Quantifying Basel III's time varying capital requirements and their impact on macro and financial variables over business and financial cycles

Saurabh Ghosh[1]

Macro Research

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[1] Department of Economic and Policy Research, Reserve Bank of India, Fort, Mumbai 400 001 [saurabhghosh@ rbi.org.in]. The views expressed and the approach pursued in the paper are strictly personal.

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Saurabh Ghosh
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Executive Summary:

1. *The collapse of Lehman Brothers in September 2008, and the ushering of the global financial crisis brought to the fore several regulatory gaps that could have long lasting financial, real and spillover effects. At the heart of the banking crisis was the pro-cyclicality of risk based banking regulations, which led to a credit boom and then its bust. The ill-effects of the financial downturn and its impact on the business cycle affected economics across Pacific and the Atlantic, causing massive economic disruptions.*
2. *With the quantum of loses mounting to an all-time high, multilateral bodies like G-20, IMF, BIS and FSB initiated several policy actions aimed at bridging gaps in the banking policy domain. Some of the major initiatives in this regard aimed at improving the quality and quantity of banking capital and introducing elements of countercyclicality in banking operations.*
3. *Since its inception in 1974 the Basel Committee has strived for stability in the banking system and it has made major changes, including risk based capital requirements in Basel II published in 2004. GFC and a plethora of academic and policy debates following this made BCBS to rethink banking regulations. A new set of regulations were initiated in a discussion paper and there final versions were published as Basel III in 2010. The capital and liquidity reforms called for higher banking capital holdings in the form of Tier-I capital, the most subordinate claim being in the case of bankruptcy. The liquidity ratios included LCR for short-term stressed market liquidity demand and NSFR for long-term asset liability matching. It also included two buffers, the conservation buffer and the countercyclical capital buffer to make credit smooth and banking countercyclical.*

4. *While the debate surrounding the adequacy a 4.5 per cent risk weighted capital as Tier-I is yet to be settled, some more controversial issues have surfaced in the academia and policy domain. One of these is related to the cost of increased capital and liquidity requirements in terms of credit deceleration and output sacrifice for more resilient banking systems and financial stability. This is especially so at this juncture when some economies are showing signs of recovery and some of the emerging markets that were considered as engine of growth are signalling tapering in output growth.*

5. *A quick review of theoretical and empirical literature in this context suggests that in a frictionless MM-world the liability side of a bank's balance sheet should not affect its asset side. However, with tax transactions and agency cost financial markets are far from frictional less and therefore subsequent literature has also documented the importance of bank size, capital and liquidity in deciphering monetary policy, deposit or other financial shocks. A bank attempting to raise capital could do so by retained earnings, raising capital from the market, a stake sale by majority holders or by infusion of capital from owners. The capital adequacy ratio, on the other hand, can be improved either by increasing capital or by changing the risk profile of the bank's asset side so that the risk weighted assets (denominator of the ratio) of the bank decline.*

6. *There is ample evidence in literature that banks attempting to raise capital generally witness an increase in their lending spreads to cover the costs of additional capital. If raising capital is costly because of asymmetric information and debt overhang problems, especially during a downturn, a bank may choose to ration lending, especially to risky ventures, to match the target capital adequacy. In a bank finance dominated economy, this in*

turn affects output and gives rise to a trade-off - the cost of macro-prudential policies vis-a-vis its benefit in terms of avoiding output loss due to a crisis.

7. *With the emphasis on the quantity and quality of bank capital in the Basel III accord, a debate has erupted on the quantum of output sacrifices for achieving financial stability and their short-run and long-run characteristics. Several multilateral organizations, think tanks and industry representatives have estimated the magnitude of the trade-off. To refer to a few, BIS's Macroeconomic Assessment Group estimated the impact of Basel III implementation on GDP to be relatively small and short lived, whereas the Institute of International Finance estimated much higher costs (in terms of decline in GDP) for implementing Basel III. While the estimated models and their assumptions differ, the trade-off depends on the timing and initial conditions (for example, the level of capitalization of banks or present interest rate cycles) in the underlying economy.*

8. *The Basel III measures of strengthening capital in the banking system were endorsed by the G-20 Banking Summit in November 2010. The Regulatory Consistency Assessment Programme (RCAP) indicates that while some countries have already completed implementing capital regulations other have made progress depending on their stages of development. There are four Asian emerging market economies (China, India, Indonesia and South Korea) that are G-20 signatories and will be implementing Basel III by 2019. Our analysis with the real GDP growth rate and capital adequacy ratio indicates a negative relationship between the two for China, Indonesia and South Korea. A dynamic panel regression also supports a negative relationship between banking capital adequacy and GDP growth for these countries. It may be mentioned here that most of these*

countries have policy rates higher than near zero rates in advanced economics, and therefore an increase in capital could have a larger impact on GDP growths as compared with those estimated by the MAG (BIS) study or by the IMF study, even after allowing for global spillovers.

9. *In India, the banking system plays a dominant role as a source of finance to the private sector. India has started implementing Basel III recommendations. The RCAP assessment in 2015 found India to be compliant with all 14 components of the Basel framework. Indian banks are presently adequately capitalized with significant portions of Tier-1 capital being contributed by common equity (CET1). However, to meet all Basel III requirements by 2019, it is estimated that the Indian banking sector will require huge capital infusions.*

10. *With the Reserve Bank and the Government of India attempting policy measures for a smooth transition to the Basel III capital framework, we made an attempt to estimate the impact of such large capital infusions on changes in lending spreads, banks' credit off-takes and risk taking and their consequent impact on GDP growth using historic data from 1996 to 2015 (quarterly) from different publicly available sources.*

11. *A correlation between banks' capital and lending rates generally indicates that banks' lending rates increase with a growth in bank capital. A stronger result holds between a bank's lending spread (lending rate minus call rate) and growth in bank capital. In a multivariate framework, the bank lending spread is found to be positively and significantly related to changes in the capital adequacy ratio (CRAR) after controlling for growth cycle, inflation, change in non-performing assets (NPAs) and a crisis period. GDP growth (and also output gap) has a positive (significant) coefficient indicating an increase in the spread*

during an economic boom, while changes in GNPA have a negative coefficient indicating decline in the spread with an increase in bad assets in the banking sector. Among the bank groups, changes in public sector banks' (PSBs) CRAR have the maximum and most significant impact on spreads, which is expected, as public sector banks dominate the Indian banking arena.

12. *Correlation results indicate that there are positive and significant correlations between an increase in banks' capital and deposit mobilization by the banks. There has been considerable debate on the negative relation between an increase in the banking sector's capital and credit growth. We attempted to evaluate the relationship between bank capital and credit growth after controlling for demand side factors affecting credit. Our findings suggest that during the sample period there existed a negative relationship between an increase in CRAR and credit off-take. This relationship held after controlling for an output-gap, stock index returns, lending rate and persistence in the credit off-take (AR(1)) coefficient. The output gap had a positive coefficient indicating a pro-cyclical increase in credit off-take, while the lending rate reported a negative coefficient. These results hold for year-on-year (y-o-y) as well as quarter-on-quarter (q-o-q) variations. However, some of these lagged changes in CRAR coefficients were weekly statistically significant.*

13. *There is debate surrounding the factors that influence a bank's risk taking, with a school of thought claiming that a bank's investments in risky assets declines with an increase in capital. In this study we took banks' investments in Gsecs with zero risk weight and banks' investments in housing loans, with risk weights depending on the loan size. Our analysis indicate that as capital requirements increase the contemporaneous (correlation)*

relationship shows an increase in banks' investments in Gsecs and a decline in their investments in housing. This indicates that higher capital requirements reduce banks' investments in risky segments.

14. *In a multivariate analysis, we controlled for other demand side factors (GDP growth, interest rate, stock returns and change in SLR) and attempted to evaluate the impact of changes in CRAR (and its lags) on the growth rates of housing credit and Gsec investments. Empirical results support our earlier findings and indicate that with an increase in banks' capital requirements they park their funds in safer investments (Gsecs). Stock returns had a positive and statistically significant coefficient for an increase in a bank's investments in housing while the coefficient was negative and significant for bank's investments in Gsecs, indicating banks' risk taking behaviour during an upturn in the financial cycle and/or market perceptions.*

15. *The relationship between bank capital and output is unlikely to be contemporaneous. This is also supported by our correlation results using different measures of output (quarterly GDP growth, IIP growth and core IIP growth and their components). These suggest the absence of contemporaneous relationship between an increase in the banking sector's capital and output growth.*

16. *To evaluate the impact of a shock to bank capital on major macro-variables, we followed existing literature and estimated an endogenous set of equations in a Vector Auto-regression framework suggested by Sims. To address the a-theoretic nature of this model, taking cue from theoretical literature and ordered these variables. We then evaluated the effect of a structural shock to a change in a bank's capital adequacy ratio on other macro-variables by analysing impulse response functions, accumulated impulse response functions and variance decompositions. To test*

the robustness of our results we used: a) generalized impulse responses which are indifferent to the ordering of the variables, as established by Pesaran, and b) a different set of variables (proxy) for output growth and/or gap. Since we used quarterly data and there is evidence of seasonality, growth rates in the macro-variables were adjusted for seasonal fluctuations.

17. *We started with the momentum measure, that is, q-o-q changes in four variables namely CRAR, bank lending spread, bank credit growth (SA) and the q-o-q growth rate of GDP. The results indicated weak evidence of increase in spread, decline of bank credit growth and decline in quarterly GDP growth. These results were consistent when generalized impulse responses were generated. The variance decomposition of q-o-q growth indicates that a small portion of the variation in quarterly GDP growth was explained by a change in CRAR, while change in the lending spread explained much more variations.*

18. *Using the same VAR framework after replacing q-o-q variations by annual variation (y-o-y) we got a statistically significant result of increase in lending spread and decline in GDP due to a shock to CRAR changes, which is robust to changes in variable ordering. However, it may be mentioned here that the magnitude of such an effect was small which reverted to the baseline within a short period. A shock to a bank's lending spread had a similar effect on output decline. These findings are in line with BIS's findings on the impact on GDP. Most of the literature surveyed in this field also claims that the new banking regulations could have a cost in terms of sacrificing GDP in the short-run. However, such cost is likely to be short lived and small compared to the output loss in case of a financial crisis.*

19. *In 2014, the Central Statistical Organization (CSO) released a new series for real output, the gross value added at basic prices*

(GVABP) which incorporates several welcoming features. In view of having an estimate with the new series, we spliced the series appropriately and got a series for historic data. Using this as a proxy for output in the VAR model, we evaluated the effect of a shock to a CRAR change and bank spread. The impulse responses were indicated a decline in bank credit to commercial sectors and to the GVABP growth rate. However, in line with earlier observations, such a decline was short lived and the effect tapered off over six to eight quarters.

20. *One of the measures introduced in Basel III refers to a countercyclical buffer with an objective of reducing pro-cyclicality in the banking system. This was considered to be one of the major evils flaring up GFC. However, there are debates surrounding the effectiveness of such measures on business and financial cycles. More precisely a school of thought led by Saurina et. al. believes that countercyclical policies based on a credit-to-GDP gap could actually result in aggravating the cycle's amplitude. In an attempt to evaluate the effect of an increase in banking capital requirements on the cycle, we evaluated cyclical variations in GVABC using different methods of estimating output gaps (HP, Bandpass filters). We then used the same VAR system after replacing the estimated output gap as a proxy for an output variable. The impulse responses clearly indicated a decline in the output gap due to a shock in banks' CRAR. This finding notes the stabilizing impact of buffer policies in the Indian context; besides macro-prudential features of a capital buffer, an increase in bank capital during an economic boom is likely to stabilize positive outputs and thereby contribute to economic stability.*

21. *To have a focused approach on the impact of an increase in bank capital on manufacturing sector, we considered seasonally*

adjusted IIP growth as a proxy for output growth and estimated the VAR system and impulse responses. The impulse responses indicated a decline in responses to the manufacturing sector's output. However, it seemed to be short lived as compared with a decline in other measures of output.

22. *Infrastructure plays a dominant role in sustaining long term growth in emerging market economies. Considering its strategic importance, we tried to evaluate how change in banks' CRAR impacts core (infrastructure) IIP. To do so, we replaced the last variable(output gap) by the seasonally adjusted core IIP growth rate and estimated the VAR model. The impulse responses using both unrestricted and generalized VAR gave a different prospective for core IIP growth, as there was no initial decline and these impulse reactions were not statistically significant.*

23. *Intrigued with this result, we estimated impulse responses for seasonal IIP growth rates of each of the eight sectors (electricity, fertilizer, cement, coal, crude, natural gas, petroleum and refinery and steel) that are included separately in the VAR framework. Impulse responses for each of these to a one standard deviation shock to the bank capital adequacy ratio indicated no immediate sign of a decline and most of these were statistically insignificant. It could be the case that long term loan contracts and active policy measures and monitoring for these sectors resulted in such difference in results.*

24. *After an extensive literature survey, considering a battery empirical techniques to evaluate lending spreads and discussing credit flow and its impact on output (using a set of proxy) it may be concluded that the new banking regulations could have a small cost in the short run as compared to already documented measures of huge losses due to financial instability. The increase in capital during an economic expansion could achieve the*

macro-prudential goals as well as being an automatic economic stabilizer. Experience with the infrastructure sector was an exception to this finding. These results are robust to the introduction of a new GVA and changes in impulse generating techniques. On the issue of what could be the exact magnitude of the shock, it may be mentioned that lending spreads of banks play a stronger role in deciding the impact of capital shocks on banks' credit disbursements and their subsequent impact on output. Therefore if CRAR changes takes place during a time when lending spreads are low, then CRAR's impact on changes in credit disbursements or quarterly output growth could be far less as compared to periods when the lending spread is already high. In a cross-country framework, countries with higher interest rates could have a significantly higher impact on bank credit or GDP growth as compared to countries that have low, near zero or negative deposit rates.

25. In this research we have empirically evaluated possible impact of an increase in banking sector capital on output. The natural progression to this could be a dynamic stochastic general equilibrium (DSGE) model incorporating financial sector that would allow us to have counterfactual set of experiments in banking sector in India. The second extension of this study could be by introducing the impact of increase in global banking sector capital on Indian economy that could attempt to quantify such spillover impact on Indian GDP and banking sector.

I. Introduction

The global financial crisis (GFC) has brought to the fore two important issues: the inadequacy of capital in the banking system and the pro-cyclicality of risk based capital. These have changed the thinking about the banking sector's capital requirements. After various rounds of discussions in the G-20, FSB IMF and in Basle Committee on Banking Supervision (BCBS), the Basel III regulations emphasize banking capital both in terms of its quality and quantity. A large number of studies, including those by Borio (2011), and Drehmann et al. (2012) clearly document that banking capital requirements decline considerably during good times and shoot up during a crisis. It has now also been unanimously accepted that risk-based capital requirements, credit demand, herding behaviour of the investors and bankers gives rise to pro-cyclicality in the banking sector and a complex mutually reinforcing loop operates between the real and financial sectors. BCBS came out with the Basel III recommendations, with extensive banking system reform measures, including changes in banking capital, supervision and disclosure requirements that are designed to address many of the policy gaps identified during the GFC.

The genesis of present version of Basel III dates back to 1974 when in response to the failure of Harstatt Bank and other disruptions in the international financial markets, central bank governors of the G-10 countries established a Committee on Banking Regulations and

Supervisory Practices. This was later renamed the Basel Committee on Banking Supervision. It was designed to act as a forum for regular cooperation on banking supervisory matters between member countries. Following comments on a consultative paper published in December 1987, the Basel Capital Accord was approved by G-10 governors; this was published in 1988. Subsequently a revised Capital Framework was released in June 2004, which is commonly known as 'Basel II'. This includes minimum capital requirements, supervisory reviews and effective disclosures for market discipline. Moreover, in close cooperation with the International Organization of Securities Commissions (IOSCO), BCBS released regulations governing the treatment of banks' trading books in 2005. In September 2010, responding to the global financial crisis the Group of Governors and Heads of Supervision announced higher global minimum capital standards for commercial banks, which along with a liquidity reform package, are now referred to as 'Basel III' (BIS October 2014).

It is now accepted that minimum common equity and Tier-1 capital ratio under Basel III will be at 4.5 per cent. While this low value (4.5 per cent) has triggered considerable debate on whether 4.5 cent of every one dollar risk weighted asset (and not the total asset) is an adequate shock absorber for the banking system, such a low value has also underlined questions regarding the composition of capital in the banking system. For instance, it is possible that a country might have an adequate CRAR,

say 10 per cent, but the common equity could be far less than 4 per cent. However, in such a situationto meet Basel III capital standards, banks have to raise a large amount of capital to meet the requirement.

To address the pro-cyclicality problem, BIS has introduced time varying capital requirements in Basel III[i] in the form of a capital conservation buffer and a counter-cyclical capital buffer. The conservation buffer (henceforth CCB) requires a bank to hold an additional 2.5 per cent in common equity (bringing the common equity requirement to 7 percent). CCB can be used during a period of stress, when banks are forced to write down bad loans. Another component of Basel III capital requirements refers to the counter-cyclical capital buffer (henceforth CCCB) that is meant to address pro-cyclicality and is designed to add another 0-2.5 per cent to CET1 once the credit to GDP gap crosses the threshold level. This takes the CETI ratio close to 9.5 percent. Further, another tool for addressing cyclicality -- dynamic provisioning-- though not an integral part of Basel III, is being contemplated by many countries, especially by Latin American countries in addition to Basel III requirements (Box I.1). Further, capital requirements for systematically important financial institutions (SIFIs) are over and above these financial requirements.

Box I.1: Summary of Capital Buffer Guidelines

A time varying buffer will act as a cushion between the financial sector and real sector and thus reduce the amplitude of financial and business cycles and their impact on economic welfare. An optimal result can be achieved through a combination of rules and discretion; while the rule part is likely to act as an automatic stabilizer, the discretion part is designed to fine tune the automatic stabilizer to suit underlined economic conditions. Among time varying provisioning tools, dynamic provisioning and capital buffers are referred to in literature. Dynamic provisioning, which depends on asset performance, has already been implemented in Spain, Peru and Columbia, and is mainly aimed at absorbing expected losses. Critics have suggested that it does not take into account large unexpected losses. Moreover, the timing of the buffer release also remains a challenge, especially after the Spanish experience.

In this vein, Basle III has included two capital buffers -- CCB and CCCB. Banks are required to add to CCB during periods of high profit and use this buffer during periods of low profit, and it comes with an automatic capital bucket-wise restriction on banks' profit distribution, for example, dividend and share buy backs. Banks, on the other hand, will accumulate the counter-cyclical capital buffer during good times when excessive credit growth is judged by the national authority to be associated with a build-up in the system-wide risk. So CCCB will lean against the excess build-up in credit in an economy. However, as Basel notes, CCCB is not designed to be an instrument for managing an economic cycle or asset prices and may be best utilized as a macro-prudential indicator, which will build-up a buffer (capital) during the period of excess credit growth and provide comfort in terms of additional capital that may be available during crises.

The objective of the counter-cyclical buffer, as stated in BIS guidelines to national authorities, is to protect the banking sector from periods of excess aggregate credit growth that have often been associated

with build-up of system-wide risks. The relevant authority using the best information available is required to assess the situation so as to determine whether a counter-cyclical buffer requirement should be imposed, increased or decreased (in the broad range of 0-2.5 per cent of RWA). The BIS guideline noted five principles --objectives, common reference guide, risk of misleading signals, prompt release and other macro-prudential tools to promote sound decision making processes. These included credit-to-GDP ratio as a common reference point that national authorities could take into account for formulating buffer decisions as it appeals directly to the objective and is easily available for a large number of jurisdictions. To take into account financial systems at different stages of development, BIS (2010) noted that jurisdictions are free to choose any other variable or information that conveys information for assessing sustainability of credit growth and level of system-wide risks taking into account local market conditions.

The main indicator suggested by the Basel guidelines to national authorities is the credit-to-GDP gap (that is,a deviation of credit-to-GDP ratio from its long term trend), as a large body of literature indicates that it could be a powerful predictor of banking crises. The guidelines indicate that the CCCB buffer accumulation could start when a gap variable crosses its lower threshold (L=2) in the range of 0-2.5 per cent of risk weighted assets (RWAs) linearly until the gap reaches its upper threshold (H=10). However, the threshold values at which the buffer becomes active and reaches its maximum value could vary from jurisdiction to jurisdiction because of the underlining economic situations.

While Basel III envisaged a prompt release of the buffer in times of stress, it suggested that authorities should not depend mechanically on the main indicator, as it is hard for a single indicator to perform its best both during the build-up and release phases. It highlighted the scope of the misleading signal contained in the credit-to-GDP gap and in any other variables especially during a release. The guidelines listed a large

number of supplementary high frequency indicators (for example, asset prices and CDS spread), while cautioning national authorities that these indicators could start releasing the buffer too early. In conclusion, the CCCB guidelines highlighted the importance of using judgment in releasing the buffer when an assessment of the underline economic conditions indicates that: (a) losses to the banking system pose a risk to financial stability, and (b) problems elsewhere in the financial system have the potential to disrupt the flow of credit and thereby undermine the performance of the real economy and the banking system.

While both CCB and CCCB are instruments that are designed to add to capital buffers, by adding over and above the minimum requirement to CET1, the most subordinate claim in liquidation of banks, with objectives to meet unexpected losses and thereby to maintain credit flows during the stress period, there are certain differences between these instruments. The most important being that CCB is a rule which requires banks to add to their minimum capital requirements in a prescribed format. CCCB, on the other hand has a large discretionary part, which is left to national authorities. In particular, the build-up of a counter-cyclical buffer depends on an early warning indicator (credit-to-GDP gap suggested by BCBS) for economic cycles; however, the relationship between the early warning indicator and the buffer capital is not mechanical. Though Basel III indicates the thumb rules for CCCB in its guidelines to national authorities, it allows policy-makers to use their judgment on how buffers are to be built and released.

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While academicians, policymakers, central bankers and relevant banking authorities have attempted to fill the policy gaps that existed in the pre-GFC period, one major issue that has gone un-noticed by many policymakers and central bankers, is how much additional capital will be required by the banking sector and what the impact of raising such a large regulatory capital in the banking system will be on the macro economy. While the G-20 countries are committed to enforcing Basel III norms during 2016-19, not many studies have been done on the consolidated impact of different capital requirements on the banking sector and on macro-variables. In particular, the macro-impact of additional capital requirements to achieve a 9.5 CET1 ratio has not been addressed for most of the emerging markets economies (EMEs). For India, Sinha (2011) made an early attempt to quantify impact of change in CRAR using data up to 2008 and this study indicated an increase in capital adequacy ratio could lead to a reduction in real GDP. Moreover, issues relating to Basel III's time varying capital requirements (Box I.1) over business and financial cycles also remain largely under-researched.

Policymakers from a number of emerging market economies are concerned that the new rules might result in a disruption of capital flows. There has been a general criticism of Basel II based on the logic that increasingly risk sensitive capital requirements will increase the capital charge for banks' exposure to corporates in EMEs as many of them may not have good ratings, mainly due to capping of their external ratings at

the ratings of the concerned sovereigns. However, Basel III proposals have not altered the position regarding this vis-a-vis the existing Basel II.

Capital flows have remained a major source of policy concerns for EMEs as these will be determined by the growth prospects in EMEs, including in India. So far the process has been aided by the very low interest rates in advanced economies. In this regard the practitioners of trade finance are concerned that the proposed new rules could make the issuance of letters of credit (LCs) costlier due to the prescription of a leverage ratio, which does not distinguish among various kinds of exposures in terms of riskiness and also uses a uniform CCF of 100 per cent. Capital buffer rules for a counter-cyclical capital buffer and SIFIs may also have some impact on EMEs if these rules are not properly adjusted / augmented to suit national conditions. Properly used, they will be able to address the concerns of individual countries to some extent.

With this as the backdrop, this paper provides an analysis of the impact of capital requirements on macroeconomic variables over a business cycle. There have not been many studies on this even in advanced economics. A study of emerging economics, which are likely to be the engines of growth for the world economy in the next decade, will be extremely useful at this juncture when Basel III capital requirements are being implemented. Among the emerging economies, India is an important special case because of its growth prospects, possibilities of a demographic dividend, the role of banking as a source of finance and

adoption of Basel III as a G-20 signatory. This paper's objective therefore is to evaluate how an increase in regulatory capital affects major macro-variables in India.

The rest of this study is organized as follows. Chapter II concentrates on available literature on bank capital and macro-variables. Chapter III discusses stylized facts on India's banking sector. Chapter IV describes data, their sources and adjustments; it also reports summary statistics. Chapter V discusses empirical findings, Chapter VI gives concluding observations policy implications and Chapter VII highlights the possible extension of this study.

II. Literature

The main question that this paper tries to address is whether the liability side of the bank balance sheet affects its asset side composition and subsequently the real economic variables. In a Modigliani-Miller (MM 1958)frictionless world, like any other corporate, or bank, the asset side is likely to remain unchanged by the composition of the liability side. However, as capital markets are imperfect, changes in the liability side may not be frictionless and could have real implications, though this should be less important for banking companies as compared to non-financial firms (Kashyap and Stein 1997). The three most important distortions to the MM frictionless world are tax advantages to debt issuances but not dividends, deposit guarantees (which make deposit rates insensitive to individual bank's safety) and other agency costs that increase the cost of raising capital. For example, a bank that raises additional equity to finance its regulatory capital, might find that the cost of capital has increased as equity investors demand more compensation for the debt overhang (Mayer 1977) or because of an information asymmetry as compared with existing shareholders. While Kashyap and Stein's work emphasizes on a Fed policy driven shock to banks' deposits, we take up the issue of increase in bank capital and attempt to evaluate the increase in the cost of capital or decrease in lending and their consequent impacts on real variables in a market with financial frictions.

II.1 Theory in brief

Literature indicates that banks' portfolio decisions crucially depend on three factors -- capital, bank size and leverage ratio. Kashyap and Stein (1995) separated banks' responsiveness to monetary shocks according to bank size and found that banks in the smallest asset category were the most responsive to policy driven shocks; while Kashyap and Stein (1997) add liquidity considerations to the model and conclude that small and most illiquid banks are most responsive to policy shocks. Krishan and Opiela (2000) add to this literature and their work concludes that capital plays an important role in determining the policy impact on banks' loan growth; small size and least capitalized groups respond significantly to changes in policy rates. They also play an important role in banks' abilities to raise funds and maintain loan growth. In a slight departure, Heuvel (2007) indicates that monetary policy effects on bank lending depend on the capital adequacy of the banking sector. Maurin and Toivanen (2012) found supporting evidence from Euro area banks and indicated that Basel II requirements have increased lending volatilities for undercapitalized and less liquid banks. Their empirical findings support the view that undercapitalized banks faced with target capital ratios restrict provision of loans as other sources may have relatively higher costs for refinancing. Capital plays two important roles: first, it discourages excessive risk taking and second it absorbs losses

during negative shocks to the banking sector during economic downturns.

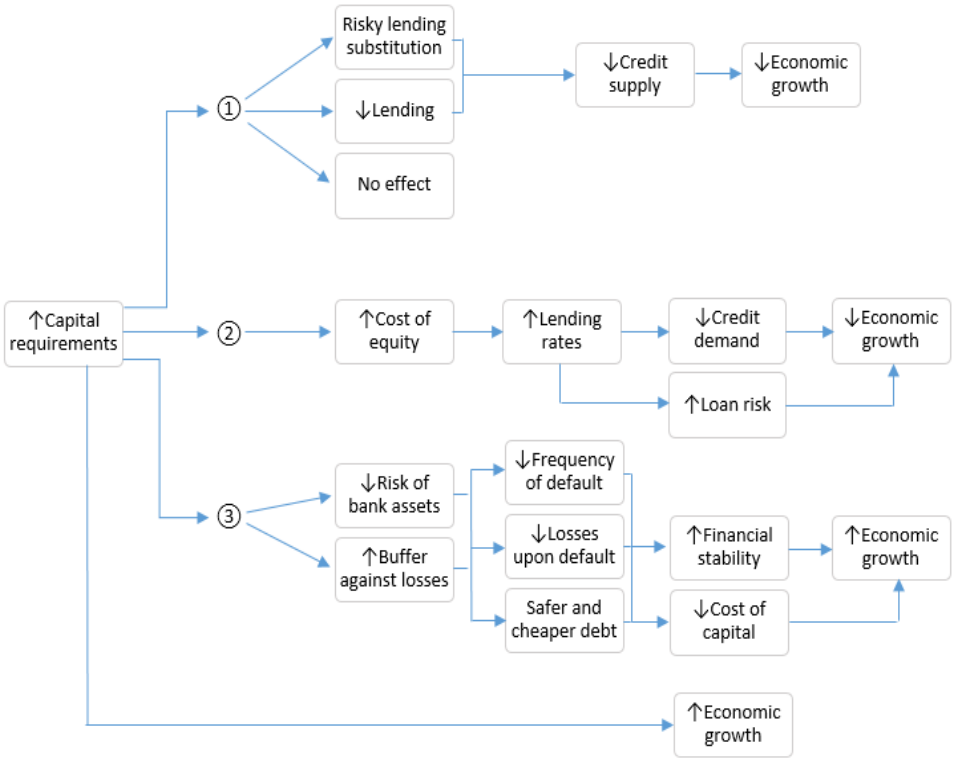
Diamond and Rajan's (2010) study indicates that better capitalized banks may reduce the probability of bank failure. There are several studies based on theory or empirical literature that support the fact that an increase in bank capital improves banking sector stability. For instance, for Italy Gambacorta and Mistrulli (2004) indicate that well-capitalized banks could absorb shocks better and also maintain their long term earnings. Gambacorta and Mistrulli also indicate that credit supply of well capitalized bank is less pro-cyclical and the solvency ratio of a high risk bank determines an overall reduction in lending. An increase in stability of the financial system adds to GDP growth in the long run. Capital buffers and liquidity measures are also likely to act as shock absorbers in the banking system.

One of the core concepts of economics that dates back to the 19th century, refers to 'no free lunches' so even financial stability does not come free of cost though its subsequent benefits are likely to far out-weigh the costs. As Steve Bartlett (2010) puts it, 'every dollar of capital is one less dollar working in the economy'. Though an increase in capital requirements acts as a shock absorber for financial shocks, it could result in an increase in the lending spread which will have a negative influence on credit and therefore on the GDP growth rate thus becoming an initial

cost to society. However, literature is not unanimous about the magnitude and directions of such effects.

Bank capital requirements could have a direct impact on the domestic GDP growth rate or they could also have indirect impacts which can manifest through an increase in the bank's cost of funds. This gives rise to a higher spread; equity capital being costly and the magnitude of such requirements being large, this could result in cost escalation in the banking system which can subsequently be passed as higher cost of credit and credit rationing. It may also lead to a decline in the volume of credit and banks may have to adjust their asset side and risk allocations, as banks may change their allocations in risky investments vis-a-vis low risk investments. It could also result in a substantial chunk of banks' lending to safer government securities with minimal risk weight and the other portion being invested in excessive risky alternatives with high yields. With the presence of non-bank financing companies as shadow banking, this opens up the possibility of regulatory arbitrage, if it is not reined in through appropriate policy measures. It also gives rise to credit activities shifting to comparatively less regulated sectors. This research mainly considers the impact of enhanced capital on the Indian banking system through different channels. The possible channels and their impact on GDP are summarized in Figure 1.

Figure 1: Impact of increase in banking capital requirements



Source: http://www.dnb.nl/en/binaries/Working%20paper%20467_tcm47-319679.pdf.

II.2 Impact on Spread

In a departure from the Modigliani-Miller irrelevance theorem, there is a large body of literature which documents an increase in the borrowing cost or lending spread as a consequence of regulatory capital requirements. For instance BCBS (2010) indicates that for OECD nations the increase in funding cost is passed on to borrowers; Slovik and Cornede (2011) find an increase in spread as a response to an increase in the capital to risk weighted assets. Baker and Wurgler's (2013) study also supports an increase in cost due to an increase in banking capital.

