The Basel III net stable funding ratio and bank net interest margins

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Abstract

The Net Stable Funding Ratio (NSFR) is a new Basel III structural liquidity requirement designed to limit liquidity mismatches between bank assets and liabilities. This study explains the NSFR and estimates this ratio for 603 banks in 17 countries. The average bank in the United States and Asia are estimated to meet the NSFR. Banks below the ratio need to increase stable sources of funding and to reduce assets requiring stable funding. The most cost-effective strategies are to increase holdings of higher-rated bonds and to extend the maturity of wholesale funding. These changes reduce net interest margins by 66 basis points on average, or 28% of their year-end 2009 values, with the biggest absolute declines for Swiss, French and German banks.

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During the 2007-2009 global financial crisis, the financial system was destabilised and the real economy suffered after banks across a range of countries became illiquid or insolvent following major losses on US sub-prime investments. Wholesale bank funding markets were disrupted and measures of counterparty credit risk rose sharply. Many banks were caught unprepared, particularly banks funding long-term assets with short-term borrowings. Northern Rock was nationalised by the UK government in February 2008 after it could no longer rollover its borrowing (Goldsmith-Pinkham and Yorulmazer 2010; Shin 2009). Then in March the US Federal Reserve brokered the takeover of a solvent but illiquid Bear Stearns by JPMorgan Chase. The turmoil worsened over the summer, reaching a peak with the failure of Lehman Brothers in September 2008. In response to the crisis in the global financial system, governments in the US and Europe were forced to intervene, recapitalizing or nationalizing many of the largest global banks using public funds measured in the trillions of US dollars.

A number of studies examine the role of funding and market liquidity in propagating contagion during the global financial crisis. These studies highlight the interlinkages created by bank funding markets and the role of bank leverage, information asymmetry and bank funding to act as channels for the contagion. Adrian and Shin (2010) show the leverage of the US investment banks was strongly procyclical and a chief determinant of overall market liquidity and volatility. Acharya, Shin and Yorulmazer (2011) find that bank liquidity is countercyclical, and tends to be inefficiently low during economic booms but excessively high during crises. The combination of procyclical leverage and countercyclical liquidity makes banks vulnerable to adverse asset shocks, resulting in fire-sales and liquidity shortages. The structure of bank funding also matters, with Huang and Ratnovski (2011) highlighting how the increasing reliance on short-term wholesale funding increased the vulnerability of banks. A number of studies document these mechanisms at play during the global financial crisis (Acharya and Merrouche 2010; Afonso et al 2012; Brunnermeier 2009; Diamond and Rajan 2009; Gorton 2009; and Longstaff 2010).

Regulators have taken steps to address this source of banking sector vulnerability. In December 2010 the Basel Committee on Banking Supervision (BCBS) announced a package of reform known as Basel III (BCBS 2010a). One of the most controversial elements of Basel III is the new global liquidity standard, consisting of two new requirements – the Net Stable Funding Ratio (NSFR) and the Liquidity Coverage Ratio

(LCR) (BCBS 2010b). The NSFR addresses liquidity mismatches between bank assets and liabilities over a one-year horizon. It is designed to promote structural changes in the risk profiles of banks away from short-term funding mismatches and toward more stable, longer-term funding of assets. The Liquidity Coverage Ratio (LCR) ensures banks have adequate funding liquidity to survive one month of stressed funding conditions. Submissions to the BCBS and studies by equity analysts suggest these liquidity requirements may dramatically and adversely impact bank business models and profitability. Given the concern expressed by banks, the lack of regulatory experience with such standards, and the potential for unintended consequences, implementation of the LCR has been delayed until 2015 and the NSFR to 2018. During this observation period, regulators will collect more data and monitor the ratios.

This paper presents the first comprehensive assessment of the NSFR and its potential impact on bank profitability. This study does not estimate the LCR as the data required to calculate this ratio is not available.[2] The paper outlines how the NSFR is calculated and examines different strategies to meet the new ratio for banks below the minimum threshold. Using Bankscope data for 603 banks in 17 countries, we estimate the NSFR for the representative bank in each of the sample countries based on data at year-end 2009. Banks in the United States, Japan, Hong Kong, Korea and Chile are estimated to have ratios above the minimum threshold at year-end 2009. For banks in the remaining 12 countries that are estimated to be below the NSFR target of 1.0, we outline a series of steps to meet the NSFR and estimate the impact on bank net interest margins. Based on a comparison of the costs, the most cost-effective strategies are to increase holdings of higher-rated bonds and to extend the maturity of wholesale funding. These changes are estimated to reduce bank net interest margins in the 12 countries by 66 basis points on average, or 28% of their year-end 2009 values. The biggest absolute declines are estimated for Swiss, French and German banks.

The regulation of bank liquidity is a new area of research.[3] Most existing studies examine capital regulation and its impact on bank behaviour.[4] One frequently cited

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[2] Banks must calculate the LCR based on what their cash outflows might be during a period of market stress. These outflows will be bank-specific and not easily estimated.

[3] Allen and Carletti (2009), Berger and Bouwman (2009), and Strahan (2008), among others, summarise the literature on the role of banks in producing liquidity.

concern is that higher regulatory requirements may lead banks to increase risk taking, undermining the effectiveness of the regulation. Theoretical models by Hellmann et al (2000), Jeitschko and Jeung (2007), Milne (2002), Park and Peristiani (2007), and Repullo (2004), among others, find that the implications are not straight-forward as they depend on the level of competition, the incentives facing managers, and the interaction with other regulatory instruments. The empirical literature on this question is also mixed. González (2005), for example, finds that regulatory restrictions increase banks' risk-taking incentives by reducing their charter value, after controlling for deposit insurance and for the quality of a country's contracting environment. In contrast, Laeven et al (2009) show that the relation between bank risk and capital regulations, deposit insurance, and restrictions on bank activities depends critically on each bank's ownership, such that the actual sign of the marginal effect of regulation on risk varies with ownership concentration. These authors find that the same regulation has different effects on bank risk taking depending on the bank's corporate governance.

This study provides a starting point for understanding the NSFR and estimating the impact on a bank's profitability. It highlights different behavioural responses, including possible unintended consequences. Banks that do not meet the NSFR need to modify the composition of their balance sheets to reduce assets requiring stable funding and to increase stable sources of funding. On the asset side, banks need to increase their holdings of unencumbered, liquid investments such as qualifying government bonds. On the liability side, banks need to increase funding from stable sources such as deposits, equity and longer maturity wholesale debt. These actions are costly. The lower interest income from holding liquid, high-quality assets and the higher interest expense from extending the maturity of wholesale funding reduce net interest income. This decline combined with the increase in interest earning assets leads to a fall in net interest margins. The fall in profitability is accompanied by a rise in a bank's capital ratio, with risk-weighted assets (RWAs) declining as less-liquid investments are replaced with higher-rated, more liquid investments. Presumably de-risking the bank brings some benefits, such as a lower cost of capital and a higher charter value. This cost-benefit trade-off is beyond the scope of this study and is left for future research.

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[4] Bhattacharya et al (1998), Dewatripont and Tirole (1994), Santos (2001), Thakor (1996), and VanHoose (2007) summarize studies of bank capital regulation.

Banks have a number of options to offset any fall in net interest margins, such as reducing operating expenses or increasing non-interest income. While some banks may be able to pass on higher costs to customers, other banks may have little scope given competition and the demand elasticities for credit and other banking services. The ability of banks to modify their pricing or balance sheets is not modelled in this paper. Future research should consider what is reasonable given a country's institutional setting and the structure of its banking sector.

An examination of the NSFR faces a number of challenges. The bank-level data required to calculate the NSFR is not currently available, even to national supervisors. To develop a first assessment, the Basel Committee conducted a quantitative impact study (QIS) over the first half of 2010. The QIS results have not been made public and the BCBS's report provides almost no details for the NSFR (BCBS 2010c). Revealing the extent of data gaps, only 166 out of the 263 banks surveyed were able to calculate the NSFR. In light of the QIS's findings, the NSFR factor weights proposed in the initial November 2009 consultation document were revised prior to publication of the requirement in December 2010. Given this lack of data, we base the estimates in this study on assumptions provided by bank regulators and other public sources. The estimates in this study are indicative of the potential costs but will vary considerably across banks. The study does not formally model the choice faced by banks, nor does it conduct an optimisation in a general equilibrium setting.

