ECONSTOR
Make Your Publications Visible.

A Service of
ZBW
Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Vale, Bent

Research Report

Effects of Higher Equity Ratio on a Bank's Total Funding Costs and Lending

Staff Memo, No. 10/2011

Provided in Cooperation with:
Norges Bank, Oslo

Suggested Citation: Vale, Bent (2011) : Effects of Higher Equity Ratio on a Bank's Total Funding Costs and Lending, Staff Memo, No. 10/2011, ISBN 978-82-7553-619-6, Norges Bank, Oslo, https://hdl.handle.net/11250/2507326

This Version is available at:
https://hdl.handle.net/10419/210226

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

http://creativecommons.org/licenses/by-nc-nd/4.0/deed.no

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

No. 10 | 2011

Staff Memo

Effects of higher equity ratio on a bank's total funding costs and lending

Bent Vale, Financial Stability

NB NORGES BANK

Staff Memos present reports and documentation written by staff members and affiliates of Norges Bank, the central bank of Norway. Views and conclusions expressed in Staff Memos should not be taken to represent the views of Norges Bank.

© 2011 Norges Bank
The text may be quoted or referred to, provided that due acknowledgement is given to source.

Staff Memo inneholder utredninger og dokumentasjon skrevet av Norges Banks ansatte og andre forfattere tilknyttet Norges Bank. Synspunkter og konklusjoner i arbeidene er ikke nødvendigvis representative for Norges Banks.

© 2011 Norges Bank
Det kan siteres fra eller henvises til dette arbeid, gitt at forfatter og Norges Bank oppgis som kilde.

ISSN 1504-2596 (online only)

ISBN 978-82-7553-619-6 (online only)

Effects of Higher Equity Ratio on a Bank's Total Funding Costs and Lending

Bent Vale*
Norges Bank (The central bank of Norway)†

September 26, 2011

Abstract

Simply stating that because equity is much more expensive than debt funding, banks total funding costs will increase accordingly if their equity ratio is increased, biases the estimated increase upwards. As recently put forwards in the literature, one has to take into account that higher equity ratio lowers the volatility of equity and hence its required return. In addition, higher equity ratio makes a bank's debt safer and lowers the required return on debt. Taking these two effects into account the Modigliani-Miller theorem implies that a bank's total cost of funding should not be influenced by the bank's equity ratio. However, the existence of explicit or implicit guarantees may reduce the latter effect and cause a bank's total funding cost to increase somewhat when the equity ratio is raised. Miles, Yang, and Marcheggiano (2011) studying UK banks find a slight increase in their funding costs if the equity ratio is increased. Applying the estimates of Miles et.al. we find that a hypothetical doubling of DnB NOR Bank's equity ratio from 5.5 to 11 per cent would increase its total funding costs in the range of 11 to 41 basis points. In steady state such an increase in Norwegian banks' funding costs could reduce lending by 0.33 to 1.23 per cent. In the short run, an abrupt increase in banks' required capital could however cause significantly larger reductions in lending due to frictions in the market for issuing equity.

*Thanks to Sigbjørn A. Berg, Thea Birkeland Kloster, Artashes Karapetyan and Ylva Søvik for valuable comments. Views and conclusions in this paper are those of the author and cannot be attributed to any of the persons mentioned nor to Norges Bank

†Address: Norges Bank, C51, Box 1179, Sentrum, N-0107 Oslo, Norway.
Fax: +47 22 42 40 62. E-mail: bent.vale@norges-bank.no

1. Introduction

How will a bank's funding costs be affected if the bank's equity ratio is increased, i.e., its leverage is reduced? A popular answer, in particular among spokespersons for the banking industry, has been that it has to increase simply because equity holders require a higher return than debt holders, or equity is more expensive. However, by itself this statement has no sound basis in corporate finance, as has recently been pointed out in particular by Admati, DeMarzo, Hellwig, and Pfleiderer (2010). Miles, Yang, and Marcheggiano (2011) using principles from standard corporate finance estimate the impact on total funding costs for UK banks of doubling their equity ratio. They find that total funding costs will increase in the range of 8 to 33 basis points (bps). Kashyap, Stein, and Hanson (2010) doing a similar study on US banks find that an increase in the equity ratio of 10 percentage points for US banks would increase their total funding costs by 24 to 45 bps.

