POST-GRADUATE STUDENT RESEARCH PROJECT

Financial Market Development and Integration:

A look at the Indian story

Prepared by

Sumit Kaur
Student of PGDM Program (Finance) 2012–2014
S. P. Jain Institute of Management and Research, Mumbai

Supervised by

Dr. R. K. Pattnaik
Professor
S. P. Jain Institute of Management and Research, Mumbai

March 2014

Financial Market Development and Integration: A look at the Indian story

Prepared by Sumit Kaur*

Abstract

In India, there has been a conscious effort by the RBI and the Government of India to develop and integrate various financial market segments in a phased manner. In this paper, the authors analyse the macro-economic dependence, current liquidity, volatility, efficiency, and integration level of four key financial market segments—money, government securities, forex and equity. The effectiveness of monetary policy transmission at the current level of financial market integration is discussed in the wake of the USD/INR depreciation episode in 2013. The regression analysis suggests behavioural dependence of the macroeconomic variables on financial indicators of government securities and forex market. The liquidity analysis indicates that money, government securities, and forex market are highly liquid. Money and government securities market are found to be less volatile, albeit highly susceptible to shocks. On the other hand, the strong influence of exogenous factors on forex and equity markets has made them highly volatile. Gradual financial reforms have enhanced the market efficiency of the country's forex market. Temporal cross-correlation studies highlight an evolutionary pattern in financial market integration—correlation between different market segments has increased over time. Such inter-market and macro-economic behavioral relationship analyses have become important in today's fragile macroeconomic scenario characterized by weak domestic performance and uncertainty in foreign investor sentiment.

* Sumit Kaur is a PGDM (Finance) student from S.P. Jain Institute of Management & Research. The author would like to express gratitude to Dr. R.K. Pattnaik, Professor at S.P. Jain Institute of Management & Research for his valuable comments and support with this paper. The views expressed in the paper are those of the author and do not necessarily reflect the opinion of the National Stock Exchange of India Ltd. The author can be contacted at post.sumitkaur@gmail.com.

Financial Market Development and Integration: A look at the Indian story

1. Introduction

May you live in interesting times.

–Ancient Chinese proverb

Post the 2008 financial crisis, the Chinese proverb quoted in the epigraph received much attention because the only thing that is interesting is "uncertainty". The definition of uncertainty has evolved and become more complicated over the years due to development and increasing integration among various financial market segments, domestically and internationally—a result of globalisation and economic liberalisation.

The development of an economy is largely influenced by financial markets—they competitively allocate financial resources that are mobilised from savers and investors among users in the economy. India's central bank, the Reserve Bank of India (RBI), has proactively shaped the development of financial markets in India through its series of economic policy reforms—market-determined interest and exchange rates, current account convertibility, monetary policy dealing with price-based instruments, auction-based allocation in the government securities market (GSM), and phased capital account. Such a closely monitored development of the financial market is essential in an emerging and developing economy such as India to avoid financial instability, which is likely to occur otherwise (Gopinath, 2008).

1.1 Objectives

Though the Indian financial markets were not significantly impacted during the 2008 global economic crisis, its aftermath increased the academic and policy interest in the operational efficiency of our financial system, of which financial markets are important components. Developments on the macro-economic front of an economy significantly impact its financial system, and hence, it is imperative to assess the depth of this relationship for a complete understanding of the financial system. The present study has been conducted to fulfil the following objectives:

a) Assess the behavioural relationship between the macro-economic environment and the instruments of financial markets.

b) Analyse the liquidity, efficiency, and volatility of the four key financial markets—money, GSM, forex, and equity.

c) Evaluate the level of integration among these financial market segments over a decade (2003–2013).

1.2 Organisation of the Paper

The rest of this paper has been organised into the following sections.

a) Literature Review

i. *Conceptual framework:* The various stages and the steps involved for the development of financial markets of a country are broadly outlined in this section.

ii. *Behavioural relationship between macro-economic and financial environment*: This section discusses how developments on the macro-economic front in India impact its financial markets, depicted through changes in key macro-economic and financial variables during 2003–2013.

iii. *Stylised facts on financial markets developments:* This section outlines the phased development (since 1990) and the current defining statistics of the four financial markets that are the focus of this study.

iv. *Financial market integration in an economy*: This section discusses the importance, the associated benefits and risks, and the measures for the integration of financial markets.

b) Research Methodology: This section outlines the research methodology employed in this study.

c) Empirical Analysis

i. *Behavioural relationship between macro-economic and financial environment:* The relationship between macro-economic fundamentals and financial market variables is evaluated in this section.

ii. *Liquidity, volatility, and efficiency of four financial markets:* The depth, stability, and efficiency of the financial markets that are the focus of this study are assessed using corresponding indicators and statistical variables.

iii. *Cross-correlation analysis to evaluate level of market integration:* The co-movement of various indicators is analysed to understand the level of integration and impulse transmission from one financial market to another. This assessment is done for a decade (2003–2013) and on a temporal basis (pre-crisis, crisis, and post-crisis). The analysis also includes a comparative assessment of cross-correlation studies conducted at different timeframes to understand the evolution of market integration.

d) Way Forward

i. *Summing up:* This section reinforces the need for the integration of financial markets and includes a brief discussion on its current level.

ii. *Recommendations:* This section presents the author's views for the further development of financial markets in India.

2. Literature Review

2.1 Conceptual Framework

The development of a country's financial markets is one of the key priorities for the think tanks of the country's central bank. The development of financial markets can be broadly classified into three stages (Rangarajan, 1997):

- *Bank-oriented stage*: Banks and other financial institutions play the most significant role in financial capital formation.
- *Early capital stage*: Issues of equity and debentures take over banks in capital formation.
- *Highly capital-oriented stage*: The capital market becomes the key source for long-term financing.

In tandem with the changing internal and external environments, the Indian financial markets have undergone significant transformations over the course of time (discussed in brief later on).

Depending on the inherent nature of an economy, one of the three segments of the debt market—the government securities market (GSM), the Public Sector Undertaking (PSU) bonds market, or the corporate debt market—would be predominantly more active than the other segments in the country. For instance, the corporate debt market would be the most predominant segment in those economies whose government did not run fiscal deficits or who are not allowed to issue

bonds in the domestic market. However, since both these factors are absent in the case of India, GSM garners the lion's share in the country's debt market (Reddy, 2007). GSM's dominance in the domestic debt market can also be attributed to the RBI's conscious role in its development through a series of steps that can be categorised as follows:

- Instrument development
- Institutional development
- Strengthening of market transparency and efficiency

2.1.1 Motivation for development of domestic financial market segments

In response to the 1997 Asian crisis, the development of the domestic bond market became significant not only for fund channelization but also for the diversification of the external sector risk in the financial system (Reddy, 2002). In general, governments are motivated by different factors for developing the domestic bond market. For instance, the Singaporean government viewed it as a means of financial intermediation for credit allocation, while the Hungarian government was motivated to reduce monetisation of the government deficit and increase competitiveness in the banking sector (that possessed wide spreads between deposits and advances) to encourage foreign investment. Whatever be the motivation factor, the macro-economic fundamentals of an economy do impact the performance of its domestic financial markets to a certain extent.

International financial market integration refers to an increase in capital flows and a tendency for prices and returns on internationally-traded financial assets to equalise on a common-country basis. The validity of various international parity conditions—purchasing power parity (PPP), covered interest parity (CIP), uncovered interest parity (UIP), and real interest parity (RIP)—provides a direct test to analyse the degree of international market integration. On the other hand, indirect tests include the measurement of the degree of correlation between national savings and investments (Jain and Bhanumurthy, 2005). This paper, however, deals only with the analysis of the integration levels of domestic financial markets.