The paper proceeds as follows. The first section provides background on the Basel III regulatory proposals with a focus on the liquidity requirements. The second section provides stylized facts on the composition of bank balance sheets and their net interest margins. The third section describes the NSFR and outlines strategies to meet this ratio. The fourth section estimates the costs to meet the NSFR using balance sheet and income statement data for 603 banks from 17 countries. It also estimates the impact on bank net interest margins, taking into account the change in RWAs from holding more, high-quality assets. The final section concludes.

I. Background on the BCBS liquidity proposals

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 (BIS 2009). 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 many advanced economies experienced a growth slowdown or recession.

In the aftermath of the crisis, banking regulators have introduced global reforms to the regulatory capital framework to increase the resilience of the banking sector. Between July 2009 and December 2010, the BCBS announced a series of reforms known as Basel III that build on the three pillars of Basel II (BCBS 2010a). The reforms raise both the quality and quantity of the regulatory capital base and enhance the risk coverage of the capital framework. Basel III strengthens the quality and level of the capital base, and introduces an internationally harmonised definition of capital. It raises capital requirements for the trading book, complex securitisation exposures and off-balance sheet exposures. These changes are underpinned by a leverage ratio that serves as a backstop to the risk-based capital measures and provides an extra layer of protection against model risk and measurement error. Finally, the Basel III introduces a number of macroprudential elements into the capital framework to address systemic risks arising from procyclicality and from the interconnectedness of financial institutions, including the use of a capital conservation buffer and a countercyclical capital buffer. Regulators are also debating additional measures for systemically-important financial institutions (SIFIs), including the use of contingent capital instruments and a systemic capital surcharge to reduce moral hazard.

To address the funding vulnerabilities exhibited by Northern Rock and other globally-active banks, the BCBS proposed two global minimum liquidity standards along with other measures to raise the core capital requirements and contain leverage (BCBS 2010b). The short-horizon LCR is designed to make banks more resilient to potential

short-term disruptions in access to funding. The LCR identifies the amount of unencumbered, high-quality, liquid assets that banks need in order to survive one month without access to wholesale funding while still being able to offset cash outflows. Although it was proposed in December 2009, supervisors lacked the detailed data required to calculate the LCR for banks.

Complementing the LCR, the NSFR is a longer-term structural ratio that addresses liquidity mismatches between bank assets and liabilities over a one-year time horizon. It covers on- and off-balance sheet items and is designed to encourage banks to adopt more stable sources of funding. In particular, the NSFR is structured to ensure that long term assets are funded with at least a minimum amount of stable liabilities in relation to their liquidity risk profiles. The NSFR aims to limit over-reliance on short-term wholesale funding and to encourage better assessment of liquidity risk across different asset classes. Like the LCR, bank supervisors proposed the NSFR in late 2009 but did not have the data needed to calculate this ratio.

Recognising that introducing a new set of liquidity standards is a complex process, the BCBC conducted the QIS between February and May 2010 to assess the impact of the Basel III liquidity proposals (BCBC 2010c). The QIS collected the data needed to measure the LCR and NSFR as of year-end 2009. A total of 263 banks from 23 countries participated in the survey, including 94 Group 1 banks – defined as well diversified, internationally-active banks with Tier 1 capital in excess of €3 billion – and 169 Group 2 banks representing all other participating banks.

On the basis of the QIS results, the BCBS revised the definitions of the LCR and NSFR in December 2010 to make the ratios less burdensome (BCBS 2010b). Tellingly, however, the QIS report reveals almost no data on the results for the liquidity ratios other than several global aggregates. Based on year-end 2009 data, the QIS estimated that the average LCR was 83% for Group 1 banks and 98% for Group 2 banks. The average NSFR was 93% for Group 1 banks and 103% for Group 2 banks. Revealing the extent of the data collection problems for the NSFR, only 166 out of the 263 banks were able to provide sufficient data to calculate this ratio. These averages conceal considerable variation across groups, with more than half the banks failing to meet either the minimum LCR or the minimum NSFR requirements.

Given the difficulties with data collection and the risk of unintended consequences, the implementation of both ratios has been delayed. Banks have until 1 January 2015 to meet the LCR standard and until 1 January 2018 to meet the NSFR standard. During this "observation phase", regulators will monitor the impact on bank business models and funding before finalising the revised ratios at the end of each period.

II. Understanding the NSFR

In December 2010 the BCBS published a revised definition of definition the NSFR, reflecting the results of the QIS (BCBS 2010b). A simplified version is shown in equation (1). Appendix A provides more details on the components and factor weights.

$$NSFR = \frac{Available\ stable\ \ funding}{\mathrm{Re}quired\ \ stable\ \ funding} = \frac{Equity + LtDebt_{>1yr} + Liabs_{>1yr} + (StableDeposits_{<1yr} \cdot 90\%) + (OtherDeposits \cdot 80\%) + (StDebt \cdot 50\%)}{(GovtDebt \cdot 5\%) + (CorpLoans_{<1yr} \cdot 50\%) + (Mtgs \cdot 65\%) + (\mathrm{Re}tLoans_{<1yr} \cdot 85\%) + (Other \cdot 100\%)} \quad (1)$$

The numerator of the NSFR measures the sources of available stable funding (ASF), with greater weight given to funding sources that are least likely to disappear under stressed market conditions. Equity, longer-term wholesale funding and longer-term liabilities are the most stable forms of funding, followed by deposits and short-term wholesale funding maturing in less than one year. Note that interbank funding is not viewed as a stable funding source and has a 0% factor weight.

The denominator of the NSFR shows a bank's required stable funding (RSF) needs, with a factor (or haircut) 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%. Qualifying government debt with a 0% risk-weight 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. Residential mortgages of any maturity as well as corporate loans greater than one-year in maturity must be funded at 65%. 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 ratio of 1 or greater.

Banks that need to increase their NSFR can pursue a number of strategies, each of which will have different costs. For example, a bank can increase their NSFR either by

extending the maturity of their wholesale funding or by reducing the maturity and/or riskiness of their assets. The preferred strategy depends on a cost-benefit analysis, with the least costly strategies expected to be implemented first. These strategies and their costs are discussed below.

Increasing available stable funding (numerator)

To increase the numerator in the NSFR, banks can: (i) issue more capital, (ii) lengthen the maturity of their wholesale funding beyond one year, or (iii) increase their deposits, particularly stable deposits. Issuing more capital is the most expensive strategy, as the cost of equity should be the most expensive form of capital, consistent with theories such as the Modigliani-Miller theorem (Modigliani and Miller 1958). Under Basel III, the predominant form of Tier 1 capital must be common shares and retained earnings. The remainder of Tier 1 capital must be instruments that are subordinated, have fully discretionary non-cumulative dividends or coupons and have neither a maturity date nor an incentive to redeem (i.e. non-cumulative, perpetual preferred shares). Innovative hybrid capital instruments will be phased out. Given this new definition, any increase in capital will appear as an increase in shareholder's equity. Given the high cost of equity relative to alternative sources of bank capital, issuing common equity or retaining earnings is likely to be the least attractive option for banks needing to raise their ASF.

If banks increase shareholder's equity while keeping the size and composition of the balance sheet constant, the increase must be offset by a decline in the quantity of liabilities. As the most expensive form of liabilities, longer-term wholesale funding should be the first liabilities to be replaced with equity (equation 2).

$$\Delta Equity + \Delta Debt = 0 \qquad (2)$$

The change in capital structure leads to a rise in the bank's cost of capital, as wholesale funding is substituted with more expensive equity. Net interest income should rise, all else equal, as the decline in the quantity of wholesale funding outstanding reduces interest expense.

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 longer-term debt. Reducing trading liabilities may also be expected to lead to a fall in trading income.

A second strategy to increase ASF is to extend the maturity of wholesale funding beyond one year. This maturity extension increases the numerator of the NSFR, but also raises interest expense as the cost of longer-term wholesale funding is typically higher than the shorter-term wholesale funding. Higher interest expense, all else equal, leads to a fall in net interest income and net interest margins. To measure the cost of this strategy, wholesale funding must be allocated between a portion of debt maturing within one year (ρ_t) and a remainder of longer-term debt (equation 3).

$$WholesaleFunding_t = Debt_t \cdot \rho_t + Debt_t \cdot (1-\rho_t) \tag{3}$$

A third option to raise ASF is to increase the share of funding coming from deposits. The NSFR recognises two classes of deposits, and assigns them different weights. Stable deposits are those deposits that are fully covered by an effective deposit insurance scheme or by a public guarantee that provides equivalent protection. Under stressed market circumstances, the expectation is that banks would lose 5% or more of these deposits, which explains their factor weight of 90%. Less stable deposits include high-value deposits, deposits from high net worth individuals, deposits that can be withdrawn quickly (e.g. internet deposits) and foreign currency deposits. While deposits are an attractive source of bank funding, they already represent around half of bank funding on average, rising to as much as 80% in some jurisdictions. Given a fixed quantity of savings in an economy, banks may have limited room to attract more deposits. Banks can only attract deposits by offering a higher deposit rate or by offering more services than their competitors. Such an action would lead to an escalation in the cost of deposits as banks compete to attract the same pool of deposits.

