The economic costs of higher capital and liquidity requirements: Impact on lending rate and GDP

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SUMMARY: This is an analysis of the economic costs of the Basel III capital and liquidity requirements and is the first of its kind for Denmark. Applying an established methodology, higher requirements are first translated into an impact on a representative bank's lending rate. Next, the impact is used as an input in the macroeconometric model for the Danish economy, ADAM. As a particular contribution, the analysis explicitly takes into account the change in requirements over both the Basel II and Basel III regulatory regimes by including the transition to Basel II risk weighting approaches, including the Internal Rating Based Models. The impact of the so-called Net Stable Funding Ratio (NSFR) is also estimated. Results show that increasing the capital ratio by 1 pct. point will raise the lending rate by a maximum of 6 basis points. The impact from the NSFR is estimated to result in a 16 basis points increase in the lending rate but subject to greater uncertainty. Results point to relatively modest macroeconomic costs from Basel III with an estimated short to medium term negative impact on GDP of 0.29 pct. and a long term impact of 0.09 pct. Noticeably, the NSFR accounts for more than half of the estimated costs.

Keywords: Financial regulation, Financial Crisis, Basel, Capital Requirements, Liquidity, Cost of Capital

JEL: G01, G21, G28

1. Part of the work documented in this article was carried out while the author worked for the Financial Crisis Commission, Kraka, ultimo 2014, cf. Jensen (2014A). I would like to dedicate a special thanks to Tony Maarsleth from the ADAM group at Statistics Denmark for his help with the experiment in ADAM. In addition, a big thanks goes to Jakob Hald, Jens Hauch, Pe-

1. Introduction

In retrospect, financial regulation prior to the financial crisis was too lenient. As a response, the Basel Committee on Banking Supervision proposed the Basel III regulatory regime which is under implementation in the EU through the Capital Requirements Directive IV (CRD IV). Basel III raises the capital ratio requirement (CR^R)[2] from the earlier Basel II regime, both in terms of quantity and quality. Additionally, two new liquidity requirements are introduced: a Liquidity Coverage Ratio (LCR) and a Net Stable Funding Ratio (NSFR).

Higher requirements come with both costs and benefits. Benefits are expected to materialize through a lower future probability of financial crisis and smaller economic losses associated with a given crisis. Costs are likely to arise to the extent that requirements increase banks' funding costs which are then passed on to households and firms either as a drop in the supply of finance and/or a higher lending rates.

In this paper, the cost-side of the Basel III regulation is analysed and quantified. The starting point is an established methodology whereby higher capital requirements are translated into an impact on the bank's lending rate. Similarly, the methodology can be applied to estimate the impact on the lending rate from higher liquidity requirements.

First, a representative bank balance sheet is constructed representing the aggregate Danish banking sector. From this balance sheet, the impact on the lending rate from higher capital and liquidity requirements is then estimated. The lending rate elasticity for the capital requirements is the increase in the lending rate necessary to recoup the extra funding cost associated with a 1 pct. point increase in the CR^R.

To go from the estimated elasticity to the final full impact on the lending rate, two important factors are taken into account. One is the reduction in funding risk and hence the required returns from a higher capitalization. The other is the relationship between changes in capital requirements and changes in banks' actual capital ratio as this is not necessarily a 1:1 relationship.

The impact from the NSFR is derived based on the assumption that banks will choose only to adjust their liabilities by increasing the average maturity. This is done as fairly detailed data is available for use in the calculations. A higher average maturity rate will increase banks' funding costs given a (normal) upwards sloping yield curve.

ter B. Sørensen, Torben M. Andersen, and Nicolai Kaarsen. Comments by anonymous referees are gratefully acknowledged. The usual disclaimer applies.

2. Throughout the text, I will use CR^R to denote the Capital Ratio Requirement and CR to denote the Capital Ratio.

Second, the estimated impact on the lending rate from capital and liquidity requirements is input into the macroeconometric model for the Danish economy, ADAM, to quantify economic and welfare costs of the new regulatory regime. Costs are measured as the percentage deviation of GDP, investments and private consumption from the baseline scenario of no regulatory change.

The analysis is the first of its kind for the Danish economy and differs from previous studies on several accounts. A particular contribution is that this analysis explicitly takes into account the earlier transition to the Basel II regulatory regime. This is important since many, especially larger, banks made a transition to a new risk weighting approach made possible by Basel II, by using so-called Internal Risk Based (IRB) models. IRB models have significantly reduced average risk weights and thus also the amount of capital necessary to raise the regulatory capital ratio by any given pct. point. This will, everything else equal, make it less costly to live up to the now higher capital requirements under Basel III. Not taking this effect adequately into account will significantly overstate the costs.

Another contribution is the analysis on the impact from the structural liquidity requirement, the NSFR. Here, a detailed maturity breakdown of bank debt and interest rates is utilized to quantify the lending rate impact from changing the maturity composition of liabilities.

Throughout the analysis assumptions are applied in a manner likely to produce results which can be interpreted as maximum impacts. Even so, the results point to moderate costs of higher capital requirements compared to other previous studies.

Estimating the impact of the NSFR is subject to greater uncertainty and the requirement has been, and is still, heavily debated as it interferes directly with banks' current business models based on maturity transformation. Interestingly, the analysis finds that the NSFR accounts for more than half of the total estimated economic costs associated with Basel III. The overall conclusion is that whereas evidence is rather robust that higher capital requirements will only offset modest costs, the costs associated with the higher liquidity requirements, in the form of the NSFR, could be relatively much higher.

2. Basel III

The Basel III regulatory regime is formulated by the Basel Committee on Banking Supervision under the Bank of International Settlements (BIS) and is implemented in the EU through the Capital Requirements Directive IV package (CRD IV). Basel III tightens the CR^R and introduces two new liquidity requirements – a so-called Liquidity Coverage Ratio (LCR) and a Net Stable Funding Ratio (NSFR) – to increase banks' resilience towards shorter and longer term liquidity shocks.

All new requirements are phased in gradually. As for capital requirements, the phase in period is from primo 2014 to ultimo 2019. The LCR requirement will have to be met fully in 2018 and CRD IV introduces a long observation period before any possible binding proposal on the NFSR, and there is no agreement on the exact definition yet.[3]

The CR^R is a risk weighted measure meaning that banks are allowed to finance assets with lower perceived risk with less capital (more debt) and vice versa. In practice, this is done by assigning risk weights to each asset using different defined methods and then summing across all assets to get the total risk weighted assets. It is against this measure that banks are required to finance a given percentage by capital as defined regulatory.

Prior to Basel II, banks applied the so-called Standard Method when assigning risk weights. However, with the transition to Basel II banks were given the option to apply for permission to use the so-called IRB models. The transitions to IRB models in predominantly the larger banks led to a significant drop in the average risk weight, thus also in the amount of capital required to finance assets, i.e. the CR^R was in fact eased.

With Basel III, the CR^R is tightened again and not just quantitatively in the sense that the CR^R level is raised, but also qualitative as changes are made especially to the definition of eligible regulatory capital, i.e. capital allowed to be included in the numerator of the CR^R. The narrowest definition of capital, reflecting capital with the highest loss absorbing capacity, is denominated Common Equity Tier 1 (CET1) and is basically equity after a number of subtractions. The analysis in this paper focuses on CET1 since equity, as opposed to debt and other hybrid forms of capital, is considered the most expensive.

On top of the general tightening of the CR^R across all banks, Systemically Important Financial Institutions (SIFIs) are met with even higher requirements based on their individual perceived level of systemicness. In Denmark, these additional SIFI-requirements have been agreed in the SIFI-agreement (SIFI-aftalen) and will apply at different levels for the four Danish SIFIs, raising their CET1 CR^R between 1 and 3 pct. points.

The LCR is designed with the purpose of ensuring that banks hold an adequate amount of liquid assets to withstand a short-run (30-day) stress-scenario with a significant reduction in the access to funding.[4] The NSFR is a more long-

3. Based on reports from the EBA, the Commission will prepare, if appropriate, a legislative proposal by 31 December 2016.
4. In the LCR, the numerator is high quality liquid assets (HQLA) and the denominator is the expected net cash outflow over 30 days under a given stress-scenario. The ratio must be 60 pct. in 2015 and increases 10 pct. points annually until it reaches 100 pct. in 2018. The stress scenario involves e.g.: 1) Significant downgrade, 2) A partial loss of deposits, 3) A loss of funding options, 4) An increase in funding haircuts, and 5) The withdrawal of collateral.

term (structural) measure designed to ensure that banks do not take excessive risk with respect to maturity transformation by forcing them to move towards a higher maturity match between assets and liabilities. Especially the NSFR has received a lot of attentions as it is likely to more fundamentally alter the business model for many banks which is heavily based on maturity transformations.