2.2 Behavioural Relationship between Macro-Economic and Financial Environment

Post the 1991 balance of payments crisis, the Indian economy really opened up to the outside world. The end of the License Raj, the liberalisation of the economy in terms of bold economic reforms, and globalisation for true economic developments were the key changes of this era. India reaped the benefits of these reforms in the truest sense during the 2003–2008 global bull-run. The Indian economy was growing at a stupendous rate of 8.7% on average (Table 1), wholesale price index (WPI) and consumer price index (CPI) inflation were at normal levels, the government had negative primary deficit, the current account deficit was just 0.3% of the gross domestic product (GDP), foreign inflows—foreign direct investments (FDIs), foreign institutional investments (FIIs), and non-resident Indian (NRI) deposits—were high, the import cover was at 14 months, and there was a net increase in the foreign exchange reserves of the economy. Truly, it was the golden period of the Indian economy (refer Table 1).

The 2008 financial crisis, whose epicentre was the U.S., had repercussions on the entire world. India's initial reaction to the global meltdown was that since it was a closely-monitored and decently regulated economy, it should remain insulated from the crisis, unlike many other countries of the world. However, this was only the partial truth. By this time, the Indian economy had integrated well enough with the global economy to feel the effects of this slowdown. The export sector of the Indian economy was significantly impacted because both the key markets for exports—the U.S. and Europe—were reeling under the effects of the crisis. Slowly and steadily, the Indian economy also started feeling the impact of the crisis. The GDP growth rate dropped to 6.7%, WPI and CPI levels were high, reserve money fell to 6.4%, the CAD/GDP and government deficits increased, and there was a decline in the net capital inflows, which ultimately resulted in a fall in the foreign reserves.

The true impact of these developments was felt when the financial indicators in the domestic economy started showing signs of distress. Short-term borrowing rates shot up, the turnover of the GSM dropped, and the overall liquidity of the system was impacted. In order to address these developments, the Indian authorities made adjustments in the policy rate (the repo rate decreased from 6.8% to 5.0%) to increase, or rather to sustain the money supply in the system. Circumstances improved over the next couple of years, only to deteriorate once again in 2012–

2013. This time, though, the crisis was more due to domestic reasons. However, the impact of the fragile global economy cannot be neglected. What remained constant during both these difficult times was that distress in the macro-economic indicators was quickly translated to distress in the financial indicators. Thus, it would not be incorrect to comment that there is moderate correlation/co-movement between the macro-economic indicators and the financial indicators of the Indian economy. This study includes an empirical analysis to test this hypothesis.

2.3 Financial Market Development since 1990 Reforms

2.3.1 Money market

The money market—the market for short-term funds—has securities with maturities ranging from overnight to one year; therefore, its financial instruments are considered the closest substitute for money. In order to achieve the ultimate goals of monetary policy—growth and price stability—the RBI had to modify its operational and intermediate objectives multiple times, primarily in response to the prevailing economic and financial environment (Mohanty, 2012).

The money market comprises various segments—call money, market repo, and Collateralised Borrowing and Lending Obligation (CBLO)—with average daily turnover as depicted in Figure 1.

The call money market—an uncollateralised market—was earlier characterised by an administered ceiling interest rate that was determined by the Indian Banks' Association (IBA) to prevent abnormal increases in the call rates (which was seen earlier when call money rates rose sharply and touched 25–30% during the early 1970s). However, regular borrowings by banks and lending by non-banking institutions kept this market highly volatile, hindering appropriate risk management and instrument pricing (Mohan, 2007). With the introduction of the CBLO, the interference in the call money market was reduced, leading to a fairly stable market. This is evident from the reduction in the call money market's market share (%) over the years (Figure 1).

The key developments of the late 1980s—the setting up of the Discount and Finance House of India (DHFI), the introduction of certificates of deposit (CDs), commercial papers (CPs), and inter-bank participation certificates, and the freeing of the call money rate—were unable to meet

their objectives of market development due to the structural rigidities in the system. Subsequently, the Internal Working Group (1997) and the Narasimham Committee (1998) made the following recommendations (Mohanty, 2012):

- Introduction of auction system for T-bills
- Gradual move towards a loan-based system from a cash credit system
- Abolishment of ad-hoc T-bills, leading to the end of the automatic monetisation of fiscal deficit (1997)

Developed and introduced by the Clearing Corporation of India Limited (CCIL) in January 2003, the CBLO was meant to help banks and non-banks manage their daily liquidity requirements. Being a collateralised instrument (government securities acted as collateral), its rate were lower than the call money rate, which was why its share in the money market transactions rose considerably from 22.4% in 2004–2005 to 53.2% in 2012–2013. In April 2004, the liquidity adjustment facility (LAF) window was augmented by the issuances of the Market Stabilisation Scheme (MSS) to insulate domestic monetary conditions from the impact of large capital flows (Gopinath, 2008).

Market repo—which is backed by collaterals (such as Central and State government securities) and operates outside the RBI's LAF—allows banks, primary dealers, non-banking entities maintaining Subsidiary General Ledger (SGL) accounts, non-bank financial companies (NBFCs), mutual funds, housing finance companies, and insurance firms to manage their short-term liquidity mismatches.

The money market in India has had a long and chequered history. While the call money market has emerged as a pure inter-bank market, the CBLO market has been helpful to both banks as well as non-bank participants. The LAF has had a smoothening effect on liquidity and has created a corridor of weighted average call between repo and reverse-repo (Figure 2). Slowly, the weighted average call emerged as the target rate. The RBI recognised and made the **repo rate** the **short-term signalling rate** or **policy rate**. Thus, the integration of various money market segments and effective policy signal transmission has been possible due to the stability of the call money rates.

Research studies on the integration of Indian money markets with global markets as a result of financial liberalisation have mostly reported negative results. This indicates the presence of a

country risk premium, and/or binding regulations on capital movements, and/or binding restrictions on interbank borrowing and lending (Buigut, 2011). Empirical investigations and the Vector Error Correction Model (VECM) have hinted at some degree of co-integration between Indian and U.S. interest rates—linkages that are less direct than the covered interest rate arbitrage (Buigut, 2011). The Indian money markets have evolved up to this stage gradually. An earlier study using CDs as the domestic borrowing rate and the USD LIBOR as the foreign interest rate concluded that the covered interest parity (CIP) deviations for India were much higher than those reported for the markets belonging to the Organisation for Economic Co-operation and Development (OECD) (Varma, 1997).

2.3.2 Government securities market

Due to the automatic monetisation of the Central government budget deficits, the interest rates on government securities were administratively kept low (to ensure low-cost government borrowings). Consequently, the GSM remained underdeveloped. Earlier, financial intermediaries such as banks and insurance companies (the Life Insurance Corporation of India, for instance) acted as key players in the GSM, thereby making it a captive market. 1992 and 1997 were two key years in the Indian GSM. 1992 saw the introduction of the auction-based system for allocation of government securities to enable the creation of a market-determined yield curve (through price discovery). The abolition of automatic monetisation through ad hoc treasury bills and the introduction of the Ways and Means Advances (WMA) in 1997 provided operational autonomy. Subsequently, in 2006, the RBI was prohibited from participating in the government securities primary market (FRBM Act 2003). Accordingly, since 1 April, 2006, there has been neither private placement of auctioned market borrowings nor devolvement.

The decline in SLR requirements—38.5% of net demand and time liabilities (NDTL) in 1992 to 25% of NDTL in 1997—also helped in shaping the GSM. Currently, the statutory liquidity ratio (SLR) stands at 23% of the NDTL for banks. Reforms for the successful completion of government securities (G-Sec) auction and the RBI's open market operations through the introduction of primary dealers have helped in the market borrowing programmes of the Central and state governments. The secondary GSM was developed and shaped with the introduction of long-term securities, such as those with 30-year maturity period (Mohan, 2004).The investor base in the GSM has widened from the mandated investment requirements to voluntary G-Sec

holdings. This has, in turn, helped in reducing the commercial banks' share in the GSM (Mohan, 2007). Effective December 2007, the Government Securities Act, 2006 facilitated lien marking, pledging of securities to raise loans against government securities, stripping, etc. Other measures included the introduction of 'when-issued' trading and 'short selling' of government securities (Gopinath, 2008).