II.3 Impact on Loan Growth

Furfine (2010) finds that for the US a one percentage increase in banks' capital requirements leads to 5.5 per cent reduction in loan growth. BCBS (1999) finds that banks' capital requirements under pressure during the cyclical downturn in the US and in Japan may have led to weaknesses in the economy. Francis and Osborne's (2009) study also supports deceleration in lending in the UK as a consequence of an increase in capital. Maurin and Trivanen using a panel of listed Euro area banks and country specific macro-variables found that adjustments towards a higher capital ratio have a significant impact on banks' assets. They, however, suggest that the impact is more on security holdings than on loan creations. Noss and Toffano (2014) indicate that an increase of 15 basis points in the aggregate capital ratio leads to a reduction of around 1.4 per cent in the level of lending after 16 quarters in the UK. Though most of the studies including those by BIS MAG (2010) and the European Banking Authority indicate that the increase in capital requirements reduces bank credit in the short run, there is also counter-evidence in literature. For instance Bernanke and Lown's (1991) study found no clear evidence of a bank's regulatory capital requirement on the macroeconomic variables. Berrospied and Edge (2010) also indicate that there exists a small effect of bank capital increase on loans.

II.4. Impact on Risk Taking

Theory suggests that enhanced capital and liquidity standards make banks safer by discouraging excessive risk taking. There is a debate in literature on higher banking capital and risk taking. The impact of an increase in bank capital on risk is also debated. One school of thought argues that with an increase in bank capital stakeholders' exposure to downside risks increases and therefore it may rein in risk taking by the bank. This is supported by most empirical studies which provide lower riskiness of a bank's assets (for example, De Jonghe2010). Kashyap et al. (2010) also find that banks' equity risk goes up with an increase in their leverage. Bridges et al. (2014) find that for UK, banks reduced their lending to commercial real estate after changes in banking capital regulations. However, there are also counter-findings. Camara et al. find that well capitalized Euro area banks took more risks before the global economic crisis.

Moreover, there is also a cost to banking sector as the conservation buffer and counter-cyclical buffer come with additional restrictions on earning distribution if banks' capital falls short by a particular percentage of the minimum requirements. Several studies have analysed this issue relating to bank capital and returns. For instance, contrary to conventional belief, Berger (1994) found that higher capital Granger causes higher earnings and vice versa.

Finally, Admati et. al. (2013) concluded that the thinking that high capital requirements will affect the credit market adversely is a fallacious claim and banks' equity is not socially expensive. They indicate that the banking sector should go ahead with further increases in capital requirements in line with other corporates.

II.5 Impact on GDP

The direct impact of an increase in banks' capital requirements on GDP growth is debated, as it differs considerably across countries, the sample period and model assumptions (structural model, DSGE, etc.). For instance, while BISMAG finds a limited impact of an increase in banks' capital on GDP growth, a study by IIF differs significantly as it finds a considerably high impact of additional bank capital requirements on GDP growth. A summary of the findings of the major studies in this area is given in BoxII.1.

Box II.1:

Impact of additional bank capital requirements on GDP growth

MAG: The BIS Macroeconomic Assessment Group (MAG) was established in February 2010 with Spephen Cecchetti as the Chair. Its report on the impact of a transition to stronger capital and liquidity requirements evaluates the potential impact of stronger regulatory requirements on growth over the next several years. It draws on forecasting and policy analysis models that have been developed in different central banks to ascertain the impact of capital requirements on the countries' GDP. The group finds that strengthening bank capital

requirements in line with the Basel requirements is likely to have modest effect on GDP; it could decline by 0.22 percentage points below the baseline forecast 35 quarters after the implementation of higher capital requirements, which translates into around a 0.03 percentage point reduction on an annual basis. Such an impact on GDP may, however, be higher if the domestic authority implements stronger requirements ahead of the Basel schedule and requires banks to hold additional voluntary buffers in addition to the minimum requirements. The factors that could lead to a smaller impact include domestic banks already having higher capital bases. The MAG report, like the IMF study also acknowledges an additional impact due to spillover effects due to simultaneous implementation by a large number of countries. While arriving at these results the country models used a large number of assumptions on the impact of the lending spread, a reduction in lending that goes beyond the impact of the spread and endogenous or exogenous monetary policy frameworks (whether the monetary policy reacts to a decline in GDP growth). The report uses advanced modelling techniques and it notes the scope of further research in the area of risk profiling, loan pricing and lending behaviour in response to regulatory changes.

IMF (WP/12/44) concluded that a synchronized global increase in banking capital requirements by a one percentage point will result in a reduction of global GDP by 0.5 percentage points (including 0.1 percent point due to the global spillover effect). It used a two-step procedure: first, estimating the change in Tier-I capital requirements on banks' credit spreads; and second, the impact of a widening credit spread on growth. IMF (2012) takes into account a simultaneous increase in global capital requirements as national estimates could underestimate the adverse impact of capital requirements on GDP for a large number of countries across the globe at the same time that such a spillover could account for 20 to 25 per cent of the impact on output. Such an impact could also depend on prevailing interest rate structures in the countries. For instance, in the US where the interest rate is at the near zero level,

the impact of a low interest spread will be lower than in India or China, where the prevailing interest rates are much higher.

The Institute of International Finance (IIF), an association which represents over 400 financial institutions across the world, gave radically different estimates on the macroeconomic impact of the on-going reforms. Using an admirably comprehensive model the study indicates that price of credit in the US with rise by 5 percentage points as a result of regulatory changes. IIF's estimates show a much higher impact than what is projected by the MAG (BIS), which claims that there will be a loss of 3 per cent in the combined GDP of the G3 (US, Euro zone and Japan) during 2011-15 on full implementation of Basel proposals.

BCBSBIS states that this is due to differences in the modelling exercise. Also, BCBSBIS has not done any tests for individual countries. Santos and Elliott (2012) study inferred that the IIF baseline has assumed capital requirements with baseline safety margins which were held at the pre-crisis level and that there is greater scope of cost cutting by banks.

References:

BIS MAG (Macroeconomic Assessment Group), (2010), "Assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements – Final Report", August.

Roger Scott and Francis Vitek, (2012), "The Global Macroeconomic cost of Raising Bank Capital Adequacy Requirements" WP/12/44.

An increase in the banking sector's capital leads to benefits mainly from crisis avoidance and output losses associated with such a crisis. But by raising the banking system's resilience, the new standards also aim to lower risk premia in financial markets and lower fragilities in bank funding markets. At the same time, they could better align risk premia

with the true underlying risks, and thereby place growth on a more sustainable path.

To summarize, higher safety margins to banks in terms of more capital and liquidity come at a cost. There are several estimates of such costs in terms of spread and decreasing lending and their effects on GDP. These studies differ in their assumption of the initial spread, transitional costs etc. Moreover, in many of the studies, especially for advanced economics, the underline assumptions are that market forces will help in implementing safety margins and therefore there will be less requirements for regulatory reforms for implementing them. A deviation from any of these assumptions will increase costs for implementing the changes.

III. Progress in Basel III implementations

III.1 G-20 members

In the quest for a more resilient financial system, the G-20 signatories have accepted that they will complete the implementation of Basel III by 2019 and also provide a level playing field to all internationally active banks.

Currently all members of FSBBCBS are already following risk based capital; by the end of 2013 they had put in place the final set of Basel III capital regulations. Basel III's aim of strengthening banking systems by infusing quality capital was endorsed by G-20 in its Seoul summit in November 2010.

Table 1: Summary of Basel III's Progress

RCAP: assessment of implementation of Basel III capital regulations (2012–2016)* Table 3

Basel Committee member jurisdiction	Assessment status	(Tentative) publication date of assessment report
European Union	Preliminary assessment	Published October 2012
United States	Preliminary assessment	Published October 2012
Japan	Completed	Published October 2012
Singapore	Completed	Published March 2013
Switzerland	Completed	Published June 2013
China	Completed	Published September 2013
Brazil	Completed	Published December 2013
Australia	Completed	Published March 2014
Canada	Completed	Published June 2014
European Union	Technical work completed	December 2014
United States	Technical work completed	December 2014
Hong Kong SAR	Under way	March 2015
Mexico	Under way	March 2015
India	Under way	June 2015
South Africa	Under way	June 2015
Saudi Arabia**	Planned	September 2015
Russia**	Planned	December 2015
Argentina**	Planned	March 2016
Turkey**	Planned	March 2016
Korea**	Planned	June 2016
Indonesia**	Planned	September 2016

* Assessments of implementation of Basel III standards relating to liquidity, leverage and G-SIBs, and follow-up assessments on capital regulations, will start from 2015.

** The assessment work will be initiated or undertaken during 2015. Ahead of that, these BCBS members will undertake self-reviews based on the RCAP assessment questionnaire.

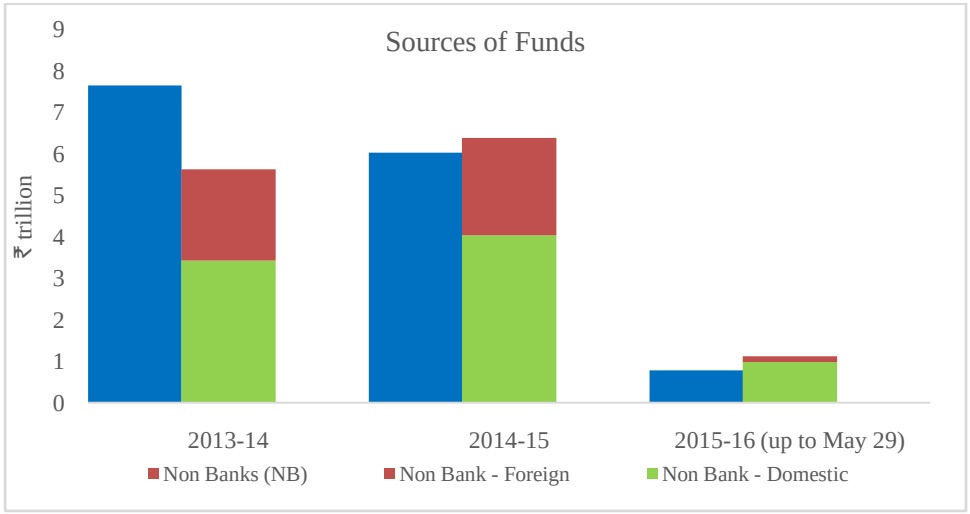
Source: Implementation of Basel standards; A report to G20 Leaders on implementation of the Basel III regulatory reforms; November 2014 (http://www.bis.org/bcbs/publ/d299.pdf).

In January 2014, the governing body of BCBS, GHOS, endorsed the final LCR standard, with public disclosures of LCR starting from 2015. BCBS intends to make NSFR a minimum standard by January 2018. A Regulatory Consistency Assessment Programme (RCAP) was put in place by BCBS in 2012 to assess progress, monitor consistency and rectify drawbacks among members. BCBS aims to complete the first round of assessment by 2016. The summary of the Basel III's progress as reported in a recent G-20 publication is summarized in Table-1.

III.2 Basel III Implementation in India

In India, while domestic sources dominated over foreign sources, banks played an important role among various domestic sources of funds. Among other domestic sources, non-bank sources for financing the private sector are gradually gaining importance. Traditionally, the banking sector has been contributing more funds to the private sector, except for past financial years (Figure 2) when non-bank sources had a marginally higher flow of credit to the private sector.

Figure 2: Sources of funds



Source: RBI, Annual Report (2014-15).

The Indian banking sector is unique as it is dominated by state owned banks, though domestic private bank are increasingly assuming an important role. Over the past few years, the Indian banking sector has remained resilient to the vagaries of different financial and banking crises that have touched the shores of India's neighbour. The consolidated CRAR of all scheduled commercial banks (SCBs) in India is around 13 per cent of the risk weighted assets (RWAs) and Tier-I capital accounts for around 9 per cent of RWAs. Out of the total Tier-I capital, approximately 90 per cent is contributed by common equity. Moreover, Indian banks generally do not have re-securitization exposures and their trading books are small. However, with regard to the treatment of minority interests, banks which have a large number of subsidiaries with minority interests could be affected by increased capital requirements.

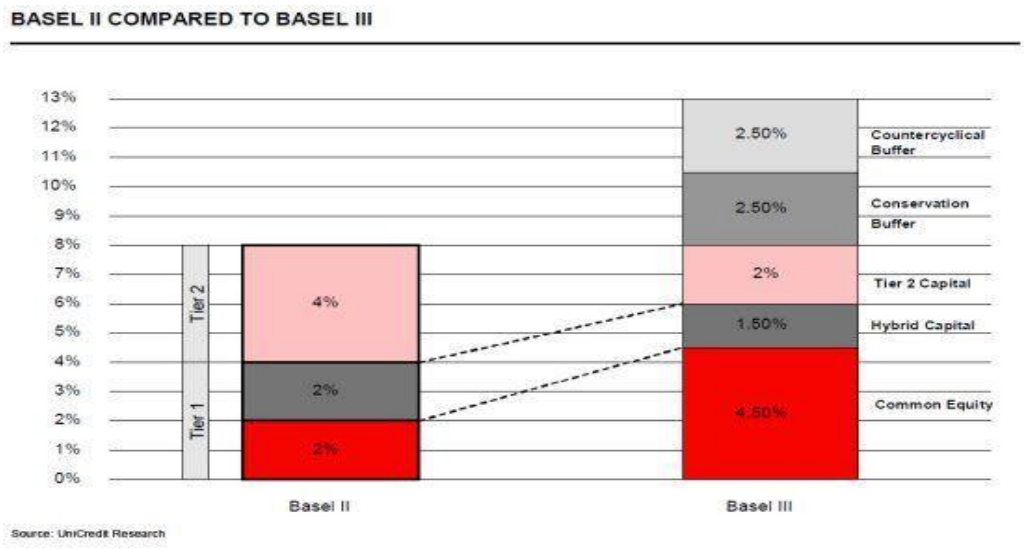
India adopted the Basel I framework in 1992-93 and responded to changes in the framework in 1996 and 2006. In a graudualistic approach the Reserve Bank followed the implementation of Basel II keeping in account the complexities involved and its impact on the Indian banking sector thereafter (Table 2). Empirical evidence on incorporating the Basel Core Principles (BCP) has so far been mixed; it also came under scrutiny after the recent global financial crisis.

Table 2: Implementation of Basel accords in India

	Introduced	Adopted by India	Inclusions / definition
Basel I	1988	1999	Credit Risk Risk Weighted Asset Risk Weights
Basel II	2004	2006-7 onwards	Capital Adequacy Risk Management Disclosure
Basel II.5	July 2009		
Basel III	2010	2013	Capital Adequacy Conservation Buffer Countercyclical Buffer Leverage Liquidity

With the fall of Lehman Brothers, the global economic crisis affected economics around the world and also touched Indian shores, though the Indian economy was resilient and recovered thereafter. However, with the changing scenario in global financial architecture and as a signatory to G-20 risk based capital requirements came into effect in India in April 2013 through a circular on the implementation of Basel III capital requirements. One of the major changes in Basel III relates to the quantity and quality of capital, which requires 7 per cent Tier-I capital (Figure 3).

Figure 3: Basel III capital requirements



This includes 5.5 per cent as common equity capital (CET1) in India. In addition, banks have to maintain conservation buffers to pay unrestricted dividends to shareholders and counter-cyclical capital buffers to address pro-cyclicality problems. These add another 2.5-5.0 per cent of RWA to CET1 to comply with Basel III requirements by 2019. In the Indian context over the past few years credit demand has remained subdued.

Several external agencies, the Government of India (GoI) and rating agencies have estimated recapitalization requirements for implementation of Basel III requirements for Indian banks. Though their exact quantum differs, they are almost unanimous about huge capital infusions to meet these new requirements. Given that retained earnings, external sources and owner infusions are the three major sources of capital infusion, authorities are concerned because in the present

environment banks are facing large NPAs, weak profitability and eroding asset quality problems.

Table 3: Some estimates of additional capital requirements for the Basel III implementations

Institution	Estimate	Source
Fitch Estimate	Indian banks require $200 billion (9.5 per cent of 2014 GDP) before Basel III implementation in 2019.	http://www.anirudhsethireport.com/indias-banks-require-200-bn-of-recapitalization-before-basel-iii-implementation-in-2019-to-9-5-of-2014-gdp/
Dr Subbarao (then RBI Governor) 2013	Rs 5 lakh crore over the next five years.	http://www.mbaskool.com/business-articles/finance/7655-basel-iii-a-its-impact-on-the-indian-banking-system.html http://www.firstpost.com/business/economy/banks-require-rs-5-lakh-cr-to-meet-basel-iii-capital-norms-says-rbi-845167.html
Moody's	Moody's-rated public sector banks will need to raise $26-37billion between FY 2015 and the full implementation of Basel III in FY 2019. Moody's rated 11 public sector banks, representing 62 per cent of net loans in the Indian banking system.	http://www.ibtimes.co.uk/indias-state-run-banks-need-37bn-meet-basel-iii-norms-moodys-1466516 https://www.moodys.com/research/Moodys-Indian-public-sector-banks-will-require-more-capital-for--PR_308725
The Hindu 2012	Additional capital of Rs1.60-1.75 lakh crore by March 2018, to conform to the Basel III norms.	http://www.thehindu.com/business/Industry/for-basel-iii-banks-may-need-rs175-lakh-crore/article3728133.ece
Budget speech 2014	PSB Rs 2.4 lakh crore for PSBs to meet Basel III by 2018.	http://www.thehindubusinessline.com/economy/budget/public-sector-banks-need-rs-24-lakh-cr-to-meet-basel-iii-norms/article6197318.ece
S& P (2013)	'The additional requirement would go up to Rs2.6 lakh crore given a tendency for banks to hold higher-than-minimum capital and the limited market for hybrid instruments in India.'	http://www.livemint.com/Industry/XGsdaZLtXcJFaSM2PYK3kJ/Banks-may-need-Rs26-lakh-crore-more-capital-for-Basel-III.html

It is, therefore, widely accepted that a large chunk of funds have to be mobilized to re-capitalized banks to meet Basel III requirements. This is as per the Reserve Bank, the finance ministry, various rating agencies and independent organizations which have estimated required capital for the Indian banking sector (Table 3). Though these organizations are unanimous about the large capital infusion requirements, even excluding CCB and CCCB over the next three years, the exact infusion varies across institutes and over time.

The Indian banking sector has been reporting weak profitability and it has been under stress because of an increase in non-performing assets over the years and also concerns which remain over the continued weaknesses in asset quality indicated by a rising trend in stressed advances ratio of SCBs, especially of public sector banks (PSBs). Moreover, global growth prospects, especially in Europe, their impact on domestic demand, falling profit margins and decreasing debt repayment capabilities of the corporate sector add to these concerns (FSR June 2015). It is therefore unlikely that banks will find it challenging for mobilising these large fund requirements through internal resources and retained earnings (Figure 4).

Figure 4(a):Asset Quality of SCB

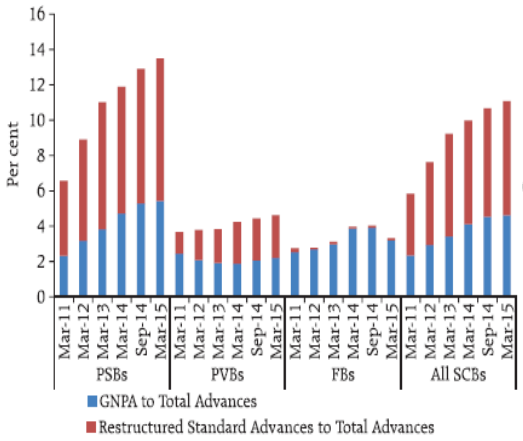
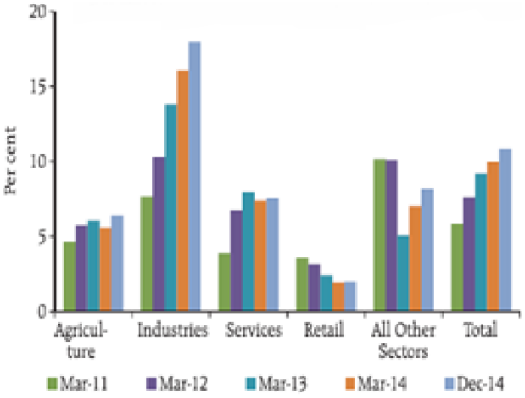


Figure 4(b):Stressed Asset Ratio*

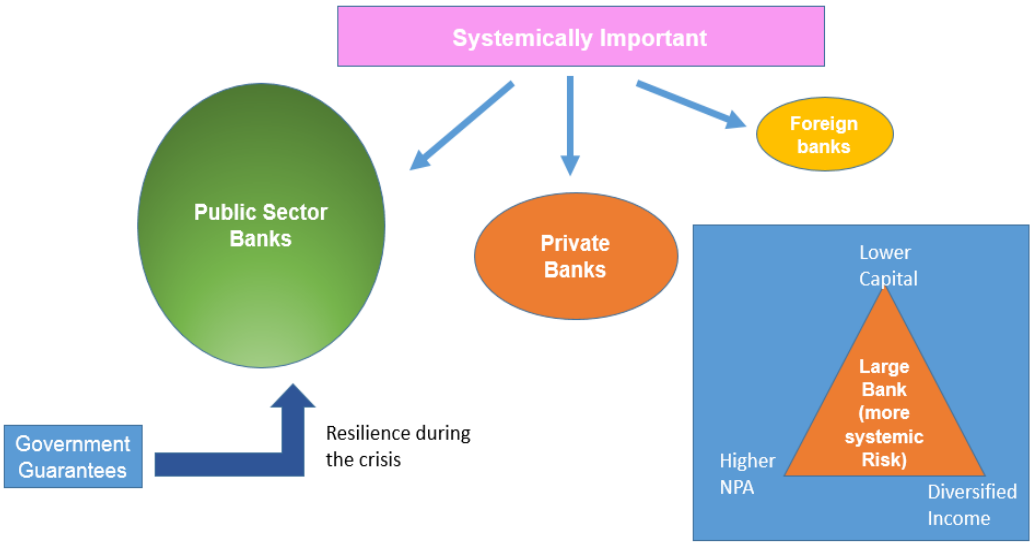


Source: FSR (June 2015), *: Per cent of total advances in respective centres.

The presence of large PSBs and their dominant share in the credit pie points towards capital infusion by the owner or the Government of India. However, given the budgetary position and the government's fiscal commitments it is unlikely that the government will be financing the huge recapitalization burden entirely on its own. As per government

estimates, Rs 2.4 lakh crore (budget speech) needs to be infused as equity in PSBs to help them meet Basel III capital regulations by March 31, 2019. The government infused Rs 586 billion between 2011 and 2014 in PSBs. In 2014-15, the government released only Rs 79 billion to PSBs against the budgetary target of Rs 112 billion. The budget has allocated ₹79 billion in 2015-16 for recapitalization of PSBs, which is perceived to be inadequate by critics in light of the prevailing asset quality trends and capital requirements for meeting the Basel-III norms (Figure 5).

Figure 5: Snapshot of the banking sector



At present, government holdings in PSBs are 56-84 per cent. It is generally observed that the dilution of government holdings in PSBs may not be sufficient for meeting Basel III capital adequacy norms. Therefore, PSBs may have to consider several options including non-voting rights share capital, differential voting rights capital and golden voting rights share capital Gandhi (2014). There have been some issues

related to raising banks' equity capital through the primary stock market, something which has been observed in the past that a large sell-off preceded the secondary market prior to the issue of large equity offers by public sector companies. In the banking sector, the State Bank of India (SBI) raised close to Rs 8,000 crore in February 2014 through a qualified institutional placement. This issue, however, did not see much participation by foreign institutional investors (FIIs), rather the Life Insurance Corporation of India (LIC) was a major subscriber. Moreover, not all institutional investors/corporates are allowed by their regulators or boards to invest in the new (Tier-I / Tier-II) instruments being issued by Indian banks.

Further, over the past few years, there has been a general credit slowdown due to demand slowdown and global economic crisis and the Euro area crisis that have culminated in a general slowdown in credit growth and there has been less pressure on bank funding. Going forward, with the revival of the economy, and consequent increase in credit demand and there is an increased possibility of funding pressure on the banks which could pose addition challenges in the recapitalization of Indian banks.

Capital requirements under Basel III, could have an immediate impact on banks' RoA and RoE. Given the restrictions under Basel III on profit distribution, enhanced capital requirements on banks' balance sheets and profitability indicators (RoA and RoE) over the credit cycle are likely to

change for implementing countries. In the Indian context, using bank level data (public and private sector banks) from 1997-2007 Gupta (2014) finds that a higher capital adequacy ratio is positively correlated with profitability indicators (RoA and RoE) and the quality of assets (less NPA). He concludes in general that a higher CRA is associated with an improvement of bank's related variables that are in line with the findings of Admati et al (2013).

Notwithstanding some of these challenges, the banking sector in India has steadily progressed in implementing Basel guidelines. The RCAP assessment process (2015) found all 14 components of the Basel framework as being compliant. In several aspects the assessment team found that the Indian framework was more conservative than what has been suggested by the Basel III framework. For instance, credit risk assessment by the RBI is more conservative as compared with that suggested under the Basel III framework. The team also found that the supervisory review process and the implementation of disclosure requirements under pillar 3 of market discipline are also compliant with the Basel III framework. Table 4 summarizes the main findings of the assessment team on the implementation of the Basel framework in India.

Table 4: RCAP's main findings with regards to India

Key components of the Basel capital framework	Grade
Overall grade:	C
Scope of application	C
Transitional arrangements	C
Pillar 1: Minimum capital requirements	
Definition of capital	C
Credit risk: Standardised Approach	C
Credit risk: Internal Ratings-Based Approach	C
Securitisation framework	C
Counterparty credit risk framework	C
Market risk: Standardised Measurement Method	C
Market risk: Internal Models Approach	C
Operational risk: Basic Indicator Approach and Standardised Approach	C
Operational risk: Advanced Measurement Approaches	C
Capital buffers (conservation and countercyclical)	C
Pillar 2: Supervisory review process	
Legal and regulatory framework for the Supervisory Review Process and for taking supervisory actions	C
Pillar 3: Market discipline	
Disclosure requirements	C

Compliance assessment scale (see Section 1.3 for more information on the definition of the grades): C (compliant), LC (largely compliant), MNC (materially non-compliant) and NC (non-compliant).

Source: https://www.bis.org/bcbs/publ/d320.pdf

With this background, this paper now empirically evaluates what could be the macroeconomic impact of Basel III capital requirements in India. We start with a birds-eye view of other emerging market economics from South East Asia that have signed the G-20, and will implement Basle III over the next four years. Besides India, these include China, Indonesia and South Korea. For instance, for China the China Banking Regulatory Commission (CBRC) has said that Basel III will have a limited impact on Chinese banks in the short-term, though the long-term impact is worth paying attention to, and that it will discuss with local banks how to gradually apply the new Basel III rules to domestic regulatory measures. The agency has also said that Chinese banks were

in a better position than their western counterparts in implementing stricter capital rules as the average capital adequacy ratio of all Chinese banks was as high as 11.1 percent at the end of June 2010. Similarly, we take into account the development in Indonesia and South Korea to have an idea on their banking developments, capital adequacy ratios and GDP growth. In the next Section, we study in details the dynamics of increase in capital in the Indian banking sector and their impacts on handing spread, credit off take, risk taking by banks and output growth.

First, we concentrate on the two indirect channels through which a bank's capital requirements could lead to an impact on the macro-economy. The first of these is the capital cost and the consequent increase in the lending spread. We evaluate how the lending spread can be impacted due to an increase in bank capital in India. It is, however, difficult to get one lending rate for the entire time horizon. We therefore use prime lending rates for the earlier period and the base rate thereafter. We also use CP and CD rates and other rate indicators for this and evaluate an impulse response of a change in capital on lending rates.

Second, in India, the credit channel plays an important role and the presence of the banking sector is very important in this context. Considering the importance of the credit channel, we evaluate the impact of increased bank capital requirements on bank credit flows and to the private sector.

After evaluating the impact of an increase in capital requirements on the credit channel and banks' lending spread we move to the second stage of evaluating the relationship of credit outflow and lending spread on GDP growth rate. We also evaluate these impacts across business cycles.

Third, to evaluate the impact of an increase in a bank's capital requirements on the risk appetite of the bank we consider the bank's investments in government securities (having no credit risk and only some market risk) and its investments in the housing market (the only sector which has a positive risk weight). These are likely to shed light on the risk appetite of the Indian banking sector in the face of increased capital requirements.

Finally, we attempt to evaluate the direct impact of higher capital requirements on quarterly GDP growth and its different components to evaluate which component is likely to be impacted by the changes in capital requirements. Next we turn to the quarterly IIP data to decode additional information from different sectoral indices of the IIP series. With time varying capital requirements, as proposed in Basel III, capital requirements are likely to be different over the business cycle. In this context it becomes crucial to determine what the additional capital requirements or release will be (through CCB and CCCB route) during boom and slump periods. One of the major challenges in business cycle estimations relates to the unobserved components and estimations of potential output. In this context appropriate adjustments may have to be

made in the estimation process With time varying capital requirements, the impact factor is likely to be different (asymmetric) over the cycle, we attempt to decipher the relationship among these (bank capital, credit and GDP) variables after adjusting them for cyclical changes.

IV. Data sources

The data requirements for this study were two-fold; the first relates to the international arena, economies in the South East Asia region that will be implementing Basel III by 2019. Data for these economics were sourced from the CEIC database. However, data on statutory bank reporting were limited; relevant variables included for this study are data on bank capital (in local currency billion),the capital adequacy ratio and real GDP (YoY) growth rates for China, Indonesia and South Korea.

The major data source for macro-variables for the Indian economy was the Database on the Indian Economy (http://dbie.rbi.org.in/) published by the Reserve Bank of India. These include monetary aggregates (aggregate deposit, bank credit, policy rate, CRR, SLR base rate, GDP series and their components) and the IIP series and their components. Most of the financial markets data (for example, CP rate, call rate and CD rates) were also sourced from the Database on the Indian Economy.

For updates and changes in definitions, CSO press releases and guidelines were referred to an appropriate splicing factors were estimated to transform the gross domestic product in factor cost constant prices to gross value added (GVA) in base prices. Splicing factors were also used to appropriately change the base period for the IIP series. IIP series were also converted to quarterly series using end quarter data. Since we are using quarterly data, there is often evidence of the presence of seasonal fluctuations. Therefore, most of these macro-series are

seasonally adjusted using the US Census Bureau X12 method (Variable_SA) and seasonally /adjusted growth rates, both year-on-year (y-o-y) and quarter on quarter (q-o-q) are computed appropriately.

For aggregate variables on the Indian banking sector the main data source was several volumes of Statistical Tables on Banking (SToB, a Reserve Bank publication); Table 2, 7 and 8 of this publication report data on liabilities and assets and NPAs and shareholding patterns of SCBs respectively. Other regulatory returns data for banks were collected from several back volumes of *Trend and Progress of Banking in India*, *Macroeconomic and Monetary Developments* (MMD erstwhile) and several past volumes of the Reserve Banks's annual reports. For data on some of the missing values, annual data from SToB were converted from annual frequency to quarterly frequency using Eviews frequency transformation tools. In some cases, for instance for calculating risk weighted assets, we used publicly available banks' capital and CRAR ratios to arrive at the closest estimate of risk weighted assets of the banking group. Some of the variables, which were not available in the public domain were proxied by appropriate variables. For instance, aggregate deposit is used for the Net Demand and Time Liability (NDTL) of the Indian banking system.

For bank specific data, audited returns and special statutory returns for select banks the Centre for Monitoring Indian Economy's *Prowess dataset* was used. In case of a variable being available in annual

frequency only, appropriate lower to higher frequency conversion techniques were used to convert it to a quarterly frequency. Variable names, data descriptions, sources and descriptive statistics for all these variables are reported in Table 5.

Finally, it may be mentioned that for the period under consideration may contain structural breaks due to the implementation of Basle II and thereafter Basel III which changed capital requirements. However, following Maurin and Toivanen (2012) we did not segregate the data as the major objective of this work is to capture the impact of such changes on the economy.

