Capital Requirements and Economic Growth in Emerging Economies

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Abstract

This thesis answers the question: what are the effects of higher capital requirements on economic growth for emerging economies? We perform a literature review to gain insight in the relation between capital and economic growth. Furthermore, we perform an empirical analysis. The question is answered by looking at both the costs and benefits of higher capital requirements. For the benefits, a logistic crisis probability model is used. For the costs, we perform OLS and IV regressions of capital on credit supply and economic growth. We find that higher capital reduces the probability of a crisis and it reduces the credit supply. Capital does not influence economic growth through the credit supply. Furthermore, we analysed what factors specific to emerging economies influence the relationship between capital and economic growth. We show that alternative financing options influence this relation but institutional quality and trade openness do not seem to affect the relation.

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1. Introduction

After the 2008 financial crisis, it became clear that banks needed more supervision. This started already by the instalment of Basel I and Basel II and was further developed by Basel III starting from 2013. Aim of these accords is to improve the regulation and supervision of banks in order to make them more resilient to future economic crises.

Basel III introduces among other things; higher capital requirements, leverage ratios and liquidity ratios. The macroeconomic consequences of these higher capital requirements have been researched by the OECD and the Bank for International Settlements. On the one, hand higher capital requirements lead to enhanced financial stability thereby having positive effects on GDP. On the other hand, it is argued that banks cut lending and/or face higher funding costs leading to a negative effect on growth.

Research on the topic of the macroeconomic effects of higher capital requirements is often done for OECD countries and systemically important banks (BCBS 2010, MAG 2010 and IFF 2011) and rarely for emerging economies (Caggiano and Calice 2011, Chiuri, Feri and Mainoni 2002). For developing countries, the introduction of higher capital requirements could have more severe or different effects. Banks in emerging economies may have more difficulties in raising new capital to comply with the new regulation, and banks in emerging economies already face higher funding costs because of adverse selection and moral hazard. Furthermore, a reduction in credit supply can have more severe effects in emerging economies. Access to credit is already limited and other channels of receiving funding are less existent. On the other hand it is argued that banks in emerging economies are already well-capitalized and do not often suffer banking crises.

This paper tries to answer the question: what are the effects of higher capital requirements on economic growth for emerging economies?

Our study answers this question by estimating the costs and benefits of higher capital requirements. We will do this by estimating the effect of capital requirements on the probability of banking crises, for which we will use a logit model, and by estimating the effect of capital requirements on credit supply and economic growth, for which we will use both OLS and IV regression analysis.

In our methodology, we will include factors that could be relevant for emerging economies, according to the literature, on the relationship between capital requirements and economic growth. This is also important from a policy perspective. The Basel accords are now homogenous across different countries. If it turns out that rules applying to advanced countries have negative effects on emerging countries, it should be considered to apply these rules less strictly or that these rules should be applied more gradual so emerging countries can adapt to them.

Our results suggest that capital requirements reduce the probability of banking crises in emerging economies. Furthermore, we find that capital requirements reduce the credit supply in the form of private credit provided by banks but does not seem to influence economic growth.

In section 2 the theoretical and empirical literature on the effects of higher capital requirements on growth is discussed. In section 3 we will lay out the additional hypotheses that we will look at empirically. Section 4 will provide the methodology used in this thesis. Section 5 will show the results. Section 6 discusses the weaknesses and limitations of our study and provides directions for future research. Section 7 will conclude and give suggestions on how the results presented in this paper can be turned into policy.

2. Literature review

This section summarizes the current literature on the effects of higher capital requirements on economic growth for emerging economies. This literature review will consist of literature about advanced and emerging economies. The review is structured as follows: section 2.1 studies the Basel 3 Accord. What does it consist of and how does it affect banks? Section 2.2 will focus on the consequences for the economy of increased capital requirements. Both the benefits and the costs of higher capital requirements will be discussed. Section 2.3 will look at why it is relevant to study emerging economies and investigates whether emerging countries would be affected differently by higher capital requirements. We will ask whether they could be more or less affected. After evaluating the relevance for emerging economies, the empirical literature on how to study the effects of higher capital requirements on growth will be studied. This part will highlight the problems in the empirical literature and how one could deal with this. The last part gives a conclusion and states what will be done in the empirical part of this thesis.

2.1 The Basel III Accord

2.1.1 What does it consist of?

Before evaluating the effects of Basel III, it is good to know what it exactly consists of and why it has been designed. The Basel Committee on Banking Supervision (BCBS) introduced the Basel III in 2010 in response to the 2008 financial crisis. Basel III tries to build on and enhance the Basel II framework developed in 2004. The Basel III framework, according to the BCBS, aims to 'improve the banking sector's ability to absorb shocks arising from financial and economic stress, whatever the source' and to 'improve risk management and governance' and to 'strengthen banks' transparency and disclosures'. It will focus on both microprudential, at the individual level, and macroprudential, at the systemic level, regulation to raise individual resilience and reduce system wide shocks. The BCBS has scheduled the implementation of the framework from 2013 till 2019.

The Basel framework consists out of three pillars. This thesis will focus on pillar 1[1] because this pillar concerns capital requirements. Pillar 2 is concerned with risk-management and Pillar 3 deals with market discipline. These pillars are more about disclosure and supervision so we will not explain them explicitly in this thesis. Basel III focuses both on the quality and quantity of capital. Several measurements are taken to make sure that banks' capital increases. Common equity (consisting of common shares and retained earnings) capital ratio will be increased to 4.5% of risk-weighted assets (RWA). Furthermore a capital conservation buffer consisting of common equity is introduced equal to 2.5% of RWA totalling the common equity ratio to 7%. The total Tier 1, including for example preferred shares, capital ratio cannot fall below 6%. Tier 1 plus the Tier 2 ratio cannot be below 8%. In total this brings the total capital ratio plus the conservation buffer to 10.5% of RWA. Lastly a countercyclical buffer is imposed in the range of 0-2.5%. This buffer can be imposed by national central banks in times when credit growth is excessive which leads to large systemic risks.

Furthermore, in December 2017, the BCBS published its final reforms which add to the Basel III reforms announced in 2010 (BCBS, 2017a). These new reports are called Basel IV but because the BCBS does not call it Basel IV we will not do this either. The new reforms will focus mainly on the calculation of risk-weighted assets and capital floors (PWC, 2017). The capital floor limits the amount of capital benefit from using internal risk models compared with standardized approaches. Risk-weighted assets calculated under internal models will have to be minimally 72.5% of risk-weighted assets under standardized models. This means risk-weighted assets will be larger for some banks using internal models and thus their capital ratios will increase. Furthermore, limits on the use of internal models and revised risk weights will increase risk-weighted assets. However, the new reforms are scheduled to be introduced from 2022 onwards and therefore, we cannot take them into account in our research.

2.1.2 How do banks comply with it?

Banks have different ways of complying with the new framework. Cohen and Scatigna (2016) identify four channels of adjustment to the new regulation.

The first strategy is to increase the retained earnings, thereby increasing common equity. A bank can increase retained earnings by reducing the profits paid out to shareholders, for example by reducing dividends. Alternatively a bank could try to increase profits. This could be done in various ways. The most direct way is to increase the spread between the interest paid on loans and deposits for example

[1] To review the full Basel III accord including other pillars, liquidity requirements and specific regulation concerning SIFI's see: Basel Committee on Banking Supervision (2011): Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems—Revised Version, June.

by demanding higher loan rates. The BCBS (2010) states that banks could also increase non-interest income, decrease deposit rates and reduce operating expenses.

Secondly, a bank could decide to increase equity by issuing new shares. According to Cohen and Scatigna this can be done to both existing and new shareholders. The latter option is not favourable for existing shareholders because their shares are diluted. Existing shareholders have less ownership and voting rights.

The last two options involve the asset side of the bank. The capital ratio is defined as capital over risk-weighted assets. Decreasing risk-weighted assets would thereby increase the capital ratio. A bank would sell its assets or decrease its loan book. Another option is to decrease the risk-weights on assets, thereby decreasing risk-weighted assets. Loans to corporations, small and medium enterprises (SME's), credit card loans or for example loans to emerging economies, would be replaced by less risky alternatives like mortgages or government securities.

The way a bank chooses to comply with the increased capital requirements can have different effects on the economy. These effects and consequences for the economy and economic growth are discussed in the next section.

2.2 Consequences of higher capital requirements

Banks having higher capital requirements can be both beneficial and disadvantageous for the economy. This section will evaluate what the advantages and disadvantages are.

2.2.1 Benefits

2.2.1.1 Financial stability

During the crisis, a lot of banks became insolvent. Lehman Brothers is an example of this. Problems at one institution quickly spilled over to other financial institutions, creating a system wide financial crisis. If banks have more capital, they are better able to withstand losses on their assets (Admati, DeMarzo, Hellwig and Pfleiderer, 2013). According to Admati et al. there would also be less risk of systemic breakdowns from mutual distrust. Furthermore, the burden on tax payers is reduced: bail-outs by the government and thus the tax payer are less needed.

Diamond and Rajan (2000) state that increased bank capital enables the bank to survive in case of a crisis more often and avoid distress. They are better able to withstand shocks on asset values. Furthermore, Beltratti and Stulz (2012) find that banks with more Tier 1 capital, performed better in the 2008 financial crisis relative to banks with less capital because they suffer less from the debt overhang problem. This is a situation in which firms have so much debt, they are not able to borrow more even if the net present value of the investment is positive (Myers, 1977). Berger and Bouwman

(2013) find that capital enhances the performance and market share in several banking crises. This is because banks with more capital engage in more monitoring and invest in safer assets.

Higher capital requirements create a buffer and thereby reduce the probability of a crisis from happening. The empirical results will be discussed in section 2.4.1.1.

2.2.1.2 Risk-taking

To evaluate whether it truly enhances financial stability, the effects of higher capital requirements on bank risk-taking should also be researched. Perhaps banks with more capital believe that they are able to take on more risk thereby decreasing financial stability.

In principal if capital requirements are higher, more of the assets are financed by shareholders and thus shareholders have more to lose. Therefore they will take less risk (Rochet, 1992) and banks are induced to screen and monitor borrowers better. However, higher capital requirements lead to lower profits or as seen before to lower dividends to increase retained earnings, which in turn leads to more risk-taking.

De Haan and Klomp (2014) find for advanced and emerging economies that capital requirements reduce bank riskiness. Calem and Rob (1999) state that risk-taking is high for banks with low capital, this is evidence of moral hazard as a result of deposit insurance. As banks' capital increases, risk-taking decreases reflecting that capital requirements reduce risk. However, for banks with even more capital, risk-taking increases again. This is not because of moral hazard but because they are solvent enough to take on these risks. This could be an explanation for studies that do find increased risk-taking for higher capital requirements.

2.2.2 Costs

This section focuses on the literature of the costs of increased capital requirements. First we will see whether there are actually costs involved in having higher capital requirements. This question can be answered by looking at whether the Modigliani and Miller theorem holds. Next we will see what studies with the view that capital requirements are costly view as costs by looking at the effects on lending and interest rates.

2.2.2.1 Does M&M hold?

As stated in section 2.1.2, if capital requirements are increased, banks can do four things. Increase retained earnings, reduce assets, increase equity or reduce asset risk (Cohen and Scatigna, 2016).

One option for banks in order to comply with increased capital requirements is to increase equity. Whether this has negative effects on GDP depends on whether you believe raising equity is costly or not, and if it is costly whether its costs are passed on to borrowers resulting in higher lending rates or

to lenders resulting in lower deposit rates. On the first glance, it is expected that capital requirements are costly. Otherwise, why would banks not fund themselves only with equity?

Modigliani and Miller (1958) state that how a firm is funded does not matter for the value of that firm. The weighted average cost of finance is thus not changed if a firm is financed more by equity or debt. If a bank has more equity, its costs of equity should fall because the bank is less risky. Miles, Yang and Marcheggiano (2013) argue that the theory of Modigliani and Miller does not hold or at least not fully. A reason for this is for example that interest payments on debt can be deducted of profits thereby lowering tax, the so-called tax shield. Debt is therefore cheaper than equity. One challenge for the literature is to establish whether the Modigliani and Miller condition holds, or in other words whether the costs of funding increases if a bank holds more capital.

Another reason why equity could be more expensive is because of the pecking order theory of Myers and Majluf (1984). This theory states that firms rather use retained earnings or debt than issuing equity to finance new projects. An issuance of new equity would suggest that the firm is overvalued because the management of the firm is more willing to sell the shares if they believe they are overvalued. Investors will see this new issuance as a signal that the company is overvalued. This is also a reason why banks could prefer to shrink assets instead of issuing new equity (Peek & Rosengren, 1995).

An alternative cause why capital requirements are costly is that cutting dividends in order to achieve higher retained earnings could signal poor performance. Furthermore, because of implicit or explicit guarantees in the form of deposit insurance on debt and/or deposits, banks are more willing to hold debt because it will be bailed out by the government. Banks are considered too big to fail because the costs of a bank failure are too large for the economy. The expectation of a government bail-out leads to low capital levels and more bank risk-taking. Bankruptcy costs, which usually increase with debt, are then negligible if banks are too big to fail. The cost of debt funding is then relatively cheaper compared to equity. Higher capital requirements will reduce the value of the too big to fail guarantee leading to higher funding costs for banks (Benink 2016).

The fact that equity is junior to debt and therefore equity holders require a higher return is another reason why equity is more expensive. However, this could be mitigated by the Modigliani and Miller theorem.

If equity is expensive, banks are unwilling to increase equity and thus are more likely to cut down assets in order to comply with capital requirements.

Admati et al. (2013) hold a different view. They state that having higher capital requirements does not lead to lower assets. Banks can simply issue new equity and thereby raise assets without having higher

costs. Although they acknowledge that equity has a higher required return, this does not mean that its overall funding costs, the cost of capital, will increase. If the bank is funded with more equity, the risk premium on equity will also be lower. Furthermore, because there is less chance of bankruptcy, the risk premium on debt will decrease resulting in lower funding costs. This is however not the case if debt is implicitly or explicitly guaranteed by the government.

