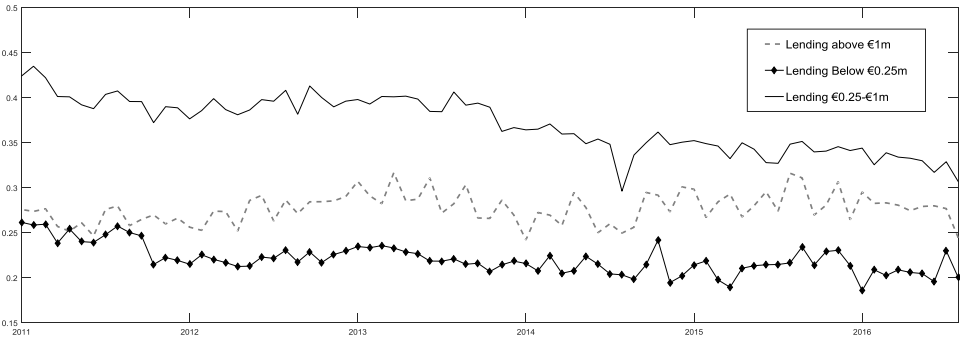
Figure 4 – Percentage of Loans with Collateral, collected from ECB statistical warehouse

With the development of the Basel framework, the need for quality assets is even more important and collateralized exposures will be weighted differently that unsecured exposures (BCBS 2015). According to the European Commission (2016), banks demand collateral to a higher extent for SMEs and it is not sufficient to just compensate with higher interest rate, as the asymmetric information issues are not fully resolved. As collateral is scarce in younger firm, this is a key issue and a major obstacle for SMEs in obtaining loans, and according to a survey conducted by the European central bank in 2016, the need for collateral has increased

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further. With collateral, the bank is able to transfer the risk of the loan to the borrower, mitigating the credit crunch that is caused by opacity between the lender and the borrower (Aghion & Bolton 1992; Hart 1995). But as the demand for collateral and the need for high-quality assets increases due to stricter capital requirements, Naveretti et al. (2015) argues that smaller firms have less capital to pledge and will suffer more from a possible credit crunch caused by Basel III. However, according to Tirole (2010) there is cost associated with pledging collateral. The value of the collateral is usually higher for the borrower than the value for the lender due to sentimental value, associated transaction costs of selling the collateral, and possible poor liquidity in the market. Although, this transfer of risk can improve the conditions of the loan (EBA 2016) and is especially important for smaller firms as it can help with issues related to asymmetric information. To what extent collateral is used depends on the nature of the competition in the market but the demand for collateral also decreases as the relationship between the borrower and the lender matures.

The literature on the effect of capital requirements on relationship lending is scarce. Some insight to the issue was given by Hancock and Wilcox (1998) who studied the effect on bank capital on lending volume between 1989 and 1992 to determine changes in bank behavior due to industry changes. The research showed that smaller banks has a higher sensitivity to changes in capital structure than larger banks, and as bank capital decreases they tend to shrink their portfolios more. Berger and Udell (2002) states that smaller banks focus more on relationship lending and are more vulnerable to industry adjustments. Further, Berger and Udell (2002) argue that because smaller banks have more relationship lending, which is based on soft information, it is harder to justify relationship-based lending to regulators and others outside that relationship. Therefore, the regulatory framework favors a more transaction-based lending approach based on hard information which would negatively impact SMEs as they are dependent on relationship lending to obtain financing.

We want to emphasize that it is not the size that is relevant, but the type of lending practice. However, as transaction-based banks are generally larger, we may encounter other factors that will affect the how these banks behave. According to Gropp and Heider (2010), optimal bank capital depends on bank-specific factors such as size. Hence, larger banks may have a lower

optimal capital level than smaller banks. If this is the case, they may be more adversely affected by an increase in the minimum Tier 1 ratio as they move further away from its optimal levels. In addition, because different methods are applied to the risk-weighted assets, lending to SMEs may be more or less favorable. Berger (2006) argues that larger banks tend to favor an Advanced IRB approach. This approach favors SME lending because of a lower comparative advantage than other methods. Berger finds that the premium charged to SMEs by larger banks are 100 basis points lower on average than the premium charged by smaller banks. Allen et al (2014) further argues that the exposure to lower risk increase, such as government bonds and mortgages. As Benetton et al. (2017) argues, banks that applied an IRB approach had a comparative advantage in issuing mortgages loans than banks that applied a standardized approach. In conclusion, given that larger and smaller banks apply different methods of risk-weights, different types of banks may prefer to shift to different assets.

Using smaller banks as proxy for relationship-based banks and larger banks as a proxy for transaction-based banks, we argue that relationship-based banks will be effected more than transaction-based banks. We state the following hypothesis:

Hypothesis II: Relationship-based banks are more adversely affected by capital requirements than transaction-based banks.

4.4 Capital Buffers and Lending

The relative size of banks' capital buffers, i.e. the amount of capital held in excess of minimum capital requirements, might have an impact on lending activities. The capital buffer theory predicts that greater capitalized banks aim at preserving their capital buffers and lesser capitalized banks to restructure an appropriate capital buffer. In theory, this finding implies that low-capitalized banks could respond to strengthened capital requirements by either reduce their total lending or by turning to less risky borrowers. This theory is further confirmed empirically by Heid and Stolz (2003) in Germany and by Jokipii and Milne (2011) in the US.

Furthermore, Gambacorta and Mistrulli (2003) attempt to explain the theory through the imperfection of the Modigliani-Miller theorem and emphasize the bank lending channel as the

possible explanation for the result. According to this theory, lower capitalized banks are perceived riskier than higher capitalized banks, which creates an adverse selection problem that reduces the possibility to raise uninsured debt, such as bonds, thus limiting the ability to shield the effects on lending of a deposit drop.

Another theory related to bank lending, also contingent on the imperfection of the Modigliani-Miller theorem, is the bank capital channel. As discussed by Van den Heuvel (2002), this theory state that banks' capital structure will affect their lending activities because of the effects from the maturity mismatch on banks' balance sheets. When short-term interest rates increase, this mismatch will lower future bank capital and reduce lending for poorly capitalized banks, which increases the volatility of less-capitalized banks. This decline in lending is dependent on the initial interest rate, where a higher level of interest rate, ceteris paribus, will have a negative impact on expected profits. Secondly, the adverse effect on bank lending of increasing short-term rates is also expected to increase over time for the less-capitalized banks.

