MACROECONOMIC DETERMINANTS OF FINANCIAL STABILITY IN A BUSINESS CYCLE
Evidence from India

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One of the important lessons from the crisis in the last decade relates to the realignment of the policies in explicit pursuit of macroeconomic and financial stability. Macro-prudential regulation with the larger objective of enhancing the resilience of financial system, calls for a comprehensive understanding of the interplay between macroeconomic factors to counter the buildup of imbalances within the financial system. This paper is an attempt to investigate into the relationship between financial stability and a set of macroeconomic determinants pertaining to a full business cycle in India. We have analyzed the macroeconomic determinants of financial stability from two perspectives, i.e., banking stability in terms of NPA ratio and financial stability in terms of credit extension. Our results show that the key determinants of banking and financial stability are rate of growth in credit, rate of growth in stock-market index and short-term interest rates apart from select sectoral GDP growth rates.

1. Introduction

With growing financial openness and liberalization, financial stability issues have come to the forefront. These issues have ranged from discussions on basic issues of the definition of financial stability itself to issues of measurement, issues of choice of instruments to achieve the objective of financial stability and even issues on the degree of activism that central banks should adopt in pursuing this objective. It is generally accepted that financial stability is a sort of equilibrium which governs the proper functioning of financial markets in an economy. Though comprehensive and all-encompassing in scope, the term 'financial stability' is usually interpreted as a persistent state of robust functioning of various financial system components – markets, institutions, market infrastructure – endowing the system to

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face any endogenous or exogenous financial shock with minimal disruptive impact. As observed by Governor, Reserve Bank of India (RBI), financial stability in India would mean (a) ensuring uninterrupted settlements of financial transactions (both internal and external), (b) maintenance of a level of confidence in the financial system amongst all the participants and stakeholders and (c) absence of excess volatility that unduly and adversely affects real economic activity (Reddy, 2004).

Pursuit of financial stability as a formal objective entails two broad aspects: first, the process aspect – rigorous, comprehensive and continuous systemic assessment of risk buildup across the financial system and second, the outcome aspect – having the necessary institutional and instrumental arrangements to take effective regulatory, supervisory and other policy measures to address the identified risks (Financial Stability Report, RBI, 2014). Recent meltdown in global economy, leading to undue volatility in financial stability, reveals that such disturbance in the equilibrium is extremely detrimental to the economic growth. Due to severe externalities attached to financial crisis we have a strong case to regulate the financial sector. This, in fact, can be seen in the emergence of prudential norms as 'best global practices' imposed by regulatory authorities in financial sector. There lie numerous regulations in place specifically framed for dealing with vagaries and nuances of financial setup of a nation; banking regulation is one such important subset. This is important given the fact that banks are important source of liquidity and financing needs even in those economies where capital markets seem to primarily dominate the scene.

Banking sector, being an important component of the financial system is faced with rather unique as also interesting implications of 'micro' failures on account of the heavily inter-related businesses, which appears as externalities due to bank failures. Interestingly, the impact of these externalities on banking industry, are largely negative in contrast to other sectors where externalities can also be positive in many cases. A failure of a bank causes panic and subsequently a run on another seemingly *similar* bank, where the latter was otherwise healthy. On the other hand, a failure of a manufacturing unit may actually make other players in the industry better off by reducing competition. The negative externalities caused by a bank failure loom large for the society and impose heavy dead weight economic cost to the system. This very concern is the primary motivation for designing a prudent bank regulation. Although, the design of prudent bank regulation has evolved through the years, several new challenges –as seen to come at fore in recent meltdown of 2007-09 – obscure the rationality of those designed earlier. Therefore, regulators can afford to be no more indifferent to these externalities and have become active in searching for causes of systemic instability.

One of the important lessons from the recent crisis relates to the realignment of the policies in explicit pursuit of macroeconomic and financial stability. While the approach and philosophy of regulation both are being revisited in most countries including India, the focus of the regulationhistorically and so far has been by and large focused on regulating individual institutions. Indeed, prudential norms have been designed from this perspective. The idea is

to generalize the stability of individual institutions to systemic stability. However, it is now accepted that this reasoning is flawed as destabilizing individual institutions can quickly translate as systemic contagion to otherwise healthy institutions due to the nature of their heavily interrelated businesses. Post crisis, it is being acknowledged that a macro prudential perspective is critical in designing and pursuing micro prudential regulation of institutions and markets (Gopinath 2010).

Systemic contagion also suggests the presence of ubiquitous factors which governs the soundness of individual institutions and hence the economy as a whole. Quintyn and Taylor (2003)have argued that the episodes of financial crisis in Latin America in late nineties and in the Nordic countries and Asia also in the decade of nineties suggests that such crisis can have both microeconomic as well as macroeconomic determinants. The individual instability emerging from microeconomic factors leads to weakening of system as a whole, which in anticipation of further weakening squeezes the liquidity out and restrain the credit flow to the economy, which leads to further weakening of economy and hence adds to financial crisis of self evolving type.

Therefore, the greater challenge for the regulators today is to marry the micro and macro dimensions of financial instability.Regulating micro dimensions of individual institutions without a grasp of dynamics of macro influences on financial stability can create havoc in stressed environment. Further it becomes all the more difficult to assimilate the features of micro and macro dimensions when the regulators for individual institutions differ from macro supervisors, as has been the case in some countries like UK.Therefore, the two distinct but highly inter-related constructs which have come to epitomize this post-crisis framework have been macro prudential regulation and systemic risk management. Both these concepts are appealing and conceptually sound, but are operationally challenging.

Against the backdrop discussed above, here in this paper we attempt to identify key macroeconomic determinants of financial stability[1] as relevant to India. It may not be out of context if we mention that the economy and the financial system in India have exhibited great amount of resilience in the recent past. We have approached the research problem, i.e., financial stability from two dimensions. Firstly, we have made an attempt to capture the determinants of banking stability by examining the relationship between asset defaults and macroeconomic variables. Secondly, the financial stability which is broader and inclusive of the banking system has been examined by looking at the relationship between smooth functioning of financial markets and macroeconomic variables. The smooth functioning is deemed to be proxied through credit extended and liquidity measures such as very short term weighted average call money interest rates.Needless to mention, the banking stability and financial stability are mutually interdependent and because of this, it is possible to identify key macroeconomic determinants for policy options.

The paper is organized as follows. In section 2 of this paper, we have reviewed relevant literature in order to comprehend the various approaches and methods for identifying

macroeconomic determinants of banking and financial stability. While section 3 outlines the research design and sources of data, section 4 presents empirical analysis, discussions and interpretations. Section 5 presents summary of the findings along with policy options. Section 6 provides the concluding remarks.

2. Review of Literature

Several empirical studieshave examined the determinants of banking crises as a homogenous cause[2]. Arpa et al. (2001) used a single equation regression model to describe the relationship between risk provisions and operating income of banks in Austria with a broad set of macro factors. He found a negative relationship between risk provisions and GDP growth and real interest rates while a positive relationship against inflation and real estate prices.