Against the pecking order argument put forward by Myers and Majluf, which states that banks prefer to issue debt over equity because of signalling problems, Admati et al. argue that the most preferred form of finance is actually retained earnings which is in fact equity. There is less information asymmetry concerning retained earnings. So, according to Admati et al., the pecking order theory predicts that banks would actually have more equity. Indeed Cohen and Scatigna show that the main channel of adjustment to higher capital requirements is dividend cuts and increased retained earnings.

In our view, Admati et al. underestimate the fact that banks could have trouble raising new equity. Either because it is not available or because increasing retained earnings by cutting dividend is costly as it signals bad performance.

It is thus not clear whether the Modigliani & Miller theorem holds and whether capital requirements are costly. The only way to determine this is then to look at the empirical literature and see whether capital requirements are costly.

2.2.2.2 Reduction in lending

Admati et al. state that if banks can comply with increased capital requirements by increasing retained earnings, the costs are not that high. Assets can grow and lending rates are not increased by much because of the decrease in risk due to more equity. However, the costs are likely to be high if the higher capital requirements are achieved by a reduction in lending. This section will look at the effects of higher capital requirements on the lending supply.

Kashyap, Stein and Hanson (2010) state that in the short term, banks are reluctant to seek new equity. Therefore, they lower or slow down the growth of their assets. Lending supply is then decreased. Kashyap et al. state that this effect primarily happens in the short run. In the long run Kashyap et al. do not find large long term effects. The reason for this is that they rely on the Modigliani and Miller theorem which makes issuing equity not expensive. Therefore they expect firms to raise equity rather than cut down on lending.

Recent literature uses natural experiments in order to test whether more capital leads to a reduction in lending. Increasing capital requirements provides opportunities to do these natural experiments because the requirements are sudden and forced by the government. Aiyar, Calomiris and Wiedalek

(2016) use UK data in which different banks faced different capital requirements. They find that lending by big banks changes substantially to capital requirements changes. Aiyar et al. estimate a 4.6 percentage point reduction in credit growth. Another natural experiment is done by Mésonnier and Monks (2014). They use unique European data, which followed after an announcement of the European Banking Authority that large European banks had to increase their Tier 1 capital ratio to 9%. Banks that had to increase their capital ratio to comply with the 9%, faced lower loan growth than banks that were not subject to the increase in capital because they already had capital surplus. The announcement was unexpected, so banks could not have pre-emptively adjusted their capital ratio, and the window in which banks could comply was short. This made sure that the change in credit supply was due to the increase in capital and not due to other causes.

2.2.2.3 Increase in interest rates

If banks raise equity, it is likely that in response, banks will increase interest rates on loans. This is of course only the case if having more or raising equity is more expensive. This section will evaluate the effects of higher capital requirements on lending spreads.

Many studies assume that funding costs increase and that this is reflected in higher lending spreads. The BCBS (2010) using a variety of macroeconomic models has estimated the effect on lending spreads. The models used by the BCBS will be discussed in section 2.4.3. The research is done for 13 members of the BCBS and does not include developing countries in the period from 1993 to 2007. The BCBS estimates that for each percentage point increase in capital ratios, lending spreads increase by 13 basis points. The main weakness of this research is that it assumes that return on equity is constant and that any higher cost of funding is fully passed through to higher lending rates.

The BCBS study assumes that the Modigliani and Miller Theorem does not hold. Other studies assume that it does hold or to a larger extent. Kashyap, Stein and Hanson (2010) find therefore lower increases in lending rates. Kashyap et al. estimate that an increase in capital requirements of one percentage point leads to an increase of lending rates by 2.5 basis points. The study is done for the period 1976 to 2008 in the United States.

Miles, Yang and Marcheggiano (2013) using UK data estimate that the M&M theory does hold to some extent and therefore the costs of increased capital requirements are fairly small. They therefore argue that the optimal level of capital is well above the levels specified in the Basel III accord. The IFF (2011) has several points regarding the analysis of both Miles et al. and Kashyap et al. Firstly, past data are used to assess the impact of future required capital requirements. The problem of this is according to the IFF that historically funding costs did not increase even if banks had more capital because deposit funding was much cheaper. Under Basel III competition for deposit funding becomes tougher and thus

funding costs are expected to rise. Secondly, both studies ignore the fact that banks have other mechanisms to deal with higher funding costs, for example tighter credit standards.

Even if the funding costs increase, it is not necessarily that the lending rates increase. According to the BCBS (2010), banks can in response to higher funding costs, increase non-interest income, reduce the rate paid on deposits and reduce operating expenses. Furthermore, IFF (2011) states that if raising new equity is particularly expensive, banks could choose to reduce assets or loan less to the riskiest lenders. This could lead to a credit crunch and is specifically present in markets where it is difficult to raise new equity.

We have seen that banks can decrease assets or raise new equity. If banks reduce assets, this has a direct effect on economic growth by lowering the credit supply. If banks increase equity, this has an indirect effect on economic growth by increasing interest rates and thereby lowering loan demand. However, banks have different ways to deal with higher funding costs and it is also argued that equity is not expensive. If equity is not costly, the indirect effect may not have a large effect on economic growth. The effects on economic growth therefore depend on whether banks can easily raise new equity or if they have to reduce assets.

2.2.2.4 Switch lending to less riskier borrowers

Albertazzi and Marchetti (2010) state that banks decrease their lending to the most riskiest and bank-dependent borrowers. This can have both positive effects and negative effects. In advanced economies it is likely to have a positive effect because the quality of investment goes up thereby enhancing financial stability. In emerging economies, in which borrowers like small and medium enterprises (SME's) already struggle in receiving credit and where access to non-bank credit is limited, it is likely to have negative effects on GDP. SME's are limited even more to credit while they could have a role in boosting economic growth in emerging economies. Brooke, Bush, Edwards, Ellis, Francis, Harimohan, Neiss and Siegert (2015) confirm this. Although they look at UK data, so it might not be valid for emerging economies, they argue that in the UK SME's have limited access to non-bank credit. They stress the importance of SME's for UK productivity and state that a reduction in credit for these firms harms economic growth. For emerging economies the problem is likely to be even bigger and therefore the costs of increased capital requirements could be higher in emerging economies.

2.2.2.5 Shadow banking

One other way in which higher capital requirements affect the stability and risk of the financial system is that higher requirements can lead to a spur in shadow banking (Plantin 2014). Shadow banking is activities usually done by banks performed by other institutions outside the regulatory scope. This is due to the large competition in the banking sector (Kashyap, Stein & Hanson 2010). Because banks only compete on low interest rates and not on for example branding, slightly higher rates due to capital

requirements could lead to customers going to the shadow banking sector. The shadow banking sector is less regulated and this brings risks to both the formal and shadow banking sectors.

2.3 The case for emerging economies

We have now seen the benefits and costs of higher capital requirements. Credit supply will be reduced, interest rates go up and there will be less lending to riskier borrowers. This will lower investment and consumption and eventually economic growth. The goal of this thesis is to evaluate what the consequences for emerging economies are. This section will evaluate whether these economies are more or less affected by higher capital requirements.

The global financial crisis of 2007 caused great harm for many developed countries. The Basel I and II accords were incapable of preventing a new economic crisis and it is even argued that Basel I was a major cause of the crisis (Cannata and Quagliariello, 2009). After the crisis, this became more and more clear and thus the demand for a new accord increased. The BCBS agreed upon Basel III in 2010 and this was introduced in 2013.

The effects of this new accord have been researched by for example Barrell, Davis, Fic, Holland, Kirby and Liadze (2009) and BCBS (2010). The main benefits are a reduced probability and severity of crises and costs are an increased lending spread and reduced credit supply. These studies focus on OECD countries and according to Suttle, Krauss and Mazzacurati (2010) most of the empirical work regarding the effects of Basel III is focused on developed countries. Why is it still necessary to do this research for emerging economies?

Although less severely, emerging economies, like developed countries, are also hit by the financial crisis. According to Banerjee and Vashisht (2010) all BRIC countries suffered from lower GDP growth rates during the financial crisis. This suggests that there are benefits in preventing these crises albeit lower than for developed countries.

Moreover, the Basel III accord was designed by and for developed countries. The question is whether this universal accord has undesired consequences for emerging countries or whether the accord does not go far enough.

One concern is the extent to which emerging economies adopt the Basel III Accord. It is not obligated to implement Basel III if you are not a member of the Basel Committee. Luckily, many emerging economies are becoming part of the Basel Committee. Of our sample of 34 countries, 19 countries are already a member of the committee including large emerging economies like Brasil, China and Russia. Furthermore, the BCBS (2017b) states that a significant number of non-Basel Committee members

have already brought key elements of Basel III into force. We can thus conclude that Basel III is implemented around the world in both advanced and emerging economies.

2.3.1 Why they might be less affected

2.3.1.1 Initial capital

Chiuri, Ferri and Majnoni (2002) state that the enforcement of capital adequacy levels has had a negative effect on the supply of bank loans. This effect is stronger for initially less capitalized banks. This seems intuitive: if banks already comply or are close to complying with the higher capital ratios, they have to raise less new equity or do not have to decrease their assets. Investment is then not affected. Countries with higher average capital levels experience a smaller negative effect of higher capital requirements while they already reap the benefits. Are banks of emerging economies better capitalized than advanced economies banks?

According to the Abdel-Baki (2012a), many emerging market economies experienced a banking crisis before the recent financial crisis of 2008. For example the 1997 Asian and the 1980s Latin American crisis. These crises were partly due to financial liberalization. In response to these crises, emerging economies revamped their supervisory frameworks and capital levels are generally quite high. As a result, emerging economies were hit less by the financial crisis of 2008 and therefore capital levels remain high in emerging economies. For example Parcon-Santos and Bernabe (2012) who study the macroeconomic effects of Basel III in the Philippines, state that banks in the Philippines are well-capitalized. Furthermore, Watanagase (2012) states that Asian countries were primarily impacted by the financial crisis through the trade channel and not because their financial sector was not resilient enough. Morgan and Pontines (2013) show that Asian banks are generally well capitalized, with overall capital levels in many cases above the regulatory target. Rojas-Suarez, Del Valle and Galindo (2012) studying Andean countries (Bolivia, Colombia, Ecuador and Peru), find that all countries would comply with their current capital levels if Basel III was introduced. This evidence seems to indicate that emerging economies will have to raise less equity or are not having to reduce assets and therefore will have lower costs of increasing capital requirements to comply with Basel III.

However, emerging economies are growing at a fast pace. Think of China which has experienced annual GDP growth of above 10 percent. They will need additional capital to support this asset expansion. Additionally, banks in emerging economies are often forced to use a standardized risk measurement approach instead of internal ratings-based approaches. The IRB approach is costly and requires many skilled people. In turn, the IRB approach leads to lower capital requirements compared with the standardized approach. Likewise, the standardized approach requires firms to have external credit ratings. Companies in emerging economies often do not have external credit ratings and therefore the risk-weights attached to these companies are higher. This will lead to a reduction in lending growth to

these companies. The IFF (2017) states that banks in emerging economies are forced to use the standardized approach, translating in higher capital requirements, which affects domestic lending and lending to emerging economies.

2.3.1.2 Public banks

According to Cull, Martinez Peria and Verrier (2017), government-owned banks represent only 18% of global banking system assets. This suggests that public banks are not key players any more. However, in emerging economies, the government plays a larger role in the ownership of banks. Especially in Brazil, China India and other South-Asian countries, government-owned banks are a large share of the total banking system (Cull, Maritinez Peria and Verrier, 2017). Does bank ownership have anything to do with the effects of capital requirements? According to Sinha (2012) who studied Indian banks, public sector banks may not face a capital constraint because the government can recapitalize banks. It would be easier to raise capital and therefore the funding costs will not increase by much. However, looking at India, it is precisely the government-owned banks that are having trouble raising capital (Fitch, 2016). This might reflect that government-owned banks have more trouble raising equity through market channels. One explanation for this is that because of government guarantees, public banks are more likely to take on excessive risk. This could be reflected in a lower stock price, making it more difficult to raise capital. This is consistent with Barth, Caprio and Levine (2004) who found that regulation of public banks is less effective.

We have shown reasons why emerging economies could be less likely to be affected by higher capital requirements. The next section will look at the reasons why they might be more affected.

2.3.2 Why they might be more affected

2.3.2.1 Institutional quality

Emerging economies generally have a lower level of institutional quality. Law, Azman-Saini and Ibrahim (2013) find that the impact of finance on growth is only positive after a certain threshold level of institutional development. Institutional quality is measured by an index consisting out of corruption, rule of law and government effectiveness. Could the same principle be true in the effects of capital requirements i.e. do they only work after a certain level of institutional quality?

Klomp and De Haan (2014) find that the negative impact of capital regulation and supervisory control on banking risk is stronger in countries with strong institutions. This means that capital requirements are not as effective in reducing risk if institutional quality is low. This could for example be because of bad enforcement, weak supervision or corruption. Countries with lower institutional quality do not reap the complete benefits of higher capital requirements. In order to have these benefits, capital requirements have to be higher leading to an even higher cost.

2.3.2.2 Availability of other credit options

Another argument put forward by Chiuri, Ferri and Majnoni (2002) is that alternative financing channels outside the banking sector are weaker in emerging economies. This would mean that if higher capital requirements were to increase lending rates and thereby decreasing bank loans this could have long-lasting effects on the economy. Borrowers cannot offset their lending by other channels. Furthermore, banks could have trouble raising new capital because of shallow domestic capital markets. According to Chiuri et al., the question is then whether banks fulfil the new requirements by reducing assets or by increasing capital. Banks wanting to raise assets may find this difficult in shallow financial markets and thus are more likely to reduce their risk-weighted assets. They find that there is a greater reduction in credit supply in countries where alternatives to bank credit are limited. On the other hand, Deli and Hasan (2016), examining the effects of bank capital regulations on loan growth, do not identify differences in results comparing systems in which borrowers rely more on bank credit.