Table 5: Summary statistics of the variables used for the study

	Data Description	Data Source	Mean	Median	Max	Min	Std. Dev.	Skew	Kurtosis	Jarque-Bera	Prob(JB)	Obs
AD	Aggregate Deposit	Database on the Indian Economy (DBIE)	30916.78	21263.4	85332.85	5189.8	24179.8	0.79	2.31	8.87	0.01	72
AD_SA	Aggregate Deposit Seasonally Adjusted	Author's Calculations	30917.85	21177.2	85145.85	5238.3	24180.1	0.79	2.31	8.88	0.0	72
BANK_GSEC	Percent of Bank Gsec Investment in NDTL	RBI Website, Sectoral deployment of credit	10228.10	7362.15	24897.51	2100.23	6729.62	0.67	2.21	6.92	0.03	68
BANK_HOUSING	Bank Housing Credit Percent of Bank NDTL	Sectoral Deployment data, RBI press releases	3832.91	3657.24	6256.44	2362.0	1167.43	0.58	2.12	2.85	0.24	32
BASE_MAX	Base Rate Max	Database on the Indian Economy	11.46	11.50	14.00	8.00	1.15	-0.25	2.99	0.72	0.70	67
BASE_MIN	Base Rate Min	Database on the Indian Economy	10.82	10.75	13.75	7.50	1.20	-0.14	3.55	1.06	0.59	67
BC	Bank Credit (Billion)	Database on the Indian Economy	21600.52	15070.77	63185.24	2756.69	18786.87	0.81	2.34	9.12	0.01	71
BC_SA	Bank Credit (Billion) Seasonally Adjusted	Author's Calculations	21608.63	14670.15	63410.66	2765.16	18802.00	0.82	2.35	9.14	0.01	71
CALL_Min	Call Money Rate Minimum	Database on the Indian Economy	5.40	5.00	9.95	0.30	2.40	0.02	1.93	3.22	0.20	67
CALL_MAX	Call Money Rate Max	Database on the Indian Economy	9.82	8.13	80.00	3.40	9.78	5.91	41.51	4529.94	0.00	67
CAP__A	Bank Capital All	Annual Accounts of Banks (DBIE)	355630.10	221362.30	1029325.00	34318.64	316390.10	0.68	2.01	8.51	0.01	73
CAP__F	Bank Capital Foreign	Annual Accounts of Banks (DBIE)	41366.26	24591.21	118342.70	4508.40	37211.70	0.68	1.99	8.63	0.01	73
CAP__P	Bank Capital Pvt	Annual Accounts of Banks (DBIE)	91793.23	53318.77	301556.60	4162.61	90523.67	0.79	2.28	9.18	0.01	73
CAP__PSB	Bank Capital PSB	Annual Accounts of Banks (DBIE)	222470.60	143452.30	609425.60	25647.63	188970.40	0.63	1.91	8.39	0.02	73
CD_AMT	Certificate of Deposit Outstanding	Database on the Indian Economy (DBIE)	1446.73	669.47	4251.70	7.36	1570.99	0.55	1.66	8.55	0.01	68
CD_ISSUE	Certificate of Deposit Issued	Database on the Indian Economy (DBIE)	230.34	47.49	1014.50	0.08	310.07	1.13	2.85	12.90	0.00	60
CD_MAX	CD rate Max	Database on the Indian Economy (DBIE)	9.55	9.44	16.50	5.09	2.39	0.53	3.50	3.90	0.14	68
CD_MIN	CD Rate Min	Database on the Indian Economy (DBIE)	6.81	7.13	10.23	3.60	1.88	-0.30	1.75	5.44	0.07	68
CP_OUTS	Commercial Paper Outstanding	Database on the Indian Economy (DBIE)	512.58	187.44	2082.48	15.00	581.99	1.15	3.09	15.81	0.00	72
CP_ISSUE	Commercial Paper Issue	Database on the Indian Economy (DBIE)	333.90	279.07	694.25	176.30	138.85	1.26	3.87	4.75	0.09	16
CP_MAX	CP rate Max	Database on the Indian Economy (DBIE)	11.13	12.00	15.25	6.20	2.65	-0.39	1.98	4.71	0.10	68
CP_MIN	CP rate Min	Database on the Indian Economy (DBIE)	7.58	7.79	11.40	3.20	1.98	-0.19	2.31	1.75	0.42	68
CP_OUTS_SA	CP Outstanding Seasonally Adjusted	Author's Calculations	517.50	184.03	2543.81	14.25	589.61	1.23	3.68	19.45	0.00	72
CRAR__A	Capital to Risk Weighted Asset All	Different Volumes of MMDs, SToB and RTP	12.65	12.71	14.95	10.40	1.10	-0.05	2.30	1.51	0.47	73
CRAR__F	Capital to Risk Weighted Asset Foreign	Different Volumes of MMDs, SToB and RTP	13.83	13.35	17.88	10.17	2.35	0.14	1.73	5.15	0.08	73
CRAR__P	Capital to Risk Weighted Asset Pvt	Different Volumes of MMDs, SToB and RTP	13.93	13.09	17.79	11.16	1.82	0.45	1.79	6.89	0.03	73
CRAR__PSB	Capital to Risk Weighted Asset PSB	Different Volumes of MMDs, SToB and RTP	12.12	12.29	13.89	10.09	0.96	-0.12	2.04	2.99	0.22	73
CRR	Cash Reserve Ratio	Database on the Indian Economy (DBIE)	6.11	5.00	11.00	4.00	2.02	1.04	2.93	12.54	0.00	69
DEP_MAX	Deposit Rate Max	Database on the Indian Economy (DBIE)	8.33	8.50	11.50	5.50	1.73	0.00	1.95	2.35	0.31	51
DEP_MIN	Deposit Rate Min	Database on the Indian Economy (DBIE)	6.34	6.50	9.00	4.00	1.71	-0.05	1.58	5.48	0.06	65
G_AD_SA_QOQ	Growth Aggregate Deposit Seasonally Adj (q0q)	Author's Calculations (Data Source DBIE)	4.06	4.08	7.13	0.42	1.38	0.05	2.68	0.33	0.85	69
G_BASIC	Growth Basic Goods (IIP use based Index)	Author's Calculations (Data Source DBIE)	4.97	4.77	16.32	-2.01	3.68	0.37	3.15	1.86	0.40	77
G_BC_SA	Growth Basic Goods Seasonally Adjusted	Author's Calculations (Data Source DBIE)	4.64	4.19	11.59	0.02	2.50	0.62	3.11	4.41	0.11	69
G_CAPITAL	Growth Capital Goods (IIP use based Index)	Author's Calculations (Data Source DBIE)	10.85	8.83	60.32	-27.74	17.81	0.48	3.18	3.04	0.22	77
G_CEMENT	Growth Cement (IIP core Index)	Author's Calculations (Data Source DBIE)	7.62	7.48	16.97	-4.20	5.07	-	2.55	0.41	0.82	40

	Data Description	Data Source	Mean	Median	Max	Min	Std. Dev.	Skew	Kurtosis	Jarque-Bera	Prob(JB)	Obs
								0.10				
G_COAL	Growth Coal (IIP core Index)	Author's Calculations (Data Source DBIE)	5.11	6.05	22.24	-18.16	6.44	-0.69	6.37	22.07	0.00	40
G_CONS_DUR	Growth in Consumer Durable (IIP use based Index)	Author's Calculations (Data Source DBIE)	9.98	8.52	46.49	-23.25	15.02	0.39	2.90	1.97	0.37	77
G_CONS_GOOD	Growth Consumer Goods (IIP use based Index)	Author's Calculations (Data Source DBIE)	6.82	5.12	34.87	-8.85	8.06	0.95	4.39	17.66	0.00	77
G_CONS_NDUR	Growth Consumer Non-Durable (IIP use based Index)	Author's Calculations (Data Source DBIE)	5.85	4.92	35.82	-21.10	7.87	0.68	6.28	40.49	0.00	77
G_CORE	Growth Core Industries (IIP core Data)	Author's Calculations (Data Source DBIE)	5.23	5.11	9.81	-0.09	2.58	-0.05	2.07	1.47	0.48	40
G_CP_OUTS_QOQ	Growth CP outstanding Quarter on Quarter	Author's Calculations (Data Source DBIE)	10.09	6.60	123.28	-53.79	25.08	1.80	10.04	184.70	0.00	71
G_CRUDE	Growth Crude Index (IIP core index)	Author's Calculations (Data Source DBIE)	1.18	-0.11	15.77	-8.14	5.22	1.00	3.86	7.93	0.02	40
G_ELE	Growth Electricity Index (IIP user based)	Author's Calculations (Data Source DBIE)	5.46	5.05	16.69	-1.74	3.44	0.69	4.13	10.16	0.01	77
G_ELEC	Growth Electricity Index (IIP core based)	Author's Calculations (Data Source DBIE)	5.77	5.12	15.65	-0.74	3.40	0.61	3.51	2.92	0.23	40
G_FERT	Growth Fertilizer Index (IIP core)	Author's Calculations (Data Source DBIE)	0.57	0.56	25.01	-25.74	8.70	-0.04	4.89	5.96	0.05	40
G_GDP_QOQ	Growth GDP QoQ expenditure side	Author's Calculations (Data Source DBIE)	1.69	1.66	4.57	-0.79	0.99	0.06	3.35	0.40	0.82	69
G_GDPFC	Growth GDP at Factor Cost	Author's Calculations (Data Source DBIE)	6.81	6.48	11.37	1.66	2.27	-0.01	2.17	2.03	0.36	70
G_GEN	Growth IIP general index	Author's Calculations (Data Source DBIE)	6.22	5.86	20.47	-5.19	5.42	0.59	3.20	4.63	0.10	77
G_GFCE	Growth Govt. Final Consumption Expenditure	Author's Calculations (Data Source DBIE)	7.62	6.59	50.45	-14.04	11.80	1.31	5.50	38.26	0.00	70
G_GFCF	Growth Gross Fixed Capital Formation	Author's Calculations (Data Source DBIE)	8.91	9.18	23.82	-9.88	7.09	-0.16	2.68	0.62	0.74	70
G_GVA	Growth Gross Value Added Basic Prices	Author's Calculations (Data Source DBIE)	7.01	7.30	11.40	1.70	2.19	-0.36	2.51	2.28	0.32	72
G_INTERMEDIATE	Growth Intermediate Goods IIP used based	Author's Calculations (Data Source DBIE)	5.61	5.13	20.67	-5.01	4.60	0.46	3.40	3.23	0.20	77
G_MINNING	Growth Mining IIP component	Author's Calculations (Data Source DBIE)	2.68	3.16	13.03	-7.56	4.07	-0.12	2.70	0.47	0.79	77
G_NGAS	Growth Natural Gas IIP core	Author's Calculations (Data Source DBIE)	1.94	-1.34	69.41	-17.66	18.73	2.11	7.28	60.16	0.00	40
G_PET_REG	Growth Petroleum Refining (IIP core)	Author's Calculations (Data Source DBIE)	6.30	3.87	34.90	-10.20	8.96	1.41	5.18	21.20	0.00	40
G_PFCE	Growth Private Final Consumption Expenditure	Author's Calculations (Data Source DBIE)	6.35	6.15	21.08	-2.45	3.30	1.01	7.48	70.36	0.00	70
G_STEEL	Growth Steel (IIP core)	Author's Calculations (Data Source DBIE)	7.30	8.14	16.39	-7.81	5.72	-0.66	2.91	2.88	0.24	40
G_WPI_SA_QOQ	Growth WPI Seasonally Adjusted (QoQ)	Author's Calculations (Data Source DBIE)	1.41	1.37	3.60	-1.70	0.97	-0.16	3.66	1.54	0.46	69
GDP	Gross Domestic Product (INR Billion)	Database on the Indian Economy (DBIE)	8992.16	8283.55	15383.80	4335.95	3257.39	0.38	1.79	5.93	0.05	70
GDP_SA	Gross Domestic Product Seasonally Adjusted	Author's Calculations (Data Source DBIE)	9003.65	8317.64	15045.49	4747.64	3239.78	0.39	1.75	6.29	0.04	70
GDPFC	Gross Domestic Product at Factor Cost	Database on the Indian Economy (DBIE)	8764.30	7928.42	15383.80	4130.06	3312.14	0.43	1.84	6.45	0.04	74
GDPM	Gross Domestic Product at Market Prices	Database on the Indian Economy (DBIE)	12257.50	9642.43	31468.33	3007.92	8313.54	0.79	2.35	8.43	0.01	70
GFCE	Government final consumption expenditure	Database on the Indian Economy (DBIE)	1075.34	1025.39	1899.51	441.47	407.96	0.38	2.07	4.51	0.11	74
GFCF	Gross fixed capital formation	Database on the Indian Economy (DBIE)	2883.76	2602.29	5402.56	1098.88	1419.38	0.33	1.60	7.45	0.02	74
GFD	Gross Fiscal Deficit as per cent of GDP	Database on the Indian Economy (DBIE)	5.39	5.31	12.36	-2.71	3.03	-	2.62	0.50	0.78	70

	Data Description	Data Source	Mean	Median	Max	Min	Std. Dev.	Skew	Kurtosis	Jarque-Bera	Prob(JB)	Obs
								0.09				
GFD (Billion)	Gross fiscal Deficit in INR Billion	Database on the Indian Economy (DBIE)	641.27	401.96	2978.59	-312.04	614.41	1.57	5.82	52.72	0.00	71
GNPA_A	Gross Non-performing Asset as per cent of All Advances Different MMD, AR, DBIE and RTP		7.24	4.54	16.28	2.32	4.92	0.56	1.67	9.22	0.01	73
GNPA_F	Gross Non-performing Asset as per cent of All Advances Foreign Banks		4.34	3.94	7.91	1.89	1.87	0.27	1.75	5.61	0.06	73
GNPA_P	Gross Non-performing Asset as per cent of All Advances Private Banks		5.63	3.25	11.80	1.88	3.68	0.49	1.49	9.92	0.01	73
GNPA_PSB	Gross Non-performing Asset as per cent of All Advances Public Sector Banks		7.85	5.22	18.58	2.09	5.50	0.60	1.82	8.59	0.01	73
GSEC_NDTL	Bank Investment in Government Securities as a percentage of NDTL		30.64	29.23	39.85	25.25	3.99	0.77	2.47	7.46	0.02	68
GVA	Gross Value Added Basic Prices	Central Statistical Organization	14106.59	12759.95	25720.50	6465.60	5524.08	0.48	1.93	6.49	0.04	76
HOUSING_NDTL	Banks Investment in Housing as a percent of NDTL		3.09	0.00	7.92	0.00	3.32	0.15	1.07	10.80	0.00	68
I_BASIC	Index Basic Goods (IIP user based)*	Database on the Indian Economy (DBIE)	114.25	109.70	180.80	65.04	32.35	0.32	1.85	5.60	0.06	77
I_CAPITAL	Index Capital Goods (IIP user based)*	Database on the Indian Economy (DBIE)	164.17	127.70	392.20	47.13	101.97	0.39	1.66	7.78	0.02	77
I_CEMENT	Index Cement (IIP core)*	Database on the Indian Economy (DBIE)	157.68	154.93	226.97	93.95	37.87	0.13	1.96	2.11	0.35	44
I_COAL	Index Coal (IIP core Data)*	Database on the Indian Economy (DBIE)	139.02	130.32	220.45	87.93	36.52	0.53	2.29	2.98	0.23	44
I_CONS_DUR	Index Consumer Durable (IIP use based)*	Database on the Indian Economy (DBIE)	154.96	122.00	327.10	46.03	94.12	0.41	1.59	8.59	0.01	77
I_CONS_GOOD	Index Consumer Good (IIP used based)*	Database on the Indian Economy (DBIE)	123.48	116.06	208.40	52.61	51.25	0.18	1.52	7.42	0.02	77
I_CONS_NDUR	Index Consumer Nondurable (IIP use based)*	Database on the Indian Economy (DBIE)	110.91	111.60	186.20	55.06	37.03	0.18	1.85	4.67	0.10	77
I_CORE	Index Core Industries (IIP core)*	Database on the Indian Economy (DBIE)	134.16	131.61	177.93	95.69	23.84	0.20	1.94	2.36	0.31	44
I_CRUDE	Index Crude (IIP core Data)*	Database on the Indian Economy (DBIE)	105.06	103.45	118.74	90.82	7.04	0.05	1.99	1.91	0.39	44
I_ELE	Index Crude (IIP core Data)*	Database on the Indian Economy (DBIE)	112.72	106.80	181.60	62.15	33.01	0.47	2.11	5.32	0.07	77
I_ELEC	Index Crude (IIP use based)*	Database on the Indian Economy (DBIE)	135.28	131.65	181.51	95.13	24.76	0.26	1.88	2.78	0.25	44
I_FERT	Index Fertiliser (IIP core Data)*	Database on the Indian Economy (DBIE)	100.67	100.11	114.59	73.78	8.48	-0.57	3.55	2.91	0.23	44
I_GEN	Index General IIP	Database on the Indian Economy (DBIE)	120.26	114.20	198.20	58.88	44.14	0.20	1.54	7.35	0.03	77
I_INTERMEDIATE	Index Intermediate IIP use base	Database on the Indian Economy (DBIE)	110.48	105.00	164.90	60.59	32.48	0.05	1.53	6.94	0.03	77
I_MINING	Index Mining IIP	Database on the Indian Economy (DBIE)	106.43	103.60	151.20	71.51	21.95	0.39	2.16	4.19	0.12	77
I_MNF	Index Manufacturing IIP	Database on the Indian Economy (DBIE)	124.36	117.10	210.40	57.35	49.73	0.20	1.50	7.78	0.02	77
I_NGAS	Index Natural Gas IIP	Database on the Indian Economy (DBIE)	120.46	108.27	180.94	94.98	24.30	1.01	2.65	7.74	0.02	44
I_PET_REG	Index Petroleum and Refinery IIP	Database on the Indian Economy (DBIE)	135.73	127.83	186.22	94.57	27.30	0.51	2.03	3.65	0.16	44
I_STEEL	Index Steel IIP	Database on the Indian Economy (DBIE)	151.89	144.32	227.30	94.51	36.38	0.29	2.03	2.36	0.31	44
MSF	Marginal Standing Facility	Database on the Indian Economy (DBIE)	8.95	9.00	9.50	8.25	0.38	-0.15	2.24	0.44	0.80	16
Proxy NDTL	Aggregate deposit has been used as a proxy	Database on the Indian Economy (DBIE)	30916.78	21263.46	85332.85	5189.80	24179.84	0.79	2.31	8.87	0.02	69
NIM_A	Net Interest Margin All Banks	Different MMD, AR, DBIE and RTP		1.54	3.21	0.00	1.01	-0.06	1.85	4.07	0.13	73
NIM_F	Net Interest Margin Foreign Bank	Different MMD, AR, DBIE and RTP		2.09	4.50	0.00	1.33	-0.06	1.90	3.75	0.15	73
NIM_P	Net Interest Margin Private banks	Different MMD, AR, DBIE and RTP		1.53	3.62	0.00	1.02	0.13	2.04	3.01	0.22	73
NIM_PSB	Net Interest Margin Public Sector Banks	Different MMD, AR, DBIE and RTP		1.57	3.32	0.00	0.99	0.00	1.91	3.59	0.17	73
NNPA_A	Net Non Performing Assets All Banks	Different MMD, AR, DBIE and RTP		2.34	8.68	0.93	2.74	0.66	1.78	9.84	0.01	73
NNPA_F	Net Non Performing Assets Foreign Banks	Different MMD, AR, DBIE and RTP		1.28	2.71	0.49	0.62	0.26	1.68	6.15	0.05	73
NNPA_P	Net Non Performing Assets Private Banks	Different MMD, AR, DBIE and RTP		1.43	7.17	0.48	2.36	0.53	1.58	9.55	0.01	73
NNPA_PSB	Net Non Performing Assets Public Sector Bank		3.96	2.74	9.99	0.93	3.08	0.70	1.92	9.59	0.01	73

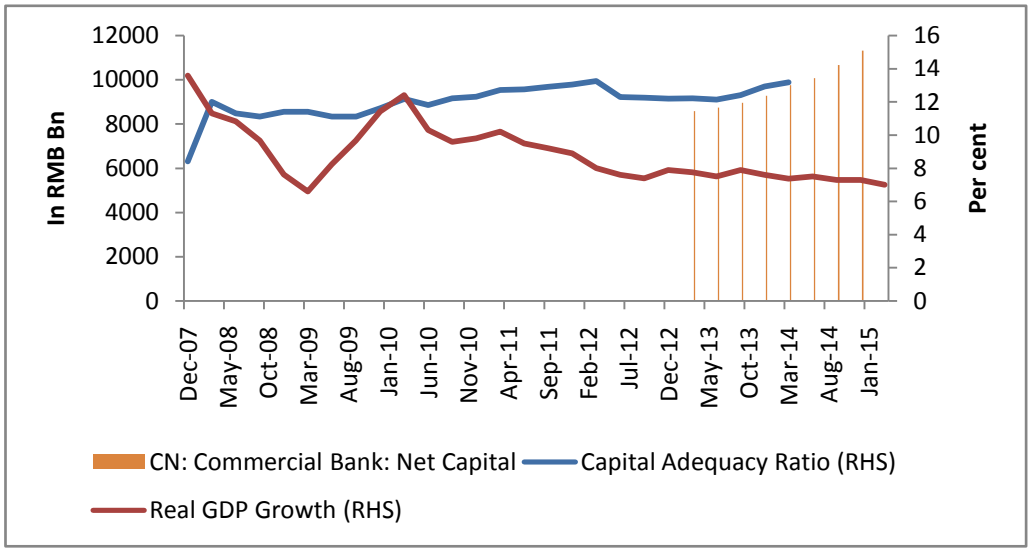
	Data Description	Data Source	Mean	Median	Max	Min	Std. Dev.	Skew	Kurtosis	Jarque-Bera	Prob(JB)	Obs
P_CEMENT	Production based cement core IIP	Database on the Indian Economy (DBIE)	17286.36	16985.00	24883.00	10300.00	4151.48	0.13	1.96	2.11	0.35	44
P_COAL	Production based coal core IIP	Database on the Indian Economy (DBIE)	43.64	40.91	69.20	27.60	11.46	0.53	2.29	2.98	0.23	44
P_CRUDE	Production based crude core IIP	Database on the Indian Economy (DBIE)	2975.01	2929.50	3362.56	2572.00	199.23	0.05	1.99	1.91	0.39	44
P_ELEC	Production based electricity core IIP	Database on the Indian Economy (DBIE)	66224.29	64445.47	88852.87	46570.00	12122.73	0.26	1.88	2.78	0.25	44
P_FERT	Production based fertilizer core IIP	Database on the Indian Economy (DBIE)	2976.57	2977.50	3404.40	2161.30	272.76	-0.46	3.18	1.59	0.45	44
P_NGAS	Production based natural gas core IIP	Database on the Indian Economy (DBIE)	3188.49	2865.59	4789.30	2514.00	643.19	1.01	2.65	7.74	0.02	44
P_PET_REG	Production based petroleum refinery products	Database on the Indian Economy (DBIE)	13371.26	12593.43	18345.25	9316.74	2689.36	0.51	2.03	3.65	0.16	44
P_STEEL	Production based steel products	Database on the Indian Economy (DBIE)	5507.59	5233.00	8242.00	3427.00	1319.05	0.29	2.03	2.36	0.31	44
PFCE	Private final consumption expenditure	Database on the Indian Economy (DBIE)	5709.52	5134.11	9833.86	3180.23	2027.84	0.54	1.98	6.76	0.03	74
R_REPO	Reverse Repo Rate	Database on the Indian Economy (DBIE)	5.66	6.00	7.50	3.25	1.14	-0.50	2.49	2.93	0.23	56
REPO	Repo Rate	Database on the Indian Economy (DBIE)	7.11	7.50	9.00	4.75	1.12	-0.58	2.38	4.04	0.13	56
RSD	Rupee Dollar Rate	Database on the Indian Economy (DBIE)	47.11	45.70	62.25	35.81	6.18	1.01	3.78	14.15	0.00	72
SLR	Statutory Lending Ratio	Database on the Indian Economy (DBIE)	24.46	25.00	25.00	21.50	0.90	-1.59	4.50	35.46	0.00	69
WCMR	weighted Average Call Money Rate	Database on the Indian Economy (DBIE)	6.79	6.97	10.38	3.23	1.83	-0.24	2.04	3.44	0.18	72
WPI	Wholesale Price Index	Database on the Indian Economy (DBIE)	116.17	107.19	185.30	69.97	35.40	0.53	2.01	6.38	0.04	72
WPI_SA	Wholesale Price Index Seasonally Adjusted	Database on the Indian Economy (DBIE)	116.18	107.54	183.50	69.98	35.41	0.53	2.01	6.39	0.04	72

V. Empirical Estimates

V.1 Basel III progress in South East Asian Economies

Four major economies in the South East Asian region (China, India, Indonesia and South Korea) as signatories to G-20 are scheduled to implement Basel III recommendations in their respective jurisdictions by 2019. The China Banking Regulatory Commission (CBRC) issued the core of Basel III in June 2012 and implemented these measures from January 2013. The RCAP assessment team (2013) found that the Chinese system was closely aligned with international Basel III standards, though the credit risk standardized component and pillar 3 components were graded as 'largely compliant'. CBRC remained in full support and indicated its willingness to revise its capital rules. Figure 6 indicates the time series plots of the capital adequacy ratio, real GDP growth (y-o-y) and the total banking sector capital in China.

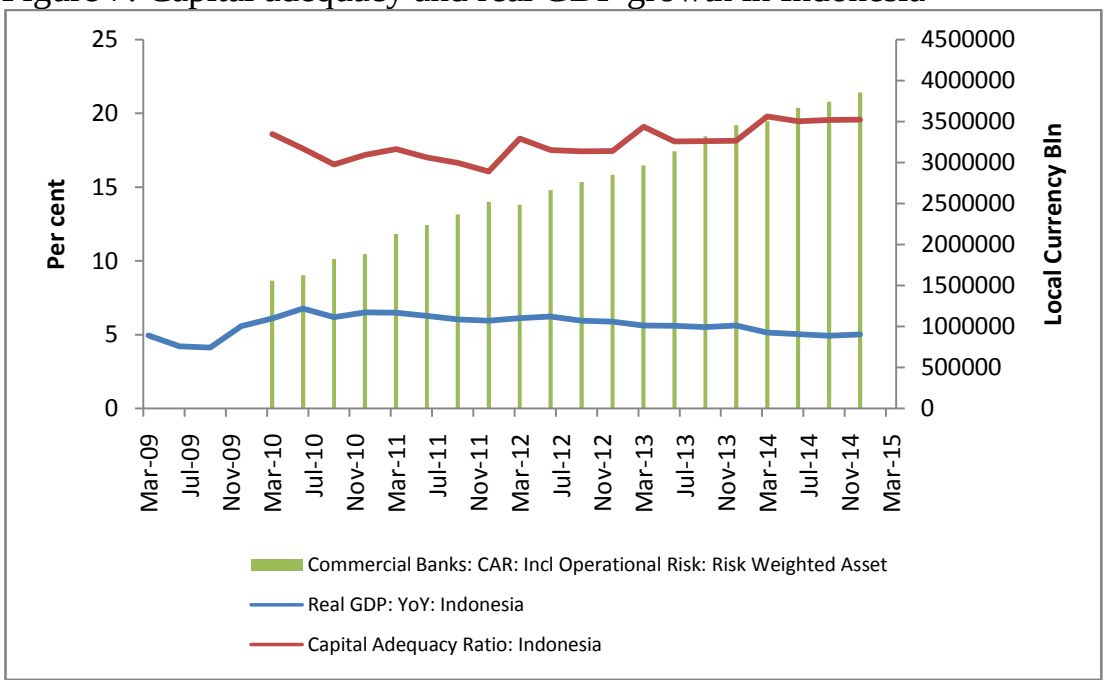
Figure 6: Capital adequacy, real GDP growth and bank capital, China



Source: CEIC database.

In Indonesia, the banking sector has been a major source of funds for the private sector, while others sources (including non-bank financing institutions, capital markets (equity and bond) and external loans contributed around 37 per cent of the funds in the last five years. In compliance with Basel III, Bank Indonesia published regulations for the capital adequacy ratio in PBI No. 15/12/PBI/2013 in December 2013, which includes the implementation of CCCB. Since 2014, banking supervisory has moved under the Indonesia Financial Supervisory Authority (IFSA) and Bank Indonesia is working together with IFSA for implementing Basel III. Basel III capital in Indonesia has been effectively implemented starting January 2014 and at present Indonesian authorities are continuing their work relating to CCCB. The time series plot of the capital adequacy ratio, GDP growth rate and bank capital are given in Figure 7**.**

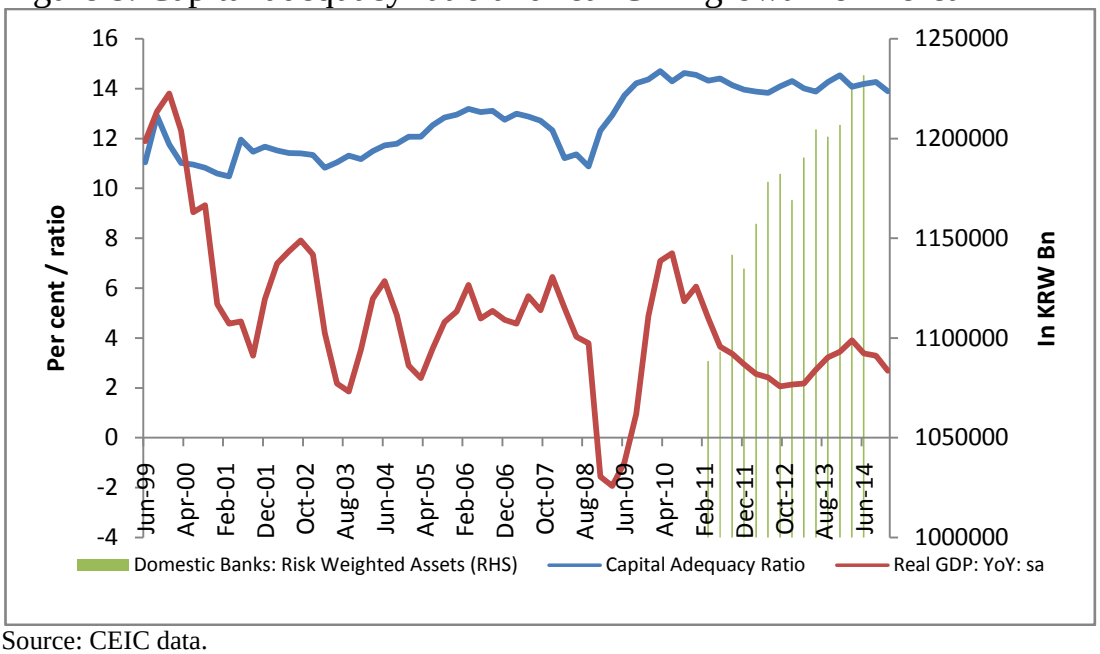
Figure 7: Capital adequacy and real GDP growth in Indonesia



Source: CEIC data.

In South Korea the capital structure is complaint with Basel III regulations with a minimum capital structure and disclosure requirements in place since 2013. The growth rate path and capital adequacy ratio are given in Figure 8.

Figure 8: Capital adequacy ratio and real GDP growth for Korea



Source: CEIC data.

A common feature of these figures points towards a negative relationship between the capital adequacy ratio and GDP growth rate. A correlation analysis confirms this negative relation during the sample period(s) for these economies (Table 6). This is an early empirical indication of an increase in capital requirements and its resulting impact on growth as indicated by the figures given here and also by the correlation coefficient given in Table 6.

Table 6: Correlation of capital adequacy ratio and GDP growth rate

	Growth: China	Growth: Indonesia	Growth: Korea
CAR: China	-0.50**		
CAR: Indonesia		-0.74***	
CAR: Korea			-0.34

Note: *** Indicates 1 per cent level of significance, **: At the 5 per cent level.

