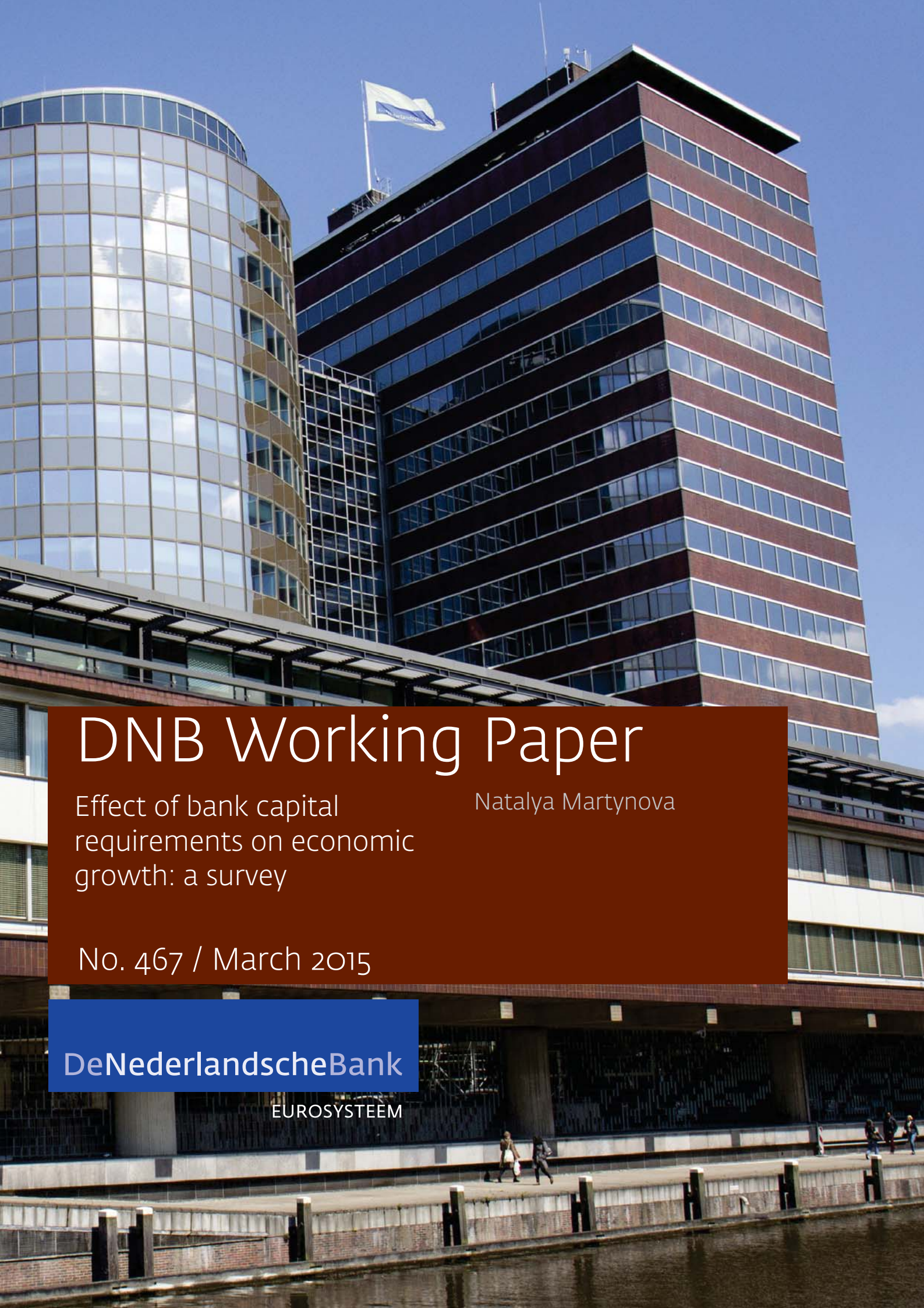

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* Views expressed are those of the author and do not necessarily reflect official positions of De Nederlandsche Bank.

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Effect of bank capital requirements on economic growth: a survey*

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Abstract

This paper reviews studies exploring how higher bank capital requirements affect economic growth. There is little evidence of a direct effect; research focuses on the indirect effects of capital requirements on credit supply, bank asset risk, and cost of bank capital, which in turn can affect economic growth. Banks facing higher capital requirements can reduce credit supply as well as decrease credit demand by raising lending rates which may slow down economic growth. However, having better-capitalized banks enhances financial stability by reducing bank risk-taking incentives and increasing banks' buffers against losses.