2.3.2.3 Indirect effects

Next to the direct effect that higher capital requirements have on the emerging economies themselves, an indirect effect also exists. Basel III is an international accord and many countries have to deal with it. The indirect effect is the effect of higher capital requirements in developing countries and the consequences of this for emerging economies. Ghosh, Sugawara and Zalduendo (2012) identify two channels through which an increase of capital requirements in developed countries influences emerging economies. The first channel is the trade flows channel. Because of higher lending rates and lower lending volumes in developed countries, due to Basel III regulation, economic activity decreases which leads to lower imports (exports for developing countries). The other channel is the financial flows channel. Developed countries will charge higher interest rates and lend less to emerging economies. Banking flows to emerging economies will therefore decrease. The financial flow channel consists out of a direct lending effect in which banks from developed countries loan less to nonfinancial institutions in emerging economies and an indirect effect in which banks from developed countries loan less to banks from emerging economies. The financial flow channel could be explained by 'flight to quality'. According to Albertazzi and Marchetti (2010), banks subject to especially risk-sensitive capital requirements choose to loan more to less risky borrowers. Banks and nonfinancial institutions in developing countries are generally seen as more risky. Developed banks decide to loan less to these riskier countries in order to decrease their risk-weighted assets so they comply with increased capital requirements.

Ghosh et al. using a dataset consisting of 17 advanced and 38 emerging markets estimate that the financial flow channel exists. For a 100 basis points increase in the lending rates of developed countries, banking flows to developing countries would decrease by 3 percentage points. Ghosh et al.

do not estimate the effect this has on GDP. To fully estimate the effects of higher capital requirements on the growth of emerging economies, this should be taken into account.

Vitek and Roger (2012), using data for 15 developed and developing countries, employ a multi-country model. This allows for a simultaneous increase in capital requirements in other countries. Vitek and Roger estimate that a 1 percentage point rise in GSIB capital requirements, the adverse impact on GDP is 0.17 percentage points. What is interesting from their analysis is the fact that emerging economies suffer the most from the spill over effects, especially China and Korea, as these economies are exposed to countries where banks are important for the economy (Japan and the US).

2.3.2.4 Reduced lending to riskiest borrowers

As stated before, higher capital requirements would lead to a shift from a risky portfolio to a safer, less productive portfolio. This is called the flight to quality. In emerging economies, access to finance for the most risky groups is limited. Limited access is due to these SME's being more risky and the large asymmetric information surrounding SME's. Higher capital requirements will further limit the access of SME's to finance.

2.3.2.5 Adverse selection

Another argument for why emerging economies are more affected by increased capital requirements is put forward by Agénor and Pereira da Silva (2017). They state that if higher capital requirements lead to higher interest rates, it attracts borrowers who want to pay these higher rates. This is called adverse selection. More risky borrowers are willing to pay higher rates so the bank ends up with a riskier loan portfolio. The benefits of higher capital requirements are then mitigated by adverse selection. Adverse selection is a bigger problem in emerging economies because the borrowers are riskier and information about the quality of borrowers is harder to collect. Adverse selection will further increase the costs of higher capital requirements.

2.4 Empirical results

We have looked at the theoretical literature on what the consequences of higher capital requirements on economic growth are. Moreover, reasons against and for the statement that emerging economies are affected more by higher capital requirements are evaluated. We will now look at the empirical results of the effect of higher capital requirements on economic growth. We will do this for advanced and emerging economies. Lastly we will discuss the issues that arise in doing empirical research for the effects of higher capital requirements on growth.

2.4.1 Advanced economies

2.4.1.1 Benefits

To estimate the benefits of a reduction in the probability of a crisis, a marginal benefit formula is used. The Basel Committee on Banking Supervision (BCBS) (2010) uses for expected marginal benefits of

increased capital requirements, the reduction in probability of systemic crises times the costs of a banking crisis. Cost of crises is measured by using the median cost of systemic banking crises in the literature. The BCBS estimates that this median cost is 63% of pre-crisis GDP. Higher capital requirements lead to a lower probability of crises. An increase in the capital requirement from 7% to 8% leads to a reduction in the probability of a crisis by one third. The expected benefits are then calculated by multiplying the cost and reduction in probability. Several assumptions are being made in the calculation of benefits. These assumptions will be discussed in section 2.4.3.

The BCBS also states that higher capital requirements are not only reducing the probability but also the severity of a crisis. More capital should insulate stronger banks from the strains faced by weaker banks. However, they only find weak evidence for this and therefore do not include it in their analysis.

Brooke, Bush, Edwards, Ellis, Francis, Harimohan, Neiss and Siegert (2015) also calculate the reduction in the probability of a crisis due to higher capital requirements. Brook et al. (2015) distinguishes between two methods of measuring this. Firstly, the bottom-down approach uses individual bank losses to estimate the probability of this bank failing and then translates this into the probability of a crisis. Secondly, the top-down approach uses capital ratios of banking systems and uses a panel logit model to predict whether a crisis is happening.

The top-down approach is preferred for two reasons. Brooke et al. state that bank losses can happen for other reasons including liquidity stress. Additionally, data for individual banks are limited for developing countries. Using cross country measurements of capital levels is more adequate for developing countries.

Brooke et al. estimate that for a Tier 1 capital ratio of 8%, the probability of a crisis is 1.8% whereas for a capital ratio of 11 the probability is 0.8%. The total cost of a crisis is estimated to be 43% GDP. This is lower than the estimate of the BCBS due to the fact that Brooke et al. account for the lower need of government bail-outs. The dataset of Brooke et al. consists only out of OECD countries and is thus not representative for developing countries.

Yan, Hall and Turner (2012) using a probit model to estimate the probability of a crisis, estimate that a 1% increase in the capital ratio reduces the probability of a crisis occurring by around 3.211%. The probability of a crisis is reduced by 4.996% when the capital ratio increases to 12%. Temporary and permanent GDP losses of a crisis are respectively 10% and 210% of pre-crisis UK GDP. The highest net benefits will then be achieved at a capital ratio of 12%.

2.4.1.2 Costs

The BCBS (2010) study estimates that a 1 percentage point increase in the capital requirement translates into a 0.09% median loss in the level of output. The MAG (2010) estimates that a 1 percentage point increase in the capital ratio would lead to a decline in the level of GDP of about 0.19% from the baseline path. The MAG study is focused on the transitional costs of higher capital requirements whereas the BCBS study is focused on the longer term costs and benefits. The MAG also states that credit supply effects, i.e. a reduction in assets, leads to larger transitional costs than increases in lending spreads, due to increases in equity. This may be a disadvantage for emerging economies where it is difficult to raise capital.

The IFF (2011) is another study estimating the effects of higher capital requirements on growth. The IFF finds much larger magnitudes in terms of GDP compared with the MAG and BCBS. The IFF estimates that higher lending rates will reduce the level of real GDP by about 0.7% per year compared with the 0.19% in the MAG study. The difference in results is mainly because the IFF incorporates changes in liquidity requirements and it states that banks have to raise a lot more capital than assumed in the BCBS study.

Locarno (2011) uses a semi-structural model. For the Italian economy, Locarno estimates that a one percentage point increase in the capital ratio, the level of GDP would decline by 0.00-0.33%. Locarno also takes into account the fact that banks not necessarily have to increase lending spread but that they can also reduce credit supply. If these ''non-spread effects'' are also taken into account, the GDP loss would rise to 0.03-0.39%.

Yan, Hall and Turner (2012) use a vector error correction model, VECM, approach to provide a cost-benefit analysis of Basel III in the UK. They estimate that for a 1% increase in the capital ratio, the spread increases by 5% and GDP decreases by 0.08%. Yan et al. also show that ROE will drop. Gambacorta (2011) using a similar method but for the US, estimate a 1 percentage point increase of the capital to asset ratio, the spread increases, 0.15 per cent and a 0.1 per cent drop in the level of output relative to the baseline. The effect on the spread is limited because the VECM studies do allow for changes in the return on equity. The VECM studies also give an insight in the difference between lending demand and supply.

De Nicolò, Gamba and Lucchetta (2014) develop a dynamic stochastic general equilibrium model, we will describe what this is in section 2.4.3, for the US. They find a U-shaped relation between capital requirements and bank lending and welfare. If capital ratios are raised by a small amount, lending will increase as banks have higher retained earnings with more lending. However, if capital requirements increase too much, it becomes more profitable to decrease lending because the return on lending is

decreasing. They find a reduction of lending of about 2.4% if capital requirements increase from 4% to 12%. However, according to Cline (2017), the study's results should be used carefully as it does not include costs of a banking crisis. The results do suggest that if capital ratios only have to increase a small amount, it may actually be beneficial to lending. This could be the case in emerging economies, where capital ratios are relatively high.

2.4.1.3 Overall impact

The BCBS (2010) using several methods finds that the benefits outweigh the costs. Net benefits remain positive for a broad range of capital ratios with the optimal capital ratio lying at 13% if one assumes that a crisis has moderate permanent effects. The MAG study did not estimate benefits.

Gambacorta (2011) using a vector error correction model, VECM, for the US does not compute the benefits but compares the calculated costs with the benefits calculated in the BCBS (2010) report and comes to the conclusion that net benefits remain positive for a broad range of capital ratios. Yan et al. (2012) also using a VECM model but for the UK, estimate the optimal capital ratio level to be at 10%. At this level, the temporary net benefits and permanent net benefit are 1.284% and 35.484% of pre-crisis GDP respectively.

2.4.2 Emerging economies

2.4.2.1 Benefits

Caggiano and Calice (2011) using a multivariate logit model on African economies, show that a 1 percent increase in the regulatory capital ratio relative to the current level would reduce the probability of banking crisis by about 0.5 percent an associated output gain of about 0.165 percent. They show that the benefits are lower for African economies than for developed countries studied in the BCBS study. One explanation for this is because African banks are already well capitalized and output losses arising from crises are not permanent in Africa.

Bernabe and Jaffar (2013) estimate for Malaysia that the benefits of complying with Basel III will be 0.76 percent of GDP. Whereas the benefits for the Philippines, studied in Parcon-Santos and Bernabe (2012) are significantly smaller namely 0.02 percent of GDP. Both studies use the same marginal benefit formula.

Laeven and Valencia (2012), using data for emerging and advanced countries, state that advanced economies tend to experience larger output losses than emerging and developing countries. The reason for this is because banking systems in advanced countries are deeper, making a banking crisis more disruptive. Laeven and Valencia show that for emerging economies the output loss is 26% and for developing countries 1.6%, whereas the output loss for advanced countries is 32.9%. This could mean that the benefit of increasing capital requirements in emerging and developing countries is lower

than for advanced countries. However, according to Gourinchas and Obstfeld (2012), banking crises happen more frequently in emerging economies compared with advanced economies. This is mainly due to a lower level of institutional quality and political instability. On the one hand, emerging economies have more to gain from higher capital requirements by reducing the frequency of crises. On the other hand, advanced economies have more to gain by preventing large output losses.

2.4.2.2 Costs

Literature on the costs of higher capital requirements is limited for emerging economies. Caggiano and Calice (2011) use a two-step approach for 22 African countries in the period 2001-2008. The first step is the relationship between capital requirements and lending spreads and the second step between lending spreads and GDP. They estimate that for a 1 percent increase in the capital-asset ratio, the lending spread increases by about 8.4 basis points.

Chiuri, Ferri and Majnoni (2002) study the effects of bank capital requirements on the supply of credit. This is done for a group of 15 emerging economies from different parts of the world. They find a negative effect on the supply of credit. Especially for less capitalized banks. The impact is smaller for foreign-owned banks. This suggests that these banks can shield the domestic banking sector from negative shocks. Chiuri et al. do not estimate the effects of a lower credit supply on GDP. Deli and Hasan (2016) look at 125 advanced and emerging economies. They also estimate the effect of higher capital requirements on loan growth. They find only a weak effect on loan growth. Deli and Hassan do not estimate the effects on GDP but do account for institutional quality and bank importance.

Naceur and Kandil (2009) study the effects of capital requirements on banks' intermediation costs in Parcon-Santos and Bernabe (2012) study the macroeconomic impact of Basel III in the Philippines. Using a VAR model, they estimate that a 1 percent increase in capital requirement increases the lending spread by 3.08 percent and decreases GDP by 0.01% of GDP. In Malaysia, the lending spread increases by 0.27% with a reduction in GDP of 0.46% of GDP.

2.4.2.3 Overall impact

The earlier mentioned Caggiano and Calice (2011) looking at 22 African countries suggest that a 1 percent increase in the capital ratio would have a cost in terms of GDP of about 0.056 percent. Net benefits would be possible for a change in Tier 1/RWA up to 9%. Naceur and Kandil (2009) do not estimate the effects on GDP. Parcon-Santos and Bernabe (2012) find a 1 percent increase in capital requirement decreases real GDP by about 0.01 percent. They find also one interesting fact: a 1 percent increase in capital requirement leads to a 4.70 percent increase in loan volume. This is counterintuitive because one would suggest that banks cut lending in order to fulfil the requirements. Parcon-Santos and Bernabe believe that higher lending allows banks to earn more interest income and thus earnings increase which allows them to meet the requirements. This fact shows that studies into the effects of

higher capital requirements should not only focus on lending spreads. Bernabe and Jaffar (2013) studying Malaysia, find that a 1 percent increase in capital requirements leads to a positive net increase to GDP of 0.3%. Morgan and Pontines (2013) studying Malaysia, The Philippines, Indonesia and Thailand find only small short-term negative effects and long-term positive effects.

Abdel-Baki (2012b) does a study for 47 emerging market economies. He uses a two stage model in which first the effect of higher requirements on credit performance is studied and the second stage captures the effects on GDP. According to Abdel-Baki, implementing Basel III would hamper growth by 3 percentage points. Especially advanced EME's are hampered the most because their banking sectors are not well prepared in terms of being capitalized.

