The Impact of Basel III on European Bank Lending

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Abstract

In reaction to the recent financial crisis, the Basel Committee on Banking Supervision (BCBS) developed the Basel III regulatory framework. The aim of the new regulatory frameworks is to raise the quality and quantity of banks' regulatory capital base and to improve the risk coverage of the banking sector, thus increasing the resilience of the banking sector to financial stress. The actual value of the Basel III regulations however are an item of discussion. Multiple studies argue that the costs of implementing stricter capital requirements may be significantly higher than the potential gains. In particular, it is expected that an increase in bank capital requirements will have a severe impact on the height of loan rates and the volume of bank lending. This increase in loan rate and decrease in levels of bank loans are subsequently expected to have a dampening impact on global economic recovery (Chami&Cosimano, 2001)(Cosimano&Hakura, 2011)(Standard & Poor's, 2011).

The aim of this paper is to determine the impact of the Basel III regulations on banks' choice of optimal lending rates and associated loan levels. In order to do so, this paper creates a link between the structural model of the capital channel of monetary policy created by Chami and Cosimano (2001) and the stricter capital requirements set under the Basel III regulatory framework. Here banks'choice of loan rate and loan levels is determined by bank capital-to-asset ratio. By modeling Basel III as a mandatory increase in bank capital-to-asset ratio, a direct link is established between the Basel III regulations and bank loan rates and loan levels.

By employing the interconnected regression analyses, created by Barajas et al. (2010), this paper estimates that the introduction of Basel III results in a 1.428 percent increase in bank loan rates and subsequently a 0.25704 decrease in bank loans in the long run. This impact is deemed to have a great impact on global economic recovery.This impact is enhanced by the introduction of the countercyclical buffer in times of economic growth. This paper estimates that the addition of the buffer results in a 3.128 percent increase in bank loan rates and subsequently a 0.56304 percent decrease in bank loans in the long run Because of the potential magnitude of the impact of the Basel III regulations on bank loan rates and loan levels, prudence is advised in the application of this regulatory toolby national authorities.

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1. Introduction

Within the framework of completing my master's degree in business administration and financial management at the University of Twente, I conducted a study on the impact of the Basel III regulations on European bank lending behavior. This concerns an independent study with the University of Twente as the sole principal.

In reaction to the recent financial crisis, the Basel Committee on Banking Supervision (BCBS) developed the Basel III regulatory framework. Basel III is a comprehensive set of voluntary regulatory standards aimed at achieving three goals; increasing the quality-and level of bank capital, strengthening the regulations in the banking sectorand strengtheningoverall risk management. According to the BCBS, a strong and resilient banking system is the foundation for sustainable economic growth. Banks function as the main provider of credit intermediation between investors and supliers and provide critical services to consumers and businesses. Any form of distress in the banking sector may therefore easily shift from the banking sector to the entire economy.According to the Basel Committee on Banking Supervision (2010), one of the main reasons the financial crisis became so severe was because thebanking sector faced a derogation of the level and quality of their capital base. This was accompanied by insufficient liquidity buffers. The banking sector was therefore unable to absorb shocks arising from financial stress, which subsequently affected the economy as a whole. The BCBS seeks to once again raise the resilience of the banking sector by strengthening the regulatory capital framework, hereby building on the previous Basel II framework. The new regulations both aim at raising the quality and quantity of banks' regulatory capital base and to improve the risk coverage of the banking sector, thus increasing the resilience of the banking sector to financial stress. The implementation of theBasel III regulations has started January 1th 2013 and it is envisaged that the rules will be fully in force on January 1th 2019 (Basel Committe on Banking Supervision, 2010).

The actual value of the Basel III regulations however are an item of discussion. Despite of the clear intentions set by the Basel Committee on Banking Supervision, literature has not been able to provide an unequivocal position on value of the regulations. Assenting literature argues that the requirements for banks to raise additional capital entails marcoeconomical benefits. For instance, according to Legland et al. (2012), Basel III encourages banks to hold more liquid assets, thus increasing the stability of bank funding. Admati et al. (2010), state that the higher capital requirements lead to a more resilient financial system. Overall the risk of bank default is thus decreased by the requirements of Basel III. Angelini et al. (2011), acknowledge that the Basel III reforms may have a modest dampening effect on the volatility of bank capital and thus on economic fluctuations. While opposing literature does not deny these possible benefits, this strand of literature argues that the costs of implementing stricter capital requirements may be significantly higher than the potential gains. Zähres (2011) argues that the increased capital requirements will force banks to attract new sources of capital. The simultaneous demand of banks will decrease the availability of capital for non-financial companies and increase the required return. Al-Darwish et al. (2011), also recognize that the Basel III regulations will affect banks' demand for and supply of certain types of debt. Since capital coverage requirements grow simultaneous with expected risk, banks will likely aloof from relative risky loans. Ultimately higher capital requirements will increase the marginal cost of loans, when the cost of capital is greater than the cost of deposits. A higher cost of equity financing relative to debt financing would encourage banks to increase the price of lending. This increased cost will likely be passed on to lenders; making is harder and more expensive to obtain funding. The increase in capital requirements thus may have a dampening effect on loan growth and on the European economy in whole(Chami and Cosimano, 2001)(Cosimano and Hakura, 2011) (Standard & Poor's, 2011).

Multiple studies have investigated the impact of capital requirements on bank capital ratios and the volume of bank lending. Bridges et al. (2014) argue that changes in capital requirements affect both capital and lending. Their research suggests that in response to an increase in capital requirements, banks gradually increase their capital ratios to restore their original buffers. Furthermore in response, banks also reduce loan growth in the year following an increase of capital requirements. These findings are supported by the model developed by Furfine (2002). This model calculates that an increase of 1% in capital requirements would result in an immediate reduction in loan growth of 4.68% and 5.46% and an increase of capital ratios from 9% to 10%. Similar, the analysis of Cosimano and Hakura (2011) estimates that under the new Basel III capital requirements the 100 largest banks of the world would raise their lending rates by on average 16 basis points. This increase in capital ratio is expected to cause loan growth to decline by 1.3 percent in the long run.

2. Problemstatement

Following Furfine (2000) and Cosimano and Hakura (2011), this paper aims to increase the understanding of the impact of increased capital requirements on bank loan growth and lending rates. More specific, this paper attempts to determine the impact of the Basel III regulations on banks' choice of optimal lending rates and the associated loan levels. In order to do so, first insight must be provided with respect to bank behavior in the absence of the regulations. Regarding this, three coherent topics are of particular interest;

How do banks choose their optimal loan level and loan rates, in what way does the availability -or absence- of capital influence this decision and how does Basel III influence bank capital-to- asset ratio?

Answering these questions allows for the determination of the theoretical optimal bank loan level and loan rate in the absence of regulations. These topics are selected based on the hypothesis that banks' capital-to-asset ratio influences bank choicewith regard to lending rates and lending levels. Because the Basel III regulations cause a considerable change in banks' capital-to-asset ratio, this paper expects an associated change in banks' lending rates and lending levels. By computing the difference which the Basel III regulations induces to banks' capital-to-assets ratio and subsequently banks' theoretical optimum, the impact of the Basel III regulations can be measured.

In order to establish bank behavior, with regard to lending levels and lending rates, in the absence of regulations, this paper uses the structural model of the capital channel of monetary policy created by Chami and Cosimano (2001). Their model functions as the theoretical foundation for this research. In this model, the bank's decision to hold capital is defined as a call option on the optimal future loans issued by the bank. In the case when capital constraints are not binding, banks choose loans such that the marginal costs of loans are equal to the marginal revenues. Profit maximization is therefore assumed to be the main goal of banks. However, when capital constrains are binding, the optimal level of loans and deposits are moderated by the availability of capital. Within the new constraints imposed, banks will aim to establish a new optimum. The reduced availability of capital and the increased costs of issuing loans is expected to cause a decrease in issued bank loans and an increase in bank loan rates.

The relations deducted from this model are used to determine the optimal level of loans and deposits for banks, in the absence of the Basel III regulations. Using three regression analyses created by Barajas et al. (2010), this paper computes banks' optimal capital-to-asset ratio, the associated loan rate and finally the associated loan levels. As this paper, the analyses by Barajas et al. (2010) are based on the structural model of the capital channel of monetary policy created by Chami and Cosimano (2001). Therefore the three analyses are linked by common variables. The marginal costs of loans is the weighted average of the marginal costs of equity and deposits, the choice of capital therefore influences bank loan rates. Subsequently, bank loan rates influence the cost of lending and therefore the volatility of loan demand. Ultimately, an increase in bank capital-to-asset ratio will cause loan rates to increase, under the condition that the marginal cost of equity exceeds the marginal cost of deposits; this will decrease the demand for bank loans.