The impact of increasing the share of deposits or extending the maturity of debt on net interest income depends on the relative costs of these different funding sources. A bank's financial statements do not separately disclose the costs of interbank funding, deposits, and wholesale funding. Instead these costs are aggregated and reported as interest expense. A bank's interest expense can be approximated by equation 4.

$$\begin{aligned} IntExp_t &= (r_{deposits} \cdot Deposits) + [r_{Debt \le 1 year} \cdot (Interbank\ \ funding + Debt_t \cdot \rho_t)] \\ &+ [r_{LtDebt} \cdot Debt_t \cdot (1-\rho_t)] \end{aligned} \tag{4}$$

where $r_{deposits}$ is the cost of deposits, $r_{Debt \le 1Year}$ is the cost of wholesale funding maturing within one year and r_{LtDebt} is the cost of longer-term wholesale funding. These costs will depend on a bank's credit rating, its business model, and other bank-specific factors.

Reducing the required stable funding ratio (denominator)

To reduce the denominator in the NSFR, banks can: (i) increase their holdings of cash and near-cash investments, (ii) shrink the relative size of the loan portfolio or reduce the maturity of corporate and/or retail loans, (iii) increase the share of highly liquid, low-risk bonds in their investment portfolios, and (iv) decrease the holdings of all other assets that must be funded at 100%.

The first option is costly, as holdings of cash and near-cash investments generate little or no return and have a negative cost of carry due to the higher cost of bank funding. Historically, banks have held low cash balances of 2.5% of total assets on average. Increasing cash holdings while holding total assets unchanged would involve reducing other interest-earning assets or assets that contribute to non-interest income, such as trading assets or fixed assets (such as buildings). This option is likely to be the least attractive.

The second option is to shrink the relative size of the loan portfolio or to reduce the maturity of corporate and/or retail loans to less than one year in maturity. The ability to pursue this strategy will depend on a number of factors that are beyond the scope of this study, such as the elasticity of loan demand, the availability of substitutes and the competitive environment. Banks are unlikely to reduce their loan portfolios, as they are higher yielding assets where banks have a comparative advantage over other financial intermediaries. Bank-level data on lending costs and the composition of loans are not widely available. For these reasons, this strategy is not evaluated in this study.

Given the high costs or unattractiveness of these first two options, banks are likely to focus on the remaining options, namely shifting the allocation of their investment portfolios towards more high-quality, liquid assets and decreasing the holdings of assets that must be funded at 100%.For example, banks may hold fewer lower-rated corporate or covered bonds (rated BBB+ or below) and increase their holdings of government bonds and higher-rated corporate or covered bonds. Increased holdings of higher-rated securities reduce the denominator of the NSFR, but would be associated with a fall in interest income. The cost of this strategy is a function of the difference in returns (or opportunity cost) between lower-yielding, more liquid investments and higher-yielding, less liquid investments. The opportunity cost (θ_t) measures this loss of interest income (equation 5).

$$Investments_t = Investments_t \cdot \theta_t + Investments_t \cdot (1-\theta_t) \quad (5)$$

The ability to lower the RSF by shifting the composition of investments is limited by the quantity of investments relative to total assets.

If changing the composition of the investments is not sufficient to meet the NSFR, banks may be required to change the composition of their assets more broadly. This final strategy would involve increasing the share of investments relative to assets in the RSF that must be funded at 100%, including trading assets and fixed assets. Any reduction in trading assets would be unattractive as it would be associated with a fall in trading income, leading to lower non-interest income and profitability. Fixed assets are also required to support a bank's operations. This strategy may therefore not be available for banks depending on their business model and the structure of their balance sheet.

Assuming that banks do have the ability to switch between this category and investments, this study assumes that there is a cost to this change. Similar to the case of the substitution of lower-rated corporate bonds with government bonds, increasing the share of investments and reducing the share of other investments is assumed to decrease interest income. The impact of changing the composition and relative size of investments on interest income may be calculated as follows (equation 6):

$$OtherIntIncome_{t+1} = OtherIntIncome_t + [Investments_{t+1} \cdot \Delta(1-\theta_{t+1}) \cdot xs_{inv}] + (\Delta OtherAssets \cdot xs_{inv}) \quad (6)$$

where xs_{inv} is the excess return earned on investments over the risk-free rate.

Synergies between the NSFR and capital requirements

The discussion of the costs to meet the NSFR has focused on the loss of interest income and the increase in interest expense of different strategies. A number of synergies exist, however, between meeting the NSFR and meeting regulatory capital requirements. As seen in the design of the NSFR, higher levels of equity relative to other sources of capital 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. All else equal, a fall in RWA would allow a bank to have less equity in its capital structure to

support a given level of assets. A lower share of equity to total assets, offset by higher wholesale funding (equation 2), leads to higher interest expense. While net interest margins decline, the bank's weighted cost of capital falls and the value of the bank increases. This benefit needs to be taken into account when measuring the cost to meet the NSFR.

Given that banks do not report how they calculate their RWAs, the impact of a fall in RWA can only be calculated indirectly based on several assumptions. The first assumption is that riskier investments in lower-rated securities bear a higher risk-weight than government bonds. Under Basel II, most 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 lower-rated securities that are sold and replaced with government bonds (θ_t), a bank's RWA will decline by a known amount (equation 7).

$$\Delta RWA = (Investments_t \cdot \theta_t - Investments_{t+1} \cdot \theta_{t+1}) \cdot riskweight_{OtherAssets} \quad (7)$$

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.

III. Stylized facts on bank balance sheets and net interest margins

This section provides stylized facts on the balance sheet structures of 603 banks in 17 countries, as well as their net interest margins. The data is shown as of year-end 2009, although results over a longer time period (1990-2009) present a similar picture.

Data and descriptive statistics

To estimate the impact on bank net interest margins, we collect income statement and balance sheet data from Bankscope for 603 banks in 17 countries (with 2-letter ISO codes in brackets): Australia (AU), Canada (CA), Chile (CL), France (FR), Germany (DE), Hong Kong (HK), Italy (IT), Japan (JP), Korea (KR), Mexico (MX), Netherlands (NL), South Africa (ZA), Spain (ES), Sweden (SE), Switzerland (CH), United Kingdom (GB), and the USA (US). Bankscope data is downloaded for 2009 for all commercial banks, investment banks, savings and cooperative banks, and mortgage banks. This study uses the consolidated entity where available (i.e. bank holding company), 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 $100 million. To ensure that there is no duplication, the final sample banks were checked by hand with the assistance of regulators in each country who identified the most important national banks. Interest rate data is collected from the following sources: deposit rates, loan rates and policy rates are from the IMF International Financial Statistics; 1-month interbank offer rates and risk-free rates at different maturities are from Bloomberg.

Table 1 provides details of the final sample. The largest number of banks are from the United States (106 banks) and Japan (122 banks). Given that the NSFR is a global standard, the sample includes banks from a number of emerging market economies such as Chile, Hong Kong, Korea, Mexico and South Africa. The overall sample is heavily weighted towards commercial banks and bank holding companies (64%), followed by cooperative and savings banks (27%). Investment banks are identified separately and represent 4% of the sample.

[Enter Table 1 here]

Table 2 shows the average income statement and balance sheet for a representative bank from each country. Each country's income statement is the average of the banks included in the sample, weighted by total assets. All items are shown as a percentage of total assets to allow comparability across countries and line items. The mean of the 17 countries in the sample is shown in the first column. There is considerable heterogeneity across countries. These differences in the composition of assets and funding sources are important for explaining the variation in the estimates of the NSFR and the impact of meeting this ratio on net interest margins.

Starting with the income statement, a bank's revenues can be divided into two broad categories: net interest income and non-interest income. Net interest income was 1.8% of total assets on average, with variation from 0.8% (Chile) to 4.5% (Mexico). Interest income is 3.9% on average, generated from interest earning assets: interbank claims, net loans and investments. The average interest expense was 2.1%, payable on deposits, interbank funding and wholesale funding. US banks had lower interest income and expense than the average bank in the sample, but higher net interest income at 2.3%. Non-interest income from trading and fees and commissions was an important source of revenues at 1.3% of total assets, with the US average much higher at 2.7%.