De Nicolò (2018) uses a simple model to estimate the effects of capital requirements on real activity. He estimates the impact of bank capitalization on bank credit-to-GDP growth. Then regresses GDP growth on the change in bank credit-to-GDP growth resulting from an increase in capital requirements. The study is simple because it is a panel dataset for 89 countries including advanced and emerging countries. The simplicity of the study allows us to include the variables that are relevant in estimating the effects for emerging economies. De Nicolò finds two main results. The negative impact of an increase in capital ratios on real GDP is sizable and it is largest for high income countries.

We have found mixed results for both advanced and emerging economies. We cannot conclude that emerging economies are affected more by capital requirements than advanced economies. We have seen that emerging economies are affected but magnitudes differ. Also the way in which they are affected differs between studies. Some studies look at credit supply and others look at increased interest rates. We have also seen that evidence for emerging economies is still limited. What is needed is a study for many emerging economies. In this way, it can be evaluated which factors contribute in amplifying the effects of higher capital requirements on economic growth.

2.4.3 Empirical issues

We have now looked at the theory and empirical results for advanced and emerging economies. Theory and empirical results suggest that capital requirements influence economic growth in different ways. In this section we will look at the empirical issues concerned in measuring these effects.

First we will look at the problems with estimating the benefits of higher capital requirements. Firstly, as Miles et al. (2013) state, there is no consensus on whether crises have a permanent or only a temporary effect on GDP. Miles et al. argue that the cost of banking crises would be much larger if crises would have a permanent effect on GDP and therefore the benefits of higher capital requirements would be larger.

Secondly, Rochet (2014) suggests that endogeneity problems exist in estimating the causal relationship between banking crises and GDP. GDP losses not caused by banking crises could in turn play a part in causing banking crises. The reverse causality also exists in that these crises hamper economic growth. For example Kaminsky and Reinhart (1999) state that banking crises precede currency crises and in turn currency crises deepen banking crises.

We will now look at the issues in estimating the costs of higher capital requirements. We will first look at the different models employed by the literature to study the effect on GDP. The BCBS roughly distinguishes three different kinds of models. The first kind of models are dynamic stochastic general equilibrium (DSGE) models. DSGE models have several advantages. It provides a unified framework to analyse how capital requirements affect macroeconomic variables and it allows for counter-factual experiments (for example the effect of counter-cyclical capital requirements). Estimating a DSGE model is however daunting and not possible for this thesis. The BCBS uses mainly DSGE models. Next to DSGE models, semi-structural models exist. These are large scale models used by national banks and are beyond the scope of this thesis. It also does not allow to estimate the effect on lending spreads (BCBS, 2010). The last sorts of models are vector error correction or VECM models. The advantage of VECM models is that it differentiates between a contraction in loan supply and loan demand. VECM models however, do not allow for counter-factual experiments. The models used in the BCBS study are complicated and not appropriate for this thesis.

Next we will look at the problems with estimating the effects of higher capital requirements on credit supply. One problem with finding the effect of higher capital requirements on loan supply is that the reduction in loan growth and ultimately economic growth, could also be because of lower loan demand. Peydro (2010) states that credit demand is correlated with credit supply. For example banks that have to comply with higher capital ratios, may reduce credit supply in order to fulfil this requirement. It could however be that credit demand also drops because of a reduced need for investment during an economic downturn. The fact that credit demand is correlated with credit supply has to be accounted for if you look at the effect of higher capital requirements on credit supply. Otherwise you cannot tell for certain that there is a causal effect.

There are several ways of dealing with this problem. Olszak, Pipień and Roszkowska (2016) identify three ways in which credit demand and supply is disentangled. The ‘‘traditional approach’’ in which is accounted for economic conditions linked to loan demand. Think of variables like inflation or the unemployment rate. Another approach is to use banks’ lending surveys. These surveys contain information on credit supply and demand but are not widely available especially for emerging

economies. The last approach is to use experiments like in Aiyar et al. although identifying these natural experiments is particularly hard.

Natural experiments are furthermore used because other endogeneity problems arise in estimating the effect of capital requirements on loan supply. Perhaps regulatory institutions base their decision on how to set capital requirements on the level of credit supply. Reverse causality could therefore exist. Furthermore, as Aiyar et al. state, omitted variable bias problems also exist. Changes to the quality of bank's loans could influence capital requirements and credit supply. Aiyar et al. test for both endogeneity problems and argue that they are both not problematic in their study. The problem with natural experiments is that they do not provide an estimate of how the reduction in lending translates to a decrease or increase in GDP growth.

Another empirical issue is according to Kashyap et al. is to show that changes in lending impact investment or eventually GDP. This is because borrowers can turn to other sources of finance.

2.5 Conclusion

Capital requirements affect economic growth by improving financial stability and changing risk-taking of banks. Furthermore, depending on how banks react to higher requirements it decreases lending supply or increases interest rates. There are reasons to believe that emerging economies are affected differently by higher capital requirements. This literature review has made clear that still a lot of research is done for advanced economies and not for emerging economies. This paper will add to this by using data for emerging economies, especially BRIC countries. The factors that explain these differences between advanced and emerging economies are not researched in the empirical literature. This paper will look at how initial capital, bank importance, institutional quality and the indirect effects influence the effect of higher capital requirements on economic growth.

Doing this research empirically will present some challenges. It is difficult to distinguish between loan demand and loan supply. Most studies only assume that higher funding costs are fully passed on to customers in the form of higher lending rates and thus demand for loans decreases and ignore the fact that banks could also lower loan supply whereas other studies only focus on the reduction in credit supply or a substitution to less risky borrowers. What is needed to estimate the full effects of higher capital requirements on growth is a model which captures both supply and demand effects. As mentioned earlier, the model also has to make sure that the supply factors are not coming from a decrease in loan demand.

The next section will show the hypotheses of this thesis. We will show how we will measure the factors mentioned in sections 2.3.1 and 2.3.2 and how we will incorporate them in our model.

3. Hypotheses

In the literature review we have seen several factors that can influence the magnitude of the effect of higher capital requirements. These factors will have to be taken into account when doing empirical research. This section will show how we take these factors into our model and how we should interpret them. Unfortunately, we do not have sufficient data or the appropriate methodology to evaluate every factor discussed in section 2.3. Therefore, we will first discuss the factors we can implement in our methodology in sections 3.1 till 3.4. In section 3.5 and 3.6, we will show two factors that could be introduced in our model if we had the data.

3.1 Initial capital

This hypothesis is based on the literature that finds that banks will trim their credit supply less if they are well-capitalized (Chiuri, Ferri and Majnoni, 2002). Banks with higher initial capital will have to raise less equity or will have to reduce their assets by a smaller amount. Initial capital will therefore show up with a negative sign. Higher initial capital will have a weakening effect on the negative consequences of higher capital requirements. Although, this would work better if our study was at the bank-level, we do show that the probability of a crisis reduces with capital.

3.2 Institutional quality

We expect that institutional quality positively affects the relationship between capital requirements and economic growth. If institutions are better, regulation is better enforced. Countries with low institutional quality do not completely reap the benefits of higher capital requirements. This hypothesis is supported by the literature. For example, Klomp and De Haan (2014) find that institutional quality affects the effectiveness of bank regulation. We try to implement this in our model by including an interaction term between capital and institutional quality. We analyse whether the relationship between capital and credit supply changes if we introduce this interaction term.

3.3 Importance of banking sector

In emerging economies, the banking sector is the main channel in which borrowers can get funds. Other channels are not well-developed. Therefore, borrowers cannot offset the reduction in lending by banks through other channels. We expect that if countries depend more on banks to get funding, they will be hit harder by the increase in capital requirements.

3.4 Indirect effects

Emerging economies will not only be influenced by higher capital requirements directly but also indirectly through higher capital requirements in advanced economies. Advanced economies will similarly experience higher rates and lower credit supply. This will affect emerging economies through a reduction in lending to emerging economies and through less trade flows. We will incorporate these indirect effects by a proxy of the openness of the economy. We expect that if an economy is more

open, it will be affected more by the indirect effects. However, there is also another side of this. Economies that are more open will have more options to raise capital on for example foreign markets. Therefore, we will not make any expectations on the sign of openness of the economy.

3.5 Public banks

We have seen that public banks are still of great importance in emerging economies. The effect of being owned by the government is however ambiguous. On the one hand, being publicly owned should make it easier to raise capital through this government. On the other hand, it could make it more difficult to raise capital privately. Studying the effects of government-ownership would be more appropriate in a bank-level study for which you have data on the ownership structure of each bank.

3.6 Importance of SME's

According to the literature, higher capital requirements will lead to a shift in bank lending from high risk borrowers to lower risk borrowers. We expect that especially small and medium business will be affected by this. Therefore we could include a proxy of the importance of SME's in our model. However, we do not have data for this and it would again be better to test this at the bank level so one could see whether banks reduce their lending more to riskier borrowers. We expect that if a country depends more on SME's in order to grow, the negative effects of higher capital requirements are larger.

4. Methodology and data

The hypotheses mentioned in section 3 will have to be incorporated in a model. This section will show this model and the data being used in the model. In section 4.1 we will discuss which countries we will investigate. Section 4.2 will give an overview of the model and data used for the costs analysis. Section 4.3 provides the methodology for the benefits analysis.

4.1 Emerging economies

This thesis studies the effects of higher capital requirements on economic growth for emerging economies. What defines an emerging economy and when is a country emerging or developing? Before doing empirical research, these questions have to be answered to determine which countries will be included in our sample. It is important to note that although the countries are given the same name, emerging economies, they do differ. For example the per capita income of Brazil in 2016 is 8650$ compared with the Philippines which only has a per capita income of 2950$. In the view of MSCI (Morgan Stanley Capital International) emerging economies must meet certain requirements like market accessibility, but they do not quite meet the standards of developed economies. MSCI distinguishes 24 emerging market economies. The IMF uses three criteria to classify countries. It looks at per capita income, export diversification and degree of integration into the global financial system. The IMF has one less country than the MSCI. Both samples are quite similar in composition, we therefore choose to combine the two classifications and use countries which are incorporated in at

least 1 sample. Our sample will then consist of 30 countries. However, due to the lack of data for Taiwan we decided to exclude Taiwan from our sample. We then end up with 29 countries. In order to estimate the benefits of increased capital requirements, we use a model to predict crises. In our sample of 29 countries, there are only a limited amount of crises. Therefore, we include 5 additional emerging countries namely: Kazakhstan, Latvia, Slovenia, Slovak Republic and Uruguay. These countries are not labelled emerging by our sources but rather frontier markets and all experienced a crisis. The full list of countries is shown in the appendix table A1.

4.2 Cost method

4.2.1 The model and estimation method

To estimate the effects of higher capital requirements on economic growth, we will use the model of De Nicolò (2018). De Nicolò derives his models from the extensive literature on finance and economic growth. The first study which looked at the relationship between finance and growth is King and Levine (1993). Using a cross-country study, they find evidence that finance promotes growth. Later studies (Shen and Lee, 2006 and Law and Singh, 2014) find that the relationship is not linear. Financial development is only beneficial for economic growth up to a certain threshold. Other studies have focused on what determines the relationship between finance and growth. For example, Law, Azman-Saini and Ibrahim (2013) find that the relationship only holds if a certain level of institutional quality is reached. This shows that in estimating the finance and growth relationship, we can add other determinants that influence growth. This allows us to test our hypotheses.

De Nicolò links the literature of finance and growth with the effects of capital requirements on economic growth. The model of De Nicolò exists out of two stages. In the first stage, capital requirements are linked to financial development which is a proxy for credit supply. In the second stage, financial development is linked to economic growth.

Our first stage will look like this:

$$Creditsupply_{it} = \alpha_0 + \alpha_1 Capitalratio_{it} + \alpha_2 ROA_{it} + \alpha_3 Creditsupply_{it-1} + \alpha_4 Depth_{it} + \alpha_i + u_{it} \quad (1)$$

And our second stage will look like this:

$$GDPgrowth_{it} = \alpha_0 + \alpha_1 Creditsupply + \alpha_2 INFL_{it} + \alpha_3 GDPgrowth_{it-1} + \alpha_i + u_{it} \quad (2)$$

De Nicolò treats financial development, which is measured by bank credit to the private sector, as the lending choice of a bank or the credit supply. This lending choice depends on four factors: Return on assets (*ROA*) which measures profitability, the possibilities of lending at alternative sources of finance (*Depth)*, the lagged bank credit to private sector (*Creditsupply*$_{it-1}$) and capital ratios (*Capitalratio)*.

The growth rate of a country depends on: bank credit to private sector (*Creditsupply)*, inflation (*INFL*) and previous period economic growth ($GDPgrowth_{it-1}$). We will add our factors that are important to emerging economies in these equations to get an understanding if emerging economies are affected more by higher capital requirements.

Estimating the relationship between finance and economic growth presents many endogeneity problems. Does finance cause economic growth or does economic growth lead to more finance? King and Levine (1993) tried to mitigate this by including initial financial development in their regressions. We will try to overcome endogeneity issues by including other factors found in the literature, for example institutional quality and trade openness. In this way we prevent omitted variable bias. To further overcome endogeneity problems, next to OLS regressions of the two equations, the equations will be estimated by doing an instrumental variable approach. In the next section we will discuss whether the instrumental variable approach is viable and whether our instruments are valid.

As stated before, if you estimate the relationship between capital and credit supply, one must control for demand side factors. This is because the reduction in credit supply could simply be because the economy is in a recession and people borrow less. De Nicolò controls for demand by standardizing his measurement of credit supply by GDP. We also do this in our study.

4.2.2 Instrumental variable approach

In the previous section we have stated that endogeneity problems exist in estimating the effect of financial depth on economic growth. Therefore, we use an instrument. For an instrument to be valid, it must fulfil two requirements. Firstly, the instrument has to be relevant. This means that the instrument must be related to the explanatory variable. In our case, capital ratios must be related to our measurement of financial development, bank credit to GDP. Our literature review has given plenty of evidence that this is the case. Banks faced with higher capital requirements will have to raise equity thereby raising their costs leading to higher interest rates and lower demand for loans, or reduce their risk-weighted assets, reducing the credit supply. The second requirement is the instrument exogeneity requirement stating that the instrument should have no partial effect on our dependent variable only through the explanatory variable. This seems to be the case, although capital requirements also affect economic growth by reducing the frequency of crises and smaller losses in case of default. We will calculate these benefits by a different model. The next section will discuss the data and data sources.