Keywords: bank capital requirement, credit growth, financial stability, economic growth, cost of equity.
JEL classifications: G21, G28.

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1. Introduction

Under Basel III banks will face stricter capital requirements implying that the ratio of equity to risk-weighted assets should increase to 8-12%. Some countries (e.g., Singapore, Switzerland, and the UK) impose even stricter capital requirements. The aim of more stringent capital regulation is to increase banks' resilience to future financial downturns. Currently, there is a debate whether such an increase in capital requirements really benefits the economy as a whole. The basic concern is that banks' response to new capital regulation will be to reduce credit and increase lending rates, which, in turn, may deepen the economic recession.

This paper provides an overview of the literature pointing out the different effects of capital regulation on economic growth. It shows that there is only limited evidence on the direct link between the two. Most research focuses on the indirect effects of capital regulation on the cost of bank capital, credit supply and bank asset risk, which in turn can have an impact on economic growth.

The study shows that the way banks meet capital requirements matters. Banks facing higher risk-weighted capital requirements can choose among three alternative responses: (1) raising equity, (2) cutting down lending, (3) reducing asset risk. The paper considers the effect of capital regulation on economic growth under each of these alternatives. We compare research results referring to the post-crisis period to studies based on earlier samples.

To complete the overview, we discuss studies assessing the overall effect of higher capital requirements on long-term economic growth. Those encompass both costs and benefits of capital regulation and suggest the level of capital requirements that maximizes long-term GDP growth.

2. Enhanced Financial Stability

The most popular argument for Basel III is that higher bank capital promotes financial stability. Financial stability will be enhanced by: (1) reducing the probability of banks' financial distress; and (2) minimizing banks' losses given default. Capital regulation affects

financial stability by reducing ex ante incentives of banks to take risk and higher capital acts ex post as a buffer against bank losses. We will discuss these effects in more detail.

As a consequence of shareholder limited liability and the implicit or explicit safety net for bank depositors, bank shareholders gain from upside returns but are protected from downside risk. In other words, since asset risk is not fairly priced by depositors, banks do not internalize asset losses fully. This encourages risk-taking (Kane, 1989; Cole et al., 1995). A higher level of capital, however, exposes shareholders to more downside risk. Thus, higher capital requirements reduce banks' incentives to take risk (Furlong and Keeley, 1989; Rochet, 1992). For example, Santos (1999) develops a model with two sources of moral hazard: one between the bank and the provider of deposit insurance, and the other between the bank and an entrepreneur who demands funds to finance an investment project. The model shows that capital regulation improves the bank's stability and can also be Pareto-improving.

A more recent study of Martinez-Miera and Suarez (2014) shifts the focus to the macroeconomic effects of higher capital requirements. In their theoretical model, banks choose their exposure to systemic risk by trading-off the gains from risk shifting and the value of preserving their capital after such shocks. They show that capital requirements can be helpful in reducing systemic risk-taking and thus decrease the cost and frequency of systemic crises.

However, there are also arguments that more stringent capital regulation may lead to higher bank risk-taking. First, higher capital requirements can cause lower profits, which in turn reduce banks' franchise value defined as the stream of future profits. Lower franchise value decreases the shareholder value that can be lost in case of low asset returns and thus induces risk-taking incentives. This can undermine the main effect of capital regulation (Hellman et al., 2000; Repullo, 2004).

Second, Blum and Hellwig (1995) argue that the anticipation of tomorrow's capital requirements may enhance excessive risk-taking today. A more recent study by Martynova et al. (2014) shows that higher bank capital increases the franchise value of core banking activities. This allows banks to attract new funds that can be used for investment in risky market-based activities.

Most empirical evidence suggests that higher bank capital leads to lower riskiness of bank assets. Using US data, Kashyap et al. (2010) find a positive relationship between bank leverage and equity risk. De Jonghe (2010) measures banks' systemic risk exposures using extreme value theory. The paper shows that higher capital reduces banks' exposure to systemic risk. Using the Capital Asset Pricing Model (CAPM) framework, Miles et al. (2012) estimate the relationship between leverage and equity beta. The study reports that higher capital reduces the chance of banking crises. Based on 40 years of data from the United States, Baker and Wurgler (2013) confirm that better-capitalized banks have both lower systematic risk (beta) and lower idiosyncratic risk.

Another line of research examines the impact of capital requirements on bank risk-taking. De Haan and Klomp (2012) use data on 200 banks in 21 OECD countries. Applying factor analysis on 25 indicators of banking risk, the study reports that capital regulation reduces 'capital and asset risk' of banks. De Haan and Klomp (2015) find similar results for a sample of emerging and developing countries.