3. Related literature

A number of key studies have estimated the expected costs of Basel III in terms of a higher lending rate and the associated impact on GDP, cf. OECD (2011), IMF (2012), BIS (2010A), BIS (2010B) and IIF (2011). Table 1 summarizes their key findings. GDP results in Table 1 are stated as annual average impacts ascribed to the implementation of Basel III. E.g., the OECD (2011) result of -0.23 pct. points means that GDP will be 1.14 pct. below the baseline GDP scenario (no regulation) after 5 years.

Table 1: Results from key studies – the impact of Basel III

	Increase in lending rate (basis points)			**Average annual impact on GDP (pct. Points)**		
Long term (steady state) impact						
	EU	**Japan**	**US**	**EU**	**Japan**	**US**
BIS (2010B)[1]	60.0	n.a.	60.0	-0.08	n.a.	-0.04
IMF (2012), Gross	30.5	18.5	49.0	n.a.	n.a.	n.a.
IMF (2012), Net	17.5	8.0	28.0	n.a.	n.a.	n.a.
Short medium term impact						
	EU	Japan	US	EU	Japan	US
IIF (2011)[2] 2011-2020 (core-scenario)	328.0	181.0	243.0	-0.40	-0.30	-0.10
IIF (2011) 2011-2015 (core-scenario)	291.0	202.0	468.0	-0.60	-0.80	-0.60
OECD (2011), 5 year adjustment	54.3	35.3	63.6	-0.23	-0.09	-0.12
	Average (17 countries)			**Average (17 countries)**		
BIS (2010A)[3] 8 year adjustment	15.5 (20.15)			-0.03		

Note:

1. The study estimates the effects from a 1-6 pct. point rise in the capital ratio. For comparability of results, the estimate for a 4 pct. point rise is shown.
2. This study stands out as it estimates substantially higher impacts from Basel III. This is partly because a much higher required return on equity is used, proxied by an estimated shadow price with a threshold from where banks will adjust by reducing lending instead. The results are very sensitive to these assumptions and the authors mention that in the longer run ("normal" market conditions) the results are likely to be less applicable.
3. The lending rate estimate (15.5 basis points) is for a 1 pct. point rise in the capital ratio. The study does not state the lending rate effect of the 1.3 pct. points expected rise. Assuming a linear relationship, the impact would be 15.5*1.3= 20.15 basis points. The stated GDP effect is based on the 1.3 pct. points increase in the capital ratio.

Not surprisingly, estimated short to medium term effects are higher than estimated long term effects. The interest rate effect is higher in the US which can be explained by a relatively higher return to capital and the fact that risk weighted assets are on average higher. American banks must therefore raise a relatively higher amount of capital per 1 pct. point increase in the capital ratio (CR). Despite this observation, the impact on GDP is generally higher in the EU since European firms are comparatively more dependent on bank funding relative to alternative sources of finance.

Results in Table 1 are not fully comparable due to differences in core assumptions and coverage of regulatory measures included in the different analyses. For an in-depth presentation and discussion of these differences, the interested reader is referred to Jensen (2013), IMF (2012) or COMM (2014).

For the purpose of this analysis, it is worth mentioning especially two core assumptions where differences can lead to large differences in the estimated results. The first assumption concerns how banks change their capital buffers[5] as a response to changes in the CR^R. The second assumption concerns the cost of raising the ratio of equity to total assets, and here the discussion of the so-called Modigliani-Miller (MM) Theorem. At its core the theorem is an irrelevance proposition providing the conditions under which a firm's funding decisions do not affect its value, hence neither its overall funding costs, cf. Modigliani and Miller (1958). A few examples will help illustrate the potentially large differences.

Despite the fact that the two studies BIS (2010A) and OECD (2011) approximately estimate the same size lending rate elasticity of higher CR^R, OECD (2011) estimates a significantly higher impact from Basel III. The difference is likely driven by the fact that OECD (2011) assumes that banks will raise their CR by the full amount of the regulatory change in the CR^R whereas BIS (2010A) assumes that banks will eat into their capital buffers first.

IMF (2012) estimates a significantly lower lending rate impact than BIS (2010B) despite the fact that IMF (2012) also includes changes in several other regulatory measures. The difference is likely driven by the fact that IMF (2012) halves the originally estimated lending rate elasticity on the count of the so-called Modigliani-Miller effect (MM-effect), and also assumes a number of other cost mitigating responses banks can activate leading to the even lower 'net' result, cf. Table 1.

5. The capital buffer is defined as the difference between the actual capital ratio (CR) and the minimum capital ratio requirement (CR^R).

4. The impact on the lending rate from capital requirements

Higher CR^R can be translated into an effect on the bank's lending rate using a zero profit balance sheet condition under the assumption of free entry into the banking industry, cf. (1).

$$r^L \cdot L + r^{OA} \cdot OA = r^E \cdot E + r^D \cdot D \qquad (1)$$

The right-hand side of (1) is the bank's Weighted Average Cost of Capital (WACC). D denotes the share of debt liabilities to total assets with the price r^D. E is the share of equity to total assets with a price (required return) of r^E. The left-hand side is the average return on the bank's investments. L denotes the share of loans to total assets with a return of r^L (the lending rate) and OA denotes the share of other assets to total assets with a return of r^{OA}. Assuming the bank can set r^L but not directly affect the price on other assets, the bank will set r^L, so that (1) holds with equality.

The implication of the equality assumption in (1) is that banks are forced to fully pass-through any additional funding costs to customers, i.e. by increasing the lending rate. In that sense, this assumption will ensure that the estimated lending rate elasticity represents an upper bound and that results are not biased downwards.

It should be noted that the Danish banking sector is not likely characterized by perfect competition, cf. Kaarsen (2014). The implication of market power would be that the left-hand side of (1) is higher than the right-hand side. Consequently, the pass-through of higher funding costs is ceterius paribus likely to be smaller, cf. RBB (2014) and Weyl (2013).

Assuming that (1) holds, let the bank raise its CR with 1 pct. point and adjust by increasing the lending rate. The result is shown in (2) where RW is the share of risk weighted assets to total assets, i.e. the average risk weight assigned to the bank's assets.

$$(r^L + \Delta r^L) \cdot L + r^{OA} \cdot OA = r^E \cdot (E + RW) + r^D \cdot (D - RW) \qquad (2)$$

Next, isolate r^L in (1) and insert in (2). Then rearrange to get the lending rate elasticity, i.e. the increase in the lending rate from a 1 pct. point increase in the CR, cf. (3).

$$\Delta r^L = \frac{(r^E - r^D)}{L} \cdot RW \qquad (3)$$

The lending rate elasticity is higher, the higher the spread between the cost of equity and debt. It is also higher, the higher the average risk weight as more capital must then be raised in order to increase the (risk weighted) CR by 1 pct. point, and it is lower for a higher share of loan assets.

So far, the implication of the MM-theorem has not been considered. It is expected that investors and creditors will lower their required returns in exchange for lower funding risk from a higher capitalization. Modigliani & Miller (1958) showed that in a market without imperfections, a company's WACC should be independent of the composition of funding. This implies that we should expect no change in funding costs from higher CR^R. However, this "full-effect" is not likely to be present due to a number of imperfections such as the tax favouring of debt over equity funding and implicit guarantees to the banking sector. The size of the potential MM-effect will be dealt with later in the analysis.

For now, if data for the four right-hand side variables of (3) can be found, the lending rate elasticity can be estimated for Danish banks.

5. Data and results – capital requirements

Data for RW and L is directly observable from banks' balance sheets whereas data for r^D and r^E has to rely on estimates which are subject to uncertainty. The impact on the lending rate in (2) does not depend on the actual (earlier) return on equity (RoE) but rather on the investor's future required return on equity. Therefore, it is not necessarily correct to use historical return on equity (RoE) as proxies for r^E which is the typical approach in previous studies.

In the following, the required return on equity is first estimated using the Capital Asset Pricing Model (CAPM) for Danish banks listed on the stock exchange. Second, returns are proxied by historical averages for all Danish banks group 1-3. The results are stated in Tables 2 and 3 and are in both cases weighted averages (using total assets) across banks in the samples. Thus, results can be interpreted as representative of a bank loan provided by the aggregate banking sector, or the SIFI banking sector which is also stated separately in Table 2.

The CAPM model can be used to estimate the bank's cost of equity, i.e. investors' required return, r^E. According to CAPM, r^E can be stated as the risk free interest rate plus a bank-specific risk premium given by the aggregate market risk premium times CAPM-beta. CAPM-beta measures the correlation between the return on the bank's stocks and the return on the aggregate (reference) stock market, and thus the relative volatility (risk) of the specific bank stock, cf. appendix A for a presentation of the CAPM-model and examples.

Applying the CAPM approach, the lending rate elasticity is estimated at 7.2 basis points, cf. Table 2 last row. The estimate is based on all Danish banks listed on the stock exchange. For SIFI banks alone, the estimate is at most 6.8 basis points. For L and RW balance sheet data is used anno 2012. For r^L, the 'cost of debt' as estimated in Bloomberg is used which is the after-tax weighted interest rate on debt, cf. appendix A for details.