Currently, however, the GSM is quite illiquid at the long end. Two prime reasons for this could be the presence of dominant investors in the form of institutional investors (who need to invest in government securities due to statutory reasons) and the limited presence of FIIs in dated securities (despite the progressive shift from banks to non-banks as the investor base). However, it should be remembered that earlier highlighted measures did help in evolving and maturing GSM. This can be ascertained from the fact that, with passage of time, there has been smooth financing of the government debt (both Central and State government) despite high and increasing fiscal deficits (Mohan, July 2007). Consequently, there has been greater recourse mandate by the Twelfth Finance Commission to conduct market borrowing for the state government (refer Appendix 5 for GSM statistics).

2.3.3 **Forex market**

Although it originated around 1978, the Indian forex market was quite limited in its early days due to the fixed exchange rate regime. Post the 1991 economic reforms, the Indian forex market evolved and developed as the result of a series of developmental reforms. The key reforms were the introduction of the market-based exchange rate regime in 1993 and the adoption of current account convertibility in 1994.

Additionally, capital account has also experienced substantial liberalisation over the years. Coherently, all these reforms were aimed at developing the institutional framework by dismantling controls and increasing instrument effectiveness and transparency for conducting foreign exchange business. The spot market within the over-the-counter (OTC) segment of the forex market was most active, as shown in Appendix 6.

Over the course of time, the forex market witnessed increased liquidity and greater market efficiency (reflected in the low USD/INR bid-ask spread in Appendix 7). Owing to the gradual opening of the capital account, forward premiums are typically aligned with the interest rate

differential, leading to manifold increases in market efficiency (Gopinath, 2008). However, the high intermediation costs currently charged by the banks reduce the transparency for players in the forex market. Under its recommendations, the RBI hinted at the usage of an instructive guide for the further opening of the capital account—a mixture of strategic controls (for instance, by defining a pecking order of flows, such as FDI-portfolio investment-debt, and a credible framework to aid foreign investors in developing their strategies) and tactical controls (for instance, steps that would be situation specific and hence would be introduced as and when situation arose and would be withdrawn when it abated) (Padmanabhan, 2011).

One of the key challenges currently impacting the efficiency of the Indian forex market is the speculation being done on the non-deliverable forward (NDF) markets. Ideally, both the on-shore and off-shore NDF markets are influenced by the same set of economic and geo-political developments at home and abroad (Padmanabhan, 2011). However, in the recent past (due to the INR depreciation in 2013), it was observed that the two rates were responding differently—the NDF rate was more pessimistic, which consequently increased pressure on the on-shore USD/INR rate as well. As the Indian authorities look forward to the progress of capital account liberalisation, this challenge needs to be addressed carefully, without impacting the liquidity of the forex market. The impact of this volatility needs to be analysed in terms of two sets of market participants—the real sector (exporters, importers, and foreign currency borrowers) and banks or authorised dealers. For the first set of participants, non-hedging techniques (such as advance payment and invoicing in home currency) were available only theoretically. Hence, derivative products (such as exchange-traded futures and options) were introduced to enable small and medium enterprises (SMEs) to cover foreign currency exposure at competitive costs. Thus, forex inclusion of SMEs and the synchronisation of the regulations for the OTC and exchange-traded markets are the two key challenges that the Indian forex market—a critical segment of the country's finance—currently faces, owing to capital account restrictions (Padmanabhan, 2012).

2.3.4 Equity market

With the establishment of the Securities and Exchange Board of India (SEBI) in 1992, reforms to enhance regulatory effectiveness and competitiveness as well as modern technological infrastructure to reduce informational asymmetries and transaction costs were undertaken. Foreign equity investments in the form of FIIs were allowed from 1992 onwards and Indian

companies were allowed to raise foreign capital in the form of American depositary receipts (ADRs), global depository receipts (GDRs), foreign currency convertible bonds (FCCBs), external commercial borrowings (ECBs), and investments through NRIs and overseas corporate bodies (OCBs). The establishment of the National Stock Exchange (NSE) in 1994 further increased the competitiveness and led to the development of volumes in the equity market in India. During 2000–2001, index futures, index options, and options and futures on individual securities were introduced to shape the Indian capital market. Currently, the Indian capital market is one of the most active and growing capital markets in the world. Futures and options of about 223 individual stocks and 4 stock indices were traded on the NSE as of March 2011. Large cap stocks/futures and index futures of Indian equity are fairly liquid and efficient.

2.3.5 Deep and diverse Indian equity market

With more than 5,000 listed companies, the Indian equity market is globally ranked second, with the U.S. equity market being the top runner. The diverse nature of stocks allows investors to gain exposure to a wide range of sectors such as automotive, banking, and pharmaceuticals, to name a few. The S&P CNX Nifty (Nifty 50), one of the most widely quoted indices, comprises stocks covering the entire spectrum—financial, industrial, and energy companies—thereby offering investors exposure to the key drivers of domestic growth, i.e., domestic consumption and infrastructure capital expenditure (capex). One of the peculiarities of the Indian equity market that reduces its depth is that more than 55% of the equity market is held by promoters (principals of companies), thereby reducing the overall free float of the stock. In order to address this peculiarity, the SEBI mandated all listed companies to raise public shareholdings to 25% by mid-2013. Another peculiarity is the higher proportion of FII holdings than domestic holdings, which renders stock prices quite volatile and vulnerable to global developments (Hubbis, 2013).

2.4 Integration of Financial Markets in an Economy

The development of financial markets occurs in its true sense only if they are well-integrated, for it is only then that the monetary policy impulses are effectively transmitted to the entire economy (Mohan, 2007). In an integrated financial market system, the central bank's short-term policy rate changes would be transmitted to the market rates (short-term as well as long-term), money market, bond market, and credit market. Technically, financial market integration means the

unification of the markets for the convergence of risk-adjusted returns on assets with similar maturity across all the markets. Factors such as deregulation (freeing pricing of financial assets), globalisation (transnational movement of capital, especially the savings of one nation to supplement the domestic savings of another nation), IT advances (electronic payment and communication systems that decrease arbitrage opportunities across financial centres), and changes in the operating framework of a monetary policy (shift to price-based instruments such as short-term policy interest rate, impacting the interest rate term structure) have significantly influenced the integration of the various market segments in India. Financial market integration is witnessing a new wave of confidence in recent years; besides individual nations, some economic regions (such as the Arab countries) are also actively discussing the possibility of having integrated financial markets (Atyeh, 2012).

2.4.1 Associated benefits and risks

Multiple factors reinforce the integration of financial markets. Integration not only allows the government machinery to transmit key price signals, but also promotes domestic savings and investments. In turn, these create opportunities for the financial sector of a nation to emerge as a financial centre at the regional or the international level. Integrated financial markets enhance equal access to financial services (for the public as well as for companies, and institutions) by innovative and cost-effective intermediation, informational efficiency, and market discipline. Global financial integration is beneficial for international risk-sharing, consumption smoothing, and enhancement of the depth and breadth of domestic financial markets. This competitive environment discourages the exorbitant profits that are associated with monopolistic/cartelised markets by decreasing costs and increasing market efficiencies. International studies such as (Ayuso and Blanco, 1999) confirm that a higher degree of financial market integration leads to higher efficiency of financial markets and thereby leads to higher availability of better risk-return combinations to investors. A number of prior studies (such as Kaminsky and Schmukler, 2002) were conducted to evaluate and understand the level of integration of international financial markets in various economies of the world.

