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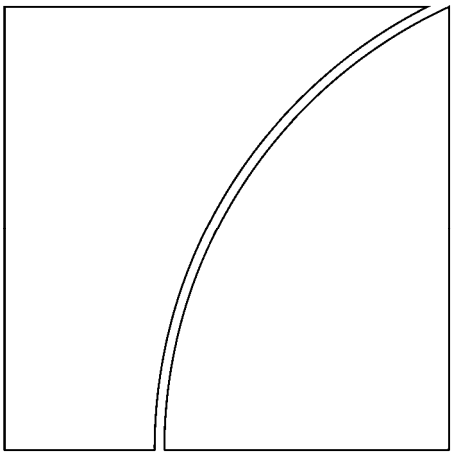

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# Mapping capital and liquidity requirements to bank lending spreads

by Michael R King

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Keywords: banks, regulation, Basel III, capital, liquidity, lending spreads

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# Mapping capital and liquidity requirements to bank lending spreads

Michael R. King[1]

## Abstract

This study outlines a methodology for mapping the increases in capital and liquidity requirements proposed under Basel III to bank lending spreads. The higher cost associated with a one percentage point increase in the capital ratio can be recovered by increasing lending spreads by 15 basis points for a representative bank. This calculation assumes the return on equity (ROE) and the cost of debt are unchanged, with no change in other sources of income and no reduction in operating expenses. If ROE and the cost of debt are assumed to decline, the impact on lending spreads is reduced. To recover the additional cost of meeting the December 2009 proposal for the Net Stable Funding Ratio (NSFR), a representative bank would need to increase lending spreads by 24 basis points. Taking into account the fall in risk-weighted assets from holding more government bonds reduces this cost to 12 basis points or less.

JEL Classification: G21; G28; E51

Keywords: banks, regulation, Basel III, capital, liquidity, lending spreads.

[1] The author would like to thank Neville Arjani, Claudio Borio, Mathias Drehmann, Neil Esho, Leonardo Gambacorta, Hamid Mehran, Jochen Shantz, Nikola Tarashev, Kostas Tsatsaronis, participants at the Macroeconomic Assessment Group meetings on 17 May and participants at the Top-down Calibration Group meetings on 22 June for helpful discussions, comments and suggestions. Garry Tang provided excellent research assistance. All remaining errors are my own. The views expressed in this paper are those of the author and do not necessarily represent those of the BIS. Please address all correspondence to Michael R. King, Monetary and Economic Department, Bank for International Settlements, Centralbahnplatz 2, CH-4002 Basel, Switzerland, michael.king@bis.org.

In December 2009, the Basel Committee on Banking Supervision (BCBS) published two consultative documents that propose increasing the quantity while improving the quality regulatory capital and reducing funding and maturity mismatches between bank assets and bank liabilities (BCBS, 2009a,b).[2] These regulatory proposals are referred to as Basel III.[3] This study outlines a methodology for mapping the possible impact of higher capital and liquidity requirements on bank lending spreads, which is the spread between the interest rate charged on bank loans and the cost of a bank's liabilities. Such a mapping provides researchers with a useful tool to study the impact of regulatory changes on the cost of credit and the real economy. An increase in the interest rate charged on bank loans should reduce loan demand, all else equal, leading to a drop in investment and output. The mapping outlined in this study was one input into the BCBS's assessment of the long-term economic impact of the proposed regulatory changes on output (BCBS, 2010; Angelini et al, forthcoming).Estimates of changes in bank lending spreads may be used as inputs into dynamic stochastic general equilibrium models that have been augmented to include a micro-founded banking sector such as Goodfriend and McCallum (2007), or as a proxy for increased financial frictions in macroeconomic models that lack a financial sector. More generally, this mapping illustrates the potential loan pricing implications of the proposed Basel III reforms, similar to the studies by Repullo and Suarez (2004) and Ruthenberg and Landskroner (2008) for the Basel II reforms. Consistent with the focus of this earlier work, this paper considers how the new rules may alter the pricing of bank loans.

Using a representative bank's balance sheet and income statement, the paper maps how changes in a bank's capital structure and the composition of its assets affect the different components of net income using accounting relationships. While banks can adjust to the regulatory reforms in a number of ways, this study assumes that they seek to pass on any additional costs by raising the cost of loans to end-customers. By measuring the change in net income and shareholder's equity associated with these regulatory changes, it is possible to calculate the increase in lending spreads required to achieve a given return on equity (ROE).[4] This approach has its limitations. The present study does not formally model the choice faced by banks, nor does it provide estimates based on an optimisation in a general equilibrium setting. Instead, it provides a starting point for understanding the behavioural response of banks to a regulatory change. Researchers and policymakers can then determine what is reasonable given a country's institutional setting, its banking sector and the elasticity of loan demand. While this mapping can suggest the potential magnitude of the change in lending spreads, deciding whether banks would be able to pass on these costs to lenders is beyond the scope of this study. Finally, the study focuses on the steady-state, and does not consider the transition period to the higher regulatory requirements.[5] In the steady-state, the supply of bank credit is taken as exogenous and credit rationing is not considered. Banks are assumed to price loans to meet the marginal cost of loan production.

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2 The proposed liquidity requirements were modified in a press release on 26 July 2010, and the proposed higher capital standards were published on 12 September 2010.

3 The 1988 Basel Accord is referred to as Basel I, while the 2004 revision is known as Basel II.

4 The author is grateful to Douglas Elliott for suggesting this approach.

5 The transition to the higher capital and liquidity requirements is the focus on the interim report of the Macroeconomic Assessment Group (2010).

The estimates in this study are illustrated using the BCBS's December 2009 proposals. The methodology presented, however, is general and can be used to estimate the impact on lending spreads from a change in a bank's capital structure, the composition of its assets, the measurement of risk-weighted assets (RWAs), or the imposition of a financial levy or tax. One benefit is that this approach does not rely on historical relationships or the availability of large datasets – requirements that may hamper the effective use of statistical methods to address this question. Another benefit is that this mapping highlights how a given change affects a bank's profitability and points to different possible behavioural responses to the regulation, including possible unintended consequences. Finally, a bottom-up, micro-founded approach provides a useful complement to top-down, structural models where the modelling of the financial sector is necessarily parsimonious. While the estimates in this study are based on a number of assumptions, all the assumptions are transparent and can be modified to check the sensitivity of the results.

The representative bank's balance sheet and income statement are calculated using Bankscope data for 6,844 banks from 13 OECD countries over the period 1993 to 2007.[6] To estimate the impact of a higher capital requirement on lending spreads, the representative bank's capital ratio is raised by increments of 1 percentage point (1pp) of RWA with no change in the composition of assets. To meet the higher capital requirement, the bank increases shareholder's equity and reduces wholesale funding by an off-setting amount with total assets unchanged. The lower quantity of debt outstanding reduces the bank's interest expense and increases net income, all else equal. ROE falls as net income is divided by a greater quantity of shareholder's equity. This fall in ROE is consistent with the intuition that a less leveraged bank is less risky and shareholders should therefore expect a lower return on their investment. If the bank wishes to avoid the fall in ROE, it must take steps to generate more net income from existing assets. The bank has a number of options such as reducing operating expenses or increasing non-interest income. In this analysis, banks are assumed to raise the spreads charged on loans with the size calibrated to offset the fall in ROE. Based on the representative bank's balance sheet, the fall in ROE associated with a 1pp increase in the capital ratio can be recovered by increasing lending spreads by 15 basis points. This calculation assumes that ROE, the cost of debt, and operating costs are unchanged, and there is no change in either bank managers' behaviour or financial system structure. If ROE and the cost of debt are assumed to fall by 10 basis points for each 1pp increase in the capital ratio, the increase in lending spreads is reduced to 13 basis points. As an alternative to raising lending spreads, the fall in ROE can be avoided by reducing operating expenses by 4 percentage points (to 96% of their previous value). If banks absorb the costs from the higher capital requirement, ROE would fall by 0.9pp for every 1pp increase in the capital ratio.

While the BCBS proposals outline two liquidity requirements, this study focuses on the Net Stable Funding Ratio (NSFR). Banks can meet the NSFR by raising equity, extending the maturity of debt, or increasing their holdings of unencumbered, liquid assets. Once banks have met the higher capital requirements, the incremental cost to meet the NSFR is principally due to the higher interest expense from extending the maturity of debt and the lower interest income from holding more liquid, less-risky assets. Similar to the case with capital, banks may wish to offset the decline in ROE by

[6] The sample countries are: Australia, Canada, France, Germany, Italy, Japan, Korea, Mexico, the Netherlands, Spain, Switzerland, the United Kingdom and the United States.

raising lending spreads. To recover the additional cost of meeting the NSFR, lending spreads are estimated to increase by 24 basis points when RWA are left unchanged. But meeting the NSFR should cause a bank's RWA to fall as less-liquid investments are replaced with high-quality, low risk investments, all else equal. This fall in RWA makes it less costly to meet the higher capital requirement, as less equity must be raised to increase the capital ratio. Taking account of the synergies between the NSFR and capital requirement reduces the cost to meet the NSFR to 12 basis points or less.

The ability for banks to charge more for loans is conditional on many factors, including the degree of banking competition, the availability of credit through private capital markets, and the elasticity of loan demand. Banks obviously have various alternatives to offset the loss of net income that do not involve changing lending spreads. A number of alternatives are discussed in this study. Given that this analysis is based on a number of assumptions, the sensitivity of the estimates to these assumptions is discussed.

The first section provides background on the BCBS's December 2009 regulatory proposals. The second section summarises recent studies looking at the impact of higher capital and liquidity requirements. The third section outlines the mapping of the regulatory changes to lending spreads. The fourth section provides details on the representative bank. The fifth section provides estimates for increases in the capital ratio while the sixth section looks at the costs to meet the NSFR. The final section concludes.

## 1. Background on the December 2009 regulatory proposals

During the 2007-2009 period, the global financial system was destabilised and the real economy suffered after banks across a range of countries became illiquid or insolvent following major losses on their investments.[7] The scale of the recent global financial crisis has been compared to the bank failures and GDP contraction of the Great Depression and the Interwar years of the 1930s. Given the importance of the financial system for the functioning of the real economy, governments and monetary authorities took action to prevent the collapse of major banks and to restore normal operation of bank funding markets. Central banks provided exceptional liquidity assistance to banks and took actions to ease monetary conditions, such as reducing policy rates and purchasing government and private sector securities. Fiscal authorities provided some combination of deposit and debt guarantees, recapitalised banks with public capital, and took actions to address impaired bank assets. Leading economies coordinated a massive fiscal stimulus while supervisors and standard setters practiced regulatory forbearance. Despite these efforts, banks in a number of countries went bankrupt or were nationalised while the leading advanced economies experienced a recession.