Table 2: Lending rate elasticities

	r^E-r^D (pct. points)	L (pct.)	RW (pct.)	Δr^L (basis points)
SIFI-banks				
Before the crisis (avg. 2004-2006)	4.0	57.9	42.9	3.0
»After« the crisis (2012)	13.4	53.2	27.0	6.8
All banks listed on the stock exchange				
Before the crisis (avg. 2004-2006)	4.0	55.8	44.1	3.1
»After« the crisis (2012)	13.1	53.5	29.4	7.2

Note: Elasticities are the increase in the lending rate from a 1 pct. point increase in the risk weighted capital ratio. All variables are weighted according to bank size (assets 2012) on a consolidated level. SIFI-banks are: Danske Bank, Sydbank, Jyske Bank, and Nordea DK. Together they covered 81.7 pct. of the banking sector in 2012. For Nordea DK data from Nordea AB (consolidated level) is used in the calculation of the required return and interest rate on debt. The share of loans to assets and the average risk weight is for Nordea DK.

Source: The Danish FSA, Bloomberg and own calculations.

The calculated lending rate elasticity is significantly lower prior to the crisis (2004-2006) than "after" (2012). If risk weights prior to the crisis (and prior to the transition to IRB models in the large banks) are used, the elasticity is only approximately 3.0 basis points. This primarily reflects that the spread between the required return on equity and debt was far smaller in the good years leading up to the crisis than it has been after the crisis.

An important observation is the large drop in the average risk weight. This effect is not included in e.g. OECD (2011) where only an average based on data prior to the crisis is used, 2004-2006.[6] A fall in the average risk weight should be included in the calculation as it lowers the capital necessary to raise the CR by 1 pct. point. As an example, the weighted average RW was 54.5 pct. for all Danish banks (group 1-3) in 2004. In 2012, this had dropped to 35.1 pct. Assuming a constant spread between r^E and r^L of 14 pct. points and a loans-to-asset ratio of 55 pct., a fall in RW from 55 to 35 would lower the estimated lending rate elasticity by as much as 4.2 basis points.

Using only historical averages from 2004-2006 (not CAPM) to determine the required return on equity raises the lending rate elasticity to 15.8 basis points, cf. Table 3 first row. Here, the average return on equity is used (15.6 pct.) as a proxy for the required return. It should be noted that the return in the years leading up to the financial crisis was historically very high.

6. Table 3, page 8 in OECD (2011).

If instead only data from 2012 is used, the impact falls to as little as 0.11 basis points. The main explanation is that the spread between the actual return on equity and the interest rate on debt falls significantly in 2012 as banks undertake large write downs and the average risk weight has fallen significantly.

A more realistic scenario would be to base the required return on a longer historical period and not only the three extraordinary good years prior to the crisis. Using data for 2000-2012, the average return was 8.1 pct. and the average interest rate on debt 2.7 pct. For L and RW, it is more accurate to use the latest available data, here 2012. The lending rate elasticity is then 4.5 basis points, cf. the last row in Table 3.

Table 3: Lending rate elasticities

All banks group 1-3	r^E-r^D (pct. Points)	L (pct.)	RW (pct.)	Δr^L (basis points)
Before the crisis (avg. 2004-2006)	13.04	45.2	54.8	15.8
After the crisis (2012)	0.13	42.3	35.1	0.11
Full period (avg. 2000-2012 for rE og rL, 2012 data for L og RW)	5.4	42.3	35.1	4.5

Note: Elasticities are the increase in the lending rate from a 1 pct. point increase in the risk weighted capital ratio. Calculations are made based on aggregate balance sheet data for group 1-3 banks covering almost the entire banking sector (99.95 pct.) measured by total assets, cf. Table B.1 in appendix B for data and calculations.

Source: The Danish FSA, banks' balance sheets and own calculations.

Based on the results in Table 2 and 3, it is reasonable to assume that a 1 pct. point increase in the CR in the most likely scenario will raise the lending rate by approximately 6 basis points, with a clear tendency that the impact is lower in good times and higher in times of financial stress. 6 basis points is the (rounded) average of the two final results in Tables 2 and 3 (7.2 and 4.5 basis points) which also happens to be the overall average across all scenarios in the Tables. Compared to the previously mentioned key studies this elasticity is rather low, cf. Table 4.

Table 4: Estimated lending rate elasticities (basis points)

OECD (2011)	**BIS (2010B)**	**BIS (2010A)**
14.3	13.0	15.5

Note: Elasticities represent the increase in the lending rate from a 1 pct. point increase in the risk weighted capital ratio. The elasticity for OECD (2011) is specifically for the euro-area.

One possible explanation is that when studies rely on historical pre-crisis averages, they do not take into account the possible drop in RW from the transition to Basel II risk weighting approaches, importantly the introduction and extension of IRB models. As mentioned, this drop has been substantial in Denmark, significantly lowering the capital necessary to raise the CR with 1 pct. point. Furthermore, it is not necessarily realistic to use averages of prices based on a few years leading up to the crisis as profits in the banking sector were extraordinarily high in many countries, including Denmark.

In order to go from the estimated lending rate elasticity, Δr^L, to the full impact on the lending rate, Δr^L_{Full}, from raising the CR^R under Basel III, two important questions must be addressed. First, what is the relationship between funding risk (leverage) and the required risk premia on equity and debt? Second, how much will banks choose to raise their actual CR when faced with a regulatory increase in the CR^R?

Adding these two factors, we can write the full impact as the above estimated lending rate elasticity, Δr^L, corrected for the relationship between funding risk and risk premia, the so-called MM-effect (1-MM), multiplied by the actual chosen pct. point increase in the CR from changing the regulatory CR^R, denoted ΔK, cf. (4).

$$\Delta r^L_{Full} = (1 - MM) \cdot \Delta r^L \cdot \Delta K \qquad (4)$$

According to the MM-theorem, MM would equal 1 in a market without imperfections and there would be no impact on funding costs from changing the composition of equity and debt.

5.1. The MM-effect

When a bank raises its capitalization, funding risk (probability of bankruptcy) reduces. As investors now face lower risks, they will lower their required return, i.e. the risk premium will fall. Consequently, the above estimated lending rate elasticity is too high as the relationship between funding risk and risk premium so far has not been accounted for.

In a market without imperfections, the negative link between funding risk and capitalization is such that a company's WACC is independent of the composition of funding (debt vs equity). This was shown in Modigliani and Miller (1958). Total asset risk of the bank's portfolio is distributed between creditors and shareholders in a "closed circuit" and is independent of the bank's choice of funding. Hence, changing the funding composition will only work as to redistribute a fixed amount of (asset) risk between creditors and shareholders, leaving the WACC unchanged.

The reasoning behind this result is intuitively simple and the debate and disagreement often concern the underlying assumptions - i.e. the prevalence of relevant market failures and their strength. Particularly two market failures are important to consider.

First, implicit guarantees for systemic institutions mean that banks' asset- and funding-risk are not fully borne by shareholders and creditors but partly also by the government (taxpayers). The implication is a decoupling or weakening of the link between investors' risk premium and funding risk, providing the banks with an incentive to undertake highly leveraged activities as shareholders will earn higher returns. Conversely, the risk premium on sovereign debt (the "insurer") will rise.[7]

Second, whereas interest paid on debt can be deducted from taxable profits, dividends paid out to shareholders cannot, creating an additional incentive for banks to leverage their balance sheet.

In other words, it is not likely that banks' funding costs will stay unchanged when altering the funding composition since multiple market failures are present. Several empirical studies have tried to estimate the size/strength of the relationship between funding risk and returns. One often cited study finds a so-called MM-effect of at least 45 pct., i.e. the rise in funding costs from reducing leverage (funding risk) is at a maximum 55 pct. of what the rise would have been, had there been no relationship between leverage and the required risk premium, cf. Miles et.al. (2011). Referencing Miles et. al (2011), IMF (2012) applies a 50 pct. MM-effect to their estimated lending rate elasticity, thereby slashing its size in half.

Based on the same methodology, attempts have been made to estimate the MM-effect for Danish banks, cf. Jensen (2014B). The overall results point to a MM-effect of at least 30 pct., although it is not possible to conclude on the effects for the Danish SIFI-institutions. In a more recent investigation on the determinants of international banks' funding costs, there is no evidence supporting that higher capital buffers will raise funding costs in the long term for the sample of Nordic and European Banks (MM-effect of 100 pct.), cf. IMF (2014).

