Financial Conditions Composite Indicator (FCCI) for India

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Abstract

Financial stability of a country needs to be tracked as an explicit policy variable for ensuring future macroeconomic stability. This study essentially explores the relationship between financial conditions and economic activity for India. Based on the information contained in money, foreign exchange, bond, commodity and equity markets, for the period April 2004 to March 2014, as well as by controlling past influences of economic activity and inflation, we construct a monthly Financial Conditions Composite Indicator (FCCI) for India and its leading indicator. We also estimate the threshold value of FCCI for identifying stress points in the economy.

Keywords: Financial condition, principal component, leading indicator, threshold, Kernel density

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Views expressed in the paper are those of the authors and not of the Reserve Bank of India.

Section I

Introduction

The term Great Moderation, coined by the renowned economists James Stock and Mark Watson (2002), is popularly used to describe the phenomena of decline in volatility of major economic variables such as GDP, industrial production, monthly payroll employment and the unemployment rate, etc. This was a situation of showing overall apparent sign of prosperity. However, the prolonged period of macro-economic stability (low volatility) had caused firms to hold less capital and to be less concerned about liquidity positions. This may be a factor for encouraging the firms to increase their leverage and decrease in risk premium required. Moreover, some sort of structural imbalances or disparities like widening current account deficit in some part of the world with surplus in others, misalignment in exchange rates and booming asset prices had also developed in the world economy. These negative developments had to undo at some point of time and when the unwinding began, they marked themselves in the form of global financial crisis. Most of the regularities in the data that economist have identified are equilibrium relationships, meaning the relationship that hold true when the economy is operating more or less normally. During a serious economic dislocation, many established connections break down and new ones emerge. In the post crisis analysis a number of factors are pointed out in the literature as the likely cause of the crisis.

In the Indian context, the phased liberalisation of economy to trade and capital flows along with a broadly market driven exchange rate regime improved the role of external demand in supporting the economic growth, and at the same time exposing the economy to the forces of globalisation. In this process, India became increasingly integrated with the world economy and maintaining financial stability assumed importance to the policy makers. The multiple indicator approach implicitly established the elements of financial stability within the monetary policy framework of the Reserve Bank of India, even before the 2008 global financial crisis. Thus Indian economy had benefited from global integration and also demonstrated significant resilience to various adverse external shocks like the east-Asian crisis (1997–98), the dot.com crisis (2000–01), etc. During 2008 crisis, despite hardly any direct exposure to the distressed assets, India was impacted like most other emerging markets. The contagion had spread through all the channels – trade, finance and confidence/expectation. Though the direct impact of the crisis on India was relatively low, however, the indirect impacts on Indian economic and financial system were significantly visible. The economy had experienced a significant slowdown in 2008–09 in comparison with the robust growth performance during the preceding five years. India's financial markets had come under pressure from different directions. The substitution of overseas financing by domestic financing brought both the money market and credit market under stress. The reversal of capital flows as part of global deleveraging process brought foreign exchange market under pressure. To meet the external obligations, corporate converted the funds raised locally into foreign currency. The Reserve Bank's intervention in foreign exchange market to manage the volatility in rupee further added to liquidity tightening. As a consequence of global liquidity crunch, Indian banks and corporate found it difficult to raise funds from external sources. The pressure escalated sharply on banks for credit requirements to the corporate sector. Corporate, in their frantic

search to substitute financing, withdrew their investments from domestic money market mutual funds; putting redemption pressure directly on the mutual funds and, indirectly on non-banking financial companies where the mutual funds had invested a significant portion of their funds.

Every crisis provides us powerful lessons. The global financial crisis has changed the perception of financial regulators about the issue of financial stability. The crisis has revealed that, even with macroeconomic stability, financial instability is very much possible and which in turn destabilise the macroeconomic stability. Therefore, financial stability needs to be tracked as an explicit policy variable. When policymakers decide upon the appropriate stance of monetary policy, they must consider the possible macroeconomic implications of developments in financial sector. In this context, measuring and evaluating financial stress in the economy; and incorporating a wide variety of information about financial markets and institutions into macroeconomic consequences, on continuous basis is crucial. This study essentially explores the relationship between financial conditions and economic activity for India. Based on the information contained in money, foreign exchange, bond, commodity and equity markets, for the period April 2004 to March 2014, as well as by controlling past influences of economic activity and inflation, a monthly Financial Conditions Composite Indicator (FCCI) for India is constructed and the threshold value for identifying stress points of FCCI are also estimated. Section II of this study presents the literature survey on development of financial conditions index. The methodology for identifying financial stress indicators, are described in Section III. The detailed empirical analysis for constructing FCCI, its threshold value and composite leading indicator, data sources and reference period under coverage are described in Section IV. Section V concludes.

Section II

Literature survey

This section discusses about the financial conditions, why these matter to an economy, and how an index, representing the financial conditions, has been constructed in practice.

2.1 Financial Conditions

Financial conditions can be defined as the current state of financial variables that influence economic behaviour and, thereby, the future state of economy. The financial instruments that characterize supply or demand relevant for economic activity may signify financial conditions of the economy. An FCCI summarizes the information about future state of economy contained in these current financial variables.

2.2 Importance of Financial Conditions

In the literature of monetary transmission mechanism, monetary policy influences economy by altering financial conditions that affect economic behaviour. The structure of financial system is a key determinant of various channels of transmission. In economies with sophisticated financial systems, the transmission channels are diverse and may change over time. When the policy transmission is

happened solely via financial conditions, FCCI would indicate whether a change in policy will alter economic prospects. It would summarize all the information about financial conditions, arising from both policy and non-policy influences. FCCI can serve as a guide to effective stance of policy, after taking into account all other factors that affect financial variables. However, the link between financial conditions and economic activity evolves over time; the importance of factors other than monetary policy on financial conditions may vary overtime; the response of financial conditions to policy changes may change; and forces other than financial conditions may affect the performance of real economy.

2.3 Some available FCCIs in Developed Countries

A variety of methodologies for constructing FCCIs have been developed over time. In most cases, financial conditions indexes are based on current values of financial variables, but some take into account lagged financial variables as well. Two broad categories of approaches are followed to construct FCCIs, *viz.*, weighted-sum approach and principal components approach. In the weighted-sum approach, the weights on each financial variable are generally assigned based on relative impacts of changes in the variables on real output. On the other hand, the principal components approach extracts a common factor from a group of several financial variables. This common factor captures the greatest common variation in the variables.

2.3.1 Bloomberg Financial Conditions Index

The Bloomberg FCI is a convenient measure to track financial conditions and updated daily. It is an equally weighted sum of three major sub-indexes: money market indicators, bond market indicators, and equity market indicators (Rosenberg, 2009). Each major sub-index is then made up of a series of underlying indicators, which receive an equal weight in that sub-index. The index consists of 10 variables in total, with history available from 1991.

2.3.2 Citi Financial Conditions Index

This index is a weighted sum of six financial variables, *viz.*, corporate spreads, money supply, equity values, mortgage rates, the trade-weighted dollar, and energy prices; all nominal values being deflated. The weights were determined according to reduced-form forecasting equations of the Conference Board's index of coincident indicators (D'Antonio, 2008). This index uses various transformations and lags of the indicators. The index is available from 1983.

2.3.3 Deutsche Bank Financial Conditions Index

Deutsche Bank utilizes a principal components approach for constructing the index (Hooper, Mayer and Slok, 2007; Hooper, Slok and Dobridge, 2010). The first principal component is extracted from a set of seven standardized financial variables that include exchange rate, bond, stock, and housing market indicators. The index is then set to the weighted sum of this principal component and the target federal funds rate. The weights are determined in a regression of real GDP growth on the financial variables and lagged GDP growth. The index is available from 1983.

2.3.4 Goldman Sachs Financial Conditions Index

The Goldman Sachs index is a weighted sum of a short-term bond yield, a long-term corporate yield, exchange rate, and a stock market variable (Dudley and Hatzius, 2000; Dudley, Hatzius and McKelvey, 2005). The Federal Reserve Board's macroeconomic model, together with Goldman Sachs modelling, was used to determine the weights. An increase in the Goldman Sachs FCCI indicates tightening of financial conditions, and a decrease indicates easing. Unlike the other indexes, Goldman Sachs index exhibits a noticeable downward trend because it uses levels of financial variables, as opposed to using spreads or using changes in the variables as in most other indexes.