However, on the flip side, integrated financial markets pose grave risks, which could lead to catastrophic developments if they are not analysed prudently. Highly integrated domestic and international financial markets run the risk of contagion due to informational asymmetry from

one market to the other markets, with the possibility of systemic instability (Mohan, 2007). Such volatility risks and surprising reversals in capital flows in the context of highly open capital accounts are likely to occur at significant costs (Jain and Bhanumurthy, 2005). Macroeconomic stability could also be jeopardised due to the pro-cyclical nature of short-term capital flows, with high chances of abrupt reversals. Capital flow volatility leads to exchange rate instability (similar to the recent episode of INR depreciation in July 2013), fluctuations in official reserves, or in extreme situations, currency crises (such as the East Asian crisis). High capital inflows can result in inflationary pressures, rapid monetary expansion, widening of the current account deficit, and real exchange rate appreciation. Hence, a phased progressive integration of financial markets is required for the economic stability of a country (Mohan, July 2007). In light of the global financial crisis of 2008, great emphasis is being laid on two elements of macro-prudential regulation (Gopinath, 2010):

- **The existence of common/correlated exposures**, arising either because institutions are exposed to the same/similar asset classes or because of indirect exposures associated with linkages among them (counter-party relationships, for instance).
- **Collective homogeneous actions on the part of institutions**, leading to risk amplification owing to interconnectedness (the pro-cyclicality element). Key channels of risk propagation include maturity mismatches and leverage.

Both these elements require an assessment of the market integration levels for appropriate regulatory steps to be devised.

2.4.2 Measures for financial market integration

Financial market integration has been possible in India due to five key measures.

- **Free pricing**: Some of the milestones that led to the development and integration of financial markets in the country include the freedom given to banks to decide deposit and credit interest rates; the withdrawal of the call money ceiling rate (10%); the substitution of the administered interest rates with auction systems for G-Secs; the substitution of ad-hoc T-bills with WMA; the shift from a single fixed exchange rate regime to a market-determined floating exchange rate regime; the gradual liberalisation of capital account; and the usage of derivatives for hedging.

- **Widening participation:** The following changes helped in increasing the liquidity and efficiency of financial markets in India: enhanced presence of foreign banks; participation of FIIs in the Indian equity market; transformation of the call money market into a pure inter-bank market; granting of permission to (a) authorised dealers to borrow, lend, and invest in foreign currencies, (b) exporters to substitute rupee credit with foreign currency credit, and (c) Indian companies to raise funds through ADRs, GDRs, FCCBs, and ECBs—a step towards integrating domestic and international capital markets; availability of options, forwards, and swaps in domestic and foreign currencies to manage long-term exposures; application of capital adequacy norms; and integration of credit and equity markets.
- **New instruments**: The introduction of repo (for short-term liquidity adjustment) and LAF (for liquidity management and overnight market signalling mechanism), inter-bank participation certificates, CDs, CPs, market repos, CBLOs, and auction-based multiple maturity T-bills enabled the development of the Indian money market. Floating rate bonds (FRBs), long-term loans with embedded put-call options, and forward rate agreements (FRAs) also facilitated the deepening of the financial markets by allowing participants to diversify their risks.
- **Institutional measures:** Inter-market linkages were strengthened by allowing institutions such as the Discount and Finance House of India (DFHI) and the Securities Trading Corporation of India (STCI) to participate in multiple markets. The establishment of the CCIL as the central counter-party helped in increasing investor confidence, and thus, the liquidity of the markets.
- **Technology, payment, and settlement infrastructure:** Technological enhancements such as the Delivery-versus-Payment system (DvP), the Negotiated Dealing System (NDS), the advanced Negotiated Dealing System-Order Matching (NDS-OM), and the Real Time Gross Settlement system (RTGS) as well as the substitution of the floor-based open outcry trading system with the electronic trading system improved settlement processes and encouraged market integration.

Financial market integration occurs either horizontally (inter-linkage of various domestic market segments) or vertically (inter-linkage of domestic and regional/international markets). The level of financial integration is primarily measured using the following parameters.

- **Institutional/regulatory measures**: These measures can further be classified into *de jure* and *de facto* measures. *De jure* measures include the legal restrictions on capital and trade inflows. *De facto* measures include the measures based on prices or quantities. Price-based measures include cross-market spreads, tests of common trends in interest rate term structure and volatility, and correlations among several interest rates.
- **Quantity measures**: For measuring the integration level of domestic markets, liquidity and turnover data are used, whereas global integration levels are measured through time analysis of capital inflows. Typically, gross capital inflows tend to be a better measure than net inflows, as the latter measure is likely to subdue the level of integration due to the amount of outflows. However, this indicator suffers from fluctuations in short-term market conditions. 'Gross stocks of foreign assets and liabilities/GDP' is a more robust measure as it is less volatile and comparatively less prone to measurement errors.

Bhoi and Dhal (1998) evaluated the degree of integration of the Indian financial markets post liberalisation. The study indicated that interest rates converged to a fair degree among the short-term markets—money, credit, and gilt; however, the capital market's behaviour remained isolated.

Currently, different financial markets are integrated at different levels and channels. The money market and the foreign exchange market are intrinsically integrated due their short-term nature and the presence of commercial banks. This linkage occurs in multiple ways—hedging facilities for corporates, bank borrowings in overseas markets, passage for overseas merchant payment transactions, and acceptance of foreign currency deposits. The GSM and the call money market are linked as government securities are largely funded by short-term borrowings. The presence of foreign institutional investors (FIIs) in the foreign exchange market and the equity market links these two segments. The RBI's increasing use of short-term monetary measures to meet the demand-supply gap (in order to curb volatility) has linked the money market, the GSM, and the foreign exchange market. Two major studies (Mohan, 2007; Ray and Prabhu, 2013) studied this cross-correlation behaviour to determine the level of market integration. In the light of the recent

financial market developments (INR depreciation against USD in 2013), it has become important to re-evaluate the analysis of cross-correlation behaviour (which is a timeframe-based study) in this paper.

3. Research Methodology

Indian financial markets can be broadly classified into organised and unorganised markets. Due to the lack of reliable and high frequency data on unorganised markets, the empirical analysis of this segment is not covered in this paper. Moreover, it is expected that the activities in such markets are on a declining trend. Organised markets can be classified into short-term and long-term markets; the notable segments of both these are highlighted below (Bhoi and Dhal, 1998):

a. Short-term markets: Money market, credit market, gilt market, and forex market
b. Long-term markets: Equity and term lending market, corporate debt market, pension funds market, insurance market, housing finance market, mutual funds market, and hire purchase and leasing finance market

Owing to issues of data availability, we considered the money market, the government securities market, the forex market, and the equity market for purposes of analysing the integration levels of the financial markets in the Indian context. The following financial instruments were used as indicators for their respective financial markets:

a. Weighted average call money rate: Money market
b. 10-year GOI bond yield: Government securities market
c. USD/INR nominal exchange rate: Forex market
d. Nifty index level: Equity market

The quantitative analysis was based on quarterly/monthly data for the period 2003–2013, which was obtained from the RBI databases and reports on currency and finance. These time series were checked for stationarity using the Dickey Fuller (DF) test in Stata 12 (Appendix 8). Financial time series are often non-stationary since means, variances, and co-variances change over time; such time series are known as trends, cycles, random walks, or a combination of these. Due to their non-stationary nature, such data cannot be predicted, modelled, or forecast. Hence, it is important to check for stationarity in data, as the results obtained using non-stationary time

series could indicate a spurious relationship. In such situations, non-stationary data series are transformed into stationary data series—time series that revert around a constant long-term mean and have a constant variance independent of time. Whether it is auto-correlation analysis (correlation assessment with itself) or cross-correlation analysis (correlation assessment with another time series), a stationarity check is important because almost all methods for identifying correlations assume the data series to be stationary and linear (Horvatic et al., 2011). For time series that are non-stationary, other complex techniques such as the Johansen and Juselius methodology and co-integration methods can be used to identify a long-run equilibrium/co-integrating relationship (Jain and Bhanumurthy, 2005). We utilised the results from similar prior studies to conduct a qualitative analysis on such series.

The majority of work on the integration of financial markets focuses on the operating efficiency indicator as opposed to the allocative efficiency indicator of financial markets. For instance, in the assessment of a money market's operating efficiency, the prime line of argument would be whether the interest rates of the key money market instruments moved together with a reference rate. One of the simplest empirical approaches to quantify operational efficiency is the simple measure of correlation coefficient. This method, however, fails if the time series are non-stationary (Bhoi and Dhal, 1998).