The Basel III regulations aim to increase the resilience of the banking sector to financial stress. The Basel Committee on Banking Supervision expect to achieve this by raising the quality and quantity of banks' regulatory capital base and by to increasing risk coverage. These requirements entail a substantial increase in bank capital-to-asset ratio. By modeling the regulations as an increase in bank capital-to-asset ratio, the introduction of Basel III is expected to cause a shift in the existing equilibrium of marginal costs and marginal revenues of bank loans and therefore the optimal loan rates and loan levels. Overall it is expected that the capital constraints imposed by the Basel III regulations will lead to an increase of bank loan rates and subsequently a decrease in the bank loan levels. Different from previous studies, this paper uses post-

crisis bank-by-bank data for European banks for the period of 2009-2013 to examine the impact of the Basel III capital requirements.

The rest of this paper is organized as follows. In section 3, the paper describes the structural model for optimal bank capital, the optimal loan level, lending rates and the existing literature on Basel III. Section 4 discusses the implications of the Basel III regulations for banks' capital-to-asset ratio. Section 5 describes the research methodology and the data sample. The estimation results for choice of capital and loan rates derived from the structural model are presented in section 6. Section 7 presents the implications for bank lending rates and loan levels. In section 8, the overall conclusion is presented. Section 9 presents a discussion regarding the results and chosen variables.

3. Review of the Literature

This section of the paper discusses existing literature which is deemed relevant to the study. In particular, the theory regarding bank choice of loan level and loan rate will be reviewed. In addition to this, the impact of capital constraints on this choice is discussed. Section 3.1 aims to establish a theoretical foundation by discussing the structural model of the capital channel of monetary policy created by Chami and Cosimano (2010) and its application to bank capital choice. Section 3.2 expands this foundation bydiscussing the equations employed by Barajas et al., (2010). These analyses allow for the determination of the optimal level of bank capital, the loan rate model and the optimal level of loans in the absence of regulations. Finally section 3.3 outlines the new bank requirements under Basel III.

3.1 Bank Choice of Capital

In order to determine the potential impact of the Basel III capital requirements on the quantity of bank loans and subsequently the bank loan rate, first bank behavior in the absence of restrictions should be explored. Chami and Cosimano (2001,2010) developed a structural model for bankcapital choice. In this model, bank are risk neutral entities who are assumed to maximize the present value of future profits, subject to a total capital constraint. This forward looking behavior of banks, leads to volatility in bank capital. The amount of capital is positively related to the expected need for capital. This need for capital causes changes in the interest- and non-interest expenses of banks. This reduces the optimal holding of loans and subsequently the optimal loan rate.

3.1.1 Profit Maximization

In the structural model developed by Chami and Cosimano (2001,2010) the banking industry is characterized as being oligopolistic. Individual banks commit to an amount of loans through its dividend policy and this is followed by loan rate competition in the next quarter. This assumption entails that the current level of regulatory capital determines the amount of future loans. Because of large information asymmetries between banks and customers regarding products and risks, changing banks entails high transaction costs for customers. This creates leverage for banks(Choudhry, 2011). The oligopolistic character of the market enables banks to individually determine their optimal amount of loans and the associated loan rate.In case of no binding constraints, banks will therefore choose the amount of loans in which the marginal revenues of these loans (MR_l) are equal to the marginal costs of these loans (MC_l). The marginal costs of issuing loans consists of the interest rate on deposits (R_d) and non-interest expenses which arise from loans (C_l) and deposits(C_d). The optimal amount of bank loans (L) and subsequently the optimal loan rate (Lr) are therefore given by:

$$L = 0.5[\alpha_0 + \alpha_2 M + \varepsilon] - \frac{\alpha_1}{2}[C_l + C_d + R_d] = \bar{L} + \frac{\varepsilon}{2}$$

$$Lr = \frac{1}{2\alpha_1}[\alpha_0 + \alpha_2 M + \varepsilon] + 0.5[C_l + C_d + R_d]$$

The issued amount of loans is a function of fixed loan demand + loan demand induced by economic activity) – (interest rate sensitivity x cost of issuing loans). Here $\alpha_1$stands for the interest sensitivity of the demand for loans. α_2 depicts the effect of economic activity M on the demand for banks loans and α_0 is the fixed demand for loans. This relation is depicted in Figure 1, where the optimal level of loans occur at point A. Here the marginal costs of issuing loans are equal to the marginal revenues. A further increase in the demand for loans would lead to an increase in the quantity of loans and the loan rate, while a decrease in the marginal costs, would lead to an increase in the quantity of loans and a decrease in the loan rate (Chami and Cosimano, 2001)(Barajas et al., 2010)

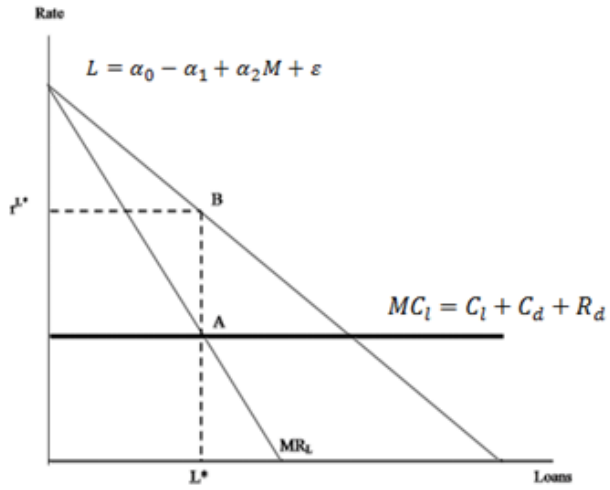
3.1.2 Capital Constraints

This profit maximizing bankbehavior is limited by the availability of capital. Banks cannot issue more loans than they can back up with capital.Given the fact that a bank balance sheet should be in equilibrium, the total loans (L) must therefore be equal to the total deposits (D) plus total capital (K).The profit maximizing level of deposits istherefore formulated as:

$$D = \bar{L} + \frac{\varepsilon}{2} - K$$

According to the findings ofChami and Cosminano (2001), the presence of capital constraints causes changes in the relation between demand for loans or the marginal cost of loans and the price and quantity of bank loans. When capital constraints are binding, an increase in the demand for loans or a reduction in the marginal costs of loans will not lead to an increase in the amount of issued loans. This is due to the absence of sufficient disposable capital. Instead an increase in loan rate is created, depicted as point B in Figure 1. This increase in loan rates however does not lead to more profits, since banks are prevented from increasing loans even though the marginal costs of issuing loans is lower than the marginal revenues (Chami and Cosimano, 2001). Barajas et al. (2010), build on this by establishing the optimal level of loans and deposits given the available capital. Here, given the fact that a bank balance sheet should be in equilibrium, the optimal amount of loans is determined by the amount of deposits and capital of individual banks.

Figure 1: Profit maximizing loans and lending rate (Adapted from Chami and Cosimano, 2001)



$$L = \frac{K}{\theta} \; and \; D = L - K = \frac{1-\theta}{\theta} K$$

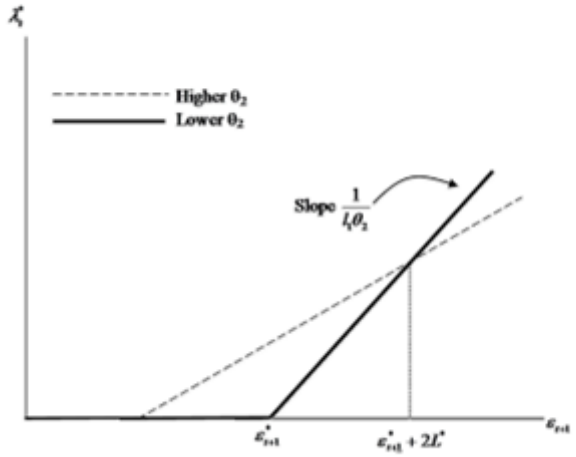
In this formula K can refer to either Tier 1 capital or Total capital in the previous quarter and θ is the required capital ratio under for instance Basel III. Readily affected by the constrained level of loans, individual banks choose a loan rate as to meet the demand for loans as in point B, Figure 1.

$$Lr = \frac{1}{\alpha_1}\left[\alpha_0 + \alpha_2 M + \varepsilon - \frac{K}{\theta}\right]$$

According to Barajas et al. (2010) it is unusual for capital constraints to be actually binding for individual banks in a given period, as in the past on average banks have chosen to hold levels of capital much higher than the required minimum. Nevertheless the structural model developed by Chami and Cosimano (2001,2010) shows that even though not actually binding, imposed capital constraints indeed do affect the optimal decision of individual banks. Here capital is modelled as a call option for banks in which the strike price (ε) is the difference between the expected optimal amount of loans and the amount of loans facilitated by the capital.

$$\varepsilon = 2[L - \bar{L}]$$

Figure 2: Value of Bank Capital
(Adapted from Chami and Cosimano, 2001)



Thevalue of holding additional capital is dependent on the expected future demand for loans. As depicted in Figure 2, the marginal value for holding capital increases with an increase in expected future demand for loans. If the expected demand for loans is low, below critical point ε_{t+1}, the optimal amount of loans decreases and subsequently the optimal amount of capital to support these loans. The amount of capital held, above minimum requirements, serves no purpose and therefore has no value. However, is the demand for loans is above the critical level, more capital is needed in order to support the optimal amount ofloans. Total capital then has a positive option value and banks will tend to hold more total capital than required by regulation, in order to be able to meet future loan demand. Chami and Cosimano (2001), formulate future total capital (K) as a positive function of its standard deviation and a negative function of the strike price. Banks are therefore expected to hold more capital when external loan demand is volatile and when regulatory capital requirements are relatively higher.

$$K = H(L - \bar{L}, \sigma)$$

Building on this structural model, Cosimano and Hakura (2011) argue that the strike price for banks with more capital will be higher since their loan capacity is greater. Therefore an increase in total capital will lead to a decrease in the demand for bank capital (K). Higher total bank capital results in an increase in the marginal cost of loans. Consequently, an increase in the future loan rate and a decrease in the optimal amount of future loans is anticipated in order to achieve profit maximization.