The relationship between banks' capital buffers and lending behavior is however ambiguous. When investigating the relationship between capital buffers and economic cycle among Brazilian banks between 2000 and 2010, Tabak et al. (2011) finds a negative relationship between capital buffers and the economy. According to the authors, this finding indicates that banks adjust their capital buffers in line with the state of the economy, e.g. increase capital buffers and decrease lending during an economic downturn. This relationship thus indicates that factors which are not bank-specific affects the capital buffers, which in turn might affect lending activities. Such a relationship would support other studies, e.g. Berger and Udell (1994) and Wagster (1999), which fails to establish a negative relationship between increased capital requirements and decreased bank lending. Furthermore, when reviewing the impact of the first Basel accord in 1988, Jackson et al. (1999) claim that it is hard to isolate the true effects on bank lending from the capital requirements since other economic factors also affect the lending flow. They also state, however, that it is likely that bank lending during some periods will be constrained by capital requirements since the purpose of the requirements is to limit the amount of risk that banks can take relative to their capital.

According to the theories outlined above, we state the following hypothesis:

Hypothesis III: A lower capital buffer has a negative impact on credit growth.

5. Method

5.1 Model Specification

To test *hypothesis I* and assess the supply-side of the relationship between SME lending and regulatory capital the following model is specified:

$$CG_{it} = \propto + \beta_1 T1R_{it} + \beta_2 CF_{it} + \beta_3 GDP_{it} + \beta_4 R_{it} + \beta_5 ROA_{it} + \beta_6 EMP_{it} + \varepsilon_{it}$$

were CG_{it} is the credit growth of SME lending, $T1R_{it}$ is the Tier 1 ratio, CF_{it} is credit cost over financial assets, GDP_{it} is the growth of the country-specific gross domestic product, R_{it} is the average interest rate to corporations in each country, ROA_{it} is the return on assets, and EMP_{it} is the number of employees.

To test *hypothesis II*, that relationship-based banks are more adversely affected than transaction-based by an increase in regulatory capital, the following steps are taken. First, we sort all observations according to the average number of employees over the sample period. Secondly, we split the dataset into two datasets in line with the method applied by Bridges et al. (2014). The dataset containing banks with a higher number of average employees is a proxy for transaction-based banks, while the dataset containing banks with a lower number of employees is a proxy for relationship-based banks, in line with Berger and Udell (2002). This allows us to test *hypothesis II*, if relationship-based banks are affected by capital requirements to a larger extent than transaction-based banks. Hence, the number of employees is used as a proxy for the amount of resources in the bank and the size of the bank, as it should reflect what type of bank it is according to Berger and Udell (2002)

Further, to test *hypothesis III* and the relationship between regulatory capital buffer and SME bank lending, the following equation is estimated:

$$CG_{it} = \propto + \beta_1 RCBR_{it} + \beta_2 CF_{it} + \beta_3 GDP_{it} + \beta_4 R_{it} + \beta_5 ROA_{it} + \beta_6 RWA_{it} + \varepsilon_{it}$$

The $RCBR_{it}$ variable is the Tier 1 capital ratio divided by the minimum requirement in a given year. A higher ratio indicates a larger regulatory buffer while a smaller ratio indicates lower capital buffer. The other variables are identical to the previous equation.

5.2 Model Variables

Unlike previous literature, this thesis uses a much wider geographical area as the focus of the study. Initially the data contained data from all member countries, which was eventually cut down to 10 countries and 70 banks. Optimally, one would include a large number of banks from every country for a longer time period, to capture both short-term and long-term effects of stricter capital requirements. However, given our previously stated hypotheses this is not an option as the data is very limited in most European countries. Many observations lack complete data on lending and many banks have no reported lending. SME lending is even more limited, and only a few selected banks have reported values. This forces us to combine data from several databases to get a good proxy of SME lending. Although this compromises the dataset, it is the only option to be able to test our stated hypotheses.

Hence, our dependent variable is a proxy for SME lending, based on corporate lending and country-specific ratios based on lending flow below €1 million in relation to total lending in that specific country. Lending below a certain level is a common proxy used in previous literature (Publishing O.E.C.D 2012.). From the ECB Statistical Data Warehouse, we retrieve data from each country on loans above €1 million and below €1 million. The proxy is the ratio of total lending flow below €1 million divided by total lending flow multiplied by the corporate lending. Once again, not every country reports these numbers on a sufficient level, and hence we are forced to only include countries with adequate data. Combining the data on corporate lending with our SME ratio, we are able to create a proxy for SME lending.

In line with previous research (Bridges et al. 2014; Osei-Assibey & Asenso 2015), we use credit growth, *CG*, as the dependent variable in our regressions. The variable is a proxy for the growth

of loan supply to SMEs, and represents each banks' annual change in corporate loan growth. To deal with stationarity issues in the dataset, the *CG* variable is transformed from lending volume into lending growth to de-trend the data (Crawley 2012), and then multiplied by the country-specific SME lending proxy (see Appendix 3 for values of the SME proxy).

The Tier 1 ratio, *T1R*, calculated as total Tier 1 capital divided by total risk-weighted asset, is the main variable of interest in our regressions since it indicates whether increases in regulatory capital will result in a change in credit growth. Furthermore, Tier 1 capital includes Common Equity Tier 1 and Additional Tier 1 (BCBS 2010), and is subject to regulatory minimum requirements according to the Basel framework. Numerous papers on bank lending include capital ratios in the regression models to capture effects of increased capital requirements (BCBS 2010b; Bridges et al. 2014; Osei-Assibey & Asenso 2015; Cohen & Scatigna 2016). Important to consider, however, is that banks can modify their Tier 1 ratio through various mechanisms. For instance, banks are able to create instruments designed to generate Tier 1 capital in an attempt to boost its total Tier 1 capital, but these instruments are limited to 15% of total Tier 1 capital (BCBS 1998). Also affecting the Tier 1 ratio is how banks choose to calculate capital requirements for credit risk, e.g. the standardized approach (SA) or the internal ratings-based (IRB) approach. The choice of method could affect the risk-weighted assets and thus modify the Tier 1 ratio while keeping the Tier 1 capital constant. According to Behn et al. (2016), the IRB approach leads to lower capital charges than the standardized approach. Moreover, Hakenes and Schnabel (2011) argue that the IRB approach could give larger banks a competitive advantage over smaller banks due to high implementation costs of the method.