Pesola (2001) showed the importance of GDP gap as a significant factor in determining banking crises in Nordic countries. Gerlach, Peng and Shu (2005) again used a regression analysis with set of variables including nominal interest rates, the CPI, property prices, equity prices, number of bankruptcies, the unemployment rate, and real GDP as explanatory variables. Theyfound that NPA ratio varies directly with nominal interest rates and number of bankruptcies, but varies inversely with inflation, GDP growth and real estate prices. Meyer and Yeager (2001) contend that only few macroeconomic variables might be sufficient to reveal the relationship with asset defaults in US. Quagliariello (2003) finds that Non Performing Assets (NPA) ratio levels are adversely impacted by real economic growth and increasing unemployment.

Marcucci and Quagliariello (2009) in an interesting setup have analyzed the impact of asymmetric effects of business cycles on credit risk posed by banks' portfolio of Italian banks. They concluded that business cycles are more significantly influencing the credit risk during downturns. Also the riskier portfolios are highly cyclical.Podpiera (2006), in another interesting study, determined a relationship between banking industry performance and the compliance toward Basel core principles for effective supervision for 65 nations. Higher compliance impacted the industry performance significantly as measured by NPA ratio and interest margins earned.

Baboucek and Jancar (2005) in a study for Czech Republic showed that rising unemployment, inflation, and fast GDP growth impacts the NPA levels adversely and significantly while real interest rate do not affect it significantly. Cihak et al. (2007) made a comparison of system-focused stress testing methods (such as Monte Carlo simulations and VAR) for Czech banking industry. He stressed on the relevance of macro variables such as exchange rate fluctuations to be used in stress tests designing apart from using banking industry variables.

In a thorough and recent study, Babihuga (2007) investigated the relationship between select macro variables and set of financial stability indicators[3] (FSIs) for the case of European,

Asian, and sub-Saharan Africa. Using an extensive list of variables he revealed the cyclical fluctuations of FSIs with business cycles. In a similar study with FSIs, Akhter and Daly (2010) reinforced the influence of business cycles, inflation and real effective exchange rates on capital adequacy levels. He also concluded that bank's profitability is a function of macro variables, bank specific micro variables and industry specific variables such as competition. Klomp (2010) while exploring causes for banking crisis in 110 countries between 1997 and 2007 finds that a high credit growth, a negative GDP growth and a high real interest rate are the most important causes of a banking crisis.

In a large number of studies relating to the stability dimension of the banking system, the banking stability is analyzed through behavior of asset default measured through NPA ratio[4]. Some studies, in addition to NPA ratio also focuses on profitability measured through ROA, operating income or the interest margins. Borio and Lowe (2002) stresses on assimilating financial data of asset prices and risk perceived by the market with macroeconomic variables to get a sound grasp of the current state of business cycles. It was found that the variables in the macroeconomic environment also influences indicators associated with overall financial stability or smooth functioning of financial markets. Further, credit relative to GDP and market liquidity proxied by call money rates which are important indicators of smooth functioning of the financial markets are found to be significantly influenced by macroeconomic changes. The evidences point towards the significant correlation between select macroeconomic variables and the flow of bank credit.

Cyclicality in asset defaults is a critical dimension affecting the banking stability. Empirical studies such as Duffie et al. (2007), Koopman and Lucas (2005) and Fama (1986) indicate that the level of real economic activity and the term structure of interest rates are important determinants of default risk. Banks seems to be prone to higher risk taking under favorable circumstances in economic upturns. Such upturns are associated with rapid credit growth, inordinate investments, export/employment growth, inordinate flow of capital and its accumulation, and higher consumption leading to inflationary pressures. Thus, during upturn banks ends up taking higher level of credit risks. The economic downturn shows just the opposite. During upturns when banks take excessive risks, they accumulate large amount of risk over a period in their chosen portfolio; the risk while in turn, would materialize in a disastrous manner in economic downturns.

Further, procyclical lending[5] by banks suggests that credit extension varies in consonance with the business cycles. During booms there are episodes of over extension of credit, which boost the bubble formation for asset prices in the market while credit is restricted to stifling level during downturns which accelerates a recession by further contributing towards slowdown of economy. Such a variance in credit extension makes banks vulnerable to sudden shocks. Also, in a way, banks contribute to failures as also accelerate the rate of failures by firms by restricting credit when they need them the most in economic downturns. Similar is the story with liquidity in the market. As evidences in the recent global crisis, the very first signs of any sudden shock to the economy are revealed through sudden evaporation of liquidity from

the market.Deterioration in banking books induced through such drying up of liquidity make other banks averse for providing short term liquidity to the market.

While the extensive literature on macroeconomic variables do exists, there are some gaps which can be readily recognized. Literature largely lacks in discussing variable/s related to asset price bubbles directly. Equity markets, which acts as a pointer towards asset prices, assumes an important position linking banking/financial (in)stability factors to macroeconomic factors. Therefore, we reckon that equity market index is one such direct variable which could reveal such bubble formations with almost no time lags. Another important dimension which needs to be attended to in the literatureis to determine key sources of variation in GDP growth. In order to capture this, we have to examine sector-wise contribution to GDP growth rather than GDP growth as a whole. It is possible that sector-wise analysis of GDP growth may help us in identifying sectors contributing more (or least) to bank/financial stability.

3. Data and Research Design

Since a full business cycle is almost captured in the first decade of the new millennium, our dataset consists of time period between first quarter of the year 2000 to the first quarter of the year 2009. Building on the empirical evidences from the literature discussed above, the macroeconomic variables that we have considered in this paper are NPA ratio, credit ratio, weighted average call money interest rates, 1 year and 10 year yield on government securities (as proxy for short term and long term market interest rates), inflation growth, equity market index (NIFTY) and GDP growth rates for eight different sectors. These variables are defined in Annexure A.This paper differs from the previous studies in at least two respects.Firstly, to get a comprehensive picture of the economic growth, we have included eight sectors and their respective growth rates. Reserve Bank of India (RBI) provides quarterly data on sector-wise GDP figures classified into eight sectors. Secondly, we have explicitly made use of equity market index to capture the asset prices without any time lag.

Underscoring the fact that banking sector dynamics are changing fast in the last decade, we find it increasingly important to include the latest data set of interacting variables. This becomes all the more important for emerging economies like India, where banking industry has witnessed a paradigm shift since liberalization. On the other hand, we must have sufficient data points so as to get adequate precision in the results for inferring from factor loadings. Keeping the above factors in mind, we have used quarterly data for several interacting variables. We have heavily relied on RBIsources to get this data. After making granularity adjustments, we have averaged[6] out some data sets with higher frequencies to conform to quarterly figures. Such adjustments and selection of quarterly figures are justified as also necessitated on account of two reasons. Firstly, figures for certain time series such as GDP are obtained only on quarterly basis, which prompts us to use the lowest frequency available. Secondly, using quarterly time series (with certain transformations) has the advantage of reducing the possibility of errors being introduced by autocorrelation.