In this paper we will try to provide some estimates of how much the funding costs of Norwegian banks may increase if there is a significant increase of their equity ratio. Assuming that the larger part or all of this increase in funding costs is passed on to borrowers, how will that affect the amount lent by banks to the non-financial sector?

The paper is organized as follows. In Section 2 we present some simple principles from corporate finance relevant for this issue. In Section 3 we present some estimates of the increase in funding costs pertaining to the largest bank in Norway based on findings by the studies on UK and US banks referred to above. In Section 4 we try to get an idea of how much this increase in funding costs may affect banks' lending. In doing so we use elasticities from an econometric macro model applied by Norges Bank. In this section we also discuss to what extent, banks in the short run may prefer to reduce lending rather than increasing equity following higher capital requirements. This latter point is emphasized by Kashyap, Stein, and Hanson (2010). Some final remarks are given in Section 5.

2. Some simple background

The *benchmark* for analysis of effects of changes in banks' liability structure is the well known Modigliani-Miller theorem (henceforth, MM) stating that the total value of a firm is independent of the composition of its liability side[1]. This will imply that also the

[1] See Modigliani and Miller (1958).

total financing cost of the firm is independent of its liability structure. Related to our specific problem: a bank's total funding cost is independent of its equity ratio. Even if the required return on equity is higher than the required return on debt, higher equity ratio implies lower volatility of the equity and hence a lower risk premium. In addition more equity relative to debt means that debt becomes safer and also requires a lower return. Mathematically this can be expressed in the following way: Assume a bank is financed by equity E and debt D which have the following required returns R_E and R_D. Denote by FC the total funding cost relative to total liability. Hence

$$FC = \frac{R_E E + R_D D}{D + E}$$

Defining the equity ratio e as $E/(D + E)$ and taking into account that R_E and R_D are decreasing in e, as explained above, FC can be expressed as:

$$FC = R_E(\underline{e})e + R_D(\underline{e})[1 - e] \quad . \tag{2.1}$$

To analyze the effect on total funding costs of a higher equity ratio we differentiate FC w.r.t. e

$$dFC = [R_E - R_D]de + \frac{\partial R_E}{\partial e} e \cdot de + \frac{\partial R_D}{\partial e}[1 - e]de \tag{2.2}$$

The first term in (2.2) is positive since equity is riskier than debt. Both the second and the third term are negative since higher equity ratio reduces the risk of both equity and debt. Henceforth, the second and the third term will be referred to as the equity premium effect and debt premium effect, respectively. Under MM (2.2) becomes

$$dFC = [R_E - R_D]de + \frac{\partial R_E}{\partial e} e \cdot de + \frac{\partial R_D}{\partial e}[1 - e]de = 0 \tag{2.3}$$

Note that MM which critically depends on a number of ideal assumptions – for instance symmetric information, no transaction costs and no distortionary taxes – is only a benchmark. Deviations from the first two assumptions we disregard for now, but we will return to them in Section 4.2. Deviation from the last assumption is, however, of less relevance for Norway as the taxation of investors in principle corrects for this bias, so we will disregard it in this analysis.[2]

[2] It might be argued that taxation of investors who are tax residents in other countries may not correct this bias.

2.1. Effects of debt guarantee

So far we have not considered a special feature of banks, an implicit and explicit guarantee of banks' debt. The guarantor is usually the government. Such a guarantee implies that bank owners do not need to compensate creditors fully for the risk of the debt, and hence the bank has access to relatively cheap debt funding as long as the guarantor does not require the bank to pay an actuarially fair premium for the guarantee. A premium reflecting changes in a bank's risk will in practice be infeasible, hence we will in the remainder assume that a bank either pays a zero premium for the guarantee or a premium independent of its risk (a flat premium). In this case the guarantee can be considered a subsidy to the banks' owners. Merton (1977) has shown that the value of this subsidy can be considered a put option, the value of which increases in the bank's leverage and the volatility of its assets.