The regulatory capital buffer ratio, *RCBR*, is constructed by dividing the Tier 1 ratio by the minimum capital requirements. A higher ratio indicates that the bank has a higher margin to the minimum level. The purpose of this variable is to test whether a small capital buffer is associated with a decrease in the credit growth, and vice versa. A bank that is close to the minimum requirement may be more risk-averse and reluctant to take additional risks to avoid falling below the minimum levels. This is a common variable included in previous research of the relationship between capital buffer and lending (Tabak et al. 2011; Osei-Assibey & Asenso 2015).

The *CF* variable is calculated as the credit cost divided by total financial assets, and is a measurement of asset quality. A higher ratio indicates a lower asset quality and a lower ratio would indicate a higher asset quality. To be able to get a better estimation of the true lending flow, we include this variable to account for any large write-downs in the assets of a bank that would negatively affect the lending stock but is not an actual decrease of the lending. Optimally one would include a corporate lending specific write-down, but such data is not available to the best of our knowledge. Osei-Assibey and Asenso, (2015) used a similar approach, by including net problem loans to control for the quality of loans in the regression.

The gross domestic product, *GDP*¸ is a control variable that measures the percentage change in GDP in each country included in our sample. This control variable allows us to control for the demand-side of the market, since a higher economic activity should yield a higher demand for loans. One should expect that GDP will capture the economic activity and should affect the credit growth positively. A higher GDP growth should result in a higher demand for loans as investment opportunities arise and better conditions for approving loans. Hence a positive relationship is expected.

The interest rate, R, is a control variable of the cost of debt and in turn the demand for loans. This allows us to further account for the demand of loans by SMEs. The purpose of this variable is to capture any changes in the credit growth by changes in cost of lending and hence we want to use an interest rate that truly reflects the cost of lending. The interest rate used is the average cost of lending for corporations up to €1 million, which is a proxy for the cost of borrowing for SMEs, collected from the ECB Statistical Data Warehouse.

Return on assets, *ROA*, is calculated as net profit over total assets, and is a control variable that captures any changes in the profitability which may affect lending volume. When profitability is relatively high, banks' may have greater lending possibilities. There are several variables that could be considered appropriate measurements of a bank's profitability. Ideally we would like a ratio that truly captures changes in real profitability of a bank, and not a measurement that could easily be inflated by accounting practices or a specific event. An alternative is return on

equity, but considering that the equity proportion of a bank is relatively low, it is exposed to large fluctuations. Athanasoglou et al. (2008) further supports the choice of using ROA as a measurement of profitability, as it is the best reflection of actual profitability of a bank.

The number of full-time employees for each bank is represented by the *EMP* variable, which is used to control for bank size. It is a common approach to include bank size as a control variable as banks of different size may behave differently. Larger banks may have greater resources to sustain a higher amount of lending during fluctuations in the overall economy or profitability, whereas smaller banks may be more sensitive to changes. One alternative approach to control for size is to use total assets, but we believe that the number employees is more accurate since it will be a better proxy of the true size because total assets may be inflated. Hence, we expect large banks to have a positive impact on credit growth.

5.3 Model Estimation

Due to the model specification and the included variable, we recognize that system Generalized Method of Moments (GMM) is the best choice. Arellano and Bond (1991) introduced the use of transformed estimators and the GMM estimation introduced by Hansen (1982), usually referred to as the differenced-GMM estimators. This allows us to create instruments from within the dataset rather than obtaining external instruments. However, a common problem is that the lagged level of the regressor is a poor instrument for the first-differenced regressor. Arellano & Bover (1995) and Blundell and Bond (2000) proposed that if we assume that the first difference of instrumenting is uncorrelated with the fixed effect of each country, we can obtain additional instruments. It uses lagged first differences and the lagged level of the variables as instruments, rather than the original model that only use lagged levels as instruments. Hence we can instrument the level equation on its own first differences which vastly increase the efficiency of the estimators (Blundell & Bond 2000). In addition, the GMM approach is the preferred choice of method in the existing body of literature related to the Basel framework and its effect on bank behavior (Gambacorta & Mistrulli 2003; Cosimano & Hakura 2011; Giordana & Schumacher 2012; Gavalas & Syriopoulos 2014; Humblot 2014; Osei-Assibey & Asenso 2015; Ashraf et al. 2016). In addition, robust standard errors are applied to handle any issues related to heteroscedasticity.

The dataset in our research includes a large number of banks but only eight time periods. In line with Judson & Owen (1999) and Roodman (2006), rather than using a panel data approach, a GMM estimation using lagged variables as instruments is more appropriate given a large number of observation with a smaller time span and will produce unbiased and more efficient estimators. This is especially true for unbalanced data, as is the case with our data.

A second argument for our GMM approach is the likelihood of endogeneity in our model. A large body of the litterateur dealing with models related to banks and regulatory framework suffer from endogeneity issues (Cosimano & Hakura 2011; Giordana & Schumacher 2012; Osei-Assibey & Asenso 2015; ECB 2015). For example, endogeneity may stem from omitted variable biased or because of correlation between the independent variables. Also, issues related to simultaneous causality between the credit growth and the Tier 1 ratio may be present because an increase in lending will affect the components of the Tier 1 ratio. A simple OLS or a dynamic panel data approach will most likely produce highly biased results, and a standard dynamic panel data approach will also not solve this issue either. This furthers strengthens the argument for choosing our approach, since the GMM model overcomes these issues by using lagged values of independent variables as instruments in addition to first-difference instruments, turning the endogenous variables predetermined and not correlated with the error term.