4.2.3 Variables and data sources

This section will discuss the data sources and variables. Our data present several challenges. First of all, Basel III is scheduled to be implemented from 2013 till 2019 with the latest reforms scheduled from 2022 onwards. Therefore, if we use recent data, the Basel reforms will not be in full effect and some banks will already be complying with Basel III whereas others are still complying with Basel II. This will

be reflected in the data. Some banks will report Basel III capital ratios and some not. The definitions of for example Tier 1 capital differ considerably between Basel II and III. For example, tier 3 capital is not defined as capital anymore under Basel III. Therefore, we cannot perform empirical analysis with recent data. The problem for older data, is that these are no longer available for individual banks. The Bankscope database is no longer accessible. Its replacement Orbis Bankfocus does not provide data from earlier than 2010. Therefore, we are forced to use aggregate country level data to study the effects of higher capital requirements on economic growth. This has the advantage that the estimation is simpler but it is less accurate and countries use different methodologies when sampling the data. We will now give the data sources and definitions of our variables.

In the first stage, the dependent variable is bank credit to the private sector to GDP. This is a measurement of financial development used in many finance growth papers like Beck, Degryse and Kneer (2014). It is defined as 'the financial resources provided to the private sector by domestic money banks as a share of GDP'. It is used as a proxy for bank credit supply. The data are retrieved from the World Bank and are based on the IMF's international financial statistics. In the second stage, the dependent variable is real per-capita GDP growth. This is defined as $lnGDPpercapita_{it}/lnGDPpercapita_{it-1}$ and retrieved from the World Bank.

Capitalratio is defined as total regulatory capital divided by risk-weighted assets. The data are aggregate country-level data retrieved from the Financial Soundness Indicators Database of the IMF. As stated before, one should be careful in comparing these data between countries, as methodologies in collecting these data could differ. Next to this problem, another problem also exists. Not all countries adopted Basel III in 2013. Definitions of capital could therefore be different between years and countries. Some instruments could qualify as capital in one country whereas in another country they do not. Although, it could be argued that our sample suffers less from these differences in definitions because emerging economies often do not have these instruments and mostly rely on common equity and retained earnings. To prevent these problems, we use data from before 2013, the year in which Basel III was implemented.

To evaluate whether bank-dependent economies suffer more from higher capital requirements, we retrieve data on *Depth*. This is a measurement of financial markets depth i.e. the existence of alternative sources of finance. We expect a positive sign on this coefficient. If there are many alternative sources of finance, we expect a bigger decrease in bank credit. However, the effect on GDP growth should be smaller because borrowers can offset their borrowing at other institutions. The variable is measured as stock market total value traded to GDP and is retrieved from the World Bank's Global Financial Development Database.

Data on *ROA* are also retrieved of the World Bank's Global Financial Development Database and are based on data from Bankscope. The data are aggregated on a country-level based on the underlying bank data.

Inflation measured by the consumer price index, is the rate of inflation to control for the macroeconomic environment. Data are available of the IMF's International Financial Statistics.

To test our hypotheses of chapter 3, we also include variables on institutional quality and trade openness. These variables are not included in the analysis of De Nicolò. The data on institutional quality are retrieved from the World Bank. The Worldwide Governance Indicators provides indices on among other things: government effectiveness, corruption and rule of law. We will include these indicators in our regressions. To test whether indirect effects like a reduction in lending from advanced to emerging and less trade play a role in the effect of higher capital requirements on growth, we retrieve data on *Tradeopenness*. These data are retrieved from the World Development Indicators from the World Bank.

The variables *Creditsupply* and *GDPgrowth* appear to have an upward trend. For example, if we look at the time series data for Latvia on both of these variables, this can be seen in the appendix figure A2 and A3, the figures clearly show an upward trend and two non-stationary variables. A result of this non-stationarity is that the relationship between the two variables could be spurious. To avoid this spurious relationship, we take the difference of the variables. First differencing makes the variables stationary as can be seen in the appendix figure A4 and A5.

All our variables are for the period 1998 till 2010. This is also our estimation period. We use data till 2010 because later data on capital ratios could suffer from some problems we described in this section.

In table 1 the full definitions and measurements of the variables are provided.

Variable	Variable Descriptions
Dependent	
Creditsupply	Private credit by deposit money banks to GDP (%).The financial resources provided to the private sector by domestic money banks as a share of GDP. Domestic money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits. Source: World Bank, Global Financial Development. It is measured as the growth rate: $\ln(\text{creditsupply})_t - \ln(\text{creditsupply})_{t-1}$.
GDPgrowth	GDP per capita growth (annual %), Annual percentage growth rate of GDP per capita based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP per capita is gross domestic product divided by midyear population. Source: World Bank, World Development Indicators. It is measured as the growth rate: $\ln(\text{GDPPC})_t - \ln(\text{GDPPC})_{t-1}$.
Independent	
Capitalratio	Bank regulatory capital to risk-weighted assets (%). Source: International Monetary Fund, Financial Soundness Indicators.
Depth	Stock market total value traded to GDP (%). Source: World Bank, Global Financial Development.
ROA	Bank return on assets (%, after tax). Source: World Bank, Global Financial Development.
INFL	Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. Source: World Bank, World Development Indicators.
Institutionalquality	Measured as government effectiveness, corruption and rule of law.
GovEff	Government Effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Source: World Bank, Worldwide Governance Indicators.
Corrup	Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Source: World Bank, Worldwide Governance Indicators.
Rule	Rule of Law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Estimates gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5. Source: World Bank, Worldwide Governance Indicators.
Tradeopenness	The sum of exports and imports of goods and services measured as a share of gross domestic product. Source: World Bank, World Development Indicators.

Table 1 Description variables cost method

4.3 Benefits method

We have shown that the benefits from higher capital requirements are mainly the reduction in the frequency and severity of crises. To estimate the benefits of increased capital requirements, we use the same method used in Barrel, Davis, Fic, Holland, Kirby and Liadze (2009) and Caggiano and Calice (2011). In this method, the benefits are calculated as the change in the probability of crises as a result of higher capital requirements times the associated output lost due to a crisis. First, we estimate the impact of capital requirements on the probability of a crisis using data from Gourinchas and Obstfeld (2012). Second, we will calculate the costs associated with a crisis using the data of Laeven and Valencia (2012).

4.3.1 Probability of crises

To estimate the effect of higher capital requirements on the probability of a crisis, we use a panel logit model. In this logit model, the dependant variable is a dummy variable taking the value 1 if a banking crisis occurred in a given country and year and 0 otherwise. To identify a systemic banking crisis, we use data from Gourinchas and Obstfeld (2012). They identify banking crises largely based on the definition of Laeven and Valencia (2010). Laeven and Valencia state that a banking crisis is systemic if two conditions are met: 'Significant signs of financial distress in the banking system' and 'significant banking policy intervention measures in response to significant losses in the banking system'. Policy interventions are significant if at least 3 of 6 measures are taken[2].

Gourinchas and Obstfeld collect data on systemic banking crises for the period 1973-2010 in 79 emerging and advanced countries. We will limit the data of Gourinchas and Obstfeld for our sample of emerging economies which we described in section 4.1. Following Caggiano and Calice (2011) and Barrell et al. (2009), we include several macroeconomic explanatory variables as well as the capital ratio. These macroeconomic variables are used in previous studies and are found to be good predictors of banking crises. The macroeconomic variables are: GDP growth, GDP per capita, real interest rate, inflation, private credit as a ratio of GDP, money supply (M2)/foreign exchange reserves, current account balance and the terms of trade. The definitions and data sources of these variables are shown in table 2. For the capital ratio, we use the same measurement as in our cost methodology: total regulatory capital over risk-weighted assets retrieved from the Financial Soundness Indicators of the IMF.

Caggiano and Calice and Barrell et al. use a general-to-specific approach. This means that you include all the variables in your first regression and then eliminate the insignificant variables. We follow this

[2] The measures are: 1) extensive liquidity support, 2) bank restructuring gross costs at least 3% of GDP, 3) significant bank nationalizations, 4) significant guarantees put in place, 5) significant asset purchases of at least 5% of GDP and 6) deposit freezes and/or bank holidays.

method but as we will see in our results section, this does not turn out to work if we include M2 (money supply) in our regression. This might indicate that M2 is collinear with another variable.

Unfortunately, the data on regulatory capital are only available from 1998 till 2014. This further limits our sample size. The capital variable makes us exclude multiple crisis episodes in the 1980's and 90's. In recent times, banking crises are quite scarce with an exception of 2008. However, emerging economies were not affected that much by the 2008 banking crises. In our sample of emerging economies we end up with only 10 episodes of banking crises. Three of these crises were in the first year of our estimation period. This makes it difficult to estimate what the causes of these crises were. Because of our small sample, we decided to include five extra countries namely Kazakhstan, Latvia, Slovakia, Slovenia and Uruguay[3]. In total we identify 15 systemic banking crises in the period 1998 till 2010.

Because we expect the effect of capital ratios on the probability of a crisis to be non-linear, we estimate a logit model using maximum likelihood estimation. Following Caggiano and Calice and Barrell et al. we estimate the model in a logistic form F. Therefore, the estimated coefficients are not marginal effects and we have to calculate the marginal effects separately. If the dependent banking crisis dummy is Y_{it}, our explanatory variables are X_{it} and our parameters to be estimated are β, we will have the following log-likelihood function:

$$\ln L = Y_{it} \ln(F(\beta X_{it})) + (1 - Y_{it}) \ln(1 - F(\beta X_{it}) \quad (3)$$

This model suffers from a so called post-crisis bias (Bussière and Fratzscher, 2006). This bias implies the behaviour of our independent variables right after the crisis. For example, as a result of a banking crisis, credit to GDP may fall. This reduction could affect other explanatory variables (Demirgüç-Kunt and Detragiache, 1998). The result is a bias. You want to compare the values of the explanatory variables right before the crisis with values during normal periods. If these values are low right after the crisis, we get a bias in our results. An example of Gourinchas and Obstfeld is public debt. Public debt tends to increase after a crisis. However, this does not mean that low levels of public debt make a crisis more likely. We try to deal with this bias by following Gourinchas and Obstfeld. They drop observations for four years after a crisis. A disadvantage of this is that we ignore data that could be valuable and we lose episodes of multiple crises (Demirgüç-Kunt and Detragiache, 1998). We already have a smaller sample compared with other crisis prediction studies. Therefore, we decide to drop only 2 periods after the crisis.

[3] The full list of crisis episodes: Argentina 2001, China 1998, Colombia 1998, Greece 2008, Hungary 2008, Kazakhstan 2008, Latvia 2008, Russia 1998 and 2008, Slovakia 1998, Slovenia 2008, Turkey 2000, Ukraine 1998 and 2008, Uruguay 2002.

Variable	Variable Descriptions
Dependent	
Crisis	Banking crisis dummy based on the definition of Laeven and Valencia (2012). Source: Gourinchas and Obstfeld (2012).
Independent	
Capitalratio	Bank regulatory capital to risk-weighted assets (%). Source: International Monetary Fund, Financial Soundness Indicators.
GDP	GDP growth (annual %). Source: World Bank, World Development Indicators.
GDPPC	GDP per capita (current US dollars). Source: World Bank, World Development Indicators.
RIR	Real interest rate (%), Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator. Source: International Monetary Fund, International Financial Statistics.
INFL	Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. Source: World Bank, World Development Indicators.
PRCGGDP	Domestic credit to private sector, Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. Source: World Bank, World Development Indicators.
M2	Broad money to total reserves ratio, Broad money is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper. Source: World Bank, World Development Indicators.
CA	Current account balance (BoP, current US$), Current account balance is the sum of net exports of goods and services, net primary income, and net secondary income. Source: World Bank, World Development Indicators.
TOT	Net barter terms of trade index (2000 = 100), Net barter terms of trade index is calculated as the percentage ratio of the export unit value indexes to the import unit value indexes, measured relative to the base year 2000. Source: World Bank, World Development Indicators.

Table 2 Description variables benefits method

4.3.2 Output lost during crisis

As stated in section 2.4.2.1, emerging economies experience smaller output losses as a result of a banking crisis. This could be due to the fact that firms rely less on external finance and thus a crisis does not harm these firms finance. To estimate the output losses for our sample of emerging economies, we use the data from Laeven and Valencia (2012). They calculate output losses for 147 banking crises in emerging and advanced countries. The output losses are computed as the cumulative sum of the difference between actual and trend real GDP over the crisis period which is set at four years. We have provided a graph which shows what Laeven and Valencia consider output losses as a

result of a crisis. In graph 1 we show an imaginative crisis in a country. The cumulative output loss is the difference between the actual GDP (green) and the pre-crisis trend (blue) for four periods.

