Modelling the Impact of New Capital Regulations on Bank Profitability

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Abstract

This study models the impact of new capital regulations proposed under Basel III on bank profitability by constructing a stylized representative bank's financial statements. We show that the higher cost associated with a one-percentage increase in the capital ratio can be recovered by increasing lending spreads. The results indicate that in the case of scheduled commercial banks, one-percentage point increase in capital ratio can be recovered by increasing the bank lending spread by 31 basis points and would go upto an extent of 100 basis points for six-percentage point increase assuming that the risk weighted assets are unchanged. We also provide the estimations for the scenarios of changes in risk weighted assets, changes in return on equity (ROE) and the cost of debt.

JEL Classification: G2; G21; G28; E44; E51; E61

Keywords: Banks, Regulation, Basel III, Capital, Interest Income

1. Introduction

Banks and bankers have been at the heart of the crisis. Even as much of the reform in response to the crisis is still work in progress, one segment of reforms that has taken a final shape and is being implemented across the globe is the Basel III framework for bank capital regulation. However, there have been debates about the desirability and the impact of new capital regulations on the profitability of banks. A growing strand of literature in favour of the new regulations argues that there are significant macroeconomic benefits from raising bank equity. Higher capital requirements lower leverage and the risk of bank bankruptcies (Admati *et al.,* 2010). On the other hand, there is another strand of literature, which argues that there could be significant costs of implementing a regime with higher capital requirements (BIS, 2010, and Angelini *et al.,* 2011). Higher capital requirements will increase banks' marginal cost of loans if, contrary to the Modigliani-Miller (1958) Theorem, the marginal cost of capital is greater than the marginal cost of deposits, i.e. if there is a net cost of raising capital. In that case, a higher cost of equity financing relative to debt financing, would lead banks to raise the lending spreads and could slow loan growth and hold back the economic recovery.

Increase in equity capital requirements is likely to increase the weighted average cost of capital and consequently banks would have to pass on the increase in cost of capital to the borrowers as higher lending rates. However, the important question is how much would be the increase in the bank loan spread and how can these inter-relations be mapped appropriately for estimation? Simultaneously, how much would be increase in interest income of the banks? Bank for International Settlements (BIS) estimates for a representative bank indicate that one-percentage point increase in the capital ratio raises loan spreads by 13 basis points (bps) and a median 0.09% decline in output (BCBS, 2010). Besides, the additional cost of meeting the liquidity standard amounts to around 25 basis points in lending spreads when risk-weighted assets are unchanged. On the other hand, the lending spreads drop to 14 basis points or less after considering the fall in risk-weighted assets and the corresponding lower regulatory capital needs associated with the higher holdings of low-risk assets. The median decline in output as a consequence of meeting a higher liquidity requirement is in the order of 0.08%.

Though literature is rich with studies on bank regulation and its impact, very few studies are reported on the modeling of the impact of capital and liquidity requirements on

bank lending spreads except the one by King (2010). Country specific studies are necessitated in order to estimate the impact of new capital regulations under Basel III proposals on profitability of banks. This would provide the much needed logic, and rational approach towards ascertaining these impacts to policy makers as well as build a body of literature capturing the uniqueness of country specific features (particularly of emerging market economies such as that of India) in this direction. Regardless of having low or almost nil exposure to the toxic assets involved in the global financial crisis and a gradualist approach towards liberalization of the financial sector, Indian financial sector was indeed affected by the global financial crisis. The Basel III norms are bound to have a significant impact on the Indian financial sector. Although, Indian financial sector is believed to be in a comfortable position to meet some of the Basel III norms, the implementation of some of the other norms will be a challenge. In this backdrop, it is required to assess the impact of Basel III proposals particularly with regard to the impact on bank lending spreads, as this would have a direct effect on the economic output. Further, the impact on profitability of banks would greatly affect their capital generation capacity as well affect proliferation of their services.

In this study, we model the impact of new capital regulations under Basel III proposals on profitability of Indian banking sector, particularly on the bank lending spreads as well as the interest income. By constructing a stylized representative bank's financial statements for different classes of banking, we estimate that the higher cost associated with a one-percentage increase in the capital ratio can be recovered by increasing lending spreads. It is observed that in the case of scheduled commercial banks (SCBs), one-percentage point increase in capital ratio can be recovered by increasing the bank lending spread by 31 basis points and would go upto an extent of 100 basis points for six-percentage point increase assuming that the risk weighted assets are unchanged. We also provide the estimations for the scenarios of changes in risk weighted assets, changes in return on equity (ROE) and the cost of debt. Assuming that RWAs are unchanged, we forecast that for 1-percentage point increase in capital ratio, interest income would raise by 17 percentage points. Similarly, for 2, 3, 4, 5 and 6-percentage point increase in capital ratio given that RWAs are unchanged, interest income would increase by 26, 37, 44, 53 and 62 percentage points respectively. When RWAs are assumed to be decreased by 20 percentage points, for 1, 2, 3, 4, 5 and 6-percentage point increase in capital ratio, interest income would increase by 14, 20, 26, 32, 38 and 44 percentage points respectively.

The design of the representative bank model is useful in mapping the changes in the bank's capital structure and in understanding as to how the composition of assets has an effect on the different components of net income using the standard accounting relationships. Even though banks can adjust to the regulatory reforms in several ways, this study supposes that they seek to pass on any additional costs by raising the cost of loans to end-customers. It is believed that by computing the change in net income and shareholder's equity associated with the regulatory changes, we can compute the increase in lending spreads required to achieve a given return on equity (ROE). In view of the enormous significance of the impact of Basel III on banks, this research outcome benefits the practitioners in the industry and researchers apart from contributing to the literature on bank regulation and risk management with newer and topical approach for quantification of the impacts of new regulatory standards.

The remainder of the paper is presented as follows. We present the theoretical considerations encompassing the recent related literature in section 2. We describe our modelling of the impact of new capital regulations under Basel III proposals and the methodology of estimation in section 3. We present the description of the data employed for the analysis in section 4. Results and discussion is presented in section 5 followed by conclusion in section 6.

2. Theoretical Considerations

Though there is a wealth of literature on bank capital and regulation (refer Dewatripont and Tirole, 1994; Bhattacharya *et al.,* 1998; Santos, 2001; and VanHoose, 2007), very few studies have highlighted on the aspect of loan pricing. Repullo and Suarez (2004) have analyzed the loan pricing implications of capital requirements in a credit market where, as in the model underlying the internal ratings based (IRB) approach of Basel II, loan default rates are driven by a single factor of systematic risk. Their loan pricing equation entails that low risk firms will accomplish decreases in their loan rates by borrowing from banks adopting the IRB approach, while high-risk firms will evade increases in their loan rates by borrowing from banks that embrace the less risk-sensitive standardized approach of Basel II. However, they contemplate a perfectly competitive market for business loans where, as in the model underlying the internal ratings based (IRB) approach of Basel II; a single risk factor expounds the correlation in defaults across firms.