In light of the losses and failures of so many banks, the BCBS published two consultative documents in December 2009 with the goal of promoting a more resilient banking sector. The proposals included a new, harmonised definition of Tier 1 capital, a 30-day liquidity requirement to increase banks' ability to survive stressed funding conditions, a leverage ratio as a supplementary measure to the Basel II risk-based framework, a countercyclical capital framework, and a revised methodology for calculating RWAs, particularly in banks' trading books.

[7] BIS (2008, 2009) and King (2009) discuss the recent crisis and the policy response in different countries.

This study focuses on only two parts of the proposed reforms. The first part relates to raising the minimum capital requirement. While previous versions of the Basel Capital Adequacy Rules (Basel I and II) specified minimum capital adequacy ratios, many instruments that qualified as Tier 1 and Tier 2 capital proved not to be loss-absorbing during the recent crisis. Instead bank creditors and counterparties demanded higher levels of tangible common equity.[8] To meet the requirement for more and higher-quality capital, banks need to increase common equity relative to total assets. Deleveraging balance sheets by selling assets may achieve this objective in the near term, but it does not change the fact that the relative share of common equity and liabilities must change.

The second part of the regulatory enhancements considered here is the enhanced liquidity requirement. Under the December 2009 proposal, banks are required to meet two new liquidity requirements – a 30-day liquidity asset ratio called the Liquidity Coverage Ratio (LCR) and a longer-term, structural liquidity ratio called the Net Stable Funding Ratio (NSFR). The LCR identifies the amount of unencumbered, high quality, liquid assets that can be used to offset cash outflows. The aim of the LCR is to ensure that banks have adequate funding liquidity to survive one month of stressed funding conditions. The LCR cannot be estimated directly as it requires details on a bank's expected cash outflows over a one-month period. This data is not available.

The NSFR addresses maturity mismatches between assets and liabilities. It establishes a minimum acceptable amount of stable funding based on the liquidity characteristics of a bank's assets over a one-year horizon. The quantity of available stable funding (the numerator in the ratio) must be greater than the required stable funding for these assets (the denominator). To meet the NSFR, banks are expected to hold more high-quality, liquid assets, financed by more stable deposits, more equity or longer maturity liabilities. This study discusses these strategies and estimates the cost to meet the NSFR. To the author's knowledge, this is the first academic study of the cost to meet the NSFR.

## 2. Recent studies of the proposed higher capital requirements

This study contributes to a large literature on bank capital and regulation.[9] Specifically, it follows in the footsteps of Repullo and Suarez (2004) and Ruthenberg and Landskroner (2008) who examine the loan pricing implications of Basel II. Both papers highlight the impact of the methodologies introduced for calculating the capital requirements for loans with different risk characteristics. Both papers conclude that banks are likely to adopt the standardized approach for high risk firms and the internal ratings-based approach for low risk firms and retail customers. While Repullo and Suarez (2004) generate predictions based on a model with perfect competition for bank loans, Ruthenberg and Landskroner (2008) employ a model with imperfect competition and then confirm their predictions using bank-level data for a leading Israeli bank. An important contribution of the latter paper is the greater detail it provides on the actual pricing of loans. Specifically, Ruthenberg and Landskroner (2008) distinguish four components of the interest rate charged on bank loans: the financial funding cost, a risk premium to compensate for the

[8] Common equity = common stock + additional paid-in capital + retained earnings – own shares held by bank. Tangible common equity = common equity – intangibles – goodwill.

[9] Dewatripont and Tirole (1994), Bhattacharya et al. (1998), Santos (2001) and VanHoose (2007) provide overviews of the literature on bank capital regulation.

risk of default by the borrower, a premium reflecting market power exercised by the bank, and the sensitivity of the cost of capital raised to changes in loans extended. This level of detail allows them to isolate the impact of these four factors in their analysis.

The current study does not address Basel II or the measurement of credit risk, but focuses instead on the relationships between a bank's capital structure, the composition and liquidity of its assets, and the implications for bank profitability. This greater level of detail is important for understanding how banks are likely to response to regulatory reforms. Banking theorists and researchers are interested in understanding these relationships, even though they may be too complex to model parsimoniously. By providing greater detail on the importance of different sources of capital, the present paper also contributes to a growing literature on bank capital structure choices and their impact on lending.[10]

Two recent papers have looked at the loan pricing implications of the proposed higher capital requirements under Basel III. Elliott (2010a) provides an accounting-based analysis of how much the interest rate charged on loans will likely increase if banks are required to hold more equity. Elliott does not examine the proposed liquidity requirements. In Elliot's stylized example, a bank holds only loans, which are funded by equity, deposits and wholesale funding. The interest rate on a loan is priced to meet a target ROE after covering the cost of liabilities and other fixed expenses (such as administrative costs and expected loan losses). Using FDIC data for the aggregate US banking system, Elliott calculates that if the ratio of common equity required for a given loan is raised by 2% (from 6% to 8% of the loan value) and no other adjustments are made, banks would need to raise lending spreads by 39 basis points to maintain a target ROE of 15%. The required increase falls to 9 basis points if ROE is allowed to decline to 14.5%, the cost of liabilities decreases by 10 basis points, the assumed loan loss provision is marginally lower, and operating costs are reduced by a small amount. Based on this analysis, Elliott concludes that the US banking system would be able to adjust to higher capital requirements through a combination of actions that would not have a strong effect on the pricing or availability of bank loans.

The benefit of Elliott's approach is its simplicity, as well as the intuition it provides on the pricing of loans and the alternatives available to banks to adjust to higher capital levels. While Elliott provides no empirical foundation for the decline in ROE and cost of liabilities, the logic of the decline is based on a modified Modigliani-Miller analysis where the weighted average cost of capital (WACC) does not change for different capital structure choices. The current study builds on Elliott's approach in a number of ways. It outlines a mapping that can be used by researchers who are unfamiliar with a bank's financial statements. It uses actual balance sheet data to calibrate the regulatory impact. It takes into account the composition of assets and liabilities, as well as the distinction between risk-weighted assets and total assets. It provides estimates for different levels of capital. It models the cost to meet the NSFR explicitly, explaining the sensitivity of this calculation to the inputs. Finally, it models the capital and liquidity requirements together, taking into account the potential synergies between the two regulatory enhancements.

[10] Berger and Bonaccorsi di Patti (2006), Gropp and Heider (forthcoming), Froot and Stein (1998), Koziol and Lawrenz (2009), Marcus (1983), Mehran and Thakor (forthcoming), and Memmel and Raupach (2010) look at bank capital structure choices. Cebenoyan and Strahan (2004), Fabi et al. (2005), Gambacorta and Mistrulli (2004), Inderst and Mueller (2008) and Thakor (1996) look at the relationship between capital and bank lending.

A second paper by Kashyap et al. (forthcoming) considers the question of the phasing-in of "substantially heightened" capital requirements, but not the liquidity requirements. The authors highlight the unintended consequences if the regulation is only applied to banks and not to the shadow-banking sector. Kashyap et al. estimate the cost of higher capital on lending spreads using a similar accounting-based approach. Again referencing Modigliani and Miller (1958), the authors argue that higher equity requirements are costly because they reduce the tax shields on debt, thereby increasing the bank's WACC. Assuming the cost of long-term debt is 7% and the corporate tax rate is 35%, their baseline estimate is that an increase in capital-to-total assets by 1pp would raise the WACC by 2.5 basis points (=7% x 35%). The authors argue that the cost may be larger if equity crowds-out cheaper, debt maturing within one year that provides a convenience premium to banks. To be conservative, they also include an "arbitrary fudge factor" of 100 basis points to the cost of equity. These additions generate a 'loose upper bound' of 4.5 basis points for every 1pp increase in equity to total assets.

Kashyap et al. intend this exercise to be illustrative, and use it to motivate an empirical study later in the paper. The point estimates themselves should not be interpreted literally for a number of reasons. They are based on ratios of equity to total assets, not equity to RWAs, which will differ. They implicitly assume that banks only hold loans, as each basis point loss in tax shields (ie after-tax income) is equated to a one basis point increase in (pre-tax) lending spreads. If loans make up a smaller portion of bank assets, the effective increase in lending spreads to generate the same net income will be higher. Different estimates of the impact on lending spreads can be generated by assuming a different cost of long-term debt and marginal tax rate. Finally, the 100 basis point convenience premium is loosely based on an estimate of 72 basis points for US Treasury securities from another study. The authors conduct an empirical analysis of the relationship between the ratio of equity-to-total assets and lending spreads. Using OLS regressions on aggregate banking data from the FDIC from 1920 to 2009, they find no statistical relationship between capital levels and two out of three proxies for lending spreads. The third proxy – the spread between the prime lending rate and the rate on Treasury bills – is positive and statistically significant. The estimated coefficient implies that a 1pp increase in equity-to-assets is associated with a 28 basis point increase in the lending spread. The authors dismiss this estimate as unrealistically high, and conclude that there is no relationship between capital levels and lending spreads. An alternative explanation is that the small sample size of 90 observations, the aggregated banking data, and the weak proxies may not allow this relationship to be tested empirically.

## 3. Methodology

This section explains how to map the higher capital and liquidity requirements to lending spreads using data from a bank's balance sheet and income statement. The aim of this exercise is to consider the impact on lending spreads in the steady state, not during the transition to the steady state. The assessment therefore assumes banks have completed the transition to the new definition of capital, and all shareholder's equity is loss-absorbing capital. This assumption can be relaxed without qualitatively changing the results. The analysis compares two steady states, one with and one without the proposed regulatory enhancements. First, the impact of higher capital requirements is considered in isolation, and then the cost to meet the NSFR is calculated assuming the higher capital requirements have already been met. Finally, the synergies between the capital and the liquidity requirements are discussed.

### 3.1 Mapping higher capital to lending spreads

The mapping exercise begins with the stylized balance sheet for a representative bank. A typical bank's assets consist of some combination of cash and central bank balances, interbank claims, trading assets, net loans, investments in securities, and other assets (equation 1). Total liabilities generally consist of deposits, interbank funding, trading liabilities, wholesale funding (eg debt), and other liabilities (equation 2). Shareholder's equity represents the residual claim of shareholders after deducting the liabilities of creditors from total assets.

$$Assets = Cash + IBclaims + TradAssets + Loans + Investments + OtherAssets \quad (1)$$

$$Liabilities = Deposits + IBfund + TradLiabs + Debt + OtherLiabs \quad (2)$$

Note that the simplest leverage ratio for a bank is the ratio of shareholder's equity to total assets. The quantity of RWAs cannot be determined by simply looking at the balance sheet, as it requires more granular detail on the nature of the assets.