On the other hand, most studies in this line of research report that there is not a strong relationship between capital requirements and bank risk.[1] Using data for 107 countries, Barth et al. (2004), for instance, document that while banks facing more stringent capital regulations have fewer nonperforming loans, the link between capital stringency and banking crises is not robust. Likewise, Demirgüç-Kunt and Detragiache (2011), who employ data for over 3000 banks in 86 countries, report that capital regulation is not robustly associated with bank risk measured by individual bank Z-scores.

In conclusion, both theoretical and empirical studies are not conclusive as to whether more (stringent) capital (requirements) reduces banks' risk-taking and makes lending safer.

Apart from its effect on banks' ex ante incentives, bank capital acts as a buffer. If the value of banks' assets falls significantly, high capital enables banks to better absorb the associated losses. Therefore, high capital can reduce the frequency and cost of bank failure (Dewatripont and Tirole, 1994).

[1] See de Haan and Klomp (2012) for a discussion of the literature. The effect can be heterogeneous across countries (Delis et al., 2012), but also across different banks. Thus, capital regulation has an impact only on low-capitalized banks (Beatty and Gron, 2001). De Haan and Klomp (2012; 2015) find that capital requirements have the strongest impact on riskier banks.

It has been well documented that undercapitalized banks reduce their lending more than well-capitalized ones. Using cross-sectional bank level data, Bernanke and Lown (1991) show that loan growth between the second quarter of 1990 and the first quarter of 1991 was positively correlated with banks' capital ratios at the beginning of the period. Woo (2003) studies the credit slowdown in Japan in 1997 and concludes that the pervasive shortage of bank capital was the reason behind it. Using data for German banks during 1965-2009, Buch and Prieto (2014) find that a long-run increase in bank capital of one percent increases bank loans by 0.23%. Interestingly, bank loans decrease with bank capital only when the capital-to-asset ratio is above 33%.

Also, during the recent financial crisis, banks with strong balance sheets were better able to maintain their lending. The study by Albertazzi and Marchetti (2010) uses Italian data in 2007-2009 and finds evidence of a contraction of credit supply associated with low bank capitalization. Kapan and Minoiu (2013) employ a sample of more than 800 banks from 55 countries during 2006-2010. They show that bank capital played a cushioning role: better-capitalized banks (with lower leverage ratio) that were exposed to the financial market shocks decreased their supply of loans less than other banks.

In conclusion, all studies referred to above suggest that higher capital makes the provision of credit more stable and robust even in economic downturns.

More capital also allows banks to better withstand financial and real shocks. Bank capital increases the capacity to raise non-insured debt and thus banks' ability to limit the effect of a drop in deposits on lending (Ashcraft, 2001). Indeed, using data for Italian banks in 1992-2001, Gambacorta and Mistrulli (2004) show that well-capitalized banks can better absorb temporary financial difficulties on the part of their borrowers and preserve long-term lending relationships.

Better-capitalized banks can also better shield their lending from monetary shocks as they have easier access to non-insured funding. Indeed, loan growth of highly leveraged banks is more responsive to monetary policy than the loan growth of well-capitalized banks (Kishan and Opiela, 2000). Thus, the negative impact of higher short-term interest rates on credit availability is stronger for banks with lower capital. Using Spanish Credit Register data on all monthly information requests lodged by banks on borrowers, Jimenez et al. (2012) show

that a one percent increase in the interest rate decreases loans granted by less-capitalized banks by 3.9 percent more than loans granted by well-capitalized banks.

As a result, higher bank capital is important in reducing banks' financial fragility (Diamond and Rajan, 2010) as well as their ability to survive financial crises (Beltratti and Stulz, 2012). In a sample of banks from advanced and emerging economies, the latter study finds that higher pre-crisis capital improved bank performance during the 2008 crisis. Similarly, Berger and Bouwman (2013) show that higher capital in US banks enables them to improve their market shares during banking crises, and these banks are generally able to maintain their improved shares afterwards (although the results are less robust for the 2008 crisis).

Since higher capital reduces bank risk and creates a buffer against losses, it makes funding with non-insured debt less information sensitive (Admati et al., 2010). This decreases the possibility of bank runs enhancing financial stability (Diamond and Rajan, 2000; Admati et al., 2010).