As an empirical test of these properties, we stack data for these three countries together in a panel format and estimate panel data models. The estimated pooled, random effect and fixed effect models confirm the observed negative relationship between increase in the capital adequacy ratio and growth rates (Table 7). Using CEIC quarterly data on y-o-y GDP growth rates and capital adequacy ratios during March 10 to March 14, the pooled regression, random effect fixed effect estimates indicate a negative coefficient of the capital adequacy ratio (CAR) on the y-o-y growth rate. To control for other factors that might have impacted the growth rate(other than increase in capital requirements), we introduced a one period lagged GDP growth as a regressor and estimated this relationship using GMM estimations.

Table 7: Panel Estimate

	Pooled		Random		Fixed		GMM	
Variable	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	15.3	0.0	11.5	0.0	15.2	0.0	2.7	0.0
GR(-1)							0.8	0.0
CAR	-0.5	0.0	-0.3	0.0	-0.5	0.0	-0.1	0.0
R-Squ	0.4		0.56		0.76		0.9	

Note: Prob is the P-value of the coefficients, coefficients are significant at the 1% level, GR: year on year growth rate of quarterly GDP, CAR: capital adequacy ratio.
Data Source CEIC, quarterly data from March 10 to March 14, balanced panel.

The regression results report negative coefficients for CAR that were significant at the one per cent level and support the (negative) relation between output growth and CAR as discussed earlier. These observations are in line with the IIF study that found a large direct impact of an increase in capital requirements on GDP growth. It may be mentioned here that most of these countries have policy rates higher than a near zero rate in the advanced economics, and therefore the increase in capital could have a larger impact on GDP growth as compared with those estimated by the MAG-BIS study or by the IMF study, even after allowing for a global spillover.

V.2 Basel III and the Indian Economy

While low capital requirements in the banking system have been cited as a major flow in the current design and a cause for the spread of global financial crises, an overhaul of bank and regulatory capital is likely to have an impact on banks' portfolio management. Under the risk based capital framework, a bank can change the capital to risk weighted assets by changing its liabilities (that is, equity (E) or deposit) or assets (loans (L) and security(S)) or changing its composition. If a simple balance sheet comprises of deposit and equity in the liability side and loans and government securitieson the asset side with risk weights 'a' and 'b' respectively, then CRAR (CRA) can be given by:

$$CRAR=E/(a*L+b*S)$$

where ‘b’ is generally taken as zero for most national authorities, and therefore Government securities will not require any risk capital, but only count in the leverage ratio. If raising capital is costly, especially during downturns, banks may choose to contract lending, especially in risky ventures.

In the following sections, we analyse in detail each of these aspects of CRAR changes on the Indian economy using macro-data. These components include banks’ efforts to raise capital, which has been proxied by an increase in the lending spread, its impact on lending growth / credit off-take, risk taking and banks’ sensitivity to overall GDP growth.

V.2.1 Effect of increase in capital on rate and spread

V.2.1.1 Contemporaneous increases in capital and rates

By and large literature is unanimous on the impact of an increase in bank capital requirements on interest rates. Like other corporates an increase in equity issuance is likely to increase the cost of equity because of asymmetric information and debt overhand problems. If a banking company plans to increase its retained earnings and thereby fund additional capital requirements, then in an attempt to increase its profitability, the bank is likely to increase its lending rate. In this section we quantify past increases in capital requirements on bank lending rates.

As already noted, the publicly available lending rate data poses some challenges as it has undergone changes from time to time (prime lending rate, base rate) and most of these data are available in the maximum and minimum

range rather than in the mean/median rate charged. To overcome this problem we used proxy for lending and borrowing rates from a large number of sources / markets which include base rate (before 2011 prime lending rates were used), certificate of deposit rate and CP rate. We also include CRR and SLR of the banking system, to compare these results with an increase in capital. Table-8 reports the correlation coefficients with increase in banking sector capital.

Table 8: Increase in bank capital and changes in lending/borrowing rate

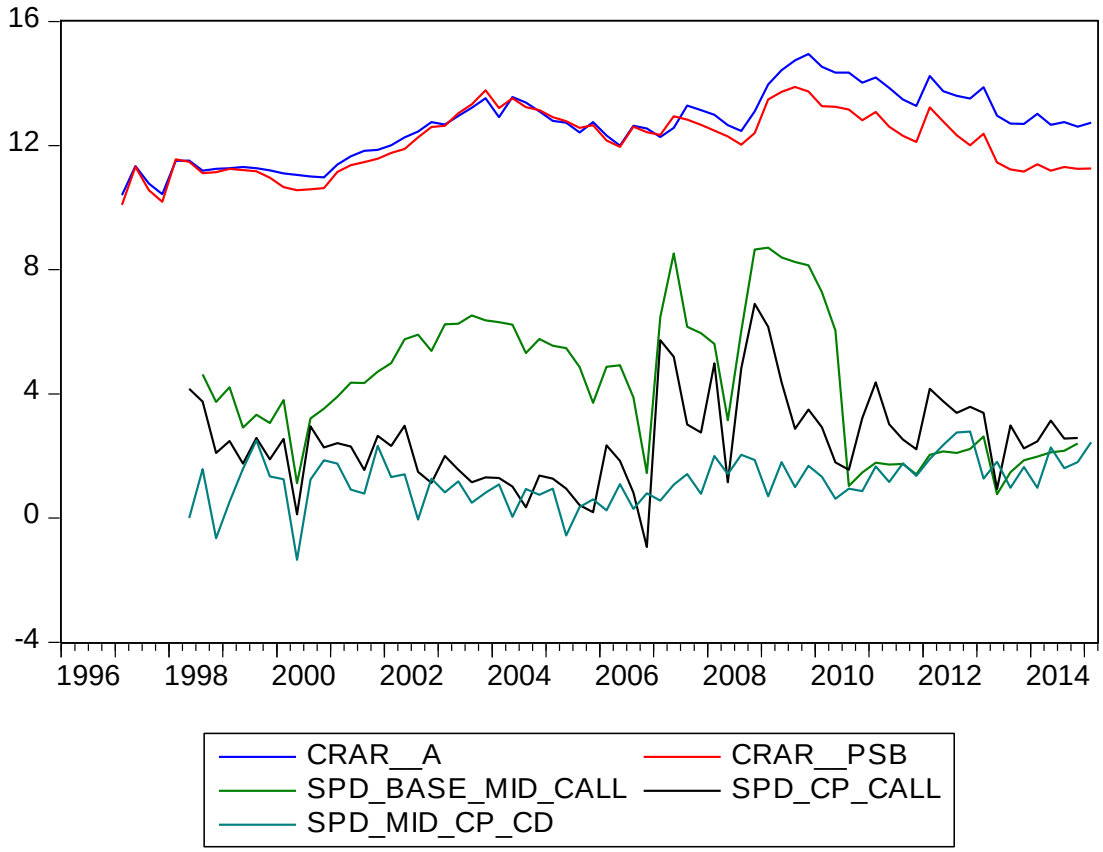
	G_CAP_A_YOY	P-value	CRAR_A	P-value	CRR	P-value	SLR	P-value
BASE_MAX	0.55	0.00	-0.23	0.08	0.56	0.00	0.47	0.00
BASE_MIN	0.57	0.00	-0.31	0.12	0.52	0.00	0.39	0.00
CD_MAX	-0.06	0.66	-0.18	0.19	-0.14	0.31	-0.63	0.00
CD_MIN	-0.23	0.08	-0.05	0.71	0.19	0.16	0.10	0.45
CP_MAX	-0.33	0.11	0.11	0.42	0.40	0.00	-0.29	0.03
CP_MIN	-0.10	0.44	-0.33	0.01	0.15	0.25	-0.54	0.00

In line with theory, a positive correlation coefficient of the base rate (both maximum and minimum) suggests that bank lending rates increase with an increase in bank capital. There is evidence of a decrease in deposit rates as indicated by CD rates. While most of these correlation coefficients were significant for y-o-y changes in bank capital, these results were not so strong or were often counter-intuitive when CRAR was used as a measure of capital (Figure 9).

An increase in bank capital had a somewhat similar effect as that of an increase in the cash reserve ratio or the statutory liquidity ratio, as it is a regulation on bank funds. The correlation coefficient had a positive sign and was significant at the 5 per cent level for banks' lending rates. An increase in

CRR, however, did not have a negative impact on the CD rate (proxy for deposit rate) while an increase in SLR actually had a negative impact on the CD rate.

Figure 9: Spread and capital adequacy ratio



CRAR_A: CRAR of all banks; CRAR_PSB: CRAR of pubic sector banks.

V.2.1.2 Contemporaneous increases in capital and spreads

This analysis of the lending / deposit (CD) rate and an increase in capital could have two shortcomings; first, the increase might be policy driven and second, it concentrates on the maximum and minimum rate. To circumvent this problem we used a spread of the lending / deposit rates from: a) the policy repo rate, and b) the call money rate. The weighted average call money rate

was used as it incorporates interbank liquidity (tight / surplus) conditions. It has also been used as an operating target for monetary policy in India since 2011. Further, since an analysis in terms of maximum and minimum rates could lead to some confusion, we incorporated a mid-rate for each of these variables which is an arithmetic average of the maximum and minimum rate. We also introduced a new spread measure, net interest margin, which is the difference between interest earned and interest expended by a bank. This is also a measure of competitiveness in the Indian banking system.

Table 9: Bank spread and increased capital requirements

	G_CAP_A_YOY	P-value	CRAR__A	P-value
SPD_BASE_MAX_CALL	0.42	0.00	0.09	0.53
SPD_BASE_MAX_POLICY	0.45	0.00	0.24	0.07
SPD_BASE_MID_CALL	0.43	0.00	0.06	0.64
SPD_BASE_MID_POLICY	0.47	0.00	0.21	0.12
SPD_BASE_MIN_CALL	0.45	0.00	0.04	0.76
SPD_BASE_MIN_POLICY	0.49	0.00	0.18	0.19
SPD_CD_CALL	0.06	0.65	0.19	0.16
SPD_CD_POLICY	-0.15	0.29	0.31	0.02
SPD_CP_CALL	-0.10	0.47	0.24	0.07
SPD_CP_POLICY	-0.27	0.15	0.33	0.01
NIM_A	0.01	0.93	0.05	0.73

Table 9 indicates that the spreads of base rate, from both the policy repo rate and the weighted average call rate, have a positive and statistically significant relation with y-o-y growth in bank capital. This holds for maximum, mid and minimum base rates. The spread of the mid-CP rate both from the policy rate and weighted average call rate was also found to be positively related to the banking sector CRAR. However, NIM's relationship (for all banks) and the

spreads from CD rates did not show any statistically significant patterns in the change in bank capital measures.

V.2.1.3. Bank spread and capital requirements-multivariate analysis:

In this context some empirical research has been done on Indian banking. For instance Das (2013) focuses on the impact of the global financial crisis on net interest margins for Indian banks. Using bank level panel data his study investigates the impact of major bank characteristics, such as size, liquidity and capitalization on a bank's margins and finds that well capitalized banks had higher margins. He explained this by noting that if a bank's capital position is higher than the regulatory requirements, it provided the bank higher flexibility in extending loans and thus the higher NIM. Das (2013) also found a positive relation between GDP growth and NIM, as during boom time there was an increase in credit demand and consequent increase in NIM. Though literature suggests that with an increase in inflation credit demand will increase and banks will charge a higher spread, leading to increase in NIM, Das's findings relating to inflation were generally statically insignificant. The other variables that had a significant contribution include size, NPAs, cost, deposit and concentration, which are in line with earlier research (Al-Jarrah, 2010; Saad et al., 2010; Sensarma Ghosh, 2004).

Sensarma and Ghosh (2004) find that the Indian banking industry witnessed a gradual decline in NIM after banking sector reforms but the decline was very slow. Using balance sheet data for all SCBs for 1997-98 to 2000-01 and exploring, inter alia, the relationship between ownership and performance

their results indicate that after controlling for bank-specific variables, NIM was significantly affected by a bank's investments in government securities and it was not significantly associated with the size of the banks. Sensarma and Ghosh found that other significant determinants of NIM were the ownership group and a bank's NPAs (higher NPAs were associated with a lower NIM). In the context of the capital adequacy ratio, the results of their work suggest a positive relation with NIM.

While these two studies concentrated on banks' NIM using bank level panel data, Ghosh and Bhattacharya (2011) concentrated on the bid-ask spread in the Indian overnight market and found it to be positively related to conditional volatility during 1999–2002. Their empirical findings indicate that an expansionary monetary policy reduces volatility of both the weighted average call rate and the bid-ask spread. Among individual policy instruments, any announcement of changes in the cash reserve ratio has a negative impact on the volatility of the call rate and spread. Other policy variables like bank rate and repo and reverse repo rates have a mixed impact on the volatility of the call rate and spread.

Based on available literature, we now analyse the impact of an increase in the CRAR ratio on the lending spread. In the Indian context, there is a paucity of long time series on the weighted average lending rate. Hence, we used the mid-base rate (average of maximum and minimum base rates) and the prime lending rate prior to 2011 as proxy for the lending rate. We used call rate and

policy rate separately to derive the spread. Call rate has an advantage as it incorporates a liquidity situation and represents the market price of funds while the repo rate was taken as the policy rate. Charts for these measures of spreads are reported in the Annex.

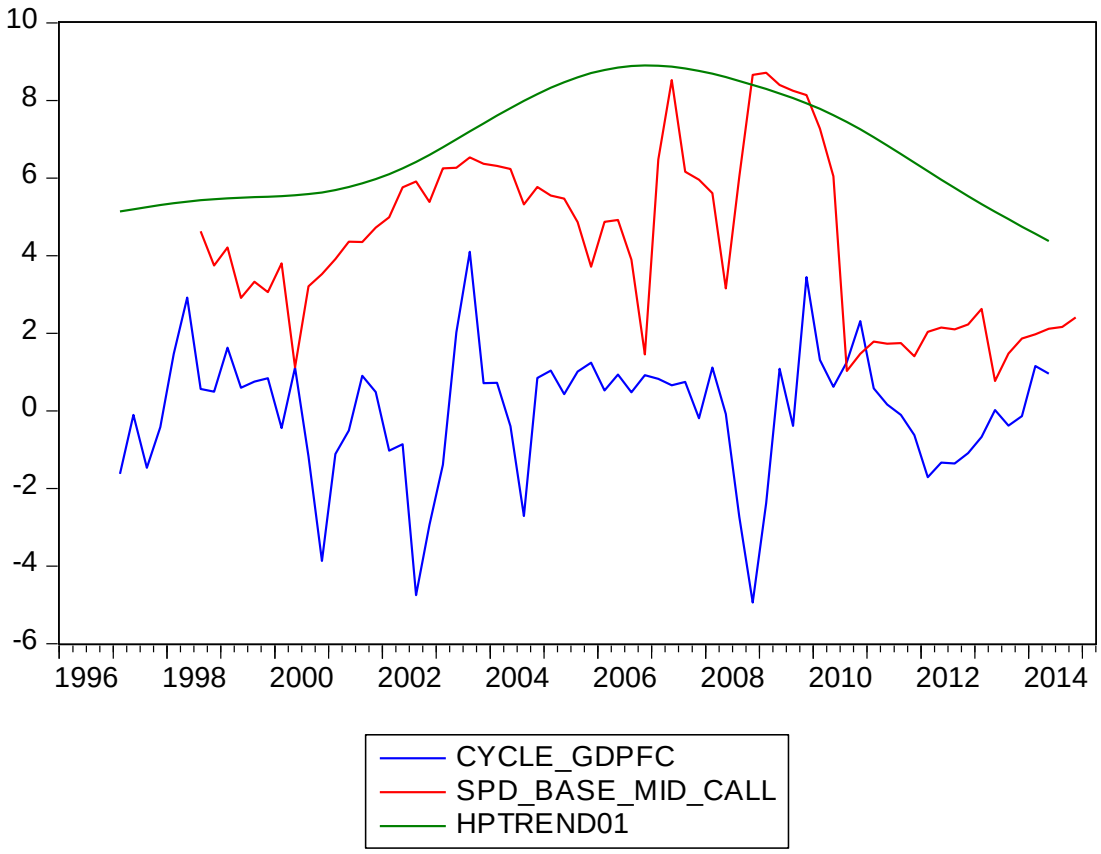
To evaluate the lead-lag relationship between spread and changes in CRAR for all banks (DCRAR_A) up to four lags of lending spread were included in the regression analysis. As indicated in Column 1 (Table 10) contemporaneous changes in CRAR and lagged changes up to three lags had an expected positive sign and were significant at conventional levels. This indicates that an increase in CRAR has a positive impact on bank spread which could be because of increasing costs of funding as indicated by BCBS (2010), Slovik and Cornede (2011) and Baker and Wurgler (2013). However, this positive impact tapered off with an increase in lags and was statistically insignificant after the fourth quarter lag.

To analyse the impact of a bank group on spread, we repeated the same regression for an increase in CRAR for public sector banks (DCRAR_PSB), private banks (DCRAR_P) and foreign banks (DCRAR_F). As indicated in column 3 (Table-10), an increase in CRAR in PSBs had a larger coefficient and a statistically significant value as compared to its private and foreign counterparts. This is in line with expectations as public sector banks still dominate the Indian banking arena and private and foreign banks have relatively small shares.

V.2.1.4 Spread, CRAR and business cycle

Taking a cue from theoretical and empirical findings that bank spread could increase during a cyclical upturn as compared to recession, and an increase in prices could increase profitability and thereby demand for credit by the manufacturing sector, we used GDP growth rate and seasonally adjusted WPI inflation (because of long time series of WPI inflation) to control for the impact of these factors on spread movements. The positive coefficient of GDP growth confirmed an increase in spread during an economic boom (Figure 10). However, inflation had a negative coefficient, which could be because of the fact that during periods of high inflation banks face difficulties in garnering deposits as the real interest rate falls. The Indian banking sector experienced such a phase during high inflation periods in the first half of 2012-13 (RBI 2012) when deposit growth declined because of low real interest rates and a relatively high rate of returns in alternate assets (for example, gold) and there was a structural pressure on interbank liquidity to meet credit demand. However, this negative coefficient of inflation was not significant at the 5 per cent level. The contemporaneous and lagged CRAR coefficients were significantly different from zero even after controlling for macro-variables (for example, growth and inflation).

Figure 10: Economic Cycle and Spread Movements



Note: Cycle_GDPFC: Cyclical component in GDPFC, SPD_BASE_MID_CALL: Spread from mid-base and call rate, HPTrend10:trend output growth rate estimated by HP filter.

V.2.1.5 Spread, CRAR relationship after controlling for business cycle, NPA and crisis

Theoretical and empirical literature suggests that bank spread could be significantly affected by the NPAs of the banking sector. Santos and Eilliot (2012) found that average bank lending rates were likely to increase by around 28 bps, 17 bps and 8 bps in US, Euro area and Japan respectively because of an increase in regulatory costs. In the context of the global financial crisis which posed a threat to banking stability and consequently to the lending spread of banks, Das (2013) indicates an increase in NIM in Indian banks, wherein PSBs appeared to be the worst affected as compared to other bank groups. In an attempt to control for the effect of NPAs on spread and the

impact of the global financial crisis, we include changes in net NPA ratios of all banks (DNNPA_A) and a dummy variable (takes value 1 during 2008Q3 to 2009Q2 for the crisis period in the earlier regression. The crisis dummy variable had a large positive coefficient indicating a large increase in spread during the global financial crisis. An increase in NPAs had a negative sign indicating a decline in spread with an increase in bad assets. This is in line with Das (2013) findings for bank-wise NIM. However, controlling for these banking sector variables and macro-variables a positive relationship between spread and capital requirements remained significant as indicated in columns 7 and 9 in Table10. These results hold even after controlling for the structural break in Lending Rate Series, that is, change in base rate from prime lending rate in May 2011.

V.2.1.6 Alternative definitions of Spread, CRAR relationship

In line with the correlation analysis, we also analysed the relationship between spread and changes in capital adequacy using different alternative definitions of spread. These include difference between mid-base rate from policy repo rate; CP rate and call rate (and policy rate separately) as prime borrowers with a P2+ rating and above borrow using CP as an instrument. We also used the difference between CP and CD rates, as CD is one of the preferred instruments of banks for mobilizing deposits during a period of high credit demand. We used each of these measures separately as dependent variables to evaluate the impact of an increase in contemporaneous CRAR and its lags after controlling for macroeconomic variables (that is, real GDP growth and

inflation) and banking stability variables (that is, NPAs and crisis dummy). Table11 reports these results.

When the spread between the mid-base rate and policy rate is used as a dependent variable, the lagged CRAR increase coefficients reported positive and significant coefficients after controlling for economic cycles and inflation, banking and crisis parameters. However, when CP was used as the lending rate and different measures of spread were calculated by using its difference from the call rate, policy rate and CD rate, the increase in capital adequacy was found to have statistically insignificant results. This could be because of several reasons, including the low share of these instruments in overall lending and borrowings by banks, a select group of customers with whom banks negotiate in these instruments and the issue of using the mid-rate for these instruments, while most of the trade will happen in select instrument buckets (Table 11).

Table 10: Relationship between lending spread of Indian banks and increase in CRAR

Variable	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	4.1	0.0	4.3	0.0	3.6	0.0	3.4	0.0	2.7	0.0	3.4	0.0
DCRAR__A	2.1	0.0			1.9	0.0	1.9	0.0	1.2	0.0	1.1	0.0
DCRAR__A(-1)	1.9	0.0			1.3	0.0	1.3	0.0	1.0	0.0	0.9	0.1
DCRAR__A(-2)	2.5	0.0			2.0	0.0	2.1	0.0	2.2	0.0	2.0	0.0
DCRAR__A(-3)	1.8	0.0			1.7	0.0	1.6	0.0	1.8	0.0	1.6	0.0
DCRAR__A(-4)	1.0	0.1										
C												
D(CRAR__F)			0.4	0.3								
D(CRAR__P)			0.3	0.4								
D(CRAR__PSB)			1.5	0.1								
G_GDPFC					0.3	0.0	0.2	0.0	0.3	0.0	0.2	0.0
G_WPI_SA					-0.2	0.1	-0.2	0.1	-0.1	0.2	-0.1	0.2
D(NNPA_A)							-1.2	0.2	-1.8	0.0	-1.2	0.1
CRISIS_D									3.7	0.0	3.4	0.0
BASE_D											-1.0	0.1
Adj R-Squ	0.41		0.08		0.41		0.48		0.63		0.65	

Note: Base_D is a dummy variable for change in prime lending rate to base rate.

Table 11: Alternative definitions of spread and their relation with CRAR

	Spread b/w Mid Base and Policy Rate		Spread b/w CP and Call Rate		Spread b/w CP and Policy Rate		Spread b/w mid Rate CP and CD	
	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	1.70	0.00	2.45	0.00	1.21	0.09	1.70	0.00
DCRAR__A	0.42	0.28	0.67	0.18	0.02	0.97	-0.19	0.51
DCRAR__A(-1)	0.62	0.09	0.21	0.64	-0.19	0.67	0.15	0.57
DCRAR__A(-2)	1.00	0.01	0.68	0.11	-0.15	0.74	0.31	0.23
DCRAR__A(-3)	1.18	0.00	0.06	0.89	-0.67	0.14	0.19	0.46
G_GDPFC	0.28	0.00	-0.08	0.27	-0.07	0.35	-0.12	0.01
G_WPI_SA	-0.03	0.69	0.09	0.27	0.22	0.01	0.04	0.38
D(NNPA_A)	-0.50	0.43	1.46	0.03	3.77	0.00	0.48	0.24
CRISIS_D	2.92	0.00	2.92	0.00	2.17	0.00	0.55	0.20
	0.60		0.31		0.51		0.08	

V.2.2 Increase in bank capital requirement deposit mobilisation and credit off take

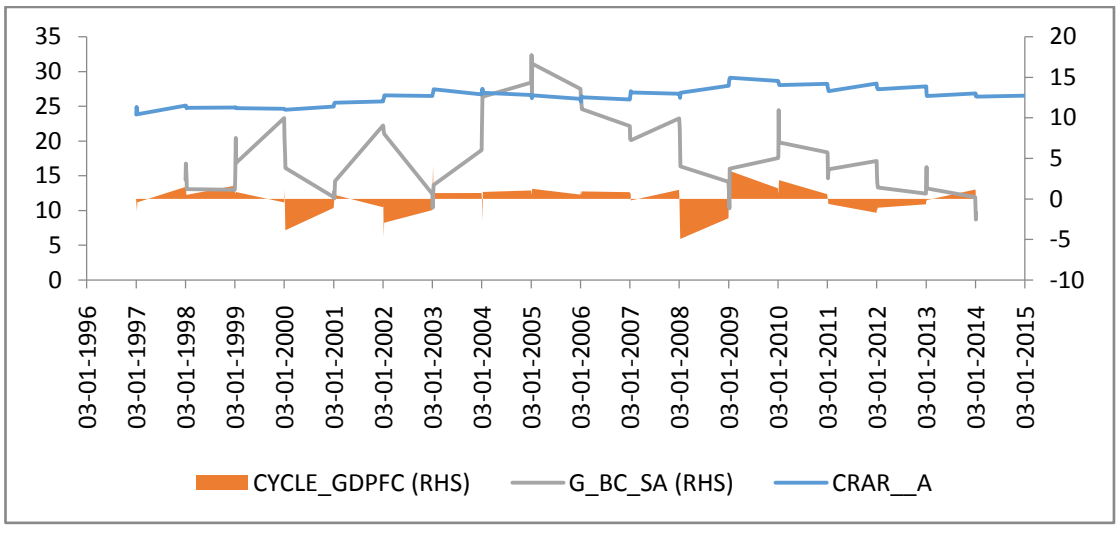
As suggested in literature, an increase in a bank's capital may affect its asset side of the balance sheet or may be a liability side adjustment. In case of the former, the banking sector will rein in credit to adjust for the changes in capital requirements while in the case of the latter the bank may increase its deposit mobilization to meet the additional requirements at least in the short run. A large body of literature, both theoretical and empirical confirms the negative relation between bank capital and its lending. Furfine (2000) has developed a theoretical model for the empirically observed relationship between bank capital and bank lending after incorporating capital regulation, capital shock and loan demand in his model. The author estimates and finds a non-linear relationship between bank capital and lending levels. His results also indicate that changes in capital regulations were the necessary ingredient to explain credit decline in the US. In the absence of any buffer, Furfine finds that the loan growth falls immediately by 5.5 per cent due to a 1 per cent increase in risk based capital.

In empirical literature, most of the studies have concentrated on bank specific characteristics, using a panel of banks for US, UK, Italy and the Euro area. These studies indicate that the lending of poorly capitalized banks was effected more than better capitalized banks due to changes in regulatory capital requirements or capital shocks. In general, the approach to quantify policy induced increase in capital requirements on bank loan is by a regression

analysis after controlling for several demands side variables. The demand side variables generally include GDP growth, interest rate cycle (or policy rate), lending surveys (for example, ECB's bank lending survey) and a proxy for overall sentiment and market financing conditions(for instance stock returns). This approach has been followed in several papers including Bernanke and Lown (1991) and Hancock and Wilxox (1994).

Shrieves and Dahl (1992), on the other hand, used an alternative approach -- a supply equation for lending for a bank and Hancock et al. (1995) used a VAR model to estimate the dynamic response to bank capital shocks. However, literature is not unanimous about this negative relationship as there is evidence (for example, Berrospide and Edge,2010) that indicates a modest impact of capital increase on lending growth.

Figure 11: Credit growth, CRAR movement and output gap (ratio, per cent)



Note: Economic cycle estimated by HP filter, growth in bank credit seasonally adjusted, CRAR for all banks.

V.2.2.1 Contemporaneous relationship

Considering these possibilities, we attempt to evaluate a contemporaneous relationship between these variables. We take four main variables -- aggregate deposit (AD), certificates of deposits (CDs), bank credit and commercial papers (CDs). Besides AD, banks issue certificates of deposit in periods of high deposit need at a higher cost. Commercial papers have been popular instruments for well rated corporates that have gained considerable importance in the absence of a deep and liquid corporate bond market in India.

As we use quarterly data and there is a seasonal pattern in credit pick-up in India, we use the aggregate deposit series, credit series and also after de-seasonalizing those using US Census Bureau's *X12* method. We also use increase in CP and CD outstanding on a y-o-y and quarter on quarter (q-o-q) basis capturing momentum effects and a combination of momentum and base effects. Our proxies for an increase in bank capital remain the same, that is, the y-o-y increase in banking sector capital and the increase in CRAR for all banks.

The correlation results in Table12 indicate that there are positive and significant correlations between an increase in bank capital and deposit mobilization by the bank. For instance, a change in CD outstanding both on a q-o-q basis and y-o-y basis were positive and significant. The same result holds for changes in aggregate deposit, both seasonally adjusted and unadjusted figures, in terms of y-o-y variations and on the basis of q-o-q variations. The correlation analysis based on its CD, AD and AD_SA

coefficients clearly indicates an increase in deposit demand when there were increases in the capital requirements of the banking sector (Table 12).

A correlation analysis based on the CRAR of the banking sector maintained similar positive signs with an increase in deposits in the banking sector. However, they were statistically insignificant at conventional levels.

In the context of a contemporaneous relationship between an increase in capital and credit growth, the relations were convoluted. To start with quarterly growths indicating momentum were not as significant as in the case of y-o-y growth. Among others, the y-o-y growth in credit, increase in outstanding CPs, and seasonally adjusted bank credit had positive sign, which were significant at the conventional levels. An increase in CRAR of the banking sector was also significantly positively correlated with an increase in CP outstanding. These findings are in line with international literature, which indicates a positive relation and could be due to the implicit counter-cyclical policy followed by Indian banks in raising their capital. In other words, banks might have raised their capital in good times when GDP and capital growth were higher. A more detailed analysis controlling for demand side variables of credit would be able to shed light on these issues.

Table12: Credit Growth and Increase in capital requirement

Correlation Probability	CD_QOQ	CD_YOY	CP_QOQ	CP_YOY	G_AD_SA_QOQ	G_AD_SA_YOY	G_AD_YOY	G_BC_SA	G_CAP_A_YOY	CRAR__A
CD_YOY	0.485336	1.000000								
	0.0001	-----								
CP_QOQ	0.080670	-0.000531	1.000000							
	0.5331	0.9967	-----							
CP_YOY	0.008938	0.143928	0.192668	1.000000						
	0.9450	0.2644	0.1335	-----						
G_AD_SA_QOQ	0.100937	0.395335	0.041635	0.197072	1.000000					
	0.4350	0.0015	0.7480	0.1247	-----					
G_AD_SA_YOY	0.100937	0.395335	0.041635	0.197072	1.000000	1.000000				
	0.4350	0.0015	0.7480	0.1247	0.0000	-----				
G_AD_YOY	0.104387	0.387142	0.040742	0.191056	0.992419	0.992419	1.000000			
	0.4194	0.0019	0.7532	0.1369	0.0000	0.0000	-----			
G_BC_SA	0.266066	0.577161	-0.074090	0.058916	0.506746	0.506746	0.507142	1.000000		
	0.0366	0.0000	0.5671	0.6492	0.0000	0.0000	0.0000	-----		
G_CAP_A_YOY	0.299931	0.489687	0.023914	0.242622	0.740816	0.740816	0.729569	0.694770	1.000000	
	0.0179	0.0001	0.8536	0.0574	0.0000	0.0000	0.0000	0.0000	-----	
CRAR__A	0.149118	0.138924	0.011814	0.276084	-0.086129	-0.086129	-0.075629	-0.135646	-0.172785	1.000000
	0.2474	0.2815	0.9274	0.0299	0.5057	0.5057	0.5591	0.2932	0.1793	-----

V.2.2.2 Multivariate relationship between credit growth and regulatory capital

In this section, we extend our earlier correlation analysis to a multivariate framework mainly concentrating on seasonally adjusted bank credit. The main objective is to evaluate the net effect of regulatory capital on the credit disbursement by banks after controlling for other demand side variables that could have a possible impact on credit disbursements. Following standard literature we include GDP growth, policy rate and stock price movements as control variables.

We first use y-o-y changes in CRAR and its lags to explain credit. As credit is known for its persistence, we include a first order auto-correlation term as an explanatory variable. The regression results are summarized in Table 13. Annually seasonally adjusted bank credit growth was as an explanatory variable and the lag structures were decided on the basis of AIC and SBC criteria.