3.2 Regression analyses

Based on the theory developed by Chami and Cosimano (2001, 2010), Barajas et al. (2010) developed three related equations. The first analysis tests the determinants of bank's capital-to-asset ratio and thus the strength of the model of capital choice. This allows to determine whether this model is suitable to use. The second analysis determines the impact of the capital-to-asset ratio on the optimal bank loan rate. Finally the third analysis determines the impact of the bank loan rate on the optimal level of loans. The analyses are interconnected by the role of the dependent variables, which are used as independent variables in the latter analyses.An elucidation of the chosen variables is available in figure 3.

3.2.1 The CC Test

In order to test the model of bank capital choice, Barajas et al. (2010) developed an equation in which the strike price of total capital influences the option value of capital and subsequently the choice of capital. The equation is based on the empirical test developed by Peek and Rosengren (1995) in which the dependent variable is the measure of total capital. Here the strike price of the total capital influences its option value and subsequently the bank choice of capital. The relation of bank choice of capital is estimated as:

$$\frac{K}{A} = a_0 + \left(a_1 + a_2\frac{K}{A}\right) \times \Delta\frac{K}{A} + \left(a_3 + a_4\frac{K}{A}\right) r^D + \left(a_5 + a_6\frac{K}{A}\right)(C_l + C_d) + a_7 \log(A) + \varepsilon$$

The call options are generally decreasing and convex in the strike price. As a result it is expected that $a_1 + a_2\frac{K}{A} < 0$ and $a_2 > 0$, $a_1 < 0$.an Increase in the total capital is followed by an increase in the strike price. Further it is expected that an increase in the deposit rate reduces the optimal amount of loans. The strike price therefore increases, $a_3 < 0$ and $a_4 > 0$. An increase in the marginal costs of deposits and loans will have the same impact as the deposit rate, $a_5 < 0$ and $a_6 > 0$. Finally thelogarithm of bank assets is included as a control variable to capture behavioral differences for large and small banks(Barajas, Chame, Cosimano, & Hakura, 2010) (Cosimano & Hakura, 2011). An elucidation of the chosen variables is available in figure 3.

3.2.2 The Loan Rate

Because of the oligopolistic nature of the banking industry, individual banks are assumed to have sufficient power to determine the loan rate, without the loss of customers. This ensures that banks can choose a loan rate where the marginal revenues of loans are equal to the marginal costs of loans. As stated earlier the marginal costs of loans consists of the interest rates on deposits (R_d) and non-interest expenses which arise from loans (C_l) and deposits (C_d). In addition to this, the rate of return on capital(r^k) also influences the marginal cost of loans. Therefore the marginal cost of loans is estimated as:

$$MC = \frac{D}{A}(R_d + C_d) + C_l + \frac{A - D}{A} r^k$$

The marginal revenues of loans depends on the economic activity (M), since this impacts the demand for loans. Following this, the optimal loan rate is estimated as:

$$r^l = b_0 + b_1 R_d + b_2(C_l + C_d) + b_3\frac{K}{A} + b_4 \log(A) + b_5 M + \varepsilon$$

According to Cosimano and Hakura (2011), an increase in the deposit rate the non-interest costs of deposits or the provisions for losses, would lead to an increase in the marginal costs of loans and, in order to offset this, subsequently to an increase in the loan rate. Furthermore, the ratio of non-performing loans adds to the marginal costs of loans. Finally an increase in the demand for loans, would increase the marginal revenues of and the loan rate. An elucidation of the chosen variables is available in figure 3.

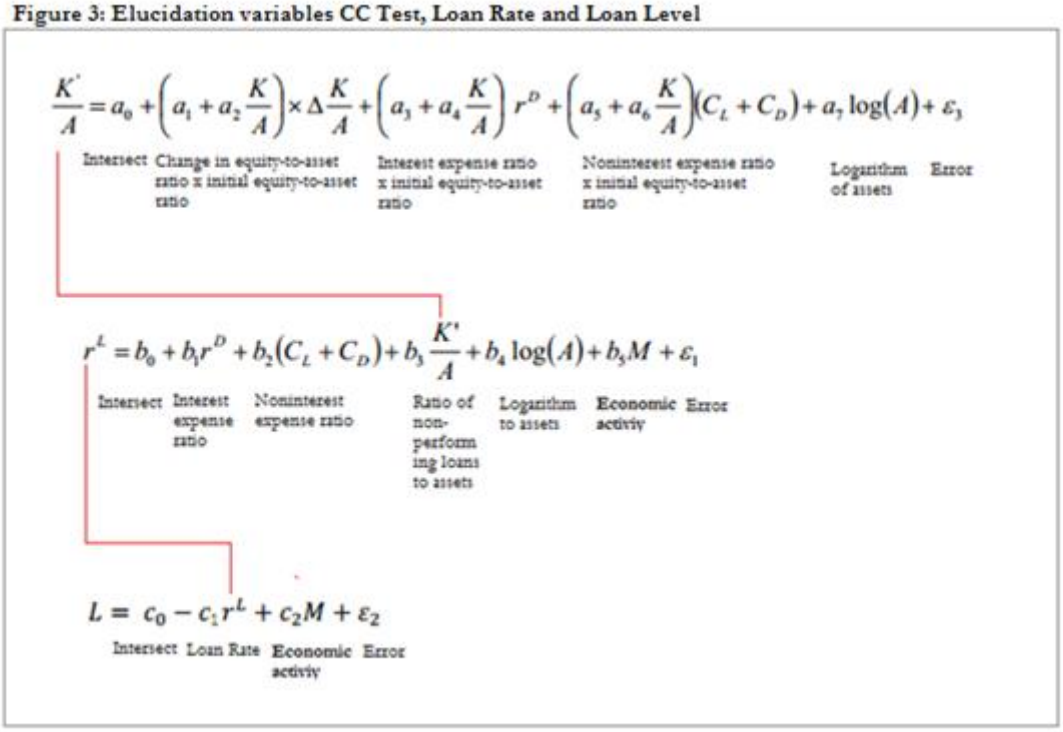
3.2.3 The Loan Level

As determined in the previous equation, banks are able to individually determine their optimal loan rate.Because customers are unable to acquire funding elsewhere, the optimal loan level will depend onthe loan rate determined by banks. According to Barajas et al. (2010), the level of economic activity (M) influences this relationship.Increased economic activity entails increased revenue potential for bank customers, which in turn increases the demand for bank loans. This results in the following equation:

$$L = c_0 - c_1 r^L + c_2 M + \varepsilon$$

The expectation is that an increase in the loan rate, will reduce the demand for loans and therefore the amount of loans which are issued by the bank. In contrast an increase in economic activity is expected to increase the demand for loans (Barajas et al, 2010). An elucidation of the chosen variables is available in figure 3.

Figure 3: Elucidation variables CC Test, Loan Rate and Loan Level



3.3 Basel III Capital Requirements

The Basel III regulations where introduced by the Basel Committee for Banking Supervision on September 12, 2010. The reforms aim to strengthen the global capital and liquidity rules with the aim of creating a more resilient banking system. The Basel III regulations are the successor of the Basel II regulations, from 2004.These regulations where created with the intention of enabling banks to absorb shocks arising from financial and economic stress. However the onset of the economic and financial crisis, in 2007, has made it abundantly clear that the requirements set by the Basel II regulations were insufficient. Through the reform package of Basel III, the BCBS aims to ameliorate proven flaws of Basel II. While Basel II primary focused on bank loss reserves, Basel III focusses on risk coverage. In this way Basel III aims to improve risk management and governance in the banking sector (Basel Committe on Banking Supervision, 2010)(Al-Darwish, Hafeman, Impavido, Kemp, & O'Malley, 2011).

The foundation of Basel III is based on the three pillar structure of the Basel II regulations. The reforms aim to extend this structure. The pillars represent the three key policy issues which the Basel regulations aim to address; minimal capital requirements, risk management and supervision and market discipline. Although the basic framework of Basel II has been retained, many of the elements have been strengthened(Figure 4, Appendix).

Pillar I: A minimum level of capital should be maintained in order to cover eventual risk. The Basel III reforms identify three different types of risk: Credit risk, market risk and operational risk. **Pillar II:**Governance and risk management should actively supervise bank capital in relation to the relative risk taken and should provide incentives to better managing risk concentrations. **Pillar III:** Bank disclosure should adequately address the risk present in order to allow more easily third party monitoring. More disclosure ultimately leads to greater financial stability in the financial sector(Basel Committe on Banking Supervision, 2010)(Basel Committee on Banking Supervision, 2013).