Even though empirical results are mixed, there are no signs that the MM-effect should be zero but rather that it could be quite large. It would therefore be misleading not to include such an effect in the estimations.[8]

In this paper, a MM-effect of 30 pct. is applied based on Jensen (2014B) which then results in a maximum effective lending rate elasticity of 4.2 basis points.[9]

7. Bail-in legislation in the EU (the Bank Recovery and Resolution Directive) addresses the issue of implicit guarantees (bail-outs). If successful, this should in theory re-establish the link between funding risk and the risk premia, thus bringing us closer to the workings of the MM-theorem.
8. Importantly, the size of the effect is also likely to depend on how other parts of the financial regulation address the imperfections affecting the link between required returns and funding risk, cf. footnote 7.
9. 4.2=(1-0.3)*6

5.2. The change in the capital ratio, *ΔK*

The next important question is: by how much are banks expected to change their actual capital buffers as a response to higher CR^R?

To answer this question we start by looking at the Basel III increase in the CR^R for CET1 capital and afterwards take into account the Basel II transition from Standard to IRB risk models starting in 2007/2008 in the larger Danish banks. As argued earlier this transition significantly reduced risk weights, contributing to a technical lift in banks' CR, helping them meet the now higher Basel III requirements without raising additional capital compared to the situation prior to the financial crisis.[10]

Here, the focus is on CET1 capital and the assumption is that CET1 replaces debt and not supplementary and/or hybrid capital which are more expensive than debt, but less expensive than equity. This assumption will like earlier assumptions ensure that results are not biased downwards.

It should be noted that since the start of the crisis Danish banks have already increased their CRs significantly, cf. Table 5 where unweighted and risk weighted capital ratios are listed for equity (E) and CET1. Listed is also the Basel III compatible CET1 ratios for which data are available from 2012.

10. Interestingly, the size of the impact on banks' CR from the transition to IRB models is actually so large that it ensures that the new solvency (total capital) requirements in CRD IV plus the additional SIFI requirements are already met on average, cf. Kraka (2013). Compared to the situation prior to the financial crisis, the new Basel III requirements are therefore primarily working by ensuring that a higher share of total capitalization (solvency) is made up of CET1 capital, i.e. capital of the highest quality (loss absorbing capacity).

Table 5: Capital ratios (weighted) for Danish banks, pct.

	2007	2008	2009	2010	2011	2012	2013
	-- Pct. --						
Group 1 banks							
a. E/RWA	8.1	10.2	11.5	12.1	13.3	16.0	16.7
b. E/A	3.3	3.0	3.4	3.5	3.8	4.2	4.8
c. CET1/RWA	6.5	8.6	9.6	10.0	11.6	14.1	14.6
d. CET1/A	2.6	2.6	2.8	2.9	3.3	3.8	4.2
Basel III compatible ratios[1]							
e. CET1/RWA	-	-	-	-	-	12.4	13.2
f. CET1/A	-	-	-	-	-	2.9	3.4
Group 2-4 banks							
g. E/RWA	11.89	12.30	13.67	14.07	16.83	15.75	-
h. E/A	10.88	9.58	10.11	10.31	11.83	10.50	-
Group 2 banks							
i. E/RWA	11.4	11.0	12.2	13.2	13.4	15.5	-
j. E/A	8.9	8.1	8.1	8.9	9.0	9.2	-

Note: E=Equity, CET1=Core Equity Tier 1 capital, A=total assets, RWA=Risk Weighted Assets. For group 2 banks, the data is on institute-level while the data for group 1 banks is on consolidated-level. The weighting is based on assets in the given year
1) Basel III compatible ratios are only stated for Danske Bank and Nordea Sweden for 2012 and 2013.

Source: The Danish FSA, annual accounts and Bloomberg.

The previously referenced key studies differ in terms of the expected rise in CR necessary to meet the new higher CR^R, cf. Table 6. These differences are due to differences in assumptions regarding banks' capital buffers.

Table 6: Assumed change in the risk weighted capital ratio (equity) from Basel III from key studies, (pct. points).

IMF(2012)[1]	OECD(2011)[2]	BIS(2010A)[3]
2.88	3.8	1.3

Note: 1, 2 For European banks. 1 Banks will choose a CET1 capital buffer of 3 pct. point, i.e. a capital ratio of (7 pct.). 2 Banks will maintain the same capital buffer as under Basel II based on annual accounts 2010.
3 Banks will reduce their capital buffer.

The conclusion from an often cited empirical study based on British banks is that banks will raise the CR with approximately 65 pct. of the change in the bank specific CR^R, cf. Francis and Osborne (2009).[11] Basel III raises the general CET1 requirement by 5 pct. points with the full phase in of CRD IV in 2019. Given the result from Francis and Osborne, this would ceterius paribus cause banks to raise their capital ratio by 3.25 pct. points.

However, on top of the 5 pct. points, SIFI-banks are required to increase capitalization further with the additional SIFI-requirements, cf. Table 7 which shows the total increase for the four Danish SIFIs and the rest of the banking sector.[12]

Table 7: Change in risk weighted capital requirements (CET1), pct. points

Danske Bank	Nordea	Jyske Bank	Sydbank	Group 2-4[1]
8	7	6.5	6	5

Note: The change includes the requirements in CRD IV and the additional SIFI-requirements.
1. Also includes Nykredit Bank A/S

Source: CRD IV, the Danish FSA and the Danish SIFI-agreement ('Bankpakke 6').

In total, the average weighted[13] increase in the CR^R for the Danish banking sector is approximately 7 pct. points, which will then likely result in an increase in the CR of approximately 4.6 pct. points, cf. the result from Francis and Osborne (2009).[14]

So far only the quantitative rise in CR^R has been considered. However, as previously mentioned Basel III also tightens quality. For European banks the CET1 ratio falls 3.25 pct. points when moving from the Basel II to the Basel III definition, cf. EBA (2014A). This is probably a bit lower for Danish banks. Danske Bank and Nordea state their Basel III compatible ratios, and they are about 2 pct. points below the Basel II ratio based on data for 2012, cf. the difference between row c and e in Table 5. It would therefore be correct to add approximately 2 pct. points to the overall tightening of the Basel III CR^R.

Based on the above reasoning and data, it is expected that the total weighted change in the CR as a consequence of Basel III plus the SIFI-requirements is approximately 5.85 pct. points.[15] However, the Basel III increase in CR^R after the financial crisis should not be seen in isolation from the relaxation of the CR^R with the transition to Basel II implemented by the large Danish banks at the beginning of the financial crisis in 2007/2008.

11. The study estimates the long term determinants of banks' target risk weighted capital ratio as a function of the bank specific capital requirement.
12. Besides these measures, the authorities can add additional requirements using a countercyclical capital buffer.
13. Weighted by loans (6.9) or by assets (7.1) anno 2012.
14. 4.6=0.65*7
15. 5.85=0.65*(7+2)

5.3. The transition to Basel II risk weighting

An earlier analysis of the transition to IRB models showed a substantial technical lift in the CR for large Danish banks through a reduction in the average RW, cf. Kraka (2013). The lift will make it easier to live up to the now higher Basel III CR^R compared to the time before the financial crisis. The technical lift has been high and increasing for several SIFIs over the period 2007-2012, cf. Table 8.

For the large Danish banks, the technical lift can be directly calculated as they state both the Basel I and Basel II CRs in their accounts. For group 2-4 banks, the transition from the standard approach under Basel I to the standard approach under Basel II meant an average reduction in RW from 91.5 pct. to 77.8 pct. from 2007 to 2008, cf. appendix B.

Tabel 8: Technical lift compared to the Basel III tightening, pct. points

		2007	2008	2009	2010	2011	2012	Tighte-ning
Danske Bank	Actual	5.6	8.1	9.5	10.1	11.8	14.5	
	Basel I	5.6	5.4	6.0	6.3	7.6	8.4	
	Technical lift	**0.0**	**2.6**	**3.5**	**3.8**	**4.2**	**6.1**	**8+2=10**
Nordea	Actual	9.5	10.3	8.9	8.9	10.1	12.1	
	Basel I	7.2	6.4	5.7	5.4	6.0	6.7	
	Technical lift	**2.3**	**3.9**	**3.2**	**3.5**	**4.2**	**5.4**	**7+2=9**
Jyske Bank	Actual	6.9	9.6	11.9	12.6	12.2	14.2	
	Basel I	6.9	7.8	9.8	9.8	9.7	11.9	
	Technical lift	**0.0**	**1.8**	**2.2**	**2.9**	**2.5**	**2.3**	**6.5+2=8.5**
Sydbank	Actual	7.8	9.3	11.5	12.7	13.4	13.8	
	Basel I	7.8	7.5	-	-	-	-	
	Technical lift	**0.0**	**1.8**	**-**	**-**	**-**	**(3.2)**[1]	**6+2=8**
Group 2-4	**Technical lift**	**-**	**-**	**-**	**-**	**-**	**(2.7)**[1]	**5+2=7**

Note: The technical lift is the difference between the bank's actual CET1 ratio calculated under Basel II (IRB models) and calculated under the Basel I standard approach.

1. It is not possible to obtain data to calculate the actual technical lift. See appendix C for calculation of the estimates.