Table 13: Bank credit off-take and increase in bank capital

Variable	Coeff	Prob.	Variable	Coeff	Prob.	Variable	Coeff	Prob.
C	0.31	0.00	C	0.09	0.31	C	0.23	0.00
DCRAR__A	-0.01	0.40	D_CRAR_A_YOY	-0.02	0.10	G_CAP_A_YOY	0.37	0.00
DCRAR__A(-1)	-0.02	0.10	D_CRAR_A_YOY(-1)	-0.01	0.47	G_CAP_A_YOY(-1)	0.24	0.03
DCRAR__A(-2)	-0.02	0.07	D_CRAR_A_YOY(-2)	-0.01	0.19	G_CAP_A_YOY(-2)	0.03	0.75
G_GDPFC	-0.003	0.27	G_GDPFC	-0.001	0.67	G_GDPFC	-0.003	0.31
R_SENSEX	0.0004	0.09	R_SENSEX	0.0006	0.03	R_SENSEX	0.0003	0.15
BASE_MID	-0.01	0.11	BASE_MID(-1)	0.01	0.27	BASE_MID	-0.01	0.04
AR(1)	0.88	0.00	AR(1)	0.85	0.00	AR(1)	0.67	0.00
Adj-R.squ	068			0.69			0.74	

Table13 broadly indicates a negative coefficient of change in CRAR (all banks) and an annualized change in CRAR, after controlling for other demand side variables. The base rate had a negative significant coefficient, indicating that the cost of credit had a negative impact on credit growth. The stock market (returns) had a positive coefficient which indicated improvements in financial conditions improved credit offtakes. Unlike CRAR, the y-o-y growth in the quantity of the capital of the banking sector, however, had a positive coefficient bank credit, which is expected. As credit grows, banks are likely to maintain more capital, which got reflected in this positive relationship.

V.2.2.3 Credit off-take capital and business cycle

In the following analysis, (following Dhremann et al., and Dhremann and Juselius (2014), we replace GDP growth by GDP gap. The output gap is calculated using the 2-sided HP filter and a lambda value of 1600. Table 14 broadly supports the negative relationship between credit and regulatory capital. Among the control variables, the GDP gap variable had a positive and significant coefficient, indicating (in line with literature), that credit demand generally increases during up-cycle periods. Other variables like base rate and stock returns maintained negative and positive signs respectively and were statistically significant, as suggested in literature. The auto-regressive coefficient also maintained a positive and significant coefficient indicating persistence in credit market when y-o-y growth was used. These results are in line with counter-cyclical capital buffer literature where output gap or credit-

to-GDP gap plays an important role in deciding on macro-prudential decision making (Table 14).

Table 14: Factors explaining variation in credit growth (y-o-y)

Variable	Coeff	Prob.	Variable	Coeff	Prob.	Variable	Coeff	Prob.
C	0.30	0.00	C	0.30	0.00	C	0.23	0.00
D_CRAR_A_YOY	-0.01	0.26	DCRAR__A	-0.01	0.60	G_CAP_A_YOY	0.37	0.00
D_CRAR_A_YOY(-1)	-0.01	0.51	DCRAR__A(-1)	-0.01	0.33	G_CAP_A_YOY(-1)	0.24	0.03
			DCRAR__A(-2)	-0.02	0.09	G_CAP_A_YOY(-2)	0.03	0.75
OUTPUTGAP(-2)	0.0052	0.05	OUTPUTGAP(-2)	0.0051	0.06	G_GDPFC	-0.0026	0.31
R_SENSEX	0.0003	0.26	R_SENSEX	0.0002	0.35	R_SENSEX	0.0003	0.15
BASE_MID	-0.01	0.08	BASE_MID	-0.01	0.08	BASE_MID	-0.01	0.04
AR(1)	0.88	0.00	AR(1)	0.88	0.00	AR(1)	0.67	0.00
Adj-R-Sq	0.69			0.71			0.75	

Finally, we analysed the q-o-q variation in credit growth, the momentum indicator, q-o-q on changes in all banks' CRAR ratios while controlling for the same set of variables (that is, GDP growth, stock market returns and base rate changes), lag-structure being decided on the basis of best AIC / SBC criteria (Table 15).

Table 15: Variation in credit growth (q-o-q)

Variable	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	4.58	0.00	8.61	0.00	7.89	0.00	7.74	0.00
DCRAR__A	-1.18	0.14	-1.64	0.03	-1.63	0.03	-1.54	0.05
DCRAR__A(-1)	-0.14	0.86	-0.99	0.19	-0.98	0.20	-1.05	0.19
DCRAR__A(-2)	-0.46	0.55	-1.20	0.10	-1.21	0.10	-1.28	0.10
WCMR(-1)			-0.58	0.00	-0.53	0.01	-0.51	0.01
G_GDP_QOQ					0.04	0.91	0.05	0.87
G_GDP_QOQ(-1)					0.20	0.50	0.18	0.59
R_SENXES_QOQ							0.0005	0.96
R_SENXES_QOQ(-1)							-0.02	0.47
			0.15		0.12		0.1	

Table 15 on quarterly growth movements supports the negative relation of changes in risk weighted capital and credit growth after controlling for demand side variables. The q-o-q GDP growth rate coefficient was not significantly different from zero, though an output gap was found to be significant. As opposed to the tables given earlier, in the quarterly version changes in stock index returns coefficients were found to be statistically insignificant. In the quarterly model, the AR(1) coefficient was found to be insignificant.

From the large number of models estimated in Section V.2.2, it may be concluded that there were some empirical evidences of bank credit being negatively related to increase in capital adequacy. Credit growth also indicated pro-cyclical tendencies and persistence during the sample period under consideration.

V.2.3 Contemporaneous increase in capital and loan risk

Loan risk is an important aspect of investments by banks. It indicates the dynamics of risk perception and risk taking by bankers. The impact of an increase in bank capital on loan risk is debated. While an increase in cost of capital is likely to increase loan risk, an increase in banks' risky assets and consequent provisioning requirements are likely to reduce risk taking encouraging bankers to invest in relatively safer assets. In this section we evaluate the impact of these two countervailing factors on sectoral deployment of credit.

There are several studies on determinants of banks' risk taking behaviour, though most of them concentrate on bank specific firm level panel data. For instance Nabila and Younes' study finds that bank corporate governance, bank capital regulation, bank charter value and bank size were major variables affecting bank level risk taking in Tunisia. Among the other factors prudential regulations of capital and bank size are positively associated with bank risks. There are several bank level studies on factors affecting risk taking, for instance Tara et al. (2009) focus on Japanese cooperative banks and find that risk, capital and inefficiencies were simultaneously determined with their empirical model indicating a negative relationship between risk and the level of capital. Altunbus et al. (2010) used similar bank specific characteristics, (size, liquidity, capitalisation, lending portfolios and profitability) along with other macro factors (for example, GDP, housing and equity prices) and found that a low level of short-term interest rate over an extended period contributed to an increase in banks' risk taking.

Though it is not possible to compare risks in any sector and a bank's loan performance may effectively depend on the borrower rather than the sector, we follow international literature (BoE Working Paper) and analyse bank investments in housing vis-à-vis banks' investments in Government of India securities. In this context it may be mentioned that the Reserve Bank imposes a risk weight in the retail housing sector while banks' investments in GoI securities is generally considered to be credit risk free (though subjected to market risks). The risk weight for capital adequacy purposes (as per the

mapping furnished by the Reserve Bank's guidelines) -- both fund and non-fund based claims on central government -- will attract a zero weight. As per the same guidelines, claims secured by residential property, which are fully secured by mortgage and that will be occupied by the borrower or will be rented, has risk weight as per Table16.

Table 16: Risk weight (housing sector) for capital adequacy purpose

Category of Loan	LTV Ratio (%)	Risk Weight (%)
(a) Individual Housing Loans		
(i) Up to Rs. 20 lakh	90	50
(ii) Above Rs. 20 lakh and up to Rs. 75 lakh	80	50
(iii) Above Rs.75 lakh	75	75
(b) Commercial Real Estate – Residential Housing (CRE-RH)	N A	75
(c) Commercial Real Estate (CRE)	N A	100

Source: Reserve Bank Master Circular on Basel III.

These two investments therefore constitute two extreme cases in terms of loan risk and if there is a reallocation of risk, it might get reflected in asset allocations in these two sectors. However, in India the minimum bank investments in government securities are given by SLR requirements, which change from time to time due to changes in policy measures and are generally mentioned as a percentage of net demand and time liability. Since net demand and time liability of the banking sector are not available in the public domain, we used aggregate deposits of the banking sector as a proxy. We analyse the ratio of bank investments in Gsec and the housing sector as a percentage of aggregate deposits. We also analyse y-o-y growth in bank investments in

Gsecs (which will somewhat be impacted by a growth in NDTL) and y-o-y growth in bank investments in housing.

V.2.3.1 Contemporaneous relations

With our measure of an increase in banking capital remaining the same, the contemporaneous relationship between an increase in banking capital and increase in bank investments in Gsec and housing are reported in Table 17.

Table 17: Contemporaneous risk and capital requirements

Correlation	G_BANK_HOUSING	G_BANK_GSEC	GSEC_AD	HOUSING_AD	G_CAP_A_YOY	CRAR__A
G_BANK_HOUSING	1.000000					

G_BANKD_GSEC	-0.680482	1.000000				
Probability	0.0001	-----				
GSEC_NDTL	-0.469109	0.697978	1.000000			
Probability	0.0118	0.0000	-----			
HOUSING_NDTL	0.039984	-0.115741	-0.336834	1.000000		
Probability	0.8399	0.5575	0.0796	-----		
G_CAP_A_YOY	**-0.602595**	**0.493493**	0.188127	0.401055	1.000000	
Probability	**0.0007**	**0.0076**	0.3377	0.1344	-----	
CRAR__A	**-0.461178**	**0.495372**	0.641844	-0.572097	0.252920	1.000000
Probability	**0.0135**	**0.0074**	0.0002	0.0015	0.1941	-----

Table 17 clearly indicates that there is a negative relationship between an increase in bank capital and bank investments in the housing sector that is significant at conventional levels. The coefficient of an increase in a bank's investments in GSecs is also positive and is found to be statistically

significant. These measures indicate that an increase in capital requirements reduces a bank's investments in higher risk segments (with risk weights on assets) as compared to the sovereign bond segment with a zero risk weight. This also supports the school of economic thought that claims that bank investments in risky assets decline with an increase in its capital requirements.

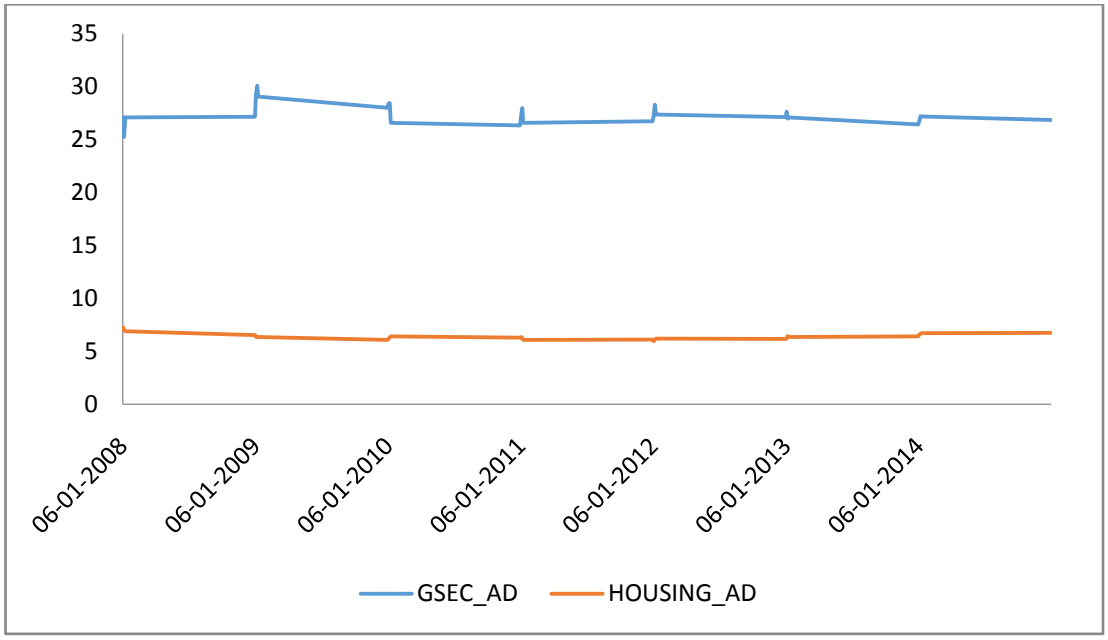
V.2.3.2 Lead lag relationship and multivariate analysis

While the correlation results indicate empirical relations in line with theoretical and empirical observations, in this section we concentrate on the lagged relationship between banks' risk taking and increase in capital requirements using the variables mentioned earlier. While evaluating this we also control for the effect of other macro-variables that could have an impact on a bank's risk taking behaviour. These variables include GDP growth rate to evaluate the effects of economic cycles on banks' investment behaviours. We also include the interest rate cycle and stock returns as control variables. Finally, in view of the regulatory statutory liquidity ratio, we include changes in SLR as a control variable.

As a starting point, we use each bank's investments in housing and government securities (as a percentage of aggregate deposits) as a dependent variable and use lags of changes in the capital adequacy ratio for all banks as explanatory variables; lags were selected on the basis of AIC criteria. However, as evident from columns1 and 3 in Table 18) none of the coefficient were statistically significant and the R-sqe value remained low when either the

housing to AD ratio or the Gsec investment to AD ratio was used as a dependent variable. It may be mentioned that both these ratios were relative stable over time, and generally banks' Gsec investment was more than the SLR limit (Figure 12).

Figure 12: Ratio of banks' investment in Gsec and Housing as a percentage of aggregate deposit



We next turn to an alternative measure of banks' investments in these sectors, which are computed in terms of a percent y-o-y increase. As indicated in columns 6 and 7 in Table 18, when a change in CRAR_A and its lags were used as explanatory variable and *growth in banks' investments in Gsec* as a dependent variable, the coefficients were positive and significantly different for zero. This finding indicates that banks faced with an increase in capital requirements, attempt to direct funds to safer investments. On the other hand, when y-o-y growth in *banks' investments in housing* was used as a dependent

variable the coefficients had negative and statistically significant values indicating less fund mobilization to the risky housing sector.

While these findings support literature, we control for some of the factors that could affect banks' flow of funds to different sectors and consequent risk taking by the banks. One of the factors that in unique to India is the statutory liquidity ratio (SLR), which requires the banks to keep a percentage of their net demand and time liabilities invested in safe liquid government securities. Changes in statutory liquidity ratio when included in these regression equations its coefficient turned out to be statistically insignificant. One of the reasons could be that Indian banks generally maintained more than required statutory liquidity ratios and therefore changes in them were seldom binding.

Literature suggests that banks' risk taking could be crucially influenced by the business cycle. To control for the changes in banks' risk taking because of the business cycle movements we include GDP growth rate as a control variable in this regression. The coefficient of GDP growth was positive for banks when growth in the *investment in housing* was used as the dependent, variable, however, it was found to be negative when growth in *banks' investment in government securities* was used as dependent variable; both of these coefficients were statistically significant at conventional levels. These results were consistent when output gap (estimated by an appropriate HP filter) was used instead of GDP growth. These findings are in line with literature which suggests those banks' risk appetite increases during economic booms. After controlling for the growth cycle, the modified regression results

confirmed a negative relationship between an increase in regulatory capital and a bank's risk taking. When a bank faces increased capital requirements, its investments in safer investment go up. This could be because of preserving funds for additional provisions for risky investments (Table 18).

Table 18: Change in CRAR and bank investment in housing and /or Gsecs

Variable	Gsec_AD		Housing_AD		G_Bank_Gsec		G_Bank_Housing	
	Coeff.	P-Value	Coeff.	P-Value	Coeff.	P-Value	Coeff.	P-Value
C	30.47	0.00	3.13	0.00	0.14	0.00	0.12	0.00
DCRAR__A	1.08	0.47	0.001	0.29	0.06	0.00	-0.04	0.00
DCRAR__A(-1)	1.70	0.19	-0.68	0.55	0.08	0.00	-0.04	0.02
DCRAR__A(-2)	1.94	0.14	-0.59	0.60	0.08	0.00	-0.03	0.03
DCRAR__A(-3)	2.08	0.11	0.01	0.99	0.07	0.00	-0.03	0.02
	0.03		-0.05		0.47		0.47	

As indicated in literature, we also controlled for the financial cycle by including stock index returns in the regression. Stock return has a positive and statistically significant coefficient for an increase in a bank's investments in housing while it reported a negative and significant coefficient for banks' investments in Gsecs. This broadly supports the findings relating to growth cycle and indicates that banks' risk taking behaviour during upturns in the financial cycle. The observed relation between capital requirements and risk taking remained unchanged after controlling for stock market movements (Table 19).

Table 19: CRAR change and banks' investment in risky assets

	G_Gsec_Bank								G_Housing_Bank							
Variable	Coef	Prob.	Coef	Prob.	Coef	Prob.	Coef	Prob.	Coef	Prob.	Coef	Prob.	Coef	Prob.	Coef	Prob.
C	0.14	0.00	0.22	0.00	0.14	0.04	0.09	0.39	0.12	0.00	0.11	0.00	0.24	0.00	0.28	0.00
DCRAR__A	0.06	0.00	0.05	0.00	0.05	0.01	0.04	0.00	-0.04	0.01	-0.05	0.01	-0.03	0.03	-0.02	0.08
DCRAR__A(-1)	0.08	0.00	0.08	0.00	0.07	0.00	0.07	0.00	-0.04	0.02	-0.04	0.02	-0.03	0.02	-0.03	0.05
DCRAR__A(-2)	0.08	0.00	0.09	0.00	0.09	0.00	0.07	0.00	-0.03	0.04	-0.03	0.05	-0.03	0.08	-0.02	0.15
DCRAR__A(-3)	0.07	0.00	0.07	0.00	0.07	0.00	0.06	0.00	-0.04	0.03	-0.04	0.05	-0.03	0.06	-0.02	0.10
D(SLR)	0.001	0.95	0.02	0.48	0.01	0.58	-0.01	0.58	0.01	0.70	0.00	0.90	0.01	0.70	0.001	0.87
G_GDPFC			-0.01	0.01	-0.01	0.00	0.001	0.74			0.01	0.25	0.00	0.84	0.001	0.57
G_GDPFC (-1)			0.00	0.95							-0.01	0.31				
BASE_MID					0.01	0.25	0.01	0.49					-0.01	0.05	-0.01	0.05
R_SENSEX					0.00	0.77	0.00	0.36					0.00	0.43	0.001	0.27
AR(1)							0.69	0.00							0.56	0.04
	0.46		0.57		0.57		0.71		0.45		0.44		0.62		0.72	

V.2.4 Increase in capital and output

V.2.4.1 Contemporaneous correlations

The relationship between an increase in banks' capital requirements and measures of output are unlikely to be contemporaneous, as they are likely to involve some lags and transmission delays to translate into a reduction in output. However, as a first step we started with a contemporaneous correlation analysis. We used two measures of bank capital's y-o-y change in all banks' capital and CRAR. As an indicator of output we used GDP at factor cost, its expenditure side components (that is, growth in GFCE, GFCF and PFCE). We also used spliced series for gross value added at basis prices, the new GVA growth rate series. As expected, the correlation analysis indicates no significant contemporaneous negative relationship between banks' capital and measures of output. This is evident from first four columns of Table20, which indicate positive correlation coefficients for growth in GDPFC, GFCF, PFCE and GVA. The only negative coefficient indicating an inverse relationship was growth in GFCE. However, the coefficient was not significantly different from zero at conventional levels.

Next we turn to the growth rate of indices of the core industries series and its major components (growth rates in cement, coal, crude, steel, electricity, fertilizer, petrol and natural gas) and their contemporaneous correlation with these two measures of increase in all banking sector capital. However, the correlation analysis indicates that there is not much evidence of a statistically

significant relation as most of these coefficients were not statistically different from zero (Table 20).

In an attempt to get a deeper insight into the relationship between output growth and banking sector capital, we used growth in general IIP and its components (manufacturing, mining and quarrying and electricity generation). The correlation result indicates a positive and significant relationship between bank capital (G_CAP_A_YOY) and growth in the general IIP index, growth in the manufacturing index, which is major component of the IIP index and growth in mining and quarrying. However, other than mining growth, such coefficients were low and were statistically insignificant when CRAR of all the banks was used as a proxy variable for an increase in capital. Growth in electricity was insignificant while using both the variables representing increase in banks' capital (Table 20).

Table20: Relationship of increase in banking capital and output

		G_CAP_A_YOY	P-value	CRAR__A	P-value	G_CAP_A_YOY	P-value	CRAR__A	P-value	G_CAP_A_YOY	P-value	CRAR__A	P-value
GDP Quarterly	G_GDPFC	**0.39**	**0.00**	0.28	0.02								
	G_GFCE	-0.03	0.78	-0.01	0.96								
	G_GFCF	**0.37**	**0.00**	0.15	0.23								
	G_PFCE	0.19	0.13	0.21	0.09								
	G_GVA	**0.28**	**0.02**	0.29	0.02								
IIP Core Indices Quarterly	G_CORE					0.14	0.39	0.18	0.26				
	G_PET_REG					0.11	0.51	-0.09	0.59				
	G_STEEL					0.07	0.65	0.11	0.51				
	G_CRUDE					-0.10	0.52	0.33	0.04				
	G_ELEC					-0.08	0.61	0.02	0.92				
	G_FERT					-0.13	0.43	0.26	0.11				
	G_NGAS					0.11	0.51	0.52	0.00				
IIP Compt.	G_GEN									0.48	0.00	0.02	0.86
	G_MNF01									0.50	0.00	0.004	0.97
	G_ELE									-0.14	0.26	0.03	0.79
	G_MINNING									0.27	0.03	0.20	0.10

This analysis suggests the absence of any contemporaneous relationship between an increase in banking sector capital and output growth. The positive coefficients indicate an increase in capital during high growth periods, which generally supports counter-cyclical trends in capital accumulation in the Indian banking sector, a policy measure initiated by the Basel III framework. These results are also in sharp contrast to findings for South East Asian countries in the earlier sections. In an attempt to get more insights into the gap's dynamics we calculated potential output after the deseasonalized logarithm of level variables, that is, GDPFC and the new spliced GVA series using the Hodrick Prescott filter with conventional lambda value (λ=1600) for quarterly data. The (logarithm) output gap correlations with proxy for bank capital requirements were negative. However, both these were found to be statistically insignificant at conventional levels. For confirming these results with different measures of output gap, we also tried with the cyclical component of output estimated using the Bandpass filter. However, the correlation results were not different from those reported earlier.

V.2.4.2. VAR framework with endogenous macro variables including capital

In this section we evaluate the cost of implementing tighter capital requirements under the Basel III framework on the economy using a set of macro-variables (for example, GDP growth, spread, credit, CRAR).

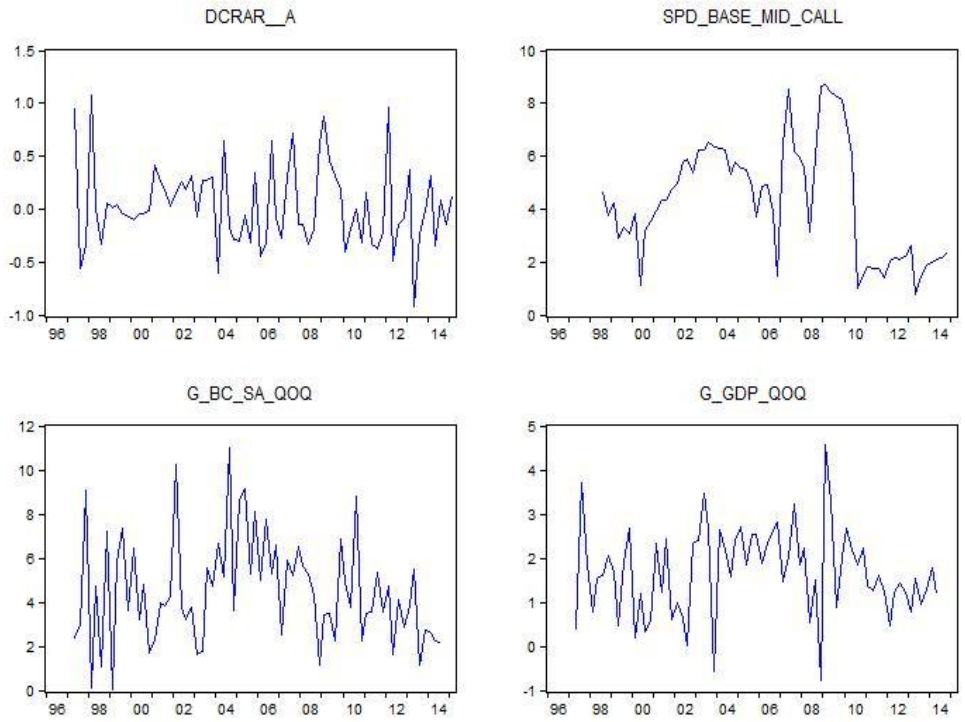
Gambarchorta (2011) followed a VECM approach based on quarterly data for the US over the period 1994-2008 and found four long- term relationships and found in line with MAG 2010 and Angelini et al. This supports the finding that the economic costs of an increase in bank capital are considerably lower than the benefits associated with reduced probability of banking crises. As noted in Gambarchorta (2011) the main advantage of this approach lies in the fact that it helps disentangle loan supply in the steady state.

The effect on the economy is generally estimated in literature by analysing sustained changes in interest rates on GDP growth. The lending wedge is generally estimated as the difference between the borrowing and lending rates. However, as mentioned in the earlier sections data on deposit rates lending rates of all the banks are not available in a long time series format for most of the emerging market economics, including India. Therefore, following MAG (2010) and Parcon and Santos' (2012) approach we used the difference between lending rate (prime lending rate and thereafter mid-base rate) and the central bank's policy rate as spread. While Gambarchorta (2010) estimated a long run relationship, Parcon and Santos (2012) used a relatively short-run relationship using the VAR model with changes in capital, lending wedge or spread loan portfolio and real GDP growth rate. We closely follow the methodology adopted by Parcon and Santos (2012) in this analysis.

V.2.4.3 Analysis with quarter-on-quarter data

As indicated in literature, we analyse data on changes in the capital adequacy ratio, lending spread, changes in seasonally adjusted credit growth and changes in GDP. In this section we concentrate on q-o-q variations. The plot of data used in this analysis is given in Figure 13.

Figure 13: Movements in CRAR, spread, bank credit and GDP



As a usual practice, before examining the relationship between time series variables, we first checked for the stationary properties of these series. A unit root test was carried out to examine whether the series were stationary using the Augmented Dickey Fuller (ADF) test. In the ADF test, the following estimation is considered:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \ldots (1)$$

where ε_t is a error term and where, $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. The number of lagged difference terms have to be included through the AIC values and in such a way that the error term in the equation is serially uncorrelated. The ADF test tests whether $\delta=0$. The results of the ADF test are reported in Table 21 which indicates that the differenced series were found to be stationary.

Table 21: Augmented Dickey-Fuller test statistic

Null Hypothesis:	t-Statistic	Prob.*
DCRAR__A has a unit root	-9.3	0.0
SPD_BASE_MID_CALL has a unit root	-2.7	0.1
G_BC_SA_QOQ has a unit root	-4.0	0.0
G_GDP_QOQ has a unit root	-8.0	0.0

Note: Test critical values:1% level-3.52; 5% level-2.90; 10% level 2.59.

After confirming the stationary properties of these variables, in line with Parcon and Santos (2012) we did a VAR system analysis for the four variables, where the current value of each variable depended on different combinations of the past values of an endogenous set of variables as well as other exogenous variables and the error term. The generic form of the equation is given by:

$$y_{1t} = \alpha + \beta_{1t} y_{1t} + \beta_{12} y_{1t-2} \ldots\ldots\ldots + \beta_{1k} y_{1t-k}$$

In the list of exogenous variables we used a dummy for the global financial crisis period (September 2008 to December 2009). Since we

were to evaluate the impact of an increase in capital requirements on spread, credit growth and GDP growth, the order of the variables was the same as it was in the case of Parcon and Santos' work. The lag length of VAR was decided by the list of criteria as summarized in Table 22. Most of the criteria including FPE, LR and AIC suggested that a lag length of two quarters was appropriate, which was incorporated in the VAR model.

One of the major criticisms of Sims' (1980) Vector Autoregressive models refers to its a-theoretic approach where more than one dependent variable and its lags are used in a regression set-up. Our ordering of the variables along with the Cholesky decomposition is likely to generate an error structure that will make shocks across the dependent error terms and built in theoretical arguments in this process (Table 22). The error structure for the given set of regression is:

Endogenous variable list:

@e1 for DCRAR__A residuals
@e2 for SPD_BASE_MID_CALL residuals

@e3 for G_BC_SA_QOQ residuals

@e4 for G_GDP_QOQ residuals

Short-run restrictions:

@e1 = C(1)*@u1

@e2 = C(2)*@e1 + C(3)*@u2

@e3 = C(4)*@e1 + C(5)*@e2 + C(6)*@u3

@e4 = C(7)*@e1 + C(8)*@e2 + C(9)*@e3 + C(10)*@u4

Long-run restrictions: @LR2(@u1) = 0

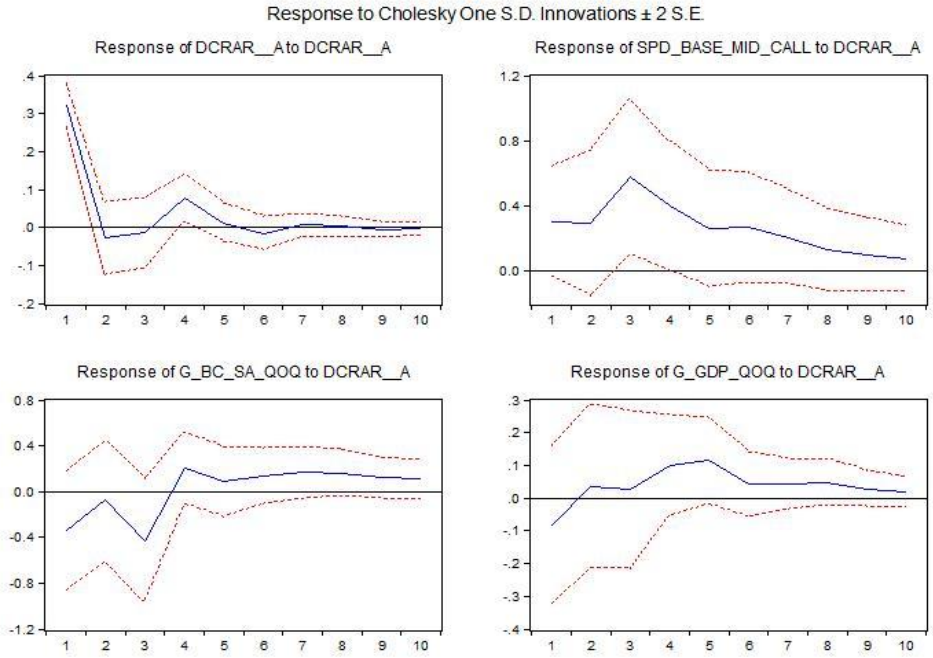
Table 22: VAR lag length determination

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-362.879	-	2.959652	12.43657	12.57742	12.49155
1	-317.68	82.73683	1.101748	11.44678	12.15103*	11.72169*
2	-301.155	28.00757*	1.090994*	11.42900*	12.69665	11.92384
3	-289.67	17.91002	1.296802	11.58202	13.41307	12.29679
4	-275.65	19.95963	1.440266	11.64917	14.04362	12.58386
5	-260.68	19.28421	1.588604	11.68406	14.64191	12.83868

Note: *: Indicates lag order selected by the criterion; LR: Sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion.