[Enter Table 2 here]

While the study focuses on net interest margins, we briefly review the profitability of the average bank in our sample. Total revenues averaged 3.1% of total assets, ranging from 1.2% (Japan) to 7.0% (Mexico). Total operating expenses amounted to 2.5% on average, with expenses the lowest in countries featuring a large number of banks such as Japan (1.3%) and Germany (1.2%). The average historical tax rate was 24% for the sample. The average ratio of net income to total assets (or return on assets) in 2009 was 0.5% across the sample, with the highest profitability in the emerging market economies and the lowest in Europe and the United States. Given the financial crisis and economic slowdown, banks in Germany, Japan and the Netherlands had losses on average.

Table 2 also shows the consolidated balance sheet for a typical bank in each country at year-end 2009. Loans net of provisions represented 52.2% of the typical banks assets, followed by investments (13.7%), trading-related assets (16.7%) and interbank claims (7.6%). The figure for interbank claims is considerably lower than the long-term average due to the disruption of interbank markets. Cash holdings were 3.0% of total assets on average, with US banks holding 5.2%. The average bank's assets were funded primarily by deposits (45.8%), trading-related liabilities (15.8%), wholesale funding (15.2%), and interbank funding (8.6%). Shareholder's equity represented 6.4% of total assets, of which common equity was the biggest portion. RWAs represented 54.1% of total assets on average, with a Tier 1 capital ratio of 11.1% and a Total capital ratio of 14.0%. Euro area banks exhibit lower than average capital ratios, while emerging market banks had higher ratios.

IV. Estimates of NSFR and impact on net interest margins

Having explained the calculation of the NSFR and the balance sheet changes required to meet this ratio, this section estimates the NSFR for the representative banks in 17 countries. In countries where the average bank does not meet the NSFR, a set of changes are outlined to raise the ratio to the minimum threshold. Based on these balance sheet changes, the impact on net interest margins is estimated for banks with different asset composition and funding profiles.

Estimates of NSFR and impact of changes on net interest margins

Table 3 provides a summary of the estimates of the NSFR and net interest margins by country. The top half of the table shows the NSFR as of year-end 2009, and any gap relative to the target ratio of 1.0. Based on the assumptions outlined below, the representative bank in only 5 out of 17 countries meets the NSFR, with increases required in the remaining 12 countries. The countries where the representative bank has a ratio above 1.0 are Chile (1.07), Hong Kong (1.38), Japan (1.25), Korea (1.25) and the United States (1.02). Banks in the remaining countries must increase their NSFR ratios on average, with the biggest gaps estimated for the following European banks: Switzerland (0.29), France (0.29), Germany (0.25), Sweden (0.24) and the UK (0.21).

[Enter Table 3 here]

The bottom half of Table 3 shows the net interest margins by country based on the representative bank. The average net interest margin across the 17 countries is 3.0% at year-end 2009. There is considerable variation across countries from a low of 1.0% in the United Kingdom to a high of 7.4% in Mexico. Based on the estimates outlined below, meeting the target NSFR of 1.0 will lead net interest margins to fall by 66 basis points in these 12 countries, or an average of 28% of their year-end 2009 values. In terms of absolute changes, the biggest declines are for banks in Switzerland (-1.7 percentage points), France (-1.2pp) and Germany (-1.0pp). As a percentage of starting values, the biggest declines are for banks in the UK (-81%), Sweden (-53%), France (-49%) and Switzerland (-45%).

Starting assumptions for calculating the NSFR

As described earlier, the detailed information required to calculate the NSFR is not disclosed in a bank's financial statements. While the BCBS collected data through the QIS, only 166 out of the 263 participating banks were able to provide sufficient data to calculate the NSFR. Given the absence of detailed inputs, the estimates in this section are illustrative with the true results likely to vary across banks and countries.

In the absence of detailed bank data, the only way to arrive at a starting value of the NSFR is to make a number of assumptions. Supervisors in the US and several other countries provided the following estimates of starting values for their banks. In the case of the US, these estimates are mean values for the 19 bank holding companies that participated in the US Treasury's stress testing exercise in May 2009 (the Supervisory Capital Assessment Program).

- 50% of wholesale funding is less than 1 year in maturity
- 70% of deposits are stable
- 18% of investments are less than 1 year in maturity
- Government debt initially represents 20% of investments
- 20% of corporate and retail loans are less than 1 year in maturity
- Committed but undrawn credit lines and other contingent liabilities each represent 3% of total assets.

Given these starting assumptions and the structure of the representative banks' balance sheet, it is possible to estimate the starting level of the NSFR for each country as of year-end 2009. Once we have a starting estimate, we can then estimate the changes required to either increase ASF and/or to reduce RSF. To estimate the costs associated with different strategies, we make the following assumptions:

- The investments on a bank's balance sheet earn a premium of 1% over the equivalent rate on high quality liquid bonds.
- The yield curve is upward sloping and the cost of wholesale funding greater than 1 year in maturity is 2pp higher than wholesale funding less than 1 year.

Table 4 provides details of the calculation for the representative bank in our sample and for banks in the five countries where the estimated values are above the minimum threshold. Column (1) shows the NSFR factors used to weight the different balance sheet items. Column (2) shows the product of the factor and the specific item from a country's weighted average bank balance sheet. For example, at year-end 2009 the average bank across the 17 countries had shareholder's equity of 6.4% of total assets. Given a factor weight of 100%, the contribution of shareholder's equity to the ASF is 0.064. In terms of ASF, shareholder's equity, wholesale funding greater than 1 year in maturity, and deposits receive the highest weights. After deducting these stable funding sources, all remaining capital sources receive a 0% weight. This category includes trading liabilities, interbank funding, and other liabilities. In terms of RSF, assets viewed as less liquid increase the need for stable funding, and have a higher factor. Cash, short-term securities, and interbank loans maturing within one year do not require funding. Only 5% of investments in government bonds with a maturity greater than one year need to be funded. Loans to corporates and retail clients with a maturity less than one year must be funded at 50% and 85%, respectively. Residential mortgages and loans with a maturity greater than one year (except loans to banks) must be funded at 65%. There

are also provisions for undrawn credit facilities and other contingent obligations. All remaining assets must be funded at 100%.

[Enter Table 4 here]

Based on the assumptions shown and the country-specific inputs, the average starting NSFR in this sample is 0.93 as of year-end 2009. This is the same value reported in the QIS for the Group 1 banks. Available stable funding is 0.58 (numerator) and required stable funding is 0.63 (denominator). To meet the NSFR, either stable funding sources must be increased or assets requiring stable funding must be decreased.

Table 4 shows the calculation of the NSFR for five other countries whose estimated ratios at year-end 2009 are above the minimum ratio of 1.0. In the United States, the average bank had an NSFR of 1.02. As seen in Table 2, the high levels of shareholder's equity (9.6% of total assets) are above the average for the sample countries and contribute to higher ASF. The smaller loan portfolio (39.2% of total assets) relative to the overall sample (52.2%) contributed to a lower RSF than the sample average. In Japan's case, the very high level of deposits (72.5% of total assets) and the low level of assets that require funding at 100% generated a high NSFR of 1.25. Consistent with feedback provided to the BCBS, many emerging market economies have already met the minimum requirement as seen for Chile (1.07), Hong Kong (1.38) and Korea (1.08).

Changes required to meet NSFR in different countries

Table 5 provides examples of the changes required to meet the meet the NSFR. We show results for banks in Australia, Germany and the United Kingdom that feature different balance sheet structures. As seen in Table 2, the representative Australian bank had net loans representing 72.7% of total assets and investments of only 3.5% at year-end 2009. The representative German bank had net loans of 38.2% of total assets and investments of 16.7%. The representative UK bank had net loans of 48.0% and investments of 9.1%. In terms of funding, Australian banks had deposits of 43.4% of total assets, wholesale funding of 20.1% and shareholders' equity of 6.2% at year-end 2009. The comparable ratios for German banks were 25.3%, 25.3% and 3.1%, respectively, and for UK banks 40.1%, 16.9%, and 4.3%, respectively. Despite having different asset profiles and capital structures, the average NSFR ratios in all three cases are below 1.0.