The explicit use of time series data on several co-integrated macroeconomic variablesmight have inherent limitations in terms of biases and errors being introduced in the results on account of autocorrelation and mutlicollinearity.We have tried to curb such biases and errors by transforming variables wherever applicable without loss of generality. Such transformation ranges from using ratios and growth rates for certain variables which are deemed to be highly auto-correlated as well as collinear with other variables. Correlations across finally transformed variables are shown in Annexure B.While we have taken measures for avoiding errors on account of multi-collinearity and autocorrelations, we were not much concerned with the problem of hetroscedasticity owing to the data sets being time series in nature rather than being a cross-sectional data set. However we have checked for the presence of hetroscedasticity by observing the residuals to confirm our beliefs.

On the design front, we have made use of multivariate regression analysis to determine the dynamics of banking stability and overall financial stability separately. In the first level analysis for the assessment of banking stability, we have tried to determine a relationship between NPA ratio, used as a proxy for banking stability (or otherwise), as a dependent variable and a set of macroeconomic variables such as credit ratio, 1 year market interest rates(nominal), equity index levels and sectoral GDP growth rates as explanatory variables. NPA levels are realized with a lag as payments due at time T may only be realized as NPA at time T+1. Thus we have used explanatory variables with a lag in this analysis. Also, NPA level being an inter-temporal short term measure on banking books could be better explained by short term interest rates rather than long term rates; we have therefore made use of this aspect also. The regression model used for analyzingbanking stabilityas relevant to Indian banking sector thus is mentioned below:

$$NPAR_{t+1} = \alpha_{1t} + \beta_{1t}.CR + \beta_{2t}.NIFTY + \beta_{3t}.1YR + \sum(\beta_{it}.SECTORAL\_GDP) + \varepsilon_t \quad \text{.....(1)}$$

Where, variables are as defined in Exhibit A and SECTORAL_GDP are the eight sectoral GDP growth variables.

Moving onto the next level analysis for overall financial stability, it may be mentioned once again that in our analytical framework financial stability or otherwise is basically seen from the perspective of the smooth functioning offinancialmarket.Therefore, we further dissect the notion of financial stability into two adjoining parts. This dimension of stability is assessed in terms of adequate flow of credit andthe provision of funding liquidity. Towards this end, we have used credit ratio, defined as ratio of credit extended to the sum of credit and investments made by banks, as dependent variable.It is worthwhile to mention that in Indian context, banking system is not only an important and critical component of the financial system, but also directly and indirectly participates in other segments of the financial system. Thus, smooth flow of bank credit mirror the smooth functioning of financial system.It is based on this logic that we have used credit ratio as dependent variable and NPA ratio, equity market Index, sectoral GDP growth rates, inflation growth rate, and short and long term

interest rates as explanatory variables. In this part of the analysis, we have made use of both 1 year and 10 year market interest rates (nominal) as explanatory variables separately. The models used are as follows:

$$CR_t = \alpha_{1t} + \beta_{1t}.NPAR + \beta_{2t}.NIFTY + \beta_{3t}.1YR + \beta_{4t}.CPIG + \sum(\beta_{it}.SECTORAL\_GDP) + \varepsilon_t \text{.....}(2a)$$

$$CR_t = \alpha_{1t} + \beta_{1t}.NPAR + \beta_{2t}.NIFTY + \beta_{3t}.10YR + \beta_{4t}.CPIG + \sum(\beta_{it}.SECTORAL\_GDP) + \varepsilon_t \text{.....}(2b)$$

On the next sub part of the analysis, we have used short term weighted average call money rates as dependent variable as a proxy to liquidity prevailing in the market. We have used credit ratio, equity market index, 10 year interest rates on Government securities, sectoral GDP growth, and inflation growth as explanatory variables. It may be mentioned that 10 year rates have been chosen on account of the role of long term yield curve in determining call money rates. The resulting model which was used is as follows:

$$CMR_t = \alpha_{1t} + \beta_{1t}.CR + \beta_{2t}.NIFTY + \beta_{3t}.10YR + \sum(\beta_{it}.SECTORAL\_GDP) + \varepsilon_t \text{.....}(3)$$

We have provided details pertaining to variables considered in our investigation in Annexure A, B and C. While Annexure A provides description of these variables, B and C offer information about association amongst variables and descriptive statistics respectively. Further, we have examined the temporal behavior of these variables for better understanding as also analysis and the results are plotted in Graph 1 – 4. These graphs show the plots for individual variables in some cases while group of variables in other, clubbing variables with similar nominal levels/units. A look into these graphs helps us in justifying the transformation for some of the time series. These transformations did help in curbing the outright non-stationarity[7]in some time series.We have, however, checked for any possibilities of biases being introduced in the coefficients on account of stationarity and other regression related problems by performing relevant testswhich are discussed below.

4. Results and Discussions

As described in the research design, we now move on to analyzing the results for two level investigations into stability viz., banking stability and financial stability.

4.1. Macroeconomic determinants of Banking Stability

We have employed multivariate regression (Equation 1) to identify as also examine the macroeconomic determinants of banking stability. As expected, results show a strong relationship between NPA ratio and the set of macroeconomic variables considered in the regression. In a way, this reaffirms the relevance of the chosen macroeconomic variables in the study. We found a significant adjusted R-square of 94.8% and a significant level of F statistics even at 1% significance (Table 1).

Among the variables found to have significant influence on banking stability, in order of importance, have been credit ratio, NIFTY, 1 year rate, growth rate in mining, manufacturing, electricity and gas, construction, financial sector and community, social and personal services GDP. In other words, the first three variables, succinctly explaining the quantum of credit/ investment are the key determinants from the financial system itself influencing the banking stability. It is pertinent to mention that several BIS studies[8] in the recent past have emphasized the importance of monitoring credit growth by regulators from systemic risk point of view, as rapid credit growth and resultant acceleration in prices of assets are amongst the key early-warning signs of financial instability. Amongst the aforesaid other key variables directly or indirectly influencing overall GDP, the extent of the influence of each variable perhaps depends on its dependability on banking as also financial system. NPA ratio is negatively related to credit ratio, on account of the fact that higher growth in credit (or credit ratio) relative to NPAs pushes the latter downward (see Graph 1) as NPAs are always expressed as percent of total credit. Further, we find negative relation between NPA ratio and NIFTY, indicating the business cycle effects on the one hand and on the other, possibly explaining the nexus between banking system and stock market. To put it differently, higher the growth in bank credit (and resultant lower NPA ratio), higher will be the portion of bank credit getting into stock markets (pushing NIFTY upward). In addition, higher growth in bank credit speaks of short-term credit or working capital finance whereas growth in stock-market essentially reflects the long-term capital. However, the relationship between NPA ratio and 1 year rates is found to be positively associated, meaning increasing interest rates resulting higher levels of defaults/NPAs. We do not wish to get into the reasons behind this positive relationship between NPA level and interest rate, as it is an acknowledged fact that the increasing interest rates in the short-run impair the repaying capacity of the borrowers. Also it must be noted that in a scenario of northward movement of interest rate, growth in credit can not but fall and vice versa, impacting the NPA levels.With regard to other significant macroeconomic parameters of banking stability, we find the relationship between NPA ratios on the one hand and growth in manufacturing, electricity & gas, community & personal services GDP on the other, is negative. Notable exception to this from amongst the variables explaining growth in GDP, are growth in mining, financial sector and construction, which showed a positive relationship.