However, studies that focus on banks in advanced economies during the 2008 crisis alone often come to different conclusions. Thus, using OECD data Huang and Ratnovski (2009) find no relationship between pre-crisis bank capital and performance during the crisis. For their sample of European banks, Camara et al. (2010) report that well-capitalized banks took more risk before the 2008 crisis. Using a sample of 36 major global banks, the IMF's GFSR (2009) finds that banks that received government support during the crisis had statistically higher capital metrics before the crisis.

To sum up, empirical evidence fails to provide a definitive answer on whether higher capital will always and everywhere enhance financial stability despite the popularity of the view that higher capital will increase banks' resilience and will reduce losses in a crisis period.

3. Possible costs of tighter capital regulation

Facing tighter capital requirements, banks have three alternatives: reduce asset size, cut down lending to risky borrowers, and raise equity.

Cut down total lending

First, banks can cut their total lending. It has been documented that banks trying to satisfy more stringent capital requirements reduce their supply of credit. The BCBS (1999) surveys the evidence for the response of banks in the G-10 countries to the introduction of the 1988 capital requirements, concluding that "bank capital pressures during cyclical downturns in the US and Japan may have limited bank lending in those periods and contributed to the economic weakness in some macroeconomic sectors" (p.2).

Using panel data on large US commercial banks between 1989 and 1997, Furfine (2000) develops a structural dynamic model. The simulations predict that a one percentage point increase in risk-based capital requirement results in 5.5% reduction in loan growth.

Some recent studies focus on the financial crisis of 2007-2009. Albertazzi and Marchetti (2010), using Italian data after the Lehman collapse, document two percentage-points higher contraction of credit supply by less-capitalized banks then well-capitalized ones. The study also highlights that borrowers had a limited ability to find substitute funding. Puri et al. (2011) study the effect of the financial crisis on the lending of German banks. The study concludes that banks hit by the crisis reject 11% more loan applications than non-affected banks.

Several studies estimate the effect of increased capital requirement on bank lending using UK data for the 1990s-2000s. Thus, Francis and Osborne (2009) model the targeted capital ratios; based on those numbers they compute capital shortfalls which are further used to explain credit growth. The authors find that a one percentage point increase in capital requirements would reduce lending in 2002 by 1.2%. Using data for the UK banks subject to time-varying capital requirements in 1998-2007, Aiyar et al. (2014b) exploit a single equation approach and show that a one percentage point rise in capital requirements reduces credit growth by 6.5-7.2 percentage points. Aiyar et al. (2014c) use a Bayesian hierarchical approach to estimate panel VAR models and find that an increase in capital requirements by one percentage point reduces the growth rate in real lending by 4.6 percentage points. Bridges et al. (2014) focusing on the effect of capital requirement on sectoral lending, provide an estimate for the reduction in total lending of 3.5% in response to a one percentage point increase in capital requirement. Aiyar et al. (2014a) using data of 1999-2006 find that

higher capital requirements reduce cross-border lending: a one percentage point increase in capital requirements is associated with a reduction in the growth rate of cross-border credit of 5.5 percentage points. Another UK study by Noss and Toffano (2014) estimates how an increase in macroprudential capital requirements might affect banks' lending in the face a credit boom. They provide an upper bound estimate of 4.5% reduction in lending associated with a one percentage point increase in risk-weighted capital requirement.

Following the approach of Francis and Osborne (2009) and using the data from 15 countries, BIS MAG (2010) estimates that a one percentage point increase in capital requirement causes a decline of 1.4% in the volume of lending.

Messonier and Monks (2014) use the recapitalization exercise of 2011-2012 by the European Banking Authority (EBA). The EBA announcement was unexpected and required banks to have higher capital ratios than foreseen in transition to Basel III. Exploiting data for 250 large banks in the euro area, they find that forcing a banking group to increase its Core Tier 1 ratio by one percentage point was associated with a reduction in this group's credit growth by 1.2 percentage points.

Brun et al. (2013) estimate the macroeconomic effect of the transition from Basel I to Basel II-based regulation in France. The study shows that a two percentage points reduction in capital requirements led to an increase in aggregate corporate lending by 1.5%, a rise in aggregate investment by 0.5% and creation or preservation of 235,000 jobs.

Thus, most empirical evidence suggests that increase in capital requirements by one percentage point force banks to cut their total lending in the short run by 1.2-4.5% or reduce credit growth by 1.2-4.6 percentage points[2]. Table 1 summarizes the effect of higher capital requirements on bank lending.

[2] For an overview of the studies documenting the effect of higher capital requirements on bank lending, see Noss and Toffano (2014).