Another recent study in this direction is by Ruthenberg and Landskroner (2008), who analyze and estimate the possible effects of the new rules on the pricing of bank loans using Israeli economic data and data of a leading Israeli bank, including probability of default of its retail and corporate customers. Their loan equation is founded on a model of a banking firm facing uncertainty operating in an imperfectly competitive loan market. They show that high quality corporates and retail customers will experience a decline in loan interest rates in (large) banks that, will embrace the IRB approach. On the other hand, high-risk customers will benefit by shifting to (small) banks that will assume the Standardized approach. This study is distinctive in their approach by estimating the loan spreads with loan rate equation involving the explanatory variables such as; loan loss provisions, market share, cost of debt (secondary market), and cost of equity sensitivity. Elliott (2010) is another significant of the recent studies that has analysed the loan pricing implications of the proposed higher capital requirements under Basel III. By providing an accounting-based analysis, Elliott (2010) has estimated how much the interest rate charged on loans would increase if banks are required to hold more equity. However, in the stylized model of Elliot, banks hold only loans funded by equity, deposits and wholesale funding and the interest rate on loan is priced in order to meet a targeted ROE after covering for the cost of liabilities and other fixed expenses (such as administrative costs and expected loan losses). Using the Federal Deposit Insurance Corporation (FDIC) data for aggregate United States (US) banking system, Elliott has calculated that if the ratio of common equity required for a given loan is raised by 2% with no other changes, banks would need to raise lending spreads by 39 basis points (bps) to maintain the target ROE of 15%. Further, if the ROE is allowed to fall to 14.5%, lending spread would have to rise only by 9 bps. Elliott summarizes that through a combination of actions the US banking system would be able to adjust to higher capital requirements and ensure that they would not have a strong effect on the pricing or availability of bank loans. The merit of the Elliott's method is in its simplicity as well as the intuition it provides on pricing of loans and the alternatives available to banks to adjust to higher capital levels. Drawing from the literature discussed earlier, we develop and present our methodology in the ensuing section.

3. Methodology

The purpose of this section is to map the capital and liquidity requirements as per Basel III[1] to bank lending spreads[2]. This estimation supposes that the return on equity (ROE) and

[1] The 1988 Basel Accord is referred to, as Basel I and the 2004 revision of the same is known as Basel II.

the cost of debt are unaffected, with no change in other sources of income and on the same line of thought; it is further assumed that there is no reduction in operating expenses. Such a mapping endows researchers with a useful instrument to analyze the impact of regulatory changes on the cost of credit and the real economy. A raise in the interest rate charged on bank loans is believed to reduce loan demand, all else equal, leading to a drop in investment and output.

This methodology has been employed in the BCBS's assessment of the long-term economic impact of the proposed regulatory changes on output (BCBS, 2010; King, 2010). Further, the benefit of these estimates of changes in bank lending spreads could be found in using them 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. Motivated by similar studies such as Repullo and Suarez (2004) and Ruthenberg and Landskroner (2008) for Basel II framework, this mapping exercise attempts to illustrate the potential loan pricing implications for the banks under the Basel III proposals.

A *representative bank*[3] is designed to map the changes in the bank's capital structure and to understand how the composition of assets has an effect on the different components of net income using the standard accounting relationships. Even though banks can adjust to the regulatory reforms in several ways, this study supposes that they seek to pass on any additional costs by raising the cost of loans to end-customers. It is believed that by computing the change in net income and shareholder's equity associated with the regulatory changes, we can compute the increase in lending spreads required to achieve a given return on equity (ROE). This approach, of course, is not without limitations as it does not formally model the choices faced by the banks, nor does it offers estimates based on an optimization in a general equilibrium setting. On other hand, as a substitute, it offers a starting point for understanding the behavioural response of banks to a regulatory change in a most acceptable practical setting. It enables the researchers and the policy makers in determining the impact given a country's institutional setting, its banking sector and the elasticity of loan demand. Though this approach can suggest the potential magnitude of the change in lending spreads, deciding whether banks would be able to pass on these costs to borrowers is beyond the scope of this

[2] *Lending spread* is the spread between the interest rate charged on bank loans and the cost of bank's liabilities.
[3] The author is grateful to Michel R King for suggesting the suitability of this approach

study. Further, this approach focuses on the '*steady state*' and does not consider the transition period to the higher regulatory requirements[4]. In the steady state, the supply of bank credit is considered as exogenous and credit rationing is ignored. It is further implied that banks price their loans to meet the marginal cost of loan production.

The approach is modified to suit the needs of Indian banking system and is understandably illustrative and general in nature and could be used to estimate the impact on lending spreads from a change in bank's capital structure, assets composition, risk weighted assets and the corporate tax paid by these banks. Also, as this approach does not rely much on the availability of very large datasets (which are obviously the requirement in effective use of statistical methods); it is acceptable particularly for practitioners for easy comprehension. Another advantage of this approach is that it explains how a given change can alter the bank's profitability and indicates to different possible behavioural responses to the regulations including the unintended consequences. Further, this approach being a bottom-up, micro-founded one, it offers a useful complement to top-down, structural models where the modeling of the financial sector is necessarily parsimonious. Although this approach is founded on several assumptions, all the assumptions are apparent, realistic, and simple and can be modified to check the sensitivity of the results. The methodology holds good in the case of Indian banking as the banks are allowed to reprice their loan books in accordance with the changes in their base rates in the much more liberalized new regulatory environment. We notice in the real world, that banks do keep repricing their loan books in line with the needs of their asset-liability management.

This approach focuses on only two elements of Basel III proposals viz, the first relating to raising the minimum capital requirement and the second relating to enhanced liquidity requirement. Firstly, though the previous Basel accords (Basel I and II) specified capital adequacy rules for minimum capital adequacy ratios, however, they could not absorb the losses during the recent crisis. In this backdrop, Basel III stipulates higher levels of tangible common equity. In order to achieve this, banks need to increase their common equity with high-quality capital. This can be achieved by deleveraging banks' balance sheets by offloading assets in the near term. Secondly, as per the Basel III framework, banks are required to meet two new liquidity standard requirements viz, liquidity coverage ratio (LCR)

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

and net stable funding ratio (NSFR). The LCR is employed to identify the amount of unencumbered, high quality, liquid assets that can be made use of to offset cash outflows. Essentially, LCR aims to ensure that banks have adequate funding liquidity to survive at least one month of a situation of stressed funding. As the related data (requires details on a bank's expected cash outflows over a one-month period) is not available for researchers, it cannot be calibrated. The aim of NSFR is to address maturity mismatches between assets and liabilities. NSFR establishes a minimum adequate amount of stable funding based on the liquidity characteristics of a bank's assets over a one-year horizon. This approach estimates the cost to meet the NSFR. This approach mostly follows the footsteps of King (2010) in estimating the impact of capital and liquidity requirements on the lending spreads.

This section of the study does not focus on measurement of credit risk, but on the relationships between a bank's capital structure, asset composition and their impact on bank's profitability. This greater level of detail is vital for understanding as to how the banks respond to the Basel III regulatory reforms. Both theorists and researchers are quite concerned in understanding these relationships, albeit they may be too complex to model parsimoniously. By offering greater detail on the significance of different sources of capital, the present study also contributes to a growing literature on bank capital structure choices and their impact on lending[5]. Largely, Elliott as well as King's approaches influence the approach of this section of the study. By actual usage of the balance sheet data to compute the regulatory impact, it takes into account the composition of the assets and liabilities as well the very important distinction between the assets and risk weighted assets. Further, it models the cost to meet the NSFR unambiguously, elucidating the sensitivity of this computation to the inputs. This study attempts to compare two steady states, namely, one with and other one without the regulatory requirements. Firstly, we consider the impact of higher capital requirements in isolation, and then the cost to meet the NSFR is computed assuming the higher capital requirements have already been met. Lastly, by considering the potential synergies between the two regulatory enhancements it models the capital and liquidity requirements together.

[5] While Marcus (1983), Froot and Stein (1998), Berger and Bonaccorsi di Patti (2006), Koziol and Lawrenz (2009), and Memmel and Raupach (2010) analysed the bank capital structure choices, Thakor (1996), Gambacorta and Mistrulli (2004), Fabi et al. (2005) and Inderst and Mueller (2008) study the relationship between capital and bank lending.