In order to check the veracity of the results, we have specifically looked into the stability of regression coefficients as also their precision by conducting tests for multicollinearity, autocorrelation and hetroscedasticity. Multicollinearity is a phenomenon where explanatory variables are heavily correlated thus obscuring the rationality of regression coefficients. We checked for multicollinearity first by observing F statistics for overall regression and t-statistics for individual coefficients simultaneously. The results which are presented in Table 1suggest that multicollinearitymight not have influenced the results as both F and t- statistics are simultaneously significant. As a second check, we also looked for Variance Inflation Factor (VIF) coefficients. For multicollinearity to significantly influence the results, VIF

factors must be well above a level of 10. As we can see from the resultsin Table 1, VIF factors are all below the benchmark level of 10. Similar conclusion can be drawn from tolerance levels which are nothing but reciprocal of VIF levels. These apart, we also checked for autocorrelation as the same if significant would influence the results and regression coefficients.We primarily relied on distribution of residuals to see whether they resemble a pattern and whether the distribution significantly deviates from normal distribution. The plot of residuals does conform to a near normal distribution (except the presence of certain outliers). Durban Watson (DW) statistics stands at 1.535 which does not, *a priori,* indicate such influence.This further let us believe for the fact that autocorrelation and hetroscedasticity may not be worrisome for the regression employed here.

4.2. Macroeconomic determinants of Financial System Stability

In so far as the determinants of the financial stability are concerned, we ran two multivariate regressions mentioned in equation (2) and (3). Before we proceed further, it must be mentioned that in our analytical framework, financial stability is captured in terms of credit ratio of the banking system on the basis of the logic explained in research design part. The regression results presented in Table 2 and 3 clearly suggest the strong relationship between credit ratio and the set of chosen macroeconomic variables. This is evident from a high adjusted R-squareand a significant F statistics even at 1% level.

From amongst the key factors influencing the financial stability captured in terms of credit ratio, NPA ratio, NIFTY, 1 year nominal interest rates, and financial and real estate sector GDP growth have emerged as key determinants in that order. While NPA ratio is negatively related to credit ratio, other factors viz., NIFTY, 1 year rate and growth in finance sector GDP are positively associated with credit extension. This positive association explains the business cycle effect i.e., unidirectional movement of these parameters on the one hand, and on the other, the inter-relationship amongst these variables. It is important to note that the finance sector GDP includes the real estate GDP, which according to the literature, *a priori,* indicates such a relationship. It is to be noted here that we have not lagged other variables here with respect to NPA ratios.We have examined the multicollinearity amongst the explanatory variables and found it to benon-significant as revealed by F and t-statistics as well as by VIF levels. In addition, the residual plot mostly conforms to near normal curve and Durban Watson (DW) statistics also at 1.496 does not support any significant influence of autocorrelation on the results.

As discussed in the research design part of this paper, we examined the relationship between credit ratio and 1 year interest rates as well as 10 years interest rates. While the results are similar in respect of both the equations (2a with 1 year interest rate and 2b with 10 year interest rates), it is interesting to note the positive relationship between both short-term and long-term interest rates and credit extension. Towards this direction, although a convincing explanation is difficult, we believe that tightening of monetary policy was aimed

mostly to curb down the inflation during the last decade. Also, interest rates can only affect the credit extension with a lag which is not captured in the model here.

We have examined the financial stability in terms of provision of liquidity by using short term weighted average call money rates as dependent variable as a proxy to liquidity (equation 3). Results indicate that there is a strong linkage between level of liquidity and the set of macroeconomic variables as the adjusted R-square is at 76.4% and F statistics significant even at 1% level. The explanatory variables used here are credit ratio, NIFTY, 10 year nominal interest rates, and sectoral GDP for eight classified sectors. Of the explanatory variables considered in the equation, 10 year interest rates, mining and financial sector GDP (including real estate GDP) have emerged as important factors influencing level of liquidity. The relationship between liquidity and 10 year interest rate is positive owing to the yield curve movements. Mining GDP growth positively influences the call money rates. However, growth in financial sector GDP negatively influences the call money rates which in a way, indicates efficiency as also deepening of the financial system.As earlier, we find multicollinearity and autocorrelation are not significant and therefore, results are not significantly influenced by these two.

5. Limitations and Future Research

Although the exercise conducted here does not indicate any major consequences of errors and biases on coefficients, these results must be interpreted with a holistic view on Indian economy. Banking in India is changing fast since the liberalization move in early 1990s and subsequently with the compliance toward the Basel norms. The fact that NPA ratio has significantly gone down has its explanation of banks in India improving on its efficiency front. Also economy as a whole has experienced a very rapid expansion for the period under investigation. Although, we may reject for any structural changes in the economy, we have reasons to believe that dynamics are changing fast so that only very recent data can reveal the relationships.

Indian bond market is still underdeveloped, which further lead us to cautiously look over the market determination of interest rates in India. Interest rate dynamics for all practical purposes can be believed to be policy determined rather than market oriented. This may impair the inferences where we have assumed short term and long term rates to be market determined.Another area of concern is that contribution to the GDP is broadly classified into eight sectors, where several uncorrelated sectors are merged into one. For instance, trade, hotels, transportation and communication are clubbed into one while financial services, insurance and real estate is merged into one. This makes the contribution of an influential sector to be masked by the relative contribution of an uncorrelated sector.

Having reiterated the research limitations, we still find great deal of information from the analysis as well as future implications for such a research. Many countries are putting on enormous efforts to develop macroeconomic indicators for financial stability. IMF, for example,

through the use of FSIs has encouraged countries to use a pragmatic approach to curb volatility in financial markets. The work in this paper can facilitate in identifying components essential to develop such a macroeconomic framework for India. Needless to say, such a macroeconomic framework with key indicators of stability or otherwise, would be of immense use in calibrating prudential norms like capital adequacy, loss provisions, liquidity levels etc to address pro-cyclicality as well.

6. Conclusion

Explicit pursuit of macroeconomic and financial stability is the single most significant positive contribution the recent global crisis.Macro-prudential regulationwith the larger objective of enhancing the resilience of financial system, calls for a comprehensive understanding of the interplay macroeconomic factors to counter the build up of imbalances within the financial system. The business cycles and subsequent changes in macroeconomic environment can have serious implications for the growth of an economy including financial sector. Our analysis was carried out against this backdrop with the objective of examining the relationship between financial stability and a set of macroeconomic variables as relevant to India.

As regard to our first stage analysis, i.e., banking stability or otherwise capturedin terms of NPA ratio, we foundcredit expansion, growth in stock market and short-term interest rate and growth rates in mining, manufacturing, electricity & gas, construction, financial sector and community, social & personal services sectors of the economy have emerged as key determinants in that order. In a way, our results emphasize the importance of monitoring credit expansion by regulators. However, the inflation as an explanatory variable was found be insignificant determinant of NPA levels in the banking system.

In regard to financial stability as captured in terms of credit extension, we included short-term and long-term interest rates separately as explanatory variables. In addition, we also used short-term weighted average call money rate as dependent variable as a proxy to liquidity in the market. With respect to financial stability captured in terms of credit extension, our results show that level of defaults, growth in stock-market and short-term interest rates are key determinants, apart from financial/real estate sector growth rates. Financial stability seen from the angle of liquidity using weighted average call money rates as proxy reveals that the same gets influenced by long-term interest rates and mining & financial sector GDP growth rates.