In addition to a decade-long correlation study, a temporal assessment of the cross-correlation of the financial markets during the pre-crisis period (2004–2008), the crisis period (2009–2010), and the post-crisis (2011–2013) period was conducted. We did not employ complex correlation models such as Structural Vector Autoregression (SVAR) to analyse the microstructure and monetary policy transmission of financial markets in the four financial market segments that are the focus of study, namely, money market, government securities market, forex market, and equity market (Ray and Prabhu, 2013). However, for the qualitative analysis, we utilised the results obtained from these complex methods.

To assess the behavioural relationships among macro-economic indicators and financial variables, multiple regressions were run with various plausible influencing variables. Quarterly data points from 2004–2012 were used for regression. The performance variable of each of the four financial markets (money, GSM, forex, and equity) was regressed with their "possible"

influencing independent variable to arrive at a regression equation that was statistically significant.

The liquidity of a market was estimated from its annual turnover growth rate. If this annual turnover growth rate was higher than the nation's nominal GDP growth rate, it was characterised as a liquid market. The market's depth was analysed from its annual average daily turnover. The volatility of a market was assessed by calculating the deviation of its data-points from the mean of the series. For this, descriptive statistics—mean and standard deviation from the mean—of the time series sample was calculated and data-point deviations were calculated in terms of standard deviations. The efficiency level of a market was estimated from its bid-ask spreads.

Domestic market integration was estimated by evaluating the cross-correlation coefficient among the following variables:

- Money market: Weighted average call money rate and CBLO rate
- GSM: 10-year government bond yield
- Forex market: USD/INR spot exchange rate
- Equity market: Nifty Index

4. Empirical Analysis

4.1 Behavioural Relationship: Instruments of financial markets and macro-economic environment

Of the four financial markets, only the GSM and forex markets yielded statistically significant regression equations (Appendix 9).

4.1.1 Government securities market

All the three independent and statistically-significant variables—Fiscal Deficit/GDP (FD/GDP), Lagged Yield Value (of the 10-year GOI bond), and WPI Change—are stationary (Appendix 8). The regression equation in Equation 1 shows that both the macro-economic variables (FD/GDP and WPI Change) do impact the 10-year GOI yield. Interestingly however, the yield is also auto-correlated, i.e., the lagged yield value has a strong influence on the subsequent yield value. The signs of the macroeconomic variables in the regression equation confirm that a higher FD/GDP or WPI directly increases the bond yields.

10-year GOI yield = 2.4264 + 0.0334 × (FD/GDP) + 0.6557 × Lagged Yield Value + 0.0759 × WPI Change (1)

4.1.2 Forex market

According to the regression equation in Equation 2, the USD/INR Nominal Exchange Rate is autocorrelated (dependent on the lagged USD/INR Nominal Exchange Rate Value) and is dependent on the CAD/GDP macroeconomic variable (which is stationary). Although the results from this test relate with the theoretical underpinnings (CAD/GDP negatively impact exchange rate), they are only indicative in nature as both the Nominal Exchange rate (dependent variable) and the Lagged Nominal Exchange rate (an independent variable) are non-stationary in nature.

USD/INR Nominal Exchange Rate = 10.3127 + 0.7586 × Lagged Nominal Exchange Rate Value - 0.3393 × (CAD/GDP) (2)

Regression analysis was conducted for all the four financial market segments. However, the money and the equity markets did not produce any statistically significant results, reinforcing the conclusions of earlier studies (Hubbis, 2013).

4.2 Liquidity, Volatility, and Efficiency Assessment

4.2.1 Liquidity

The empirical data in Table 1 suggests that the money market, the government securities market, and the forex market in India are highly liquid in nature. Surprisingly, the equity market turned out to have lesser liquidity despite the presence of domestic and foreign institutional and retail investors. This observation is further reinforced by the comparative assessment of the Turnover/GDP ratio (Table 1). Except for the equity market, the Turnover/GDP ratio increased for the other three financial markets.

Table 1: Liquidity Analysis for Four Financial Markets

Particulars	Statistics for Liquidity for Apr'04-Mar'13				
	Annual Turnover Growth Rate	Nominal GDP Growth Rate	Comparison	Turnover/GDP (Nominal) 2004-05	Turnover/GDP (Nominal) 2012-13
Money Market	20.8%	15.15%	Highly liquid	0.0045	0.0067
GSM	26.8%	15.15%	Highly liquid	0.2791	0.6028
Forex Market	24.1%	15.15%	Highly liquid	0.0446	0.0732 (2011-12)
Equity Market	11%	15.15%	Not that liquid	**0.3516**	**0.2702**

4.2.2 Volatility

Money market and government securities market

The comparable mean and median hint at lower volatility in the money market and the GSM; this finding is similar to the findings reported in an earlier study (Ray and Prabhu, 2013). This can be attributed to multiple factors: (a) the inherent nature of these markets—both tend to get impacted by systemic liquidity and monetary measures; (b) the presence of institutional set-ups such as the Clearing Corporation of India (CCIL); and (c) alternative instruments such as CBLO and different maturity bonds. However, in the case of shocks, significant volatility occurs in these markets, which can be inferred from the relatively high maximum and minimum values. For instance, during the INR depreciation episode in 2013, the call money rate and the 10-year GOI bond yield surged significantly, thereby hurting investor gains. An interesting difference between the Indian money market and GSM that came out in this analysis is that the money market's median is about two standard deviations away from its mean, while the GSM's median is about 24 standard deviations away from its corresponding mean (Table 2).

Table 2: Descriptive Statistics for Volatility Analysis

Particulars	Descriptive Statistics for Volatility (Apr'03-Jul'13)						
	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Money Market (Weighted Average Call Rate)	6.08%	6.05%	14.07%	0.73%	0.0199	0.4041	1.0409
GSM (10-year GOI Bond Yield)	7.40%	7.64%	9.35%	5.11%	0.0100	-0.9098	0.0706
Forex Market (USD/INR Exchange Rate)	46.55	45.58	59.59	39.37	4.1973	0.8903	0.7308
Equity Market (Nifty Level)	3,942.07	4,301.36	6,096.11	963.20	1,551.93	-0.3725	-1.2587

Forex market and equity market

Both these markets were found to be significantly impacted by exogenous factors such as the significant presence of foreign players. There was high volatility in these markets (depicted by relatively high standard deviation values). With the increasing openness of the Indian economy, it is becoming imperative for Indian policy makers to contain the Current Account Deficit (CAD) to reduce this volatility and bring stability to the market. Table 3 depicts the percentage change in the absolute values of these reference indicators.

Table 3: Descriptive Statistics for Volatility Analysis—Absolute Number Change

Particulars	Descriptive Statistics for Volatility (Apr'03-Jul'13): Changes in Absolute Values						
	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Money Market	6.28%	0.60%	764%	-69.83%	0.7063	10.2937	111.2248
GSM	0.30%	0.11%	13%	-25.52%	0.0455	-1.3900	8.8785
Forex Market	0.21%	-0.04%	7%	-4.27%	0.0205	0.7961	1.4338
Equity Market	1.68%	2.63%	20%	-23.69%	0.0641	-0.5341	1.9505

4.2.3 **Efficiency**

Due to the unavailability of data related to the bid-ask spread in the public domain, the efficiency analysis was qualitative in nature; it was primarily based on the results reported in the extant literature.

Forex market

With economic reforms and technological advancements, the bid-ask spread in the forex market has declined over the years. The lower the spread, the more efficient market is said to be. With the presence of a floating exchange rate regime (where the rate is determined by the market forces of demand and supply), market efficiency in the forex market is becoming an important concern for the Indian central bank. Transactional and operational costs are taken into consideration while assessing market efficiency. The current bid-ask spread is:

- Spot market: ¼ of 1 paisa–1 paisa
- Swap market: 1–2 paisa

Until the 1990s, the USD/INR spread was high and volatile due to low liquidity in the market, caused by unidirectional participation. Post the economic reforms in 1991, the depth and liquidity of the forex market increased, leading to higher efficiency (in other words, a decline in the bid-ask spread). Table 4 presents the results of a regression study conducted by the RBI to estimate the rupee-dollar bid-ask spread (SPD) using '1-month ATM rupee-dollar option price volatility' (IV, which is a proxy for expected volatility) and daily turnover (VOL) in the forex market (spot, forward, and swap) as the dependent variables. This empirical work reinforces that the rupee-dollar volatility impacts its bid-ask spread. Trading volume, on the other hand, has a negative yet smaller impact on the spread—an increase in the trading volume decreases the spread, thereby increasing the market efficiency. The high intercept value of the regression equation indicates spread flatness due to low volatility in the forex market.