The impulse responses generated with the vector auto-regression model discussed here and the Cholesky decomposition for structured errors is given in Figure-14.

Figure 14: Response to one SD CRAR shocks to macro variables (q-o-q)

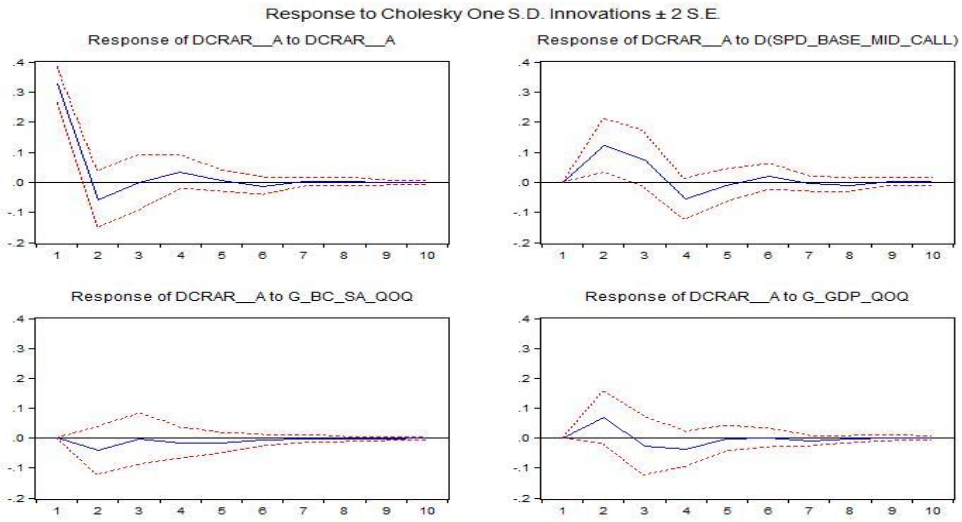


It represents a one standard deviation shock to the CRAR of all banks' increased lending spreads over the first three quarters which eventually declines thereafter, though remaining above initial levels. The increase in

CRAR and banks' lending spreads jointly impact banks' credit growth which declines for around three quarters. In line with theoretical projections, this factor impacts GDP negatively, which declines for around two quarters, before rising thereafter. While these results are in line with the theoretical and empirical literature surveyed, problems remain with wide standard error bands, which suggest that some of these impulse responses may not be statistically significant.

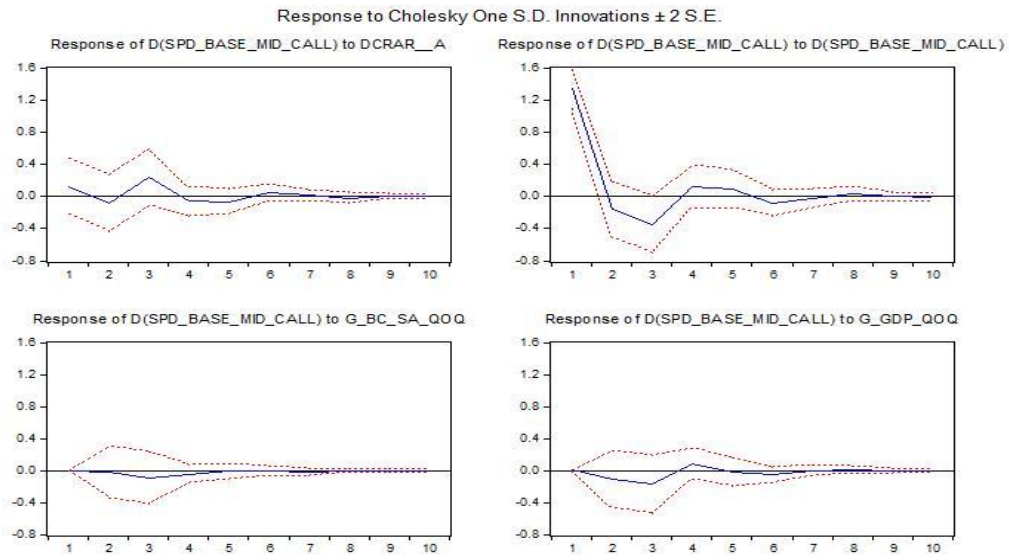
As an alternative specification, we replace a change in banks' lending spreads (that is, difference in spreads over a quarter) in our vector auto-regression, while the other specification and the crisis dummy remain the same. The impulse responses as obtained through the modified VAR framework are reported in Figure 15. These impulse responses broadly corroborate all the observations made here. Moreover, the standard error bands are far narrower, indicating the significance of the VAR system estimation done here. Initially the GDP increased but declined for around 2-3 quarters before rising to the pre-shock period levels.

Figure 15: Impulse response with (Q-o-Q) difference in spread, shock to CRAR



We also evaluated impulse responses when the system was given one standard deviation shock to changes in banks' lending spreads. The effect of the shock remained as anticipated in terms of a decline in credit and GDP growth, with its effect lasting for around three quarters. The time paths of these variables are given in Figure-16.

Figure 16: Impulse response with (Q-o-Q) difference in spread, SD shock to spread

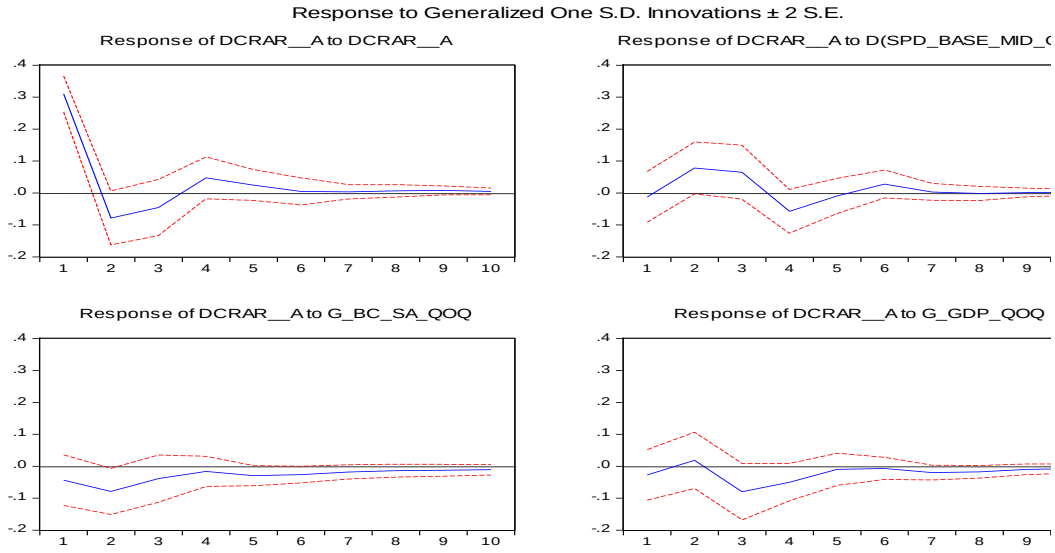


V.2.4.4. Generalized impulse responses

The impulse response functions of traditional VAR model depend on the ordering of the variables and therefore have been criticized by a number of authors. In order to circumvent this problem we used the generalized impulse response analysis which was developed by Pesaran and Shin (1998). This follows a non-linear impulse response and takes the mean of responses for all the shocks. A major advantage of the generalized impulse response as compared to the traditional Cholesky decomposition is that the former does not require orthogonalization of shocks which in turn makes it independent of the ordering of the variables in the VAR system of equations.

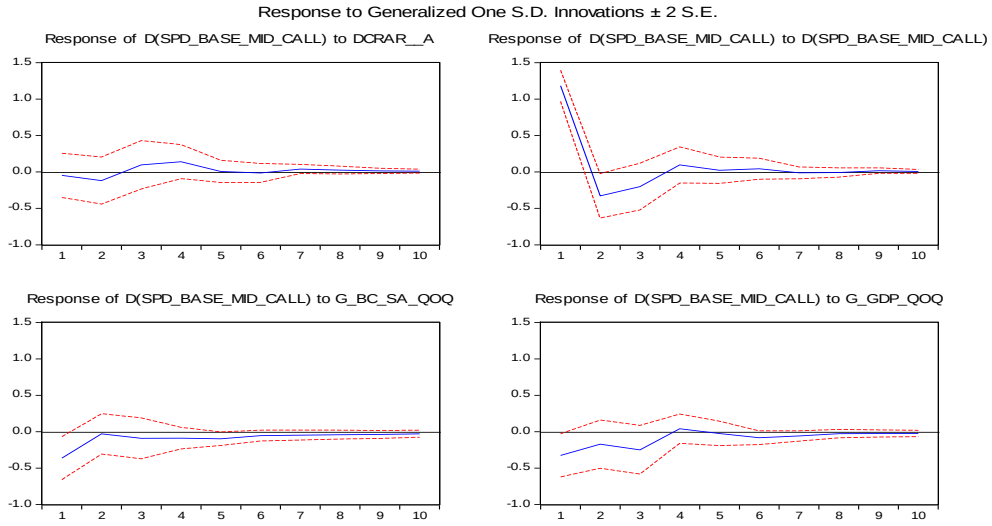
In an attempt to check whether our impulse responses were robust to changes in ordering of the variables, in this section we generate the same set of impulse response functions using Pesaran's generalized impulse response methodology. The impulse responses for a one standard deviation generalized shock broadly confirm the observations in the earlier sections, where an increase in CRAR is followed by an increase in banks' lending spreads, which in turn have an impact on banks' credit disbursements and q-o-q GDP growth (Figure-17).

Figure17: Generalized impulse responses of macro variables to CRAR shock



Shocks to banks' lending spreads have a similar impact on credit disbursement by the banks which decline in the short run. The impact to q-o-q growth in GDP also remains similar to that observed with the Cholesky decomposition. Figure 18 indicates that these observations are robust to ordering and confirms the impact of banks' credit disbursement on GDP.

Figure18: Generalized impulse responses to macro variables to Spread shock



V.2.4.5. Variance Decomposition

We now analyse the variance decomposition of credit growth and changes in GDP. As Table 23 indicates, the maximum variance in GDP growth rates was contributed to by self-variation, which tapered off over the period. Changes in banks' CRAR explain around 1 per cent of the variation in GDP which remains steady over time lags. Changes in bank lending spread explain around 12 per cent of the variation in q-o-q changes in GDP which also remain steady over the quarters.

Table 23: Variance decomposition of GDP (q-o-q) growth

Period	S.E.	DCRAR__A	DSPD_BASE_MID_CALL	G_BC_SA_QOQ	G_GDP_QOQ
1	1.3	0.3	4.3	0.4	94.9
2	1.4	0.4	4.7	1.3	93.5
3	1.4	0.9	12.4	1.9	84.8
4	1.4	1.0	12.4	1.9	84.7
5	1.5	1.2	12.5	1.9	84.3
6	1.5	1.2	12.5	1.9	84.3
7	1.5	1.3	12.6	1.9	84.2
8	1.5	1.3	12.6	1.9	84.2
9	1.5	1.3	12.6	1.9	84.2
10	1.5	1.3	12.6	1.9	84.2

A similar picture emerges when we analyse the variance decomposition for banks' credit growth (q-o-q). Besides their own contribution accounting for the maximum variation in the series, change in banks' lending spreads emerge as the second most important factor explaining around 5.5 per cent of the variations in bank credit. Changes in CRAR explain around 2.75 per cent of the changes in bank credit (Table24).

Table 24: Variance decomposition of bank credit growth (q-o-q, SA)

Period	S.E.	DCRAR__A	DSPD_BASE_MID_CALL	G_BC_SA_QOQ	G_GDP_QOQ
1	0.3	0.9	5.1	94.0	0.0
2	0.4	0.9	5.0	92.9	1.2
3	0.4	2.8	5.4	80.4	11.4
4	0.4	2.8	5.5	80.4	11.3
5	0.4	2.8	5.5	79.5	12.2
6	0.4	2.8	5.6	79.2	12.4
7	0.4	2.8	5.7	79.1	12.4
8	0.4	2.8	5.7	79.1	12.4
9	0.4	2.8	5.7	79.1	12.4
10	0.4	2.8	5.7	79.1	12.4

One of the observations that emerge from the q-o-q analysis is that lending spreads of banks plays a stronger role in deciding the impact of the shock on banks' credit disbursement and its subsequent impact on GDP. Therefore, if CRAR changes take place during the time when lending spreads are low, that is, when there are surplus liquidity conditions or the economy is in a good stage keeping the spread low, then the impact of CRAR changes on credit disbursement or quarterly GDP could be far less as compared to periods when the lending spread is already high. In a cross-country framework, countries with higher interest rates could have a severe adverse impact on bank credit or GDP growth as compared to countries which have low, near zero or negative deposit rates.

V.2.4.6.Quantifying the impact of one SD increase in CRAR ratio, accumulated impulse responses

So far we have evaluated impulses response in terms of one standard deviation shock to CRAR. Table 25 indicates the *accumulated* impact of such shocks so that we can have a quantitative impact on the overall effect of such a change on the GDP growth rate. The accumulated impulse response indicates that one SD change in the CRAR ratio (q-o-q) could lead to a small one quarter lagged decline in the seasonally adjusted q-o-q growth rate (Table 25). However, there are indications of improvement after 4-quarter lags. A change in a bank's lending spread by one SD shock over the quarter leads to a similar impact on the q-o-q GDP growth rate.

Table 25: Accumulated Response of one SD change in CRAR

	Change in CRAR			
Period	DCRAR__A	SPD_BASE_MID_CALL	G_BC_SA_QOQ	G_GDP_QOQ
1	0.32	0.00	0.00	0.00
2	0.29	0.16	-0.06	0.03
3	0.28	0.22	-0.07	-0.03
4	0.35	0.22	-0.06	-0.04
5	0.37	0.24	-0.07	-0.02

In the context of bank credit, as expected, the impact of a change in bank credit was much higher as compared to that of GDP.

V.2.4.7. Annual variation (y-o-y) changes

In the last section we analysed q-o-q changes in all key variables as these capture the momentum effect of the underlined variable. In this section we extend this analysis by incorporating both the momentum and base effects in the consideration, and therefore concentrate on y-o-y variations in these four variables (effect of an increase in the CRAR ratio on lending spread, y-o-y change in bank credit and in y-o-y GDP growth).

In general, we follow the steps followed in the last section for the analysis and start with ADF tests for stationary properties of these variables. The ADF tests indicate that their y-o-y changes were found to be stationary. We then move to a selection of appropriate lag length using a battery of criteria as indicated in Table26. The LR - Test and AIC indicate lag length 2 to be suitable while SC and HQ criteria found lag length 1 to be appropriate. However, maintaining consistency with the q-o-q analysis we selected a lag length of two quarters for our study

Table 26: Lag length Selection on a y-o-y basis

Lag	LogL	LR	FPE	AIC	SC	HQ
0	52.57550	NA	2.39e-06	-1.591982	-1.302646	-1.479807
1	167.9124	205.9587	6.91e-08	-5.139728	-4.271720*	-4.803203*
2	181.4843	33.03723*	7.63e-08	-5.691834*	-3.606330	-4.492135
3	199.7217	27.35619	7.24e-08	-5.132919	-3.107567	-4.347694
4	220.1642	27.74339	6.50e-08	-5.291579	-2.687556	-4.282005
5	247.3714	32.03723	4.74e-08*	-5.691841	-2.509139	-4.457910

We estimate a four variable VAR model with two lags, and variables ordering similar to the earlier Section, , to evaluate the impact of y-o-y

changes in CRAR ratio of all banks on changes in lending spread (y-o-y), credit growth (y-o-y) and growth in GDPFC (old series). After estimating the VAR model, we evaluate the impact of one SD shock to changes in CRAR and in lending spreads on all other variables. To identity structural equation errors, we first used the Cholesky decomposition. The effect of shocks in the above set of variable is summarized in Figure-18, which clearly indicates that a shock to a change in CRAR translated to higher lending spreads charged by banks in the short run, which slowly tapered-off over time. Unlike the earlier (q-o-q) analysis, credit, in case of y-o-y variations at best tapered off for the first few quarters and then took off. Seasonally adjusted GDPFC growth (y-o-y),however, declined for around two years before converging to the pre-shock level (figure 18, 19).

The experience with one SD shock in spread was more or less similar in terms of seasonally adjusted credit growth and lending spread. However, GDP growth declined and rebounded in around 1.5 years as compared with around 2 years in the case of CRAR increase. While generating this impulse response we ordered the variables in line with theoretical erogeneity and the identification criterion corresponded to that of short term and long term constraints as indicated in the previous section. We also attempted to evaluate generalized responses to test the robustness of our results to changes in ordering by using Preseran's generalized impulse response functions (Figures 20 and 21).

Figure-19 (a): Impulses of CRAR shock to Macro Variables (y-o-y)

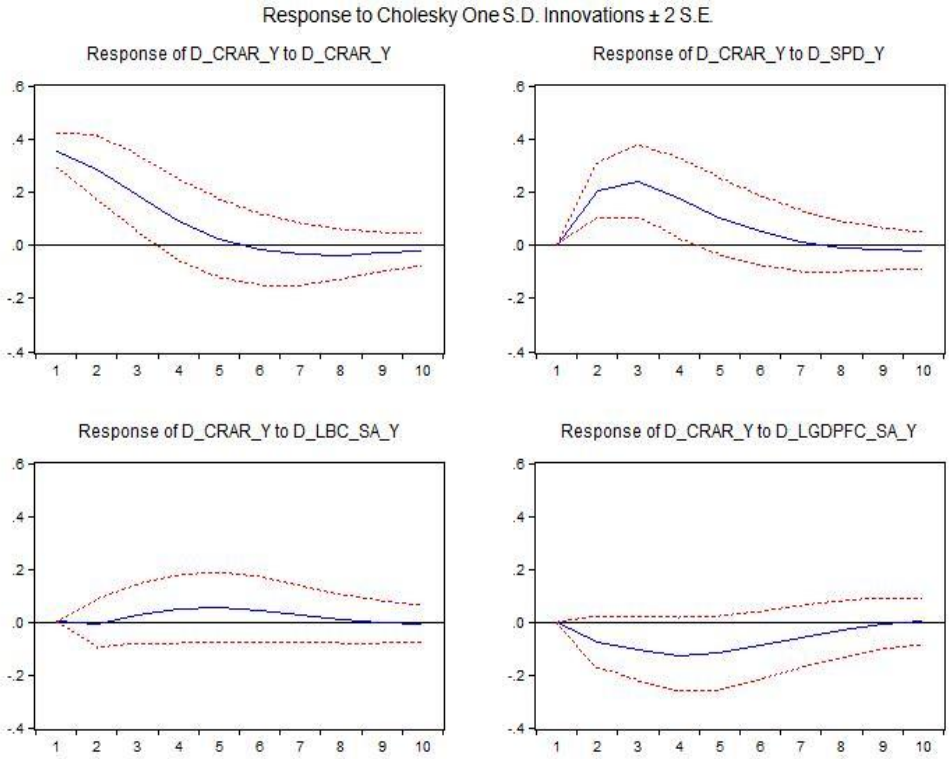
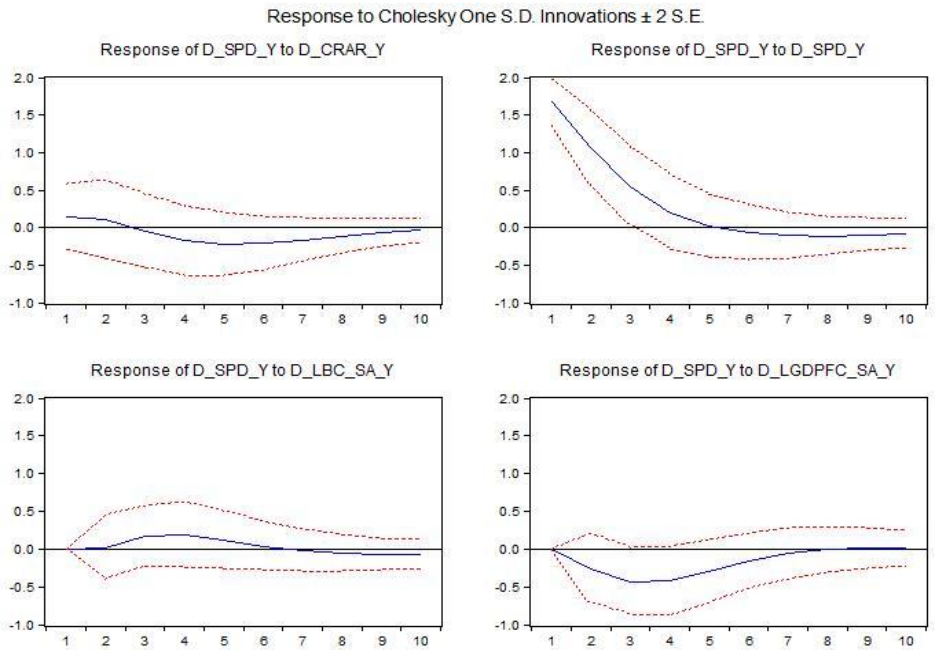
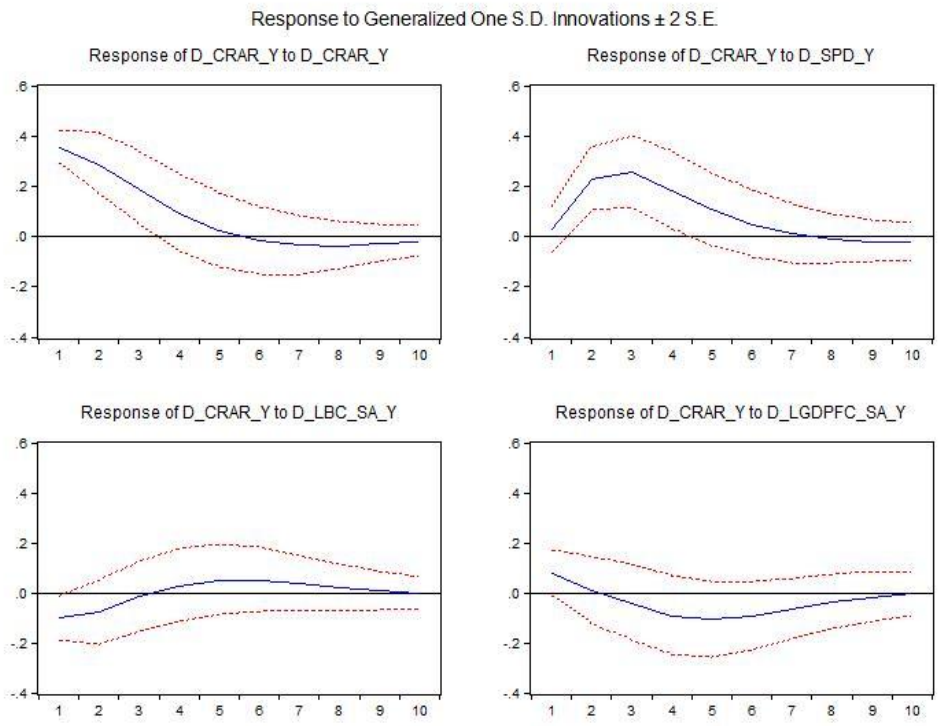


Figure-19 (b): Impulses of Spread shock to Macro Variables (y-o-y)



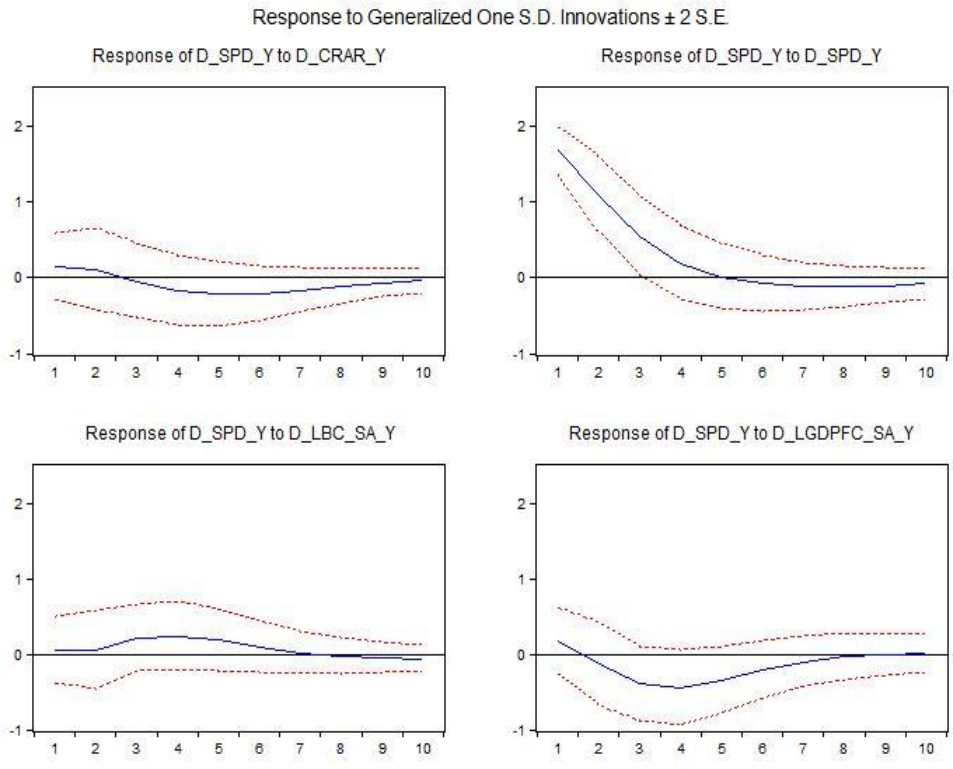
The generalized impulse response functions for one SD shock to CRAR broadly support the findings of the Cholesky decomposition. While bank lending spreads increased and GDP growth declined, and the effect tapered off by around 2 year, the major observable change in the impulse response functions came from the behaviour of y-o-y changes in credit. Here in case of a generalized impulse response function, credit growth first declined for around three quarters and then gradually picked up. The pick-up, however, tapered off by around the end of the tenth quarter. These findings are in line with theoretical evidence and the narrow spread of standard errors further supports the findings in terms of their statistical significance (Figure20).

Figure-20: Generalized Impulses of CRAR shock to Macro Variables (y-o-y)



As an alternative measure, a one SD generalized shock to a change in lending spreads produced almost identical impulse responses that were observed in case of Cholesky decomposition and supported the robustness of the findings. The standard error bands were much narrower in this case supporting the statistical significance of these impulse response functions (Figure 21).

Figure-21: Generalized Impulses of Spread shock to Macro Variables (y-o-y)



To summarize these observations, when y-o-y variations in banking parameters were used, the VAR results indicated robust results as compared to those observed in case of q-o-q variations, which are essentially momentum indicators. This is evident from the narrower standard deviation bands as indicated in impulse response functions and

similarity of order sensitive impulse response functions, as indicated in Cholesky decomposition and generalized impulse response functions. Finally, the impulse response observation broadly supports theoretical and empirical observations that an increase in CRAR is generally associated with an increase in the lending spread, a decline in credit in the short run and a decline in GDP growth rate which last for around 6-8 quarters before tapering off.

V.2.4.8. Gross value added at basic prices (GVABP)

So far, our analysis has been based on old quarterly GDP at factor cost at constant prices. In 2014, the Central Statistical Organization (CSO) released new GDP figures for the Indian economy which incorporated several changes. The new GDP series is in line with the System of National Accounts (SNA 2008) and takes into account value rather than volume and based on a MCA 21 survey rather than IIP and ASI data (for update with two years lag). While the new GDP series came with several welcome features, its growth rate and differences with the old series triggered several discussions in policy circles. Among them one of the most important issues was the absence of comparable long historical time series, which restrict policy calibrations.

In this section we try to bridge this gap by splicing the common data points of the new and old series and use these splice factors appropriately to get a historic new GVA data series. We use y-o-y seasonally adjusted growth rate from this new series and instead of

GDPFC we use the new GVABC for VAR and generalized impulse response functions. The impulse responses indicate similar characteristics when the old series was used for generating impulses. However, it appears that a dip in GVA was less pronounced (Figure 22 and Figure 23). This observation also holds for impulse responses for a change in spread.

Figure 22 - Generalized impulse responses to CRAR shock with new GVA series

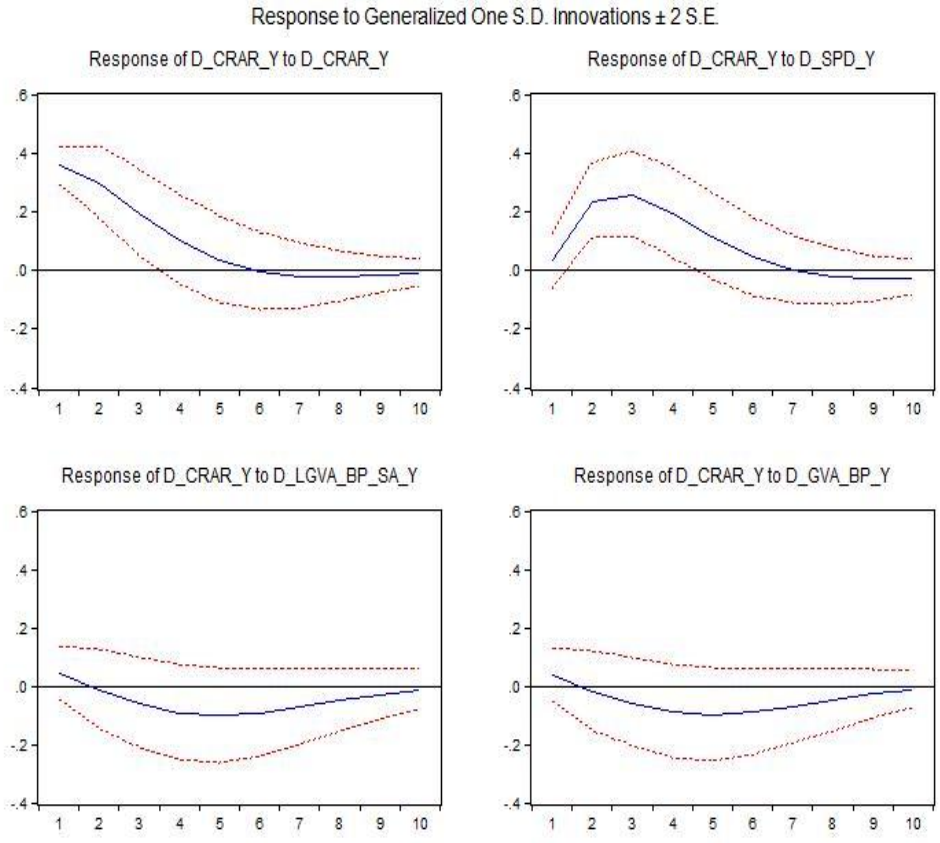
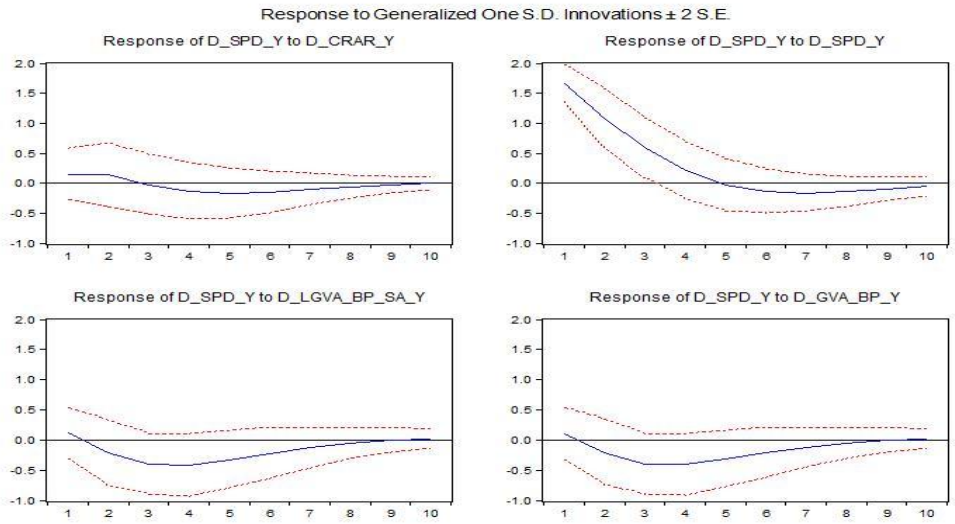


Figure 23 - Generalized impulse responses to Spread shock with new GVA series



V.2.4.9. Output GAP and countercyclical policies

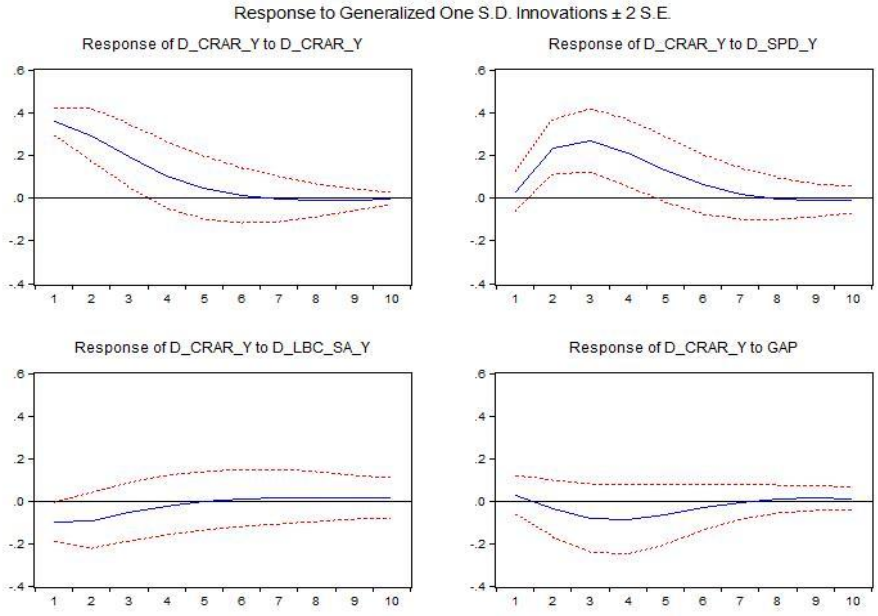
As indicated in the literature survey the 2008 crisis brought to the fore the nuances of a business cycle which have an impact on the banking sector, loan disbursement, risk taking and its attendant consequence on the real economy. Thereafter, FSB, Basle III and academia have emphasized the role of prudential regulations and banking capital policies during the economic and financial cycle. One of the major measures included in the Basel III accord relates to the counter-cyclical capital buffer that is designed to accumulate buffer capital during up-turns which can be used during economic downturns.