2.3.5 Federal Reserve Bank of Kansas City Financial Stress Index

This index is a principal-components measure of 11 standardized financial indicators (Hakkio and Keeton, 2009). The financial variables can be divided into two categories: yield spreads and asset price behaviour. A positive index value indicates that financial stress is higher than its longer term average, and vice versa for a negative value.

2.3.6 Macroeconomic Advisers Monetary and Financial Conditions Index (MAFCI)

Macroeconomic Advisers constructed its monetary and financial conditions index in the late 1990s to take into account the dynamic effects of financial variables on GDP over time (Macroeconomic Advisers, 1998). They used five different financial variables, *viz.*, a real short rate, real long rate, dividend ratio, real exchange rate, and real stock market capitalization, and developed a "surface impulse response" methodology in aggregating these variables. Response functions are generated by estimating the partial effects of changes in the financial variable on real GDP growth over time using simulations with MA's large-scale macroeconomic model. These functions are then inverted and aggregated so that the MAFCI at any point in time shows the combined effects of current and past changes in each of the financial variables on real GDP growth in the current period.

2.3.7 OECD Financial Conditions Index

The Organization for Economic Co-operation and Development (OECD) FCI was constructed in 2008. It is a weighted sum of six financial variables (Guichard and Turner, 2008), where the variables are weighted according to their effects on GDP over the next four to six quarters. The OECD set the index weights from a regression of the output gap on a distributed lag of the financial indicators. The weights were normalized relative to the change in interest rates.

Section III

Methodology

Before moving to the methodological discussion on construction of FCCI, let us interpret the concept of financial stress indicators; their identification procedures; construction of stress index and its difference from FCCI.

Financial stress is defined as the force put forth on economic agents by uncertainty and varying expectations of loss in financial markets. Study of financial stress in the economy is vital for the policy makers to effectively gauge the current status of the economy and to make informed decision. In order to quantify the financial stress in the economy, appropriate indicators from different sectors of the economy are selected first and then are combined by using suitable methods. In general, indicators are selected from various sectors of the economy viz. Banking Sector, Foreign exchange market, Debt market and Equity market. Financial Stress Index (FSI) attempts to combine all these different indicators into a unified index and quantify the current degree of stress in financial system. It captures the contemporaneous level of stress.

3.1 Identification of Financial Stress Indicators

The identification of financial stress indicators lies on the effective measures of probable loss, risk, and uncertainty in different financial sectors such as the banking, foreign exchange, debt, and equity markets.

3.1.1 Banking Sector

In banking sector, some of the measures which reflect the happening within the sector are "banking-sector beta", computed over a 12-month rolling window; Certificate of Deposit (CD) spread; and non-linear measure of volatility of banking stock. Beta greater than unity indicates that banking stocks are moving more than proportionately with the overall stock market, implying banking sector is relatively risky. The CD spread is computed over the short-term (overnight) weighted-average call money rates.

3.1.2 Foreign Exchange Market

Foreign exchange (currency) crises are usually defined as significant devaluations, losses in reserves, and/or defensive interest rate increases. Exchange market pressure index (EMPI) is an indicator constructed based on weighted average of change in exchange rate, foreign exchange reserve and interest rate. EMPI increases as the exchange rate depreciates or as international reserves decline. Further, the non-linear measure of volatility in exchange rate is also used as indicator.

3.1.3 Debt Market

Bordo and Schwartz (2000) characterize a debt crisis as the inability of sovereign nations or the broad private sector to service foreign debts. Some of the indicators pertaining to Debt markets are (a) corporate bond yield spread (All-rated long-term corporate bond yield minus the G-Sec long-term bond yield); (b) inverted yield curve: 10 year G-sec benchmark bond yields minus the 91Days Treasury bill rate; and (c) Commercial paper spread: Commercial paper rate minus 91Days Treasury bill rate.

3.1.4 Equity Market

Most studies define equity crises as a sharp decline in the overall market index. The decline can be indicative of greater expected loss, higher dispersion of probable loss (higher risk), or increased uncertainty about the return of firms. General stock Price Index as a per cent of its maximum value over the preceding one year; and

non-linear measure of volatility of the General Stock Index are commonly used indicators for equity market.

3.2 Construction of Financial Stress Index (FSI)

The choice of how to combine the variables (the weighting method) is perhaps the most difficult aspect of constructing an FSI. Various weighting techniques such as factor analysis, variance-equal weights, and transformations of the variables using their sample Cumulative Distribution Functions (CDF) are being commonly used.

The basic idea of factor analysis is to extract weighted linear combinations (factors) of a number of variables. This technique has two main purposes, *viz.*, reduction of number of variables, and detection of the structure in the relationships between variables. A variance-equal weighting method generates an index that gives equal importance to each variable. The variables are assumed to be normally distributed, which is the primary drawback of this approach. The mean is subtracted from each variable before it is divided by its standard deviation, hence the term "variance-equal" weights. In case of Cumulative Density Functions (CDFs) method, each variable is transformed into percentiles based on its sample CDF, such that the most extreme values, corresponding to the highest levels of stress, are characterized as the 99th percentile. The smallest values, corresponding to the lowest levels of stress, are characterized as the first percentile. The transformed variables are then summed equally to create the composite indicator.

3.3 Relationship between FSI and FCCI

The terms "financial conditions" and "financial stresses" are almost similar, each bearing the current state of financial variables. StijnClaessens (2010) of International Monetary Fund (IMF) mentioned FCCI as the counterpart of FSI; where, FSI and FCCI captured the stress and buoyancy of financial markets, respectively. Hatziuset. al. (2010) defined FCCI as a summarization of information about the future state of economy contained in the current financial variables. They referred FCCI as a measure of financial shocks, exogenous in nature, and thereby free from endogenous reflection of past economic activity. Illing and Liu (2003) identified stress as the product of a vulnerable structure and some exogenous shock. If financial stress is systemic, economic behaviour can be altered sufficiently to have adverse effects on the real economy. Therefore, financial stress is a continuous variable with a spectrum of values, where extreme values are called a crisis.

3.4 Construction of FCCI

In order to construct FCCI, the identification of a group of indicators, those capture the build-up of vulnerabilities and imbalances within the main segments of the domestic financial market, has of prime importance. There is a vast range of potential financial variables to be included in FCCI. However, it is observed that, in seven Financial Conditions Indexes, described in Section II, the indicators from four different markets, viz., money market (indicators are TED spread,[4] Commercial Paper/T-Bill Spread, Libor-OIS[5] Spread, etc.), debt market (indicators are yield

[4] TED spread is difference between interest rates on interbank loans and on Treasury Bills.

[5] LIBOR-OIS is the difference between LIBOR and the overnight indexed swap (OIS) rates.

spreads, corporate spreads, short-term bond yield, a long-term corporate yield, etc.), equity market (indicators are equity values, real stock market capitalization, etc.) and foreign exchange market (indicators are trade-weighted dollar, real effective exchange rate, etc.) were selected for constructing a single index. Apart from the above indicators, housing market indicators like real housing wealth to GDP, energy prices, money supply, etc. were also used. Once the indicators are selected, the next step is to combine the selected indicators using either of the two broad methods as detailed below.

Method 1: (a) Standardising the indicators (subtracting mean and then dividing by standard deviation), or alternatively, converting the indicators into percentile score (Cumulative Density Function (CDF)) and then (b) computing arithmetic average of these standardised indicators.

Method 2: This method differs from the standard applications for summarizing the information contained in the selected financial indicators, by eliminating feedback from macroeconomic conditions, and by using more than a single principal component (Hatzius et. al. (2010)). The variability in each of the indicators explained by current and past real activity and inflation, are eliminated so that the principal components reflect exogenous information associated with the financial sector, rather than feedback from macroeconomic conditions. In some sense, the residuals, obtained by eliminating feedback impact reflect financial market behaviour not fully explained by macro-fundamentals. Summarising the information collected in residuals, the top factors containing the maximum information (relating to the financial sector) are extracted through Principal Component Analysis (PCA). FCCI is then constructed as the weighted average of the factors, weights being taken as percentage variation explained by the factors.