Table 4: Efficiency Analysis for USD/INR

Particulars	Independent Variable	Dependent Variables	Regression Equation	t-value at 1% significance
Forex Market	Rupee-dollar bid-ask spread (SPD)	1-month ATM rupee-dollar option price volatility (IV); daily turnover (VOL)	Log SPD = -4.46 – 0.01 log VOL + 3.29 IV R^2 = 0.15 and DW = 2.10	(-31.63), (-0.94), and (5.18)

Source: Report on Currency and Finance, Volume III, RBI (2003–2008)

4.3 Cross-Correlation Analysis for Assessing Level of Market Integration

The degree of co-movement among the various financial market segments appears to have increased since 1996. Earlier empirical studies suggested that the capital market was the least integrated with the other market segments (Bhoi and Dhal, 1998). A low degree of correlation of the equity market with risk-free instruments was found, indicating greater volatility of stock returns (Mohan, 2007).

A study of the integration of financial markets requires an examination of the cross-correlation coefficients or the degree of association of the various rates in the financial markets. The results of the decade-long (2003–2013) cross-correlation analysis that we conducted is presented in Table 5.

Table 5: Cross-Correlation Analysis (2003–2013)

Particulars	Call Money Rate	10-year G-o-I Bond	USD/INR Spot Exchange	Nifty Index
Call Money Rate	1.0000	0.5635	0.2470	0.3948
10-year GoI Bond	0.5621	1.0000	0.1137	0.7866
USD/INR Spot Exchange	0.2470	0.1097	1.0000	0.2384
Nifty Index	0.3948	0.7911	0.2384	1.000

4.3.1 Money market integration

The money market is medium-level integrated with the GSM due to the role played by commercial banks and the capital-raising requirements of government. Due to the differences in the maturity profiles of various instruments, these markets are not highly integrated with each other despite having similarities. Owing to their short-term nature and the role played by commercial banks, the money and forex markets have low-medium integration. The presence of institutional players makes money and equity markets medium-level integrated as well. Within the money market, a strong correlation occurs among the various instrument rates—call money, CBLO, and market repo (Ray and Prabhu, 2013).

4.3.2 GSM integration

A high-level correlation occurs between the GSM and the equity market. This can be understood from the relationship between the level of economic activity and the government's revenue-generating capacity. In a situation when the business fundamentals are strong, the government is expected to earn higher tax revenues, thereby reducing its capital demand from the debt market. In this manner, the government's debt rating is likely to improve and receive higher market participation, leading to high positive activity in the GSM. Simultaneously, strong business fundamentals are likely to result in the enhanced performance of the equity market, which is known as the Efficient Market Hypothesis (EMH). The level of integration is low between the

GSM and the forex markets because of the differences in the inherent nature of these markets—the GSM is functional at the long-end while the forex market primarily operates at the short-end.

4.3.3 Forex market integration

A certain level of integration is present between the forex market and the equity market because of the role played by FIIs in them. The forex market is positively correlated with all the other focused financial markets; however, the degree of correlation is low. This can be attributed to the excessive capital inflows to India during the period of the study due to various plausible factors—interest rate differential between India and foreign countries, better yield-seeking behaviour of foreign investors, and the resilient macroeconomic fundamentals of India.

4.3.4 Temporal cross-correlation analysis

Pre-crisis period

The pre-crisis period (2004–2008) involved periods of liquidity surplus (April 2005–November 2006, when the RBI had to suck liquidity out of the system) and liquidity deficit—December 2006–November 2008, when liquidity was injected into the system (Ray and Prabhu, 2013). The extant literature suggested that money market instruments—call money rate, CBLO rate, and market repo rate—all showed high levels of correlation before the financial crisis. Domestic inter-market integration during this period can be assessed from the results of the correlation study (Table 6), the salient features of which are presented below:

- The call money market depicted moderate levels of correlation with the GSM and the equity market, and low but negative correlation with the forex market.
- The forex market depicted a negative correlation with all the other three markets. The negative correlation was strongest in the case of the equity market, while it was lowest in the case of the money market.
- The GSM depicted a strong positive correlation with the equity market. The period of study involved the global bull run, during which time the Indian macroeconomic fundamentals were strong enough to pull foreign capital inflows—both the GSM as well as the equity market benefited and moved in tandem with each other.

Table 6: Pre-crisis Cross-Correlation Analysis

Particulars (Pre-Crisis: Apr'03-Jul'08)	Call Money Rate	10-year GoI Bond	USD/INR Spot Exchange	Nifty Index
Call Money Rate	1.0000	**0.5316**	-0.2139	0.4976
10-year G-o-I Bond	0.5316	1.0000	-0.5376	0.7964
USD/INR Spot Exchange	-0.2139	-0.5376	1.000	-0.8080
Nifty Index	**0.4976**	0.7964	**-0.8080**	1.000

Crisis period

The global financial crisis of 2008 impacted financial markets across the world. The Indian financial markets were also affected, though not immediately and as drastically as other markets. As shown in Table 7, the cross-correlation among the various financial markets changed as a result of the crisis. Some of these changes are highlighted below.

- **Money market**: The call money market's correlation declined with the key indicators of the GSM and the equity market. Its positive correlation with the GSM decreased from approximately 0.53 in the pre-crisis period to approximately 0.38 in the crisis period. This can be attributed to the increased uncertainty within the inter-bank market (call money is now a purely inter-bank rate) due to the bank failures that were happening globally. Hence, the call money rate did not remain a function of the macro-economic or the financial fundamentals of an economy. Owing to monetary easing (through lowering of repo and reverse repo) and fiscal stimulus (by increasing government expenditure), perhaps the transmission mechanism weakened between these two markets. Consequently, they depicted a lower degree of positive correlation (as compared to the earlier period). The call money market's correlation with the forex market became even more negative in this period. However, the most significant change came with the equity market—from a medium-level positive correlation, it went to a feeble negative correlation. This can also be attributed to the uncertainty in the financial domain during

the crisis due to which equity wealth was eroded (leading to a decline in the indices), while the yields for money market instruments rose. The weakening of degree of correlation between the short-term (call money) instruments and the long-term (10-year GOI bonds) instruments severely impacted the equity market.

- **GSM**: A key change occurred in the correlation of the GSM with the forex market—from 0.53 in the pre-crisis period to 0.75 in the crisis period. A plausible explanation for this change is the fluctuation in the currency exchange rates due to increasing government debt levels (which might have witnessed revision due to the expansionary economic policy to avoid the trickling down of the global meltdown in the country). While this change is quantitatively significant, the change in correlation with the equity market was small—from approximately 0.79 in the pre-crisis period to approximately 0.68 in the crisis period.
- **Forex market**: The cross-correlation of the forex market with the equity market remained negative, although it weakened slightly (from -0.80 to -0.76).