[Enter Table 5 here]

Table 5 outlines different scenarios to meet the minimum ratio. These strategies, outlined in section 3, involve changes to the bank's capital structure and the composition of its assets. In the case of the representative Australian bank, one possible scenario is to extend the maturity of wholesale funding such that only 10% is maturing within one year. Then banks need to increase their holding of high-quality liquid bonds from 20% of investments to 100% of the portfolio. Finally, the relative size of investments needs to increase to 6% of total assets, with other assets declining by an off-setting amount to 4.7%. These changes increase the ASF and reduce the RSF by the required amounts to reach the target ratio of 1.0. The average German bank could meet the NSFR by extending the maturity of wholesale funding and increasing the allocation to high quality bonds. No other actions are required as the quantity of investments was already high at 17% of total assets (the fifth highest in the sample). Finally, the average UK bank would need to make the biggest changes: extending all wholesale funding beyond one year, raising the holdings of high-quality bonds to 100% of investments, and increasing the size of investments to total assets by more than 50% (or five percentage points).

These changes are indicative of the magnitude of changes required by banks to meet the NSFR. Banks in these countries will need to decide what is feasible and identify the most cost-effective strategies based on their circumstances. These strategies, however, may go beyond changes to the composition of their existing balance sheets; banks may also need to exit some businesses or adopt new business models.

Impact on net interest margins across countries

Table 6 summarises the impact of changes required to meet the NSFR on net interest margins for the 12 countries in the sample where the representative bank is below the required threshold. The first row presents the simple average of the results for the 12 countries. The average country's bank needs to increase its ratio by 0.16, with considerable variation. Some banks need to raise their ratios by significant amounts, notably France (0.29), Switzerland (0.28), and Germany (0.24).

[Enter Table 6 here]

Column (2) shows the magnitudes of changes required to the size of investments as a share of total assets to meet the NSFR. The average country's banks need to increase their investment portfolio by 2.5pp. This increased share of investments is offset by the fall in other assets, holding the size of the balance sheet unchanged (equation 6). The

rise in investments thus equates to an equivalent increase in interest earning assets (column3) that – all else equal – will lead to a decline in the net interest margin. Column (4) shows the estimated fall in interest income from holding more high quality, liquid bonds relative to lower-rated, less-liquid investments. On average, interest income declines by 0.1pp. The increase in high quality liquid bonds increases liquid assets as a share of total assets by an equal amount, and contributes to meeting the LCR.

Column (5) shows that RWA decline by 7.2pp on average, driven by two changes. First, a change in the composition of existing investments with no change in the size of the investment portfolio will be associated with a decline in RWA as higher-quality bonds with a low risk weight are substituted for riskier investments with a higher risk weight. This change is most obvious in the cases of Canada and Mexico, where the relative size of investments is unchanged but RWAs decline. Second, increases in the share of investments relative to other assets reduce RWAs if the average risk-weight on the assets bought is assumed to be lower than the assets sold. In this study, the high-quality bonds are assumed to have a risk-weight of 0% while the investments sold are assumed to have a 100% risk-weight.

Column (6) shows the impact of the fall in RWA on shareholder's equity. A lower level of RWA for a given quantity of equity leads to a higher capital ratio, all else equal. Given that equity is the most expensive form of capital, banks are assumed to reduce their equity such that their capital ratio returns to its starting level. On average, the quantity of shareholders equity is reduced by 0.7% for this sample. The decline in equity is offset by an increase in wholesale funding, shown in column (7). Column (8) shows the increase in interest expense associated with the rise in wholesale funding, both the maturity extension and the increased quantity. Based on estimates of the cost of equity and wholesale funding in this study, the average increase is 0.3pp. Note that interest expense may rise with no change in the relative share of wholesale funding in cases where banks extend the maturity of wholesale funding beyond one year with an upward sloping yield curve. This maturity extension explains the rise in interest expense for banks in Italy, the Netherlands, and Spain where the quantity of wholesale funding is unchanged.

Finally, column (9) shows the impact of these changes on net interest income. The average decline in net interest income of 0.4% is the sum of the fall in interest income of 0.1% and the rise in interest expense of 0.3%. Column (10) shows the equivalent

change in net interest margin, where net interest income is divided by interest earning assets. On average, net interest margins decline by 66 basis points. The change in net interest margins range from only 7 bps in Italy to as much as 166 basis points in France. Column (11) expresses these declines as a percentage of their year-end 2009 starting values. The average change in net interest margins across the 12 countries is a decline of 28%, with the biggest relative decline for UK banks (-81%), Swedish banks (-53%) and French banks (-71%).

Sensitivity of estimates to assumptions

The estimates in this study are based on a series of assumptions, as discussed at the outset of this section. Table 7 shows how changing some of these assumptions affects the cost to meet the NSFR in 12 countries.

[Enter Table 7 here]

First, the estimates rely critically on the assumption of how much interest income is lost by switching into government bonds relative to other lower quality, less liquid investments. Presumably these investments generate a higher return than government bonds. In this analysis, the opportunity cost of holding government bonds relative to other investments is assumed to be 1.0% (100 basis points). An increase (decrease) in this opportunity cost raises (lowers) the cost to meet NSFR. Table 7 shows the estimates for the 12 countries under three scenarios. The base case is a fall in net interest margins of 66 basis points. If the opportunity cost of holding government bonds is 2.0% (0%), the average fall in net interest margins is 80 (53) basis points.

Second, the exercise is based on market estimates of the cost to extend the maturity of wholesale funding, holding the quantity of deposits unchanged. Extending the maturity of wholesale funding beyond one-year increases interest expense if the yield curve is upward sloping. If the yield curve is 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 wholesale funding. In this study, the base case assumption is that longer-maturity debt costs 2% (or 200 basis points) more than short-term debt. This premium represents the slope of the yield curve and the credit premium. Table 7 shows that the average change in net interest margins declines to 57 basis points if the premium is only 1%, and 48 basis points if the yield curve is flat. There is still a reduction in net interest margins because changing the maturity of wholesale funding is only one part of the calculation.

Third, the calculations take into account the fall in RWAs from holding high quality liquid assets. The assumption that banks will seek to rebalance their equity following a fall in RWAs is based on the belief that a bank's return on equity (ROE) is a more important measure of profitability to shareholders than net interest margins. While holding more debt increases interest expense and reduces net interest margins, it also reduces the cost of capital and increases ROE. Table 7 shows that if RWAs are not assumed to fall, the average decline in net interest margins is marginally smaller at 60 basis points. This estimate is equivalent to assuming that the risk-weight on investments is 0%, leading to no change in RWAs from changing the composition of a bank's assets.

Possible bank reactions to maintain profitability

This analysis provides an estimate the impact of meeting the NSFR on bank net interest margins. Given the higher costs associated with this liquidity requirement, banks may pursue a number of strategies to recover some or all of these costs. The most cost-effective strategies and the ability to pass through higher costs will depend on country and bank characteristics.

First, banks may increase the NSFR by reducing the maturity of their corporate loans to take advantage of the difference in factor weights used in calculating the NSFR. Corporate loans greater than 1 year in maturity must be funded 65%, while similar loans with a maturity of less than 1 year must be funded 50%. Reducing the maturity of corporate loans to below one year reduces the RSF and increases the NSFR, all else equal. Given the relative factor weights, such a change would have limited impact on the NSFR. While this change would have some benefit for banks, it would impose a cost on a bank's customers, as they will bear greater roll-over risk on their borrowing. To make such a strategy more palatable, banks might try to offer contingent credit lines to their customers that effectively extend the maturity of the loan. The undrawn amount of committed credit and liquidity facilities must only be funded at 5%, bringing the factor weight of the combined short-maturity loan plus credit line to 55%. The weighting of other contingent funding obligations, however, is left to the discretion of national supervisors. By charging a higher haircut, supervisors could make this strategy unattractive.

A second alternative is for banks to issue debt with a maturity greater than 1 year and to 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 the bank's cost of wholesale funding 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. In other words, banks will pay a negative cost of carry for this strategy equivalent to their credit spread over government bonds with a similar maturity. If the bank has an AAA rating, for example, the cost of carry would be around 25-50 basis points per annum, given bank borrowing conditions in 2009. The ability to engage in this strategy will depend on the calibration of the leverage ratio, which will limit the ability to grow liabilities relative to total assets. The leverage ratio under Basel III acts as a back-stop to risk-weighted capital measures, as it is based on the ratio of Tier 1 capital to total assets.

A third alternative is for banks to increase the cost of credit by raising lending spreads. Such a strategy, if successful, would have costs for the broader economy as a higher cost of credit, all else equal, should be associated with lower investment and GDP growth. Of course, if lending spreads cannot be increased, banks can offset the costs of meeting the NSFR by reducing operating expenses or increasing non-interest income. The ability to engage in these strategies will depend on a bank's efficiency ratio and their competitive environment. Future research may consider whether these strategies are feasible.