3.1 The Model

A typical bank's assets consist of cash and central bank balances, interbank claims, trading assets, loans and advances, investments in securities, and other assets (Eqn 1).

$$Asts_{it} = Cas_{it} + IBC_{it} + TA_{it} + LA_{it} + Inv_{it} + OA_{it} \quad \text{.....} \rightarrow (1)$$

Where $Asts_{it}$ represents the assets of the bank 'i' at time't'. Similarly, Cas_{it}, IBC_{it}, TA_{it}, LA_{it}, Inv_{it} and OA_{it} represent cash, inter-bank claims, trading assets, loans and advances, investments and other assets respectively of the bank 'i' at time 't'. Similarly, total liabilities of a bank typically consist of deposits, interbank funding, trading liabilities, wholesale funding (e.g. borrowing), and other liabilities (Eqn 2). Shareholder's equity represents the residual claim of shareholders after deducting the liabilities of creditors from total assets.

$$Liab_{it} = Dep_{it} + IBF_{it} + TL_{it} + BD_{it} + OL_{it} \quad \text{.....} \rightarrow (2)$$

where $Liab_{it}$, Dep_{it}, IBF_{it}, TL_{it}, BD_{it}, OL_{it} represent liabilities, deposits, inter-bank funding[6], trading liabilities, bank debt (also called bank borrowings) and other liabilities respectively of the bank 'i' at time 't'. When we look at a bank's consolidated income statement we find various components that generate net income (Eqn 3). Net income can be explained as the sum of two broad categories of income viz., net interest income, and non-interest income. While the loans and advances, investments and interbank claims generate the interest income, interest expense is due to the interest payable by the bank on its deposits, inter-bank funding, and bank debt (borrowings). Non-interest income can be categorized into trading income and other income. While the trading income is generated by trading assets and liabilities, other income is generated by the fees and commissions levied by the bank. Thus, Net income of the bank equals difference between the total revenues and the operating expenses & taxes.

$$NI_{it} = [(IL_{it} + OII_{it} - IE_{it}) + NII_{it} - OE_{it}] * (1-Tx_{it}) \quad \text{.....} \rightarrow (3)$$

where, NI_{it}, IL_{it}, OII_{it}, IE_{it}, NII_{it}, OE_{it}, and Tx_{it} represent the net income, income loans, other interest income, interest expense, non-interest income, operating expenses and tax rate respectively for the bank 'i' at time 't'. After having specified the components of different assets, their financing, and the income they generate, in the next step we identify the costs of

[6] Indian financial system in recent years is experiencing the ascendance of non-bank financial institutions in the interbank market. The phenomenon that could be explained by direct foreign investments due to interest rate differential with developed countries has possibly altered the lending spread strategies of Indian banks. As such, this methodology has the limitation of not assessing non-banks role in the interbank lending market.

different sources of capital. It is known that bank borrowings include both short-term and longer-term liabilities. Short-term liabilities such as interbank funding, trading liabilities, and debt maturing within one year need to be charged with an interest rate that is normally lower than the interest rate charged on long-term debt. Even though the one-year threshold may appear arbitrary, it is imperative as it is specified in NSFR definition. As such, bank debt (borrowings) is split into a portion of debt maturing within one year (ρ_t) and a remainder of long-term debt (Eqn 4).

$$BD_{it} = BD_{it} * \rho_t + BD_{it} * (1 - \rho_t) \quad \text{.....} \rightarrow (4)$$

Where, BD_{it}, $BD_{it}*\rho_t$ and $BD_{it}*(1- \rho_t)$ represent bank debt (borrowings), short-term bank debt and long-term bank debt respectively for the bank 'i' at time't'. This distinction is imperative in computing the cost to meet the NSFR and cost of a bank's liabilities. As the cost of inter-bank funding, trading liabilities, deposits and bank debt (borrowings) are generally not disclosed in the bank's financial statements these costs are aggregated as interest expense (Eqn 5).

$$IE_{it} = r_{dep} * Dep_{it} + r_{BD \leq 1year} * (IBF_{it} + TL_{it} + BD_{it} * \rho_t) + r_{ltDB} * BD_{it} * (1 - \rho_t) \quad \text{.....} \rightarrow (5)$$

Where r_{dep} represents the cost of deposits, $r_{BD \leq 1year}$ represents the cost of short-term debt of less than or equal to one year and r_{ltDB} represents the cost of long-term debt. Further, it is also required to distinguish the cost of three types of liabilities namely cost of deposits, cost of short-term liabilities (maturing within one year) and cost of long-term liabilities. Using the representative bank's ratio interest expense to interest paying liabilities, we can calculate;

$$r_{dep} = x \quad \text{.....} \rightarrow (6)$$

The cost of deposits is set equal to some value x%. Then, to calculate cost of short-term liabilities it is set as x% + 100 bps.

$$r_{BD \leq 1year} = x + 0.01 \quad \text{.....} \rightarrow (7)$$

Similarly, the cost of long-term liabilities is assumed as x% + 200 bps[7].

$$r_{ltDB} = x + 0.02 \quad \text{.....} \rightarrow (8)$$

[7] There could be an argument that the variables should have to be calibrated with market data. However, in an empirical estimation based on the international/national standards, there is a need to make standard assumptions for the purpose of computation. Therefore, the margins of 100 basis points for cost of short-term liabilities and 200 basis points for cost of long-term liabilities are believed to be rightly adopted.

It is so assumed that 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. Founding on these assumptions, the cost of each type of liabilities is computed using equation 5. The ultimate source of bank funding is the shareholder's equity. The popular 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 (Eqn 9).

$$r_{equity} = ROE = \frac{NI_{it}}{E_{it}} \quad \text{..... 9}$$

Where R_{equity} is the cost of equity and ROE measures the amount of profit earned per unit of shareholder's equity E_{it} of a bank 'i' in a given year't'. Regardless of the fact that this ratio is very volatile, over a long-time horizon it bestows a measure of the return expected by shareholders. Nevertheless, shareholder's equity may consist of various equity-like securities with different features and claims on dividends; we can assume that by and large all equity securities bear the same cost as common equity, which can bias the cost estimates upwards. The expected return on common equity is considered to be the highest across different sources of bank capital, as common equity has the lowest residual claim on the bank's assets. Following this rational and in consistency with theories such as the Modigliani-Miller theorem, the relative costs of different forms of capital in 'normal times' are expected to follow the relationship as detailed in Eqn 10.

$$r_{dep} < r_{BD \leq 1year} < r_{ltDB} < r_{equity} \quad \text{..... 10}$$

Since this relationship may be disregarded for a bank in financial distress; during normal times this correlation ensures that different capital providers receive an expected return commensurate with the risk of their investment. In addition, it is essential to distinguish between regulatory capital ratios and accounting ratios based on a bank's balance sheet. As per the existing banking regulations, the quantity of capital that must be held for regulatory purposes is associated with the risk-weighted assets. As such, the quantity of RWAs used in calculating capital adequacy ratios, however, need not equal the quantity of total assets found on a bank's balance sheet. Accordingly, capital adequacy ratio is defined as qualifying capital (tier 1 capital) divided by RWAs (Eqn 11).

$$CAR = \frac{E_{it}}{RWA_{it}} \quad \text{..... 11}$$

Where RWA_{it} represents the risk weighted assets and E_{it} represents equity of a bank 'i' in a given year't'. We can now attempt to compute the impact of higher capital requirements on lending spreads given the relationships presented in Eqn 1 to 11. However, we need to emphasise that a unit of shareholder's equity is increased as against RWAs in order to meet the targeted capital adequacy ratio. It is assumed that the size and composition of the balance sheet is held constant but the shareholders' equity and total liabilities are altered. A 1-percentage point increase in shareholders' equity against RWA is in general smaller than the total assets (Eqn 12).

$$CAR = E_{it} + \Delta CAR * RWA_{t+1} \quad (12)$$

It is further assumed that increase in shareholder's equity is matched by an equal and offsetting decrease in the amount of liabilities. Since long-term debt being the most expensive form of liabilities, would be the first among the liabilities to be replaced with equity[8]. Accordingly, Eqn (13) follows as below.

$$\Delta BD_{it} = -\Delta E_{it} \quad (13)$$

Now we arrive at a situation where the change in capital structure results in increase in the cost of capital, as the bank's debt is substituted with equity that is more expensive. Therefore, net income should rise, all else equal, since the decline in the quantity of debt outstanding decreases interest expense and increases net income (Eqn 3 & 5). When the net income rises, ROE typically cascades as the relative increase in equity in the denominator is higher than the increase in net income in the numerator (Eqn 9). This correlation holds well when the pre-tax cost of debt is lower than the cost of equity (Eqn 10).