The existence of such a subsidy is one reason why bank owners usually prefer low equity ratio in banks over high equity ratio. Lower equity ratio increases the value of any debt guarantee, implicit or explicit. It may also contribute to explaining why a bank's shareholders prefer being paid dividends rather than accumulating retained earnings as equity in the bank.[3]

What will such a debt guarantee imply for the validity of MM in banks, or more specifically, how a higher equity ratio affects the total funding cost of a bank? Essentially there are three parties involved in the funding of a bank: the banks' share holders, its creditors or debt holders, and the guarantor of the bank's debt. Correspondingly, a bank's total *social* funding costs consist of three elements: the required return on equity, the required return to the debt holders (including a possible flat premium for the debt guarantee), and the cost to the guarantor of being paid less than an actuarily fair premium for the debt guarantee. Thus considering the total *social* funding costs SFC we can rewrite (2.1) and (2.3) as

$$SFC = R_E(\underline{e})e + R_{Dg}(\underline{e})[1-e] + P(\underline{e})[1-e] \tag{2.4}$$

$$dSFC = [R_E - R_{Dg} - P]de + \frac{\partial R_E}{\partial e} e \cdot de + \frac{\partial R_{Dg}}{\partial e}[1-e]de + \frac{\partial P}{\partial e}[1-e]de = 0 \tag{2.5}$$

[3]This, of course, does not rule out other explanations. Bank owners may want to avoid managers' wasteful spending to their own private benefit by restricting how much cash flow the managers can control. See Jensen and Meckling (1976) for a classical reference in corporate finance on this point.

where R_{Dg} is the required return on debt in presence of a debt guarantee[4], and P is the cost of the this guarantee to the guarantor, i.e., the cost of being paid less than an actuarily fair premium for the debt guarantee. Note that this cost is also negative in e, i.e., a higher equity implies lower cost of the debt guarantee. (2.5) states that as long as the the total social funding costs, i.e., the funding costs borne by all parties are considered, MM is still valid. An increase in the equity ratio will not change total social funding costs. However, there will be a redistribution of the costs, or the required returns, between the three parties. A higher equity ratio implies a lower cost for the guarantor, hence, the last term in (2.5) is negative. Due to the guarantee, higher equity ratio will have a smaller or no effect on the required return of the creditors, hence, the third term $\partial R_{Dg}/\partial e[1-e]de$ will be negative or equal to 0 depending on whether the debt guarantee is partial or full. The second term is negative, higher equity ratio implies a less volatile value of the bank's equity for a given volatility of the bank's assets. The first term will be positive, since the required return on equity is always larger than the required return on debt plus the cost of the debt guarantee.[5]

The total *private* funding costs PFC, are the total social funding costs minus the guarantor's cost of the debt guarantee. I.e.,

$$PFC = R_E(\underline{e})e + R_{Dg}(\underline{e})[1-e] \tag{2.6}$$

The private funding costs are those that appear in the bank's calculation and that the bank more or less can pass on to the borrowers. In the literature private funding costs is usually referred to just as total funding costs, a convention we will follow in the remainder. How will these total funding costs be affected by an increase in the equity ratio? Applying (2.5) and taking into account that $\partial P/\partial e[1-e]de < 0$, higher equity ratio reduces the cost to the guarantor, we must have

$$dPFC = [R_E - R_{Dg}]de + \frac{\partial R_E}{\partial e}e \cdot de + \frac{\partial R_{Dg}}{\partial e}[1-e]de > 0 \tag{2.7}$$

When there is a debt guarantee with zero or a flat premium, a higher equity ratio implies higher funding costs. I.e., the bank cannot enjoy the full benefit from lower cost of debt as its equity ratio is raised, part of that benefit accrues to the guarantor. Another way of

[4]Including a possible flat premium for the debt guarantee

[5]$R_{Dg} + P$ corresponds to the required return on debt in perfect market without debt guarantee. Given the priority of debt over equity, this sum will be lower than the required return on equity.

seeing it is that higher equity ratio will reduce the value of the subsidy inherent in the debt guarantee.[6]

Having established that the existence of a debt guarantee may cause higher equity ratio to increase the total funding costs of a bank, one can of course not rule out that such an increas in funding costs may also have other causes, for instance the tax treatment of debt.