Source: Annual accounts and own calculations.

Table 9 summarizes the findings by stating the detailed breakdown of the higher CR^R and compares the total with the size of the technical lift (column e) per 2012. Included for all banks is also the earlier mentioned implicit tightening of 2 pct. points from the change in the quality (definition) of capital.

Table 9: Basel III tightening vs. technical lift (pct. CET1)

	a. Basel III	b. SIFI-requirement	c. Implicit tightening	d. Total tightening (a+b+c)	*e. Technical lift*	**f. Net-tightening (d-e)**
Danske Bank	5	3	2	10	*6.1*	**3.9**
Nordea	5	2	2	9	*5.4*	**3.6**
Jyske Bank	5	1.5	2	8.5	*2.3*	**6.2**
Sydbank	5	1	2	8	*3.2*	**4.8**
Group 2-4	5	-	2	7	*2.7*	**4.3**

Note: The table compares the total tightening of the capital requirements (fully phased in 2019) with the technical lift as stated in Table 8 calculated based on annual accounts 2012.

Source: The table compares the total tightening of the capital requirements (fully phased in 2019) with the technical lift as stated in Table 8 calculated based on annual accounts 2012.

Based on the results stated in Table 9, the weighted average net tightening of the requirement is approximately 4.13 pct. points.[16] This end-result thus includes both the quantitative and qualitative tightening of the Basel CR^R, the Danish SIFI-requirements and takes into account the transition to Basel II risk weighting.

Finally, the results should be adjusted for the empirically identified relationship between the actual change in CR and CR^R in Francis and Osborne (2009). Based on this, the conclusion is that the Danish banking sector will raise the CR by approximately 2.7 pct. points.[17]

5.4. Summary - The impact on the lending rate from higher capital requirements

The above results can now be inserted in (4) to find a full impact on the lending rate of 11.3 basis points, cf. (4′).

$$11.3 = (1 - 0.3) \cdot 6 \cdot 2.7 \qquad (4')$$

Where 0.3 is the MM-effect, MM, 6 is the estimated lending rate elasticity, Δr^L, and 2.7 is the change in the CR, ΔK.

6. The impact on the lending rate from liquidity requirements

It is difficult to calculate the impact of the LCR due to a lack of data. The EBA has assessed the impact of the LCR in the EU based on data for 2012 provided volun-

16. The sum of individual net tightenings times their weight (loans) anno 2012: 4.13 =3.9*0.47+3.6*0.19+6.2*0.07+4.8*0.04+4.3*0.23
17. 2.7=0.65*4.13

tarily by banks, cf. EBA (2014B). The conclusion is that the LCR will have a negligible negative impact on EU GDP of about 3 basis points in the long term.

There is a general concern that the NSFR will have a higher impact on banks' funding costs or ability to provide long term financing as it more fundamentally restricts the possibility to undertake maturity transformations and thus directly interferes with banks' current business models. It is uncertain how banks will choose to adjust to the NSFR, but in general there are 5 different adjustment channels:

1. Lengthen the maturity of liabilities.
2. Shorten the maturity of assets.
3. Increase capital.
4. Shift to assets of a higher quality (lower risk weight and return).
5. Shrink the balance sheet (deleverage).

BIS (2010B) calculates the impact from the NSFR by assuming that banks as a first reaction will choose channel 1. More specifically, it is assumed that banks will phase-out all debt with a maturity up to and including 1 year. Given a normal upwards sloping yield curve, this will increase funding costs.[18]

In the following, it is assumed that banks will only choose to adjust by lengthening the maturity of debt liabilities while keeping the maturity of assets unchanged. The impact on the lending rate can again be estimated using (1), here in a slightly more elaborate version where debt liabilities are now split into different maturities, M, cf. (1').

$$r^L \cdot L + r^{OA} \cdot OA = r^E \cdot E + r_1^D \cdot D_1 + r_2^D \cdot D_2 + \ldots + r_M^D \cdot D_M \qquad (1')$$

Say for simplicity that the bank will adjust to the NSFR by moving all debt with a maturity up to 1 year to a maturity of 2 years, cf. (5).

$$\Delta D_1 = -\Delta D_2 \qquad (5)$$

This will result in higher funding costs given a normal (positive sloping) yield curve, cf. (6).

$$r_1^D < r_2^D < \cdots < r_M^D \qquad (6)$$

18. E.g., BIS (2010B) assumes a spread of 100 basis points (1 pct. point) between short and long term debt.

Given (6) this will increase the cost of debt and lead to a fall in the return on equity. The bank is then assumed, as for the capital requirements, to react by raising the lending rate until (1′) again holds with equality. The necessary change in the lending rate is then, cf. (7).

$$\Delta r^L = \frac{\Delta D_1 \cdot (r_2^D - r_1^D)}{L} \tag{7}$$

Alternatively, and perhaps more realistically, the bank can react by phasing out debt with M=1 and under, and distribute it on other maturities given a 'debt distribution profile', cf. (8).

$$\Delta D_1 = -(\Delta D_2 + \Delta D_3 + \cdots + \Delta D_M) \tag{8}$$

The impact on the lending rate would then be as in (9).

$$\Delta r^L = \frac{\Delta D_1 \cdot r_1^D + \Delta D_2 \cdot r_2^D + \cdots + \Delta D_M \cdot r_M^D}{L} \tag{9}$$

In order to make the above calculations, a number of additional non-trivial assumptions are necessary. The analysis is sensitive to these assumptions and they are described in box 3 along with the data used.

The BIS (2010B) assumption that banks will phase out all debt with a maturity of 1 year and below is probably too strict as Basel revised the NSFR in January 2014. According to the former definition, all funding with a maturity below 1 year was given a zero weight in the calculation of the bank's Available Stable Funding (ASF), i.e. it did not count as stable funding. In the latest revision, all funding with a remaining maturity under 1 year from non-financial business customers, public institutions and other non-private institutions is given a weight of 50 pct. and so is funding from credit institutions with a remaining maturity between 6 months and below 1 year. In other words, approximately 50 pct. of short term funding can now be counted as ASF.

Box 3: Assumptions, data and calculations – impact of the NSFR

Assumptions, debt distribution and interest rates

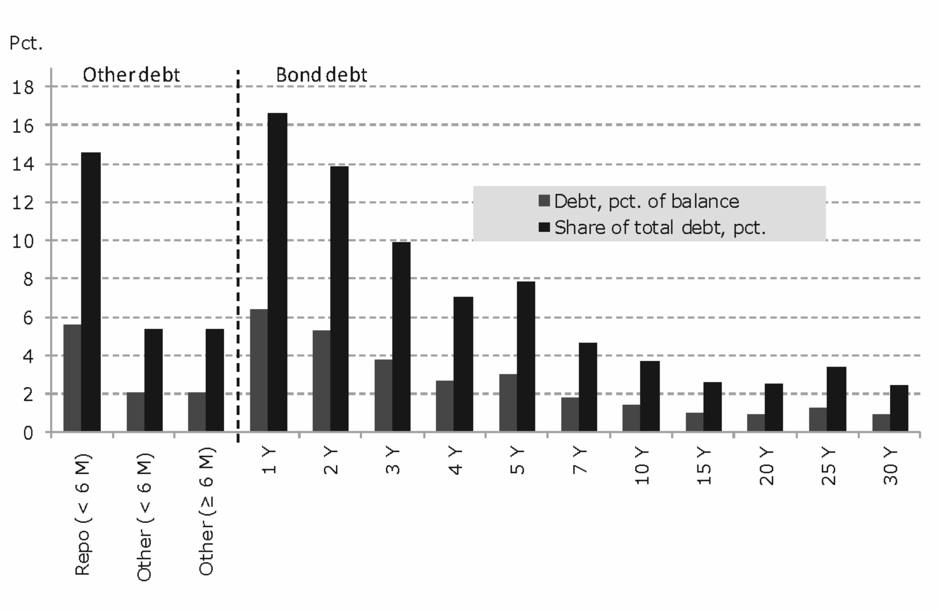
First, assume the bank cannot replace debt with deposits but only alter the composition of bond, repo and other debt. Next, it is necessary to know how much debt banks have, with what maturity distribution and at what prices. For debt, Danske Bank's annual report for 2013 is used as it provides detailed data. Also, it is expected that it is mostly the larger Danish banks that will have to adjust to fulfill the NSFR as many smaller banks already meet the ratio, cf. IMF (2014).[19]

Danske Bank's total debt (excl. deposits) makes up 38.3 pct. of the balance.[20] The distribution is approximately 28.6 pct. bond debt and 9.7 pct. debt to credit institutions and central banks, here called 'other debt'. 'Other debt' is distributed between repo debt[21] (secured) and other debt (unsecured), here called 'other' with respectively 5.6 pct. points and 4.1 pct. points. Almost all of this debt has a maturity of a maximum of 1 year.[22]

In the calculations, it is assumed that all repo debt has a maturity below 6 months and that the remaining debt 'other' is distributed evenly between a maturity below 6 months, and 6 months or above, i.e. 2.05 pct. points in each category. The maturity profile of bond debt is based on the aggregated 'debt distribution profiles' for the four largest banks (Danske Bank, Nordea Denmark, Jyske Bank, and Sydbank). Figure 1 shows the debt maturity profile.