V. Conclusion and future research

The Net Stable Funding Ratio (NSFR) is a new structural liquidity requirement introduced under Basel III designed to limit liquidity mismatches between bank assets and liabilities. Banks that do not meet the minimum requirement need to modify the composition of their balance sheets to increase stable sources of funding and to reduce assets requiring stable funding. This study explains the NSFR and estimates this ratio for banks in 17 countries. Using a reasonable set of assumptions, we find that the representative bank in 5 out of the 12 countries appears to meet the ratio. Banks in the United States, Japan and a number of other Asian economies are estimated to have ratios above the minimum threshold at year-end 2009. For the remaining 12 countries, the most cost-effective strategies are to increase holdings of higher quality liquid bonds and to extend the maturity of wholesale funding. These changes are estimated to reduce bank net interest margins by 66 basis points on average, or 28% of their year-

end 2009 values. The biggest absolute declines are estimated for Swiss, French and German banks.

This paper provides a starting point for understanding the NSFR, which will undergo an extended observation period before implementation by year-end 2018. Given the lack of detailed data required to calculate this ratio, this study can suggest the potential magnitude of the change in bank net interest margins and outline the costs of these strategies. Banks will need to calculate the true costs based on data that only they currently possess. The analysis points to different possible behavioural responses to the regulation, including possible unintended consequences. Future research may determine what is reasonable given a country's institutional setting and the structure of its banking sector. Future research should also consider how the extent of liquidity mismatches revealed by the low NSFRs at year-end 2009 for a number of European banks may be related to the problems experienced over the recent financial crisis.

VI. References

Acharya, Viral V and Ouarda Merrouche, 2010, "Precautionary Hoarding of Liquidity and Inter-Bank Markets: Evidence from the Sub-prime Crisis" NBER Working Paper No 16395.

Acharya, Viral V, Hyun Song Shin, and Tanju Yorulmazer, 2011, Crisis Resolution and Bank Liquidity, Review of Financial Studies 24, 2166-2205.

Adrian, Tobias and Hyun Song Shin, 2010, "Liquidity and Leverage" Journal of Financial Intermediation 19, 418-437.

Afonso, Gara, Anna Kovner and Antoinette Schoar, 2011, Stressed, not Frozen: The Federal Funds Market in the Financial Crisis, Journal of Finance 66, 1109-1139.

Allen, Franklin and Elena Carletti, 2009, "The Roles of Banks in Financial Systems" in A. Berger, Phil Molyneux, J. Wilson (Eds.), Oxford Handbook of Banking, Oxford University Press.

Angbazo, Lazarus, 1997, "Commercial Bank Net Interest Margins, Default Risk, Interest-Rate Risk, and Off-Balance Sheet Banking" Journal of Banking and Finance 21, 55-87.

Bank for International Settlements, 2009, 79th Annual Report. Basel, Switzerland.

Basel Committee on Banking Supervision, 2010a, "Basel III: A global regulatory framework for more resilient banks and banking systems."

Basel Committee on Banking Supervision, 2010b, "Basel III: International framework for liquidity risk measurement, standards and monitoring."

Basel Committee on Banking Supervision, 2010c, "Results of the comprehensive quantitative impact study."

Berger, Allen N and Christa H S Bouwman, 2009, "Bank Liquidity Creation" Review of Financial Studies 22, 3779-3837.

Bhattacharya, S, A W A Boot and A V Thakor, 1998, "The economics of bank regulation" Journal of Money, Credit and Banking 30, 745–770.

Brunnermeier, Markus, 2009, Deciphering the 2007–2008 Liquidity and Credit Crunch, Journal of Economic Perspectives 23, 77–100.

Dewatripont, M and J Tirole, 1994, The Prudential Regulation of Banks, MIT Press, Cambridge.

Diamond, Douglas W and Raghuram Rajan, 2009, The Credit Crisis: Conjectures about Causes and Remedies, American Economic Review 99, 606-610.

Goldsmith-Pinkham, Paul and Tanju Yorulmazer, 2010, "Liquidity, Bank Runs, and Bailouts: Spillover Effects During the Northern Rock Episode" Journal of Financial Services Research 37, 83-98.

Gorton, Gary B, 2009, Information, liquidity and the (ongoing) panic of 2007, American Economic Review 99, 567-572.

Hellmann, T F, K C Murdock, and J E Stiglitz, 2000, Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough? American Economic Review 90, 147-165.

Huang, Rocco and Lev Ratnovski, 2011, "The dark side of bank wholesale funding" Journal of Financial Intermediation 20, 248-263.

Jeitschko, Thomas D, and Shin Dong Jeung, 2007, Incentives for risk-taking in banking – A unified approach, Journal of Banking & Finance 29, 759-777.

Lepetit, Laetitia, Emmanuelle Nys, Philippe Rous and Amine Tarazi, 2008, "Bank Income Structure and Risk: An Empirical Analysis of European Banks" Journal of Banking and Finance 32, 1452-1467.

Longstaff, Francis A, 2010, The subprime credit crisis and contagion in financial markets, Journal of Financial Economics 97, 436-450.

Maudos, Joaquin and Liliana Solis, 2009, "The Determinants of Net Interest Income in the Mexican Banking System: An Integrated Model" Journal of Banking and Finance 33, 1920-1931.

Memmel, Christoph, 2010, "Banks' Exposure to Interest Rate Risk, Their Earnings from Term Transformation, and the Dynamics of the Term Structure" Journal of Banking and Finance 35, 282-289.

Milne, Alistair, 2002, Bank capital regulation as an incentive mechanism: Implications for portfolio choice, Journal of Banking & Finance 26, 1-23

Modigliani, F and M H Miller, 1958, "The cost of capital, corporate finance, and the theory of investment." American Economic Review 48, 261–297.

Park, Sangkyun and Stavros Peristiani, 2007, Are bank shareholders enemies of regulators or a potential source of market discipline? Journal of Banking & Finance 31, 2493-2515.

Repullo, Rafael, 2004, Capital requirements, market power, and risk-taking in banking, Journal of Financial Intermediation 13, 156-182

Rosen, Richard J, 2007, “Banking Market Conditions and Deposit Interest Rates” Journal of Banking and Finance 31, 3862-3884.

Santos, J A C, 2001, “Bank capital regulation in contemporary banking theory: A review of the literature” Financial Markets, Institutions & Instruments 10, 41–84.

Saunders, Anthony and Liliana Schumacher, 2000, “The Determinants of Bank Interest Rate Margins: An International Study” Journal of International Money and Finance 19, 813-832.

Shin, Hyun Song, 2009, “Symposium: Early Stages of the Credit Crunch: Reflections on Northern Rock: The Bank Run That Heralded the Global Financial Crisis” Journal of Economic Perspectives 23, 101-119.

Stiroh, Kevin J and Adrienne Rumble, 2006, “The Dark Side of Diversification: The Case of US Financial Holding Companies” Journal of Banking and Finance 30, 2131-2161.

Strahan, Philip, 2008, “Liquidity Production in 21st Century Banking” NBER Working Papers No 13798.

Thakor, A V, 1996, “Capital requirements, monetary policy, and aggregate bank lending: Theory and empirical evidence.” Journal of Finance 51, 279–324.

VanHoose, D, 2007, “Theories of bank behavior under capital regulation.” Journal of Banking and Finance 31, 3680–3697.

Table 1: Composition of sample by country and bank type

Country	Number of banks	Commercial & BHC	Investment banks	Cooperative & savings banks[1]	Mortgage banks
Number of banks	603	384	23	163	33
Per cent of sample	*100%*	*64%*	*4%*	*27%*	*5%*
Of which:			% of banks by category:		
Australia (AU)	9	89%	11%	0%	0%
Canada (CA)	15	87%	7%	7%	0%
Chile (CL)	8	88%	0%	0%	13%
France (FR)	18	61%	0%	28%	11%
Germany (DE)	47	40%	2%	34%	23%
Hong Kong (HK)	16	100%	0%	0%	0%
Italy (IT)	43	51%	12%	37%	0%
Japan (JP)	122	80%	1%	20%	0%
Korea (KR)	14	93%	7%	0%	0%
Mexico (MX)	35	94%	0%	0%	6%
Netherlands (NL)	12	83%	0%	8%	8%
South Africa (ZA)	6	100%	0%	0%	0%
Spain (ES)	49	27%	0%	73%	0%
Sweden (SE)	48	23%	2%	67%	8%
Switzerland (CH)	26	31%	4%	62%	4%
UK (GB)	29	52%	14%	0%	34%
USA (US)	106	77%	7%	15%	1%

1. Includes German Landesbanks and Swiss cantonal banks.

Source: Bankscope, author's calculations.