Despite the fact that these pillars are designed to support and reinforce each other, this paper solely focusses on the capital requirements underPillar I. The structural model of the capital channel of monetary policy created by Chami and Cosimano (2010), argues that the capital-to-asset ratio of banks is associated with optimal loan rate and subsequently the optimal level of loans. Theoretically only Pillar I capital requirementsinfluence the capital-to-asset ratio of banks and though this the model. The key elements of Pillar I will therefore be further discussed.The content of Pillar I covers four coherent subjects. The reforms first address both the quality and the quantity of the regulatory capital base. Secondly the risk coverage of the capital framework is addressed. These two subjects are underpinned by a leverage ratio, which acts as a backstop to the risk based capital measures. Finally in order to address pro-cyclical financial shocks thought-out the financial markets, a capital conservation buffer and a countercyclical buffer is introduced (Basel Committe on Banking Supervision, 2010).

3.3.1 Capital Base

Capital base has a primary role of absorbing unexpected losses and thus enabling banks to have sufficient capital to meet its existing obligations. Banks should have sufficient capital to absorb losses and support its continuation, but at the least a bank should have sufficient capital to meet its existing obligations if it were to cease existing (Al-Darwish, Hafeman, Impavido, Kemp, & O'Malley, 2011). According to the Basel Committee on Banking Supervision (2010), it is therefore critical that banks' risk exposures are backed by a high quality capital base. This being said, not all capital is of equal quality. Basel III has adapted the existing framework of Basel II and distinguishes betweenTier 1 and Tier 2 capital, where Tier 1 is higher quality of capital.

The Basel III reforms require the predominant form of Tier 1 capital to be common equity, which is considered to be the highest quality component of bank capital. Common equity Tier 1 capital consists of common shares issued by the bank, stock surplus, retained earnings and accumulated other comprehensive income and other disclosed reserves. The remainder of the Tier 1 capital base must consist of instruments that are subordinated, that have discretionary non-cumulative dividends which have no maturity date nor an incentive to redeem. Tier 2 capital consist of instruments issued by banks which are considered loss absorbing capital base, but which are not included in Tier 1. Examples are hidden reserves, revaluation reserves, general provisions and subordinated loans.

Under the Basel III requirements the elements of capital base are subject to the following restrictions. Common equity Tier 1 must at least be 4.5% of risk-weighted assets at all times. Tier 1 capital must at least be 6.0% of risk-weighted assets at all times. The total capital (Tier 1 and Tier 2) must at least be 8.0% of risk-weighted assets at all times. In order to introduce these requirements in a manner that minimizes the disruption of the banking sector, these requirements are phased in over a period of seven years (Table 1).

Table 1: Basel III phase-in arrangements capital base (Adapted from BCBS. 2013)

Phases	2013	2014	2015	2016	2017	2018	2019
Minimum common equity capital ratio	3,5%	4,0%		4,5%			4,5%
Minimum Tier 1 Capital	4,5%	5,5%		6,0%			6,0%
Minimum Total Capital	8,0%			8,0%			8,0%

3.3.2 Risk Coverage

In addition to raising the quality and the quantity of bank capital base, the Basel Committee on Banking Supervision aims to capture on and off balance sheet risks and derivative risks. One of the flaws of Basel II was the inability to capture these risks in the framework. Several studies argue that this flaw was one of the key destabilizing factors during the financial and economic crisis (Blundell-Wignall & Atkinson, 2010) (Basel Committe on Banking Supervision, 2010)(Al-Darwish, Hafeman, Impavido, Kemp, & O'Malley, 2011). In response to these shortcomings Basel III will introduce a number of reforms to the framework, which strengthen the requirements for management and capitalization of counterpart credit (Accenture, 2012). The depiction of the precise content of these reforms are irrelevant for this study. Therefore the details of the Basel III risk coverage reforms are omitted from this paper. However a study conducted by the Bank for International Settlements (2010), processes these rules into implications for bank common equity Tier 1, Tier1 and total capital ratios. By employing the results from this study in this paper, the effects of the enhanced risk coverage rules under Basel III are not being overlooked.

3.3.3 Leverage Ratio

An excessive on – and off balance sheet buildup of leverage was one of the underlying flaws which amplified the financial and economic crisis. During the crisis, the banking sector was forced to reduce its leverage in such unfavorable manner that created downward pressure on asset prices. This resulted in a further deterioration in the loop between losses, reducing bank capital and available credit. (Basel Committe on Banking Supervision, 2010)(Accenture, 2012). In order to prevent an excessive buildup of leverage on balance sheets in the future, Basel III a leverage ratio requirement to supplement the risk-based framework. The leverage ratio aims to mitigate the risk of destabilizing de-leveraging processes, such as presented during the crisis, which can damage the economy and to reinforce the risk based requirements with a non-risk based backstop measure. Although the regulatory leverage ratio is not intended to be a binding instrument at this stage, the Basel Committee on Banking Supervision is reviewing the option of mandating the instrument as of 2018.

An institution's capital measure divided by the total exposure measure is the basis of the leverage ratio calculation. The average of the monthly leverage ratio over a quarter is divided by the sum of the exposure values of all assets and off balance sheet items not deducted from the Tier 1 capital calculations. Starting from 1 January 2013 the Basel Committee on Banking Supervision introduced a minimum Tier 1 leverage ratio of 3% during the period to 1 January 2017 (Figure 5). In this period the EBA will report to the European Commission on whether this is an appropriate level (Accenture, 2012) (Basel Committe on Banking Supervision, 2010).

Figure 5: Leverage Ratio Requirement Basel III

$$Leverage\ Ratio = \frac{Tier\ 1\ Capital}{Total\ Exposure} \geq 3.0\%$$

3.3.4 Capital buffers

In addition to the requirements for bank capital base, the Basel III regulations introduce two capital buffers. Outside periods of stress, banks should hold capital buffers above the required minimum of bank capital base. These buffers can be drawn down as losses are incurred. In this way it can be ensured that bank capital base remains above the regulatory minimum in periods of significant downturn. When the buffers have been drawn down, banks are required to rebuild them by reducing dividend distributions, bonus payments and buybacks (Basel Committe on Banking Supervision, 2010) (Blundell-Wignall & Atkinson, 2010). The proposed capital buffers consist of two separate frameworks, the capital conservation buffer and the countercyclical buffer.

The capital conservation buffer requires banks to hold a capital buffer of 2.5% of common equity Tier 1 capital above the regulatory minimum capital requirement, at all times. Outside periods of stress this would result in a total common equity Tier 1 requirement of 7%. When the requirements are not met, distribution constraints are imposed in order to rebuild the buffer. The impact of these constraints gradually increases with the range in which the buffer is being drawn down (Table 2) (Basel Committe on Banking Supervision, 2010).

Table 2: Individual bank minimum captial conservation standards

Common Equity Tier 1 Ratio	Minimum Capital conservation Ratio
4,5% - 5,125%	100%
5,125% - 5,75%	80%
5,75% - 6,375%	60%
6,375% - 7,0%	40%
>7,0%	0%

The countercyclical buffer aims to incorporate the influence of environmental factors into the Basel III capital framework. The Basel Committee on Banking Supervision (2010) argues that in times of economic growth, banks increase their lending activities, while in times of economic downturn, banks decrease their lending activities. This behavior makes it more difficult and more expensive for non-financial institutions to obtain funding in times of economic downturn. This behavior therefore has an amplifying negative effect on the economy. Fear of not meeting the required minimum capital base under Basel III, may amplify this pro-cyclical bank behavior. The countercyclical buffer aims to decrease this pro-cyclical bank behavior by introducing a second capital buffer. The height of the buffer is judged by national jurisdictions and depends on the excess aggregate credit growth. In times of economic growth the height of the buffer increases and in times of economic downturn the height of the buffer decreases. This allows banks to retain their lending activity. As for this moment the countercyclical buffer is set between 0% - 2.5% of common equity Tier 1 capital. As for the capital conservation buffer, distribution constraints are imposed if requirements are not met (Table 2)(Basel Committe on Banking Supervision, 2010) (Accenture, 2012) (Breaking into Wall Street, 2012).

The introduction of the capital conservation buffer and the countercyclical buffer will be phased as of January 1th. 2016 and will become fully effective January 1th. 2019 (Table 3). National authorities have the possibility of shortening the transition periods of the two buffers.