19. IMF (2014) calculates and compares the NSFR for banks across 28 countries including the 35 largest Danish Banks (excl. Nordea DK) based on 2012. Only 5 of the Danish banks do not fulfill a NSFR-ratio of a minimum of 1 (Danske Bank, Sydbank, Spar Nord Bank, FIH Erhvervsbank, and Alm. Brand A/S).
20. Approximately 924 bio. kr.
21. A repo-agreement is a loan agreement between two parts where the borrower provides the lender with safety in the form of e.g. government bonds. The bonds are given to the lender with the promise of repurchase at a given price at a given future point in time.
22. Danske Bank's annual report 2013, p. 66, note 21, p. 104 and note 27 p.109.

Figure 1: Debt maturity distribution profile, (pct.)



With the associated interest rates for each debt and maturity class, the impact on the lending rate from the redistribution of debt can now be estimated. For bond debt, a yield curve based on Danske Bank's outstanding bond debt (unsecured senior euro-denominated debt) is used. For repo debt, the lending rate of the Danish National bank is used.[23] For 'other', the unsecured money market rate is used, the so-called CIBOR-rate[24], denoting the price for unsecured lending between credit institutions. Debt with a maturity below 6 months is given a 3-month CIBOR rate and debt with a maturity of 6 months and over a 6-month CIBOR-rate. Table 10 summarizes the debt distribution and prices.

23. This rate is the lending rate charged by the National bank for a secured loan, e.g. a so-called repo-loan. These loans often have a maturity of one week.
24. Copenhagen Interbank Offered Rate.

Adjusting debt liabilities

Simplified, the cost-calculation of the NSFR is made based on a one-time adjustment of debt liabilities. The NSFR assigns a zero weight to debt with a maturity below 6 months when calculating the bank's Available Stable Funding (ASF). It is therefore assumed that all repo debt and the part of 'other' with a maturity below 6 months becomes 'other' with a maturity of 6 months and above. In other words, this debt is moved to a 6 months CIBOR-rate. Bond debt with a maturity of 1 year is reduced by 50 pct. which leaves this particular maturity class with a size of 3.19 pct. of the balance, cf. Table 10. The bank can therefore only choose to add bond debt to maturities above 1 year until the particular maturity class reaches 3.19 pct. of the balance since these classes over time eventually will also reach an outstanding maturity of 1 year and below. Therefore, it is assumes that the bank will "smoothen" the maturity profile so that no bond debt maturity class exceeds 3.19 pct. of the balance.

The above described debt redistributions result in a 21.4 basis points impact on the bank's lending rate according to (9). Since it is only expected that it is the larger institutions that will have to make the adjustment, the impact can be multiplied by a factor of 0.8 denoting the approximate market share of the four largest banks. This reduces the impact to 17 basis points. A sensitivity analysis shows that if banks instead only wish to phase out half of its 'other debt' with a maturity below 6 months, as for 1 year bond debt, the result does not change much as this would lead to a lending rate impact of 14.7 basis points.

Table 10: Debt distribution and prices

	Price pct.	Pct. of assets	Pct. of total debt
Repo debt (secured)			
<6 mths.	0.2	5.6	14.58
Other debt (unsecured)			
< 6 mths.	0.375	2.05	5.35
≥ 6 mths.	0.55	2.05	5.35
Bond debt (unsecured senior)			
≤ 1 year	0.514	6.39	16.67
≤ 2 year	0.618	5.31	13.85
≤ 3 year	0.764	3.79	9.88
≤ 4 years	0.941	2.70	7.04
≤ 5 years	1.144	3.01	7.86
≤ 7 years	1.588	1.80	4.71
≤ 10 years	2.073	1.43	3.74
≤ 15 years	2.536	0.99	2.58
≤ 20 years	2.746	0.97	2.54
≤ 25 years	2.827	1.30	3.39
≤ 30 years	2.851	0.95	2.47
Sum		**38.34**	**100**

Note: For repo debt, the lending rate from the Danish National Bank is used. For 'other debt', a 3 and 6 month CIBOR-rate is used. The debt maturity distribution profile for bond debt is based on the Danish SIFI's outstanding bond debt ultimo 2013.The distribution of bond and 'other debt' is based on Danske Bank's annual account 2013.

The bond yield curve is calibrated from Danske Bank's outstanding euro-denominated unsecured senior debt as of 14 July 2014.

Source: Bloomberg (DDIS for outstanding debt maturity distributions and BVAL-curves for the yield curve), the Danish National Bank, and Danske Bank's annual accounts 2013

Applying the data and assumptions presented in Box 3 and using (9), the estimated impact of the NSFR on the lending rate is approximately 16 basis points.

Comparatively, BIS (2010) finds that the NSFR will likely result in a 14 to 25 basis points increase in the lending rate. IMF (2012) estimates that in sum the NSFR and LCR will increase the lending rate by 14 basis points (specifically for the Euro Area).

7. The combined impact of capital and liquidity requirements

The combined full impact on the lending rate from higher capital and liquidity requirements can be calculated as the sum of the two estimated impacts, cf. (10), where the impact of the NSFR is denoted Liq.

$$\Delta r_{Full}^{L} = (1 - MM) \cdot \Delta r^{L} \cdot \Delta K + Liq \qquad (10)$$

With Liq=16, MM=0.3, ΔK=2.7 and Δr^L=6, the estimated impact on the lending rate is 27.3 basis points. With a full MM-effect (MM=1), the only impact left would be the one from the NSFR.

It should be noted that as the two regulatory measures (CR^R and the NSFR) are interlinked, the cumulative impact of the measures is likely smaller than the sum of their individual impacts, i.e. the 27.3 basis points is biased upwards in this respect.

As an example, a higher capitalization will help reach a higher NSFR by increasing its numerator, i.e. the bank's ASF. The bank can also choose to meet the higher liquidity requirements by shifting to higher quality (lower risk) assets which will lead to a fall in the risk weighted assets and thus help meet the higher CR^R.

8. The macroeconomic impact of Basel III

In the following, the macroeconometric model for the Danish economy, ADAM, is used to estimate the economic costs of the higher capital and liquidity requirements by feeding the estimated changes to the lending rate into the model. As mentioned earlier, this analysis does not deal with the economic benefits expected to follow from the regulation in the form of increased financial stability and better access to finance in a recession.

The model is used to simulate the effects of a rise in both banks' lending rates and mortgage rates.[25] A positive shock to these rates will increase the user cost of

25. Basel III also applies to mortgage banks. Therefore, also the short and long mortgage rate is raised in ADAM (iwb30 and iwbflx). Danish mortgage banks cannot issue equity and the assumption is that they will react by raising contribution rates. The lending rate (iwlo) is

physical capital and in the short run affect investments and housing consumption negatively. As a consequence unemployment will rise, thus instigating a downwards pressure on wages which eventually leads to an improvement in competitiveness, gradually restoring employment in the long run.

In the longer run, the higher cost of physical capital leads to a substitution from capital to labour and the model assures equilibrium on the labour market through a wage driven crowding-in effect so that employment remains largely unchanged.[26] The result is a negative impact on GDP in the short run and a marginal long run negative impact due to a less capital-intensive economy (a less productive economy). The composition of consumption also changes as the share of housing consumption will fall and there is a general negative impact on private consumption.

None of the interest rates shocked in the experiment will affect profit in the financial sector. This is essential since the underlying assumption in the calculation of the lending rate elasticity is that profits are left unchanged. This condition is fulfilled in ADAM as long as the money market interest rate is not changed. [27]

8.1. Modifications to the experiment in ADAM

In order to ensure that estimations fit the experiment in the best way possible, three modifications are implemented.

The first two modifications concern competitiveness. First, a rise in the user costs will initially affect prices upwards, reducing competitiveness. But, as Basel III is implemented in other countries simultaneously, a similar impact on costs and prices should also be expected in these countries. Competitiveness is therefore likely to develop differently. The "true" impact depends on numerous factors like capital intensities, the composition of foreign trade, etc. For simplicity, price competitiveness in foreign trade is here assumed to be unaffected by setting the relative import and export prices as exogenous.

raised. A rise in iwlo can best be compared to a shock to the user cost for businesses' physical capital while a rise in iwb30 and iwbflx increases the user cost of housing and property. The mortgage rates are variables in the user cost of housing capital with a coefficient determining the distribution of long (bobl30) and short term debt (1-bobl30).