In this paper, Method 2 was followed for constructing the indicator. Following the approach of Hatzius *et. al.* (2010), let us consider, X_{it} as i^{th} financial indicator at time *"t"*, and Y_t as a vector of macroeconomic indicators. In this paper, the year-on-year (YoY) growth rates of Index of Industrial Production (IIP) and Wholesale Price Index (WPI) are considered. The regression equation thus constructed is as follows:

$$X_{it} = A_i(L)Y_t + v_{it} \quad (1)$$

where, $A(L)$ is the polynomial of lag *"L"*, v_{it} is uncorrelated with current and lagged values of Y_t and hence, it is assumed that, the feedback impacts of economic activity and inflation are removed. Further, we consider the decomposition of v_{it} as follows:

$$v_{it} = \lambda_i^{/} F_t + u_{it} \quad (2)$$

where, F_t is a vector of unobserved financial factors, u_{it} captures "unique" variation in v_{it} that is unrelated to F_t and Y_t. Under the assumption that u_{it}'s are uncorrelated (or "weakly" correlated) across the financial variables, the vector F_t captures the co-movement in financial indicators. Thus the goal of the econometric analysis is to estimate F_t. When the panel is balanced, the solution to least squares problem provides principal components of estimated residuals $\hat{v}_{it}$, which can be computed as the eigenvectors of sample covariance matrix. In the unbalanced panel, iterative methods can be used to find the least squares solution.

3.5 Derivation of Threshold Value for FCCI

Identification of threshold value for FCCI is important because, whenever the index crosses the value, it implies significant financial stress in the system. Threshold

values for are derived on the basis of historical financial stress episodes, which precede the economic slowdowns or the loss of level of the real output. However, there is no unique way to identify the stress episodes.

3.5.1 Opinion Survey of Experts

In order to identify most stressful events/periods and the reasons behind those events happened economy in the past, the opinion survey of experts, including policy-makers, economists, market participants, etc., may be conducted (Illing and Liu (2003)). The study based on survey data may be used to build the relationship of those events with FCCI for validation and identification of threshold level of FCCI.

3.5.2 Kernel Density Approach

Based on the probability distribution of individual indicators, the threshold for indicators (similar to Value at Risk) may be identified, and diffusion index (i.e. proportion of indicators exceeds its own threshold) may be constructed. In this approach, 90^{th}/95^{th} percentile value may be considered.

3.6 Construction of Leading Indicator for FCCI

The study of financial conditions of economy should not be complete until the early warning signals of financial stress are identified. In this context, the major task is to detect the variables, from a list of selected variables that are able to provide signals in advance, i.e., detection of lead indicators.

In order to construct a composite leading indicator for FCCI, a list of potential indicators is at first prepared. The leading property of these indicators is judged by cross-correlation analysis and pair-wise Granger Causality test. Thereafter, the factor analysis technique is applied on these selected indicators for extracting the common unobserved leading forces. The weighted combination of extracted factors (weights being the percentage variations explained by the factors) is the composite leading indicator for FCCI.

Section IV

Empirical Analysis

This section describes the empirical analysis related to construction of FCCI, identification of stress period, measurement of threshold value, and finally, construction of leading indicator for FCCI.

4.1 Data Source and Frequency of Indicators

To construct the FCCI for India, ten indicators were selected from different sectors, viz., Banking sector, Equity market, Bond market, Foreign exchange market, Monetary sector, etc., of the Indian financial system. These indicators, along with definitions, are presented in Table 1.

The analysis for constructing FCCI was performed on monthly basis for the period April 2004 to March 2014. All data series required to construct the FCCI for India was collected from the Database on Indian Economy (DBIE), Reserve Bank of

India. All the selected indicators were standardised. The series which depict seasonality were adjusted prior to standardization.

Selected Indicators for constructing FCCI

Table 1

Sector	Indicators
Banking	**(1) Banking Beta:** β = cov(r,m)/var(m),calculated monthly over a rolling 1-year time horizon, where, r = per cent change (YoY) in Bank Total price Index (BANKEX); m = per cent change (YoY) in general stock index (SENSEX)
	(2) CD spread: CD rate minus 15–91Days TBills rate
Foreign Exchange	**(3) Exchange Rate Market Pressure (EMP):** Weighted average of change in exchange rate, foreign exchange reserve and interest rate.
	(4) USD_NNL_SD: ARCH(1) measure of volatility of INR-USD exchange rate.
Debt	**(5) Inverted Yield Spread:** 15–91Days TBills rate minus 10 year Government of India benchmark bond yields
	(6) CP spread: CP rate minus 15–91Days TBills rate
Equity	**(7) Calibrated YoY Stock Return (STOCK_YOY_CALB):** (Maximum of YoY return of NIFTY index)minus (current month YoY NIFTY return)
	(8) SENSEX_NNL_SD: ARCH(1) measure of volatility of BSE SENSEX.
Monetary Sector	**(9) DLM3_SA:** Seasonally adjusted Month-over-Month (MoM) change in M3.
Commodity Price	**(10) DLGOLDP:** MoM change in Gold Price.

Note: ARCH implies Autoregressive Conditional Heteroskedasticity

4.2 Construction of factors and FCCI

As described in the methodology mentioned in sub-section 3.5, the year-on-year growth rate of monthly Index of Industrial Production (IIP) and Wholesale Price Index (WPI) were considered as the performance of economic activity and measure of inflation, respectively. These series were also standardised before running equation (1) on each of the ten selected indicators. Six months lags of IIP growth and inflation were imposed in the equation. The residual series, hence obtained, could be treated as free from feedback impacts of economic activity and inflation. Table 2 shows the correlation between extracted residual series of indicators. Some indicators show high correlations in the residual series. In order to extract the common forces from residual series, such that, common forces are orthogonal to each other, the factor analysis based on principal component technique was applied. Accordingly, three factors were extracted. The weighted aggregation of selected factors (weights being determined according to the respective percent variation explained) was considered as FCCI for the economy (Chart 1).

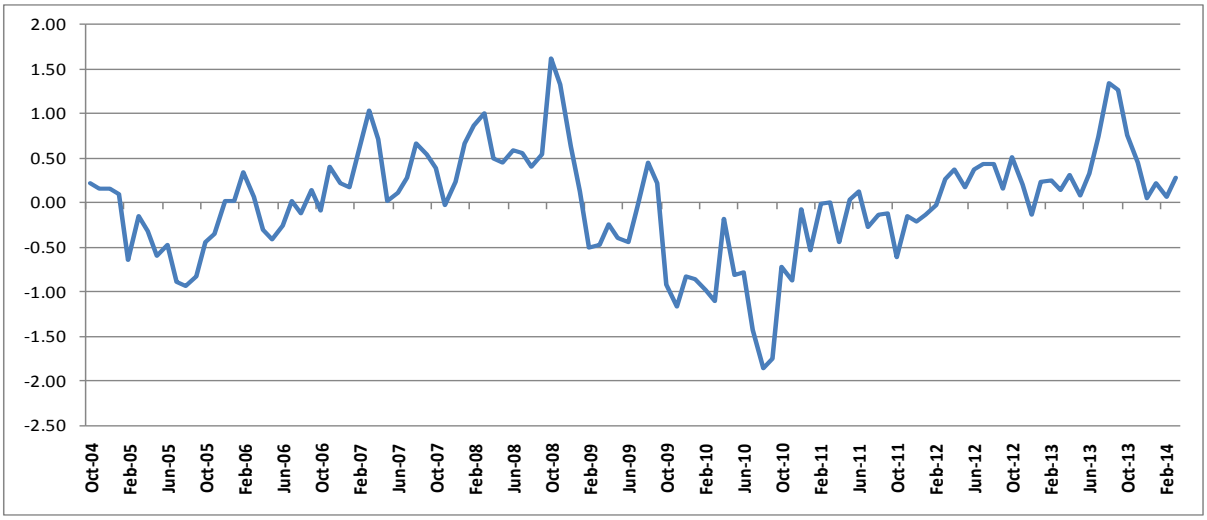
Correlation Table of Residual Series of Selected Indicators