Table 1. Estimates for lending reduction due to a one percentage point increase in capital requirements

Study	Francis and Osborne (2009)	BIS MAG (2010)	Aiyar et al. (2014c)	Bridges et al. (2014)	Messonier and Monks (2014)	Noss and Toffano (2014)
Lending reduction, %	1.2	1.4		3.5		4.5
Credit growth reduction, p.p.			4.6		1.2	
Sample	UK	15 countries	UK	UK	France	UK
Period	1996-2007	-	1998-2007	1990-2011	2011-2012	1986-2010
Period of the accumulated effect, months	48	24	< 3	36	9	36

The main challenge of these studies, however, is to disentangle the credit supply and credit demand effect. Contraction of lending may be caused by demand factors, such as weakening of the borrowers' balance sheets. However, banks may also decrease their loan supply due to the shortage of equity capital, which is referred to as supply effect.

Some studies report that there is no clear effect of capital on macroeconomic variables (Bernanke and Lown, 1991; Berger and Udell, 1994). Capital shortage has a limited effect on the availability of loans. Also, no link is found between bank capital to asset ratios and employment growth. Therefore, the major factor in economic slowdown may be decreased credit demand rather than credit supply.

To sum up, although most evidence suggests that higher capital requirements reduce bank lending, leading to a slow down of economic growth, the difficulty is in clearly identifying credit supply effect arising from capital pressure on banks.

Reduce lending to riskiest borrowers

Second, banks can alternatively decrease credit supply only to the riskiest and most bank-dependent borrowers (Peek and Rosengren, 1995; Albertrazzi and Marchetti, 2010). Such an effect is called flight to quality.

Berger and Udell (1994) argue that higher capital requirements encourage banks to reduce lending to the most risky categories of borrowers. They show that US banks reduced their commercial loans and increased their holdings of Treasuries in the early 1990s. However, the reduction in borrowers' risk profile can increase banks' financial soundness.

Small businesses heavily depend on banks for credit, since it may be difficult for them to find alternative sources of funding (Brewer et al., 1996; Cole et al., 1996). Lower lending to these borrowers can slow down economic growth as shown by Hancock and Wilcox (1998) in their study on the U.S. for the 1989-1992 period. Small firms become more credit constrained when banks are under pressure to satisfy capital requirements. This has been documented by Popov and Udell (2012). They study the sensitivity of credit supply to banks' financial conditions in 16 emerging European countries before and during the recent financial crisis. Results suggest that the effect of positive and negative shocks to a bank on its lending is greater for riskier firms and firms with fewer tangible assets.

Another type of lending that banks cut when being capital constrained is loans to the real estate sector. Peek and Rosengren (2000) consider the Japanese banking crisis as an exogenous loan supply shock and find that it is linked to construction activity in U.S. commercial real estate markets, thereby affecting economic activity in the U.S. Similarly, Bridges et al. (2014) report that UK banks faced with a one percentage point increase in capital requirements reduce commercial real estate loan growth by 8 percentage points within one year after the change in capital regulation. For other corporate lending, the decline in loan growth is 3.9 percentage points. Hence, both commercial and residential real estate activity can decline as a result of a bank capital crunch (Hancock and Wilcox, 1997).

Empirical evidence suggests that such a credit contraction due to bank capital pressures contributes to the decline in real economic activity (Peek and Rosengren, 2000).

Raising external equity

In order to satisfy capital requirements, banks may opt for issuing equity instead of cutting lending. The common view is that banks are unwilling to raise equity, because it is expensive.

However, the basic theory suggests that equity is not expensive, since higher capital makes both equity and debt funding safer, and therefore the cost of funding is reduced as capital requirements go up. The argument comes from Modigliani and Miller (1958) who claim that a firm's total risk depends on the composition of its assets, not on how they are funded. This effect is also highlighted in Admati et al. (2010). They point out that "the return on equity contains a risk premium that must go down if banks have more equity". Thus, the weighted average cost of capital remains unchanged as the capital-to-asset ratio rises.

Further theories provide an explanation of why equity is costly. The main reason is that banks are facing imperfect markets for equities.

First, equity may be costly because extra equity increases downside risks for bank shareholders, implying higher compensation for that risk referred to as debt overhang (Myers, 1977). Additional equity reduces debt repayment risk. This means an increase in the value of debtholders' claim on the bank, which comes from the decrease in the value of existing equity. As a result, current shareholders are reluctant to issue extra equity.

Second, markets require higher a equity premium upon new equity issuance (Myers and Majluf, 1984). Shareholders have better information about the bank's prospects than new outside investors. To outsiders, issuing equity can be considered as a signal that equity is currently overvalued, since banks with better prospects do not issue equity, but wait until the higher return is realized. This is known as the adverse selection problem in the market for equity.