The bank's consolidated income statement shows the various components that generate net income (equation 3). A bank's revenues can be divided into two broad categories: net interest income and non-interest income. Net interest income is interest income less interest expense. Interest income is generated by interbank claims, net loans and investments. Interest expense is payable on deposits, interbank funding, and wholesale funding. Wholesale funding consists of debt maturing within one year, and longer-term debt. Non-interest income may be divided into two sources: trading income generated by trading assets and trading liabilities, and fees and commissions. Total revenues less operating expenses and taxes equals net income.

$$NetIncome = [(IncomeLoans + OtherIntIncome - IntExp) + NonIntInc - OpExp] \cdot (1 - tax) \quad (3)$$

Having specified the quantities of different assets, how they are financed, and the income they generate, the next step is to specify the costs of different sources of capital. First, we must distinguish between liabilities shorter than one year in maturity and longer-term liabilities. Shorter term liabilities such as interbank funding, trading liabilities, and debt maturing within one year are charged an interest rate that is typically lower than the interest rate charged on longer-term debt. The one-year threshold may appear arbitrary, but is important as it is specified in the definition of the NSFR. In this study, wholesale funding is split between a portion of debt maturing within one year ($\rho_t$) and a remainder of longer-term debt (equation 4).

$$WholesaleFunding_t = Debt_t \cdot \rho_t + Debt_t \cdot (1 - \rho_t) \quad (4)$$

This distinction is important when calculating the cost to meet the NSFR. This information is also required to calculate a more accurate cost of a bank's liabilities. A bank's financial statements do not separately disclose the costs of interbank funding, trading liabilities, deposits, and wholesale funding. Instead these costs are aggregated and reported as interest expense, as shown in equation 5.

$$IntExp_t = r_{deposits} \cdot Deposits + r_{Debt \le 1 year} \cdot (IBfund + TradLiabs + Debt_t \cdot \rho_t) + r_{LtDebt} \cdot Debt_t \cdot (1 - \rho_t) \quad (5)$$

where $r_{deposits}$ is the cost of deposits, $r_{Debt \le 1Year}$ is the cost of debt maturing within one year and $r_{LtDebt}$ is the cost of long-term debt. In this study, it will be important to distinguish the cost of three types of liabilities: a cost of deposits, a cost of short-term liabilities

(maturing within one year) and a cost of long-term liabilities. These costs may be calibrated based on a representative bank's ratio of interest expense to interest-paying liabilities by solving the following three equations:

$$r_{deposits} = x \tag{6}$$

$$r_{Debt \leq 1 year} = x + 0.01 \tag{7}$$

$$r_{LtDebt} = x + 0.02 \tag{8}$$

The cost of deposits is set equal to some value x%, with the cost of debt maturing within one year set to x% + 100 basis points, and the cost of long-term debt x% + 200 basis points (equations 6 to 8). The lowest cost for deposits is consistent with the existence of deposit insurance schemes, which reduce the risk of this source of funding relative to other liabilities. These spreads generate an upward sloping yield curve and are based on long-term historical averages for the countries in this sample. Based on these assumptions, the cost of each type of liabilities can be calibrated using equation 5.

The final source of bank funding is shareholder's equity. One measure of the expected return for a bank's shareholders is the long-term average ROE, which is the ratio of net income to shareholder's equity (equation 9).

$$r_{equity} = \overline{ROE} = \frac{NetIncome}{Equity} \tag{9}$$

where $r_{equity}$ is the cost of equity. ROE measures the amount of profit per unit of shareholder's equity in a given year. While this ratio is very volatile, over a long time horizon it provides a measure of the return expected by shareholders.

While shareholder's equity may consist of various equity-like securities with different features and claim on dividends, this study assumes that all equity securities bear the same cost as common equity, which biases the cost estimates upwards. The expected return on common equity will be the highest across different sources of bank capital, as common equity has the lowest residual claim on the bank's assets. On this basis, and consistent with theories such as the Modigliani-Miller theorem, the relative costs of different forms of capital in normal times should follow the relationship (equation 10):

$$r_{deposits} < r_{Debt \leq 1 year} < r_{LtDebt} < r_{equity} \tag{10}$$

While this relationship may be violated for a bank in financial distress, in normal times this relationship ensures that different capital providers receive an expected return commensurate with the risk of their investment.

Finally, it is important to distinguish between regulatory capital ratios and accounting ratios based on a bank's balance sheet. Under current banking regulations, the quantity of capital that must be held for regulatory purposes is related to the riskiness of the assets. The quantity of RWAs used when calculating capital adequacy ratios, however, may not equal the quantity of total assets shown on a bank's balance sheet. This study focuses on the total capital ratio, defined as qualifying capital divided by RWAs (equation 11).

$$TotalCapitalRatio = \frac{E}{RWA} \tag{11}$$

Given the relationships in equations 1 to 11, it is possible to calculate the impact of higher capital requirements on lending spreads. We assume that the quantity of shareholder's equity is increased relative to RWAs to meet a target capital adequacy ratio. The size and composition of the balance sheet is held constant but the relative share financed by shareholder's equity and total liabilities changes. An increase of the capital ratio of 1pp generates a smaller rise in shareholder's equity as RWA are typically smaller than total assets (equation 12).

$$E_{t+1} = E_t + \Delta TotalCapitalRatio \cdot RWA_{t+1} \quad (12)$$

The increase in the quantity of shareholder's equity is matched by an equal and offsetting decrease in the quantity of liabilities. As the most expensive form of liabilities, long-term debt should be the first liabilities to be replaced with equity (equation 13).[11]

$$\Delta Debt = -\Delta Equity \quad (13)$$

The change in capital structure leads to a rise in the bank's cost of capital, as debt is substituted with more expensive equity. Reported net income should rise, all else equal, as the decline in the quantity of debt outstanding reduces interest expense and raises net income (equations 3 and 5). While net income rises, ROE typically falls as the relative increase in the quantity of equity in the denominator is greater than the rise in net income in the numerator (equation 9). This relationship holds when the pre-tax cost of debt is lower than the cost of equity (equation 10).

The reduction in bank leverage should be expected to lower the expected returns of creditors and shareholders. In theory, both the cost of equity and the cost of debt should decline as leverage decreases and the risk of default becomes smaller. While the theoretical predictions of changing capital structure are clear, it is not evident that these theories hold in practice. Empirically, the historical return earned by investors in bank stocks is much lower than would be predicted based on the degree of bank leverage. One explanation for this discrepancy is that banks may be viewed as having an implicit government guarantee, which reduces the risk of default ex ante, leading bank shareholders to expect a lower expected return. Similarly, the cost of deposits reflect an implicit subsidy due to the presence of deposit insurance schemes, while the cost of wholesale funding is also lower than observed for corporations with similar levels of financial leverage.[12] The base case in this study assumes that the bank's ROE and cost of long-term debt are unchanged despite the reduction in leverage, rather than falling, which biases the cost estimates upwards. This base case may be reasonable given the existence of deposit insurance and implicit guarantees that currently underpin the low cost of bank liabilities. If a bank's ROE and cost of debt are allowed to decline, the impact on lending spreads is reduced.

In this study, it is assumed that banks respond to the fall in ROE by raising the lending spread (α) charged on loans. The lending spread is a variable that cannot be observed

[11] Banks will not likely reduce the quantity of deposits, as they represent one of the least expensive forms of liabilities and they help meet the NSFR. Similarly, interbank funding and trading liabilities are funded in short-term markets and are less expensive than long-term debt. Reducing trading liabilities may also be expected to lead to a fall in trading income.

[12] Empirically, it is possible to identify an inverse relationship between bank capital ratios and historical ROEs, with bank ROEs lower for more highly capitalised banks. Given the lack of data on secondary market prices for bank debt, however, the empirical relationship between bank capital ratios and the cost of wholesale funding is less clear.

directly, as it is not disclosed by banks. This effect is modelled, therefore, as an increase in the average spread charged on the entire loan portfolio (equation 14).

$$IncomeLoans_{t+1} = IncomeLoans_t + \alpha \cdot Loans_{t+1} \quad (14)$$

The size of increase in lending spreads is determined such that the increase in net income exactly offsets the increase in the cost of capital, allowing ROE to be unchanged at its previous value (equation 15).

$$\alpha = \frac{\left[\frac{(ROE_{t+1} \cdot E_{t+1})}{(1-tax)} - (OtherIntIncome_{t+1} - IntExp_{t+1} + NonIntIncome_{t+1} - OpExp_{t+1})\right] - IncomeLoans_t}{Loans_{t+1}} \quad (15)$$

This mapping provides a measure of the rise in lending spreads needed to offset the fall in ROE associated with a 1pp increase in the capital ratio. As long as long-term debt is replaced by equity and the costs of debt and equity are unchanged, the increase in lending spreads rises linearly with the increase in the capital ratio. If cheaper forms of liabilities are replaced with more expensive equity, the rise in lending spreads is higher.

The relationships outlined in equations (1) to (15) allow us to anticipate how sensitive the results are to different assumptions. In general, the estimate of the marginal cost to increase the total capital ratio is not affected by the levels of any variables. For example, the results are not sensitive to the level of tax rates, provided that they are the same before and after the capital change, as taxes will only change the level of net income (equation 3). While a lower tax rate will lead to a higher level of net income for a given level of shareholders equity (equation 9), the impact on lending spreads is unaffected as long as the tax rate is the same before and after the change in capital structure. In a world with no taxes, for example, an increase in equity relative to debt requires the same change in lending spreads.

Similarly, this exercise assumes all items in shareholders equity qualify as regulatory capital. Preferred shares and other hybrid instruments may be treated as shareholder's equity for accounting purposes but may not qualify as capital for regulatory purposes. Hybrid securities typically bear a higher cost than long-term debt but a lower cost than common equity. If banks can increase their capital ratios by repurchasing hybrid securities and issuing common shares, the impact on lending spreads may be lower depending on the impact on net income.