Table 2

	DLM3_SA	DLGOLDP	Banking Beta	SENSEX_NNL_SD	STOCK_YOY_CALB	CD spread	CP spread	EMP	Inverted Yield Spread	USD_NNL_SD
DLM3_SA	1.00									
DLGOLDP	0.05	1.00								
Banking Beta	-0.09	-0.02	1.00							
SENSEX_NNL_SD	0.11	0.04	-0.14	1.00						
STOCK_YOY_CALB	0.03	-0.07	0.10	0.32	1.00					
CD spread	0.16	0.03	-0.38	0.35	0.42	1.00				
CP spread	0.14	0.06	-0.30	0.34	0.38	0.87	1.00			
EMP	0.11	0.13	0.01	-0.06	0.11	-0.06	-0.05	1.00		
Inverted Yield Spread	-0.01	0.01	0.38	-0.26	-0.05	-0.50	-0.35	0.11	1.00	
USD_NNL_SD	-0.01	-0.11	0.03	0.27	0.27	0.17	0.22	0.08	0.03	1.00

Financial Conditions Composite Indicator for India

Chart 1



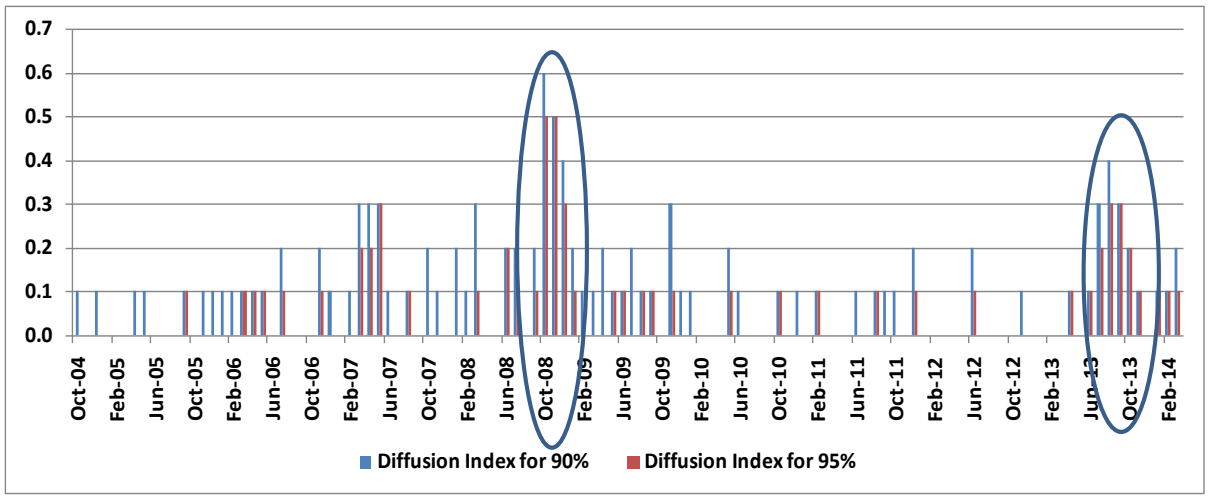
4.3 Derivation of threshold value for FCCI

To estimate the threshold value of FCCI and to identify the stress point, the kernel density approach was considered. The kernel densities of residual of ten selected indicators as well as the diffusion index are provided in Annex 1. Based on probability distribution of individual indicators and risk appetite, the threshold values for indicators were identified (similar to Value-at-Risk technique). Thereafter, the diffusion index i.e. proportion of indicators exceeding its own threshold, was constructed (Chart 2). During the stress period, the diffusion index usually shows high value. If 90th percentile of the monthly diffusion index is selected as the threshold value, then the corresponding average FCCI value is the considered as threshold for FCCI. Accordingly, at 90th and 95th percentile levels, the threshold value for FCCI stood at 1.04 and 1.51, respectively (Chart 3). During the period under

study, i.e., April 2004 to March 2014, based on FCCI and threshold values, the sub-periods "*September 2008 to December 2008*" and "*August–September 2013*" are the stressful periods. Specifically, the month "*October 2008*" is identified as the most stressful period of the Indian economy. The first sub-period coincides with global financial crisis of 2008. In case of second sub-period, the stress is short-lived, and it aligns with the period of latest currency crisis. During this period, the Indian Rupee to US Dollar (INR-USD) reference rate touched the highest level at 68.3611 (date: 28-August-2013).

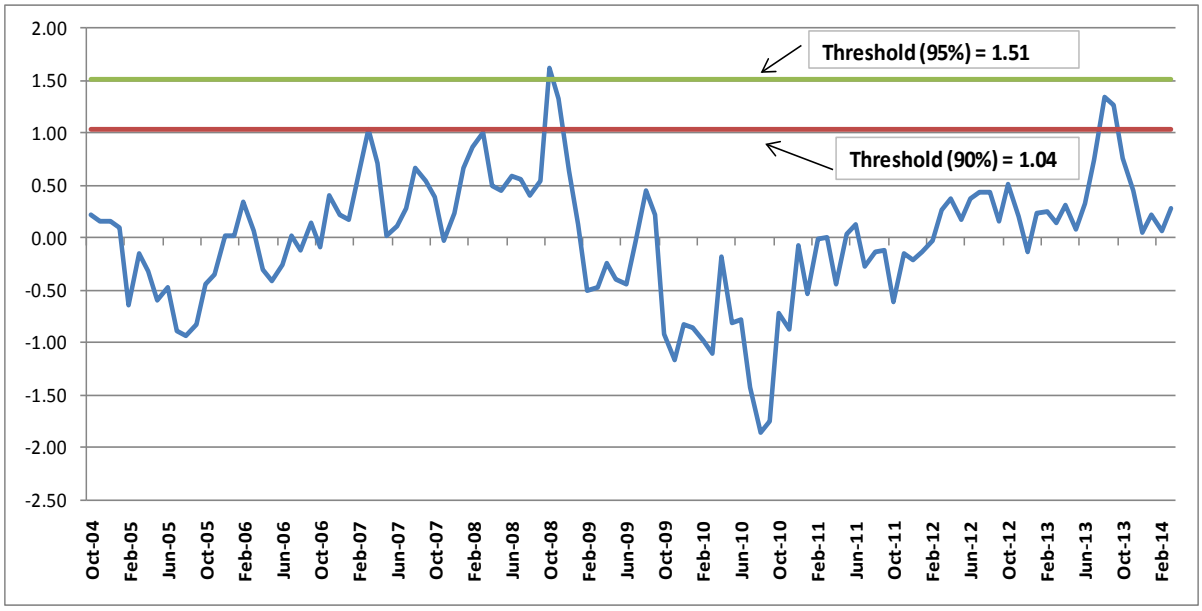
Diffusion Index of Indicators exceeding respective threshold value

Chart 2



Financial Conditions Composite Indicator for India

Chart 3



4.4 Composite Leading Indicator for FCCI

Different indicators are selected from different sectors of the economy for judging the leading properties of them (Table 3). Exports (in US$), Imports (in US$), Terms of Trade (i.e., Exports to Imports ratio), and Net inflows of Foreign Institutional Investment (FII) in debt and equity segments are taken from external sector. From the banking sector, deposits volume, credit volume, deposits rate, lending rate, assets with bank, investment in India, and net foreign exchange assets are considered. All the series, expect Terms of Trade, Net FII inflows, deposits rate, and lending rate, are taken in terms of year-on-year growth rates. The selected eleven series are also stationary, based on standard unit root tests. The leading properties of these indicators are tested by cross-correlation analysis and pair-wise Granger causality test.