It is highly likely that our data contains fixed effects since we have 10 different countries in our dataset. Unobservable effects, such as cultural differences, may be present and it is likely that these fixed effects may be included in the error term and cause biasedness (Roodman 2006). Further, as discussed in section 5.4, the economic environment differs in terms of both gross domestic product and the cost of debt. Assuming that the differenced instruments are uncorrelated with the fixed effect of the countries in our dataset, we are able to account for the country specific effects in our estimators. Assuming constant country specific effect, this assumption should hold.

5.4 Data

This thesis is based on countries in Europe. Data were collected from the ECB Statistical Data Warehouse and the database SNL Financial. Due to the lack of extensive data, we have removed banks that lacked to many observations from our dataset. Unfortunately, several countries were removed from the set because no data was available or crucial data was missing for several time periods. Our estimations are, however, based on an unbalanced dataset as some values were randomly missing in the dataset. In Table 1 below, we present the 10 countries together with the number of observations included in our dataset.

Table 1. Countries and number of observations

Country	*No. Observations*
Austria	*11*
Belgium	*1*
Finland	*3*
France	*19*
Germany	*15*
Italy	*6*
Netherlands	*3*
Portugal	*5*
Slovakia	*3*
Spain	*4*
Total	***70***

The data retrieved spans from 2008 until 2015 from 10 different countries, summing up to 70 banks in total. Even though our sample is limited in terms of time span, the econometric method is chosen to optimally handle the structure of our data, and hence it poses no real issue to the validity of the results. In our sample, we have one G-SIB according to the Financial Stability Board (FSB 2016). This bank may behave differently than other banks, as it will be required to hold additional CET1 at the beginning of 2016. Although this additional requirement is not introduced during our studied dataset, the bank might have adjusted before the introduction of

the requirement. However, as this bank only accounts for a minor part of our dataset, we do not expect it to have a large impact on our results.

Our model includes eight variables, which are presented in Table 2. In addition, we have included total assets, to further asses our data. The dependent variable, *CG*, shows a positive mean of 5.32% and has increased over the period, but it is worth noticing that it has a relatively large standard deviation. Although we have removed the most extreme outliers, we still believe the numbers could be affected by other factors that we have not been able to control for, such as mergers and acquisition, or large write-downs. Optimally, one would account for such events since these may alter our results. We have, however, accounted for write-downs with the *CF* variable, since it will capture large write-downs in a given year. Unfortunately, we are unable to find reliable data to correct our raw data for mergers and acquisitions.

Table 2. Variable statistics – Full sample

Variable	Mean	Median	Std. Dev.	Min	Max
CG	5.32%	4.72%	15.97%	-49.27%	50.78%
T1R	12.54%	11.87%	3.90%	5.74%	28.04%
RCBR	2.62	2.45	0.80	1.28	6.03
CF	0.57	0.35	0.80	-2.53	7.66
GDP	1.59%	2.04%	2.39%	-6.55%	7.96%
R	4.21%	3.60%	0.20%	1.86%	11.17%
ROA	0.39%	0.33%	0.78%	-5.07%	6.32%
TA	$1.33 \cdot 10^8$	$1.70 \cdot 10^7$	$3.51 \cdot 10^8$	375 940	$2.20 \cdot 10^9$
EMP	10 747.10	2838	24 392.70	141	164 103

In Figure 5 we present the control variables related to bank size. We observe an increase in total assets from 2008 to 2011, but since 2012 we have seen a decrease. In our model we use total full-time employees as control variable for bank size, which is presented in Figure 5. From 2008 to 2015, the number of employees has decreased in our sample.
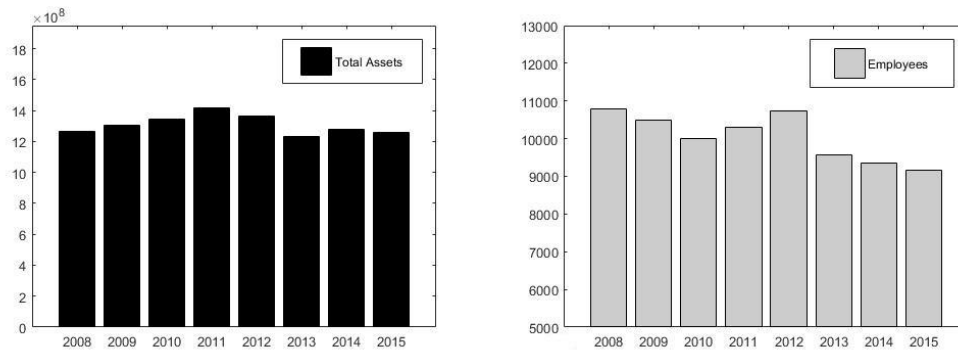
Figure 5. Sum of Total Assets & Average number of Employees

In the second hypothesis, we argue that relationship-based banks are more negatively affected by increased capital requirements. To test our hypothesis, we use size (total number of full-time employees) as a proxy for bank type, and argue that smaller banks are more likely to be characterized by relationship-based lending. Before performing our regressions, we split the dataset according to size, leaving us with one dataset including includes smaller banks, i.e. relationship-based banks, and another dataset including larger banks, i.e. transaction-based banks.

Table 3. Descriptive statistics – Small & large banks

	Small Banks		Large Banks	
	Mean	*Median*	*Mean*	*Median*
Credit Growth	*4.45%*	*2.47%*	*6.16%*	*5.60%*
Tier 1 Ratio	*12.52%*	*11.52%*	*12.56%*	*12.11%*
Capital Buffer	*2.61*	*2.40*	*2.62*	*2.49*
Employees	*1349.36*	*1296.50*	*19 810.29*	*6311*
Total Assets	$2.79 \cdot 10^7$	$1.41 \cdot 10^7$	$2.35 \cdot 10^8$	$4.30 \cdot 10^7$

When studying the descriptive statistics of smaller banks, one can see that the average credit growth is 4.45% and that the average size according to total assets and the number of full-time employees is €27.9 million and 1,349.36 respectively. The median value of the total number of employees, 1296.50, is somewhat lower than the mean value, which could indicate possible skewness in the dataset.