Notwithstanding the limitations, we conclude that the key determinants of banking and financial stability are easily identifiable, viz., rate of growth in credit, rate of growth in stock-market index and short-term interest rates. Needless to mention, these are the variables that the regulators must monitor to ensure smooth functioning of financial system. The similarity with respect to key macroeconomic determinants for both banking and financial stability is also on account of the fact that in our model banking system is given prominence in capturing the latter.

ANNEXURE AND TABLES

Annexure A

Variable Definition

Sr. No.	Variable	Label	Description
1	CR	Credit ratio	Ratio of total credit extended to the sum of total credit extended and total investments
2	NPAR	NPA Ratio	Ratio of Non Performing Assets to total credit extended
3	CMR	Call Money rate	weighted average call money rate
4	CPIG	CPI growth	Average Growth rate in Consumer Price Index
5	NIFTY	NIFTY	Broad stock market Index (NSE)
6	1YR	1 Yr Int rate	Average1 year interest rate
7	10YR	10 Yr Int rate	Average 10 year interest rates
8	AGRI	Agri GDP	Average GDP growth rate of Agriculture & allied activities
9	MING	Ming GDP	Average GDP growth rate of Mining & Quarrying
10	MFDG	Mfd GDP	Average GDP growth rate of Manufacturing
11	EGWS	Elec GDP	Average GDP growth rate of Electricity, Gas & Water Supply
12	CONS	Const GDP	Average GDP growth rate of Construction
13	THTC	Trade GDP	Average GDP growth rate of Trade, hotels, transport & communication
14	FIRB	Fin GDP	Average GDP growth rate of Finance, Insurance, Real Estate & Business Services
15	CSPS	Comm GDP	Average GDP growth rate of Community, Social & Personal Services

Note: 1. Variable are quarterly firgures, ratio or averages for respective field

Annexure B

Correlations

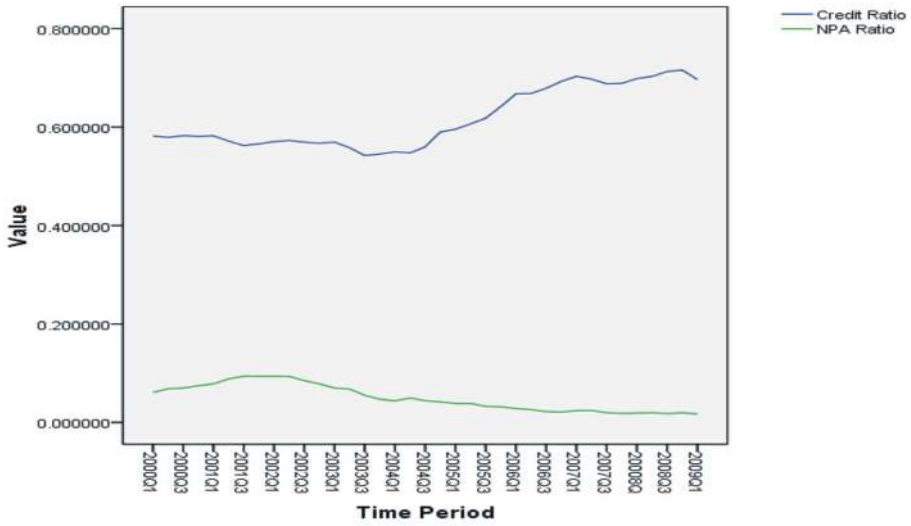
	Credit Ratio	NPA Ratio	Call Money rate	Inflation Growth	Nifty	1Yr Int rate	10Yr Int Rate	Agri GDP	Ming GDP	Mfd GDP	Elec GDP	Const GDP	Trade GDP	Fin GDP
Credit Ratio	1.0000	-0.8041	0.2105	0.3320	0.8984	0.2397	0.0919	0.0440	0.0857	0.0185	-0.0402	0.0018	0.0781	0.2427
NPA Ratio	-0.8041	1.0000	0.1730	-0.2581	-0.8439	0.1112	0.2664	-0.0433	-0.0969	-0.1015	-0.0867	-0.1332	-0.1177	-0.2393
Call Money rate	0.2105	0.1730	1.0000	-0.0274	0.0853	0.8759	0.8210	0.0206	0.1321	0.0910	-0.1186	-0.0559	0.0270	0.0693
Inflation Growth	0.3320	-0.2581	-0.0274	1.0000	0.3106	0.0777	0.0417	0.0208	-0.4087	-0.3680	-0.2398	-0.4674	-0.2586	-0.5137
Nifty	0.8984	-0.8439	0.0853	0.3106	1.0000	0.1810	-0.0043	0.0453	0.0672	0.0403	0.0171	0.0382	0.0764	0.1574
1Yr Int rate	0.2397	0.1112	0.8759	0.0777	0.1810	1.0000	0.9606	-0.0500	-0.1012	-0.0513	-0.1519	-0.1893	-0.1089	-0.1335
10Yr Int Rate	0.0919	0.2664	0.8210	0.0417	-0.0043	0.9606	1.0000	-0.0832	-0.1314	-0.0723	-0.1694	-0.2252	-0.1319	-0.1612
Agri GDP	0.0440	-0.0433	0.0206	0.0208	0.0453	-0.0500	-0.0832	1.0000	0.4989	0.0693	0.1839	0.2445	0.5560	0.1892
Ming GDP	0.0857	-0.0969	0.1321	-0.4087	0.0672	-0.1012	-0.1314	0.4989	1.0000	0.7869	0.2886	0.6764	0.8580	0.8396
Mfd GDP	0.0185	-0.1015	0.0910	-0.3680	0.0403	-0.0513	-0.0723	0.0693	0.7869	1.0000	0.1368	0.6510	0.7796	0.7696
Elec GDP	-0.0402	-0.0867	-0.1186	-0.2398	0.0171	-0.1519	-0.1694	0.1839	0.2886	0.1368	1.0000	0.2839	0.1744	0.2603
Const GDP	0.0018	-0.1332	-0.0559	-0.4674	0.0382	-0.1893	-0.2252	0.2445	0.6764	0.6510	0.2839	1.0000	0.5945	0.6635
Trade GDP	0.0781	-0.1177	0.0270	-0.2586	0.0764	-0.1089	-0.1319	0.5560	0.8580	0.7796	0.1744	0.5945	1.0000	0.7360
Fin GDP	0.2427	-0.2393	0.0693	-0.5137	0.1574	-0.1335	-0.1612	0.1892	0.8396	0.7696	0.2603	0.6635	0.7360	1.0000
Comm GDP	0.0311	-0.0432	0.1775	-0.4121	0.0050	0.0568	0.0291	-0.2267	0.6084	0.8277	0.1656	0.5367	0.4690	0.7329