3. Estimates of increase in funding costs

In this section we will as an example look at a doubling of the equity ratio of Norway's largest bank DnB NOR. This bank is the only major bank in Norway which is fully owned by investors holding the bank's ordinary shares.[7] By the end of 2010 the DnB NOR Bank had an equity ratio of 5.51 per cent,[8] i.e., we study effects of increasing it to 11.02.

We stick to the assumption that there is full debt guarantee, i.e., there is no debt premium effect from higher equity ratio. That may seem a bit unrealistic, but the effect of it is to be somewhat pessimistic in estimating the effect on funding costs, i.e., rather get it a little too high than too low.

At first, we present a naive estimate also assuming no equity premium effect. Secondly, we present estimates based on the methods applied by Miles, Yang, and Marcheggiano (2011) and by Kashyap, Stein, and Hanson (2010), studies that do take the equity premium effect into account.

In the first case – the naive case – only the first term in (2.7) comes into consideration, i.e., we have $dPFC = [R_E - R_{Dg}]de$. In our case de is 0.0551. As an estimate for R_E, the required return on equity, we use the average annual return on the DnB NOR stock. For the years 2004 through to 2010 it was 13.86 per cent.[9] To estimate R_{Dg} the required

[6](Admati, DeMarzo, Hellwig, and Pfleiderer, 2010, p. 11) shows a very simple numerical example where they implicitly assume the bank's debt is riskless even without a guarantee. In that case, MM implies that the impact on funding costs of the lower required return on equity exactly cancels the direct effect of having more costly funding. In expositions of MM in elementary parts of coporate finance courses, assuming riskless debt without a guarantee is not uncommon, see for instance Spiegel (1999).

[7]The two largest shareholders are the Norwegian government and DnB NOR Savings Bank Foundation holding 34 per cent and 10.3 per cent of the shares, respectively.

[8]All numbers regarding DnB NOR are publically available, from its annual report or the Oslo Stock Exchange.

[9]This return applies to the holding company DnB NOR who in addition to being the sole owner of DnB NOR Bank owns two insurance companies and an asset management company, all of them as the sole shareholder. Among these subsidiaries, the bank is by far the largest. The shares that are traded are those

return on bank debt, we assume that if a bank has to replace debt with equity it wants to get rid of the most expensive parts of its debt. That would normally be bonds. However, bonds are usually considered a more stable source of funding than other debt, so we will instead assume a bank would reduce its short term money market debt. We use the annual average of the three months NIBOR as a proxy for the interest cost of this debt. With this money market rate usually being slightly lower than interest costs of bond debt, as previously, we err on the side of estimating the effect on funding costs as a little too high. Over the years 2004 through to 2010 the three months NIBOR was 3.48 per cent. Thus, a naive estimate of the increase in the bank's funding costs from raising its equity ratio from 5.51 per cent to 11.02 per cent is

$$dFC_{NAIVE} = [13.86 - 3.48] \cdot 0.0551 = 0.57 \text{ or } 57 \text{ bps.}$$

This estimate is the highest we will arrive on, and a fairly unrealistic one since we have disregarded the equity premium effect.

3.1. Estimates including the equity premium effect based on Miles et. al

Miles, Yang, and Marcheggiano (2011) apply the Capital Asset Pricing Model to estimate UK banks total funding costs under different leverage ratios. For the required equity return R_E on any individual firm, the CAPM states that

$$R_E = R + \beta_{equity} R_p \tag{3.1}$$

where R and R_p are the risk free interest rate and the equity risk premium for the whole market, respectively. As a starting point they observe that under CAPM

$$\beta_{asset} = \beta_{equity} \frac{E}{D+E} + \beta_{debt} \frac{D}{D+E}$$

which under the assumption of debt guarantee ($\beta_{debt} = 0$) implies

$$\beta_{equity} = \frac{D+E}{E} \beta_{asset}$$

I.e., a partial doubling of a bank's leverage should double its equity-β. To take this relation to the data, they first estimate the equity-βs for each of six large UK banks by regressing

of the holding company. By using this return for the bank we assume the bank has the same return as the rest of the companies in the group.