Following this literature, Bolton and Freixas (2006) argue that outside equity capital is costly due to the asymmetric information about banks' net worth. The problem is most severe during the crisis. As a result, bank lending is constrained by equity capital requirements, and such a constraint becomes tighter in crisis times.

More recent papers use the segmentation of the deposit and equity markets to explain why high leverage is attractive for bank. The study by Allen and Carletti (2013) adds friction in

the form of intermediation cost, showing that in the equilibrium, the cost of equity financing is equal to the cost of deposit funding and those intermediation costs. Since equity is more expensive, high leverage is justified. DeAngelo and Stulz (2013) focus on the role of banks to provide liquidity and demonstrate that if there is a market premium for (socially valuable) liquid financial claims, high leverage is optimal.

As also noted by Miles et al. (2012), the Modigliani-Miller irrelevance theorem may not hold due to two major distortions: tax advantages for issuing debt as well as underpriced guarantees (implicit or explicit) for debt. In other words, bank can have a preference for debt financing due to lower cost of this funding due to the tax deductibility of debt and incorrect pricing of debt. The latter can be associated with the underestimation of asset risk by bank creditors or regulator. Another argument put forward is that even in the absence of such guarantees, high leverage can also be beneficial due to the disciplining role of debt (Calomiris and Kahn, 1991; Diamond and Rajan, 2001).

However, these above mentioned arguments in favor of lower equity ratio are treated by Admati et al. (2010) as lacking empirical support or representing no social cost in case of imposed higher capital requirement.

However, many empirical studies find that equity is more expensive, and any increase in cost of equity can be passed on to borrowers (BCBS, 2010). The intuition behind is the following. Higher capital requirement reduces return on equity (ROE). The reason is the decrease in net income due to the substitution of debt with more expensive equity. To keep ROE unchanged, banks can raise lending rates (King, 2010).[3] The main concern is that higher lending rates may result in lower lending and thus reduced economic activity.

Several studies evaluate the impact of increased capital requirements on lending rates. Those mainly differ by their assumptions on whether the Modigliani-Miller theorem holds or not and the data used.

The study by the BCBS (2010) uses data of 13 OECD countries. It assumes that (1) increase in funding costs are fully passed through to the borrowers (which is a common assumption

[3] Studying 13 OECD countries, King (2010) shows that the higher cost associated with a one percentage point increase in the capital ratio can be recovered by increasing lending spreads by 15 basis points for a representative bank. It is based on the assumption that return on equity and cost of debt are unchanged.

for similar studies), and (2) the cost of capital does not fall as banks become less risky (Modigliani-Miller theorem does not hold). The simple mapping shows that one percentage point increase in capital ratio raises loan spreads by 13 basis points.[4]

Using data for the US and a model-based calibration approach, Kashyap et al. (2010) show that the long-run steady-state impact on loan rates to households and corporations will be modest. They estimate that for a one percentage-point increase in the capital requirement, lending rates increase by 2.5-4.5 basis points.

Based on data from 3 OECD countries between 2004 and 2006, Slovik and Cornede (2011) show that a one percentage point increase in the ratio of capital to risk-weighted assets will push up bank lending spreads by 14.4 basis points on average, with a higher effect in the US.

Baker and Wurgler (2013) report that a one percentage point increase in Tier 1 capital to risk-weighted assets will increase the weighted average cost of capital by 6-9 basis points per year.

Table 2 summarizes the main findings and assumptions of the studies mentioned above. It clearly demonstrates the sensitivity of the results to the Modigliani-Miller assumption made. Naturally, introducing this assumption lowers the estimate for the impact of capital requirement on lending rates.

Table 2. Effect of one percentage-point increase in Tier 1 capital to risk-weighted assets on lending rates

Study	King (2010)	BCBS (2010)	Kashyap et al. (2010)	Slovik and Cournede (2011)	Baker and Wurgler (2013)
Effect on lending rates, basis points	15	13	2.5-4.5	14.4	6-9
Modigliani-Miller assumption holds	No	No	Yes	No	Yes

The concern of the regulator is that higher lending rates can reduce credit demand, because they make it less affordable for some categories of borrowers (Thakor and Furlong, 1995).

[4] Note that due to the specific assumptions used in the study, this number provides an upper bound estimate.

However, it is hard to estimate the effect on the economic activity, since borrowers who cannot get bank loans may seek for alternative funding elsewhere.