In contrast, larger banks have an average credit growth of 6.16% and average size of €235 million in total assets and 19,810.29 in full-time employees. Again, when comparing the mean and median values of the total number of employees, one can observe a possible signal of skewness in the dataset since there is a relative large difference between the two values. For full descriptive statistic of large and small banks, please see Appendix 1 and Appendix 2.

When examining the supply-side of bank lending, it is important to also account for the demand-side of the equation. If the loan demand is low, we expect credit growth to decrease. To capture these effects, we include GDP and cost of debt as control variables. In Table 4, the GDP growth of each country is illustrated. Although it is possible to observe some common trends in these countries, such as the economic downturn during 2008 and 2012, one can also observe some discrepancies. This is a signal of country-specific effects and that countries may experience different economic cycles, which could impact credit growth and our results.

Table 4. Gross Domestic Product

	2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Austria	3.39%	-1.97%	2.95%	4.75%	2.75%	1.71%	2.44%	2.87%
Belgium	2.71%	-1.49%	4.68%	3.84%	2.21%	1.09%	2.32%	2.38%
Finland	3.82%	-6.55%	3.35%	5.22%	1.49%	1.77%	1.05%	1.96%
France	2.58%	-2.85%	3.07%	3.04%	1.34%	1.36%	1.17%	1.92%
Germany	1.93%	-3.96%	4.87%	4.77%	2.04%	2.46%	3.46%	3.72%
Italy	1.40%	-3.63%	2.01%	2.05%	-1.48%	-0.54%	1.07%	1.46%
Netherlands	4.22%	-3.38%	2.26%	1.81%	0.35%	1.18%	1.57%	2.04%
Portugal	1.94%	-1.91%	2.55%	-2.09%	-4.41%	1.11%	1.65%	3.71%
Slovakia	7.96%	-4.70%	0.24%	1.78%	-2.42%	-0.24%	3.94%	3.32%
Spain	3.28%	-3.33%	0.17%	-0.97%	-2.86%	-1.36%	1.11%	3.72%
Average	*2.60%*	*-2.79%*	*2.77%*	*2.77%*	*0.33%*	*0.96%*	*2.28%*	*3.58%*

The average interest rate of corporate loans below €1 million in each country is presented in Table 5. We can clearly see a negative trend in that the cost of debt has decreased substantially in all countries. Although the trend is similar for all countries in our sample, the borrowing cost differs greatly. For example, corporations in Portugal are facing much higher costs

throughout the sample period compared to corporations in Belgium. Hence, the economic environment and the demand for loans could differ greatly between countries.

Table 5. Average interest rate of corporate loans below €1m.

	2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Austria	*5.47%*	*2.89%*	*2.43%*	*2.92%*	*2.46%*	*2.28%*	*2.26%*	*2.02%*
Belgium	*5.68%*	*3.07%*	*2.58%*	*2.95%*	*2.40%*	*2.15%*	*2.16%*	*1.86%*
Germany	*6.06%*	*3.79%*	*3.60%*	*3.94%*	*3.32%*	*2.98%*	*2.89%*	*2.58%*
Spain	*6.06%*	*4.14%*	*3.72%*	*4.61%*	*5.17%*	*5.12%*	*4.55%*	*3.41%*
Finland	*5.60%*	*3.01%*	*2.70%*	*3.23%*	*2.84%*	*2.83%*	*2.94%*	*2.97%*
France	*5.58%*	*4.00%*	*3.31%*	*3.72%*	*3.47%*	*2.88%*	*2.76%*	*2.18%*
Italy	*5.98%*	*3.54%*	*3.09%*	*3.93%*	*4.64%*	*4.36%*	*3.92%*	*2.99%*
Netherlands	*5.69%*	*4.17%*	*3.82%*	*4.12%*	*3.63%*	*3..56%*	*3.47%*	*3.10%*
Portugal	*7.64%*	*5.71%*	*5.43%*	*6.90%*	*7.08%*	*6.39%*	*5.53%*	*4.21%*
Slovakia	*5.74%*	*4.44%*	*3.97%*	*4.50%*	*4.07%*	*3.89%*	*3.81%*	*3.42%*
Average	*6.01%*	*3.84%*	*3.44%*	*4.05%*	*4.07%*	*3.77%*	*3.52%*	*2.81%*

There appears to be large differences in the economic environment and the demand for loans in our sample. Due to the fact that we include 10 different countries in our estimations, one can expect some country-specific effects that may affect our results. Cosimano and Hakura (2011) found evidence that the impact of regulations varies greatly and it is clear that we observe economic differences in our sample as well. For these reasons, we include GDP and cost of debt that varies between countries. Besides, our SME proxy differs between countries, which is presented in Appendix 3. We also observe that SME lending has increased in relation to total lending. In addition to the variance of these variables, unobservable effects may be present, e.g. cultural differences.

Our data includes the introduction and the phase-in process from Basel II to Basel III. One of the main differences between Basel II and Basel III regarding the capital requirements is that the minimum Common Equity Tier 1 ratio increases from 2% to 4.5% of risk-weighted assets (see Table 6). In addition, the total Tier 1 capital increase from 4% to 6%. In the transition from Basel II to Basel III, there is a phase-in period for the capital requirements. As can be seen in

Table 6 below, the Basel III framework will be phased in between 2013 and to the beginning of 2019.

Table 6. Phase in of Basel III

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Minimum Common Equity Capital Ratio	*3.5%*	*4.0%*	*4.5%*	*4.5%*	*4.5%*	*4.5%*	*4.5%*
Capital Conservation Buffer	*-*	*-*	*-*	*0.625%*	*1.25%*	*1.875%*	*2.5%*
Minimum common equity plus capital conservation buffer	*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%*	*8%*	*8%*	*8%*	*8%*	*8%*	*8%*
Minimum Total Capital plus conservation buffer	*8.0%*	*8.0%*	*8.0%*	*8.625%*	*9.25%*	*9.875%*	*10.5%*