Table 3: Basel III phase-in arrangements capital buffers (Adapted from BCBS, 2013)

Phases	2013	2014	2015	2016	2017	2018	2019
Capital conservation buffer				0,625%	1,25%	1,875%	2,5%
Countercyclical buffer				0,625%	1,25%	1,875%	2,5%
Minimum common equity	3,5%	4,0%	4,0%	4,5%	4,5%	4,5%	4,5%
Minimum common equity plus conservation buffer	3,5%	4,0%	4,0%	5,125%	5,75%	6,375%	7,0%
Minimum common equity plus buffers	3,5%	4,0%	4,0%	5,75%	7,0%	8,25%	9,5%
Minimum total capital	8,0%	8,0%	8,0%	8,0%	8,0%	8,0%	8,0%
Minimum total capital plus conservation buffer	8,0%	8,0%	8,0%	8,625%	9,25%	9,875%	10,5%
Minimum total capital plus buffer	8,0%	8,0%	8,0%	9,25%	10,5%	11,75%	13,0%

In Summary, banks are assumed to be oligopolistic entities, who pursue a profit maximizing strategy. This is achieved where the marginal costs of issuing loans is equal to the marginal revenues. This ultimately results in an equilibrium of an optimal bank loan rate and the associated bank loan levels. The availability of capital forms a constraint in this pursuit and determines the extent to which banks can achieve an efficient optimum. Moreover, bank capital influences the marginal costs of issuing loans (Chami and Cosimano 2001, 2010).

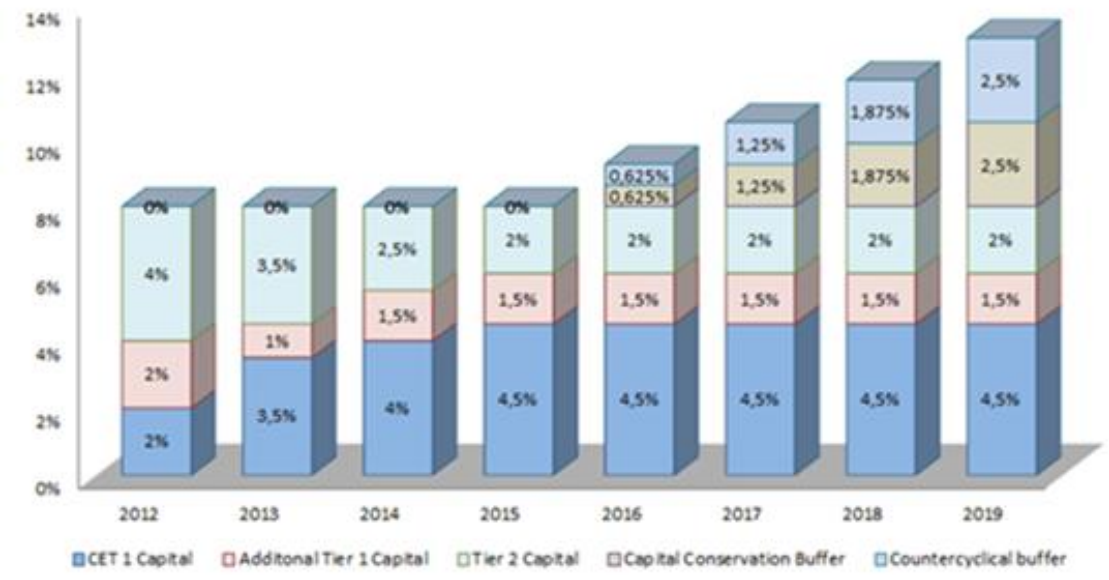
Following this model, a direct link exists between bank capital-to-asset ratio, bank loan rates and bank loan levels. Here an increase in bank capital-to-asset ratio would cause an increase in bank loan rates and subsequently a decrease in bank loan levels (Barajas et al., 2010).

The capital requirements set under the Basel III requirements are expected to directly impact bank capital-to-asset ratio, by dictating the required amount of capital banks should retain and can therefore not utilize. As of 2019, banks are required to maintain a minimum total capital buffer of 8% of risk-weighted assets. This amount is increased by the additional capital conservation buffer and the counter-cyclical buffer. In total a minimum total capital buffer of 13% is required in times of economic growth.

4. Implications forcapital-to-asset ratio

Overall the reforms of Basel III have a significantly higher impact on bank capital requirements than its predecessor, Basel II. Common Equity Tier 1 capital base requirements have increased from 2% to 4.5%. The additional Tier 1 capital base requirements have decreased from 2% to 1.5%. The total capital base requirements (Tier 1 + Tier 2) are unchanged at 8%, thus the focus of the bank capital base has shifted from Tier 2 capital base to common equity Tier 1 capital base. In addition to the total minimal capital base requirements, the capital conservation buffer adds another common equity Tier 1 capital requirement of 2,5%. This increases the minimum common equity Tier 1 capital ratio to 7% (4.5% + 2.5%). This furthermore increases the total Tier 1 minimum capital requirements to 8.5% (6%+2.5%) and the overall total minimum capital requirements to 10.5% (8%+2.5%). Adding to the minimum capital ratio is countercyclical buffer intended to be enforced in times of economic growth. In spite of the fact that national authorities have the power to alter the minimum required ratio, the countercyclical minimum capital ratio may be set as high as 2.5% in addition to the minimum total capital base and the capital conservation buffer. Since the countercyclical buffer should consist of common equity Tier 1 capital, this potentially raises the minimum capital requirements of common equity Tier 1 capital to 9.5% (4.5% + 2.5% + 2.5), Tier 1 capital to 11% (6% + 2.5% + 2.5%) and the total minimum capital requirements as high as 13% (8% + 2.5% + 2.5), in times of economic growth (Figure 6).

Figure 6: Overview Basel III capital requirements



In order to determine the impact of the new Basel III requirement for banks, the Bank for International Settlements (2010) conducted a quantitative impact study. This study focused inter alia on the overall changes in regulatory capital ratios that resulted from the new minimum capital requirements. The study collected data from 263 international banks, including 74 banks which are internationally active (group 1) and 133 other banks (group2). Assuming that the international sampleused in this study is representative for our sample of European banks, the results of this study can be employed to determine changes in bank capital-to-asset ratio. Given the fact that the banks, which are included in the data sample of this paper, are all internationally active, solely the results for group 1 banks are deemed to be representative.

Overall the study conducted by the Bank for International Settlements (2010) calculates significant changes in regulatory capital ratios. These changes in capital ratios are attributed to changes in the definition of capital (Tier 1 and Tier 2) and changes in the calculation of risk-weighted assets as determined by the Basel III reforms. Under the new Basel III capital requirements group 1 banks' average common equity Tier 1 capital ratio would fall from 11.1% to 5.7%. For group 2 banks the ratio would decline from 10.7% to 7.8%. According to the Bank for International Settlements (2010), this indicates that the Basel III reforms have a considerable larger impact on larger, internationally active, banks, such as the sample used in this paper. The occurring declines are mainly attributed to the new definition of capital deductions and filters at the common equity Tier 1 capital, resulting from the reforms aimed at increasing the quality and quantity of bank capital base. In addition to changes in common equity Tier 1 capital ratios, changes in Tier 1 capital ratios and changes in the total capital ratios are calculated. According to the study on average Tier 1 capital ratios for Group 1 banks would decrease from 10.5% to 6.3% and total capital ratios would decrease from 14% to 8.4% (Bank for International Settlements, 2010).

When comparing the calculated changes in average capital ratio to the required ratios under the Basel III reforms including the capital conservation buffer, it is clear that on average banks do not meet the requirements.The results from the Bank for International Settlements (2010) indicate that on average banks must increase their common equity Tier 1 ratio with 1.3% (7.0% – 5.7%). In addition on average banks must increase their Tier 1 capital ratio with 2.2% (8.5 – 6.3%) and their total capital ratio with 2.1% (10.5 – 8.4%). Furthermore, in times of economic growth, banks are required to increase their ratio with 2.5% countercyclical buffer. This increases the gap between the actual and the required capital ratio (Table 4).

Table 4: Changes in average capital ratios (Adapted from the Bank of International Settlements, 2010)

	Current	New	Required	Difference	Buffers	Difference
Common equity Tier 1	11,1%	5,7%	7,0%	-1,3%	9,5%	-3,8%
Tier 1 capital	10,5%	6,3%	8,5%	-2,2%	11,0%	-4,7%
Total capital	14,0%	8,4%	10,5%	-2,1%	13,0%	-4,6%

Following Barajas et al., (2010) and Cosimano and Hakura, (2011), this paper assumes that the new equity to risk-weighted ratio, calculated by the Bank for International Settlements (2010), is an appropriate proxy for the capital-to-asset ratio used in the structural model of the capital channel of monetary policy created by Chami and Cosimano (2010). The required increase in bank capital ratio can therefore be employed as a capital constraint in the structural model. However in contrast to previous studies, the total capital ratio measure will be employed. Since the total capital ratio has fewer quality requirements to meet, it outlines a better representation of the content –and the quality of the average bank equity-to-asset ratio, than the common equity Tier 1 or Tier 1 capital. This results in the acknowledgement that on average the bank capital-to-asset ratio must be increased with 2.1% in order to meet the minimum capital requirements under Basel III and with 4.6% in order to meet the requirement of the countercyclical buffer in times of economic growth.