In view of the recent increase in counter-cyclical policies and the emphasis that has been placed on them in recent literature, in this section we evaluate the impact of an increase in the CRAR ratio on the output gap. We use GVABP series and HP filters to evaluate potential output

and the output gap. Then instead of GVABP growth we use the gap in these growth numbers from their potential as the fourth (output) variable. We use vector auto-regression and generalized impulse responses to analyse the effect of an increase in capital to the gap. Besides similar observations on the lending spread and bank credit growth the impulse response function indicates that the gap declines as a result of an increase in the CRAR ratio.

This finding is in agreement with the spirit of the counter-cyclical capital buffer policies that have been included in Basel III and have been implemented in India by the Reserve Bank. This indicates that past data suggest that an increase in the bank capital adequacy ratio will add to financial stability and also to macro-stability due to its impact in smoothening cyclical fluctuations (Figure 24).

Figure 24: Generalized Impulse to a shock to CRAR to output gap



Finally we attempt to quantify the possible impact of a change in the capital adequacy ratio on the GDP growth rate. In an attempt to get a quantitative understanding of this we tabulate the accumulated impulse response due to a one SD shock on the seasonally adjusted y-o-y growth rate. Table 27 indicates that over 2.5 years (10 quarters) the accumulated response of a CRAR change to GVAFC remains small but negative. It appears from Table 27 that the estimated impact remains small, and is in between estimates of MAG and IIF studies. In this context, it may be noted that the rate of interest in India is much higher than those observed in advanced economics (AEs), where presently the rate is near zero lower bound.

Table 27: Accumulated Impulse Responses

Period	D_CRAR_Y	D_SPD_Y	D_LBC_SA_Y	D_LGDPFC_SA_Y
1	0.356114	0.000000	0.000000	0.000000
	(0.03278)	(0.00000)	(0.00000)	(0.00000)
2	0.650958	0.221792	-0.013687	-0.055138
	(0.08212)	(0.05377)	(0.04548)	(0.03140)
3	0.849584	0.466565	0.003490	-0.106754
	(0.14448)	(0.11383)	(0.08805)	(0.05404)
4	0.949900	0.635902	0.024230	-0.161620
	(0.20619)	(0.17832)	(0.13671)	(0.07696)
5	0.980987	0.728593	0.046885	-0.198443
	(0.26017)	(0.23487)	(0.18199)	(0.09284)
6	0.971398	0.763588	0.056938	-0.219549
	(0.30364)	(0.27702)	(0.22375)	(0.10354)
7	0.946854	0.766672	0.057338	-0.227264
	(0.33524)	(0.30386)	(0.26174)	(0.11100)
8	0.921889	0.754541	0.050498	-0.228801
	(0.35501)	(0.31849)	(0.29736)	(0.11751)
9	0.902931	0.738233	0.040882	-0.227880
	(0.36469)	(0.32528)	(0.33143)	(0.12365)
10	0.890730	0.723020	0.030436	-0.226970
	(0.36725)	(0.32830)	(0.36444)	(0.12946)

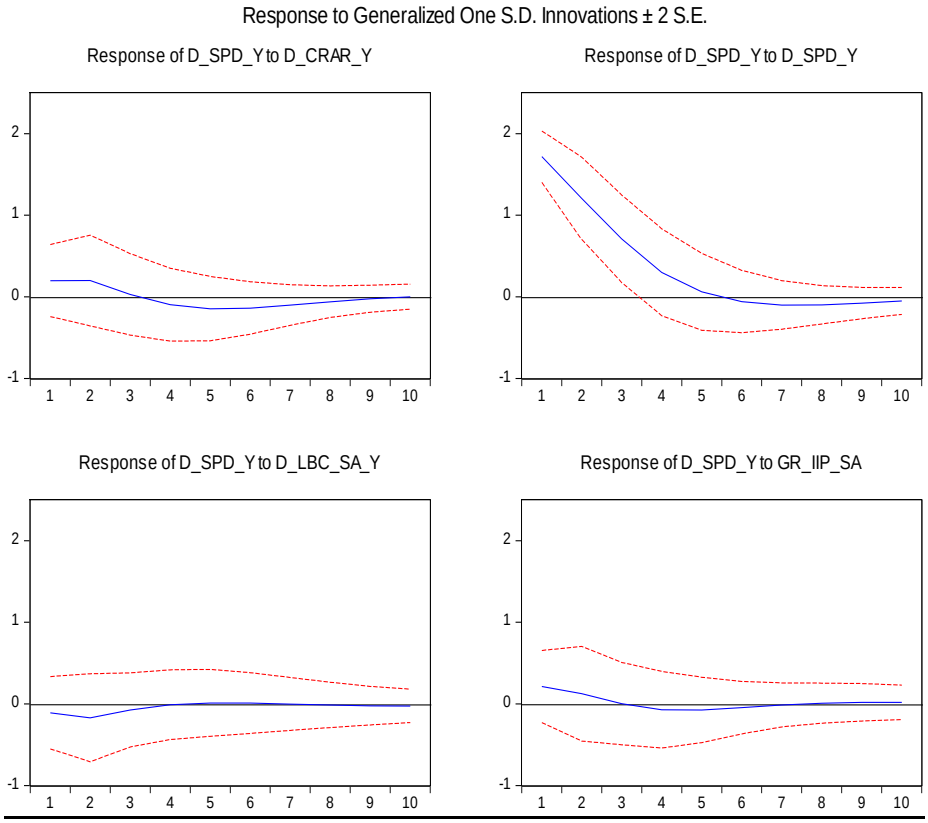
V.2.4.10. IIP Growth and Bank capital increase

So far we have concentrated on GDPFC and it new version GVABC. Now we take a concentric look at the manufacturing sector, which is generally perceived to be a formal banking and credit sensitive sector of the economy. For this we used quarterly IIP data, which has around 75 per cent weight in the manufacturing sector and acts as a representative one for the same. The IIP series generally indicates considerable seasonal patterns. Therefore, we used a quarterly seasonally adjusted IIP growth rate for our study. However, the IIP series has an advantage of being of monthly frequency, which makes it more convenient to use for policy purposes.

We tested for the time series property of the growth IIP series and found it to be stationary and we included it in our four variable VAR model as an indicator of output growth.

As earlier we estimated the VAR system of equation with change in CRAR, change in banking spread, growth rate of seasonally adjusted bank credit and finally seasonally adjusted growth rate in the IIP series. We generated the impulse response function using Pasaran's generalized impulse responses. The resulting impulse responses are given in Figure 25.

Figure 25: Generalized one SD change in CRAR on IIP Growth



The effect of one SD generalized shock to the four variable system generally remains in line with that of GDPFC and GVABC. The shock had an impact of an increase in spread, decline in credit growth and decline in IIP growth. The difference in terms of the output growth path using IIP growth from that of GDPFC or GVABP is that IIP growth declined after a lag and such a decline was short lived as compared to earlier observations (Table 28).

Table28: Variance decomposition of growth rate of IIP

Period	S.E.	D_CRAR_Y	D_SPD_Y	D_LBC_SA_Y	GR_IIP_SA
1	0.347203	10.11120	0.769640	0.050978	89.06818
2	0.489944	12.84325	2.209864	2.525298	82.42159
3	0.575442	16.78428	2.380629	4.456433	76.37866
4	0.620388	20.36633	2.299261	6.399946	70.93447
5	0.640860	22.50163	3.236601	8.157859	66.10391
6	0.648940	23.24416	4.758331	9.729831	62.26768
7	0.652245	23.18928	6.156284	11.12452	59.52992
8	0.654213	22.84894	7.113164	12.34310	57.69479
9	0.655787	22.48533	7.639379	13.37832	56.49697
10	0.656993	22.17966	7.873455	14.22990	55.71699

This finding is also indicated in the variance decomposition function of the IIP growth series. Besides self-fluctuations explaining changes in the seasonally adjusted IIP growth rate an increase in CRAR also plays an important role in explaining IIP variations. The variance decompositions indicate that CRAR explains 23 per cent of the changes in GR_IIP_SA during six to seven quarter lags, and such a large effect tapers off.

V.2.4.11. IIP for Core (Infrastructure) industries

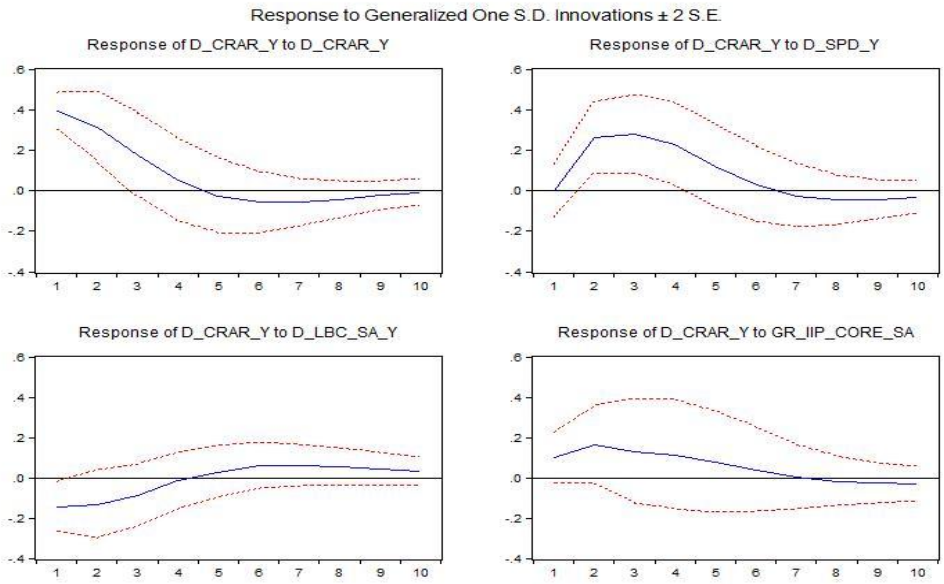
Infrastructure has been a major bottleneck in achieving a higher growth path. This has been especially true in the case of emerging markets like India, where long gestation periods, large NPAs in the infrastructure sector, uncertainty in the legal and regulatory framework in key areas such as environmental clearances, land acquisition and use of natural resources and weak business sentiments have an adverse impact on infrastructure investments.

Considering the importance of the sector the Reserve Bank has provided many incentives for encouraging the flow of bank credit to it. The Reserve Bank allowed banks to raise funds for lending to the infrastructure sector without regulatory requirements such as CRR, SLR and priority sector lending targets. The union budget has also sought to improve infrastructure through measures related to public-private partnerships (PPPs) and setting up of a National Industrial Corridor Authority in order to coordinate the development of industrial corridors with smart cities linked to transport connectivity. Given the infrastructure deficit, a large opportunity awaits the private sector for participation in the growth of the sector. These opportunities exist in road, railways, ports and power sectors. Improved contractual arrangements can rekindle interest in this space and help the investment cycle to turn around soon. The Government of India also took several measures in union budget 2014-15 to boost investment in infrastructure.

Considering the importance of easing infrastructure and supply bottlenecks, its forward and backward linkages for an emerging market economy, we considered the impact of an increase in CRAR in the banking sector on the infrastructure industry. This requires considerable policy attention when we consider that the Indian banks have accumulated large NPAs from their investments/loans in the infrastructure sector in India. So an increase in CRAR could theoretically lead to reduction in bank loans to the sector resulting in adverse feedback on the further development of the economy. To evaluate how far this is supported by past data, we re-employed our earlier four variable VAR model with growth of seasonally adjusted core (infrastructure) IIP as one of the endogenous variables. The impulse responses using the VAR framework and using generalized shocks are reported in Figure 26.

One aspect that clearly emerges from Figure 26 is that while the impact of an increase in CRAR on bank lending spread and seasonally adjusted bank credit growth remain similar, there is a difference between earlier measures of output and the core (infrastructure) IIP growth rate. The impulse response for core IIP did not decline immediately as a result of one SD shock in CRAR, as in the case of other measures of output. There was a sign of decline but it was much more gradual as compared with those measures of GDP (Figure 26).

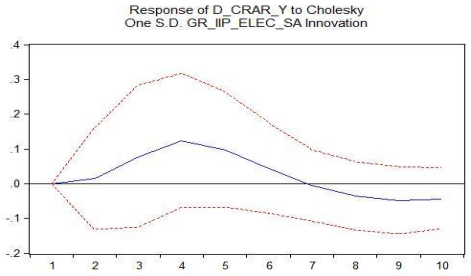
Figure 26: Generalized impulse response to core industries (core IIP growth)

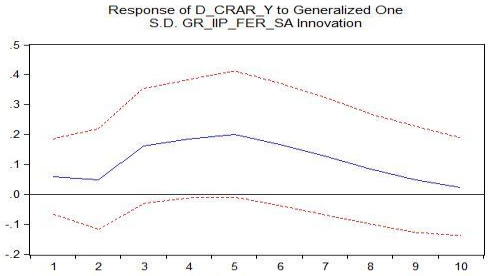


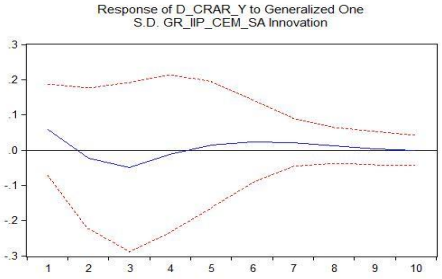
V.2.4.12. Impulse response of different infrastructure sectors included in core IIP

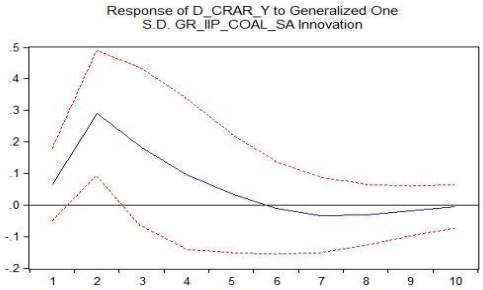
These findings of different impulse responses prompted us to investigate IIP production based indices from different sectors and their relationship with an increase in the capital adequacy ratio of the Indian banking sector's lending spreads and credit growth. For this we included all the eight sectors of the IIP core (namely cement, coal, crude, fertilizer, petroleum and refinery, electricity, steel and natural gas) separately in our generic VAR model to evaluate impulse responses (Figure 27).

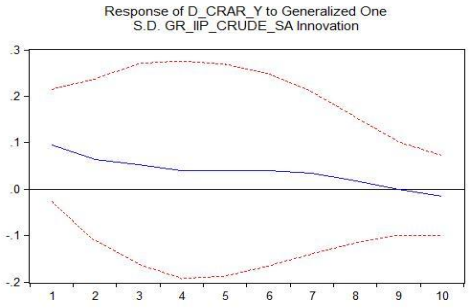
Figure 27: Impulse response of a CRAR change to different infrastructure sectors included in core IIP (Electricity, Fertilizer, Cement, Coal, Crude, Natural Gas, Petroleum and Steel)

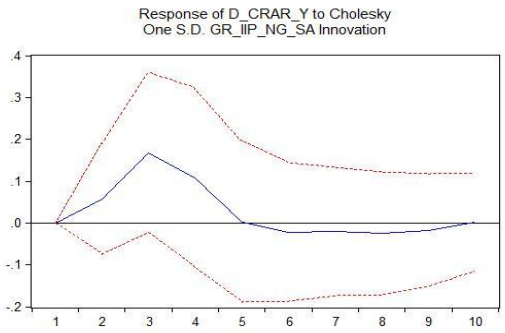


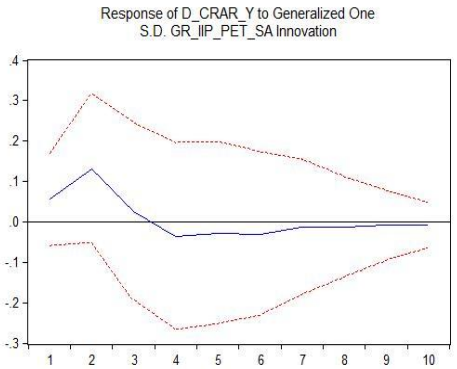


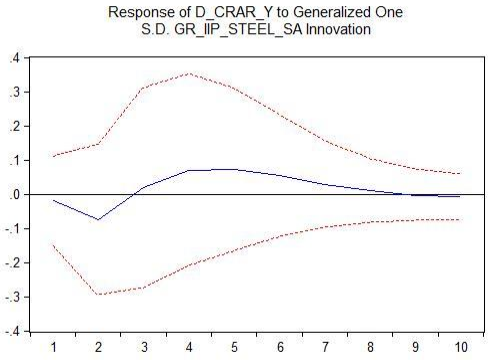












The impacts of a one standard deviation shock to different infrastructure sectors are summarized in Figure 28. Empirical observations are summarized in the generalized impulse responses to one SD shock to a change in CRAR on lending spreads while the bank credit growth remains the same as in earlier observations. However, impulse responses to these components of core industries lead to certain observations, which are very different from those observed in case of GDPFC, GVABP or even IIP growth rates. First, in case of these infrastructure sectors, there was hardly any immediate decline in their index growth, which is very different from what was observed for different measures of real output; second, the decline in these indices, if it took place at all was after a long lag (5-8 quarters) and that too at a much gradual pace as compared to the output indices in general; third, among these industries only the steel industry witnessed an initial decline; and finally, as indicated by the wide standard deviation band, most of these responses may be statistically insignificant at the conventional level. Though weak, empirical evidence does suggest that the behaviour of sectoral indices of core IIP (infrastructure) was different and there was no statistically significant evidence of an immediate decline in these indices as a result of an increase in banks' CRAR ratios. This could be because of several policy measures that safeguard the strategically important infrastructure sector from paucity of credit in the advent of policy changes that could affect banks 'credit off-take.

While we emphasize the observed differences, there are certain data issues when we use IIP core and its components. First, these dataset are available since 2004, and because we work with quarterly data, we have around 37 observations for these series. With lagged coefficients, there is a lesser degree of freedom for this analysis. Second, these are production based indexes and so some of them are quite volatile. Therefore, the results in this section, though emphasized from the policy point of view need to be interpreted with these caveats.

VI. Summary, Conclusions and Policy implications

Since 2008, the GFC have highlighted the ill effects of banking crises and the inherent pro-cyclicality of risk based banking capital. After a series of discussions, deliberation, multilateral organisations (e.g. G-20, BIS) have initiated several measures to address these policy gaps. Some of the major initiatives in this regard aimed at improving the quality and quantity of banking capital and introducing elements of counter cyclicality in banking operations. The capital reforms call for higher banking capital holdings in the form of Tier-I capital, the most subordinate claim being in the case of bankruptcy. A bank attempting to raise capital could do so by retained earnings, raising capital from the market, a stake sale by majority holders or by infusion of capital from owners. There is ample evidence in literature that banks attempting to raise capital generally witness an increase in their lending spreads to cover the costs of additional capital. If raising capital is costly because of asymmetric information and debt overhang problems, especially during a downturn, a bank may choose to ration lending, especially to risky ventures, to match the target capital adequacy. With the emphasis on the quantity and quality of bank capital in the Basel III accord, a debate has erupted on the quantum of output sacrifices for achieving financial stability and their short-run and long-run characteristics. Several multilateral organizations, think tanks and industry representatives have estimated the magnitude of the trade-off. To refer to a few, BIS's Macroeconomic Assessment Group (BIS) estimated the impact of Basel

III implementation on GDP to be relatively small and short lived, whereas the Institute of International Finance estimated much higher costs (in terms of decline in GDP) for implementing Basel III. While the estimated models and their assumptions differ, the trade-off depends on the timing and initial conditions (for example, the level of capitalization of banks or present interest rate cycles) in the underlying economy.

The Basel III measures of strengthening capital in the banking system were endorsed by the G-20 Banking Summit in November 2010. The Regulatory Consistency Assessment Programme (RCAP) indicates that while some countries have already completed implementing capital regulations other have made progress depending on their stages of development. Our analysis with the real GDP growth rate and capital adequacy ratio indicates a negative relationship between the two for China, Indonesia and South Korea. A dynamic panel regression also supports a negative relationship between banking capital adequacy and GDP growth for these countries.

India has started implementing Basel III recommendations. The RCAP assessment in 2015 found India to be compliant with all 14 components of the Basel framework. Indian banks are presently adequately capitalized with significant portions of Tier-1 capital being contributed by common equity (CET1).

With the Reserve Bank and the Government of India attempting policy measures for a smooth transition to the Basel III capital framework, we made an attempt to estimate the impact of such large capital infusions on changes in lending spreads, banks' credit off-takes and risk taking and their consequent impact on GDP growth using historic data from 1996 to 2015 (quarterly) from different publicly available sources.

A correlation between banks' capital and lending rates generally indicates that banks' lending rates increase with a growth in bank capital. A stronger result holds between a bank's lending spread (lending rate minus call rate) and growth in bank capital. In a multivariate framework, the bank lending spread is found to be positively and significantly related to changes in the capital adequacy ratio (CRAR) after controlling for growth cycle, inflation, change in non-performing assets (NPAs) and a crisis period. GDP growth (and also output gap) has a positive (significant) coefficient indicating an increase in the spread during an economic boom, while changes in GNPA have a negative coefficient indicating decline in the spread with an increase in bad assets in the banking sector. Among the bank groups, changes in public sector banks' (PSBs) CRAR have the maximum and most significant impact on spreads, which is expected, as public sector banks dominate the Indian banking arena.

Correlation results indicate that there are positive and significant correlations between an increase in banks' capital and deposit

mobilization by the banks. There has been considerable debate on the negative relation between an increase in the banking sector's capital and credit growth. We attempted to evaluate the relationship between bank capital and credit growth after controlling for demand side factors affecting credit. This relationship held after controlling for an output-gap, stock index returns, lending rate and persistence in the credit off-take (AR(1)) coefficient. The output gap had a positive coefficient indicating a pro-cyclical increase in credit off-take, while the lending rate reported a negative coefficient.

There is debate surrounding the factors that influence a bank's risk taking, with a school of thought claiming that a bank's investments in risky assets declines with an increase in capital requirements. Our correlation analysis results indicate that as capital requirements increase, banks' investments in Gsecs increase and their investments in housing decline. This indicates that higher capital requirements reduce banks' investments in risky segments.

In a multivariate analysis, we controlled for other demand side factors (GDP growth, interest rate, stock returns and change in SLR) and attempted to evaluate the impact of changes in CRAR (and its lags) on the growth rates of housing credit and Gsec investments. Empirical results support our earlier findings and indicate that with an increase in banks' capital requirements they park their funds in safer investments (Gsecs). Stock returns had a positive and statistically significant

coefficient for an increase in a bank's investments in housing while the coefficient was negative and significant for a bank's investments in Gsecs, indicating banks' risk taking behaviour during an upturn in the financial cycle and/or market perceptions.

The relationship between bank capital and output is unlikely to be contemporaneous. This is also supported by our correlation results using different measures of output (quarterly GDP growth, IIP growth and core IIP growth and their components). These suggest the absence of significant contemporaneous relationship between an increase in the banking sector's capital and output growth.

To evaluate the impact of a shock to bank capital on major macro-variables, we followed existing literature and estimated an endogenous set of equations in a Vector Auto-regression framework suggested by Sims. We then evaluated the effect of a structural shock to a change in a bank's capital adequacy ratio on other macro-variables by analysing impulse response functions, accumulated impulse response functions and variance decompositions. To test the robustness of our results we used: a) generalized impulse responses which are indifferent to the ordering of the variables, as established by Pesaran, and b) a different set of variables (proxy) for output growth and/or gap. We started with the momentum measure, that is, q-o-q changes in four variables -- CRAR, bank lending spread, bank credit growth (SA) and the q-o-q growth rate of GDP. The results indicated weak evidence of increase in spread,

decline of bank credit growth and decline in quarterly GDP growth. These results were consistent when generalized impulse responses were generated. The variance decomposition of q-o-q growth indicates that a small portion of the variation in quarterly GDP growth was explained by a change in CRAR, while change in the lending spread explained much more variations.

Using the same VAR framework after replacing q-o-q variations by annual variation (y-o-y) changes we got a statistically significant result of increase in lending spread and decline in GDP due to a shock to CRAR changes, which is robust to changes in variable ordering. A shock to a bank's lending spread had a similar effect on output decline. These findings are in line with BIS's findings on the impact on GDP. In view of having an estimate with the new series, we spliced the series appropriately and got a series for historic data. Using this as a proxy for output in the VAR model, we evaluated the effect of a shock to a CRAR change and bank spread. The impulse responses were indicated a decline in bank credit to commercial sectors and to the GVABP growth rate. In an attempt to evaluate the effect of an increase in banking capital requirements on the cycle, we evaluated cyclical variations in GVABC using different methods of estimating output gaps (HP, Bandpass filters). We then used the same VAR system after replacing the estimated output gap as a proxy for an output variable. The impulse responses clearly indicated a decline in the output gap due to a shock in banks' CRAR.

This finding notes the stabilizing impact of buffer policies in the Indian context; besides macro-prudential features of a capital buffer, an increase in bank capital during an economic boom is likely to stabilize positive outputs and thereby contribute to economic stability.

To have a focused approach on the impact of an increase in bank capital on manufacturing sector, we considered seasonally adjusted IIP growth as a proxy for output growth and estimated the VAR system and impulse responses. The impulse responses indicated a decline in responses to the manufacturing sector's output. However, it seemed to be short lived as compared with a decline in other measures of output.

Infrastructure plays a dominant role in sustaining long term growth in emerging market economies. Considering its strategic importance, we tried to evaluate how change in banks' CRAR impacts core (infrastructure) IIP. To do so, we replaced the last variable (output gap) by the seasonally adjusted core IIP growth rate and estimated the VAR model. The impulse responses using both unrestricted and generalized VAR gave a different prospective for core IIP growth, as there was no initial decline and these impulse reactions were not statistically significant. It could be the case that long term loan contracts, active policy measures and monitoring for these sectors resulted in such difference in results.

After an extensive literature survey, considering a battery empirical techniques to evaluate lending spreads and discussing credit flow and its impact on output (using a set of proxy) it may be concluded that the new banking regulations could have a small cost in the short run as compared to already documented measures of huge losses due to financial instability. The increase in capital during an economic expansion could achieve the macro-prudential goals as well as being an automatic economic stabilizer. Experience with the infrastructure sector was an exception to this finding. These results are robust to the introduction of a new GVA and changes in impulse generating techniques. On the issue of what could be the exact magnitude of the shock, it may be mentioned that lending spreads of banks play a stronger role in deciding the impact of capital shocks on banks' credit disbursements and their subsequent impact on output. Therefore if CRAR changes takes place during a time when lending spreads are low, then CRAR's impact on changes in credit disbursements or quarterly output growth could be far less as compared to periods when the lending spread is already high. In a cross-country framework, countries with higher interest rates could have a significantly higher impact on bank credit or GDP growth as compared to countries that have low, near zero or negative deposit rates.

VII. Way ahead

In this research we have empirically evaluated the possible impact of an increase in banking sector capital on output. Taking cue from theoretical and empirical literature, we attempt to evaluate such impact on the basis of historic data in a partial equilibrium, multivariate regression and all endogenous variables (VAR) frameworks. The natural progression to this could be a dynamic stochastic general equilibrium (DSGE) model incorporating financial sector that will allow us experiment with counterfactual with different assumptions for Indian banking sector. However, literature on DSGE models with a financial sector that fits the characteristics of EMEs are still in the nascent stage, though some work in this direction has already been initiated by the MAG in the BIS.

The second extension of this study could be by introducing the impact of an increase in global banking sector capital on Indian economy. An IMF working paper in this area indicates an additional decline in GDP due to global spillovers effects. In this context it may be mentioned that the RBI Annual Report 2014-15 highlighted the importance of global spillover and spillback for India. An analysis of the impact of spillovers from the Fed's QEs shows that the largest favourable impact came from QE1 that pushed capital flows into India, helping finance a widening current account deficit. These spillovers were transmitted mainly through the portfolio rebalancing channel, followed by the liquidity channel. However, to the best of our knowledge no formal work has

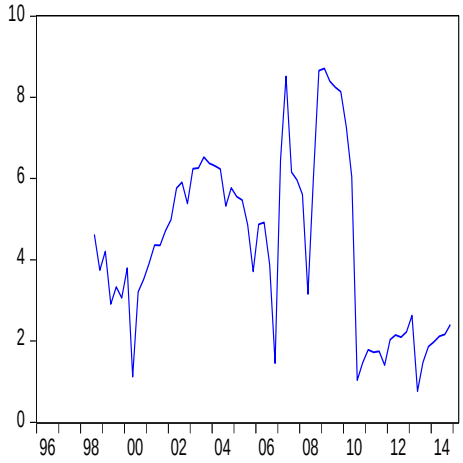
been done in this context for Indian economy, which explicitly incorporates the spillover and spillback effects of an increase in banking capital requirement in global scale and its consequent impact on global output. A possible extension of this study could therefore attempt to quantify such spillover impact on banking sector and GDP.