Our main variable of interest, *T1R*, is plotted in Figure 5 in relation to the minimum requirement. The trend of the Tier 1 ratio is relatively clear, and has increased over the time period, averaging at 12.54%. In relation to the minimum requirement of 6.00%, the banks in our sample are all above the minimum requirement. To see the full dataset of Tier 1, please see appendix 4.
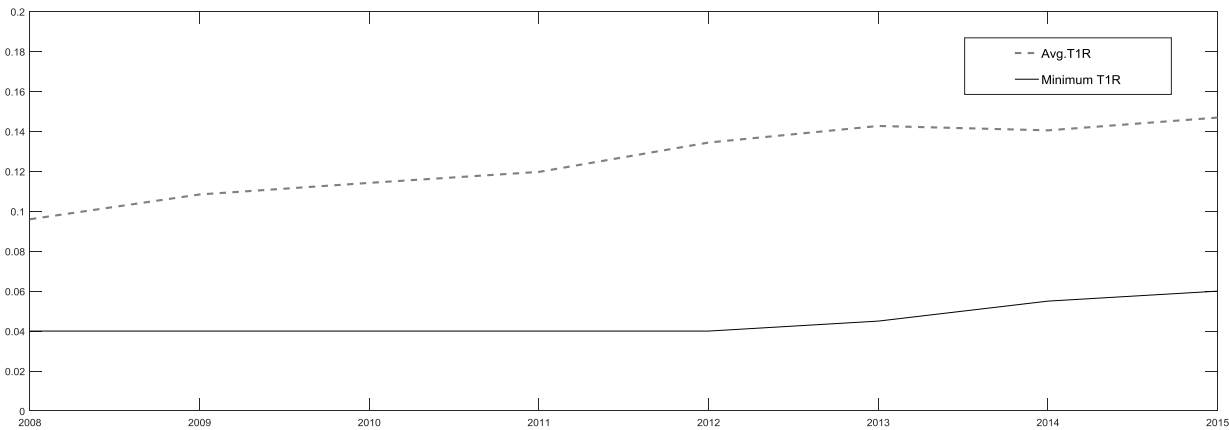

Figure 5 – Average Tier 1 capital in our Sample in relation to Minimum requirement

6. Results

In Table 7 we present our estimation results for our four models. The first column represents the estimations for SME credit growth with the Tier 1 ratio as the main variable. The second column is our estimation of the SME credit growth with the regulatory capital buffer ratio, RCBR, as the main variable. The third and fourth column represent estimations on large and small banks based on datasets divided by risk-weighted assets. All estimations are based on annual data from 2008 to 2015.

Table 7. Regression Results

Variables	CG_{SME}	$CG_{Large\ Banks}$	$CG_{Small\ Banks}$	CG_{SME}
Tier 1 ratio	-1.2389***	-1.3242***	-1.1054**	
	(0.3939)	(0.4600)	(0.4522)	
RCBR				-0.0676***
				(0.0256)
CF	-0.0072	-0.0111	-0.0096	-0.0053
	(0.0137)	(0.01852)	(0.01874)	(00168)
GDP	0.2636	0.7651	-0.1694	1.3157*
	(0.0.3559)	(0.5106)	(0.4800)	(0.8001)
R	1.0710**	0.8887*	1.3657	1.8516**
	(0.4869)	(0.5349)	(0.8454)	(0.8095)
ROA	3.8844***	9.1916***	1.5035*	5.2769***
	(1.1921)	(1.9950)	(0.7721)	(2.0135)
EMP	$4.84 \cdot 10^{-7}$***	$6.08 \cdot 10^{-7}$***	$-8.54 \cdot 10^{-6}$*	$1.91 \cdot 10^{-7}$
	$(1.73 \cdot 10^{-7})$	$(1.88 \cdot 10^{-7})$	$(1.49 \cdot 10^{-5})$	$(2.75 \cdot 10^{-7})$
Constant	0.1434***	0.1286*	0.1464**	0.09677
	(0.0557)	(0.0662)	(0.0690)	(0.0717)
No. Observations	504	257	247	305
Number of Instruments	55	61	61	34
AR(1) p-value	0.000	0.000	0.000	0.000
AR(2) p-value	0.102	0.327	0.062	0.903
Hansen-Test (Robust)	0.356	0.965	0.965	0.416

An initial observation is that besides from our last estimation, our main variables are significant at a 5% or 1% level in each model. From this we can draw the conclusion that regulatory capital seems to have an impact on the SME credit growth in Europe, although the results are not all in line with our stated hypotheses. A second observation is that generally we have mixed results considering the control variables and for the variables related to the demand-side. All four estimations vary in their number of instruments and observations, as is expected with a GMM approach given that different lagged levels are used affecting the number of observations. Hence, the variety in the significance and robustness of the results is expected were our first estimation has the most observations and is expected to produce more significant results.

In our first estimation, we conclude that the Tier 1 ratio has a negative impact on the credit growth of SME. As the Tier 1 ratio increase by 1 unit (1%), the credit growth of SME decreases by 1.2389 units (1.2389%) ceteris paribus. The result is significant at a 1% level. This confirms *hypothesis I*, increased regulatory capital will have a negative impact on SME bank lending in line with previous research (Angelkort & Stuwe 2011; Brun et al. 2013; Humblot 2014; Osei-Assibey & Asenso 2015). The *GDP* variable, designed to capture the demand-side of the equation, is positive but not significant. One would expect that as the economy improves, SME demands more loans to induce growth. Although we find significant results for *R*, the interest rate, it is not in line with our expectations. We have observed a decrease in the interest rate over our time period and given that the interest rate is the cost of lending, one should expect a negative relationship. This suggest that we have only found a correlation and not been able to isolate the true relationship between credit growth and interest rate. We find no significance in credit write-downs (*CF*). However, we find significance for *ROA* and *EMP* at a 5% and 1% level respectively. Hence, profitability and size are key drivers of lending growth. As profitability increases, banks are able to lend more to SMEs. The reason for the low coefficient of *EMP*, is because of a mismatch of the units. A unit of employment is a very low number in relation to a unit of credit growth, and hence a single unit change should not impact the credit growth to a large extent.