Cross Correlation of Indicators with FCCI — Table 3

Indicator\No. of month (i)		0	1	2	3	4	5	6	7	8	9	10	11	12
Exports	Lag	-0.139	-0.125	-0.081	-0.066	-0.008	0.000	0.039	0.041	0.047	0.101	0.110	0.196	0.228
	Lead	-0.139	-0.170	-0.158	-0.249	-0.304	-0.352	-0.377	-0.343	-0.385	-0.389	-0.425	-0.402	-0.388
Imports	Lag	-0.153	-0.057	0.005	-0.005	-0.009	-0.054	-0.042	0.009	0.081	0.176	0.258	0.297	0.285
	Lead	-0.153	-0.189	-0.185	-0.165	-0.173	-0.155	-0.157	-0.138	-0.194	-0.262	-0.303	-0.301	-0.250
Terms of Trade	Lag	0.022	-0.046	**-0.101**	-0.097	-0.080	-0.033	0.024	0.015	-0.039	-0.052	-0.115	-0.049	0.035
	Lead	0.022	-0.020	-0.038	-0.123	-0.159	-0.194	-0.227	-0.259	-0.254	-0.175	-0.184	-0.111	-0.150
Net FII inflows - Debt and Equity	Lag	**-0.333**	**-0.305**	**-0.300**	-0.158	-0.114	-0.095	-0.047	-0.023	0.053	0.003	-0.046	-0.002	0.069
	Lead	-0.333	-0.247	-0.268	-0.236	-0.203	-0.136	0.005	-0.002	-0.096	-0.114	-0.098	-0.040	-0.061
Aggregate Deposits	Lag	0.212	0.203	**0.242**	0.230	0.200	0.182	0.146	0.129	0.105	0.067	0.021	0.010	-0.005
	Lead	0.212	0.190	0.184	0.198	0.186	0.181	0.238	0.219	0.201	0.190	0.166	0.177	0.149
Non-Food Bank Credit	Lag	0.022	0.005	0.008	0.020	0.027	0.065	0.081	0.103	0.134	0.164	0.169	0.182	0.191
	Lead	0.022	-0.021	-0.075	-0.122	-0.155	-0.166	-0.146	-0.147	-0.131	-0.139	-0.159	-0.172	-0.198
Deposits Rate	Lag	**0.528**	**0.520**	**0.499**	0.485	0.466	0.431	0.417	0.391	0.356	0.330	0.276	0.209	0.143
	Lead	0.528	0.510	0.491	0.447	0.413	0.365	0.309	0.246	0.190	0.129	0.077	0.014	-0.034
Lending Rate	Lag	0.413	0.360	0.278	0.181	0.128	0.067	0.058	0.029	0.031	0.030	-0.005	-0.030	-0.069
	Lead	0.413	0.427	0.442	0.417	0.446	0.476	0.490	0.506	0.519	0.509	0.449	0.381	0.342
Assets with banks	Lag	0.097	0.196	0.255	**0.295**	0.285	0.267	0.254	0.224	0.188	0.159	0.175	0.172	0.153
	Lead	0.097	0.037	0.012	0.038	0.050	0.059	0.048	0.009	-0.046	-0.063	-0.079	-0.146	-0.170
Scheduled Commercial Banks' Investment in India	Lag	0.107	0.060	0.015	-0.027	-0.060	-0.072	-0.103	-0.119	-0.179	-0.236	-0.308	-0.351	-0.388
	Lead	0.107	0.126	0.173	0.216	0.240	0.263	0.303	0.355	0.413	0.448	0.446	0.440	0.405
Net Foreign Exchange Assets	Lag	0.413	0.427	0.426	0.454	0.486	**0.490**	0.446	0.420	0.386	0.327	0.277	0.223	0.157
	Lead	0.413	0.371	0.334	0.310	0.272	0.238	0.206	0.184	0.132	0.125	0.105	0.085	0.050

Table 4 presents the cross-correlation between different indicators and FCCI values upto 12 months. Here, "i" indicates lead or lagged number of months. Fori = 0, the contemporaneous correlations are reported. The "lag" row for each indicator at ith month indicates the correlation of current FCCI value with i^{th} month lagged value of corresponding indicator. For "lead" rows, the correlation coefficients between lead values of indicators with current FCCI values are mentioned. Hence, for selecting leading indicators, "lag" row values are important. However, "lead" rows also tell whether FCCI is leading or not.

Out of four selected external sector indicators, exports and imports are lagging to FCCI. This is observed from the movement of correlation of "lead" rows. From the "lag" rows, if the lags upto eight months are considered, then contemporaneous correlation coefficient is highest for both cases. Thereafter, the decrease in correlation is observed. Further, the values of correlation coefficient in "lead" rows are higher than those of "lag" rows. The third indicator, "Terms of Trade" is showing leading nature (at lag 2) to FCCI, although the correlation

coefficient is very low (–10.1 percent). Further, almost all the lead correlations are higher than the lag correlations. The pair-wise Granger causality test in Table 4 also does not indicate its leading nature. As this indicator includes both of the merchandise exports and imports information, hence based on cross correlation information, it is selected as a leading indicator. Moreover, it has also been observed at the time of aggregation of selected leading indicators that, the inclusion of this indicator has improved the leading capability of composite indicator. In case of Net FII Inflows in Debt and Equity segments, the contemporaneous correlation is highest. As the lag increases, the correlation value decreases. It is observed from the "lag" row that, upto lag 2, this decrease is not rapid. But in the "lead" row, the correlation is lower and its decrease is also rapid. This indicates a possibility of leading property of the indicator.

Among the banking sector indicators, Non-food Bank Credit, Scheduled Commercial Banks' (SCB) Domestic Investment, and Lending Rate are lagging to FCCI. The cross correlation pattern of Deposits Rate is similar to that of Net FII inflows. The remaining three indicators, *viz.*, Aggregate Deposits, Assets with banks, and Net Foreign Exchange Assets are leading to FCCI with 2, 3, and 5 months, respectively.

Next we describe the results obtained from pair-wise Granger causality test. Table 4 presents the probabilities of F-statistics corresponding to the test. The null hypothesis is one variable does not Granger cause the other. If 5 percent level of significance is considered, then Deposits rate, Assets with banks, and Net Foreign Exchange Assets cause FCCI at 2, 1, and 3 lags, respectively; i.e., these indicators are leading to FCCI. Further, FCCI is leading to Exports, Non-Food Bank Credit, and Lending Rate. For the other five indicators, no causality hypothesis is accepted.

Probabilities of F-statistics in Pair-wise Granger Causality Test

Table 4

Indicator\No. of month (i)		0	1	2	3	4	5	6	7	8	9	10	11	12
Exports	Lag	-0.139	-0.125	-0.081	-0.066	-0.008	0.000	0.039	0.041	0.047	0.101	0.110	0.196	0.228
	Lead	-0.139	-0.170	-0.158	-0.249	-0.304	-0.352	-0.377	-0.343	-0.385	-0.389	-0.425	-0.402	-0.388
Imports	Lag	-0.153	-0.057	0.005	-0.005	-0.009	-0.054	-0.042	0.009	0.081	0.176	0.258	0.297	0.285
	Lead	-0.153	-0.189	-0.185	-0.165	-0.173	-0.155	-0.157	-0.138	-0.194	-0.262	-0.303	-0.301	-0.250
Terms of Trade	Lag	0.022	-0.046	**-0.101**	-0.097	-0.080	-0.033	0.024	0.015	-0.039	-0.052	-0.115	-0.049	0.035
	Lead	0.022	-0.020	-0.038	-0.123	-0.159	-0.194	-0.227	-0.259	-0.254	-0.175	-0.184	-0.111	-0.150
Net FII inflows - Debt and Equity	Lag	**-0.333**	**-0.305**	**-0.300**	-0.158	-0.114	-0.095	-0.047	-0.023	0.053	0.003	-0.046	-0.002	0.069
	Lead	-0.333	-0.247	-0.268	-0.236	-0.203	-0.136	0.005	-0.002	-0.096	-0.114	-0.098	-0.040	-0.061
Aggregate Deposits	Lag	0.212	0.203	**0.242**	0.230	0.200	0.182	0.146	0.129	0.105	0.067	0.021	0.010	-0.005
	Lead	0.212	0.190	0.184	0.198	0.186	0.181	0.238	0.219	0.201	0.190	0.166	0.177	0.149
Non-Food Bank Credit	Lag	0.022	0.005	0.008	0.020	0.027	0.065	0.081	0.103	0.134	0.164	0.169	0.182	0.191
	Lead	0.022	-0.021	-0.075	-0.122	-0.155	-0.166	-0.146	-0.147	-0.131	-0.139	-0.159	-0.172	-0.198
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	Lead	0.528	0.510	0.491	0.447	0.413	0.365	0.309	0.246	0.190	0.129	0.077	0.014	-0.034
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	Lead	0.413	0.427	0.442	0.417	0.446	0.476	0.490	0.506	0.519	0.509	0.449	0.381	0.342
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	Lead	0.107	0.126	0.173	0.216	0.240	0.263	0.303	0.355	0.413	0.448	0.446	0.440	0.405
Net Foreign Exchange Assets	Lag	0.413	0.427	0.426	0.454	0.486	**0.490**	0.446	0.420	0.386	0.327	0.277	0.223	0.157
	Lead	0.413	0.371	0.334	0.310	0.272	0.238	0.206	0.184	0.132	0.125	0.105	0.085	0.050