Annexure C

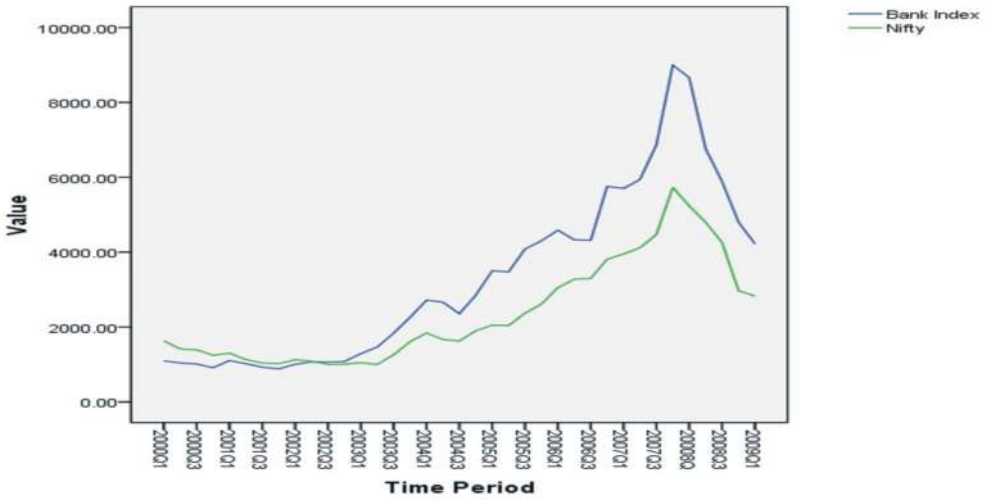
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Credit Ratio	37	0.5423	0.7159	0.6167	0.0606
NPA Ratio	37	0.0173	0.0939	0.0491	0.0269
Call Money rate	37	4.1700	10.3800	6.4570	1.7383
Inflation	37	432.0000	686.0000	532.3243	72.8873
Inflation Growth	37	-0.8922	4.0767	1.2458	1.1298
Nifty	37	998.9600	5729.0800	2356.5181	1372.9547
1Yr Int rate	37	4.3900	10.5000	6.8612	1.6709
10Yr Int Rate	37	5.1300	11.4900	7.7094	1.6677
Agri GDP	37	-23.9200	78.2900	5.4023	37.4069
Ming GDP	37	-16.8200	16.8400	1.9828	9.9072
Mfd GDP	37	-6.8700	8.1200	1.8515	4.5097
Elec GDP	37	-2.9900	4.9600	1.1543	1.7222
Const GDP	37	-3.5800	11.1000	2.6123	3.9613
Trade GDP	37	-10.2300	16.2700	2.8885	7.6644
Fin GDP	37	-4.9400	7.4400	2.2448	2.7174
Comm GDP	37	-30.5200	37.6900	3.4120	16.2096
GDP Growth	37	-9.6000	19.6300	2.1069	8.9980

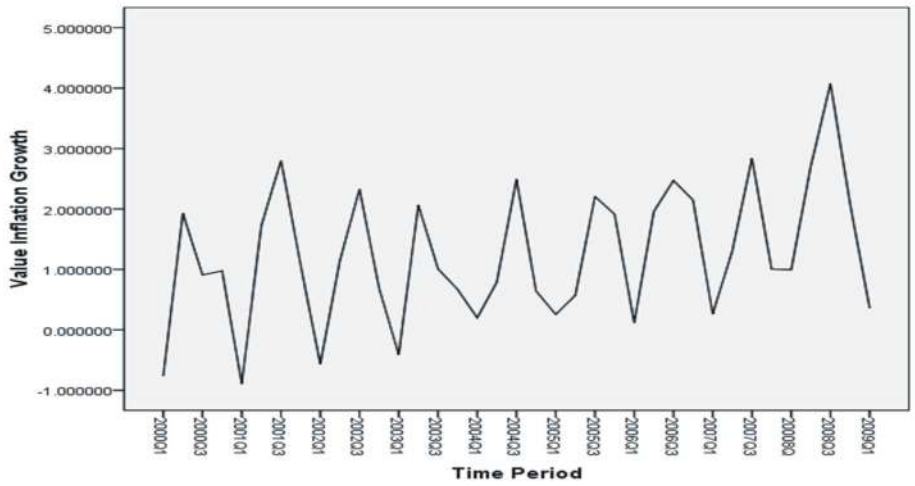
GRAPH 1



GRAPH 2



GRAPH 3



GRAPH 4

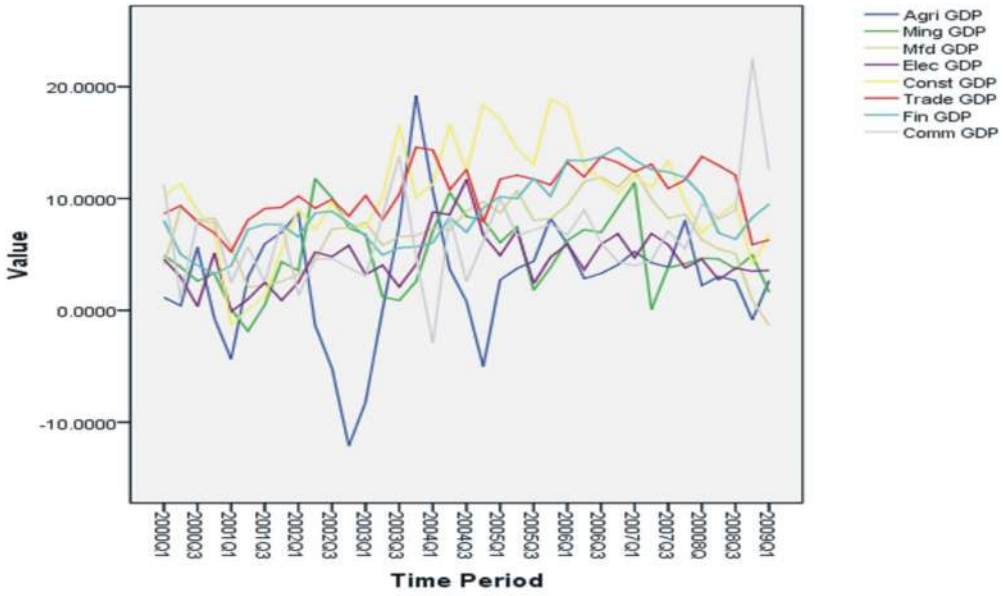

Agri GDP
Ming GDP
Mfd GDP
Elec GDP
Const GDP
Trade GDP
Fin GDP
Comm GDP
20.0000
10.0000
0.0000
-10.0000
Value
2000Q1
2000Q3
2001Q1
2001Q3
2002Q1
2002Q3
2003Q1
2003Q3
2004Q1
2004Q3
2005Q1
2005Q3
2006Q1
2006Q3
2007Q1
2007Q3
2008Q1
2008Q3
2009Q1
Time Period

Table 1: Multivariate Regression for Eq (1)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.9819	0.9642	0.9484	0.0062

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.	DW
1	Regression	0.02570	11.00000	0.00234	61.15886	0.00000	1.53500
	Residual	0.00096	25.00000	0.00004			
	Total	0.02665	36.00000				