In our second and third estimations, we have divided the data set according to size, with number of employees as a proxy for size. Our main variable, the Tier 1 ratio, is significant in both of

our estimation but for large banks the effect of Tier 1 capital on credit growth is larger. From this, we cannot confirm our hypothesis that relationship-based banks will be effected more by capital requirements than transaction-based banks, but we find evidence of the opposite. This is conflicting results to the theory suggested by Berger and Udell (2002). In both datasets we find that the number of employees and ROA is positively correlated with credit growth. We find no correlation between the GDP and credit growth, and the interest rate is positively correlated with credit growth for transaction based banks. Once again, this is most likely not the causal effect as it is not economically intuitive.

In our fourth estimation we test *hypothesis III* by introducing the variable RCBR, regulatory capital buffer ratio. In line with our previous discussion, we expect a positive coefficient as the margin to the minimum requirement increase, a bank should be less affected. However, this is not in line with our results. According to our estimations, as a bank increase its margin to the minimum Tier 1 capital ratio, SME lending is expected to decrease by 0.0676% and the result is significant at a 1% level. We cannot confirm our hypothesis or the results produced by Osei-Assibey and Asenso (2015), Gambacorta and Mistrulli (2003), and Heid and Stolz. (2003). Rather, our results are in line with arguments suggested by Tabak et al. (2011) and Wagster (1999) that allocation of capital within a bank is set by other factors. This suggests that regulatory capital may be of secondary-importance for banks in their choice of capital allocation. Economic cycles and bank specific effect may be better determinants of how much capital is allocated. Once again, *ROA* is significant at a 1% level, once again confirming that profitability is a key driver of credit growth to SMEs. We find that GDP is affecting credit growth, in line with economic intuition. Although the interest rate is significant, it is positive and not intuitive.

6.1 Instrument Validity

One of the main reasons that we prefer system GMM over differenced GMM is that the latter often results in weak instruments of the endogenous variable. This causes a downward biased GMM estimator (Blundell & Bond 1998). By introducing additional instruments through the system GMM we can strengthen our instrument validity. However, there is a trade-off between the numbers of instruments used, as the instruments are created within the sample we have to

sacrifice observations for additional instruments. This is why we observe different observations for each estimation.

To be able to determine how to create instruments we first test for autocorrelation. We detect first order autocorrelation in the error term. Given we are using first difference models, this is expected since the $\Delta\varepsilon_{it}$ are constructed of ε_{it-1}, and clearly it should be correlated with $\Delta\varepsilon_{it-1}$ aswell. Test for second order correlation are conduced and we conclude that we find no evidence of any second order correlation. A condition for a valid instrument, is that the instrument is not correlated with the error term. This is true for the second order lag, and hence we used second order lags to create or instruments for estimation 1, 3 and 4. In equation 2, we find second order correlation and hence we used the third lag as instruments.

To further asses the validity of our instruments we perform a Difference-in-Hansen tests of endogeneity of the instruments, and conclude that our instruments appear to be exogenous in all four regressions. The null hypothesis of the test is that our instruments are exogenous. For all estimations, this holds for all instruments as a group but also the subsets of our instruments (leveled and lagged instruments).

6.2 Stationarity Test

To be able to determine any non-stationarity in our data, we apply the Fisher-type test for unit root, which allows unbalanced panel data. This method applies the methods proposed by Choi (2001). The test assumes that the panel data is either finite or infinite but also that the groups within the panel differs, in the sense that they have different types of non-stochastic and stochastic components in addition to the fact that some groups may have a unit root and other groups may not. This is performed by through a combination of p-values generates from a unit root test for each group in the data. The underlying test is the Dickey-Fuller test. Given that our dataset includes 10 countries, we feel confident in our choice of method given that it allows for differences within groups. We have a wide range of countries included, that differs not only from a geographical perspective, but descriptive statistics differs greatly between countries.

Our tests conclude that the credit growth variable is stationary at 1% significance, and hence not time dependent.

6.3 Discussion

In our first estimation, we conclude that there is a relationship between Tier 1 capital ratio and SME lending. When a bank increases its Tier 1 capital ratio, our estimation predict that the lending should decrease by approximately 1.24%. This confirms *hypothesis I,* but it only confirms the relationship and not the cause. If we dissect the component of the Tier 1 capital ratio, we know that it can increase in several ways. As discussed by Cohen and Scatigna (2016), a bank can increase retained earnings by either increase retention rate or increase profits, e.g. through increased lending spreads. A secondary option is for a bank to issue new equity but this may be perceived as the least favorable option. As a third option, a bank may choose to shrink their balance sheet, by a reduction of either sell loans or decrease lending rate. Alternatively, a bank can change its risk-weighted assets and decrease risker exposure, such as SME lending. After our initial estimation, the questions still remains: What is the cause of the relationship? What drives the increase in the Tier 1 ratio? Either the capital requirement forces banks to increase its capital allocation, in line with Brun et al. (2013), Humblot (2014), Angelkort and Stuwe (2011) and Osei-Assibey and Asenso (2015) or it is driven by factors related to the economic environment or optimal capital structure, in line with Tabak et al. (2011) and Wagster (1999).

In our second and third estimations, we find, in opposite of *hypothesis II*, that transaction-based banks are more adversely affected by an increase in regulatory capital. This is not in line with the theoretical framework and our expectations. These results suggest that transaction-based banks may behave differently than relationship-based banks because they have other incentives and different opportunity costs. The results could also be affected by the fact that our proxy incorporates properties of large and small banks, rather than the type of banking practice. As previously discussed, larger banks tend to apply a different method for its risk-weights which might favor other assets, such as mortgages lending as argues by Benetton et al. (2017). Another explanation could be due to the fact that larger banks has a different optimal level of capital, and hence will be affected differently than smaller banks. These large banks could be more

adversely affected during the recent financial crisis and hence had more incentives to recapitalize, and in turn took more dramatic actions to recapitalize. As the larger banks are more complexed, the consequences of recapitalizing may be more severe and the need to decrease lending may be of more importance. In our sample, we observe that the bank set containing larger banks has a very high average number of employees, but a much lower median value. Hence, we have some very large banks present, and specific properties of these banks may be reflected in the result. However, one must consider the fact that we have divided an already limited dataset to create these two sub-samples. Each regression is only based on 257 and 247 observations over a limited time span, and for this reason we are reluctant to draw any major conclusions, as our sample may not be representing the true population.