Note: The symbol ≠> means "does not Granger cause"

Based on cross-correlation analysis and pair-wise Granger causality test, the indicators, that are finally selected, are Terms of Trade, Net FII inflows, Aggregate Deposits, Deposits Rate, Assets with banks, and Net Foreign Exchange Assets (Charts in Annex 2). Among these indicators, Deposits Rate, Assets with banks, and Net Foreign Exchange Assets satisfy both procedures.

The aggregation of six finally selected indicators is done by factor analysis technique for arriving at composite leading indicator for FCCI. The main advantage of using factor analysis technique is that, it extracts the common unobserved forces (i.e., factors) from the system, so that these factors are orthogonal to each other. It also reduces the number of variables. Further, it solves the scaling problem, because, the preliminary descriptive statistics (i.e., mean, median, minimum, maximum, standard deviation) of different indicators have different magnitudes and scales (Table 5). From six indicators, two factors are extracted. The weighted combination of these two factors is the required composite leading indicator for FCCI. Here, weights are percentage variations explained by the factors (weights: 54.6 percent and 45.4 percent).

Descriptive Statistics of selected Leading Indicators of FCCI

Table 5

Indicator	Mean	Median	Minimum	Maximum	Range	Standard Deviation
Terms of Trade	66.8	66.2	47.5	91.0	43.5	8.3
Net FII inflows	1338.0	1184.5	-7535.6	7164.4	14700.0	2374.1
Aggregate Deposits	18.1	17.6	10.2	25.9	15.7	3.8
Deposits Rate	7.8	8.3	5.3	9.6	4.4	1.1
Assets with banks	16.9	16.5	-35.5	68.2	103.7	20.3
Net Foreign Exchange Assets	10.3	9.4	-7.5	45.7	53.2	10.4

Movement of FCCI and its Composite Leading Indicator

Chart 4

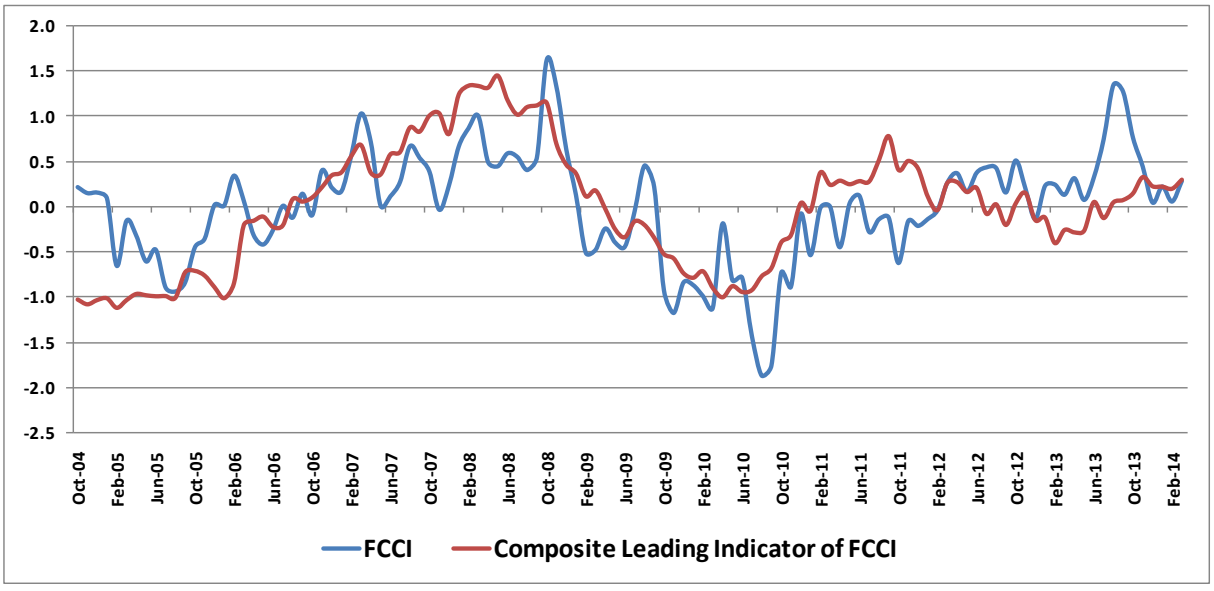


Chart 4 presents the movements of FCCI and its composite leading indicator (CLI) for the period October 2004 to March 2014. From the visual inspection, it is observed that, CLI captures the stress during the sub-period "*September 2008 to December 2008*" in Indian financial system well in advance. For the second sub-period "*August–September 2013*", the upward movement in stress is also captured by CLI well in advance. However, the movement of CLI during the period "December 2013 to March 2014" indicates persistence of stress at lower level. The pair-wise Granger causality test between FCCI and its CLI as well as turning point analysis also supports leading properties of CLI (Tables 6 and 7). Based on these two procedures, it may be concluded that, the movement of CLI is, on an average, 3–4 months leading to FCCI.

Granger Causality Test (FCCI and its CLI) – Probabilities of F-statistics — Table 6

		1	2	3	4	5	6
CLI of FCCI	**≠> FCCI**	**0.008**	**0.017**	**0.032**	0.086	0.313	0.156
FCCI	**≠> CLI of FCCI**	0.478	0.700	0.787	0.868	0.889	0.905

Note: The symbol ≠> means "does not Granger cause"

Turning Point Analysis between FCCI and its CLI — Table 7

Turning Point Date for		**Lead**
FCCI	**CLI of FCCI**	**(in months)**
Oct-08	May-08	5
Aug-10	Apr-10	4
May-13	Feb-13	3
Average Lead		**4**

Section V

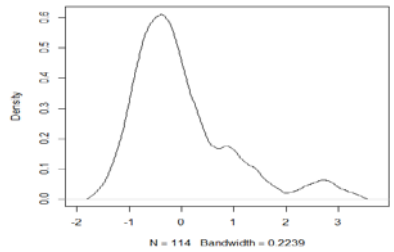
Conclusion

Financial stability of a country needs to be tracked as an explicit policy variable for ensuring future macroeconomic stability. This study essentially explores the relationship between financial conditions and economic activity for India. An attempt has been made to construct the Financial Conditions Composite Indicator (FCCI) for India following the principal component analysis (PCA) applied by Hatzius *et. al.* (2010). In this approach, at first, the indicators were selected from different sectors viz., Banking sector, Equity market, Bond market, Foreign exchange market, Monetary sector, etc., of Indian economy, and thereafter, the feedback impacts of economic growth and inflation on different financial indicators were removed, so that, financial market behaviour was not fully explained by macroeconomic fundamentals. Subsequently, PCA was applied on the resultant residual series, which were free from effect of economic growth and inflation. The weighted aggregation

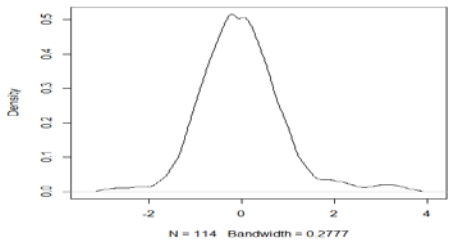
of extracted three factors was considered as FCCI. To estimate the threshold value of FCCI and to identify the stress point, kernel density approach was considered. Thereafter, the diffusion index i.e. proportion of indicators exceeding its own threshold level, was constructed. Based on risk appetite, the threshold value for FCCI was determined. During the period under study, i.e., April 2004 to March 2014, based on constructed FCCI and its 90th and 95th percentile threshold values, (i.e., 1.04 and 1.51, respectively), the sub-period "*September 2008 to December 2008*", and specifically, the month "*October 2008*" was identified as the most stressful period of the economy. Further, in order to identify the early warning signals of financial stress in the economy, a Composite Leading Indicator (CLI) for FCCI was constructed. It was found that, CLI captured upward movement in stress well in advance. However over time, the effectiveness of selected leading indicators for FCCI may be reduced and certain other indicators may exhibit the leading properties. Hence, it is imperative to update the list of selected indicators and judge the leading properties of these indicators on a continuous basis while constructing and updating CLI of FCCI.