5. Methodology

5.1 Estimation approach

In order to determine the precise impact of the Basel III regulations on the optimal bank loan rate and on the optimal bank loan level, first the impact of bank capital-to-asset ratio on the optimal loan rate and subsequently the optimal loan level should be determined. To achieve this, a three stage regression is employed. In the first stage, the capital regression is expected to determine bank's optimal level of capital. Changes in the capital-to-asset ratio, the interest- and noninterest expense ratio and the non-performing loans, as well as their relationships are assumed to influence the optimal bank capital ratio. The results from this regression are used to determine the strength of our theoretical foundation and are then employed in the second stage regression. Here the loan rate is inter alia determined by capital-to-asset ratio employed by the bank. Finally in the third stage, the optimal amount of bank loans is determined using the calculated optimal loan rates. Because these three regression stages are interdependent, it is possible to determine the impact of a change in bank capital-to-asset ratio on the employed loan rate and corresponding optimal loan level (Figure 3, Appendix). By modelling the Basel III regulations as an increase in bank capital-to-asset ratio (2.1%, 4.6%), the equations developed by Barajas et al. (2010) allow for the estimation of the impact of the Basel III regulations on the optimal loan rate and the corresponding optimal loan level.

5.2 Data

The analysis is based on data obtained for the 47 largest European banks, based on total assets for the period 2009-2013. Following Borio (2012) and Claessens et al. (2013) the global financial crisis is allocated to the period 2007-2009. However, selecting a sample outside this period will in all probability not circumvent the possible unintended influences of the financial crisis. Despite the fact the financial crisis occurred between 2007-2009, many organization today still face the aftermath of this period and are thus still being influenced. It is therefore impossible to completely circumvent the influence of financial crisis. By selecting a period outside 2007-2009, this paper however aims to reduce the impact of the financial crisis on the sample data.

In order to compile the sample data, this paper adapts the December 2013 report on the top 100 largest banks prepared by SNL Finance. In this report, banks are ranked based on their total assets they report under their accounting regimes. (SNL Finance, 2013) This method of organizing is assumed to be suitable for this study, since capital-to-assets is one of the main variables employedin the regression analyses. From this list, the largest European banks are extracted; representing a sample size of 47. An additional advantage of extracting solely European banks if the fact that these banks all report under IFRS, which makes the comparison between banks more accurate. From this sample, financial data for the period 2009-2013 is collected directly from the annual financial reports issued by each individual bank. Based on this data, this paper re-compiles the rankings as shown in figure 6 (Appendix). Financial data reported in native currencies, was converted to euro's, using the prevailing exchange rate on 30/10/2014. It is recognized that the exchange rates from the period 2009-2013 may be more suitable for this conversion, however this would entail proceedings well out of the range of this paper.Due to the fact that several banks merged or dissolved during the sample, three banks are omitted from the data sample. The final sample therefore consists of 44 European banks.

The level of economic activity during 2009-2013 is determined by country's GDP per capita. This data was obtained from The Eurostat Database (2014)This paper deems this measure of economic activity as suitable, because it nullifies the influence of size of individual countries on the economic activity. A point of concern is however that the banks in this data sample are all internationally active. This entail that entities are active in multiple counties and thus should face different levels of economic activities.

Despite the fact that this paper acknowledges this fact, GDP per capita is still deemed to be a suitable measure. The ECB requires internationally active banks to report their claims and liabilities on a worldwide consolidated basis. This data must be assigned to countries on an ultimate risk basis. This often amounts to worldwide claims and liabilities being allocated to the country in which the head office is located(De Nederlandsche Bank, 2014). This distribution makes is possible to match data sample to the individual country GDP per capita. Following Barro (1999), this paper also incorporates a nation's gross capital formation as a measure for economic growth. While GPD per capita represents economic performance, the capital formation ratio determines the amount of wealth which is re-invested in nations. Given this fact, this paper deems that the addition of the capital formation ratio to the GDP per capita ratio, benefits the overall measure of economic growth. Data is collected from The World Bank Database (2014) for the period 2007-2009. Country and year dummies are included in the analyses.

6. Estimation results

The following tables display the estimation resultsfor the regression analyses created byBarajas et al. (2010).These estimations relate to banks' choice to hold capital, banks' choice of optimal loan rate and the associated loan level. The dependencies are formulated on the conditions provided by the structural model of the capital channel of monetary policy created by Chami and Cosimano (2001). In addition to the displayed variables, year and country dummies are included. Furthermore significances of 5 percent(**) and 1 percent(***) are indicated.

Table 5 provides the estimation results for the first-stage regression analysis regarding banks' choice to hold capital. The table indicates that for the largest 44 European banks, the choice of bank capital is negatively related to a change in capital-to-asset ratio in a previous period and positively related to the change in capital-to-asset ratio * initial capital to asset ratio. These results correspond to the initial expectation of this paper, moreover the change in capital-to-asset ratio * initial capital to asset ratiovariable is statistically significant at five percent. As expected, the interest expense ratio isnegatively correlated to the capital-to-asset ratio and is statistically significant at one percent. The positive value of the interest expense ratio*initial capital to asset ratio is also in line with the expectations of this paper, however these results are not significant. The non-interest expense ratio, contrary to the expectations, shows a positive value. This leads to believe that a one percent increase in the non-interest expense ratio, leads to a 3,93 percent increase in bank capital-to-asset ratio. The non-interest expense ratio*initial capital ratio shows a positive value as well, however this is in line with the expectations elicited by the theory.Both variables are significant to a 1 percent level. The non-performing loans ratio shows a positive value, however this variable is not significant. The logarithm of assets variable exhibits a negative value. This evidence suggests that relatively larger banks, tend to hold less equity compared to assets. More specific, a one percent increase in assets, results in a 0,28 percent reduction in bank capital-to-asset ratio. The overall model has an adjusted r-square of 0,885. The data therefore strongly supports the structural model of the capital channel of monetary policy created by Chami and Cosimano (2001) and subsequently the first-stage regression analysis.

Table 5: Estimation results first-stage regression analysis

	Dependent variable: capital-to-asset ratio
Change in capital-to-asset ratio	-0,150
	(,238)
Change in capital-to-asset ratio * initial capital-to-asset ratio	5,073**
	(,002)
Interest expense ratio	-0,257***
	(,000)
Interest expense ratio * initial capital-to-asset ratio	2,575
	(,033)
Non-interest expense ratio	-1,577***
	(,000)
Non-interest expense ratio* initial capital-to-asset ratio	3,929***
	(,000)
Non-performing loans ratio* initial capital-to-asset ratio	0,927
	(,020)
Logarithm of assets	-0,276
	(,069)
Constant	5,812
Observations	235
R-squared	0,889
Adjusted R-squared	0,885

Table 6 provides the estimation results for the second-stage regression analysis regarding banks' choice of optimal loan rate. The equation created byBarajas et al. (2010), operationalizes the optimal bank loan rate as an equilibrium of marginal costs of loans and market demand. The marginal costs of issuing loans is measured as the interest- and non-interest expense ratio. Both variables exhibit a positive value, which is in line with the expectations of this paper. The data suggests that an increase in the marginal costs of issuing loans, leads to an increase in the optimal bank loan rate. An one percent increase in the interest expense ratio or the non-interest expense ratio, would cause the optimal loan rate to an increase by 1,009 or 0,923 percent. Both measures are significant to a 1 percent level, which strengthens the belief in this dependency. The logarithm of assets exhibits a negative value; this suggests that larger banks tend to issue relative lower loan rates. Cosmano and Hakura (2001), explain that banks with a higher capital base are able to facilitate a larger amount of loans. The equilibrium of optimal- loan rate and loan level can therefore be attained at a higher amount of loans and subsequently a lower loan rate. The effects of bank size has a significant effect to a 1 percent level. The loan demand, which is operationalized as economic activity, is measured by the GDP growth ratio and the capital formation as percentage of GDP. Contrary to the expectations of this paper, the latter variable exhibits a positive value. This would indicate that an increase of economic activity would lead to an increase in optimal loan rate. The GDP grow ratio, however exhibits a negative value, which partly confirms our expectations. An increase in economic activity would lead to a decrease in optimal loan rate.

The predictions of both variables seem to contradict each other, which is striking since they represent the same phenomenon. The overall model has an adjusted r-squared of 0,901 which, in spite of the conflicting data for economic activity, strongly suggests the correctness of the loan rate model. In contrast, the effect of both measures of economic activity is deemed insignificant. Because of this, the contradiction in results is considered as less important. Overall, a one percent increase in bank capital-to-asset ratio would therefore result in a 0,68 percent increase in the optimal bank loan rate.

Table 6: Estimation results for second-stage regression analysis

	Dependent variable: Interest income-to-asset ratio
Interest expense ratio	1,009***
	(,000)
Non-interest expense ratio	0,923***
	(,000)
Capital-to-asset ratio	0,680***
	(,001)
Logarithm of assets	-1,036***
	(,000)
GDP growth ratio	-0,017
	(,325)
Capital formation as % of GDP	1,791
	(,358)
Constant	5,387
Observations	235
R-squared	0,903
Adjusted R-squared	0,901

Table 7 reports the estimation results for the long-run loan level equation, created by Barajas et al. (2010). The analysis is constructed using the interest income-to-assets ratio, as usedin table 6, as a counterpart of the economic activity. According to the model, the optimal loan level is a function of the costs of borrowing and the demand for loans. This demand is determined by the future value of the borrowed amount for the borrowers. The loan demand is operationalized as the economic activity of a region and, as in the second-stage regression operationalized as the GDP growth ratio and the capital formation as a percentage of GDP. As expected the interest income-to-assets ratio has a negative value. This indicates that an increase in loan rate, decreases the desirability of bank loans and thus the demand for loans. This variable is significant to a one percent level and is therefore perceived as an important determinant. The GDP growth ratio and the capital formation as a percentage of GDP both exhibit a positive value. As expected, an increase in economic activity, increases the optimal loan level. However, both variables have no significant value.