The drop 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 reduce as leverage decreases and the risk of default lessens. Though the theoretical postulations about changing capital structure are explicit, it may not be evident that these theories always hold good in practice. It is empirically found that the historical return earned by investors in bank stocks is much lower than would be forecasted based on the degree of bank leverage. One

[8] Banks will not likely reduce the quantity of deposits, as they represent one of the least expensive forms of liabilities and help meet the NSFR. Likewise, interbank funding and trading liabilities are funded in short-term markets and are less expensive than long-term debt. On the contrary, reducing trading liabilities may result in drop in trading income.

justification for this inconsistency is that banks may be looked at as having an implicit government guarantee, which reduces the risk of default ex ante, thus leading bank shareholders to expect a lower expected return. Likewise, the cost of deposits indicate 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[9].

The primary assumption of this study is that the bank's ROE and cost of long-term debt are unchanged regardless of the reduction in leverage. This logic holds good given the existence of deposit insurance and implicit guarantees that currently underpin the low cost of bank liabilities. On other hand, if a bank's ROE and cost of debt are allowed to decline, the impact on lending spreads gets contracted. We assume that banks respond to the fall in ROE by increasing the lending spread (α) charged on loans. However, this lending spread as a variable cannot be observed directly, as it is not disclosed by banks. We can capture this effect in a model as an increase in the average spread charged on the entire loan portfolio (Eqn 14).

$$IL_{it+1} = IL_{it} + \alpha * LA_{it+1} \qquad (14)$$

The extent of increase in lending spreads is dependent on the increase in net income, which exactly offsets the increase in the cost of capital, allowing ROE to be unaffected at its prior value (Eqn 15).

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

This modeling offers a better measure of the rise in lending spreads needed to offset the fall in ROE coupled with 1 percentage point increase in the capital ratio. It can be stated that as long as long-term debt is substituted by equity and the costs of debt and equity are unaffected, there is a linear relationship between the lending spreads the capital ratio. As cheaper forms of liabilities are replaced with equity that is more expensive; the rise in lending

[9] Empirically, one can recognize an inverse relationship between bank capital ratios and historical ROEs, with bank ROEs lower for more highly capitalized banks. In view of the lack of data on secondary market prices for bank debt, the empirical correlation between bank capital ratios and the cost of wholesale funding is not so clear.

spreads is higher. In general, the estimate of the marginal cost to increase the total capital ratio is not affected by the levels of any variables. For instance, the results are indifferent to the level of tax rates, provided, they are the same before and after the capital change, as taxes will only change the level of net income (Eqn 3). While a lower tax rate will lead to a higher level of net income for a given level of shareholders equity (Eqn 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 results in the same change in lending spreads. Thus, the relationships modeled in equations (1) to (15) enable us to predict how sensitive the results are to different scenarios of assumptions. The results of the analysis are presented after the ensuing section about modeling the mapping of net stable funding ratio (NSFR) to lending spreads.

3.1.1 Modeling the Impact of NSFR to Lending Spreads

Net Stable Funding Ratio is intended to promote higher levels of medium and long-term funding of the assets and activities of banking organizations. As a metric NSFR sets a minimum adequate amount of stable, funding based on the liquidity tendencies of an institution's assets and activities over a one-year horizon. BCBS states that this standard is designed to act as a minimum enforcement mechanism in order to complement the liquidity coverage ratio (LCR) and reinforce other supervisory efforts by promoting structural changes in the liquidity risk profiles of institutions away from short-term funding mismatches and toward more stable, longer-term funding of assets and business activities. Since NSFR involves several variables, computing cost of meeting the NSFR is intricate than the cost to meet higher capital requirements. Further, the complexity is further compounded as the inputs to the NSFR are not disclosed in a bank's financial statements. In this direction, BCBS in its December 2009 consultative document has proposed a definition and a calibration for the NSFR. A simplified version is adopted here (Eqn 16).

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

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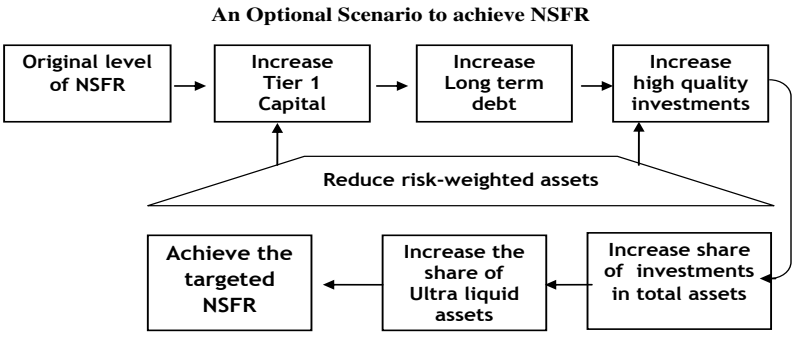
While the numerator quantifies the sources of available stable funding (ASF), the denominator encapsulates required stable funding (RSF), with a factor or haircut applied on the basis of their expected liquidation value under stressed conditions[10]. Higher weights are given to funding sources that are more stable and least likely to wane under stressed conditions. Obviously, to achieve a targeted NSFR, banks ought to have an ASF higher than their RSF, leading to a NSFR of 1 or greater than 1 (or 100% or more than 100% in percentage terms). An optional scenario with other possible options to achieve NSFR is illustrated in Figure 1.

Figure 1: An optional strategy to meet NSFR



Source: Developed by author

Possible options:

(i) Increase term loans particularly to corporates and retails as well

(ii) Reduce the contingent liabilities

(iii) Reduce all other assets

(iv) Issue debt and purchase government bonds

Normally, banks can increase their NSFR by extending the maturity of their funding while reducing the maturity or riskiness of their assets. Assuming that holding higher equity relative to debt improves the NSFR, the analysis presupposes that banks have already met the higher capital requirements. When the banks lengthen the maturity of their bank borrowings beyond one year (Eqn 10), the maturity extension thus caused increases the numerator of the NSFR (Eqn 16) and raises interest expense (Eqn 5) as the cost of long term borrowings (bank debt) is assumed to be higher than cost of short-term bank borrowing (Eqn 10). Thus, higher interest expenses all else equal leads to a fall in net income (Eqn 3) and ROE (Eqn 9).