their daily stock returns on the daily FTSE returns over discrete periods of six months covering 1992 to 2010. In this way they obtain 38 observations of the equity-β for each of the six banks. They then regress these equity-βs on the banks' leverage ratio at the beginning of each half-year, using both OLS and Fixed Effects

$$\beta_{i,t} = a + b \cdot \frac{D+E}{E} + \epsilon_{i,t} \tag{3.2}$$

The predicted equity-βs from (3.2) are inserted into the basic CAPM equation to get an estimate of how the return on bank equity depends on bank leverage:

$$R_E = R + \left(\widehat{a} + \widehat{b} \cdot \frac{D+E}{E}\right) R_p \tag{3.3}$$

Assuming a risk free rate of 5 per cent, an equity risk premium R_p of 5 per cent, using the estimated coefficients from the fixed effect model, and applying the current leverage of UK banks of 30, they get an R_E of 14.85 per cent. Inserting this estimate into (2.6) and assuming a required return of 5 per cent on bank debt, they get a total funding cost of 5.33 per cent. Halving the leverage ratio to 15 would have implied a total funding cost of 5.51 per cent, i.e., an increase by 18 bps. By instead relying on the OLS estimates they would have got an increase of 21 bps.

They also estimate a log-linear version of (3.2), which yields a stronger effect from the leverage on the equity-beta. With this specification, and using their fixed effects model, a halving of the gearing from 30 to 15 would have caused an increase in total funding costs of only 8 bps.

At the other end, using the naive approach, they would have obtained an increase of 33 bps.

When applying this method to the Norwegian banks we face a problem with lack of data. Since DnB NOR is the only bank with traded ordinary shares we get way too few observations to be able to estimate a relation between the bank's equity-beta and its leverage. Instead we will rely on the parameter estimates from Miles, Yang, and Marcheggiano (2011). We start by calculating the equity risk premium from the whole market, R_p. In doing so, we callibrate R_p from (3.3), assuming that (3.3) as estimated by Miles et. al., holds for DnB NOR.[10] Furthermore in this callibration, for R_E we use the average annual

[10]Applying parameters estimated over several banks in one country (UK) to one specific bank (DnB

return on the DnB NOR share from 2004 to 2010 of 13.86 per cent. For the riskless rate we use the average of Norges Bank key policy rate for the same period, 2.91 per cent. We use an initial gearing ratio at 18.149 which is the inverse of DnB NOR Bank's equity ratio of 5.51 per cent by end 2010.

To calculate how a doubling of the equity ratio – or halving of the leverage ratio – of DnB NOR Bank affects the total funding cost, we insert the R_p we arrived at above, the halved leverage ratio 9.074, and the unchanged riskless interest rate into (3.3) to calculate the new R_E. Inserting this new R_E into (2.6) and using the same interest rate for bank debt as in the naive example, 3.48, we calculate the new total funding cost. These two steps of calculations are performed using both the OLS and the fixed effects coefficients both for the linear and for the log-linear specification of (3.2). Results are shown in Table 1.1.

Table 3.1: Effects of doubling equity ratio of DnB NOR

β-leverage equation	Linear specification		Log-linear specification	
Estimation method	OLS	FE	OLS	FE
Initial ROE	13.86	13.86	13.86	13.86
Initial funding costs (PFC)	4.05	4.05	4.05	4.05
Market equity premium	6.47	6.70	7.79	8.01
ROE after halved leverage	12.39	11.97	10.12	9.69
PFC after halved leverage	4.46	4.42	4.21	4.16
Increase in PFC	0.41	0.37	0.16	0.11
Increase in PFC, naive method		0.57		

The equity ratio is increased from 5.51 per cent to 11.02 per cent. The riskless interest rate is set to 2.91, and bank debt is assumed to have an interest rate of 3.48. The funding costs, both the initial and the new, are calculated as the weighted average of R_E and the interest rate on bank debt using the equity ratio and debt ratio as weights according to (2.6) .