There is also another effect: higher lending rates may attract lower quality borrowers who are willing to pay high price for their loans (Stiglitz and Weiss, 1981). This may increase bank loan risk and reduce financial stability.

As a result, when banks choose to satisfy higher capital requirements by raising equity, one can expect lending to decline and riskiness of bank loans to increase. The latter effect may reduce financial stability.

4. Overall assessment of the impact of capital regulation

On the one hand, higher capital requirements may reduce credit supply. On the other hand, higher capital requirement reduce the probability and severity of the financial crisis. Figure 1 summarizes those indirect effects of higher capital on economic growth.

There are few studies that try to quantify the direct effect of higher capital requirements on economic growth.

The BCBS (2010) assesses the long-term economic impact of stronger capital requirements by evaluating benefits and costs of higher capital using econometric models as well as DSGE and semi-structural models. It compares two steady states, one with and one without the proposed regulatory enhancements.

The benefits are measured as the expected yearly output gain associated with the reduction in the frequency and severity of banking crises. To get the probability of banking crisis, the study estimates the historical link between capital ratios and subsequent banking crises. The second method treats the banking system as a portfolio of securities which allows establishing the link between capital and default. The average probabilities of a banking crisis for specific capital requirements are reported in Table 3.

The costs of capital regulation are associated with the increase in lending spreads necessary to recover the additional cost of raising equity as described earlier in Section 3. Higher cost of bank credit lowers investment and consumption, in turn influencing the steady-state level

of output. The results suggest that net benefits remain positive for the broad range of capital ratios. The maximum net benefits are achieved when capital requirement is around 13% (assuming moderate permanent effect on GDP).

Another study by Miles et al. (2012) reports long-run costs and benefits of higher bank capital requirements in terms of GDP based on UK data. Similar to the previous study, it measures the benefits of higher capital requirements as the expected cost of a financial crisis that can be avoided. Miles et al. (2012) suggest that during banking crises the proportionate fall in the value of bank assets is often equal to the decline in GDP. Assuming a normal probability distribution for bank assets, they also include calibrations for GDP with the added probability of extreme bad events using data from 1821 to 2008. The average probabilities of a banking crisis for specific capital requirements are reported in Table 3.

Table 3. Average probability of a banking crisis for different Tier 1 capital to risk-weighted assets

Capital to Risk-Weighted Assets Ratio, %	2	5	6	7	8	9	10	11	12	13	14	15	20
BCBS(2010)			7.2	4.6	3.0	1.9	1.4	1.0	0.7	0.5	0.4	0.3	
Miles et al. (2012)	13.8	7.0					2.5					1.2	0.4

To estimate the cost of capital regulation, the study uses Capital Asset Pricing Model calibrated on the panel data from 1997 to 2010. It finds that if leverage drops from 30 to 15 (equivalent to doubling Tier 1 capital to assets ratio), banks cost of funding increases by around 18 basis points, which corresponds to the fall in long-run GDP of 14.9%. The maximum net benefits are achieved when the capital requirement is around 18-20% (assuming moderate permanent effect on GDP).

The results of the abovementioned studies are quite sensitive to the assumptions they are based upon. First, it is important whether the study assumes the Modigliani-Miller paradigm. Second, studies may not account for the causal relationship between GDP growth and banking crises. And finally, the severity of banking crises across countries differ based on

the resolution mechanisms employed. Therefore, their results must be interpreted with caution. For a detailed comparison of those studies, see Rochet (2014).

Another study by Martinez-Miera and Suarez (2013) presents a theoretical macroeconomic model. It argues that capital requirements reduce systemic risk-taking but at the cost of reducing credit and output in calm times. Parameterizing the general equilibrium model, they show that the optimal capital requirement is 14%, much higher than 7% (a level close to the requirements of core Tier 1 capital set by Basel III). The gain from the optimal requirement is equivalent to a perpetual increase of 0.9% in aggregate net consumption. The main reason for this gain is the lower average fraction of bank capital devoted to support systemic lending: 25% of bank capital under 14% capital requirement rather than 71% under 7% requirement. Also, the optimal requirement implies a much lower fall in aggregate net consumption (only 4.6% fall instead of 17.5%), GDP (only 10.0% fall instead of 33.7%), and bank credit (only 24.4% fall instead of 65.8%) in the year after a systemic shock.

To sum up, studies providing an overall assessment of the effect of higher capital requirements on economic growth agree that the current level of capital ratios is too low (Table 4).