Table 2: Representative income statement and balance sheet for 17 countries, year-end 2009
(As percentage of total assets)

Country[1]	Avg	AU	CA	CH	CL	DE	ES	FR	GB	HK	IT	JP	KR	MX	NL	SE	US	ZA
INCOME STMT																		
Interest income	3.9	5.2	3.2	2.3	4.7	3.5	4.2	2.9	2.4	2.0	3.5	1.6	5.2	8.3	3.3	2.6	3.5	7.5
- Interest expense	2.1	3.4	1.5	1.5	1.6	2.7	2.1	1.9	1.3	0.5	1.6	0.6	3.0	3.7	2.3	1.6	1.2	4.9
Net interest income	1.8	1.8	1.8	0.8	3.1	0.8	2.0	1.0	1.1	1.5	1.9	1.0	2.2	4.5	1.0	1.0	2.3	2.6
+ Non-int. income	1.3	0.9	1.5	2.8	1.8	0.4	0.9	0.7	1.1	1.0	0.9	0.2	1.2	2.4	0.6	0.6	2.7	2.6
= Revenue	3.1	2.7	3.2	3.7	4.9	1.2	3.0	1.7	2.2	2.5	2.9	1.2	3.4	7.0	1.6	1.6	5.0	5.1
- Operating expenses	2.5	1.9	2.5	2.7	3.5	1.2	2.3	1.5	2.3	1.4	2.6	1.3	2.8	5.5	1.6	1.2	4.9	4.0
- Taxes	0.1	0.3	0.2	0.1	0.3	0.0	0.1	0.0	-0.1	0.2	0.1	0.1	0.1	0.4	0.0	0.1	0.0	0.3
= Net income	0.5	0.6	0.6	0.9	1.2	-0.1	0.6	0.2	0.0	1.1	0.3	-0.2	0.4	1.4	-0.1	0.3	0.2	1.0
ASSETS																		
Cash	3.0	2.6	0.9	4.2	5.9	0.7	2.4	1.9	3.0	3.6	1.0	1.5	3.8	5.9	2.9	1.8	5.2	3.4
Interbank claims	7.6	2.7	3.0	4.7	5.8	16.0	6.4	11.7	10.5	14.6	11.0	3.6	2.5	9.1	7.4	7.2	7.2	6.2
Trading assets	16.7	11.2	23.3	39.2	7.5	24.3	8.8	29.6	24.2	9.3	13.9	4.1	4.6	22.0	10.9	19.2	12.8	18.3
Net loans	52.2	72.7	48.2	35.2	66.6	38.2	64.3	36.5	48.0	40.2	61.7	45.9	69.4	41.4	57.1	65.0	39.2	57.3
Investments	13.7	3.5	12.2	7.4	11.9	16.7	12.3	13.4	9.1	26.2	5.7	38.8	14.6	18.6	13.7	2.3	21.0	4.9
Other assets	6.9	7.2	12.3	9.4	2.4	4.0	5.9	6.8	5.3	6.1	6.8	6.1	5.2	3.0	8.0	4.5	14.6	10.0
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
LIABS+EQUITY																		
Deposits	45.8	43.4	62.5	39.0	57.1	25.3	42.8	27.4	40.1	72.3	36.9	72.5	52.0	48.4	39.2	25.4	44.4	49.0
Interbank loans	8.6	3.2	3.5	17.2	13.3	17.6	5.4	13.5	13.5	4.4	13.1	1.3	6.7	2.3	7.9	14.2	1.0	9.1
Trading liabilities	15.8	21.3	13.1	11.4	8.4	23.3	16.4	23.0	20.1	4.8	9.6	12.0	8.3	27.7	17.7	16.5	17.6	17.6
Wholesale funding	15.2	20.1	1.6	15.1	10.2	25.3	23.7	19.9	16.9	2.7	28.1	5.2	19.5	4.6	17.1	29.8	15.8	3.0
Other liabilities	8.2	5.9	13.5	11.7	2.6	5.5	5.4	12.5	5.0	7.2	4.9	4.6	6.3	5.3	13.9	9.7	11.5	14.0
Total liabilities	93.6	93.8	94.2	94.4	91.6	96.9	93.6	96.2	95.7	91.4	92.6	95.6	92.8	88.3	95.8	95.6	90.4	92.6
Equity	6.4	6.2	5.8	5.6	8.4	3.1	6.4	3.8	4.3	8.6	7.4	4.4	7.2	11.7	4.2	4.4	9.6	7.4
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
CAPITAL RATIOS																		
RWA / total assets	54.1	46.5	42.2	44.1	89.8	38.8	63.9	39.6	44.4	57.6	63.0	52.7	64.5	59.3	39.9	49.5	70.4	53.8
Tier 1 capital ratio	11.1	9.2	13.1	15.8	7.3	9.7	9.6	9.2	11.4	12.4	9.8	8.8	10.3	13.8	14.4	11.6	11.7	11.0
Total capital ratio	14.0	11.9	15.9	16.9	14.3	13.2	12.7	10.7	15.2	16.7	12.5	11.0	14.0	16.1	16.4	12.2	13.9	14.2

1. AU=Australia, CA=Canada, CH=Switzerland, CL=Chile, DE=Germany, ES=Spain, FR=France, GB=United Kingdom, HK = Hong Kong, IT=Italy, JP=Japan, KR=Korea, MX=Mexico, NL= Netherlands, SE=Sweden, US=United States and ZA=South Africa.

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

Table 3: Estimates of Net Stable Funding Ratio and change in net interest margins for 17 countries, year-end 2009

Country	Mean	AU	CA	CH	CL	DE	ES	FR	GB	HK	IT	JP	KR	MX	NL	SE	US	ZA
Net Stable Funding Ratio (NSFR):																		
Before	0.93	0.85	0.87	0.71	1.07	0.75	0.98	0.71	0.79	1.38	0.94	1.25	1.08	0.94	0.89	0.76	1.02	0.81
Target	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Gap if below	0.17	0.15	0.13	0.29		0.25	0.02	0.29	0.21		0.06			0.06	0.11	0.24		0.19
Net Interest Margins (%):																		
Before	3.0	3.4	4.6	3.7	3.4	2.8	2.9	2.4	1.0	1.9	2.0	1.4	2.6	7.4	2.4	1.7	4.2	3.4
After	2.5	2.8	4.3	2.0	3.4	1.8	2.8	1.2	0.2	1.9	1.6	1.4	2.6	7.2	2.1	0.8	4.2	2.8
Change for 12 countries with NSFR below 1.0:																		
NIM	-0.7	-0.6	-0.3	-1.7		-1.0	-0.1	-1.2	-0.8		-0.4			-0.2	-0.3	-0.9		-0.6
% 2009 NIM	-28%	-18%	-6%	-45%		-35%	-2%	-49%	-81%		-19%			-3%	-12%	-53%		-16%

Source: Bankscope, author's calculations

Table 4: Calculation of net stable funding ratio as of year-end 2009

	(1)	(2) Average of 17 countries	(3) USA	(4) Japan	(5) Chile	(6) Hong Kong	(7) Korea
Available stable funding (ASF)	**Factor**						
Shareholder's equity	100%	0.064	0.096	0.044	0.084	0.086	0.072
Wholesale funding >1 yr.	100%	0.117	0.136	0.049	0.064	0.049	0.129
Wholesale funding <1 yr.	50%	0.038	0.039	0.013	0.026	0.007	0.049
Stable deposits	90%	0.288	0.280	0.457	0.359	0.456	0.328
Less stable deposits	80%	0.069	0.067	0.109	0.086	0.108	0.078
A. Total ASF (numerator)		0.576	0.619	0.671	0.619	0.706	0.655
Required stable funding (RSF)							
Qualifying government debt >1yr	5%	0.001	0.002	0.003	0.001	0.002	0.001
All other investments	50%	0.045	0.069	0.127	0.039	0.086	0.048
Loans to corporate clients < 1yr	50%	0.052	0.039	0.046	0.067	0.040	0.069
Residential mortgages + loans >1yr	65%	0.203	0.153	0.179	0.260	0.157	0.271
Loans to retail clients <1 year	85%	0.089	0.067	0.078	0.113	0.068	0.118
All other assets	100%	0.236	0.273	0.102	0.099	0.154	0.098
Undrawn credit facilities	5%	0.002	0.002	0.002	0.002	0.002	0.002
Other contingent obligations	5%	0.002	0.002	0.002	0.002	0.002	0.002
B. Total RSF (denominator)		0.629	0.606	0.538	0.581	0.510	0.608
NSFR ratio (A/B)		**0.929**	**1.022**	**1.248**	**1.066**	**1.384**	**1.078**