NOR) in Norway will of course involve some inaccuracy. It might be argued that the implicit guarantee for creditors in DnB NOR is stronger than the one for the average UK bank in the sample used by Miles et. al. If so, the reduction in the put option value of the guarantees following a given increase in the equity ratio, will be larger for DnB NOR share holders than for UK bank share holders. Can that bias the parameter estimates once they are applied to DnB NOR? If, somehow, shareholders manage to get compensation for the loss in the put option value through a partially higher R_E, the estimated parameters may be biased in the following way: The absolute value of $\partial R_E / \partial e$ should be smaller for DnB NOR than for the UK banks. (In (3.3) this would correspond to $\widehat{b}$ being overestimated). I.e., a stronger guarantee for DnB NOR's debt may partially cause us to underestimate the increase in the bank's total funding cost following a higher equity ratio. However, our main purpose is not to study DnB NOR per se, but rather to use that as an example of how all Norwegian banks having external equity owners may be affected by higher equity ratio. Since any implicit guarantee for these other Norwegian banks most likely is smaller than for DnB NOR, this bias regarding DnB NOR may not matter for our purpose.

Doubling the equity ratio will give an increase in the bank's total funding cost in the range of 11 bps to 41 bps, when one takes into account that the required return on bank's equity decreases in its equity ratio. If this effect was disregarded, the naive approach, we would have arrived at an estimate of 57 bps. These calculations illustrate that this naive approach may considerably overestimate the increase in a bank's funding cost stemming from a higher equity ratio.

In their paper, Kashyap, Stein, and Hanson (2010) essentially use the same method as (later on) applied by Miles, Yang, and Marcheggiano (2011) in order to find the effect on total funding costs of a higher equity ratio on US banks. Their results are rather similar to those of Miles et. al. In fact their simple OLS estimate of the coefficient of a bank equity ratio on the bank's equity-beta is almost the same as that of Miles et. al. for UK banks.

4. Effects on bank lending to the non-financial sector

In order to study the effects on bank lending to non-financial sector from higher equity requirements on banks we need to distinguish between the immediate or short run and the longer run or stationary equilibrium effects. As pointed out by Kashyap, Stein, and Hanson (2010), when faced with higher capital requirements banks may not want to raise equity in the market in order to abide with these requirements. This is due to frictions in the market for equity. Instead, banks may in the short run prefer to lower the denominator of the capital requirement, and restrict their lending to a larger extent than the increased funding costs analyzed in Section 3.1 by themselves should cause. Thus, this rise in funding costs should be interpreted as the difference in funding costs between two steady states equilibria, one with an equity ratio as at present and the other with an equity ratio considerably higher once banks have been able to raise the equity required to operate at their current scale, for instance through retained earnings. In this section we will first analyze the longer term quantitative impact on lending by comparing these two steady state equilibria. Next, we will discuss the impact on lending during the transition from an equilibrium with the present equity ratio to one with a substantially higher equity ratio.

4.1. Longer term impact of higher equity ratio on lending

In this analysis we start by using estimated coefficients of a household credit equation in Norges Bank's Small Macroeconomic Model (SMM) as documented by Hammersland and Træe (2010). This model is a quarterly dynamic econometric model. Its financial block does, however, not contain bank capital as a variable. Instead, we proceed by interpreting its household credit equation as households' demand for credit. In our context we are not interested in the short term quarter by quarter dynamics of this relation, but only in its stationary or long run part, which reads as

$$cr = 0.9ph - 0.03RL + 0.4inc \tag{4.1}$$

where cr, ph, inc are the $\ln$ of real credit to the household sector (in NOK mill.), real prices on residential houses, and household real wage income (NOK mill.), respectively. RL is the nominal interest rate on total bank loans as per cent.