Subsequently, banks raise the share of higher-rated, liquid bonds in their investment portfolios (increasing their holdings of government bonds and corporate (or covered) bonds

[10] In simple understanding, available stable funding (ASF) includes; equity, long-term debt, long-term liabilities, 85 percent of stable deposits and 70 percent of other deposits. On the other hand, required stable funding (RSF) includes; 5 percent of government debt, 50 percent of corporate loans, 85 percent of retail loans, and 100 percent of other assets.

rated AA or higher). Increase in holdings of higher-rated securities thus shrinks the denominator of the NSFR (Eqn 16), but is linked with a decrease in interest income and net income (Eqn 3). Accordingly, 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 which we can term it as 'θ_t' captures the lower return from holding higher-rated and more liquid bonds (Eqn 17).

$$Inv_{it} = Inv_{it} . \theta_t + Inv_{it} . (1- \theta_t) \quad \text{.....} \rightarrow (17)$$

Banks' capability to raise the NSFR by varying the composition of existing investments is also restricted to some extent by the existing quantity of investments relative to total assets. In case the changes in the composition of the investments are not adequate to meet the NSFR, banks would have to resort to alter the composition of their assets to some extent. In this setting, banks are implicit to increase the size of investments while reducing "Other Assets" (OA_{it}). When Other Assets (which are assumed to earn higher return than government bonds) are reduced interest income decreases (Eqn 18).

$$OII_{it+1} = [OII_{it} + Inv_{it+1} * \Delta (1- \theta_{t+1}) * r_{inv} + \Delta OA_{it} * r_{inv} - \Delta Cash * r_{inv}] \quad \text{.....} \rightarrow (18)$$

Where, r_{inv} is the return on investments of a bank. When we consider the measures taken to meet the NSFR, they tend to reduce the net income (Eqn 3) as well as reduce ROE (Eqn 9). However, the banks obviously do not like to see a fall in their ROE and hence may seek to replace the lost income by raising the loan spreads (Eqn 15). This increase is over and above the earlier increase to meet the higher capital requirements.

A number of synergies co-exist in meeting the increase in capital requirements and meeting the NSFR. One of the significant synergies can take place by increasing the holdings of high quality, liquid investments. This change in a bank's investment[11] (investments include loans and advances also in this part of discussion) portfolio decreases a bank's RWAs and results in lowering of the quantity of equity required to meet a target CAR (Eqn 11 and 12). The lesser is the need of equity the lesser is the impact on the required loan spread. On the other hand, if lesser amount of equity has to be raised, would lead to lesser increase in the

[11] Investments include loans and advances also in this part of discussion

lending spread? Since the banks do not report as to how they calculate their RWAs, the impact of this change can only be captured indirectly based on some assumptions. The first of such assumptions is that high-risk investments in lower-rated corporate bonds bear a higher risk-weight than the government bonds. For instance, government bonds bear a 0% risk weight while lower-rated or unrated corporate securities bear a risk weight of 100% or greater under the Basel II regulations. In such a scenario, RWA gets affected for each unit of corporate securities and loans being sold and replaced with high rated securities and government bonds (θ_t) (Eqn 19).

$$\Delta RWA = (Inv_{it} . \theta_t - Inv_{it+1} * \theta_{t+1}) * RW_{OA} \quad \text{.....} \rightarrow (19)$$

Thus, the synergy between meeting the NSFR, lowering RWAs, and reducing the equity that must be held to meet a target CAR turn out to be more important as the quantity of higher-rated securities held in a bank's investment portfolio increases. The analysis presented below elucidates that the incremental cost of meeting the NSFR decreases as the CAR increases as more equity increases the NSFR (Eqn 16).

3.2. Model motivated from OECD Approach

In this section, we model the impact of new capital regulations under Basel III proposals on bank lending spreads drawing motivation from the OECD approach, wherein it is based on accounting identities applied to stylized banking sector balance sheets. We consider two categories of bank assets for the purpose of the assessment: *(i)* lending assets of the banks (*LA*) that comprise bank's loans and advances to households and non-financial corporations held on banking books, and *(ii)* Investments and Other assets of the banks (*IOA*), which represent a residual category that comprises assets held on trading books, interbank assets, government bonds and other remaining assets. Further, one of the significant assumptions is that a bank can directly affect the pricing of *LA* by adjusting its lending spread. The pricing of *IOA* is mainly market driven and it is therefore assumed that a bank cannot directly affect the pricing of these assets. The balance-sheet identity presented in Eqn (1) postulates that the return on bank assets is equal to bank funding costs, which are determined by the cost of liabilities and the cost of equity.

$$r^{LA}{}_t \text{ x } LA_{it} + r^{IOA}{}_t \text{ x } IOA_{it} = r^{Liab}{}_t \text{x } Liab_{it} + r^{E}{}_t \text{ x } E_{it} \quad \text{.....} \rightarrow (1)$$

Eqn (2) incorporates a one-percentage point increase in bank capital relative to risk-weighted assets. An increase in bank capital will affect bank liability and equity structures and as a consequence, the overall bank funding cost.

$$r^{LA}_{t+1} \times LA_{it} + r^{IOA}_{t} \times IOA_{it} = r^{Liab}_{t} \times \left(Liab_{it} - \frac{RWA_{it}}{100}\right) + \left(r^{E}_{t} \times \frac{RWA_{it}}{100}\right) \quad \text{(2)}$$

To maintain equilibrium for the change in funding cost banks are assumed to adjust their lending spreads, while their costs of equity and debt financing are assumed to remain constant (Eqn 3).

$$\left(r^{LA}_{t+1} - r^{LA}_{t}\right) = \left(r^{E}_{t} - r^{Liab}_{t}\right) / LA_{it} \times \frac{RWA_{it}}{100} \quad \text{(3)}$$

Combining equations (1) and (2) leads to Equation (3), which shows the increase in bank lending spreads as a result of a one-percentage point increase in the ratio of bank capital to risk-weighted assets. Where, LA_{it} represents the percentage of *loans and advances to total assets,* IOA_{it} - the percentage of *investments and other assets to total assets,* $Liab_{it}$ - the percentage of *liabilities to total assets,* E_{it} - the percentage of *common equity to total assets,* RWA_{it} - the percentage of *risk-weighted assets to total assets,* r^{LA}_{t} - the percentage or *return on advances,* r^{IOA}_{t} - the percentage of *return on investments and other assets,* r^{Liab}_{t} - the percentage of *cost of borrowing,* and r^{E}_{t} represents the percentage of *cost of equity.*

4. Data Description

A more popular definition for the lending spread is that it is the difference between the interest rate charged on loans and the rate paid on deposits (Repullo and Suarez, 2004). Goodfriend and McCallum (2007) determine the lending spread as the difference between the uncollateralized lending rate and the interbank rate. Further, the rate charged by banks on loans varies on several factors like; terms of the loan, the characteristics of the borrower, the collateral provided and other costs associated with the loan. For constructing a representative bank's financial statements, the stylized balance sheet and income statement data for SCBs in India is collected from Capitaline Plus database[12], respective websites of the banks under study, RBI database, and Basel II Pillar III disclosures of respective banks from their

[12] Capitaline Plus provides fundamental and market data on more than 20,000 Indian listed and unlisted companies, classified under more than 300 industries, along with powerful analytic tools. Extensive data and analysis on every company profile, directors, 10-year financials (P&L, balance sheet, cash flow, consolidated financial data, segment data, forex data, R&D data, ratios, etc), quarterly results, ownership pattern, finished products, raw materials, share price data, directors' report, management discussion, notes to account, business news, corporate events, etc. www.capitaline.com

websites. The data employed for analysis is for the period from 2002 to 2011 as the Capitaline Plus database provides complete datasets only for a ten-year period (Table 1).

Table 1: Sample distribution by category of SCBs

Year	Public Sector Banks	Private Sector Banks	SCBs
2002	30	87	117
2003	30	94	124
2004	30	93	123
2005	30	97	127
2006	30	88	118
2007	30	86	116
2008	30	83	113
2009	29	69	98
2010	29	87	116
2011	28	85	113

Source: Compiled by the author

IDBI Bank Ltd. in spite of its dual nature it is also included amongst the public sector banks. Public sector banks category also includes the State Bank of India and its associate banks. Private Banks also include the foreign banks operating in India. SCBs include both the public and private banks.