Overall the model has an adjusted r-squared of 0,065. This indicates that explanatory value of this model is particularly low. This suggests that other influences, beside the used variables, impact bank loan levels. Another explanation for the low explanatory power of the third model might be that the employed variables for economic activity are unsuitable. This would explain the insignificance ofthe GDP growth ratio and the capital formation as a percentage of GDP as determinant in both the second-stage and third-stage regression analysis. This would also explain the contradicting results of these variables in the second-stage regression analysis. Overall the relative low explanatory power of this model makes it difficult to correctly predict the impact of an increase in loan rate on the demand for loans. In the discussion section, this paper discusses possible ways to improve the explanatory power of this model, however in the absence of a superior model, the estimation results are employed.The application of the model would imply that an one percent increase in the interest income-to-asset ratio, would decrease the demand for loans by 0,18 percent.

Table 7: Estimation results for third-stage regression analysis

	Dependent variable: Total loans-to-assets
Interest income-to-assets ratio	-0,180***
	(,000)
GDP growth ratio	0,003
	(,998)
Capital formation as % of GDP	0,447
	(,265)
Constant	0,427
Observations	235
R-squared	0,078
Adjusted R-squared	0,065

The combined results of the staged regression analyses can be used to determine the impact of bank capital-to-asset ratio on the optimal bank loan rate and the associated loan levels. This paper interprets the explanatory power of the first-stage regression analysis as being supportive of the structural model of the capital channel of monetary policy created by Chami and Cosimano (2001) andfeels it is therefore safe to assume the correctness and applicability of the model as a theoretical foundation. The results from the second-stage analysis implicate that an increase in bank capital-to-asset ratio of one percent, would result in an increase of bank loan rate of 0,68 percent. The results from the third-stage regression analysis indicate that an one percent increase of bank loan rate, would result in a 0.18 percent decrease in demand for bank loans. Overall, a one percent increase in bank capital-to-asset ratio, would therefore result in a 0.68 percent increase in bank loan rate and subsequently a 0.1224 percent decrease in optimal loan level in the long run. These results are consistent with the initial expectations of this paper.

7. Impact Basel III regulations

Using the new equity to risk-weighted ratio, calculated by the Bank for International Settlements (2010), as a proxy for bank capital-to-asset ratio, the impact of the Basel III regulations can be modelled as a mandatory increase in bank capital-to-asset ratio.According to the Bank for International Settlements (2010), the introduction of the Basel III risk coverage reforms, would on average cause total bank capital ratio to decrease from 14% to 8.4%. Comparing this to the minimum capital requirements under Basel III (10.5%), this would imply that, under the new regulations, on average bank capital-to-asset ratio would increase by 2.1 percent. Furthermore, the requirements under the countercyclical buffer in times of economic growth (2.5%) would enlarge this difference. This would result in a required increase in bank capital-to-asset ratio of 4.6 percent.

Applying this mandatory increase in bank capital-to-asset ratio to the model of the capital channel of monetary policy created by Chami and Cosimano (2001), the Basel III regulations have a direct impact on bank loan rates and loan levels. A 2.1 percent increase in bank capital-to-asset ratio, would result in a 1.428 percent increase in bank loan rates and subsequently a 0.25704 percent decrease in bank loans in the long run. The addition of the countercyclical buffer would result in an increase in bank capital-to-asset ratio of 4.6 percent. This would result in a 3.128 percent increase in bank loan rates and subsequently a 0.56304 percent decrease in bank loans in the long run (Table 8).

Table 8: Impact of an increase in capital-to-asset ratio on bank loan rate and bank loan levels

	1 %	Basel III minimum requirements	Basel III plus CC buffer
Capital-to-asset ratio	1,0%	2,1%	4,6%
Bank loan rate	0,68%	1,428%	3,128%
Bank loan level	-0,1224%	-0,25704%	-0,56304%

The introduction of the Basel III regulations willtherefore have major consequences for the optimal bank loan rate and loan levels. In the long-term the regulations will likely have a inhibiting effect on economic growth. Higher lending rates makes it more expensive to for firms to acquire funds. This reduces the amount of investments made and subsequently reduces economic growth. This effect is enlarged because consumers are encouraged to spend less and save more, subsequently business production declines and foreign appetite for exports falls. Because of this vicious sequence of events, a slowdown in GDP growth is an inevitable consequence (Wall Street Journal, 2014).

The estimation results are generally consistent with the findings of Furfine (2002), who found a 5.46% increase in loan rates, and with the analysis of Cosimano and Hakura (2011). The latter estimated that under the new Basel III capital requirements the 100 largest banks of the world would raise their lending rates by on average 16 basis points. This increase in capital ratio is expected to cause loan growth to decline by 1.3 percent in the long run. The difference in estimation results may be attributable to the difference in sample selection of the difference in sample period. Furthermore the results of this paper are based on changes in total capital requirements, instead of Tier 1 capital requirements. Finally the difference in results might also be caused by the low explanatory value of the third regression analysis. Assuming that the selection of other variables would haveproduced a different dataset, this might have had a significant impact on the final results.

8. Conclusion

The financial crisis, which reigned in the 2007-2009 period, has had an enormous impact on the global economy and has made it clear thatbank requirements set by the Basel II regulations were insufficient to repel the financial issues. With the purpose of ameliorating the shortcomings of Basel II, the Basel Committee on Banking Supervision (BCBS) developed the Basel III regulatory framework.The BCBS seeks to once again raise the resilience of the banking sector by strengthening the regulatory capital framework, bank risk management and overall transparency in the banking sector. In spite of the sound intentions set by the Basel Committee on Banking Supervision, there is much debate about potential increased costs for banks and customers. An increase in costs, associated with higher capital buffers, would result in higher loan rates and subsequently lower levels of bank loans. In order to determine the impact of the Basel III regulations on loan rates and loan levels, this paper establishes the main determinants of bank loan rates and loan levels and subsequently observes 44 large European banks during 2009-2013. More specifically, the main focus of this research is to determine:

How do banks choose their optimal loan level and loan rates, in what way does the availability -or absence- of capital influence this decision and how does Basel III influence bank capital-to- asset ratio?

By employing the model of the capital channel of monetary policy created by Chami and Cosimano (2001), this paper determines that the optimal bank loan rate and loan levels are determined by profit maximizing bank behavior; an equilibrium is found where the marginal costs of issuing loans is equal to the marginal revenues. This theoretical optimum is moderated by the availability of bank capital, which has the dual function offunding the amount of issued loans and absorbing unexpected losses. An increase in bank capital enables banks to issue more loans, while simultaneously increasing the marginal cost of issuing these loans. For this reason, the amount of bank capital is determined by the expected future demand for bank loans.

By employing the regression analyses, created by Barajas et al. (2010), a direct link between bank capital-to-asset ratio, bank loan rates and loan levels is identified.A one percent increase in bank capital-to-asset ratio, results in a 0.68 percent increase in bank loan rate and subsequently a 0.1224 percent decrease in bank loans in the long run.The Basel III regulations are modelled as a mandatory increase of 2,1% in bank capital-to-asset ratio, which directly impacts bank loan rates and loan levels.This paper estimates that the introduction of Basel III will cause a 1.428 percent increase in bank loan rates and subsequently a 0.25704 decrease in bank loans in the long run.

The countercyclical buffer, which will be introduced in times of economic growth, will greatly enlarge this impact. In spite of the fact that the minimum required ratio may vary in size, the countercyclical minimum capital ratio may be set as high as 2.5%. This ratio is an addition to the minimum total capital base and the capital conservation buffer. The addition of the buffer results in a 3.128 percent increase in bank loan rates and subsequently a 0.56304 percent decrease in bank loans in the long run.

The findings of this paper strongly suggests the notion that the Basel III regulations will increase costs for banks and its customers. In all probability, the estimated increase in loan rates and decrease in loan levels will have an inhibitory effect on the just recovering global economy in the long run. This would imply that the regulations created by the Basel Committee on Banking Supervision in order to prevent an event similar to the financial crisis, simultaneously functions as an extra obstacle for economic recovery and might even slow down recovery.

The enhancing effect of the countercyclical buffer, makes it a powerful tool, which may both decrease pro-cyclical bank behavior, as well as damage economic growth. Careless application of the countercyclical buffer, and even solely the Basel III regulations, may therefore cause more harm than benefit. Nevertheless, the height, and thus the impact, of the countercyclical buffer may be determined by national jurisdictions. This paper feels that these authorities lack the financial expertise to properly determine the long-run impact of their choices. It is therefore strongly recommended that this decisional power is centralized to an overarching financial institution, for instance the ECB or the IMF, in order to ensure uniform and responsible application.