### 3.2 Mapping NSFR to lending spreads

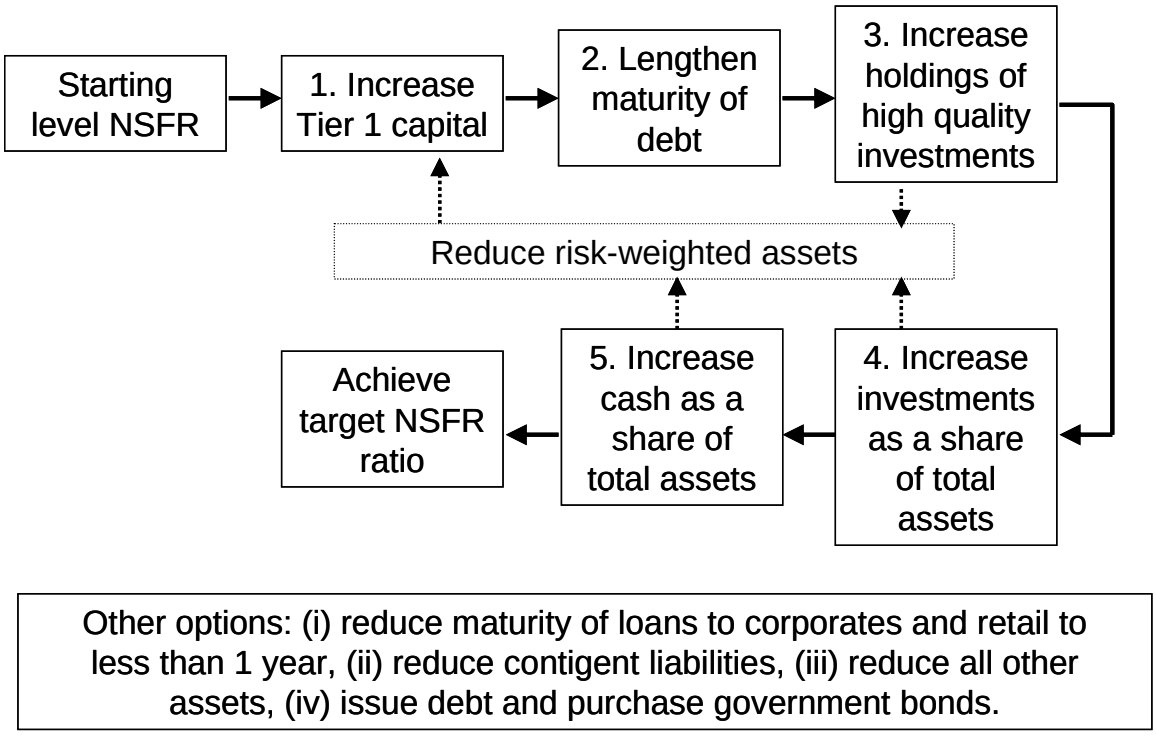
Estimating the cost of meeting the NSFR is more difficult than the cost to meet higher capital requirements, as the inputs to the NSFR are not disclosed in a bank's financial statements. The December 2009 BCBS consultative document proposed a definition and a calibration for the NSFR. A simplified version is shown here (equation 16).

$$NSFR = \frac{ASF}{RSF} = \frac{Equity + Debt_{>1yr} + Liabs_{>1yr} + (StableDeposits_{<1yr} \cdot 85\%) + (OtherDeposits \cdot 70\%)}{(GovtDebt \cdot 5\%) + (CorpLoans_{<1yr} \cdot 50\%) + (\mathrm{Re}tLoans_{<1yr} \cdot 85\%) + (OtherAssets \cdot 100\%)} \quad (16)$$

The numerator measures the sources of available stable funding (ASF), with greater weight given to funding sources that are more stable and least likely to disappear under stressed market conditions. Equity, longer-term debt and longer-term liabilities are the most stable forms of funding, followed by deposits. The denominator shows assets that require funding, with a factor (or haircut) applied based on their expected liquidation value under stressed circumstances. Cash, securities with less than 1 year to maturity, and interbank loans do not have to be funded and have a factor of 0%. Government debt is considered very liquid and must only be funded at 5% of face value. Corporate loans and retail loans that mature within one year must be funded 50% and 85%, respectively. The assumption is that legally they do not have to be rolled over when they mature (which does not recognise potential reputational risk). All remaining assets must be funded at 100%. To achieve a target NSFR, banks must have an ASF greater than their RSF, leading to a NSFR of 1 or greater.

In general, banks can increase their NSFR by extending the maturity of their funding while reducing the maturity or riskiness of their assets. The flow chart in Figure 1 outlines a series of steps that banks may follow to meet the NSFR. The steps are based on a cost-benefit analysis, with the least costly strategies used first followed by more expensive strategies. Given that holding more equity relative to debt improves the NSFR, the analysis assumes that banks have already met the higher capital requirements. While this analysis follows the scenario in Figure 1, more efficient strategies may be available by bank and by country.

**Figure 1: One possible scenario to meet the NSFR**



First, banks lengthen the maturity of their wholesale funding beyond one year (equation 10). This maturity extension increases the numerator of the NSFR (equation 16), but also raises interest expense (equation 5) as the cost of long-term debt is assumed to be higher than the cost of debt maturing within one year (equation 10). Higher interest expense, all else equal, leads to a fall in net income (equation 3) and ROE (equation 9).

Next, banks increase the share of higher-rated, liquid bonds in their investment portfolios. For example banks may hold fewer lower-rated corporate bonds that must be funded at 100%, and increase their holdings of government bonds and corporate (or covered) bonds rated AA or higher. Increases in holdings of higher-rated securities reduces the denominator of the NSFR (equation 16), but is associated with a fall in interest income and net income (equation 3). The loss of interest income is a function of the difference in returns from holding more liquid, higher rated securities relative to higher-yielding but less liquid assets. This opportunity cost ($\theta_t$) captures the lower return from holding higher-rated and more liquid bonds (equation 17).

$$Investments_t = Investments_t \cdot \theta_t + Investments_t \cdot (1 - \theta_t) \quad (17)$$

The ability to increase the NSFR by shifting the composition of existing investments is also limited by the existing quantity of investments relative to total assets. If changes of the composition of the investments are not sufficient for meeting the NSFR, banks may be required to change the composition of their assets more broadly. In this analysis, banks are assumed to increase the size of investments while reducing the category called “Other Assets”. Similar to the case of the substitution of lower-rated corporate bonds with government bonds, interest income declines assuming other assets earn a higher return than government bonds (equation 18).

$$OtherIntIncome_{t+1} = OtherIntIncome_t + Investments_{t+1} \cdot \Delta(1 - \theta_{t+1}) \cdot r_{inv} + \Delta OtherAssets \cdot r_{inv} - \Delta Cash \cdot r_{inv} \quad (18)$$

where $r_{inv}$ is the return on investments. Taken together, the changes required to meet the NSFR reduce net income (equation 3) and reduce ROE (equation 9). Similar to the case with higher capital requirements, banks may wish to avoid a fall in their ROE and may seek to replace the lost interest income by raising lending spreads (equation 15). This increase is over and above the earlier increase to meet the higher capital requirements.

Banks face other options to raise their NSFR, but a number of these options are either unavailable or unattractive. On the asset side, banks are not likely to reduce their holdings of loans, which are higher yielding assets where banks have a comparative advantage over other institutional investors. Banks may also seek to reduce their trading assets, as these assets must be funded at 100%. Any reduction in trading assets, however, would likely result in a fall in trading income, leading to lower net income and lower ROE. On the liability side, banks have limited room to attract more deposits in the steady state as deposits are already a significant portion of liabilities. Given a fixed quantity of savings in an economy, banks can only attract deposits by offering a higher deposit rate or by offering more services. Such an action would lead to an escalation in the cost of deposits as banks compete to attract the same pool of deposits. Similarly banks will not likely raise more equity than necessary to meet the NSFR because equity is costly relative to liabilities.

### 3.3 Synergies between enhanced capital and liquidity requirements

A number of synergies exist between raising capital requirements and meeting the NSFR. As seen in the design of the NSFR, higher levels of equity relative to other sources of capital reduce maturity mismatches and improve the numerator of the NSFR. The synergies from higher capital are limited, however, as a large quantity would need to be raised to have an important impact on the ratio.

A more important synergy arises from increasing holdings of high-quality, liquid investments. This change in a bank's investment portfolio reduces a bank's RWAs and lowers the quantity of equity required to meet a target capital adequacy ratio (equations 11 and 12). If less equity needs to be issued, the required increase in lending spreads is reduced. Given that bank's do not report how they calculate their RWAs, the impact of this change can only be calculated indirectly based on several assumptions. The first assumption is that riskier investments in lower-rated corporate bonds bear a higher risk-weight than government bonds. Under Basel II, government bonds bear a 0% risk weight while lower-rated or unrated corporate securities bear a risk weight of 100% or greater. For each unit of corporate securities that are sold and replaced with government bonds ($\theta_t$), the bank's RWA will decline by a known amount (equation 19).

$$\Delta RWA = (Investments_t \cdot \theta_t - Investments_{t+1} \cdot \theta_{t+1}) \cdot riskweight_{OtherAssets} \quad (19)$$

This synergy between meeting the NSFR, lowering RWAs, and reducing the quantity of equity that must be held to meet a given capital adequacy ratio becomes more important as the quantity of higher-rated securities held in a bank's investment portfolio increases. As the analysis below will show, the incremental cost of meeting the NSFR falls as the capital ratio increases as more equity increases the NSFR (equation 16).

## 4. Data and descriptive statistics

The previous section has outlined the mapping from higher capital and liquidity requirements to bank lending spreads. The remainder of this study provides estimates based on a representative bank. This section provides stylized facts on bank lending spreads, and explains how to calculate the representative bank's financial statements.

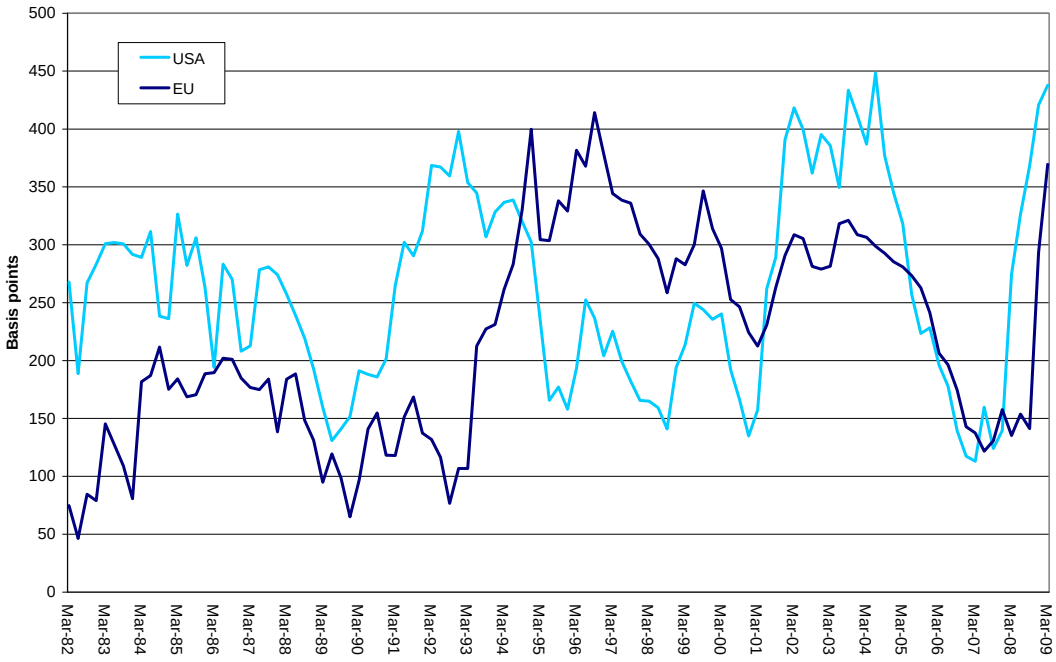
### 4.1 Stylized facts on bank lending spreads

The focus of this study is on bank lending spreads, which is the spread between a bank's cost of liabilities and the average rate charged on its loan portfolio. The liabilities of a bank consist of some combination of deposits, wholesale funding (whether in interbank markets or capital markets) and other liabilities. The rate charged by banks on loans will vary depending on the terms of the loan, the characteristics of the borrower, the collateral provided and other costs associated with the loan. Researchers have measured the lending spread using various proxies. A common definition is the difference between the interest rate charged on loans and the rate paid on deposits. Repullo and Suarez (2004) use this definition.[13] Goodfriend and McCallum (2007) measure the lending spread as the difference between the uncollateralised lending rate and the interbank rate.