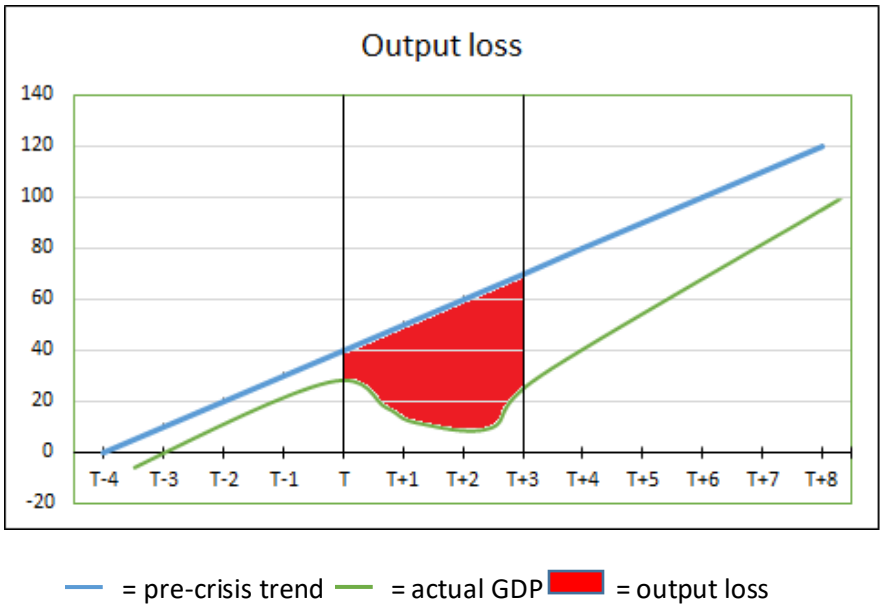

Figure 1 Output loss

Laeven and Valencia assume crises to have only temporary effects on output. They find an average output loss in percent of GDP of 26.0% in emerging economies compared with 32.9% in advanced economies. If one considers a banking crisis to have more permanent effects like Boyd, Kwak and Bruce (2005), the resulting output losses are much larger. There is reason to believe that banking crises have a permanent effect on output. The BCBS (2010) names for example, increased risk aversion or indirect effects due to policies of the government in response to a crisis like higher taxation as reasons for permanent output losses. More recently, the effects of quantitative easing could have a permanent effect on the economy. However, it is difficult to determine and calculate the exact costs of these permanent effects as this is different for every country. Therefore, we use the data of Laeven and Valencia which set a crisis period of four years. Furthermore, we believe that the permanent output losses are smaller for emerging economies as these economies recover quickly to their pre-crisis growth level.

Following Caggiano and Calice, we calculate the median output loss for our sample of countries which experienced a crisis using Laeven and Valencia's methodology. The 15 crises under consideration are shown in footnote 3. For our sample of crises, we find a median output loss of 32% of GDP. This is similar to the median output loss found by Caggiano and Calice for African countries which is 33% of GDP. The estimate is slightly higher than the 26% output loss estimated by Laeven and Valencia for all emerging economies. This is mainly due to the fact that our sample is for a shorter and more recent

time period which includes the 2008 crisis. The crisis of 2008 was large in terms of output losses. For example in Latvia, the output loss was 106% in terms of GDP.

4.3.3 Total benefits

Now that we have calculated the output loss resulting of a crisis and the reduction of the probability of a crisis, we can calculate the total benefits of increased capital requirements. We do this by multiplying or output loss estimate times the change in probability of crises due to higher capital requirements.

$$Total\ Benefit = \Delta output\ loss * \Delta probabilty\ of\ crises$$

5. Empirical results

Our results section will consist out of the results for our costs and benefits. In the cost section we estimated the effect of capital ratios on financial development and economic growth. In the benefit section we provide the results of our estimation of capital ratios on the probability of crises. In the last section we will make a cost-benefit analysis to determine whether higher capital requirements are beneficial for emerging economies.

5.1 Costs results

This section estimates the costs associated with higher capital requirements. We estimate the costs by regressing credit supply on capital ratios, and then regress economic growth on credit supply. An instrumental variable approach is used. We will first provide and discuss some summary statistics. These summary statistics are shown in table 3.

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent					
GDPgrowth	408	0,010	0,018	-0,115	0,060
Creditsupply	402	0,048	0,136	-0,478	0,561
Independent					
Capitalratio	401	14,898	4,286	2,500	41,800
Depth	422	20,013	28,130	0	160,450
ROA	433	1,137	1,624	-9,880	7,610
INFL	439	9,148	11,973	-24,218	143,693
Rule	374	-0,005	0,694	-1,654	1,356
Tradeopenness	439	74,317	39,282	16,439	220,407

Table 3 Summary statistics costs

The average capital ratio is 14,90%. Compared with the average capital ratio in De Nicolò (2018), this is slightly lower. De Nicolò also includes advanced economies in his analysis and this might explain why he finds a higher average capital ratio. Although, this is not what we would expect, because according to the literature, banks in emerging economies have higher capital ratios.

5.1.1 OLS regressions

Before turning to our instrumental variable approach, we first perform simple OLS regressions. First we regress our measurement of credit supply on capital ratios and subsequently we regress economic growth on credit supply. The models are the same in section 4.1.1 but we do not use the IV estimation method. In table 4, we show the results of the regression of credit supply on capital ratios.

Independent Variables	(1)	(2)	(3)	(4)	(5)
Capitalratio	-0,010***	-0,011***	-0,014***	-0,014***	-0,007*
	0,002	0,002	0,002	0,002	0,005
Depth	0,001***	0,001***	-0,003**	0,001***	0,001***
	0,0003	0,0003	0,001	0,000	0,000
lagged Creditsupply	-0,114***	-0,093***	-0,104***	-0,106***	-0,102***
	0,015	0,015	0,015	0,019	0,016
ROA		0,019***	0,019***	0,026***	0,017***
		0,005	0,004	0,007	0,005
Capitalratio*Depth			0,0003***		
			0,0001		
Rule				0,115**	
				0,056	
Tradeopenness					0,001
					0,001
Capitalratio*Rule				-0,005	
				0,004	
Capitalratio*Tradeopenness					0,000
					0,000
_cons	0,557***	0,478***	0,566***	0,557***	0,420***
	0,068	0,069	0,073	0,085	0,085
Observations	365	362	362	307	362
Number of groups (countries)	34	34	34	34	34
R2 (within)	0,200	0,214	0,244	0,258	0,208

*Table 4 OLS regression costs 1. The dependent variable is: Creditsupply. The first row is the coefficient and the second row is the standard error. The sample is from 1998-2010 and consists out of 34 countries. *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level. See table 1 for definitions.*

In column (1), we have the simplest OLS model including our measurement of depth. All the coefficients are significant. The coefficient on *Capitalratio* is positive meaning that higher capital ratios reduce the growth rate of private credit provided by banks. Our measurement of *Depth* which measures the availability of outside financing possibilities, is positive. This suggests that bank lending and non-bank lending is complementary. In column (2), we include *ROA* which has a positive sign: higher return on assets increases private credit provided by banks.

In the remaining columns, we test the hypotheses laid out in chapter 3 relevant to emerging economies. We include interaction terms between *Capital* and *Depth, Rule* and *Tradeopenness.* In

column (3) we test whether in countries in which there are more other opportunities to receive finance, the negative effect of capital is smaller. We show that the negative coefficient on *Capital* becomes larger. However, the coefficient on the interaction term *Capitalratio*Depth* is positive and significant. This means that if there are many alternative sources of finance, the negative effect of capital on private credit provided by banks will eventually be mitigated. This supports the findings of Chiuri, Ferri and Majnoni (2012) and our hypothesis in section 3.3.

The other interaction terms *Capitalratio*Rule* and *Capitalratio*Tradeopenness* are insignificant. This means we can reject the hypotheses that institutional quality and trade openness are a factor in how emerging economies are hit by capital requirements. This could indicate that the spill-over effects described in section 2.3.2.3 are rather limited. The other measurements of institutional quality, *GovEff* and *Corrup* are insignificant and thus we do not report them.

Including fixed effects for country and time, does not change the significance and coefficients of table 4. Therefore, we decided not to report them.

In table 5, we show the results from our OLS regression of *GDPgrowth* on *Creditsupply*.

Independent Variables	(1)	(2)	(3)	(4)	(5)
Creditsupply	0,030	0,076	0,030	0,074	-0,142**
	0,055	0,060	0,055	0,060	0,058
INFL	0,001	0,004***	0,001	0,004***	-0,003***
	0,001	0,001	0,001	0,001	0,001
lagged GDPPC	-0,008	-0,020**	-0,013*	-0,022**	-0,187***
	0,007	0,009	0,007	0,009	0,028
Rule		0,020		0,014	
		0,015		0,016	
Tradeopenness			0,000**	0,000	
			0,000	0,000	
_cons	0,148***	0,234***	0,157***	0,228***	1,502***
	0,056	0,072	0,056	0,073	0,228
Observations	402	336	400	335	402
R2 (overall)	0,007	0,054	0,017	0,059	0,456

*Table 5 OLS regression costs 2. The dependent variable is GDPgrowth. The first row is the coefficient and the second row is the standard error. The sample is from 1998-2010 and consists out of 34 countries. *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level.*

In contrast to the literature, for example, Beck, Degryse and Kneer (2014), we do not find a significant effect of private credit provided by banks and economic growth. The coefficients in column (1) of table 5 are insignificant. A reason for this could be because we did not adequately control for endogeneity specifically for reverse causality.

In column (2), (3) and (4), we include *Rule* and *Tradeopenness*. We show that *Tradeopenness* has a significant effect on economic growth but the coefficient is small. *Rule* does not seem to influence economic growth.

In order to account for time effects and time invariant country effects, we include year dummies and fixed effects in our regression. This can be seen in column (5). The results are somewhat surprising. The coefficient on *Creditsupply* is negative and significant indicating that higher private credit provided by banks leads to lower GDP growth. This is counterintuitive, as credit leads to investment and ultimately to economic growth. One explanation for the negative coefficient could be that credit in the economy is so high that it leads to a financial crisis and eventually reduces economic growth. This has happened in the economic crisis of 2008. In this case, higher capital requirements are beneficial for the economy as it reduces credit. Another explanation of our counterintuitive sign is that our model is specified or estimated incorrectly. In section 5.1.2, we introduce an instrumental variable approach to account for the endogeneity problems addressed earlier. We will see whether this method does give us our expected results.

A problem of our insignificant results is that we cannot estimate the effects of higher capital requirements on economic growth. We only showed that capital ratios reduce the private credit provided by banks but this does not seem to influence economic growth. That is why we perform an instrumental variable approach, to see whether we do find significant results. Our results in our first OLS regression of *Creditsupply* on *Capitalratio* are valuable in that allow us to test the hypotheses of chapter 3. We have showed that alternative sources of finance reduce the negative effects of higher capital requirements but the interaction terms on *Rule* and *Tradeopenness* are insignificant.

5.1.2 IV regressions

In order to estimate an instrumental variable model, we need to have valid instruments. We have touched on this subject briefly in section 4.1.2 and concluded that *Capitalratio* could be a valid instrument. Our regression results of section 5.1.1 further provide evidence of this being the case. The results of table 4 show that *Capitalratio* is relevant for *Creditsupply.* Testing whether the instrument is exogenous is more difficult and we will come back to this in the discussion chapter 6. To get an idea of whether the instrument is exogenous, we regressed our dependent variable on our instrument in an OLS regression. This regression can be seen in the appendix table A6. The results show that *Capitalratio* could be an exogenous instrument.

In table 6 we provide the results of our instrumental variable estimation. Although are coefficient on *Creditsupply* is now positive, it is also insignificant. Contrary to De Nicolò (2018), we do not find any significant results in the second stage of our instrumental variable regression in column (1). This could

be because of several reasons. The first reason is that *Creditsupply* simply has no effect on economic growth. This is not in line with the literature on finance and growth like Beck, Degryse and Kneer who do find significant effects and therefore not likely. The second reason is that we use invalid instrumental variables. This means that the instruments are exogenous or not relevant. We will discuss this in the discussion. However, we follow the same variables as De Nicolò and he does find significant results.

In column (1) of table 6, we included the logarithm of the lag of *Creditsupply.* In column (2) we also include the lag but not the logarithmic form of *Creditsupply*. The results suggest that a 1% increase in *Creditsupply* increase per capita GDP growth by 0.44%. In the third column, we exclude the lag of *Creditsupply* completely. The results are significant and positive. In column (4), we include our interaction term but it is insignificant.

Including time effects does not give significant results in our second stage. The coefficient on *Creditsupply* turns negative again. We do not report the regression including time effects.

	L.lnCreditsupply		L.Creditsupply		no L.Credisupply		L.Creditsupply	
Variables	CS	Y	CS	Y	CS	Y	CS	Y
First stage								
Capitalratio	-0,012***		-0,009***		-0,008		-0,008***	
	0,002		0,002		0,002		0,002	
Depth	0,000		0,000		0,001		0,001	
	0,000		0,000		0,000		0,001	
lagged Creditsupply	-0,222***		-0,004***				-0,004***	
	0,017		0,000				0,000	
ROA	0,009**		0,013***		0,025		0,012***	
	0,004		0,004		0,004		0,004	
Capitalratio*Depth							0,000	
							0,000	
Second Stage								
Creditsupply		0,170		0,438***		0,842***		0,426***
		0,113		0,143		0,251		0,142
INFL		0,002		0,003**		0,005***		0,003**
		0,001		0,001		0,002		0,001
lagged GDP		-0,015		-0,027		-0,045*		-0,026
		0,019		0,020		0,025		0,020
Constant		0,193		0,272		0,390**		0,268
		0,157		0,167		0,198		0,167
Observations	362	362	362	362	362	362	362	362
R2	0,512	.	0,409	.	0,264	.	0,411	.

*Table 6 IV regression costs. The dependent variable in the first stage is Creditsupply and in the second stage GDPgrowth. The definitions of the variables is given in table 1. Equations 1 and 2 are estimated using 2SLS with fixed effects. . The sample is from 1998-2010 and consists out of 34 countries. *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level. See table 1 for definitions. Note that all the explanatory variables in the second stage are automatically also included in the first stage but we do not report them.*

Overall, our results suggest that capital requirements do affect credit supply in the form of private credit provided by banks. Credit supply does not seem to influence economic growth in emerging economies. We can thus conclude that capital requirements do not affect economic growth through a reduction in credit supply.

5.2 Benefit results

In this section we will look at the effects of higher capital ratios on the probability of crises. Then we will relate the reduction in probability with the calculated output losses in section 4.3.2 to gain an estimate of the total benefits of increased capital requirements.