Annex 1

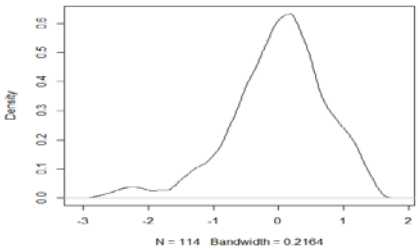
USD_NNL_SD



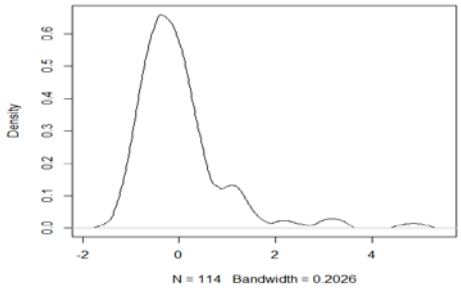
EMP



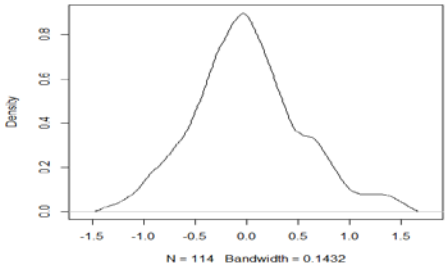
BANKING BETA



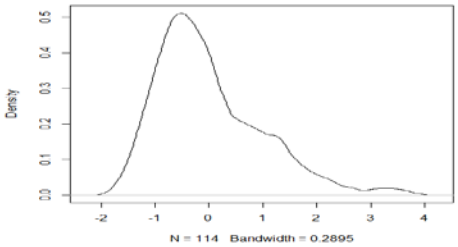
SENSEX_NNL_SD



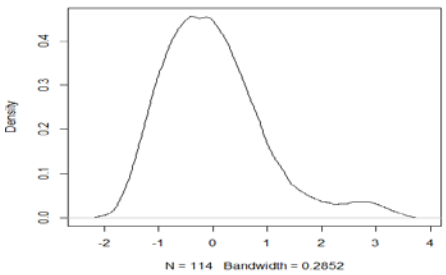
STOCK_YOY_CALB



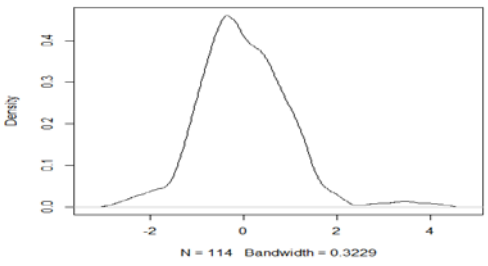
CD_Y91



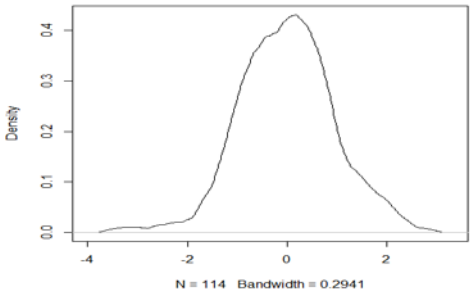
CP_Y91



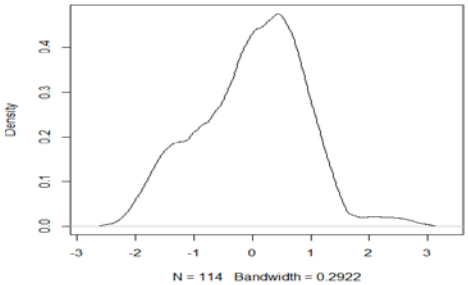
DLM3_SA



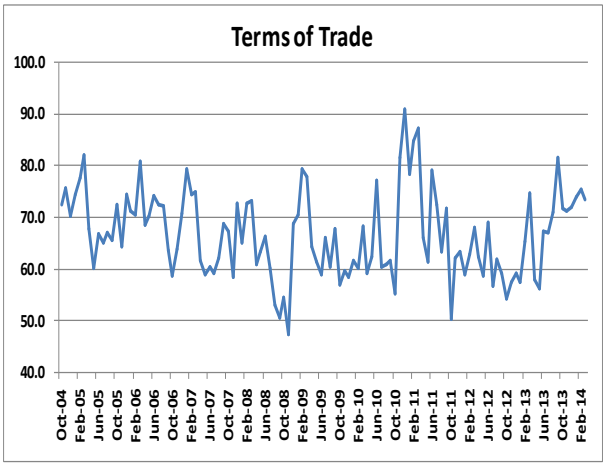
DLGOLDP

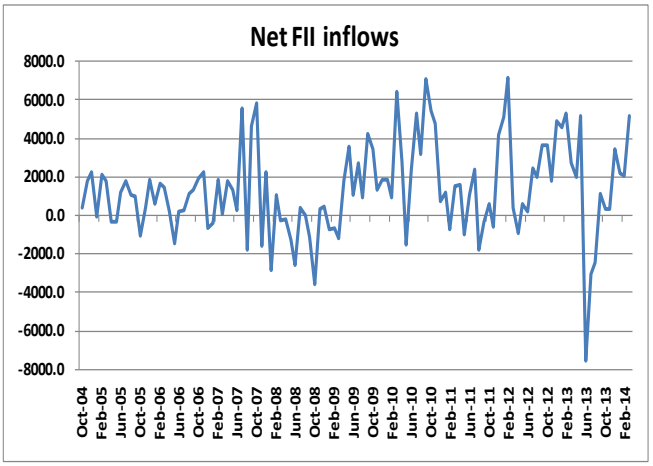


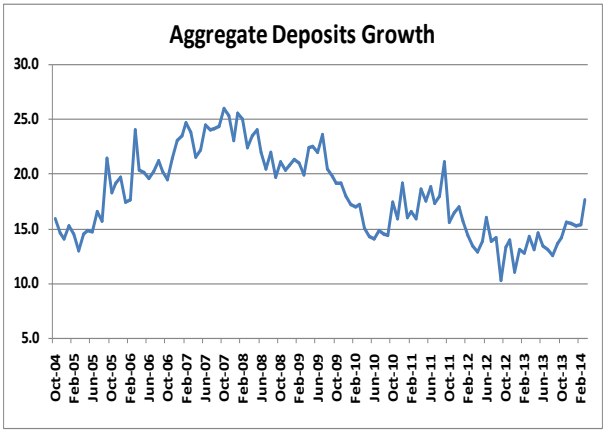
INV_YIELDNEG

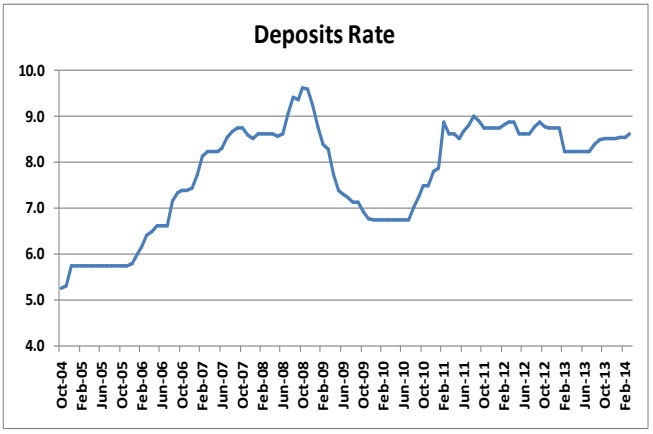


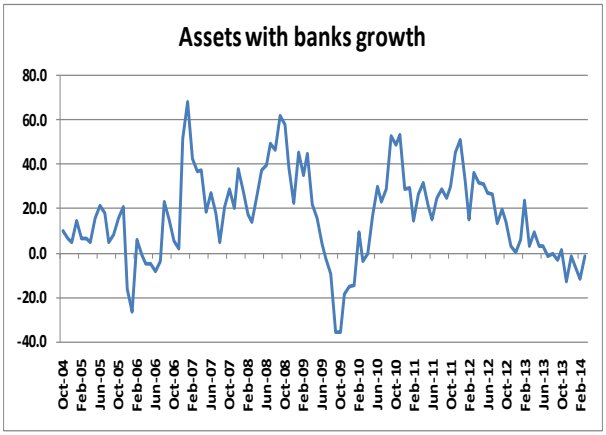
Annex 2

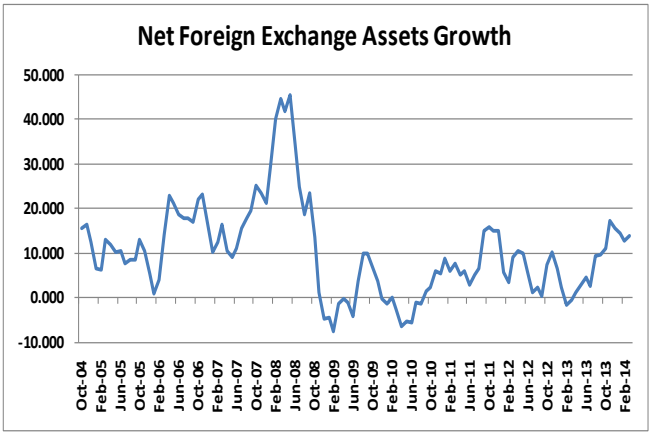

Terms of Trade
100.0
90.0
80.0
70.0
60.0
50.0
40.0
Oct-04 Feb-05 Jun-05 Oct-05 Feb-06 Jun-06 Oct-06 Feb-07 Jun-07 Oct-07 Feb-08 Jun-08 Oct-08 Feb-09 Jun-09 Oct-09 Feb-10 Jun-10 Oct-10 Feb-11 Jun-11 Oct-11 Feb-12 Jun-12 Oct-12 Feb-13 Jun-13 Oct-13 Feb-14


Net FII inflows
8000.0
6000.0
4000.0
2000.0
0.0
-2000.0
-4000.0
-6000.0
-8000.0
Oct-04 Feb-05 Jun-05 Oct-05 Feb-06 Jun-06 Oct-06 Feb-07 Jun-07 Oct-07 Feb-08 Jun-08 Oct-08 Feb-09 Jun-09 Oct-09 Feb-10 Jun-10 Oct-10 Feb-11 Jun-11 Oct-11 Feb-12 Jun-12 Oct-12 Feb-13 Jun-13 Oct-13 Feb-14


Aggregate Deposits Growth
30.0
25.0
20.0
15.0
10.0
5.0
Oct-04 Feb-05 Jun-05 Oct-05 Feb-06 Jun-06 Oct-06 Feb-07 Jun-07 Oct-07 Feb-08 Jun-08 Oct-08 Feb-09 Jun-09 Oct-09 Feb-10 Jun-10 Oct-10 Feb-11 Jun-11 Oct-11 Feb-12 Jun-12 Oct-12 Feb-13 Jun-13 Oct-13 Feb-14


Deposits Rate
10.0
9.0
8.0
7.0
6.0
5.0
4.0
Oct-04 Feb-05 Jun-05 Oct-05 Feb-06 Jun-06 Oct-06 Feb-07 Jun-07 Oct-07 Feb-08 Jun-08 Oct-08 Feb-09 Jun-09 Oct-09 Feb-10 Jun-10 Oct-10 Feb-11 Jun-11 Oct-11 Feb-12 Jun-12 Oct-12 Feb-13 Jun-13 Oct-13 Feb-14


Assets with banks growth
80.0
60.0
40.0
20.0
0.0
-20.0
-40.0
Oct-04 Feb-05 Jun-05 Oct-05 Feb-06 Jun-06 Oct-06 Feb-07 Jun-07 Oct-07 Feb-08 Jun-08 Oct-08 Feb-09 Jun-09 Oct-09 Feb-10 Jun-10 Oct-10 Feb-11 Jun-11 Oct-11 Feb-12 Jun-12 Oct-12 Feb-13 Jun-13 Oct-13 Feb-14


Net Foreign Exchange Assets Growth
50.000
40.000
30.000
20.000
10.000
0.000
-10.000
Oct-04 Feb-05 Jun-05 Oct-05 Feb-06 Jun-06 Oct-06 Feb-07 Jun-07 Oct-07 Feb-08 Jun-08 Oct-08 Feb-09 Jun-09 Oct-09 Feb-10 Jun-10 Oct-10 Feb-11 Jun-11 Oct-11 Feb-12 Jun-12 Oct-12 Feb-13 Jun-13 Oct-13 Feb-14