[13] In the model of Repullo and Suarez (2004), banks charge a lending rate that maximizes the expected discounted value of the spread between the rate charged on loans and the cost of deposits.

Figure 2 shows proxies for the lending spread for the US and the Euro area from 1982 to 2009. The lending spread for the US is taken from Drehmann et al. (2010) and for the Euro area is based on Calza et al. (2006). Both studies create a composite lending rate by weighting the interest rate charged on different types of bank loans (mortgage rates, commercial and industrial lending rates, consumer credit), where the weights are the relative size of these categories in national accounts. The lending spread is then the difference between this lending rate and the three-month interbank rate. The average lending spreads over the period 1993 to 2007 are 275 basis points and 256 basis points for the US and the Euro area, respectively. The magnitude of the lending spread based on composite lending rates is similar to the average spread over the same period between the US prime lending rate and the effective federal funds rate of 300 basis points. Using data on rates charged on bank loans and paid on customer deposits from the IMF's International Financial Statistics, the average lending spread from 1993 to 2007 has been higher in Australia (480 basis points) and Canada (342 basis points), similar in Switzerland (272 basis points) and lower in Japan (191 basis points). These proxies for lending spreads provide a useful benchmark for comparing the size of the estimated increases in lending spreads discussed later in this study.

**Figure 2: Lending spreads in the United States and Euro area, 1982–2009**




## 4.2 Constructing a representative bank's financial statements

Income statement and balance sheet data for banks in 13 OECD countries is downloaded from Bankscope from 1993 to 2007. The average over this 15-year period is chosen to provide an estimate of the steady-state. Given the lag with which data is reported in Bankscope for many countries, data for 2008 is not yet available.

**Table 1: Sample distribution by country and year**[1]

| Year | AU | CA | CH | DE | ES | FR | GB | IT | JP | KR | MX | NL | US | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993 | 6 | 0 | 14 | 51 | 94 | 228 | 18 | 160 | 59 | 29 | 4 | 32 | 491 | 1,186 |
| 1994 | 7 | 11 | 16 | 52 | 97 | 250 | 18 | 172 | 61 | 32 | 4 | 35 | 813 | 1,568 |
| 1995 | 9 | 11 | 17 | 54 | 105 | 270 | 21 | 185 | 65 | 41 | 6 | 46 | 853 | 1,683 |
| 1996 | 7 | 11 | 17 | 58 | 119 | 270 | 22 | 201 | 71 | 50 | 7 | 51 | 896 | 1,780 |
| 1997 | 8 | 11 | 18 | 61 | 121 | 260 | 16 | 197 | 73 | 51 | 13 | 47 | 932 | 1,808 |
| 1998 | 7 | 13 | 17 | 57 | 119 | 254 | 14 | 204 | 92 | 28 | 16 | 52 | 965 | 1,838 |
| 1999 | 7 | 13 | 17 | 61 | 108 | 304 | 16 | 209 | 579 | 25 | 19 | 54 | 1,498 | 2,910 |
| 2000 | 5 | 14 | 22 | 60 | 106 | 309 | 15 | 207 | 639 | 23 | 20 | 58 | 1,622 | 3,100 |
| 2001 | 7 | 15 | 23 | 55 | 111 | 306 | 12 | 217 | 609 | 23 | 23 | 56 | 1,721 | 3,178 |
| 2002 | 5 | 15 | 24 | 54 | 118 | 309 | 11 | 248 | 589 | 25 | 21 | 64 | 1,960 | 3,443 |
| 2003 | 8 | 15 | 25 | 57 | 125 | 318 | 14 | 292 | 579 | 26 | 21 | 66 | 2,070 | 3,616 |
| 2004 | 9 | 15 | 27 | 63 | 98 | 312 | 28 | 228 | 594 | 32 | 28 | 66 | 2,156 | 3,656 |
| 2005 | 9 | 15 | 27 | 64 | 137 | 330 | 43 | 316 | 591 | 35 | 31 | 66 | 2,340 | 4,004 |
| 2006 | 9 | 15 | 28 | 81 | 142 | 308 | 45 | 340 | 580 | 33 | 32 | 67 | 2,385 | 4,065 |
| 2007 | 9 | 15 | 27 | 81 | 115 | 294 | 41 | 368 | 581 | 28 | 31 | 61 | 2,367 | 4,018 |
| Total | 112 | 189 | 319 | 909 | 1,715 | 4,322 | 334 | 3,544 | 5,762 | 481 | 276 | 821 | 23,069 | 41,853 |

1. AU=Australia, CA=Canada, CH=Switzerland, DE=Germany, ES=Spain, FR=France, GB=United Kingdom, IT=Italy, JP=Japan, KR=Korea, MX=Mexico, NL= Netherlands, and US=United States.

Source: Bankscope.

The raw Bankscope data contains multiple observations for a given bank in a given year. Both the consolidated entity and the subsidiaries may be included. There may also be several entries for the same bank for a given year, based on different filing dates or accounting standards. This study uses the consolidated entity where available, taking the last filing in a calendar year. Financial statements based on IFRS are used where available, except for US banks where local GAAP is used. The sample is restricted to banks with total assets greater than $250 million. After cleaning, the final sample consists of 6,844 bank-year observations, which account for around 70% of the total assets for all banks in Bankscope over this period. Table 1 provides the breakdown of banks by country and year. The number of banks increases by year due the expansion of Bankscope coverage.[14] Banks that merge or file for bankruptcy are included in the sample until the year they disappear, at which point any surviving bank is included.

Bankscope does not report RWAs directly in this dataset. Instead the quantity of RWAs must be backed out with reference to two ratios: the reported Tier 1 capital ratio, or the reported total capital ratio. There are significant outliers in the data, particularly for Japanese banks. For this reason, these capital adequacy ratios are winsorized at the 1% and 99% to reduce the impact of outliers.

Based on this data, a representative balance sheet and income statement is constructed for each country by taking the weighted average values for banks headquartered in a given country. The weights are based on total assets. Table 2 shows the stylized

**Table 2: Representative balance sheet and income statement, 1993–2007**
(As percentage of total assets)

| Balance sheet | Average | Income statement | Average |
|---|---|---|---|
| Cash and balances at central banks | 2.3 | Interest income | 5.9 |
| Interbank claims | 12.2 | Interest expense | 4.0 |
| Trading-related assets | 10.4 | A. Net interest income | 1.8 |
| Net loans, leases and mortgages | 51.6 | Trading income | 0.2 |
| Investments and securities | 16.1 | Non-interest income ex trading | 1.3 |
| Other assets | 7.4 | B. Non-interest income | 1.5 |
| TOTAL ASSETS | 100.0 | C. Total revenues (A + B) | 3.3 |
| | | Personnel expenses | 0.9 |
| Deposits (retail, corporate) | 43.5 | Other administrative expenses | 1.2 |
| Interbank funding | 12.6 | D. Total operating expenses | 2.1 |
| Trading-related liabilities | 15.2 | E. Operating profit (D – E) | 1.2 |
| Wholesale funding | 14.2 | F. Income tax provision | 0.4 |
| Other liabilities | 9.3 | G. Net income (return on assets) | 0.8 |
| TOTAL LIABILITIES | 94.7 | | |
| TOTAL SHAREHOLDERS' EQUITY | 5.3 | *Return on equity (ROE) (%)* | *15.5%* |
| TOTAL LIABILITIES & STOCKHOLDERS' EQUITY | 100.0 | *Leverage multiple* | *18.8x* |
| *Risk-weighted assets / total assets* | *53.3* | *Average effective tax rate (%)* | *33%* |

Source: Bankscope, author's calculations. Totals may not add up due to rounding.

[14] In the overall sample, there are significant jumps in Bankscope's coverage in 1993 and 1999, driven by increases in coverage of banks headquartered in Japan and the USA.

balance sheet and income statement for the representative bank. All items are shown as a percentage of total assets. Loans represent about half of the typical banks assets, followed by investments (16.1%), interbank claims (12.2%), and trading-related assets (10.4%). These assets are funded primarily by deposits (43.5%), trading-related liabilities (15.2%), wholesale funding (14.2%), and interbank funding (12.6%). Shareholder's equity represents 5.3% of assets, of which common equity is the majority (4.7%). RWAs represent around half of total assets on average. This ratio will be important when calculating the cost of meeting the higher capital requirement. If RWAs represent half of total assets, an increase in the capital ratio of 1pp requires only a rise in shareholder's equity of half a percentage point.

Table 2 also shows the consolidated income statement for the representative bank. In terms of the composition of net income, net interest income is 1.8% with non-interest income also important at 1.5%. Total operating expenses amount to 2.1%. Personnel expenses represent around 40% of total operating expenses. Net income (or ROA) is 0.8%, implying that the average return on equity (ROE) is around 15%. The average historical tax rate is 33%.

# 5. Estimates of higher capital requirements

Having outlined the mapping for the calculation and the financial statements of the representative bank, this section provides an example of the calculation of the potential impact of raising the capital ratio on lending spreads.

## 5.1 Impact of a 1 percentage point increase in the capital ratio

Table 3 provides estimates of the potential impact on lending spreads of higher capital requirements. Initially the discussion will focus on the estimates assuming no change in a bank's ROE or cost of debt in response to the change in capital structure, although this assumption will be relaxed later. Only quantities of capital are assumed to change, specifically the quantity of equity and the quantity of debt. The first column in Table 3 shows the increase in the capital ratio, which rises by increments of 1pp from its initial starting value. The next column (column A) shows the increase in lending spreads required to maintain ROE at its historical level. A 1pp increase in the capital ratio can be offset by increasing the lending spread by 15 basis points. Note that the relationship is linear, with each 1pp increase in the capital ratio requiring an additional 15 basis point increase in lending spreads. The magnitude of this change can be compared to the proxies of lending spreads discussed earlier. This increase would raise US lending spreads, for example, from a historical average of 275 basis points to 290 basis points, an increase of around 5%. Whether it is possible for banks to pass on this increase to borrowers depends on the elasticity of the demand for loans, as well as other country-specific and institutional factors.