Coefficients

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
			Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.20803	0.02889		7.20168	0.00000		
	Credit Ratio	-0.25667	0.05361	-0.57141	-4.78786	0.00006	0.10062	9.93838
	Nifty	-0.00001	0.00000	-0.30986	-2.73865	0.01121	0.11195	8.93234
	1Yr Int rate	0.00552	0.00090	0.33873	6.09543	0.00000	0.46408	2.15480
	Agri GDP	-0.00013	0.00028	-0.02605	-0.45726	0.65143	0.44151	2.26497
	Ming GDP	0.00113	0.00043	0.13929	2.60313	0.01532	0.50054	1.99786
	Mfd GDP	-0.00230	0.00061	-0.26768	-3.78651	0.00086	0.28678	3.48698
	Elec GDP	-0.00202	0.00064	-0.17991	-3.17227	0.00398	0.44559	2.24420
	Const GDP	-0.00084	0.00037	-0.14727	-2.24246	0.03404	0.33230	3.00937
	Trade GDP	-0.00031	0.00088	-0.02817	-0.35245	0.72746	0.22438	4.45676
	Fin GDP	0.00184	0.00058	0.20705	3.14932	0.00421	0.33158	3.01586
	Comm GDP	-0.00141	0.00036	-0.22136	-3.93929	0.00058	0.45386	2.20330

a. Predictors: (Constant), Comm GDP, 1Yr Int rate, Agri GDP, Fin GDP, Const GDP, Ming GDP, Elec GDP, Nifty, Mfd GDP, Trade GDP, Credit Ratio

b. Dependent Variable: NPA Ratio

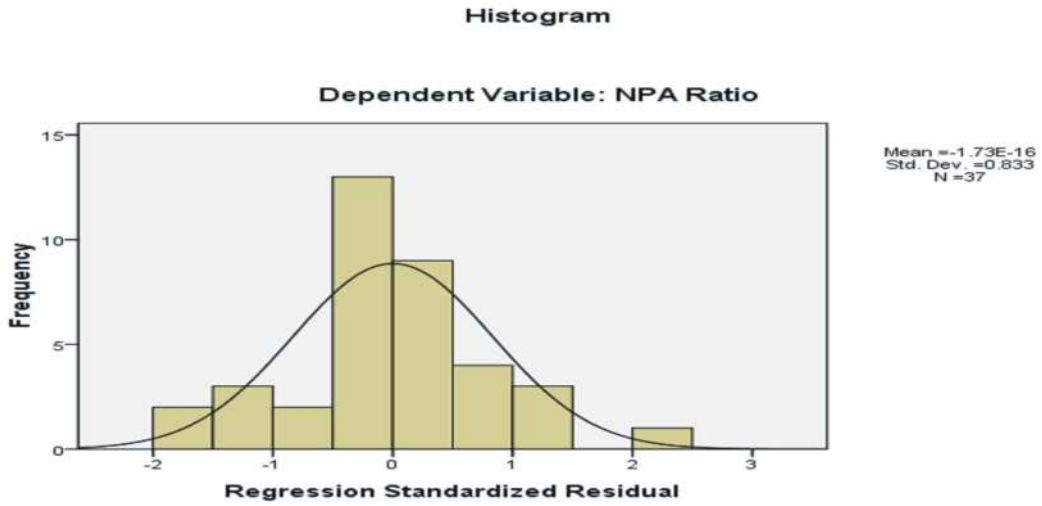


Table 2a: Multivariate Regression forEq(2a)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.968106943	0.9372311	0.9058466	0.0185873

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.	DW
1	Regression	0.1238068	12	0.0103172	29.862889	0.000	1.496
	Residual	0.0082917	24	0.0003455			
	Total	0.1320985	36				

Coefficients

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
			Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.6140728	0.0466266		13.170004	1.779E-12		
	NPA Ratio	-1.291783	0.3525985	-0.572943	-3.663609	0.0012269	0.1069373	9.3512747
	Inflation Growth	0.0039191	0.0030281	0.0730977	1.2942635	0.2078902	0.819921	1.2196297
	Nifty	1.409E-05	6.66E-06	0.3192764	2.1151823	0.0449863	0.1147878	8.7117296
	1Yr Int rate		0.0028884	0.1869336	2.3462506	0.0275553	0.4120097	2.4271274
	Agri GDP	-0.000824	0.0008529	-0.074851	-0.966443	0.343461	0.4360015	2.2935702
	Ming GDP	0.0018646	0.0013805	0.103196	1.3506685	0.1894003	0.4480285	2.2320008
	Mfd GDP	-0.00316	0.0019302	-0.16524	-1.637237	0.1146278	0.2567591	3.8947016
	Elec GDP	-0.003519	0.0020859	-0.140788	-1.686947	0.1045705	0.3754955	2.6631476
	Const GDP	-0.001364	0.0011261	-0.108094	-1.211711	0.2374186	0.3286449	3.0427974
	Trade GDP	-0.002025	0.0026993	-0.082615	-0.750265	0.460388	0.2156985	4.6361
	Fin GDP	0.0057664	0.0015443	0.2913827	3.7338668	0.0010293	0.429461	2.3285001
	Comm GDP	-0.00035	0.0012032	-0.024694	-0.290828	0.7736815	0.3627746	2.7565323

a. Predictors: (Constant), Comm GDP, 1Yr Int rate, Agri GDP, Inflation Growth, Fin GDP, Const GDP, Ming GDP, Elec GDP, Nifty, Mfd GDP, Trade GDP, NPA Ratio

b. Dependent Variable: Credit Ratio

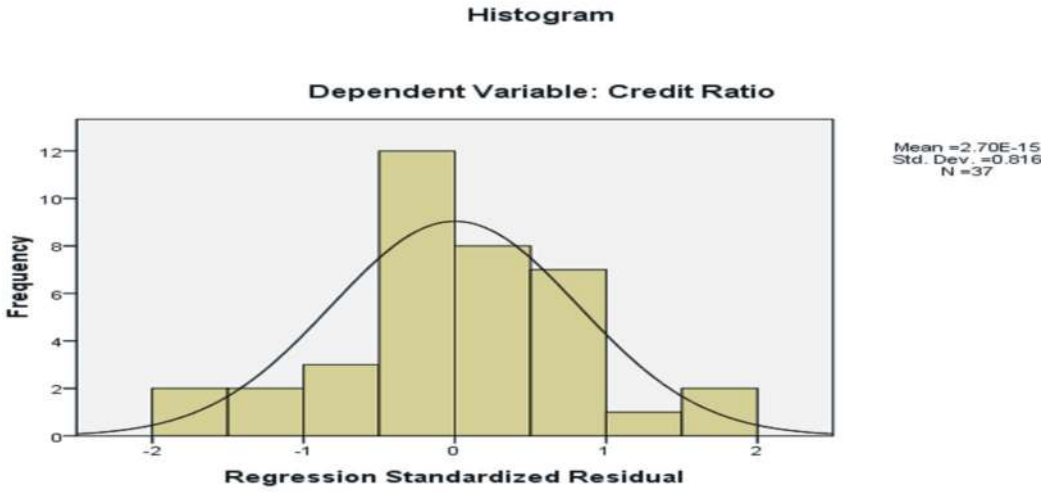


Table 2b: Multivariate Regression for Eq(2b)