References

Bordo, M. and A. Schwartz, (2000), "Measuring Real Economic Effects of Bailouts: Historical Perspectives on How Countries in Financial Stress Have Fared With and Without Bailouts", NBER Working Paper No. 7701.

Cassidy John, (2009), *How Markets Fail: The Logic of Economic Calamities*.

D'Antonio, P., Appendix, pages 26–28, in DiClemente, R. and K. Schoenholtz (September 26, 2008), "A View of the U.S. Subprime Crisis", EMA Special Report, Citigroup Global Markets Inc.

Dudley, W., and J. Hatzius (June 8, 2000), The Goldman Sachs Financial Conditions Index: The Right Tool for a New Monetary Policy Regime, Global Economics Paper No. 44.

Dudley, W., J. Hatzius, and E. McKelvey, (April 8, 2005), Financial Conditions Need to Tighten Further, US Economics Analyst, Goldman Sachs Economic Research.

Guichard, S. and D. Turner, (September 2008), "Quantifying the effect of financial conditions on US activity", OECD Economics Department Working Papers.

Hakkio, C. S. and W. R. Keeton, (2Q 2009), "Financial Stress: What is it, how can it be measured, and why does it matter?", Federal Reserve Bank of Kansas City *Economic Review*.

Hatzius J. Hooper P., Mishkin F., Schoenholtz K. L., and Watson M. W., (2010), "Financial Conditions Indexes: A Fresh Look after the Financial Crisis", Draft edition.

Hooper, P., T. Mayer and T. Slok, (June 11, 2007). "Financial Conditions: Central Banks StillAhead of Markets", Deutsche Bank, *Global Economic Perspectives*.

Hooper, P., T. Slok and C. Dobridge, (January 6, 2010), "Improving Financial Conditions BodeWell for Growth", Deutsche Bank, *Global Economic Perspectives*.

Mark Illing and Ying Liu, (2003), "An Index of Financial Stress for Canada", Bank of Canada working paper, 2003/14.

Reserve Bank of India, (2010), *Report on Currency and Finance 2008–09*.

Rosenberg, M., (2009), "Financial Conditions Watch", Bloomberg.

StijnClaessens, Giovanni Dell'Ariccia, DenizIgan, and Luc Laeven, (2010), "Lessons and Policy Implications from the Global Financial Crisis", IMF Working Paper, WP/10/44.

Stock, James H., and Mark W. Watson, (2002), "Has the Business Cycle Changed and Why?", NBER Macroeconomics Annual 2002, Volume 17.

The IMF, *World Economic Outlook*, April 2009.