In our fourth estimation, we attempt to confirm *hypothesis III,* and to further support the results from hypothesis I, that banks closer to the minimum level should have a lower credit growth. Theory suggest that if a bank is close to the minimum levels, more extreme measures is taken to increase its capital ratio and this is done through a decrease in lending. Hence, banks are driven by the regulatory framework. However, our results cannot confirm this theory and we find the reverse relationship. Banks with larger capital buffers will decrease its lending more than banks with a smaller capital buffer. These results are more in line with Tabak et al. (2011) and Wagster (1999) that capital allocation is driven by other factors than the regulatory framework, such as the economic cycle. Although we have previously concluded that an increase in Tier 1 capital ratio will reduce SME lending, this estimation suggest that minimum requirements are of second-order importance and other factors related to optimal capital structure are more important. Our time period includes financial crisis of 2008, and this may affect these results. Because the banking sector was severely affected by the financial crisis, it may be the case that banks choose to allocate more capital as a necessity to survive rather than as a response to stricter capital requirements. Given another time period and a different economic cycle, our model could produce different results.

7. Conclusions

This thesis investigates the supply-side of bank lending and whether increased capital requirements have an adverse effect on bank lending to SMEs using data of 70 banks in 10 European countries between 2008 and 2015. In our study, we apply the system Generalized Methods of Moments (GMM) approach to control for endogeneity issues and to deal with the small T and large N dataset. We test the following hypotheses: (i) Increased regulatory capital has a negative impact on SME bank lending, (ii) relationship-based banks are more adversely affected by capital requirement than transaction-based banks, and (iii) a lower capital buffer has a negative impact on credit growth

Our initial results suggest that increased capital requirements negatively impact bank lending to SMEs. However, this only confirms the relationship and not the cause. Secondly, we find that transaction-based banks are more adversely affected by the increased capital requirements than relationship-based banks. This result rejects our stated hypothesis that relationship-based banks, which are believed to be more reliant on relationship-based lending, are disproportionally affected by strengthened capital regulations. However, we believe that our proxy for relationship-based banks and limited dataset might be potential weaknesses. Thirdly, our results indicate that there is a negative relationship between larger capital buffers and bank lending to SMEs. This finding suggests that it is not the capital requirements per se that decrease bank lending to SMEs, thus supporting theories that capital buffers are related to other factors, such as the economic cycle, and that banks' optimal capital ratios might be higher than the stated minimum requirements.

We believe our research contributes to the scarce literature of SME lending and capital requirements by including banks from multiple countries and over a recent time period. Additionally, our results further emphasize the importance of fully understanding the relationship between increased capital requirements and bank behavior, and especially bank lending to the most bank-dependent firms. To fully understand the relationship of capital requirements and SME bank lending we believe that further research is necessary. As time progress, a similar research method could include a longer time frame to capture the effects during different economic cycles, and also the short-term and long-term effects on lending.

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9. Appendix

Appendix 1. Variable statistics – Large Banks

Variable	Mean	Median	Std. Dev.	Min	Max
CG	6.16%	5.60%	17.28%	-47.24%	50.79%
T1R	12.56%	12.11%	3.44%	5.83%	23.87%
RCBR	2.62	2.49	0.72	1.30	5.09
CF	0.60	0.39	0.67	-0.56	4.89
GDP	1.50%	1.94%	2.35%	-6.55%	7.96%
R	4.48%	3.79%	2.15%	1.86%	11.17%
ROA	0.44%	0.37%	0.68%	-4.21%	3.11%
TA	$2.35 \cdot 10^8$	$4.30 \cdot 10^7$	$4.69 \cdot 10^8$	1 700 813	$2.20 \cdot 10^9$
EMP	19 810.29	6311	31 661.09	2384	164 103

Appendix 2. Variable statistics – Smallest Banks

Variable	Mean	Median	Std. Dev.	Min	Max
CG	4.45%	2.47%	16.61%	-49.27%	50.24%
T1R	12.52%	11.52%	4.33%	5.74%	28.04%
RCBR	2.61	2.40	0.88	1.28	6.03
CF	0.54	0.31	0.91	-2.53	7.66
GDP	1.69%	2.13%	2.43%	-6.55%	7.96%
R	3.94%	0.88%	1.72%	2.02%	11.17%
ROA	0.33%	0.31%	0.86%	-5.07%	6.32%
TA	$2.79 \cdot 10^7$	$1.41 \cdot 10^7$	$5.27 \cdot 10^7$	375 940	$4.21 \cdot 10^8$
EMP	1349.36	1296.50	649.62	141	3313

Appendix 3. SME Proxy

	2008	2009	2010	2011	2012	2013	2014	2015
Austria	24.51%	24.72%	24,45%	26.65%	26.11%	25.64%	13.79%	14.26%
Belgium	25.60%	25.56%	25.26%	27.56%	27.08%	26.56%	28.50%	28.49%
Germany	26.11%	25.23%	23.98%	27.01%	26.13%	26.20%	17.82%	18.35%
Spain	26.94%	25.46%	24.90%	26.18%	25.97%	26.69%	42.75%	52.89%
Finland	24.05%	24.91%	24.13%	25.38%	25.47%	25.81%	24.51%	25.19%
France	25.41%	25.55%	25.16%	25.84%	25.80%	26.68%	32.58%	35.44%
Italy	27.94%	26.89%	24.69%	24.87%	24.61%	24.63%	38.93%	40.03%
Netherlands	26.01%	26.22%	25.05%	24.77%	23.59%	23.07%	11.77%	12.06%
Portugal	30.23%	31.68%	29.14%	27.81%	25.77%	24.30%	56.16%	59.34%
Slovenia	21.38%	22.39%	18.75%	17.50%	16.86%	17.30%	24.34%	22.31%
Average	25.82%	24.72%	24.45%	26.65%	26.11%	25.64%	26.39%	27.88%

Appendix 4. Average and minimum Tier 1 ratio

	2008	2009	2010	2011	2012	2013	2014	2015
Avg. T1r	9.62%	10.84%	11.42%	11.97%	13.44%	14.27%	14.05%	14.69%
Minimum T1r	4.00%	4.00%	4.00%	4.00 %	4.00%	4,50%	5,50%	6.00%