Let us assume that banks can pass on the entire increase in funding costs to borrowers, an assumption that overestimates the impact on lending rather than underestimating it. Denoting credit (in NOK mill) to the household sector as CR, (4.1) gives

$$\frac{\partial CR}{\partial RL} = -0.03CR$$

Thus a partial increase in interest rate on bank loans of 1 percentage point reduces household borrowing by 3 per cent. Applying this to the various estimates of increase in bank funding costs reported in Table 1.1 we obtain an estimate of reduced steady state bank lending in the range of 0.33 to 1.23 per cent after an increase in bank equity ratio of 5.5 percentage points. One caveat is that the credit equation of SMM includes only credit to households. Hence, the numbers we have arrived at here hinge on the interest elasticity of borrowing by households being equal to that of other non-financial sectors.

4.2. Immediate to short run effects of higher required equity ratio

As mentioned earlier, firms that try to increase their equity by issuing new equity in the market can often become subject to frictions in that market. The existing shareholders may have to sell the new shares at a discount and become diluted. A theoretical explanation for this has been provided by Myers and Majluf (1984). New outside investors in a firm have less information about the true value of the firm than has the management who

acts on behalf of existing shareholders. Such an information structure implies that the firms with the strongest incentive to issue new shares in the market are those firms which are currently overvalued, i.e., there is a typical lemon problem in this market. Hence, if a firm issues new equity it can often be interpreted as a negative signal about the firm's true value, and the firm's shares have to be sold at a discount in the issuance. This implies that existing shareholders have a preference for increasing equity through retained earnings rather than through issuing new shares.

In particular, a bank that experiences a negative shock to its equity and finds itself uncomfortably close to, or even below, its capital requirement, will as an immediate remedy prefer to reduce its lending rather than raise new equity.[11] There are empirical papers studying the bank lending channel who give support for this prediction. These papers do find evidence that banks with higher capital or equity ratios are more willing to lend more than banks with lower capital ratios.[12] I.e., the further a bank is above the minimum capital requirement the less restrictive is the requirement on its lending. However, these studies do not take into account that regulators may not impose the exact same capital requirements on all banks. Perhaps more importantly, banks may have different internal targets for their capital ratio.

One paper that takes this into account is a paper by Francis and Osborne (2009). They find that UK banks with a larger capital buffer relative to their internal individual capital target has a higher loan growth in the short to medium run. Furthermore, a simulated sudden increase in the required capital by 1 percentage point will result in 1.2 per cent reduced lending as long as four years after the hike, with two thirds of the reduction taking place during the first year.

These results indicate that the short term lending reduction resulting from a higher capital requirement exceeds the steady state longer term impact arrived at in Section 4.1. That may be bad news for ambitions for a large increase in the capital requirements over a short time horizon in countries hampered by recession. However, it may be good news for the use of a countercyclical capital buffer to dampen credit booms. The results found by Francis and Osborne (2009) certainly indicate that a hike in a bank's capital requirement

[11] In such a situation there are no positive earnings to retain.

[12] Examples include Jimenez, Ongena, Peydro, and Saurina (2010) and Foglia, Piersant, and Santoto (2010).

can have an impact on lending during the first year after the hike.[13]

There is one caveat though. None of the papers referred to above have analyzed data from periods where banks across the board suddenly where faced with significantly higher regulatory capital requirements. When regulators require all banks to raise their equity ratio within a short horizon, issuing new equity in the market may not be a significant negative signal about the true value of the individual bank. Thus bank owners may be more willing to raise equity in the market, which may dampen the negative impact on bank lending – whether the hike in the required capital ratio is part of a structural increase in the capital requirement or an implementation of a countercyclical capital buffer.