9. Discussion

In this section a number of issues are discussed, which may have had an effect on the correctness and suitability of the utilized data. In particular, this involves three issues that may have had unintended effects on the measured results and their interpretation. This regards the operationalization of economic activity, the allocation of economic activity to the country where the head office resides and bank risk diversifying behavior.

The low explanatory power of the third regression analysis, raises questions regarding certain assumptions made in this research. In particular, the chosen variables for economic activityare questioned in hindsight. This doubt is caused by the low significance of both GDP growth ratio and capital formation as a percentage of GDP in the second- and the third-stage regression analysis. Also the fact that these variables produce contradictory results for the second-stage regression analysis is a point of concern. Afterall, these variables supposedly measure the same phenomenon.

Overall analysts tend to prefer the GDP growth ratio as a measure of economic activity. However,this has resulted in insignificant results for this paper and this is also the case for the paper of Furfine (2000) and Cosmano and Hakura (2001,2011). This leads to believe that another measure might be more suitable; perhaps the Net National Product growth ratio, which represents gross national product reduced by capital consumption. The advantage of this measure is that is more accurately depicts the economic growth in individual countries, because of the incorporation of depreciation of assets.(Bureau Van Dijk, 2014)

In their paper, Cosimano and Hakura (2001,2011) used GDP growth ratio as well as Consumer Price Index as a measures for economic activity. The employment of these measures resulted in contradicting results as well. However, the consumer price index variable did prove to be significant. This can be interpreted as an improvement to the employment of the capital formation as a percentage of GDP.

Another factor that might have influenced the explanatory power of the loan level model is the choice to allocate measures of economic activity to the country where the head office is located. Despite the fact that, accounting wise this assumption is generally accepted, banks in fact are internationally active and thus operate in regions with different levels of economic activity. It is therefore ultimately incorrect to allocate an entire bank to solely the country where the head office is located. The adoption of this assumption might have influenced the measure of economic activity considerably.

A final point of discussion in risk diversifying bank behavior. Because of their risk adverse nature, banks aim to decrease their exposure to any form of risk. Because of the complexity of- and variation in which banks are able to hedge their exposure to risk, this paper has not discussed this. However risk diversifying bank behavior might be an important moderating factor in the impact of the Basel III regulations on bank capital-to-asset ratio. Mandatory levels of capital base are partly determined by banks' exposure to risk. Any decrease in bank exposure to risk, induced by risk hedging, will likely impact the amount of mandatory capital base. The impact of Basel III might therefore be greatly attenuated by bank diversification. However, it lies outside the scope of this paper to determine this moderating impact. Further research will be needed to determine in what way risk diversification and hedging will impact the mandatory risk-weighted capital base under Basel III.

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Appendix

Figure 3: Elucidation variables CC Test, Loan Rate and Loan Level

$$\frac{K'}{A} = a_0 + \left(a_1 + a_2\frac{K}{A}\right) \times \Delta\frac{K}{A} + \left(a_3 + a_4\frac{K}{A}\right) r^D + \left(a_5 + a_6\frac{K}{A}\right)(C_L + C_D) + a_7 \log(A) + \varepsilon_3$$

Intercept | Change in equity-to-asset ratio x initial equity-to-asset ratio | Interest expense ratio x initial equity-to-asset ratio | Noninterest expense ratio x initial equity-to-asset ratio | Logarithm of assets | Error

$$r^L = b_0 + b_1 r^D + b_2(C_L + C_D) + b_3\frac{K'}{A} + b_4 \log(A) + b_5 M + \varepsilon_1$$

Intercept | Interest expense ratio | Noninterest expense ratio | Ratio of non-performing loans to assets | Logarithm to assets | Economic activity | Error

$$L = c_0 - c_1 r^L + c_2 M + \varepsilon_2$$

Intercept | Loan Rate | Economic activity | Error

Figure 4: Overview Basel III reforms. (Adapted from BCBS, 2013)

Pillar 1			Pillar 2	Pillar 3
Capital	Risk coverage	Containing leverage	Risk management and supervision	Market discipline
Quality and level of capital Greater focus on common equity. The minimum will be raised to 4.5% of risk-weighted assets, after deductions. **Capital loss absorption at the point of non-viability** Contractual terms of capital instruments will include a clause that allows – at the discretion of the relevant authority – write-off or conversion to common shares if the bank is judged to be non-viable. This principle increases the contribution of the private sector to resolving future banking crises and thereby reduces moral hazard. **Capital conservation buffer** Comprising common equity of 2.5% of risk-weighted assets, bringing the total common equity standard to 7%. Constraint on a bank's discretionary distributions will be imposed when banks fall into the buffer range. **Countercyclical buffer** Imposed within a range of 0-2.5% comprising common equity, when authorities judge credit growth is resulting in an unacceptable build up of systematic risk.	**Securitisations** Strengthens the capital treatment for certain complex securitisations. Requires banks to conduct more rigorous credit analyses of externally rated securitisation exposures. **Trading book** Significantly higher capital for trading and derivatives activities, as well as complex securitisations held in the trading book. Introduction of a stressed value-at-risk framework to help mitigate procyclicality. A capital charge for incremental risk that estimates the default and migration risks of unsecuritised credit products and takes liquidity into account. **Counterparty credit risk** Substantial strengthening of the counterparty credit risk framework. Includes: more stringent requirements for measuring exposure; capital incentives for banks to use central counterparties for derivatives; and higher capital for inter-financial sector exposures. **Bank exposures to central counterparties (CCPs)** The Committee has proposed that trade exposures to a qualifying CCP will receive a 2% risk weight and default fund exposures to a qualifying CCP will be capitalised according to a risk-based method that consistently and simply estimates risk arising from such default fund.	**Leverage ratio** A non-risk-based leverage ratio that includes off-balance sheet exposures will serve as a backstop to the risk-based capital requirement. Also helps contain system wide build up of leverage.	**Supplemental Pillar 2 requirements.** Address firm-wide governance and risk management; capturing the risk of off-balance sheet exposures and securitisation activities; managing risk concentrations; providing incentives for banks to better manage risk and returns over the long term; sound compensation practices; valuation practices; stress testing; accounting standards for financial instruments; corporate governance; and supervisory colleges.	**Revised Pillar 3 disclosures requirements** The requirements introduced relate to securitisation exposures and sponsorship of off-balance sheet vehicles. Enhanced disclosures on the detail of the components of regulatory capital and their reconciliation to the reported accounts will be required, including a comprehensive explanation of how a bank calculates its regulatory capital ratios.

Figure 6: Largest European Banks ranked on Total Assets

Rank	*Company Name*	Total assets *(31/12/2013)* *
1	HSBC Holdings	€ 2.110.341
2	BNP Paribas	€ 1.800.139
3	Deutsche Bank	€ 1.611.400
4	Crédit Agricole Group	€ 1.536.873
5	Royal bank of Scotland	€ 1.308.078
6	Barclays Plc	€ 1.295.475
7	Société Générale	€ 1.235.262
8	Groupe BPCE	€ 1.123.520
9	Banco Santander	€ 1.115.637
10	ING Bank NV	€ 1.080.624
11	Lloyds Banking Group	€ 1.077.930
12	UniCredit	€ 845.838
13	UBS	€ 838.184
14	Credit Suisse Group	€ 724.429
15	Rabobank Group	€ 674.139
16	Crédit Mutuel Group	€ 658.618
17	Nordea Bank	€ 630.434
18	Intesa Sanpaolo	€ 626.283
19	Banco Bilbao Vizcaya Argentaria	€ 599.482
20	Commerzbank	€ 549.661
21	Standard Chartered	€ 532.760
22	Danske Bank	€ 419.517
23	DZ Bank	€ 386.978
24	ABN AMRO Group NV	€ 372.022
25	CaixaBank	€ 340.190
26	OAO Sberbank of Russia	€ 327.785
27	Cassa depositi e prestiti	€ 314.685
28	DNB	€ 286.733
29	Swenska Handelsbanken	€ 273.879
30	Landesbank Baden-Wuttemberg	€ 273.523
31	Skandinaviska Enskilda Banken	€ 273.332
32	Banco Finaciero y de Ahorros	€ 269.159
33	Bayerische Landesbank	€ 255.601
34	Nationwide Building Society	€ 242.708
35	KBC Group NV	€ 241.306
36	Dexia	€ 222.936
37	La Banque Postale	€ 214.677
38	Norddeutsche Landesbank Girozentrale	€ 200.845
39	Swedbank	€ 200.289
40	Erste Group Bank	€ 199.876
41	Banca Monte dei Paschi di Siena	€ 199.106
42	Nykredit Realkredit	€ 184.264
43	Belfius Banque	€ 182.777
44	Banco de Sabadell	€ 163.441
45	Landesbank Hessen-Thüringen	€ 161.823
46	VTB Bank	€ 157.833
47	Hypo Real Estate Holding	€ 122.454

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