Table 4. Optimal capital requirement (Tier 1 capital to risk-weighted assets)

Study	BCBS (2010)	Miles et al. (2012)	Martinez-Miera and Suarez (2014)
Optimal capital requirement, %	13	19	14

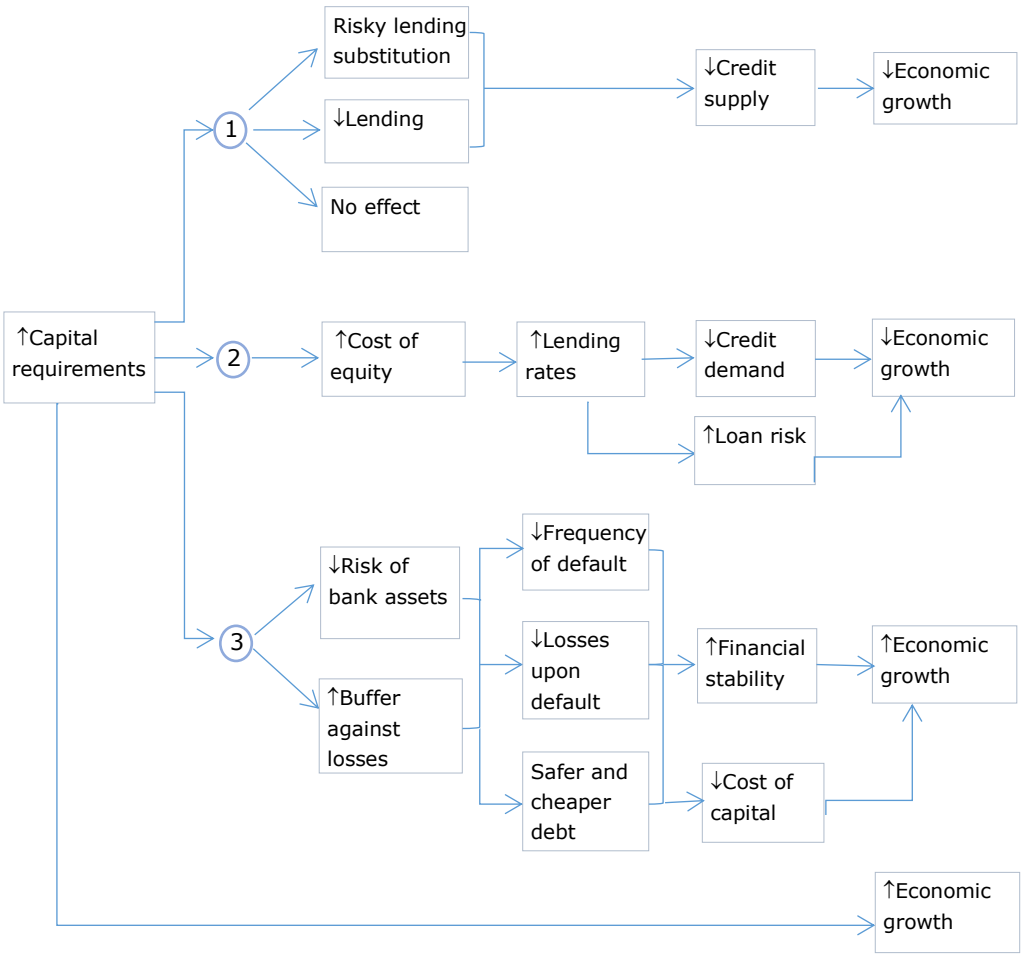
More stringent capital regulation can achieve a positive long-run effect on GDP growth, since the benefits of reducing the expected cost of avoiding banking crises outweigh the costs of complying with more stringent capital requirements, such as higher lending spreads and reduction in lending.

5. Conclusions

There is not much direct evidence on whether higher bank capital requirements increase or decrease economic growth.

The discussion takes into account three main indirect effects (mapped in Figure 1). First, higher bank capital requirements may reduce bank lending, especially to the most bank-dependent borrowers, such as small businesses. This may decrease economic growth. Second, higher capital requirements increase bank cost of equity, but reduce cost of debt. Higher cost of equity can be passed on to the borrowers in the form of higher lending rates. This reduces credit demand and slows down economic growth.

Figure 1. Direct and indirect effects of capital requirements on economic growth



Third, higher capital promotes financial stability by reducing bank risk-taking incentives and providing a buffer against losses. Thus, better capitalized banks lead to lower credit volatility.

There are not many studies evaluating the interaction of these effects and their impact on economic growth. However, those that make attempt to quantify net economic benefits/costs from introducing more stringent capital requirements unanimously report that imposing capital requirements higher than the current level may result in higher economic growth.

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