26. The wage relation in ADAM is a Phillips-curve linking changes in wages and unemployment. A rise in unemployment will reduce wages, thereby putting downwards pressure on prices and increase competitiveness. Thus, exports and production will rise and unemployment will return to the model's baseline-level.
27. This model feature is convenient with respect to this particular experiment. However, it is not very intuitive that changes in the interest rates do not change interest flows. This is due to the way credit institutions are treated in the national accounts. Here, a special reference rate is used and interest rates that deviate from this rate are treated as financial services. Shocks to iwlo, iwb30 and iwbflx therefore only affect the cost of capital (housing and physical capital).

This modification has the inappropriate feature that Danish imports now only depend on the activity in the domestic economy and that exports are in fact exogenous. This is not satisfactory. Just as an interest rate rise results in a less capital-intensive domestic production, a global interest rate rise is expected to result in a less capital-intensive global production. Overall, this means a lower production in other countries and hence a lower demand for Danish exports on the world market. Therefore, the second modification captures the fact that demand for Danish exports is expected to fall. This is done by simply setting the negative impact on exports proportional to the estimated impact on Danish imports from the increase in lending rates.

The third modification concerns the public sector's balance which is permanently weakened. In other words, there is no fiscal policy reaction ensuring that public finances are balanced in the long run. This is not a desirable feature in the experiment as an increasing public deficit is financing a lift in private consumption, i.e. the impact on private consumption is affected. In ADAM, this is dealt with by "resetting" the public balance by "forcing" it back on the baseline track with the introduction of a non-distortionary tax.[28]

8.2. Results

In the short run, the higher regulatory requirements (Basel III plus SIFI capital requirements and liquidity requirements - NSFR) will result in a short run fall in GDP of 0.29 pct. and in the long run 0.09 pct., cf. Table 12.

Tabel 12: Economic costs of higher capital and liquidity requirements

Liquidity (NSFR) and capital requirements (27.3 basis points)		
	Short run (5 years)	**Long run (70 years)**
GDP, pct.	-0.29	-0.09
Investments, pct.	-1.20	-0.38
Private consumption, pct.	-0.33	-0.05
Employment, pers.	-5,150	
Liquidity requirements (NSFR), (16 basis points)		
	Short run (5 years)	**Long run (70 years)**
GDP, pct.	-0.17	-0.06
Investments, pct.	-0.71	-0.22
Private consumption, pct.	-0.20	-0.04
Employment, pers.	-3,042	

Note: Numbers are deviations from the baseline scenario in the modified experiment
Source: ADAM-simulations, including the three modifications described in the main text.

Compared to the previously mentioned studies, the estimated impact on GDP is low. As an example, OECD (2011) estimates a short run negative GDP impact of

28. The variable 'capital transfers from the private to the public sector' (tk_hc_o) is used to adjust the public balance.

higher capital requirements alone (not incl. SIFI requirements) of 1.14 pct. for the Euro Area, cf. Table 1.[29] One possible explanation is that the study does not include the potential significant fall in the average risk weight, nor does it include any MM-effect.

It is also worth noting that whereas higher capital requirements are most often the focus of the cost debate, the stand-alone impact from the NSFR (16 basis points) is a short run fall in GDP of 0.17 pct. and a long run fall of 0.06, i.e. more than half of the total estimated economic cost can be ascribed to the NSFR alone.

As mentioned throughout the text, a number of assumptions applied in the analysis point towards an upwards "bias" in the estimated results:

29. Table 1 states the average annual impact on GDP. This is for OECD (2011) -0.23 or a total negative impact on GDP after 5 years of approximately -1.14 pct.

1. Equity is replacing debt and not other hybrid or supplementary capital instruments that are more expensive than debt.
2. No "mitigation" effects such as a downwards pressure on the average risk weight due to adjustments in the balance sheet or increased efficiency are included.
3. Considerations about imperfect competition and market power affecting the pass-through of higher costs to final customers are not included.
4. No overlaps between higher capital requirements and NSFR are included.

Overall, the presented results point to relatively modest economic costs of the Basel III regulatory requirements.

8.3. The possible benefits of higher capital requirements

As mentioned, estimating the expected benefits of higher capital requirements is not part of this analysis. However, benefits are expected to materialize through a more stable financial system with fewer and less severe crises, i.e. lower variance in GDP and a reduced probability of financial crisis affecting the long term development in productivity.

The starting point is that a relatively modest strengthening of financial regulation has been implemented and that the strengthening was from a low level. It is therefore not surprising that most studies attempting to quantify the benefits find that they surpass the cost.

The expectations of net benefits are supported by a Swedish study of the macroeconomic costs and benefits of regulating the Swedish financial sector, cf. Riksbanken (2011). Here, the conclusion is that the CR^R in Basel III is too weak in relation to the large Swedish banks given a number of characteristics pertaining to the Swedish financial sector, also relevant for the Danish financial sector: i) the sector is very large relative to the economy, ii) concentration in the sector is high, iii) banks are highly interconnected on the market for finance implying a high contagion risk, and iv) banks use a high degree of short term and foreign funding.

The socially optimal level of capitalization (CET1 Basel III definition) is estimated to lie between 10 and 17 pct. of risk weighted assets in the Swedish analysis, cf. Riksbanken (2011). The Basel committee has also analysed the long term benefits and costs of the higher CR^R, cf. BIS (2010B). The conclusion is that the social optimal level of capitalisation is between 13 and 15 pct. of risk weighted assets.[30] In Denmark, Danske Bank has received the highest CET1 requirement of 10 pct. (Basel III plus SIFI requirements). It is doubtful whether these analyses ac-

30. Capital is in BIS (2010B) based on the Basel II definition, TCE (Tangible Common Equity), whereas the definition in Riksbanken (2011) is the final Basel III definition of CET1 capital. Both capital measures are in essence equity from which a number of posts are deducted, and more for CET1, which is therefore the most narrow (highest quality) measure of capital.

count for the impact of the transition to Basel II risk weighting approaches, here especially the transition to IRB models, which in Denmark led to a large fall in the real capital requirement.

9. Conclusion and scope for further research

The results of this analysis point to relatively modest economic costs of higher capital and liquidity requirements as formulated in Basel III plus the SIFI requirements. The estimated short run negative impact on GDP is 0.29 pct. and the long run impact 0.09 pct. These impacts are likely to be biased upwards given a number of conservative assumptions and can thus be interpreted as maximum results.

It is worth noting that whereas capital requirements are often at the centre of the debate on the costs of financial regulation the liquidity requirements, here the NSFR, account for more than half of the estimated impact. In general, the impact of the NSFR is prone to higher uncertainty as maturity transformation is key to the current business model of banks. This is also one of the reasons why the NSFR is currently under observation before any binding requirement is implemented in the future. In contrast, it is safer to conclude that higher capital requirements are not likely to increase banks' funding costs substantially and are thus also likely to have only a negligible cost impact on GDP compared to their potential benefits.

This analysis should interpreted as a "long run" or structural analysis in the sense that it is assumed that banks will adjust to higher requirements solely by replacing debt with equity (capital requirement) and extending the maturity of its debt liabilities (liquidity requirement). Whereas these reactions are probably more likely under normal market conditions, alternative adjustment reactions are likely to prevail in the short run given a situation characterised by high market uncertainty. This could lead banks to cut back on lending and/or reduce the supply of long term finance in order to meet the higher requirements with more severe economic consequences to follow. Too little is known about the choice of adjustment channels and the disentanglement of demand-side effects from the effects of changes to financial regulation in the transition to higher requirements.

10. Appendices

Appendix A – CAPM and the cost of debt

The Capital Asset Pricing Model - CAPM

According to the CAPM-model, the bank specific required return on equity (cost of equity), r^E, can be written as (11):

$$r_{it}^E = r_t^F + \beta_i \cdot (Expected\ market\ return - r_t^F) \qquad (11)$$

Where r^F is the risk free interest rate, CAPM beta, β, measures how risky the specific bank stock is relative to the reference stock market and the parenthesis is the market risk premium measured as the expected market return corrected for the risk free rate. CAPM beta is estimated in Bloomberg as the correlation coefficient between the bank's stock index and the KFX-index based on weekly observations over a two year period. The risk free rate is set as the 10-year German government bond rate. The expected Danish market return is estimated from the dividends discount model. Here, the expected market return is a function of projected growth rates, revenue, dividends, pay-out ratios, and present values.

For Danske Bank, the cost of equity was in 2012 estimated to 14.76 pct., cf. Table A.1.

Table A.1: Example – 'Cost of equity' for Danske Bank 2012

r^F	β	Expected market return
1.07 pct.	1.09	13.65 pct.

Source: Bloomberg.