Table 7: Crisis Period Cross-Correlation Analysis

Particulars (During Crisis: Aug'08-Dec'10)	Call Money Rate	10-year GoI Bond	USD/INR Spot Exchange	Nifty Index
Call Money Rate	1.0000	**0.3860**	-0.2817	-0.0895
10-year G-o-I Bond	0.3860	1.0000	-0.7586	0.6898
USD/INR Spot Exchange	-0.2817	-0.7586	1.0000	-0.7656
Nifty Index	**-0.0895**	0.6898	**-0.7656**	1.000

Post-crisis period

- **Money market:** Post the 2008 financial crisis, the money market instruments (primarily the call money rate) returned to its moderate degree of correlation with the GSM instruments. This can be attributed to multiple factors such as the increased monetary policy rates, high fiscal deficit (due to measures taken to mitigate the impact of the global financial crisis), and persistent inflation. Weighted average call money rate, which was a

significant policy development during this period, became the operating target of the monetary policy and the repo rate became the policy rate since May 2011. This improved the transmission mechanism of interest rates from short-end to long-end. With the call money rate becoming the operating target, the correlation with the forex market gradually increased in the positive direction. However, so far, this correlation seems to be on the weaker side. Therefore, the measures taken by the RBI in mid-2013 to curb volatility in the USD/INR exchange rate possibly did not yield significant results. The money and equity markets remained negatively correlated, though the degree of correlation increased from feeble to medium.

- **GSM**: The cross-correlation between the GSM and the forex market decreased (in quantity) from approximately 0.75 to approximately 0.35. The correlation between the GSM and the equity market witnessed a sharp turn from 0.68 (during the crisis period) to 0.71 (during the post-crisis period). One plausible reason for this change could be the reversal of capital flows from India in 2013, i.e., the rupee depreciation episode. Investor sentiments in the equity market are typically guided by the debt segment return. In the event of rupee depreciation, foreign currency risk becomes high, resulting in the reversal of flows.

- **Forex market**: The correlation between the forex and the equity markets as well as that between the forex and money markets took a shift from a strong negative correlation to a weak positive correlation. One plausible explanation for this change could be the depreciation in INR value (after the Quantitative Easing (QE) announcement by the U.S. in February 2013), which was followed by certain monetary measures—such as reducing the systemic liquidity by raising level of raising Marginal Standing Facility (MSF)—that increased the money market bond yields significantly and hence led to the change in the co-movement.

Table 8: Post Crisis Cross-Correlation Analysis

Particulars (Post Crisis: Jan'11-Jul'13)	Call Money Rate	10-year GoI Bond	USD/INR Spot Exchange	Nifty Index
Call Money Rate	1.0000	**0.5113**	**0.3355**	-0.5868
10-year GOI Bond	0.5113	1.0000	**-0.3518**	-0.7153

Particulars (Post Crisis: Jan'11-Jul'13)	Call Money Rate	10-year GoI Bond	USD/INR Spot Exchange	Nifty Index
USD/INR Spot Exchange	0.3355	-0.3518	1.0000	0.1105
Nifty Index	**-0.5868**	**-0.7153**	**0.1105**	1.000

Table 9: Comparison of Cross-Correlation Results with Earlier Studies

Correlation Among Financial Markets (Apr'93-Mar'00)				
Particulars (Pre-Crisis: Apr'03-Jul'08)	**Call Money Rate**	**10-year GoI Bond**	**USD/INR Spot Exchange**	**Natural Logarithm of BSE Sensex**
Call Money Rate	1.00	0.46	-0.04	-0.10
10-year G-o-I Bond	0.46	1.00	-0.06	-0.05
USD/INR Spot Exchange	-0.04	-0.06	1.00	-0.30
Natural Logarithm of BSE Sensex	-0.10	-0.05	-0.30	1.00
Correlation Among Financial Markets (Apr'00-Dec'06)				
Particulars (Pre-Crisis: Apr'03-Jul'08)	**Call Money Rate**	**10-year GoI Bond**	**USD/INR Spot Exchange**	**Natural Logarithm of BSE Sensex**
Call Money Rate	1.00	0.79	0.06	0.01
10-year G-o-I Bond	0.79	1.00	0.06	-0.11
USD/INR Spot Exchange	0.06	0.06	1.00	-0.56
Natural Logarithm of BSE Sensex	0.01	-0.11	-0.56	1.00

4.4 Evolution of Financial Market Integration

Using the results of a cross-correlation study from an earlier timeframe (Mohan, 2007) and the results of this study, the pattern of evolution of the integration of financial markets can be estimated.

- Money market and GSM remained medium-level positively correlated. However, their level of correlation was dependent on domestic and external macro-economic developments.
- Forex market's correlation with money and government securities market evolved from faint to medium correlation level.

- Similarly, the correlation between the money market and equity market also increased with the passage of time.
- The correlation between the GSM and the forex market followed a bell-shaped curve—from a faint correlation during 1993–2000, to a strong correlation during 2001–2010, followed by a decrease in correlation levels since 2011.
- The correlation levels between the GSM and the equity market increased and remained consistently strong during the period of this study.

Prior literature (Ray and Prabhu, 2013) suggested that monetary policy shocks (such as those to the policy rate, which is the repo rate in India) do not impact the forex market in the initial few days. However, within a month, the positive impact of such monetary policy shocks became evident, i.e., the increase in the policy rate led to the appreciation of the domestic currency exchange rate. Similarly, such positive policy shocks had a positive impact on the equity market (an increase in the stock market). In the case of the GSM, a positive shock in the repo rate resulted in an initial negative effect (for about 3–6 days), which later experienced mean reversion. The absence of impulse responses in the equity market due to monetary policy shocks could be attributed to the high alignment of the domestic stock market with the international stock markets—a direct consequence of the role played by FIIs. It is interesting to note that in India, there is an asymmetry in the monetary policy transmission to the short end of the financial markets—the transmission is faster in liquidity deficit conditions than in liquidity surplus conditions (Ray and Prabhu, 2013).

4.4.1 Financial market integration and INR depreciation

In response to global cues (QE tapering) and weak domestic macroeconomic fundamentals, INR depreciated against USD since May 2013. In response to this, the RBI tightened the short-term liquidity of the system through a series of measures, such as the rise in the MSF rate and the tightening of LAF amount (0.5% of NDTL), leading to a sharp decline in bond prices. These steps had a limited impact on the USD/INR rate; on the other hand, it severely impacted the short-term bond market. A plausible explanation for this could be the weak correlation between the money and the forex markets. This episode shows that low integration among the various financial market segments hinders the effective transmission of monetary policy.

4. Way Forward

Financial markets in India have registered considerable development with the onset of financial sector reforms starting in the 1990s. It is pertinent to note that the development in these markets has been in a gradual and calibrated manner, sequenced in line with the reforms in the real sector. The impact of these reforms has been evident in the price discovery process, the easing of restrictions, and the lowering of transaction costs. Apart from these, there has been evidence of greater domestic market integration. The development of financial markets is an on-going process and should not be considered as an event. It is important, therefore, that the authorities and market participants should play proactive and complementary roles to sustain the future large investment needs of a growing country such as India.

The results of this study show that the money, foreign exchange, government securities, and equity markets in India have developed into reasonably deep, resilient, and liquid markets over time. The integration of the financial markets has been helpful in the effective transmission of monetary policy through the interest rate channel, the credit channel, and the foreign exchange channel.

Trickling down and translation of economic growth into the development of the financial market has been a hot topic among researchers. The extant literature suggests that real GDP growth is not necessarily and directly translated to real equity market returns, not even in developed countries. On similar lines, the regression analysis between India's GDP growth and the BSE 30 equity returns produces a flat regression line, indicating no direct relationship between these two parameters (Hubbis, 2013). The presence of such phenomena makes it imperative for policy makers to enhance the level of integration of the financial markets so that fundamental macroeconomic changes are reflected in all markets. The financial market integration level was found to vary across financial market segments—the money market was fairly integrated, while the GSM is moderately integrated. The forex and equity markets were correlated to a certain extent due to the presence of common players. Understanding the level of inter-market integration becomes helpful for policy makers in designing policies to generate the required monetary impulse.

Going ahead, the authorities should focus on the derivative segment of the forex and equity markets, in terms of both potential market participants as well as product development. With regard to the GSM, further development is required to increase transparency (level of disclosures); additionally, the development of newer instruments and regulatory incentives to increase the size of the trading books could be undertaken. In the money market segment, our recommendation is to develop a market mechanism for participants to take a medium-long term perspective on interest rate and liquidity.