**Table 3: Impact of higher capital requirements on lending spreads (basis points)**

| Increase in capital ratio (percentage points) | No change in ROE or cost of debt (A) | Fall in ROE and cost of debt per 1pp increase in capital ratio | | |
|---|---|---|---|---|
| | | 10 basis points (B) | 15 basis points (C) | 20 basis points (D) |
| 0 | 0 | 0 | 0 | 0 |
| +1 | 15 | 13 | 12 | 11 |
| +2 | 30 | 26 | 24 | 22 |
| +3 | 45 | 39 | 36 | 33 |
| +4 | 60 | 52 | 48 | 44 |
| +5 | 75 | 65 | 60 | 55 |
| +6 | 90 | 78 | 72 | 66 |

Table 4 provides details of the calculation for a 1 pp increase in the capital ratio. Column A presents the starting point. In column B, the capital ratio is raised from 10% to 11%, an increase of 1pp. Given that RWA represent 53.3%, a 1pp increase in the capital ratio

**Table 4: Calculation of rise in lending spreads for 1pp increase in capital ratio assuming no change in ROE or cost of debt**

| | | No change in lending spreads | | Increase in lending spreads | |
|---|---|---|---|---|---|
| | (A) | (B) | (C) | (D) | (E) |
| | Before | After | Change | After | Change |
| Total capital / RWA | 10.0% | 11.0% | 1.00% | | 1.00% |
| Risk-weighted assets / Total Assets | 53.3% | 53.3% | 0.00% | | 0.00% |
| Shareholder's equity | 5.3% | 5.9% | 0.53% | | 0.53% |
| Wholesale funding | 14.2% | 13.6% | -0.53% | | -0.53% |
| | | | | | |
| Increase in lending spreads | | 0.00% | | 0.15% | |
| Interest income on loans | 3.3% | 3.3% | 0.00% | 3.4% | 0.08% |
| + Interest income ex loans | 2.5% | 2.5% | 0.00% | 2.5% | 0.00% |
| = Interest Income | 5.9% | 5.9% | 0.00% | 6.0% | 0.08% |
| - Interest expense | 4.1% | 4.1% | -0.03% | 4.1% | -0.03% |
| = Net interest income | 1.8% | 1.8% | 0.03% | 1.9% | 0.11% |
| + Non interest income | 1.5% | 1.5% | 0.00% | 1.5% | 0.00% |
| = REVENUE | 3.2% | 3.3% | 0.03% | 3.4% | 0.11% |
| - Operating expenses | 2.1% | 2.1% | 0.00% | 2.1% | 0.00% |
| = Pre tax income | 1.1% | 1.1% | 0.03% | 1.2% | 0.11% |
| NET INCOME | 0.7% | 0.8% | 0.02% | 0.8% | 0.07% |
| Return on equity | 13.8% | 12.9% | -0.90% | 13.8% | 0.00% |

Source: Author's calculations. Totals may not add up due to rounding.

requires an increase in equity of 0.53%. Given that total assets are unchanged, the rise in equity is offset by a decline in wholesale funding. This decline in the quantity of wholesale funding, with no change in the cost of this debt, leads to a decline in interest expense of 3.2 basis points and an equivalent increase in pre-tax income. After taxes are deducted, net income increases by 2.1 basis points. While net income has increased, shareholder's equity has increased by 53 basis points implying that ROE falls by 0.9 percentage points. Column D illustrates how the bank can offset the fall in ROE by raising lending spreads. In order to return ROE to its previous level, net income has to be increased by an additional 5.2 basis points to 0.81%. Pre-tax income must therefore increase by 7.8 basis points. Given that loans represent 51.6% of total assets, the increase in lending spreads required to generate this additional income is 15 basis points. Provided that increases in equity are met by decreases in wholesale funding, the increase in lending spreads required to offset a rise in equity will be linear. A 2pp increase in the capital ratio will require a 30 basis point increase in lending spreads.

### 5.2 Estimates assuming fall in ROE and cost of debt

The analysis thus far has assumed that banks wish to maintain their existing ROE and the cost of debt is unchanged when leverage decreases. This assumption is conservative, as theory would suggest that both rates should fall as leverage falls and the bank becomes less risky. A recent paper by Admati et al. (2010) makes the case convincingly that a bank's expected ROE should fall if leverage is decreased. The theoretical basis for the fall in ROE is provided by Modigliani and Miller (1958), who argue that both the cost of equity and the cost of debt should fall when a firm becomes less risky. A reduction in financial leverage increases the firm's ability to service existing debt, reducing credit risk and the probability of default. The cost of debt should be expected to decline as the probability of bankruptcy is reduced. Lower financial leverage also reduces the co-variance of the firm's stock price to market movements, implying a lower expected return in equilibrium. The expected ROE of an unleveraged firm should therefore be lower than the expected ROE of a leveraged firm. A large number of empirical studies have established that capital structure choices clearly do matter for corporations, although these studies typically do not consider banks (Myers 2001). Gropp and Heider (forthcoming), however, show that corporate finance theories do generally apply to banks, providing support for the expected change in ROE.

While these statements are uncontroversial in corporate finance, it is not clear *a priori* that they apply to banks. Banks are heavily regulated entities that operate with the benefit of explicit deposit insurance and implicit government guarantees in many countries. This support allows banks to operate with high leverage but lower borrowing costs for wholesale debt than would otherwise be justified by the degree of leverage. The incentive for bank shareholders in this setting is to increase the bank's expected ROE by increasing financial leverage. The ability to take on increased leverage is restricted by capital regulation, with Basel I and Basel II setting a minimum total capital ratio of 8% of RWA. If RWAs represent around half of total assets on average, then a bank can still leverage its equity up to 24 times, leading to a ratio of equity to total assets of 4%. Such a high leverage ratio is not feasible for a corporation, as the firm would be viewed as financially distressed and its ability to fund itself in capital markets would be severely curtailed. If banks reduce their leverage, it is not clear that their cost of borrowing will fall. Instead, the implicit subsidy provided by governments may be reduced with no change in the wholesale funding costs of banks.

Given limited empirical evidence on the value of either implicit or explicit bank guarantees, it is worth exploring the impact on lending spreads if ROE and the cost of debt are assumed to decline as leverage decreases. Table 3 provides three potential scenarios. ROE and the cost of debt are assumed to fall by 10, 15 and 20 basis points for each 1pp increase in capital ratio. These declines are provided for expositional purposes only and are not calibrated based on a theoretical model.[15] The results show that the estimated impact on lending spreads is reduced. If ROE and the cost of long-term debt decline by 10 basis points for each 1pp increase in capital ratios, the increase in lending spreads is reduced to 13 basis points. If the fall in ROE and the cost of debt is greater, the required increase in lending spreads is lower.

These results highlight the sensitivity of the estimates to the relative cost of equity and liabilities. The impact on lending spreads depends on the gap between the steady-state ROE and the cost of debt, as well as the relative costs of different forms of liabilities. When the initial gap between expected ROE and the cost of debt is smaller, the rise in lending spreads to offset the fall in ROE is also smaller, all else equal. At the margin when the cost of debt and expected ROE are the same, a change in capital structure should have no impact on a bank's lending spreads.

### 5.3 Sensitivity of estimates to assumptions

Estimates of the required increase in lending spreads are sensitive to differences in the size of loans to total assets, and differences in the size of RWA to total assets. In the first case, the relative size of loans to total assets has a direct impact on estimates of the required change in lending spreads. In response to an increase in capital requirements, a given quantity of net income must be recovered by raising pre-tax income on the existing loan portfolio. If the loan portfolio represents a larger share of total assets, a smaller increase in lending rates per loan can generate the increase in loan income.

In the second case, differences in the quantity of RWAs across banks affect the quantity of equity that must be raised for a given increase in capital. In the example above, RWA represented 53.3% of total assets. If this number is 100%, a 1pp rise in the capital ratio will require an equivalent increase in shareholder's equity. The increase in lending spreads required to offset this increase will therefore be approximately double at 28.5 basis points. By changing the denominator in the capital ratio, a change in RWA has the same impact as a change in the numerator. For this reason, the impact of revisions to the risk-weighting of assets under Basel III can be modelled using the mapping above.

Given that the analysis focuses on changes from one steady-state to another, the estimates are not affected by variables that do not change from one steady-state to another. Take the example of the tax rate. Assume that the tax rate for a given jurisdiction is only 25% instead of 33%. The lower tax rate, all else equal, will be associated with a higher starting level of ROE. When this higher starting level of ROE is used in the example above, the increase in lending spreads in response to a 1pp increase in the capital ratio is again 15 basis points. The intuition for this result is provided by equation 15. While the calculation of the impact on lending spreads is

[15] The author conducted an empirical analysis using Bankscope data where bank ROE was regressed on capital ratios and other control variables. The estimated coefficient suggested a 1pp change in a bank's capital ratio was associated with a change in ROE of 25 basis points (results not reported). Given the lack of data on the cost of wholesale funding, a similar analysis could not be conducted for the relationship between capital ratios and the cost of debt.

shown to include ROE in the numerator, this first term can be simplified by removing taxes and using pre-tax income. Given that all the remaining variables are pre-tax, it becomes clear that the tax rate does not affect the results.

Note that if a capital change is combined with a change in the tax rate, the results will be different. In such a scenario, both net income and ROE will be affected by the fiscal change as well as the capital structure change. This discussion highlights that it is important to focus on only one policy change in isolation. While a change in minimum capital requirements will affect ROE and potentially lending spreads, a change in the tax regime will also have an impact. The mapping shown above may be used to model a banking levy or financial tax. Assuming no change in a bank's capital structure, the introduction of a financial levy would reduce net income and reduce ROE, all else equal. Any decrease in net income from higher taxes would need to be off-set by an equivalent increase in loan income, providing an estimate of the increase in lending spreads required to offset the lower net income.

### 5.4 Alternatives to raising lending spreads

Banks have various alternatives to offset the loss of net income that do not involve changing lending spreads. For example, banks could (i) reduce operating expenses, (ii) increase non-interest sources of income, (iii) redirect activity towards more profitable lines of business, or (iv) absorb the higher costs and reduce ROE. The relative merits of different strategies would depend on the bank's competitive environment. In practice, banks are likely to follow a combination of strategies. To the extent that banks can absorb some of the costs by increasing efficiency or reducing operating expenses, the costs of the new reforms will be lower. Higher capital requirements, however, may lead to less desirable bank behaviour, such as increasing the riskiness of their activities or increasing funding and currency mismatches.