5. Conclusions and some potential policy implications

In this paper we have demonstrated that a sizeable increase in banks' equity ratio (an increase of 5.5 percentage points) will increase funding costs by an interval ranging from 11 bps to 41 bps. Assuming banks can pass all of the cost increase on to borrowers, the resulting reduction in lending will range from 0.33 to 1.23 per cent of the outstanding stock of loans. However, if a substantially higher equity requirement is implemented with a short deadline, banks are more likely to reduce their lending rather than raise new equity in the stock market due to frictions in that market. In that case the resulting fall in bank lending would be much larger. Hence, in periods where reduction in bank lending is not what regulators want, a substantial increase in capital requirements should be phased in over time, leaving banks with the ability to increase equity by retaining more of their earnings. Increasing equity in that manner could be aided by restrictions on banks ability to distribute dividends until the new capital ratio requirement is met. However, assuming that Norwegian banks retain as much earnings as possible in 2010, would increase the equity ratio by approximately 0.8 percentage points. Allowing for a growth in lending of as much as 10 per cent would reduce the increase in the equity ratio through retained earnings to only 0.1 percentage point (see Andersen, Kloster, and Larsen (2011)). Hence,

[13]However, even if banks do expect the supervisors to impose countercyclical buffers in booms, there may be high uncertainty among banks as to how or when supervisors will impose the extra buffers. In that case, banks may prefer to permanently hold capital buffers large enough that they are not much affected when counter cyclical buffers are imposed. Hence the countercyclical effects of buffers may be much lower than anticipated, but there will be a structural effect: imposition of countercyclical buffers from time to time make banks voluntarily operate with higher capital ratios than they otherwise would have done.

relying on retained earnings to increase the equity ratio by a substantial amount would take too long. Issuing new equity will be necessary, but when it is done as a result of higher required capital for all banks, issuing new equity may not be associated with a negative signal for the individual bank. Thus, in response to higher capital requirements for all banks, they may be more willing to raise equity in the market, rather than to forego profitable business opportunities by reducing their lending.

References

Admati, A. R., P. M. DeMarzo, M. F. Hellwig, and P. Pfleiderer (2010): "Fallacies, Irrelavant Facts, and Myths in the Discussion of Capital Regulation: Why Bank Equity is *Not* Expensive," Stanford GSB Research Paper 2063, Stanford Graduate School of Business.

Andersen, H., T. B. Kloster, and U. Larsen (2011): "Effekter av krav om motsyklisk kapitalbuffer," Unpublished paper, Norges Bank, Financial Stability. In Norwegian only.

Foglia, A., F. Piersant, and R. Santoto (2010): "The Importance of the Bank Balance Sheet Channel in the Transmission of Shocks to the Real Economy," Unpublished paper, Banca d'Italia.

Francis, W., and M. Osborne (2009): "Bank Regulation, Capital and Credit Supply: Measuring the impact of Prudential Standards," Occasional Paper Series 36, UK Financial Services Authority, London.

Hammersland, R., and C. B. Træe (2010): "The financial accelerator and the real economy – Self-inforcing feedback loops in a core macroeconomic model for Norway," Paper presented at Eurostat 6th Colloquium on Modern Tools for Business Cycle Analysis.

Jensen, M., and W. H. Meckling (1976): "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," *Journal of Financial Economics*, 3, 305–360.

Jimenez, G., S. Ongena, J.-L. Peydro, and J. Saurina (2010): "Credit supply, identifying balance sheet channels with loan applications and granted loans," Working paper 1179, European Central Bank, Frankfurt.

Kashyap, A. K., J. C. Stein, and S. Hanson (2010): "An Analaysis of the Impact of 'Substantially Heightened' Capital Requirements on Large Financial Institutions," Unpublished.

Merton, R. C. (1977): "An Analytical Derivation of the Cost of Deposit Insurance and Loan Guarantees – An application of modern option pricing theory," *Journal of Banking and Finance*, 1, 3–11.

Miles, D., J. Yang, and G. Marcheggiano (2011): "Optimal Bank Capital," External MPC Unit Discussion Paper 31, Bank of England.

Modigliani, F., and M. H. Miller (1958): "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, 48, 261–297.

Myers, S., and M. Majluf (1984): "Corporate financing and investment decisions when firms have information that investors do not have," *Journal of Financial Economics*, 13, 187–221.

Spiegel, Y. (1999): "Class notes on corporate finance," Berglas School of Economics, Tel Aviv University, http://tau.ac.il/ spiegel/teaching/corpfin/Topic1.pdf.