This study employs the consolidated entity wherever available, taking the last filing in a calendar year. Table 1 provides the details of banks by category and year. The number of banks varies by year due to the merger, closure, or entry of a new foreign bank in the year. Capitaline Plus database does not report RWAs directly in its datasets. Instead the quantity of RWAs is collected from the more authenticate source; i.e the Basel II Pillar III disclosures of respective banks from their websites. Since the Capitaline Plus database presents the data for category of banks, there was no problem of the outliers and the requirement of winsorization of capital adequacy ratios to reduce the impact of outliers. Based on the data described, a representative bank balance sheet and income statement is constructed for each category of banks by taking the weighted average values for each component of the balance sheet and the income statement for banks in each category of study. The weights are based on total assets of the category of the banks[13]. Table 2 shows the stylized balance sheet and income statement for the representative bank of SCBs and all components are shown as a percentage of total assets.

[13] All variables are standardized by dividing by bank's total assets in each year

Table 2: Stylized balance sheet and income statement of SCBs

Balance Sheet	Average	Income Statement	Average
Cash & Balances with RBI	5.59	Interest Income	6.21
Interbank claims	4.09	Interest expended	3.97
Investments & securities	31.48	A. Net Interest Income	2.24
Loans & Advances	53.23	B. Other Income	1.28
Fixed Assets	0.99	C. Total Revenues (A+B)	3.52
Other Assets	4.63	D. Personnel Expenses	0.95
TOTAL ASSETS	100.00	E. Other admin expenses	1.37
Deposits by Customers(retail and corporate)	75.65	F. Operating Expenses (D+E)	2.32
Inter-bank funding (borrowing)	9.16	G. Operating Profit (C-F)	1.20
Other Liabilities & Provisions	8.06	H. Tax Provision	0.36
TOTAL LIABILITIES	92.88	I. Net Income (G-H)	0.84
Capital	1.05		
Reserves Total	6.06		
Equity Share Warrants	0.00		
Equity Application Money	0.00	Return on Equity (ROE) (%)	0.15
Total CAPITAL	7.12	Leverage Multiple	6.60
TOTAL LIABILITIES & CAPITAL	100.00		
Risk Weighted Assets / Total Assets	65.77	Average Effective Tax Rate	33.00%

Loans & advances represent about more than half of the typical bank's assets, followed by investments & securities (31.48%), cash and balances with RBI (5.59%), other assets (4.63%) and interbank claims (4.09%). These assets are funded mainly by deposits (75.65%), bank borrowings or interbank funding (9.6%). Shareholder's equity is to the extent of 7.12%. RWAs constitute around 65.77% total assets on average. This ratio is significant when calculating the cost of meeting the higher capital requirement. Table 2 also shows the consolidated income statement for the representative bank. In terms of the composition of net income, net interest income is 2.24% with non-interest income also important at 1.28%. Total operating expenses constitute 2.32% of total assets. Personnel expenses represent around 41% of total operating expenses. Net income (or ROA) is 0.8%, implying that the average ROE is around 15%. The average historical corporate tax rate is accepted at 33%.

5. Results and Discussion

The study presupposes that the ROE and cost of debt do not change with lower leverage. We also assume that banks pass on any additional costs to lending spreads, and do not adjust other sources of income or operating expenses. For each category, the impact on lending spreads is calculated (i) assuming no change in RWA, and (ii) allowing RWA to decline as steps are taken to meet the NSFR (namely holding more government bonds relative to other investments). Within each scenario, the costs are calculated for incremental increases in capital ratios of 1 percentage point. These costs are linear in the increase in capital ratios.

Some of the important assumptions that have been considered in this section of the study are detailed below:

(i) A representative bank balance sheet and income statement for each category of banks under study is for the years from 2002 to 2011. Equations (1) to (4) as explained in the methodology part represent the standard accounting relationships. The cost of equity is assumed as the average ROE for each category (Eqn 5). Equity is believed to be the most expensive form of capital. Debt is considered as less expensive due to its higher claim on a bank's assets and its tax advantage. A Corporate tax rate of 33% is made use of in this analysis.

(ii) The costs of deposits, short-term and long-term wholesale debt are standardized to match the historical ratio of interest expense to total assets. If the cost of deposits is equal to some value of x%, the cost of short-term debt is assumed to be x% + 100 bps and the cost of long-term debt is assumed as x% + 200 bps (Eqn 6 to 8). These spreads are consistent with historical averages across the categories in this sample, and generate an upward-sloping yield curve. The share of short-term debt (less than one year in maturity) (rho) is considered as 25% (Eqn 10). Interest expense is then computed as per Eqn (11).

(iii) Interest income is generated by interbank claims, loans and investments. Trading income is generated by trading assets minus trading liabilities. A portion of investments (θ *theta*) is invested in government bonds that return a risk-free rate of interest, while the remaining investments are made in higher-yielding securities. The risk premium on these higher-yielding investments is the difference between the return on investments and the risk-free rate (Eqn 9).

(iv) The quantity of TCE/RWA is gradually increased in the analysis by increment of 1 percentage point to meet specific target of RWA (Eqn 14). While the size and composition of the balance sheet is held constant, the relative share financed by equity and debt changes. An increase of TCE/RWA of 1 percentage point generates a smaller rise in equity as RWA are typically only 50% of total assets (Eqn 15). This increase in the quantity of equity is matched by a decrease in the quantity of debt (Eqn 16). As the most expensive form of debt, long-term debt is the first to be replaced with equity.

(v) The change in capital structure results in increase in the bank's cost of capital, as tax-advantaged debt is substituted with more expensive equity. A higher amount of equity for a set level of net income leads to a fall in ROE (Eqn 5). Simultaneously, part of

this fall in ROE is offset by the decrease in interest expense due to the decrease in amount of debt outstanding (Eqn 11 and 16).

(vi) In theory, the cost of equity and debt should both decline as leverage decreases and the risk of default decreases. The estimates in this analysis therefore are conservative, as a fall in either of these costs would reduce the impact on loan spreads. Banks respond to the fall in ROE by raising the spreads charged on loans (α alpha, Eqn 17). The size of the increase in loan spreads is determined such that the increase in net income offsets the rise in the cost of capital, allowing ROE to be unchanged (Eqn 18).

The experiment assumes that the TCE/RWA ratio is raised by increasing equity and reducing long-term debt correspondingly. Especially, it is assumed that (i) any higher cost of funding associated with this change is *fully recovered completely* by raising loan rates – 100% pass through; and (ii) that the costs of equity and of debt are *not* affected by the lower riskiness of the bank. The results are obviously sensitive to a host of the assumptions in the analysis. The rise in lending spreads associated with a 1-percentage point increase in the capital ratio could be avoided by reducing operating expenses too. Certainly, there are enough reasons to believe that the cost of capital would *decline* in response to a reduction in bank leverage. As capital levels raise and the bank turns out to be safer, both of these costs tend to decline by further decreasing the impact on lending spreads. Moreover, the modification in the cost of capital may perhaps reduce to tax effects (Modigliani and Miller, 1958). However, such a scenario has not been studied in arriving at the estimates presented in the Table 3. After having outlined the methodology and data employed for the computation of the stylized bank balance sheet and the income statement, this section provides the results of the estimations of the potential impact of raising the capital ratio on lending spreads.

Table 3: Impact on lending spreads (in bps) for SCBs

Increase in capital ratio (percentage points)	Cost to meet capital (A)	Cost to meet NFSR (B)	A+B	Cost to meet capital (C)	Cost to meet NFSR (D)	C+D
	Assuming RWAs unchanged			Assuming for decline in RWAs		
0	0.00	18	18.00	0	13	13
+1	11.40	20	31.40	8	14	22
+2	22.80	22	45.20	15	16	31
+3	34.20	25	59.00	23	18	41
+4	45.60	27	72.80	30	20	50
+5	57.00	30	86.60	38	21	59
+6	68.40	32	100.40	46	23	68

Source: Author's calculations

A one-percentage point increase in the ratio of capital to risk-weighted assets will push up bank lending spreads by 31 bps given that RWAs are unchanged (Table 3). However, the bank lending spread declines to 22 bps when the RWAs are assumed to decline by 20 percentage points. Similarly, for a 2-percentage point increase, bank-lending spread would rise by 45 bps when RWAs are unchanged and would increase by 31 bps when RWAs are assumed to decrease by 20 percentage points. For a 3-percentage point increase in CAR, bank-lending spread would rise by 59 bps given that RWAs are believed to be unchanged and 41 bps when RWAs are decreased by 20 percentage points. On the same lines, it was observed that for an increase of 4, 5 and 6-percentage points in ratio of capital to risk-weighted assets, the bank-lending spread would increase by 73 bps, 87 bps and 100 bps given that RWAs are unchanged and would rise by 50 bps, 59 bps and 68 bps when RWAs are assumed to decrease by 20 percentage points.