Banks can maintain their current ROE by reducing variable expenses such as compensation or interest expense. Based on the representative bank shown in Table 2, a 1pp increase in the capital ratio can be offset by lowering operating expenses by 4% (to 96% of their previous value). Banks may be able to reduce personnel expenses, which represent around 40% of operating expenses on average. Banks with above average compensation as a share of total revenues could reduce this amount to bring it in line with their industry. Banks may also be able to reduce their interest expense. Given that deposits are relatively inelastic to interest rates, for example, banks in some jurisdictions may be able to pay less for deposits.

Banks can also reduce operating costs by increasing their operating efficiency. Banks may exit low margin businesses, reducing the provision of services to the economy. This exit may be positive when there is evidence of overbanking, but it may also reduce the availability of credit to certain businesses (eg small and medium sized enterprises) or sectors of the economy. Banks may also spend less time on monitoring. Lower monitoring, all else equal, would lead to a rise in non-performing loans, which would increase operating expenses. Banks may therefore have a greater incentive to securitize or syndicate loans and mortgages in order to reduce their exposure to default risk.

Banks may increase non-interest sources of income by charging higher fees for services, such as fees for electronic banking or undrawn credit lines. By increasing the effective cost of credit, this type of activity would likely have the same impact on the economy as an increase in lending spreads. Banks may also enter into new, higher-margin lines of business such as asset management and prime brokerage. New business lines may turn

out to be a source of risk. Past efforts to expand into insurance, private equity and merchant banking have proven costly.

Banks may preserve their ROE by accepting riskier-projects in areas where capital requirements are lower, such as on the trading book. Otherwise taking on riskier projects would increase RWA and reduce a bank's capital ratio, requiring even more equity. Banks may also increase risk-taking off-balance sheet. The ability to assume such risks without requiring more capital is conditional on the degree of enforcement of regulation and the ability to engage in regulatory arbitrage. Regulators have proposed limiting the activities of banks (eg Volcker rule) to limit risk-taking by depositary institutions. As an alternative to changing the risk profile of their assets, banks may seek to reduce their funding cost by engaging in more maturity and currency mismatches. Such actions would increase the risk profile of a bank's liabilities without raising their capital requirement. This possibility is being addressed by the NSFR proposal.

Of course, banks could absorb the fall in ROE without changing lending spreads. As seen in Table 4, a 1pp increase in the capital ratio is associated with a drop in ROE of 0.9pp. The reduction in leverage, however, will likely reduce the riskiness of banks and the volatility of their earnings. Investors may prefer more stable bank shares, and the future costs to the taxpayer of bank bail-outs may be reduced.

# 6. Mapping the NSFR to lending spreads

The calculation of the cost to meet the NSFR is sensitive to the definition of the ratio, assumptions about the composition of bank's assets and liabilities, and estimates of the returns on different assets and the costs of different liabilities. This detailed information is not disclosed in a bank's financial statements, but is being collected by the BCBS through the Quantitative Impact Study (QIS).[16] The estimates in the present study are based on the December 2009 proposal of the NSFR, which was modified in July 2010 with the implementation date moved out to 2018.[17] The estimates in this section are illustrative, and estimates across banks may vary significantly.

## 6.1 Starting assumptions for NSFR

In the absence of detailed QIS data, the only way to arrive at a starting value of the NSFR is to make a number of assumptions. Supervisors in some countries provided the following estimates of starting values for their banks:

- 75% of deposits are stable
- government debt initially makes up 25% of investments
- 25% of investments are less than 1 year in maturity
- 25% of corporate and retail loans are less than 1 year in maturity
- 25% of wholesale funding is less than 1 year in maturity
- committed but undrawn credit lines and other contingent liabilities are each assumed to be 3% of total assets.

[16] See: http://www.bis.org/bcbs/qis/.

[17] See: http://www.bis.org/press/p100726.htm.

Given these assumptions and the structure of the representative banks' balance sheet, it is possible to estimate the starting level of the NSFR and the cost of different strategies to raise the ratio to the desired level. Table 5 provides details on the calculation of the NSFR. Column A shows the factors applied to different balance sheet items. Column B shows the relative weights of different items on the representative bank's balance sheet as a percentage of total assets. Column C is the product of columns A and B, and shows the contribution of each category to the NSFR.

In terms of the ASF, funding sources viewed as stable receive higher weights. These categories include shareholders equity of 5.3%, longer-term debt and liabilities of 19.9%, and deposits of 43.5% (divided between stable and less stable deposits using judgement). After deducting these stable sources of funding, all remaining liabilities are given a 0% weight in the ASF, implying that they are not viewed as stable. This category represents 31.3% of the representative bank's balance sheet. This category includes

**Table 5: Calculation of the NSFR**

| | NSFR Factor (A) | % of Total Assets (B) | NSFR (A x B) |
|---|---|---|---|
| AVAILABLE STABLE FUNDING (ASF) | | | |
| Tier 1 and Tier 2 capital instruments | 100% | 5.3% | 0.05 |
| Wholesale funding and liabilities >1 year | 100% | 19.9% | 0.20 |
| Stable deposits < 1 year (as % of total deposits) | 85% | 32.6% | 0.28 |
| Less stable deposits (as % of total deposits) | 70% | 10.9% | 0.08 |
| All other liabilities not included above | 0% | 31.3% | 0.00 |
| Total ASF (numerator) | | 100.0% | 0.61 |
| | | | |
| REQUIRED STABLE FUNDING (RSF) | | | |
| Cash and short-term, unsecured, liquid instruments | 0% | 2.3% | 0.00 |
| Securities <1 year | 0% | 4.0% | 0.00 |
| Loans to financials <1 year (eg interbank) | 0% | 12.6% | 0.00 |
| Debt issued by sovereign and quasi-sovereigns | 5% | 3.0% | 0.00 |
| Loans to corporate clients < 1year | 50% | 12.9% | 0.06 |
| Loans to retail clients <1 year | 85% | 12.9% | 0.11 |
| All other assets not included above | 100% | 52.3% | 0.52 |
| Undrawn amount of committed credit and liquidity facilities | 10% | 3.0% | 0.00 |
| Other contingent obligations | 10% | 3.0% | 0.00 |
| Total RSF (denominator) | | 106% | 0.70 |
| | | | |
| NSFR ratio (ASF/RSF) | | | 0.86 |

Source: Author's calculations. Totals may not add up due to rounding.

debt and liabilities due within one year, as they are expected to roll off during stressed market conditions. In terms of the RSF, assets viewed as less liquid bear a higher factor, implying a greater need for stable funding. Cash, short-term securities, and interbank loans maturing within one year do not require funding. Investments in government bonds with a maturity greater than one year represent 3% of total assets, of which 5% of the par value must be funded.[18] Loans to corporates and retail clients with a maturity greater than one year must be funded at 50% and 85%, respectively. After deducting these assets, the remaining on-balance sheet assets that must be fully funded represent 52.3% of the representative bank's balance sheet. Off-balance and contingent liabilities must be funded at 10% of their value.

The starting NSFR is 0.86, below the target of 1.0. Available stable funding is 0.61 (numerator) and required stable funding is 0.70 (denominator). To meet the target NSFR of 1.0 or greater, either stable funding sources must be increased or illiquid assets decreased.

Table 6 provides two sets of estimates of the cost to meet the NSFR. Within each scenario, the costs are shown for incremental increases in the capital ratio of 1pp. One set of estimates shows the impact on lending spreads assuming no change in RWAs. When RWAs are assumed to be unchanged, lending spreads need to be increased by 24 basis points to maintain a target ROE. When the synergies between meeting higher capital and liquidity requirements are taken into account, the additional cost to meet the NSFR is lower. Holding more high-quality investments lowers RWAs as investments with a higher risk-weight are replaced with government bonds with a 0% risk-weight. The fall in RWAs, all else equal, reduces the amount of capital that must be raised to satisfy a given capital adequacy requirement. When the fall in RWAs is taken into account, the incremental cost to meet the NSFR is 12 basis points or less. In both cases, the incremental cost of meeting the NSFR declines with higher levels of capital, as more equity increases the numerator of the ratio.

**Table 6: Impact of meeting NSFR on lending spreads in basis points**

| Increase in capital ratio (percentage points) | Cost to meet capital with no change in ROE or cost of debt (A) | Assuming RWA unchanged | | Accounting for decline in RWA | |
|---|---|---|---|---|---|
| | | Cost to meet NSFR (B) | Capital + NSFR (A+B) | Cost to meet NSFR (C) | Capital + NSFR (A+C) |
| 0 | 0 | 24 | 24 | 12 | 12 |
| +1 | 15 | 24 | 39 | 10 | 25 |
| +2 | 30 | 24 | 54 | 9 | 39 |
| +3 | 45 | 24 | 69 | 7 | 52 |
| +4 | 60 | 23 | 83 | 6 | 66 |
| +5 | 75 | 23 | 98 | 4 | 79 |
| +6 | 90 | 23 | 113 | 3 | 93 |

[18] Under the December 2009 proposal, securities with a maturity less than 1 year require no funding.

### 6.2 Extending the maturity of wholesale debt

Table 7 provides an example of the changes required to meet the NSFR and their impact on a bank's net income. These strategies, outlined in section 3, involve changes to the bank's capital structure and the composition of its assets. While changes to capital