Table 5: Changes to meet NSFR in Australia, Germany and United Kingdom as of year-end 2009

	Australia			Germany			United Kingdom		
	BEFORE	AFTER	CHG	BEFORE	AFTER	CHG	BEFORE	AFTER	CHG
Assumptions:									
% of wholesale funding <1 yr.	50%	10%	-40%	50%	0%	-50%	50%	0%	-50%
Eligible debt issued by sovereign >1yr	20%	100%	80%	20%	100%	80%	20%	100%	80%
% of deposits that are stable	70%	70%	0%	70%	70%	0%	70%	70%	0%
Available stable funding (ASF)	Change in NSFR:			Change in NSFR:			Change in NSFR:		
Tier 1 and Tier 2 capital	0.062	0.056	-0.005	0.031	0.021	-0.010	0.043	0.034	-0.010
Wholesale funding >1 year	0.130	0.238	0.109	0.154	0.317	0.164	0.110	0.229	0.119
Stable deposits < 1 year	0.274	0.274	0.000	0.160	0.160	0.000	0.252	0.252	0.000
Less stable deposits	0.065	0.065	0.000	0.038	0.038	0.000	0.060	0.060	0.000
Wholesale funding <1 yr.	0.050	0.010	-0.040	0.063	0.000	-0.063	0.042	0.000	-0.042
A. Total ASF (numerator)	0.581	0.644	0.063	0.445	0.536	0.090	0.508	0.575	0.067
Required stable funding (RSF)									
Debt issued by sovereign >1yr	0.000	0.002	0.002	0.001	0.007	0.006	0.001	0.006	0.005
Other investments	0.011	0.000	-0.011	0.055	0.000	-0.055	0.030	0.000	-0.030
Loans to financials <1 year (e.g. interbank)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Loans to corporate clients < 1year	0.073	0.073	0.000	0.038	0.038	0.000	0.048	0.048	0.000
Loans to retail clients <1 year	0.124	0.124	0.000	0.065	0.065	0.000	0.082	0.082	0.000
Residential mortgages + other loans >1year	0.284	0.284	0.000	0.149	0.149	0.000	0.187	0.187	0.000
All other assets	0.184	0.159	-0.025	0.284	0.281	-0.003	0.295	0.251	-0.044
Undrawn credit and liquidity facilities	0.002	0.002	0.000	0.002	0.002	0.000	0.002	0.002	0.000
Other contingent obligations	0.002	0.002	0.000	0.002	0.002	0.000	0.002	0.002	0.000
B. Total RSF (denominator)	0.679	0.645	-0.034	0.595	0.543	-0.052	0.645	0.576	-0.069
NSFR ratio (A/B)	**0.855**	**1.000**	**0.144**	**0.748**	**1.000**	**0.238**	**0.787**	**1.000**	**0.212**

Table 6: Details of changes to meet NSFR in 12 countries and impact on net interest margins, year-end 2009
(As a percentage of total assets except net interest margin)

Change in:	(1) Change to NSFR	(2) Invest-ments	(3) Interest earning assets	(4) Interest Income	(5) Risk weighted assets / total assets	(6) Share-holder's equity	(7) Whole-sale funding	(8) Interest expense	(9) Net interest income	(10) Net interest margin (bps)	(11) As % of 2009 NIM
Mean	0.16	2.5%	2.5%	-0.1%	-7.3%	-0.7%	0.7%	0.3%	-0.4%	66	-28%
Australia	0.14	2.5%	2.5%	-0.1%	-5.3%	-0.5%	0.5%	0.3%	-0.4%	-59	-18%
Canada	0.13	0.0%	0.0%	-0.1%	-9.7%	-1.0%	1.0%	0.1%	-0.2%	-28	-6%
France	0.29	4.1%	4.1%	-0.2%	-14.8%	-1.1%	1.1%	0.5%	-0.7%	-166	-49%
Germany	0.24	0.3%	0.3%	-0.1%	-13.7%	-1.0%	1.0%	0.6%	-0.7%	-99	-35%
Italy	0.06	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	-0.3%	-7	-19%
Mexico	0.06	0.0%	0.0%	0.0%	-2.8%	-0.5%	0.5%	0.1%	-0.1%	-119	-3%
Netherlands	0.11	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	-0.2%	-84	-12%
South Africa	0.19	4.1%	4.1%	-0.1%	-8.0%	-1.0%	1.0%	0.2%	-0.3%	-37	-16%
Spain	0.01	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	-0.1%	-21	-2%
Sweden	0.22	4.7%	4.7%	-0.1%	-6.5%	-0.5%	0.5%	0.5%	-0.6%	-29	-53%
Switzerland	0.28	9.6%	9.6%	-0.2%	-15.5%	-1.7%	1.7%	0.4%	-0.6%	-92	-45%
UK	0.21	4.4%	4.4%	-0.2%	-11.7%	-1.0%	1.0%	0.4%	-0.6%	-55	-81%

Table 7: Sensitivity of decline in net interest margins to different assumptions (In basis points)

	1. Premium on investments vs. high quality liquid bonds:			2. Premium on wholesale funding >1yr :			3. Allow fall in RWAs:	
	2%	1%	0%	2%	1%	0%	Yes	No[1]
Mean	-80	-66	-53	-66	-57	-48	-66	-60
Australia	-68	-59	-50	-59	-49	-39	-59	-55
Canada	-43	-28	-13	-28	-26	-23	-28	-20
France	-147	-119	-92	-119	-103	-88	-119	-110
Germany	-119	-99	-80	-99	-80	-61	-99	-92
Italy	-37	-37	-37	-37	-29	-22	-37	-37
Mexico	-26	-21	-17	-21	-19	-16	-21	-14
Netherlands	-29	-29	-29	-29	-23	-16	-29	-29
S. Africa	-71	-55	-40	-55	-52	-49	-55	-41
Spain	-7	-7	-7	-7	-5	-4	-7	-7
Sweden	-104	-92	-79	-92	-77	-63	-92	-88
Switzerland	-207	-166	-125	-166	-153	-139	-166	-153
UK	-105	-84	-63	-84	-72	-59	-84	-77

1. Because the fall in RWAs is due to the substitution between investments and high quality, liquid bonds, this option is equivalent to setting the risk-weight on investments to 0%.

Appendix A: Summary of Net Stable Funding Ratio

Available stable funding		Required stable funding	
Item	Factor	Item	Factor
• Tier 1 & 2 capital instruments • Other preferred shares and capital instruments having an effective maturity of one year or greater • Other liabilities with an effective maturity of one year or greater	100%	• Cash • Short-term unsecured actively-traded instruments (< 1 yr.) • Securities with exactly offsetting reverse repo • Securities with remaining maturity < 1 yr. • Interbank claims with remaining maturity < 1 yr.	0%
• Stable deposits of retail and small business customers (non-maturity or residual maturity < 1yr)	90%	• Government debt with a 0% risk weight under Basel II • Debt issued or guaranteed by sovereigns, central banks, BIS, IMF, EC, non-central government, multilateral development banks with a 0% risk weight under Basel II standardised approach	5%
• Less stable deposits of retail and small business customers (non-maturity or residual maturity < 1yr)	80%	• Unencumbered non-financial senior unsecured corporate bonds and covered bonds rated at least AA-, and debt that is issued by sovereigns, central banks, and public sector entities with a risk-weighting of 20%; maturity ≥ 1 yr.	20%
• Wholesale funding provided by non-financial corporate customers, sovereign central banks, multilateral development banks and public sector entities (non-maturity or residual maturity < 1yr)	50%	• Unencumbered listed equity securities or non-financial senior unsecured corporate bonds (or covered bonds) rated from A+ to A-, maturity ≥ 1 yr. • Gold • Loans to non-financial corporate clients, sovereigns, central banks, and public sector entities with a maturity < 1 yr.	50%
• All other liabilities and equity not included above (including interbank lending)	0%	• Unencumbered residential mortgages of any maturity and other unencumbered loans, excluding loans to financial institutions with a remaining maturity of one year or greater that would qualify for the 35% or lower risk weight under Basel II standardised approach.	65%
		• Other loans to retail clients and small businesses having a maturity < 1 yr.	85%
		• All other assets	100%
		• Undrawn amount of committed credit and liquidity facilities	5%
		• Other contingent funding obligations – factor at discretion of national supervisors	

Source: BCBC (2010b).