Elliot (2009, 2012) in his studies on the effect of tightening capital requirements on banks' lending spreads in the United States, using a method close to the one presented in this section, suggests that these effects are small, especially if banks are able to offset any increase in their funding costs by other means (e.g., a reduction in their return on equity (from 15% to 14%), in the remuneration of deposits and administrative costs). Further, Elliott observes that without these offsets, lending rates would rise by about 80 bps in the long run in response to a 4-percentage point increase in the ratio of equity over unweighted assets and lending rates would only increase by 20 bps with the adjustments. Assuming that banks provide only part of the credit in the economy, Elliott concludes that this 20 bps increase would translate into an overall increase in lending costs of 5 or 10 bps. Kashyap *et al.,* (2010) have observed that the long-run costs of increasing capital requirements are likely to be small and state that, as a first approximation, the Modigliani-Miller theorem seems to describe fairly well the empirical relationship between banks' return on equity and their leverage. Higher capital ratios, as such, should significantly lower banks' per-unit cost of capital. Using data for the US, they estimate that a 4 percentage point raise in the capital to unweighted assets would result in the long run, to a 10 bps increase in banks' funding costs if tax effects are the only departure from Modigliani-Miller and rise only to up to 18 bps if further possible departures are considered.

Table 4: Impact on interest income (in percentage points) for SCBs

Increase in capital ratio (percentage points)	Increase in Income on loans due to increase in capital (A)	Increase in Income on loans due to increase in capital in order to meet NSFR (B)	A+B	Increase in Income on loans due to increase in capital (C)	Increase in Income on loans due to increase in capital in order to meet NSFR (D)	C+D
	Assuming RWAs unchanged			Assuming for decline in RWAs		
0	0.00	0	0.00	0	0	0
+1	15.77	1.64	17.41	13.34	1.14	14.47
+2	23.06	3.18	26.24	18.20	2.16	20.36
+3	30.35	7.29	37.64	23.06	3.18	26.24
+4	37.64	6.25	43.89	27.92	4.20	32.12
+5	44.93	7.78	52.70	32.78	5.22	38.00
+6	52.22	9.30	61.52	37.64	6.24	43.88

Source: Author's calculations

This study also estimated the impact of increases in capital and liquidity standards on the interest income for SCBs in India. The results of the estimations are presented in Table 4. Assuming that RWAs are unchanged, for 1-percentage point increase in capital ratio, interest income would raise by 17 percentage points. Similarly, for 2, 3, 4, 5 and 6-percentage point increase in capital ratio given that RWAs are unchanged, interest income would increase by 26, 37, 44, 53 and 62 percentage points. When RWAs are assumed to be decreased by 20 percentage points, for 1, 2, 3, 4, 5 and 6-percentage point increase in capital ratio, interest income would increase by 14, 20, 26, 32, 38 and 44 percentage points. We present in Table 4A, the results of the estimation for impact of increase in capital ratio on lending spreads for SCBs. A one-percentage point increase in the ratio of capital to risk-weighted assets will push up bank lending spreads by 15.63 bps on average given that RWAs are unchanged. However, the bank lending spread declines to 15.01 bps when RWAs are assumed to decline by 20% and rise to 21.22 bps when RWAs are assumed to increase by 20%.

Table 4A: Impact on lending spreads (in bps) for SCBs - OECD Approach

Increase in capital ratio (percentage point)	Cost to meet capital change in lending spread (bps) [assuming RWAs unchanged]	Cost to meet capital change in lending spread (bps) [assuming decline in RWAs]	Cost to meet capital change in lending spread (bps) [assuming increase in RWAs]
1	15.63	15.01	21.22
2	31.26	30.02	42.44
3	46.89	45.03	63.66
4	62.52	60.04	84.88
5	78.15	75.05	106.10
6	93.78	90.06	127.32

Source: Author's calculations

The estimated sensitivities (for scenarios like; RWAs unchanged, Increase in RWAs and Decrease in RWAs) of bank lending spreads to a one percentage point increase in capital requirements for scheduled commercial banks are presented in Table 4B.

Table 4B: Increase in bank lending spreads for one percentage point increase in bank capital for SCBs - OECD approach

$(r^{E}_{t} - r^{Liab}_{t})$ (basis points)	*LA* (percentages)	RWAs (percentages)	$(r^{LA}_{t+1} - r^{LA}_{t})$ (basis points)
12.65	53.22	65.77	15.63
12.65	53.22	78.92	21.22
12.65	53.22	52.61	15.01

Source: Author's calculations

We now present the estimations of the impact on lending spreads for public sector banks in Table 5.

Table 5: Impact on lending spreads (in bps) for public sector banks

Increase in capital ratio (percentage points)	Cost to meet capital (A)	Cost to meet NFSR (B)	A+B	Cost to meet capital (C)	Cost to meet NFSR (D)	C+D
	Assuming RWAs unchanged			Assuming for decline in RWAs		
0	0	16	16	0	12	12
+1	14	15	29	10	10	20
+2	24	11	35	17	12	29
+3	35	19	54	24	13	37
+4	45	22	67	31	14	46
+5	55	24	79	38	16	54
+6	66	26	92	45	17	62

Source: Author's calculations

A one-percentage point increase in the ratio of capital to risk-weighted assets will push up bank lending spreads by 29 bps given that RWAs are unchanged (Table 5). However, the bank lending spread declines to 20 bps when the RWAs are assumed to decline by 20 percentage points. Similarly, for a 2-percentage point increase, bank-lending spread would rise by 35 bps when RWAs are unchanged and would increase by 29 bps when RWAs are assumed to decrease by 20 percentage points. For a 3-percentage point increase in CAR, bank-lending spread would rise by 54 bps given that RWAs are believed to be unchanged and 37 bps when RWAs are decreased by 20 percentage points. On the same lines, for an increase of 4, 5 and 6-percentage points in ratio of capital to risk-weighted assets, the bank-lending spread would increase by 67 bps, 79 bps and 92 bps given that RWAs are unchanged and would rise by 46 bps, 54 bps and 62 bps when RWAs are assumed to decrease by 20 percentage points.

Table 5A: Impact on lending spreads (in bps) for public sector banks - OECD approach

Increase in capital ratio (percentage point)	Cost to meet capital change in lending spread (basis points) [assuming RWAs unchanged]	Cost to meet capital change in lending spread (basis points) [assuming decline in RWAs]	Cost to meet capital change in lending spread (basis points) [assuming increase in RWAs]
1	12.48	9.99	14.98
2	24.96	19.98	29.96
3	37.44	29.97	44.94
4	49.92	39.96	59.92
5	62.4	49.95	74.90
6	74.88	59.94	89.88

Source: Author's calculations

For public sector banks, a one-percentage point increase in the ratio of capital to risk-weighted assets will increase the lending spread by 12.48 bps on average given that RWAs are unchanged (Table 5A). However, the bank lending spread declines to approximately 10 bps when RWAs are assumed to decline by 20% and rise to 14.98 bps when RWAs are assumed to increase by 20%. We present in Table 5B, the estimated sensitivities (for scenarios like; RWAs unchanged, increase in RWAs and decrease in RWAs) of bank lending spreads to a one percentage point increase in capital requirements for public sector banks.