**Table 7: Changes to assets and liabilities to meet NSFR (as percentage of total assets)**

| | | Step 1: Lengthen maturity of wholesale funding | | Step 2: Increase holdings of government debt by 3.5pp | | Step 3: Increase holdings of government debt by 6.8pp | |
|---|---|---|---|---|---|---|---|
| | Before | After | Change | After | Change | After | Change |
| **Panel A: Calculation of NSFR** | | | | | | | |
| Wholesale funding >1 year + liabilities | 19.9 | 23.4 | 3.5 | 23.4 | 3.5 | 23.4 | 3.5 |
| Liabilities given 0% weight in ASF | 31.3 | 27.7 | -3.5 | 27.7 | -3.5 | 27.7 | -3.5 |
| Holdings of government debt >1 year | 3.0 | n.a. | n.a. | 6.5 | 3.5 | 9.8 | 6.8 |
| Assets given 100% weight in RSF | 52.3 | n.a. | n.a. | 48.8 | -3.5 | 45.6 | -6.8 |
| A. Available stable funding (ASF) | 0.61 | 0.64 | 0.03 | 0.64 | 0.03 | 0.64 | 0.03 |
| B. Required stable funding (RSF) | 0.70 | 0.70 | 0.00 | 0.67 | -0.03 | 0.64 | -0.06 |
| Net stable funding ratio (NSFR) | 0.86 | 0.91 | 0.05 | 0.95 | 0.09 | 1.00 | 0.14 |
| **Panel B: No change in RWA** | | | | | | | |
| RWA / Total Assets | 53.3 | 53.3 | 0.0 | 53.3 | 0.0 | 53.3 | 0.0 |
| Change in lending spreads | | | 0.07 | | 0.16 | | 0.24 |
| Interest income on loans | 3.34 | 3.37 | 0.04 | 3.42 | 0.08 | 3.46 | 0.13 |
| + Income on investments | 2.54 | 2.54 | 0.00 | 2.49 | -0.05 | 2.45 | -0.09 |
| = Interest Income | 5.87 | 5.91 | 0.04 | 5.91 | 0.04 | 5.91 | 0.04 |
| - Interest expense | 4.11 | 4.15 | 0.03 | 4.15 | 0.03 | 4.15 | 0.03 |
| = Net interest income | 1.76 | 1.76 | 0.00 | 1.76 | 0.00 | 1.76 | 0.00 |
| Shareholders equity | 5.32 | 5.33 | 0.01 | 5.33 | 0.01 | 5.33 | 0.01 |
| **Panel C: Fall in RWA** | | | | | | | |
| RWA / Total Assets | 53.3 | 53.3 | 0.0 | 51.0 | -2.3 | 48.8 | -4.5 |
| Change in lending spreads | | | 0.07 | | 0.10 | | 0.12 |
| Interest income on loans | 3.34 | 3.37 | 0.04 | 3.39 | 0.05 | 3.40 | 0.06 |
| + Income on investments | 2.54 | 2.54 | 0.00 | 2.49 | -0.05 | 2.45 | -0.09 |
| = Interest Income | 5.87 | 5.91 | 0.04 | 5.88 | 0.00 | 5.84 | -0.03 |
| - Interest expense | 4.11 | 4.15 | 0.03 | 4.16 | 0.05 | 4.17 | 0.06 |
| = Net interest income | 1.76 | 1.76 | 0.00 | 1.71 | -0.05 | 1.67 | -0.09 |
| Shareholders equity | 5.32 | 5.33 | 0.01 | 5.10 | -0.23 | 4.88 | -0.44 |

Source: Author's calculations. Totals may not add up due to rounding.

structure may be captured by looking at the bank's WACC, changes to the asset composition can only be captured by looking at the bank's income statement. Panel A of Table 7 shows the changes to key balance sheet items and the change in the NSFR. Panel B shows the impact assuming no change in RWAs. The change in lending spreads required to maintain ROE is shown, and the different components of net interest income. Panel C shows the same calculations allowing for the fall in RWAs.

The first step to meet the NSFR is to extend the maturity of wholesale debt. All debt maturing within one year is extended beyond one year in maturity such that the category of longer-term debt and other liabilities increases from 19.9% to 23.5% of total assets. Recall that deposits, interbank funding and trading liabilities are unaffected. This change increases the ASF with no change in the RSF, leading to a rise in the NSFR to 0.91. Long-term debt bears a higher cost than debt maturing within one year in this analysis, so this strategy increases interest expense. The rise in interest expense, all else equal, lowers net income and reduces ROE. The increase in lending spreads required to offset the fall in ROE is 7 basis points. This cost does not change whether RWA are left unchanged (Panel B) or allowed to fall (Panel C), as extending the maturity of debt does not involve a change in the composition of assets. This change would, however, raise the bank's WACC as the proportion of more expensive long-term debt increases.

### 6.3 Increasing holdings of government bonds

The second step to increase the NSFR is to lower RSF by increasing the holdings of liquid, unencumbered bonds such as qualifying government debt. While the bank's investment portfolio represents 16.1% of the representative bank's balance sheet, the assumption is that three-quarters of this portfolio is invested in higher-yielding securities such as corporate bonds, equities and other securities. Increasing the holdings of government bonds in this portfolio, all else equal, requires these other investments to be sold. The assumption is that interest income will decline, as higher-yielding but less liquid investments are replaced with lower-yielding but more liquid securities. The corresponding cost estimates rely critically on the assumption of how much interest income is lost by switching into government bonds relative to other higher-yielding investments. In this analysis, the opportunity cost of holding government bonds relative to other investments is assumed to be 100 basis points per annum. The impact on lending spreads is approximately linear in (proportional to) this loss of income from investments. Thus, if the opportunity cost on investments is 200 basis points, the impact on lending spreads is approximately double.

Panel A of Table 7 shows the impact of raising the holdings of government debt with a maturity greater than one year by 3.5pp to 6.5% of total assets. This increase implies a corresponding decrease in residual assets that must be funded 100%, which decline to 48.8% from 52.3%. This change reduces RSF and increases the NSFR to 0.95. Panel B shows the impact on lending spreads if RWAs are left unchanged at 53.3% of total assets. Interest income excluding loans falls by around 4 basis points due to the loss of income on investments. Taken together with the increased interest expense from extending the maturity of wholesale debt, lending spreads must be raised by 16 basis points to avoid a fall in ROE. Panel C takes into account the fall in RWAs from holding more government debt. The change in portfolio leads RWAs to decline by 2.3pp. Given an unchanged target capital ratio, a lower quantity of shareholder's equity is required to meet a given capital ratio. When this synergy is taken into account, lending spreads must only be increased by 10 basis points to restore ROE to its target level.

To achieve a NSFR of 1.0, Table 7 shows that the holdings of government bonds greater than one year in maturity must be increased further to 9.8% of total assets, an increase of 6.8pp. This change reduces RSF until it equals ASF, resulting in the desired ratio being met. Increased holdings of government bonds reduce income from investments further, requiring an off-setting increase in income on loans. With no change in RWA, Panel B shows that the required increase in lending spreads is 24 basis points. When the fall in RWA of 4.5pp is taken into account, Panel C shows that the offsetting increase in lending spreads is only 12 basis points.

### 6.4 Sensitivity of estimates to assumptions

The calculation of the NSFR is based on a series of assumptions, as discussed at the outset of this section. Changing any of the starting assumptions would affect the starting NSFR and alter the cost to meet a ratio of 1.0. This issue can only be addressed by collecting more detail on the composition and maturity structure of a bank's assets and liabilities. Taking the starting level of the NSFR as given, the following assumptions will affect the estimates of the impact on lending spreads.

First, the opportunity cost of reducing risky investments and holding more government bonds is estimated at 100 basis points per annum. An increase in this opportunity cost raises the cost to meet NSFR linearly, as discussed above. Raising the capital ratio by 1pp with an opportunity cost of 200 basis points per annum would require lending spreads to rise by 48 basis points if RWA are unchanged and 24 basis points if the fall in RWA is taken into account.

Second, the exercise assumes that deposits are the cheapest source of liabilities, with debt maturing within one year costing 100 basis points more and long-term debt costing 200 basis points more. While these relative costs have been chosen to reflect historical averages and to generate an upward sloping yield curve, changes in these costs will affect the result. In particular, a flat or downward sloping yield curve would reduce the cost to meet the NSFR as there would be no penalty to extend the maturity of debt.

Third, the calculation assumes that all increases in the quantity of equity are off-set by reductions in the quantity of long-term debt. Reducing debt maturing within one year instead would raise the estimated impact on lending spreads as the gap between the cost of debt maturing within one year and the target ROE is greater. It should be noted, however, that this assumption would worsen the NSFR as debt maturing within one year is viewed as an unreliable source of funding during stressed market conditions.

Fourth, the calculations for the fall in RWA assume that a 50% risk-weight is applied to other assets and investments other than government bonds. An increase in this risk-weight would reduce the cost to meet the NSFR, as the fall in RWA from holding more government bonds would be greater.

### 6.5 Alternatives to raising lending spreads

This analysis provides something analogous to an upper bound for the impact of meeting the NSFR on lending spreads, as there are other strategies that may be more cost-effective depending on country and bank characteristics. For example, this analysis does not take into account any steady-state impact on bank borrowing costs if all banks wish to extend the maturity of their debt. This increased supply, given existing demand, might be expected to raise borrowing costs. This type of impact is not considered here.

The impact on lending spreads shown in Table 6 is specific to the strategy chosen to meet the NSFR. The following alternatives are not considered in this analysis but would likely reduce the costs. First, banks can meet the NSFR by reducing the maturity of corporate loans to less than one year. Loans greater than 1 year in maturity must be funded 100% while loans with a maturity of less than 1 year must only be funded 50%. Banks can meet the NSFR by reducing the maturity of corporate loans to less than one year and forcing their clients to bear the roll-over risk. Banks can offer customers contingent credit lines at expiry of the loan to extend the effective maturity. These contingent credit lines must only be funded at 10%, compared to 50% for a corporate loan greater than one year in maturity.

Second, banks could issue debt with a maturity greater than 1 year and use the proceeds to purchase government debt. This strategy would increase the size of total assets, but would not increase RWAs as government bonds have a risk-weight of 0%. The cost to the bank would be the difference between their cost of borrowing and the risk-free rate. Assuming the assets and liabilities have the same maturity, the cost to the bank is its credit spread above the risk-free rate. This strategy may be less costly than switching existing investments. The ability to engage in this strategy will depend on the calibration of the leverage ratio, which will limit the growth of liabilities to total assets.

Similar to the case of higher capital requirements, banks could avoid raising lending spreads by increasing operational efficiencies, finding other sources of income, or absorbing the fall in ROE.

## 7. Conclusion and future research

This study has presented a methodology for mapping the possible impact of higher capital and liquidity requirements on bank lending spreads. Such a mapping provides researchers with a useful tool to study the impact of regulatory changes on the cost of credit and the real economy. While the mapping to lending spreads has been illustrated using the BCBS's December 2009 proposals, the methodology presented is general and can be used to estimate the impact from a change in a bank's capital structure, the composition of assets, the measurement of RWAs, or the imposition of a financial levy.

The higher cost associated with a one percentage point increase in the capital ratio can be recovered by increasing lending spreads 15 basis points for a representative bank. This calculation assumes the bank's expected ROE and cost of debt are unchanged, with no change in other sources of income and no reduction in operating expenses. If ROE and the cost of debt are assumed to decline, the impact on lending spreads is reduced. To recover the additional cost of meeting the December 2009 proposal for the Net Stable Funding Ratio, a representative bank would need to increase lending spreads by 24 basis points. Taking into account the fall in RWAs from holding more government bonds reduces this cost to 12 basis points or less. Based on these estimates, an increase in the capital ratio by two percentage points while meeting the NSFR can be offset by raising lending spreads by around 40 to 60 basis points.

The mapping outlined in this paper provides a starting point for analysing the impact of higher capital and liquidity requirements on a bank's profitability and lending spreads. As highlighted at the outset, the estimates are sensitive to changes in the balance sheet structure of different banks and their costs of capital. Future research may therefore

calculate such estimates for different categories of banks (eg regional banks vs. multinationals) based on actual balance sheet data taking into account the revised capital and liquidity proposals of the BCBS. It will be important to compare such estimates to the elasticities of loan demand across countries to better understand the ability of banks to pass on such costs. Such an analysis would also highlight the different macroeconomic impact across countries, as well as the potential spillovers.

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