The cost of debt

The cost of debt, r^L, is estimated using (12) based on balance sheet data.

$$r^L = \left[\frac{SD}{TD} \cdot TN \cdot AF + \frac{LD}{TD} \cdot TB \cdot AF\right] \cdot (1 - TR) \qquad (12)$$

SD is short term debt, LD is long term debt, TD is total debt, TN is the average return on treasury notes (skatkammerbeviser), TB is the return on bond debt, and AF is an adjustment factor based on the average credit spread between the return on corporate bonds and government bonds for a given rating class, i.e. a lower rating means a higher spread which will adjust the price upwards. Finally, TR is the effective tax rate estimated as the year's tax payments divided with the annual result before taxes. As an example, Danske Bank's weighted interest rate on debt was 0.64 pct. in 2012, cf. Table A.2.

Table A.2: Example- 'Cost of debt' for Danske Bank, 2012

LD	1,022,115	TB	1.07 pct.
SD	241,241	TN	0.05 pct.
TD	1,263,356	AF	1.33 pct. points
TR	44.57 pct.	Rating	A-

Source: Bloomberg.

Appendix B – Underlying data for Table 3 in the main text

1. Liabilities	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Deposits	760,035	805,258	843,505	931,729	1,034,118	1,178,359
Debt to credit institutions and central banks	475,919	563,623	643,463	705,820	704,544	803,395
Bond debt	109,826	154,765	188,975	216,646	236,246	318,543
Subordinated debt	40,647	47,611	51,143	52,007	56,544	72,305
Total deposits and debt	1,386,427	1,571,257	1,727,086	1,906,202	2,031,452	2,372,603
Equity	116,841	116,917	131,001	139,748	146,109	173,456
1.1. Weight						
Deposits	0.55	0.51	0.49	0.49	0.51	0.50
Debt to credit institutions and central banks	0.34	0.36	0.37	0.37	0.35	0.34
Bond debt	0.08	0.10	0.11	0.11	0.12	0.13
Subordinated debt	0.03	0.03	0.03	0.03	0.03	0.03
2. Interest expenditure						
Deposits	28,614	27,809	22,107	17,100	16,496	18,358
Debt to credit institutions and central banks	24,321	23,948	18,570	15,588	18,283	29,614
Bond debt	6,364	5,758	5,505	4,380	4,865	7,922
Subordinated debt	2,756	2,813	2,412	2,318	2,549	2,964
3. "Interest rate", (pct.)						
Deposits	3.76	3.45	2.62	1.84	1.60	1.56
Debt to credit institutions and central banks	5.11	4.25	2.89	2.21	2.60	3.69
Bond debt	5.79	3.72	2.91	2.02	2.06	2.49
Subordinated debt	6.78	5.91	4.72	4.46	4.51	4.10
rL	**4.48**	**3.84**	**2.81**	**2.07**	**2.08**	**2.48**
4. Yearly result after tax	14,371	14,465	15,115	20,677	22,914	27,067
rE	**12.30**	**12.37**	**11.54**	**14.80**	**15.68**	**15.60**
rE-rL	**7.82**	**8.53**	**8.72**	**12.73**	**13.61**	**13.12**

1. Liabilities	2006	2007	2008	2009	2010	2011	2012
Deposits	1,290,391	1,618,890	1,678,435	1,654,384	1,624,744	1,623,376	1,720,386
Debt to credit institutions and central banks	1,038,419	1,265,627	1,177,683	852,738	766,965	797,869	800,085
Bond debt	379,509	448,789	585,469	676,849	634,379	500,426	389,903
Subordinated debt	82,013	93,397	95,250	121,490	119,780	112,184	107,104
Total deposits and debt	2,790,332	3,426,703	3,536,837	3,305,462	3,145,868	3,033,854	3,017,478
Equity	216,598	244,010	231,699	242,100	249,669	269,583	271,610
1.1. Weight							
Deposits	0.46	0.47	0.47	0.50	0.52	0.54	0.57
Debt to credit institutions and central banks	0.37	0.37	0.33	0.26	0.24	0.26	0.27
Bond debt	0.14	0.13	0.17	0.20	0.20	0.16	0.13
Subordinated debt	0.03	0.03	0.03	0.04	0.04	0.04	0.04
2. Interest expenditure							
Deposits	26,946	47,298	60,269	38,639	16,096	20,524	17,824
Debt to credit institutions and central banks	40,786	53,820	63,424	16,785	8,837	8,809	4,587
Bond debt	13,896	21,135	21,971	14,280	11,897	12,786	10,739
Subordinated debt	3,379	3,989	4,517	5,753	6,866	6,853	6,074
3. "Interest rate", (pct.)							
Deposits	2.09	2.92	3.59	2.34	0.99	1.26	1.04
Debt to credit institutions and central banks	3.93	4.25	5.39	1.97	1.15	1.10	0.57
Bond debt	3.66	4.71	3.75	2.11	1.88	2.56	2.75
Subordinated debt	4.12	4.27	4.74	4.74	5.73	6.11	5.67
rL	**3.05**	**3.68**	**4.25**	**2.28**	**1.39**	**1.61**	**1.30**
4. Yearly result after tax	33,453	32,600	-6,116	-15,524	1,689	1,950	3,895
rE	**15.44**	**13.36**	**-2.64**	**-6.41**	**0.68**	**0.72**	**1.43**
rE-rL	**12.40**	**9.68**	**-6.89**	**-8.70**	**-0.71**	**-0.89**	**0.13**

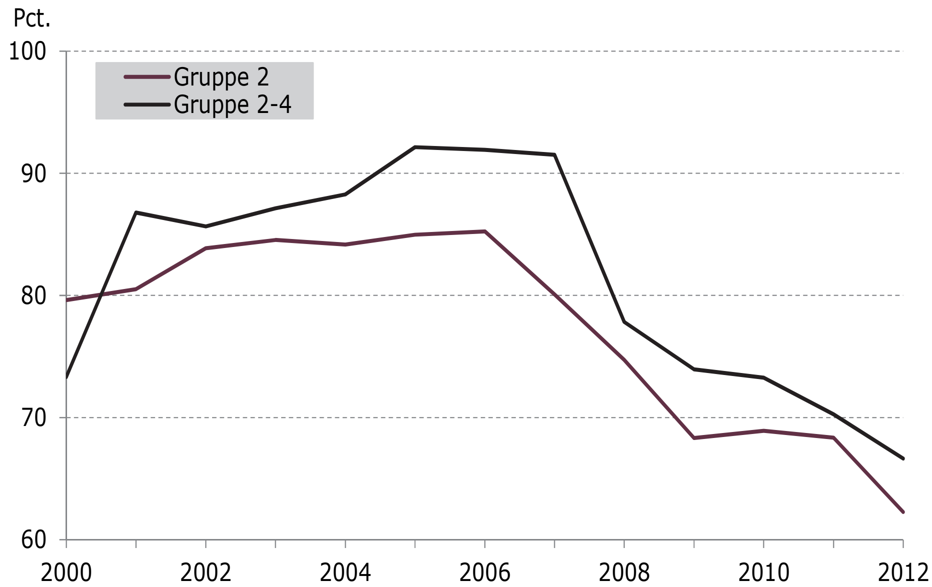
Source: The Danish FSA and own calculations.

Appendix C –The technical lift from the transition to Basel II risk weighting

Group 2-4 banks

Figure C.1 shows the development in the average risk weight, RW, for group 2 and group 2-4 banks over the period 2000-2012. As evident, RW falls significantly in from 2006 to 2009 with the transitions to the Basel II standard approach.

Figure C.1: Average risk weights, RW, 2000-2012, (pct.)



Source: The Danish FSA and own calculations.

Technical lift anno 2012 for group 2-4 banks and for Sydbank

Sydbank states their Basel I compatible risk weighted assets up until and including 2008. Sydbank's technical lift is in Table 8 estimated to be approximately 3.2 pct. points in 2012. This value is estimated based on the balance for 2012 and the fall in RW from 2007 to 2008 of approximately 14 pct. points (from 61.9 to 47.8).

More specifically, the lift is estimated using the below formula based on the 2012 balance where RW is the average risk weight and A is total assets.

$$3.2 = \left(\frac{CET1}{RW \cdot A}\right) - \left(\frac{CET1}{(RW + 0.14) \cdot A}\right) = \left(\frac{9{,}854}{0.47 \cdot 152{,}713}\right) - \left(\frac{9{,}854}{(0.47 + 0.61) \cdot 152{,}713}\right)$$

The technical lift for group 2-4 banks using the standard approach was also significant. However, it is not possible to get the size of the lift in the same manner as for the SIFIs as they no longer state their Basel I compatible risk weighted assets in the annual accounts after the transition to the Basel II standard approach. As for Sydbank, an approximation is used based on the fall in RW from 2007 to 2008. Data is from the FSA why the lift is based on equity, E, and not CET1 capital.

$$2.7 = \left(\frac{E}{RW \cdot A}\right) - \left(\frac{E}{(RW + 0.14) \cdot A}\right) = \left(\frac{55{,}918}{0.67 \cdot 532{,}636}\right) - \left(\frac{55{,}918}{(0.67 + 0.14) \cdot 532.636}\right)$$

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