Table 5B: Increase in bank lending spreads for one percentage point increase in bank capital for PSBs - OECD approach

$(r^{E}_{t} - r^{Liab}_{t})$ (basis points)	LA (percentages)	RWAs (percentages)	$(r^{LA}_{t+1} - r^{LA}_{t})$ (basis points)
12.65	54.73	52.54	12.48
12.65	54.73	63.04	14.98
12.65	54.73	42.03	9.99

Source: Author's calculations

Table 6: Impact on interest income (in percentage points) of public sector banks

Increase in Capital Ratio (percentage points)	Increase in Income on loans due to increase in capital (A)	Increase in Income on loans due to increase in capital in order to meet NSFR (B)	A+B	Increase in Income on loans due to increase in capital (C)	Increase in Income on loans due to increase in capital in order to meet NSFR (D)	C+D
	Assuming RWAs unchanged			Assuming for decline in RWAs		
+1	15.63	1.55	17.18	13.35	1.07	14.42
+2	22.48	2.99	25.47	17.92	2.03	19.94
+3	29.33	4.43	33.76	22.48	2.99	25.47
+4	36.18	5.86	42.05	27.05	3.94	30.99
+5	43.03	7.30	50.33	31.62	4.90	36.52
+6	49.88	8.74	58.62	36.18	5.86	42.05

Source: Author's calculations

The results of the estimations of the impact of increases in capital and liquidity requirements on interest income (in percentage points) for public sector banks are presented in Table 6. Assuming that RWAs are unchanged, it is observed that for 1-percentage point increase in capital ratio, interest income would raise by 17 percentage points. Similarly, for 2, 3, 4, 5 and 6-percentage point increase in capital ratio given that RWAs are unchanged, interest income would increase by 25, 34, 42, 50 and 58 percentage points. When RWAs are assumed to be decreased by 20 percentage points, for 1, 2, 3, 4, 5 and 6-percentage point increase in capital ratio, interest income would increase by 14, 20, 25, 31, 37 and 42 percentage points.

We now present the estimations of the impact on lending spreads of private sector banks in Table 7 and Table 7A and 7B.

Table 7: Impact on lending spreads (in bps) for private sector banks

Increase in Capital Ratio (percentage points)	cost to meet capital (A)	cost to meet NFSR (B)	A+B	cost to meet capital (C)	cost to meet NFSR (D)	C+D
	Assuming RWAs unchanged			Assuming for decline in RWAs		
0	0	13	13	0	5	5
+1	11	18	29	9	12	21
+2	16	24	40	12	18	30
+3	21	30	50	16	24	40
+4	25	36	61	19	30	49
+5	30	42	72	22	36	58
+6	35	48	83	25	42	67

Source: Author's calculations

A one-percentage point increase in the ratio of capital to risk-weighted assets will push up bank lending spreads by 29 bps given that RWAs are unchanged (Table 7). However, the bank lending spread declines to 21 bps when the RWAs are assumed to decline by 20 percentage points. Similarly, for a 2-percentage point increase, bank-lending spread would rise by 40 bps when RWAs are unchanged and would increase by 30 bps when RWAs are assumed to decrease by 20 percentage points. For a 3-percentage point increase in CAR, bank-lending spread would rise by 54 bps given that RWAs are believed to be unchanged and 37 bps when RWAs are decreased by 20 percentage points. On the same lines, for an increase of 4, 5 and 6-percentage points in ratio of capital to risk-weighted assets, the bank-lending spread would increase by 61 bps, 72 bps and 83 bps given that RWAs are unchanged and would rise by 49 bps, 58 bps and 67 bps when RWAs are assumed to decrease by 20 percentage points.

Estimations under OECD approach for private banks, a one-percentage point increase in the ratio of capital to risk-weighted assets will raise the lending spread by 22.48 bps on average given that RWAs are unchanged. However, the bank lending spread declines to approximately 17.98 bps when RWAs are assumed to decline by 20% and rise to 26.98 bps when RWAs are assumed to increase by 20% (Table 7A).

Table 7A: Impact on lending spreads (in bps) for private sector banks - OECD approach

Increase in capital ratio (percentage point)	Cost to meet capital change in lending spread (basis points) [assuming RWAs unchanged]	Cost to meet capital change in lending spread (basis points) [assuming decline in RWAs]	Cost to meet capital change in lending spread (basis points) [assuming increase in RWAs]
1	22.48	17.98	26.98
2	44.96	35.96	53.96
3	67.44	53.94	80.94
4	89.92	71.92	107.92
5	112.40	89.9	134.90
6	134.88	107.88	161.88

Source: Author's calculations

The estimated sensitivities (for scenarios like; RWAs unchanged, increase in RWAs and decrease in RWAs) of bank lending spreads to a one percentage point increase in capital requirements for private sector banks are presented in Table 7B.

Table 7B: Increase in bank lending spreads for one percentage point increase in bank capital for private sector banks - OECD approach

$(r^{E}_{t} - r^{Liab}_{t})$ (basis points)	LA (percentages)	RWAs (percentages)	$(r^{LA}_{t+1} - r^{LA}_{t})$ (basis points)
11.59	49.53	96.09	22.48
11.59	49.53	115.38	26.98
11.59	49.53	76.87	17.98

Source: Author's calculations

Table 8: Impact on Interest Income (in percentage points) of private sector banks

Increase in Capital Ratio (percentage points)	Increase in Income on loans due to increase in capital (A)	Increase in Income on loans due to increase in capital in order to meet NSFR (B)	A+B	Increase in Income on loans due to increase in capital (C)	Increase in Income on loans due to increase in capital in order to meet NSFR (D)	C+D
	Assuming RWAs unchanged			Assuming for decline in RWAs		
+1	13.08	1	14	12.12	0.65	12.77
+2	15.97	1	17	14.04	1.06	15.10
+3	18.86	2	21	15.97	1.46	17.43
+4	21.75	3	24	17.89	1.87	19.76
+5	24.63	3	28	19.82	2.27	22.09
+6	27.52	4	31	21.75	2.68	24.42

Source: Author's calculations

The results of the estimations of the impact of increases in capital and liquidity requirements on Interest Income (in percentage points) for public sector banks are presented in Table 8. Assuming that RWAs are unchanged, it is observed that for 1-percentage point increase in capital ratio, interest income would raise by 14 percentage points. Similarly, for 2, 3, 4, 5 and 6-percentage point increase in capital ratio given that RWAs are unchanged, interest income would increase by 17, 21, 24, 28 and 31 percentage points. When RWAs are assumed to be decreased by 20 percentage points, for 1, 2, 3, 4, 5 and 6-percentage point increase in capital ratio, interest income would increase by 13, 15, 17, 20, 22 and 24 percentage points.

6. Conclusion

In this study, we have modelled the impact of new capital regulations under Basel III proposals on the profitability of banks. We estimate that one-percentage point increase in the ratio of capital to risk-weighted assets will push up bank lending spreads by 31 basis points (bps) given that RWAs are unchanged. However, the bank lending spread declines to 22 bps when the RWAs are assumed to decline by 20 percentage points.

On a comparison of increase in bank lending spreads for a one-percentage point increase in capital ratio of bank groups, it is observed that private banks experience significant lending spread when compared other categories of banks. Further, the results of this study are comparable to other contemporary international studies. On a comparison of the estimates for USA, Euro region, Japan and India, the sensitivity is found to be comparatively greater in the United States (mainly due to a higher return on equity and a higher share of risk-weighted assets in bank balance sheets) and lower in Japan (mostly due to a lower return on equity and a higher share of lending assets in bank balance sheets)

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