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
			Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.6054187	0.0496238		12.200171	8.867E-12		
	NPA Ratio	-1.229287	0.3540807	-0.545224	-3.471772	0.0019755	0.1103904	9.0587597
	Inflation Growth	0.0035921	0.003105	0.0669991	1.1568886	0.2587034	0.8117539	1.2319004
	Nifty	1.72E-05	6.261E-06	0.3898202	2.747015	0.0112249	0.1351987	7.3965198
	10Yr Int Rate	0.0058668	0.0028151	0.1615205	2.0840279	0.0479755	0.4532429	2.2063226
	Agri GDP	-0.000898	0.0008775	-0.08153	-1.023088	0.3164688	0.4287145	2.3325546
	Ming GDP	0.0019294	0.0014136	0.1067813	1.364933	0.1849345	0.4448481	2.2479583
	Mfd GDP	-0.002728	0.0019188	-0.142656	-1.421867	0.167931	0.2704677	3.6972998
	Elec GDP	-0.003582	0.0021273	-0.143309	-1.683768	0.1051907	0.3758348	2.6607438
	Const GDP	-0.001455	0.0011452	-0.115245	-1.270329	0.216145	0.3308016	3.0229597
	Trade GDP	-0.001783	0.0028362	-0.072752	-0.628806	0.5354157	0.2033858	4.9167649
	Fin GDP	0.0050395	0.0015125	0.2546534	3.3317902	0.0027868	0.4660531	2.1456782
	Comm GDP	-8.68E-05	0.0012215	-0.006122	-0.071024	0.9439673	0.3663956	2.7292906

** Analysis with 10 Yr Int rate*

Table 3: Multivariate Regression for Eq (3)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.91426	0.83587	0.76365	0.84508

ANOVA

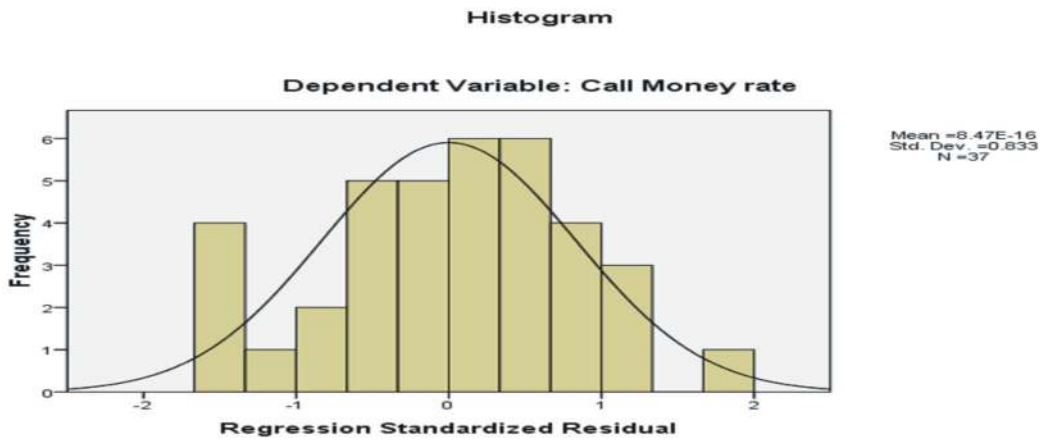
Model		Sum of Squares	df	Mean Square	F	Sig.	DW
1	Regression	90.925	11	8.266	11.574	0.000	2.107
	Residual	17.854	25	0.714			
	Total	108.779	36				

Coefficients

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
			Std. Error	Beta			Tolerance	VIF
1	(Constant)	-6.3437	3.9767		-1.5952	0.1232		
	Credit Ratio	13.8585	7.3297	0.4829	1.8907	0.0703	0.1006	9.9375
	Nifty	-0.0003	0.0003	-0.2110	-0.8764	0.3892	0.1133	8.8255
	10Yr Int Rate	0.7313	0.1194	0.7016	6.1263	0.0000	0.5006	1.9977
	Agri GDP	0.0529	0.0388	0.1675	1.3648	0.1845	0.4357	2.2951
	Ming GDP	0.2103	0.0595	0.4057	3.5354	0.0016	0.4986	2.0055
	Mfd GDP	0.0846	0.0816	0.1541	1.0369	0.3097	0.2971	3.3664
	Elec GDP	-0.1628	0.0865	-0.2270	-1.8833	0.0713	0.4518	2.2132
	Const GDP	-0.0706	0.0507	-0.1948	-1.3925	0.1760	0.3355	2.9808
	Trade GDP	0.0369	0.1230	0.0525	0.3001	0.7666	0.2147	4.6574
	Fin GDP	-0.1962	0.0766	-0.3455	-2.5631	0.0168	0.3613	2.7677
	Comm GDP	0.0336	0.0495	0.0827	0.6798	0.5029	0.4438	2.2532

a. Predictors: (Constant), Comm GDP, Agri GDP, Fin GDP, 10Yr Int Rate, Const GDP, Ming GDP, Nifty, Elec GDP, Mfd GDP, Trade GDP, Credit Ratio

b. Dependent Variable: Call Money rate



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Footnotes

1. The term 'Financial stability' as used in this paper would mean the smooth functioning of broad financial markets as may be envisaged by the objective of a central bank as a social planner of an economy. More specifically this objective is captured in the notion of "the safety and soundness of the [entire] financial sector" as is often claimed by regulation (for example, see Cecchetti (1999))
2. See, for example, Caprio&Klingebiel, (1996,2003), Demirgüc-Kunt&Detragiache, (1997), Hardy &Pazarbaþioðlu, (1998), Kaminsky& Reinhart, (1999), Hermosillo-Gonzalez, (1999), Garcia Herrero& Del Rio, (2003) and Cihák, (2007).
3. The International Monetary Fund (IMF), as part of its surveillance, technical assistance, and policy development initiatives has developed a database termed as FSIs (Financial Stability Indicators). FSIs are regularly being compiled by many nations and revealed to IMF. The IMF publishes them regularly in its quarterly publication titled the Global Financial Stability Report (GFSR).
4. One of the popular measures for assessing the stability or resilience of the banking system has been 'stress test' wherein the stability in terms of capital adequacy is examined under different scenarios of NPAs. See RBI (2009)- Report of the Committee on Financial Sector Assessment.
5. See, for example, Jokipi and Milne (2008) for pro-cyclicality in banking.

6. For instance, Equity Index is available on daily basis; to conform this variable into quarterly figure, we averaged it out for the relevant quarter. While doing this we have taken care of any odd difference between mean and median for such data and adjusted the granularity wherever required.
7. For example, ratio transformation helps in eliminating stationarity in NPA levels; growth rate transformation does the same for Inflation rates.
8. See, Jaime Caruana (2010): Systemic Risk: How to Deal With, Source:http://www.bis.org/publ/othp08.htm, Reddy, Y V (2011): Global Crisis Recession and Uneven Recovery, Orient Black Swan, 2011 and Fernandez et al (2000): Credit Growth, Problem Loans and Credit Risk Provisioning in Spain (BIS Paper 1), Source: http://www.bis.org/publ/bppdf/bispap01p.pdf