Annex

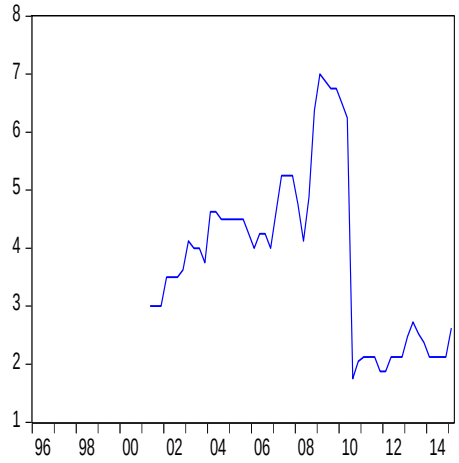
(Variables defined in Table Five, G_variable indicate growth rate, Variable_SA indicate seasonally adjusted)

A1: Behaviour of bank lending spread

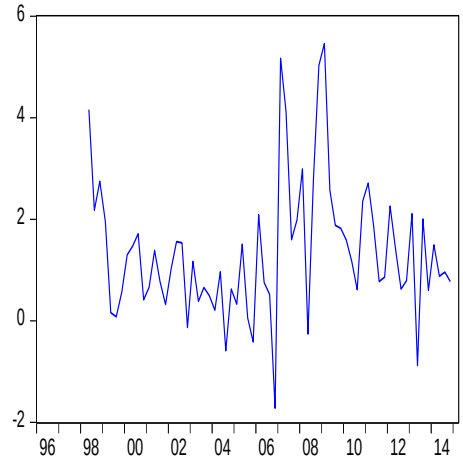
SPD_BASE_MID_CALL



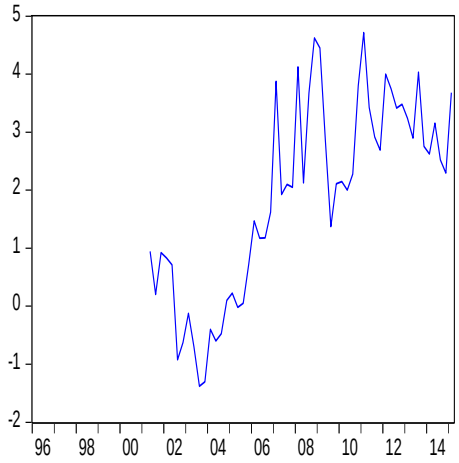
SPD_BASE_MID_POLICY



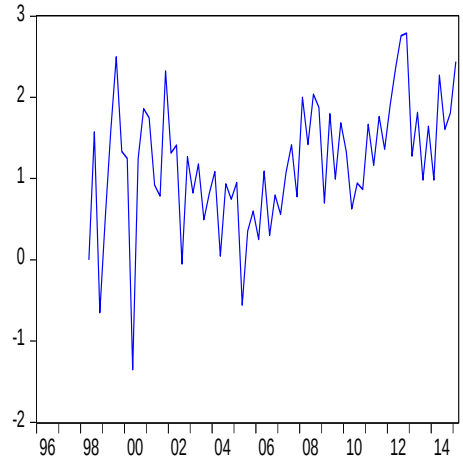
SPD_CD_CALL



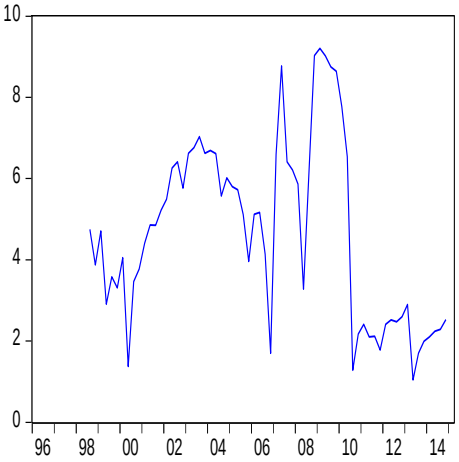
SPD_CP_POLICY



SPD_MID_CP_CD

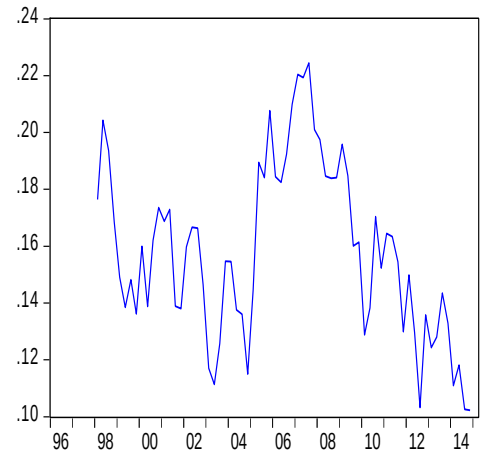


SPD_BASE_MAX_CALL

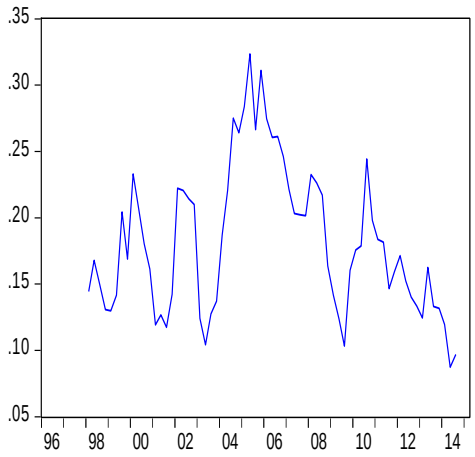


A2: Behaviour of banks' lending / borrowings

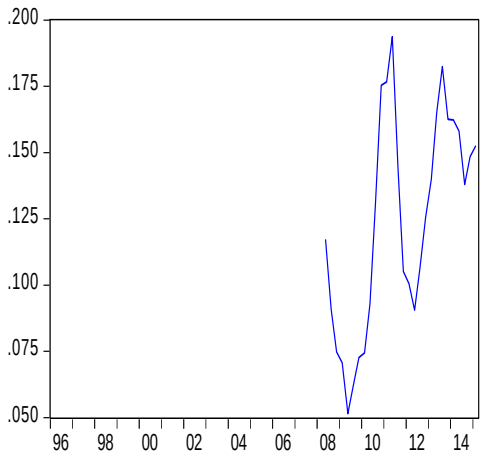
G_AD_SA_YOY



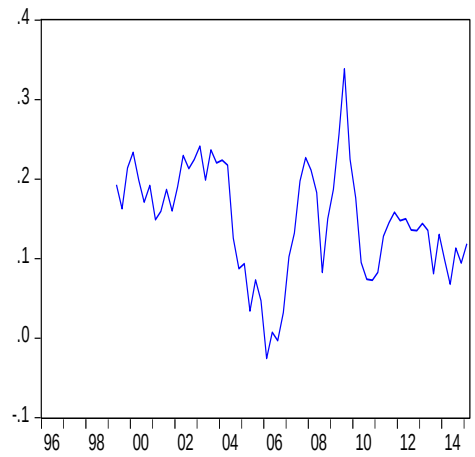
G_BC_SA



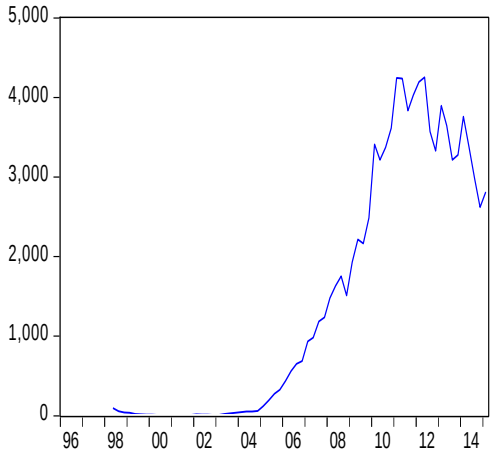
G_BANK_HOUSING



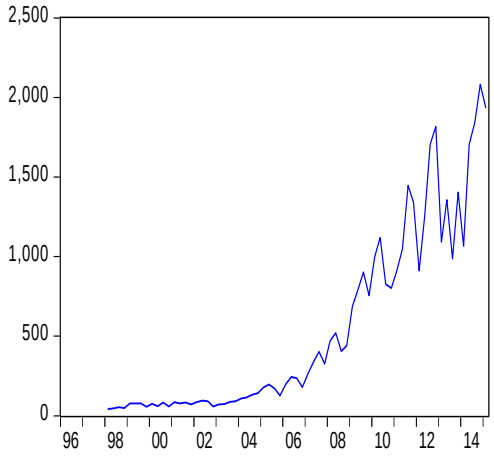
G_BANKD_GSEC



CD_AMT

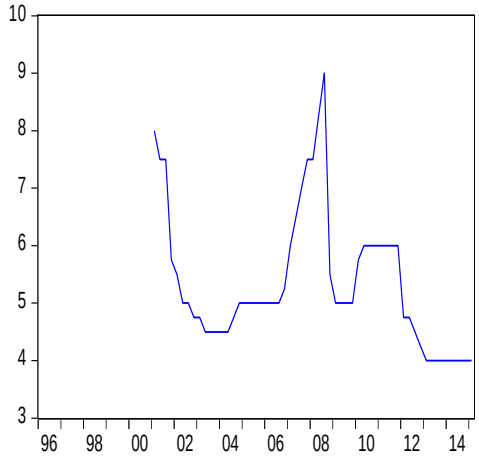


CP_AMT

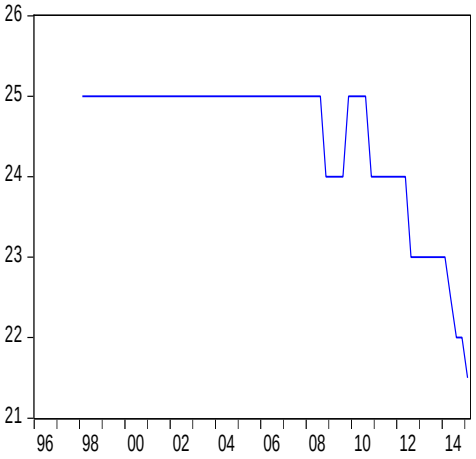


A3: Movement of monetary policy variables

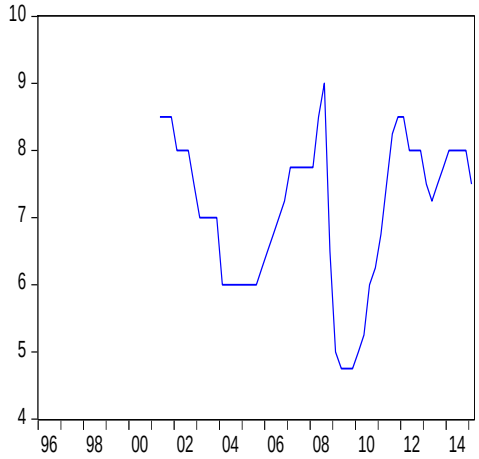
CRR



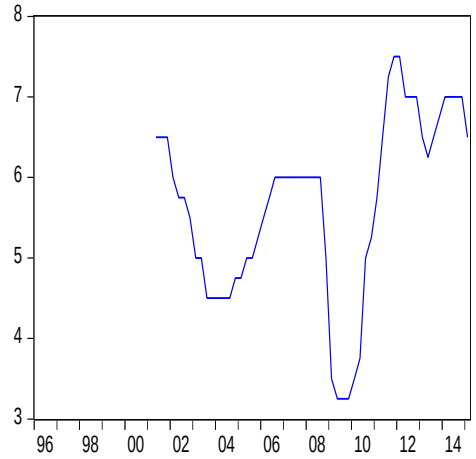
SLR



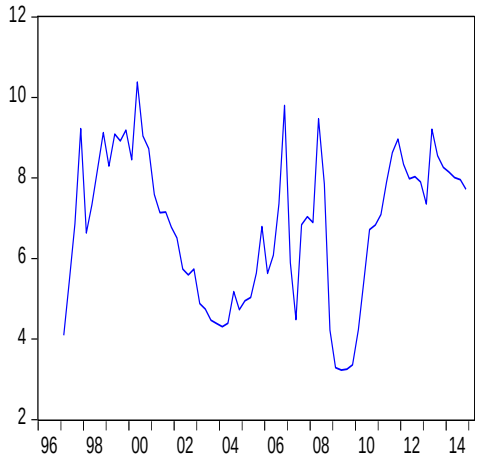
REPO



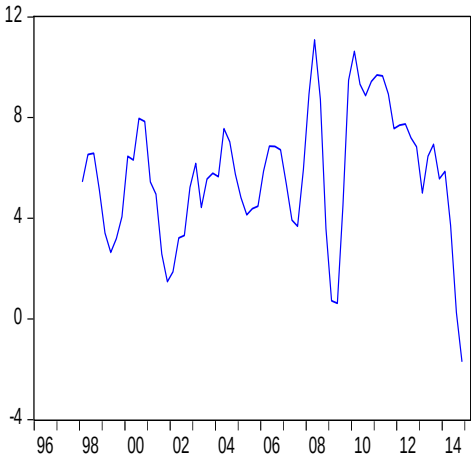
REV_REPO



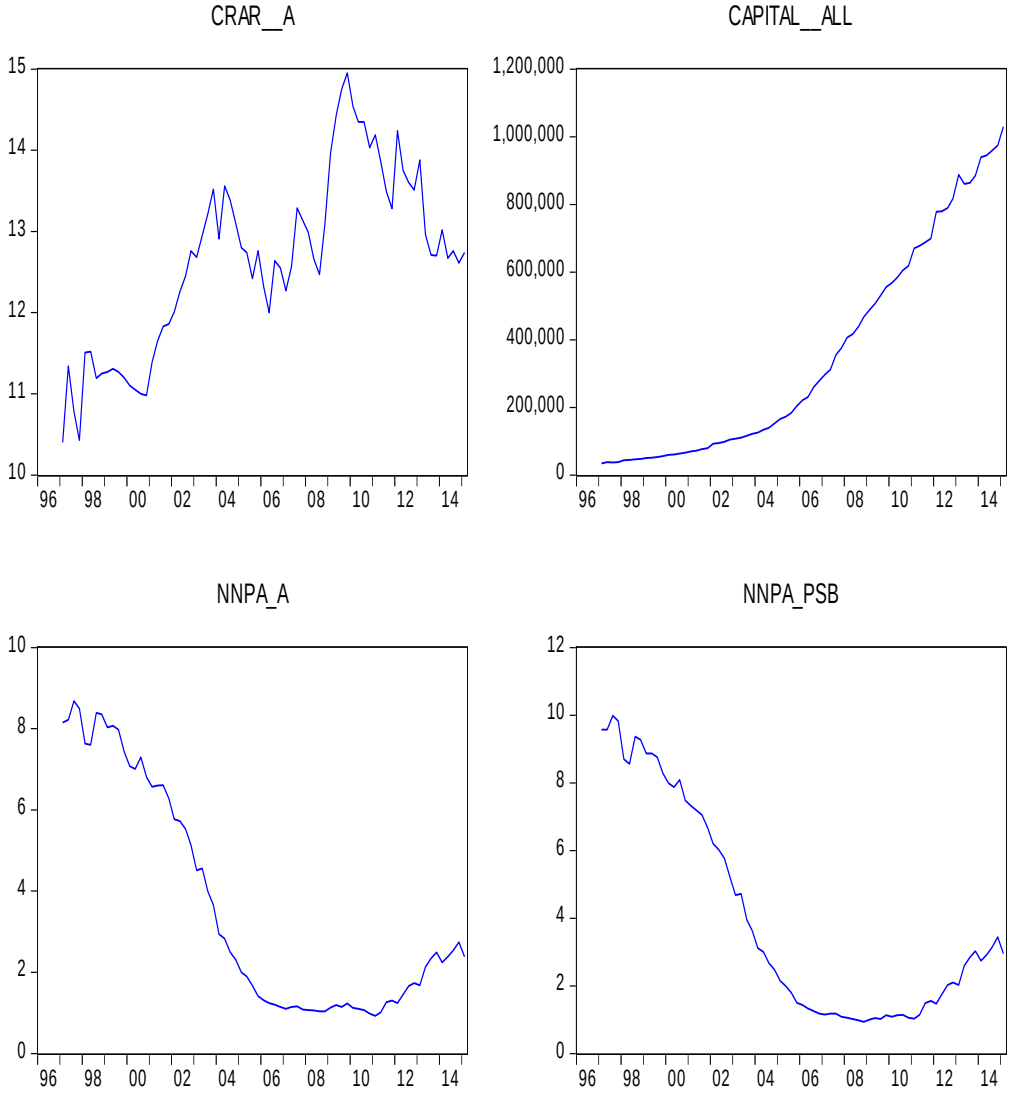
WCMR



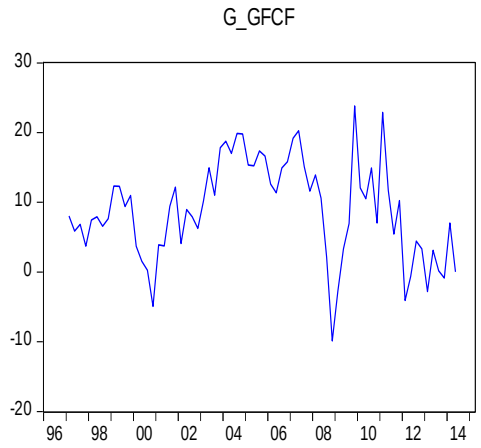
G_WPI_SA

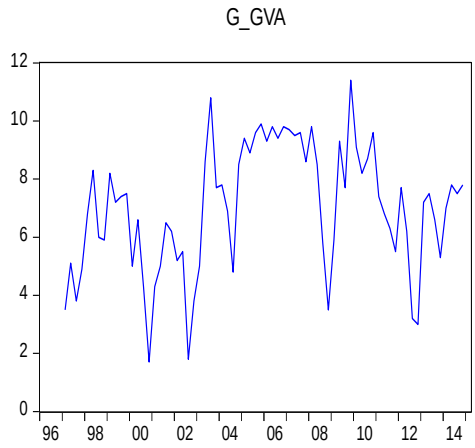


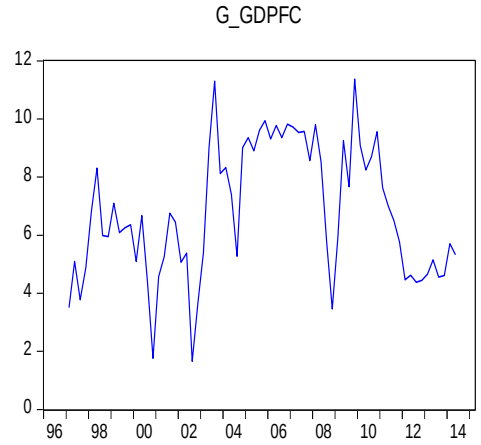
A4: Banking variables

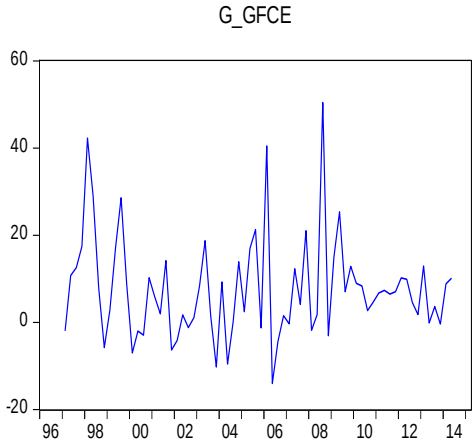


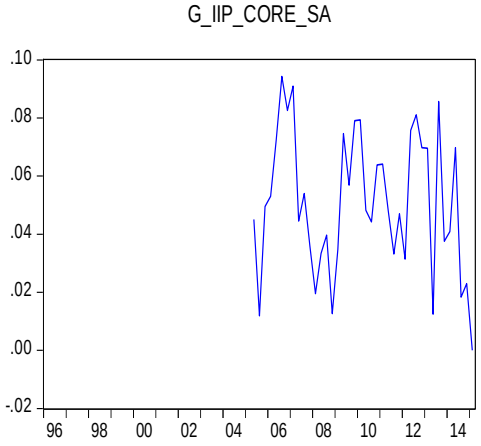
A5: Measures of output growth

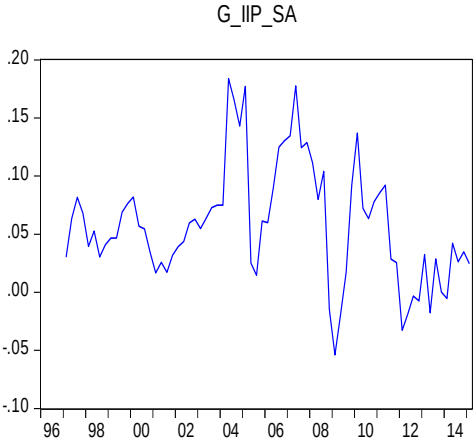




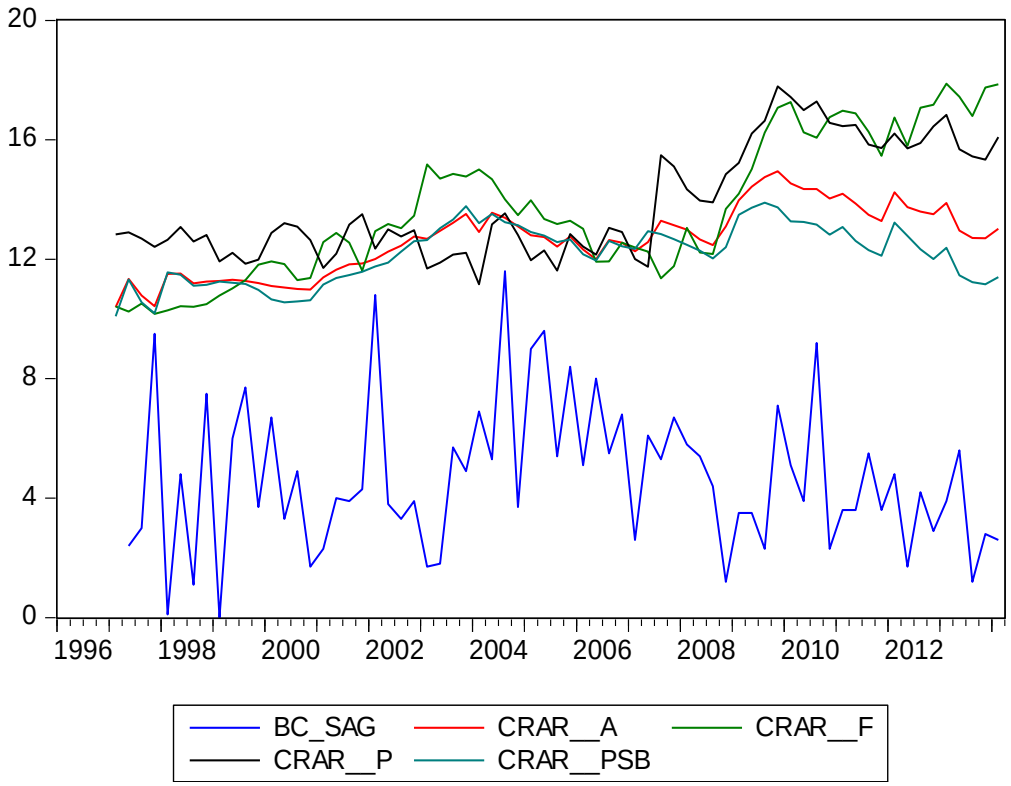




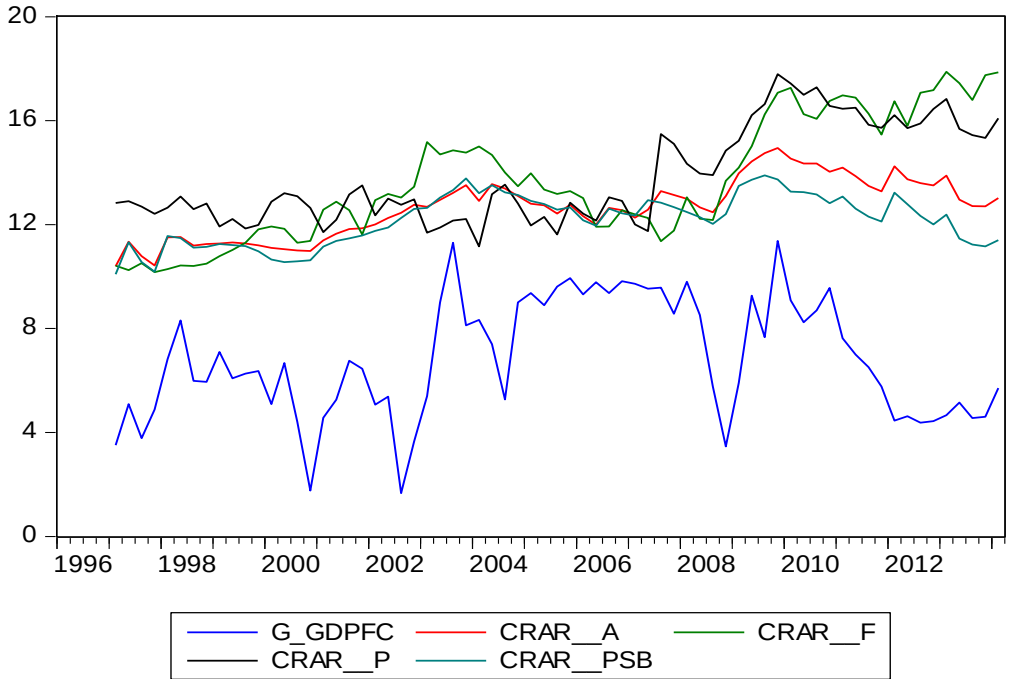




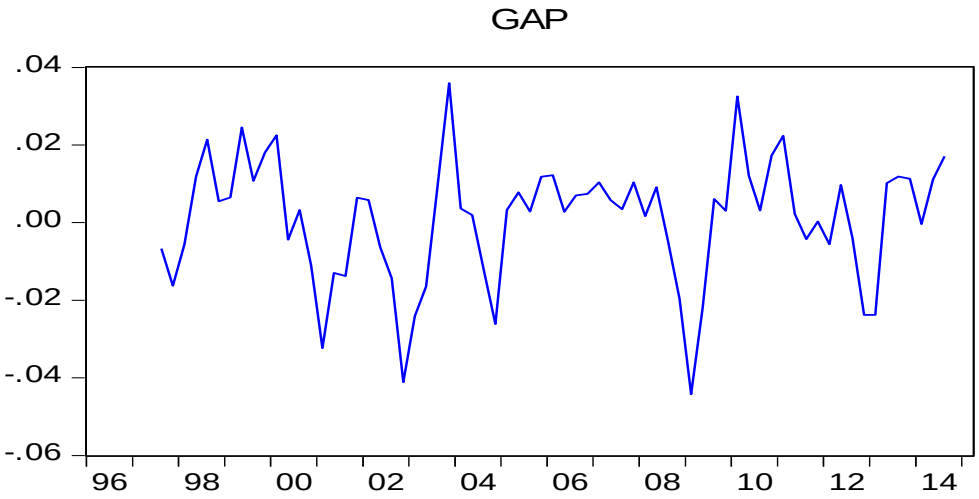
A6: Movement in all banks CRAR and bank credit growth seasonally adjusted

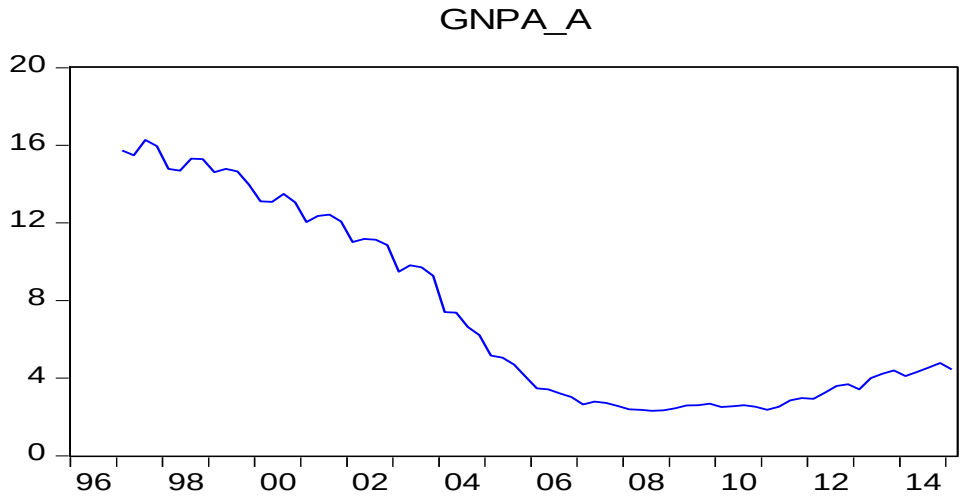


A7: Movement in all banks CRAR and real GDP growth



A8: Gap movements and banking variables





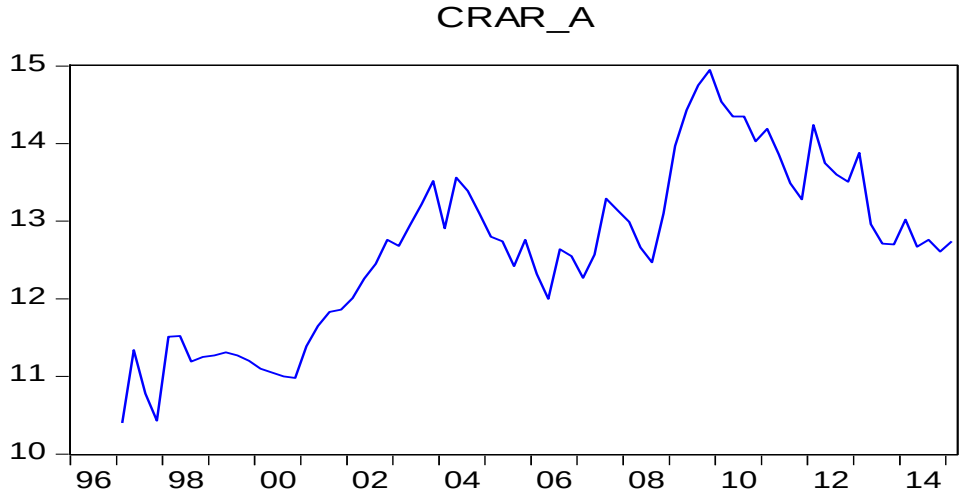


Table –A1 Correlation Analysis

Sample (adjusted): 3/01/1997 3/01/2014 Included observations: 69 after adjustments Balanced sample (list wise missing value deletion)

	CRAR__A	CRAR__F	CRAR__P	CRAR__PSB	G_GDPFC	G_GFCE	G_GFCF	G_GVA	G_PFCE
CRAR__A	1.000000								

CRAR__F	0.820328	1.000000							
Probability	0.0000	-----							
CRAR__P	0.739504	0.718061	1.000000						
Probability	0.0000	0.0000	-----						
CRAR__PSB	0.877941	0.539153	0.361063	1.000000					
Probability	0.0000	0.0000	0.0023	-----					
G_GDPFC	0.362220	0.057118	0.006530	0.554534	1.000000				
Probability	0.0022	0.6411	0.9575	0.0000	-----				
G_GFCE	-0.021375	-0.123179	-0.006194	0.013596	0.099138	1.000000			
Probability	0.8616	0.3133	0.9597	0.9117	0.4177	-----			
G_GFCF	0.178046	-0.048078	-0.208503	0.426216	0.702961	-0.041706	1.000000		
Probability	0.1433	0.6948	0.0856	0.0003	0.0000	0.7337	-----		
G_GVA	0.379438	0.124764	0.079526	0.513309	0.941334	0.132086	0.592630	1.000000	
Probability	0.0013	0.3071	0.5160	0.0000	0.0000	0.2793	0.0000	-----	
G_PFCE	0.298281	0.123504	0.151551	0.331533	0.489067	0.202164	0.247639	0.457659	1.000000
Probability	0.0128	0.3120	0.2138	0.0054	0.0000	0.0957	0.0402	0.0001	-----

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About the Author

Dr. Saurabh Ghosh is an officer in the Economic Research Department of the Reserve Bank of India. He is presently responsible for compilation, research and analyses related to monetary aggregates. Ghosh has also worked in research groups in the Financial Markets Department and the Monetary Policy Department in the Reserve Bank. He was also a project leader in the SEACEN Centre (KL). He did his Advanced Studies Program from Kiel Institute for the World Economy (Germany), his Ph.D. from IGIDR and has also received the CFA® charter, FRM® and CAIIB. Dr. Ghosh has been publishing in several reputed academic journals and has been referring for journals. His primary research interests include financial economics, banking and macroeconomic policy. Views expressed in this paper are his personal and not necessary of the institution that he belongs to, usual disclaimer applies.