5.2.1 Effect on probability of crisis

We start by providing some summary statistics. The summary statistics can be seen in table 7. The summary statistics show that the frequency of crises in our sample of countries is 8.88%[4]. This is higher than the estimate in Caggiano and Calice (2011) for African countries. This is mainly due to the fact that they calculate the frequency for a sample consisting also out of countries which did not experience a crisis. The average capital ratio is 14,9%. This is well above the minimum total capital requirement required by Basel III. This reflects the fact that emerging economies are generally already well-capitalized.

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent					
Crisis	169	0,059	0,237	0	1
Independent					
Capitalratio	153	14,932	4,136	2,500	30,900
GDP	169	4,158	5,203	-14,800	14,231
GDPPC	169	7904,317	6616,337	635,709	31997,28
RIR	118	7,120	13,559	-18,952	93,915
INFL	169	10,771	14,869	-9,680	143,693
PRCGGDP	135	44,440	31,592	0,186	126,300
M2	110	3,173	1,787	0,965	10,498
CA	168	-1,697	5,912	-21,073	17,474
TOT	153	106,587	23,393	76,907	216,879

Table 7 Summary statistics benefits

We will now turn to our regression analysis. Following Caggiano and Calice and Barrell at al., we perform a general to specific approach. This approach starts by including all the specified variables and then gradually exclude insignificant variables. However, if we include all our variables discussed in section 4.2.1, standard errors are not shown. This suggests that there is hidden collinearity in one or more of our variables. To check for collinearity, we check the correlation between our independent

[4] This is calculated as follows: The number of crises divided by the product of the number of countries and number of years. 15/(13*13)=0.088.

variables. This correlation matrix can be seen in the appendix table A7. From the correlation matrix, it can be seen that none of the variables seem significantly correlated. However, after experimenting with what variables to include, the broad money supply (M2) over reserves seems to be the collinear variable. Therefore, we decide to exclude this variable. As stated earlier, we drop the post-crisis observations for 2 years to prevent the post-crisis bias.

First we estimate a model with all the independent variables described in section 4.2.1. The results are shown in table 8. As can be seen in column 1, all the variables are insignificant. Following the general-to-specific method employed in the literature, we exclude the least significant variable which is the inflation rate. Subsequently, we eliminate GDP growth, GDP per capital, domestic credit to private credit and the real interest rate. Our ultimate model consists out of capital, the current account and terms of trade. These variables are also found to be significant in the study of Caggiano and Calice. Although they also find GDP growth, credit growth and the real interest rate to be significant. Our final equation looks like this:

$$\log\left[\frac{p(crisis)}{1-p(crisis)}\right] = -0{,}392\ capital - 0{,}126\ CA + 0{,}038\ TO$$

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
capital	-0,551	-0,523	-0,507	-0,524	-0,277	-0,392**
	0,403	0,363	0,364	0,359	0,187	0,156
GDP	-0,059	-0,074				
	0,220	0,205				
GDPPC	0,000	0,000	0,000			
	0,000	0,000	0,000			
RIR	-0,117	-0,145	-0,133	-0,128	-0,087	
	0,171	0,120	0,112	0,103	0,087	
INFL	0,031					
	0,158					
PRCGGDP	-0,018	-0,016	-0,016	-0,018		
	0,030	0,028	0,028	0,028		
CA	-0,197	-0,197	-0,218	-0,243	-0,088	-0,126**
	0,193	0,190	0,184	0,173	0,065	0,059
TOT	0,047	0,046	0,048	0,050	0,035	0,038**
	0,038	0,037	0,037	0,037	0,026	0,015
_cons	-0,125	0,040	-0,847	-0,403	-3,029	-2,047
	4,854	4,772	4,138	3,926	2,511	1,762
Observations	61	61	61	61	79	115
Pseudo R2	0,218	0,217	0,213	0,206	0,193	0,227

*Table 8 Regression results. Dependent variable: Crisis dummy taking the value 1 if a crisis happened. The quantities in below the estimates are the standard errors. The sample is from 1998-2010 and consists out of 13 countries. *** Significant at the 1 percent level, ** Significant at the 5 percent level, * Significant at the 10 percent level. See table 2 for definitions.*

In order to be able to estimate the benefits of a reduction in the probability of a crisis, we need to calculate the marginal effects of capital on the probability. The marginal effects are shown in table A8 in the appendix. The marginal effects show that a 1 percent increase in the total regulatory capital decreases the probability of a crisis happening with 1 percent. The marginal effects are calculated at the average capital ratio, current account and terms of trade. If we do not drop post-crisis observations, our results change and the effect of capital on the probability is smaller. Our results suggest that countries in which the banking system is better capitalized, experience crises less often. Our study does not empirically provides reasons why this could be the case. As stated in the literature review, this could be because banks take on less risk, screen better or are better able to withstand shocks on assets. The fact that our variables are only significant in our last estimation is mainly due to our sample size being smaller compared with samples in other crisis prediction studies.

5.2.2 Total benefits

Our results have shown that an increase of capital ratios of 1 percent, reduces the probability of a crisis by 1 percent in our sample of countries. We have also stated that the median output loss of a crisis is 32%. These two facts allow us to calculate the total benefits of increased capital requirements. We do this by using our formula:

$$Total\ Benefit = \Delta output\ loss * \Delta probabilty\ of\ crises$$

$$0.33 * 0.01 = 0.0033$$

Our total benefits equal 0,33% of GDP for an increase in capital ratios of 1 percent.

5.3 Cost-Benefit analysis

Now we have calculated the associated costs and benefits of higher capital requirements, the next step would be to perform a cost-benefit analysis to give an idea whether higher capital requirements are beneficial for emerging economies. However, we do not find a significant effect on economic growth through a reduction in the credit supply. Therefore, the analysis in this section will rather be qualitative than quantitative.

The results of table 8 indicate that, even though crises in emerging economies are less harmful, increasing regulatory capital reduces the probability of a banking crisis and therefore benefits the economy. The benefits are relatively modest but this may also be due to the fact that emerging economies are already well-capitalized as marginal effects are decreasing as capital increases.

Our analysis on the costs of capital requirements did not lead to significant results on economic growth. This does not mean that we can increase capital requirements unlimitedly, we have showed that capital requirements do influence the credit supply in the form of private credit provided by banks. We have provided evidence that this negative effect is more pronounced in countries in which

alternative sources of finance outside the banking sector are limited. The literature provides convincing evidence that credit supply influences economic growth. Our results should therefore be taken with care. It is probable that if credit supply is decreased by a large amount, that economic growth in emerging economies will slow down. This is further amplified by the already mentioned spill-over effects from advanced economies. We have tried to include these effect by including *Tradeopenness,* but it did not turn out to be significant. This measurement is also limited but we will go further into this in the next section. The fact that we did not attain significant results on economic growth could also be of our problems with our model. This will also be discussed in the next chapter.

It is difficult to determine the real costs or benefits of increased capital requirements. Our study does not give a conclusive answer to this but it does indicate that the costs and benefits of higher capital requirements are likely to be low.

6. Discussion

This chapter will provide a discussion on this thesis. The weaknesses of our study will be discussed and how it fits in the literature. We will highlight what the strengths of our study are and what it adds to the already existing literature on the consequences of Basel III. Lastly, we will give an indication on what future research on the topic should focus on.

Our empirical study consists out of a benefits and a costs part. We will start by discussing the benefits part. Our methodology follows the existing literature in that it relates capital ratios to the probability of crises. Our study adds to this by extending this research to emerging economies. More specifically, we studied 13 emerging economies and found that higher capital requirements decrease the probability of a crisis. One strength of our analysis is that we accounted for the post-crisis bias described in section 4.3.1. Other studies looking at the benefits of capital requirements do not do this (for example Caggiano and Calice, 2011) and we showed that this changes our results. A consequence of this is that we reduce our number of observations. Our number of observations is already limited due to the availability of data on capital and because of the limited crisis episodes in emerging economies. Our results should therefore be taken with care. This is further supported by the fact that we do not find the same significant variables as in the literature.

In calculating the output losses of crises, this study assumes that crises take 4 years. This is quite the assumption as it is argued that the costs of crises are much more permanent. This can be considered as a weakness of this study. However, it is difficult to calculate permanent output losses and there is much uncertainty about this. Furthermore, many of our crisis episodes are in the year 2008. Calculating permanent output losses would not be possible for these crises as these output losses are likely to still be felt today.

Another weakness of our benefits analysis is that we only looked at the effect of capital on the probability of crises. Our study does not analyse how capital influences the severity of crises. As noted by the BCBS (2010), higher capital requirements should insulate banks from the strains faced by lower capitalized banks. These banks can keep providing lending and liquidity thereby lowering the severity of a banking crisis.

We have shown that capital decreases the probability of a banking crisis. What we did not show in this paper is what the sources of this reduction are. Is it because banks survive more often, less tax money is needed to bail-out banks or is it because banks took less risks? If it is the case that capital requirements increase bank risk-taking in emerging economies, capital requirements may not be a long-term solution. Therefore, future research could look at how the factors discussed in this paper, for example institutional quality, or bank structure influences the relationship between capital requirements and bank risk-taking. Two nice examples of these kind of studies are Klomp and De Haan (2014) and Klomp and De Haan (2015). They however do not analyse how this risk-taking affects economic growth.

Our cost analysis is somewhat alternative to the literature. We follow the method of De Nicolò (2018), who uses an instrumental variable approach. Although it provides a nice framework to study the effects of capital requirements on credit supply and economic growth, and allows us to study how relevant factors influence these relationships, we do have some doubts about the validity of this approach.

First of all, our panel data are on a country level rather than at the bank level. This is done because of two reasons. First, data availability prevents us from using data on capital ratios for individual banks. Data from BankScope are no longer available and its replacement, Orbis Bankfocus, has limited data. Second, having panel data at the country level allows us to easily introduce country-level macroeconomic variables. However, using bank-level capital ratios would be more appropriate. Banks individually adjust to higher capital requirements by increasing equity, decreasing assets or other ways. Furthermore, the data on regulatory capital are gathered by national institutions and thus suffer from differences in methodology. The IMF therefore warns in comparing these data across countries and therefore our costs analysis should be taken with care. Using bank-level data would have the problem of some banks already having implemented Basel III whereas other banks are still transitioning to Basel III as Basel III is still being implemented.

Another weakness of our study is that it suffers from the Lucas Critique. The Lucas Critique states that using historical data to analyse the effects of policy changes is not viable because optimal decisions of economic agents change in respond to policy. In order to find causal relationships between capital and

credit supply or economic growth one should use DSGE models. In DSGE models, agents' expectations are explicitly modelled. These models are however difficult to estimate. Another way to find causal relationships is to use natural experiments. However, these natural experiments do not analyse the effect on economic growth as mentioned earlier and are hard to identify.

Another aspect of our cost methodology that we are worried about is whether we have controlled sufficiently for demand for loans. As stated in section 2.4.3, a reduction in credit could also be due to a reduction in credit demand. This reduction in credit demand could be because of higher loan rates in response to higher capital requirements or because of other reasons having nothing to do with capital requirements. Our study focuses on credit supply and thus has to control for demand. Future research should also take demand factors into account.

The last thing about our methodology that we are concerned about is the viability of our instrumental variables. We touched briefly upon this in section 4.2.2. We expected to find more or less the same results as De Nicolò (2018). However, our results were not significant. Although it would not explain why De Nicolò does find significant results, one reason why we do not get significant results is because our instrumental variables are not valid. Our main concern is that our instrumental variables are correlated with omitted variables influencing economic growth. As stated before, *Capitalratio* seems to be exogenous but for our other variables in the first stage *Depth, Rule* and *Tradeopenness,* this does not seem to be the case.

One goal of our study was to analyse how different macroeconomic variables influence the relationship between capital requirements and economic growth. We did this by including these variables in our methodology. For example, by including trade-openness, we could see whether being more open could be beneficial, because of the availability to raise capital abroad, or negative, because of indirect effects. However, we did not provide magnitudes of how large the indirect effects were. Future research should focus on how regulation in advanced countries affects emerging economies. Another area of future research plays a role in this too. Higher capital requirements could lead to a shift from 'risky' lending to safer lending. Again, this could mean that advanced economies lend less to emerging economies or that the riskiest borrowers cannot get finance anymore in an emerging country. An alternative is that higher capital requirements lead to higher lending rates, which attracts more risky borrowers because of moral hazard. This thesis does not look at these effects and future research should take this into account. One way of doing this would be to look at a proxy of SME (small and medium enterprises) importance. In our model, we could have included this proxy in our model and see whether countries in which SME's are more important, suffer more from capital requirements. This would indicate that adverse selection is a problem. However, we were not able to gather proper

data on this kind of proxy. This would however work better in studies with panel data at the bank-level. Then, one could see whether banks reduce lending more to riskier borrowers. The same applies for testing whether bank ownership (government or private owned) has an effect on capital requirements and credit supply and economic growth. Future research could focus on whether public banks have more or less difficulty in raising capital and what the consequences are for emerging countries in which public banks are still prominent.

7. Conclusion and policy implications

This study tried to answer the question: what are the effects of higher capital requirements on economic growth for emerging economies? Our study consisted out of an analysis on both the costs and benefits of higher capital requirements. We found that capital requirements decrease the probability of crises and thereby have a positive effect on economic growth. We also found that capital requirements reduce the credit supply in an economy. However, this does not seem to influence economic growth. The exact level of capital depends is likely different for each country. We also tried to find what factors influence the relationship between capital requirements and economic growth. Our analysis provides evidence that if a country has more channels of finance outside the banking system, that increased capital has a less negative effect on the credit supply. This indicates that countries with more developed financial systems are better able to shield the negative effects of higher capital requirements. We also studied whether institutional quality influences the relationship but we did not find significant effects. Lastly, we found no significant effects of trade openness on the relationship between capital and economic growth. It seems that more open countries do not benefit in that they are better able to raise capital or are not damaged by indirect effects as a result of increased regulation in advanced economies.

Our study should however be taken with care. As mentioned in chapter 6, our methodology suffers from several problems regarding data, instrumental variables and estimation methods. Furthermore, not all aspects in the relationship between capital requirements and economic growth are taken into account. For example, adverse selection could make higher capital requirements much worse in emerging economies.

One policy implication of our study could be that for countries with relatively shallow financial systems, the Basel III accord should be implemented more carefully. One option could be to allow more time for emerging economies to implement the Basel III accord.

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Appendix

Argentina
Bangladesh
Brazil
Bulgaria
Chile
China
Colombia
Czech Republic
Egypt
Greece
Hungary
India
Indonesia
Kazakhstan
Latvia
Malaysia
Mexico
Pakistan
Peru
Philippines
Poland
Qatar
Romania
Russia
Slovakia
Slovenia
South Africa
South Korea
Thailand
Turkey
Ukraine
United Arab Emirates
Uruguay
Venezuela

Table A1 List of countries

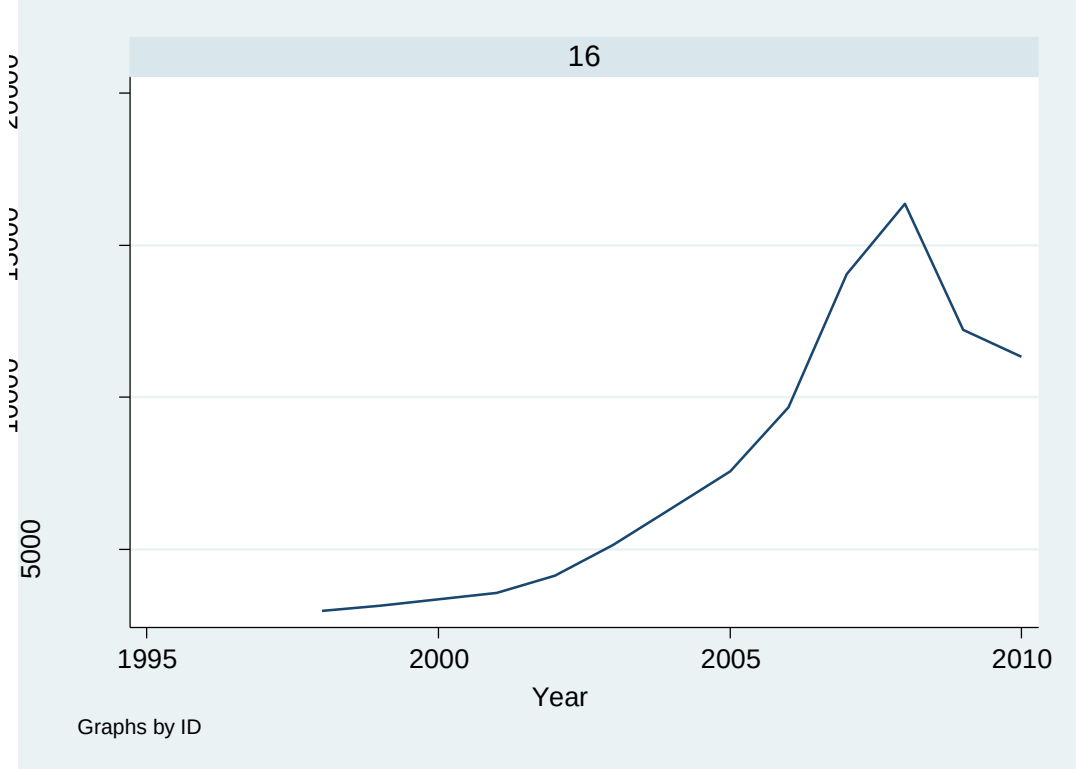

Figure A2 GDP Per Capita Latvia

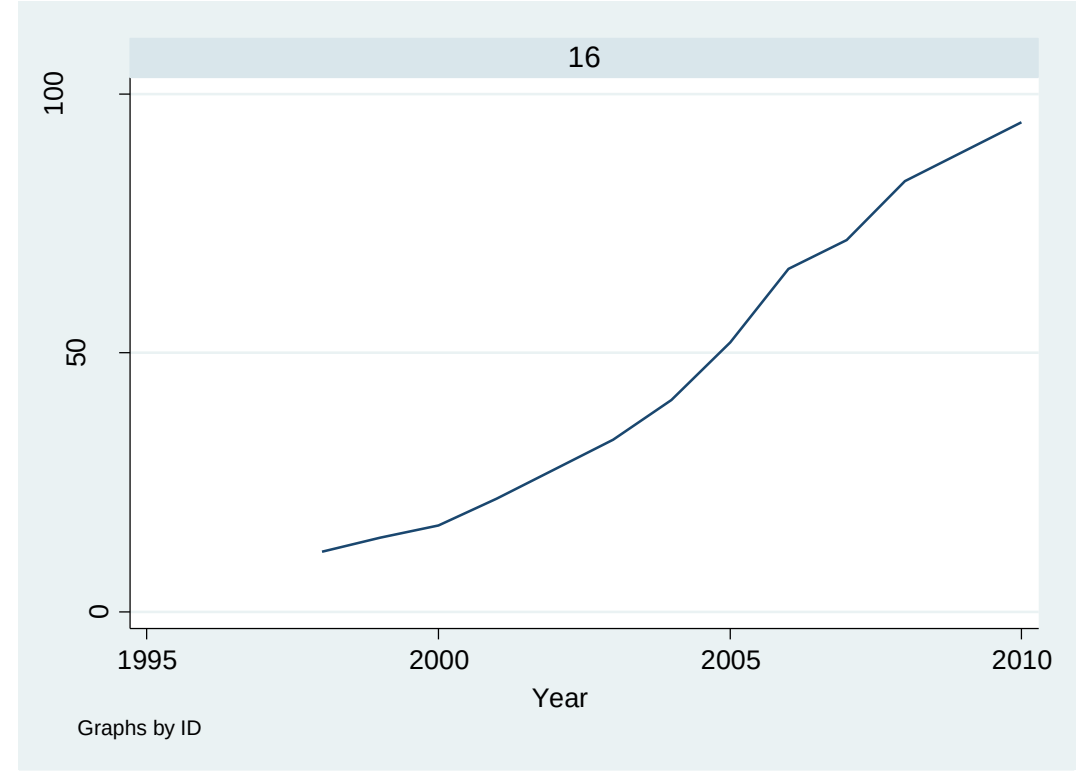

Figure A3 Credit supply Latvia

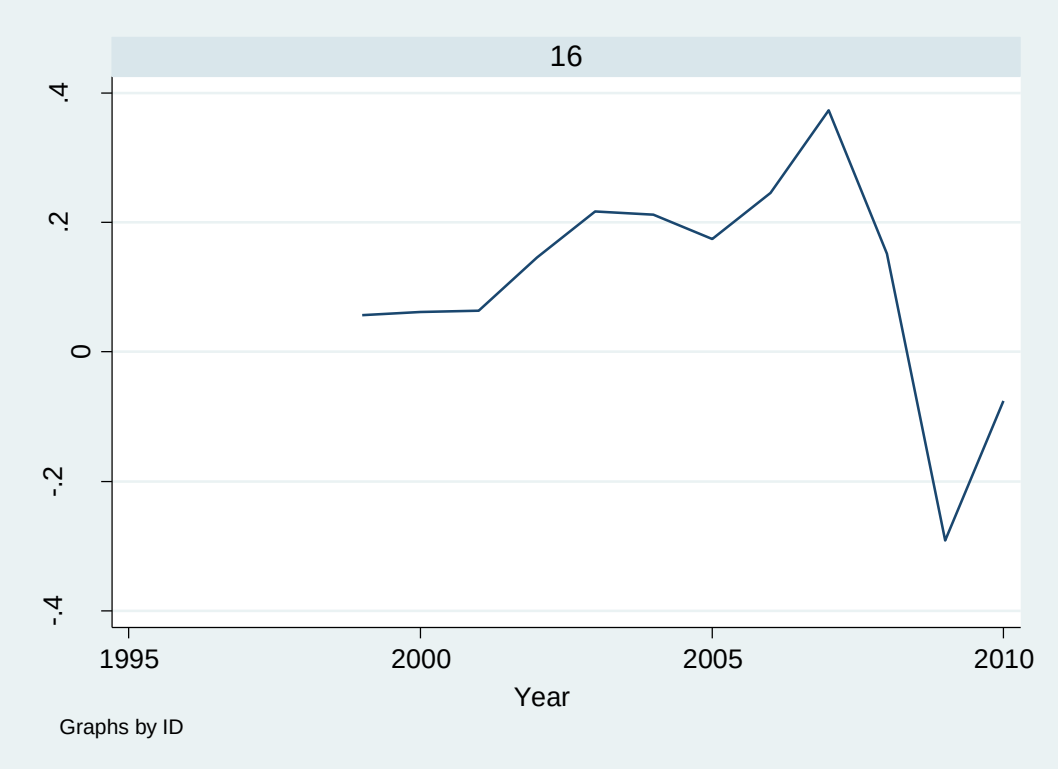

Figure A4 GDP per capita differenced Latvia

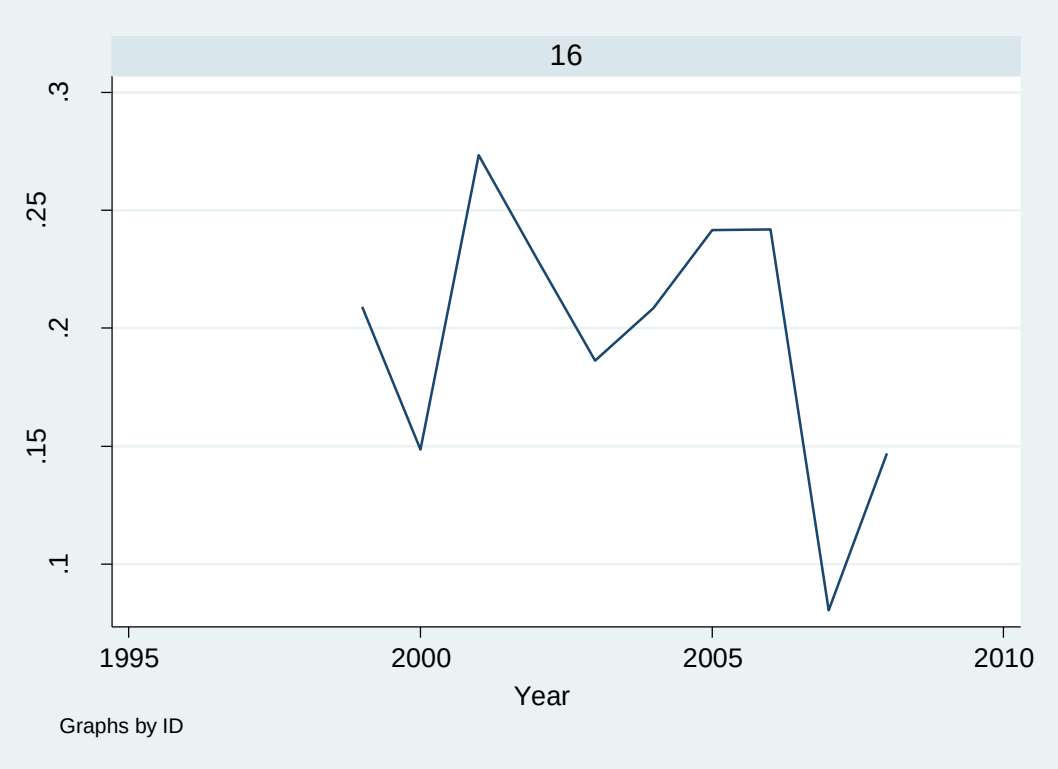

Figure A5 Credit supply differenced Latvia

```
. xtreg lnGDPgrowth INFL L.lnGDPPC capital

Random-effects GLS regression                   Number of obs     =        376
Group variable: ID                              Number of groups  =         34

R-sq:                                           Obs per group:
     within  = 0.0090                                         min =          3
     between = 0.2038                                         avg =       11.1
     overall = 0.0215                                         max =         12

                                                Wald chi2(3)      =       8.19
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0423
```

lnGDPgrowth	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
INFL	.0017406	.0007781	2.24	0.025	.0002155	.0032657
lnGDPPC L1.	-.0080245	.0064965	-1.24	0.217	-.0207574	.0047083
capital	.0000925	.0017283	0.05	0.957	-.003295	.0034799
_cons	.1408209	.0606111	2.32	0.020	.0220254	.2596164
sigma_u	0					
sigma_e	.13638635					
rho	0	(fraction of variance due to u_i)				

Table A6 Exogenous test instrument

	capital	GDP	GDPPC	RIR	INFL	PRCGGDP	M2	CA	TOT
capital	1.0000								
GDP	-0.2363	1.0000							
GDPPC	0.2226	-0.2342	1.0000						
RIR	-0.1035	-0.3980	-0.0475	1.0000					
INFL	0.1164	0.0729	-0.0044	-0.5365	1.0000				
PRCGGDP	-0.6693	0.3763	-0.2354	-0.0779	-0.1793	1.0000			
M2	-0.4896	-0.0537	-0.2569	0.5027	-0.5862	0.5745	1.0000		
CA	-0.0659	0.5166	-0.3111	-0.3479	0.2198	0.1712	-0.3372	1.0000	
TOT	0.2151	-0.1125	0.4142	-0.2122	0.3252	-0.2418	-0.3127	0.0486	1.0000

Table A7 Correlation matrix benefits

```
. margins, dydx (capital CA TOT) atmeans

Conditional marginal effects                    Number of obs     =        115
Model VCE    : OIM

Expression   : Pr(bankvar1), predict()
dy/dx w.r.t. : capital CA TOT
at           : capital         =    14.87678 (mean)
               CA              =   -2.444735 (mean)
               TOT             =    107.0964 (mean)
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
capital	-.0105749	.0045092	-2.35	0.019	-.0194128	-.001737
CA	-.0033999	.002077	-1.64	0.102	-.0074708	.0006709
TOT	.0010112	.0005227	1.93	0.053	-.0000133	.0020357

Table A8 Marginal effects