We close this paper with the following excerpt from the Committee on Financial Sector Assessment (Government of India and Reserve Bank of India, 2009, Chapter 4, page 296): "Stability in financial market augurs well for financial soundness. In fact, markets are the major conduits for transmission of impulses which could either enhance or impact the stability of the financial system as a whole. While financial market reforms need to be accorded appropriate priority, given the risks arising from cross-sectoral spillover of financial markets to other segments of financial spectrum, there is a need to be careful and nuanced in approaching financial markets reforms in the interest of financial stability."

Bibliography

Atyeh, M. H. (2012). The Theoretical Considerations of Financial Markets Integration: The case of Arab countries. *Journal of Economics and Sustainable Development*, ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online), 3(1).

Ayuso, J. and Blanco R. (1999). *Has financial market integration increased during the nineties?* Research Department, Banco de Espana.

Bhoi, B.K. and Dhal, S.C. (1998). Integration of Financial Markets in India: An empirical evaluation. *RBI Occasional Papers*, 19(4), 345–380.

Buigut, S. (2011). International Financial Integration of the Indian Money Markets. *International Journal of Economics and Finance*, 3(4).

Committee on Financial Sector Assessment, R. (2009). *India's Financial Sector - An Assessment.* Mumbai: RBI and GoI.

Database on Indian Economy. http://www.rbi.org.in

Gopinath, S. (January 2008). *Financial Markets in India: Recent Developments and Challenges*. Cairo: RBI and FIMMDA-PDAI. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/85236.pdf

Gopinath, S. (January 2010). *Financial markets – some regulatory issues and recent developments*. Mumbai: RBI and FIMMDA–PDAI. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/SMRM040109.pdf

Handbook of Statistics on Indian Economy. http://dbie.rbi.org.in/DBIE/dbie.rbi?site=home

Horvatic, D., Stanley, H. E., and Podobnik, B. (2011). Detrended Cross-correlation Analysis for Non-stationary Time Series with Periodic Trends. *EPL Journal*, 94, 18007.

Hubbis. (April 2013). Equity Markets. Featured Article. *The Guide to Investing in India 2013.*

Jain, S. and Bhanumurthy, N.R. (December 2005). Financial Markets Integration in India. *Asia Pacific Development Journal*, 12(2). www.unescap.org/pdd/publications/apdj_12_2/jain.pdf

Kaminsky, G. and Schmukler, S. (2002). Short and Long-Run Integration: Do capital controls matter. *World Bank Discussion Paper*.

Mohan, R. (March 2004). *A Decade of Reforms in Government Securities Market in India and the Road Ahead.* Mumbai: Reserve Bank of India. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/60551.pdf

Mohan, R. (May 2007). *Development of Financial Markets in India.* Mumbai: Reserve Bank of India. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/77375.pdf

Mohan, R. (September 2007). *Recent Financial Market Developments and Implications for Monetary Policy*. RBI and IIF. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/80014.pdf

Mohanty, D. (December 2012). *Money Market and Monetary Operations in India*. Mumbai: RBI. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/SMMIED171212.pdf

Padmanabhan, G. (August 2011). *Forex market development: Issues and challenges—Thoughts of a returning forex market regulator*. Singapore: RBI and Forex Association of India. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/EDGPS110811.pdf

Padmanabhan, G. (August 2012). *Changed Contours of the Indian Forex Markets: New realities and priorities*. Goa: Reserve Bank of India and Forex Association of India. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/RSFA20082012.pdf

Rangarajan, C. (1997). Activating Debt Markets in India. *Mumbai: Reserve Bank of India and SBICAP Debt Market Seminar*. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/2507.pdf.

Ray, P. and Prabhu, E. (May 2013). *Financial Development and Monetary Policy Transmission Across Financial Markets: What Do Daily Data Tell for India?* Mumbai: Department of Economic and Policy Research, Reserve Bank of India. http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/WPS070513FDTP.pdf

RBI. (2003-08, Volume III). *Development of Financial Markets and Role of the Central Bank - Reports on Currency and Finance.* Chapter 4, p. 296.

Reddy, D. Y. V. (March 2002). *Developing Bond Markets in Emerging Economies*: *Issues and Indian Experience*. Bangkok: RBO, FIMMDA, PDAI, and Thai BDC. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/26957.pdf

Reddy, D. Y. V. (October 2007). *Developing Debt Markets in India: Review and Prospects*. Washington: RBI. http://rbidocs.rbi.org.in/rdocs/Speeches/PDFs/81067.pdf.

Varma, J. R. (1997). *Indian Money Market: Market Structure, Covered Parity and Term Structure.*

Appendices

Appendix 1

Major Macroeconomic and Financial Indicators								
Particulars	Pre-crisis	Crisis			Post Crisis			Average 2000-01 to 2009-10 (10 years)
	Average 2003-04 to 2007-8 (5 years)	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	
Overall Real GDP (% Change)	8.7	9.2	6.7	8.4	8.4QE	6.2	5.5	7.3
Wholesale Price Index Annual Average (% change) - All commodities	5.5	4.7	8.1	3.8	9.6	8.9	7.4	5.3
Consumer Price Index (Average % Change) - Industrial Workers	5.0	6.2	9.1	12.4	10.4	8.4	10.4	5.9
Reserve Money (M_0) (% Change)	20.4	31.0	6.4	17.0	19.1	4.3	8.4	15.4
Broad Money (M_3) (% Change)	18.6	21.4	19.3	16.9	16.1	13.2	13.6	17.0
Scheduled Commercial Banks								
Aggregate Deposits (% Change)	19.0	22.4	19.9	17.2	15.9	13.5	14.2	18.1
Time Deposits (% Change)	18.5	22.5	23.9	16.2	18.7	15.7	15.1	18.5
Demand Deposits (% Change)	21.9	22.0	-0.2	23.4	-0.6	-1.8	5.6	16.4
Bank Credit (% Change)	25.5	22.3	17.5	16.9	21.5	17.1	14.1	21.8
Non-food Credit (% Change)	26.7	23.0	17.8	17.1	21.3	16.8	14.0	22.4
Investments in Govt Securities (% Change)	13.3	23.5	20.6	19.3	8.6	15.9	15.5	17.7
Credit-Deposits Ratio (%)	68.0	73.9	72.4	72.2	75.7	78.0	78.0	64.8
Credit-GDP Ratio (%)	39.5	47.7	49.8	50.1	50.6	51.4	52.5	38.0
Central Government Finances (% of GDP)								
Revenue Deficit	2.3	1.1	4.5	5.2	3.2	4.4	3.9	3.4
Fiscal Deficit	3.6	3.6	6.0	6.5	4.8	5.7	5.2	4.8
Primary Deficit	-0.2	-0.9	2.6	3.2	1.8	2.7	2.0	0.9
External Sector								
Current Account Deficit/GDP (%)	0.3	1.3	2.3	2.8	2.7	4.2	4.8	0.5
Net Capital flows/GDP (%)	4.6	8.7	0.6	3.8	3.7	3.6	4.8	3.3
- Debt Flows ($ billion)	10.6	20.3	-15.0	29.0	29.4	16.8		7.1
- Non-debt Flows ($ billion)	15.3	34.7	41.7	33.1	25.9	33.0		16.7
- NRI Deposits Flows ($ billion)	2.0	0.2	4.3	2.9	3.2	11.9	14.8	2.5
Reserve Change (+: decrease, - increase) $ bn	-40.3	-92.2	20.1	-13.4	-13.1	12.8	-3.8	-22.9
External Debt Stock ($ billion)	156.5	224.0	224.5	260.9	305.9	345.5	390.0	157.3
Debt-GDP Ratio (%)	17.7	18.1	20.3	18.3	17.5	19.7	21.2	19.1
Import Cover of Reserves (in months)	14.0	14.4	9.8	11.2	9.6	7.1	7.0	12.6
Short-term Debt/Total Debt (%)	13.6	20.4	19.3	20.0	21.2	22.6	24.8	11.8
Debt Service Ratio (%)	8.5	4.7	4.4	5.5	4.4	6.0	5.9	9.8
Reserves/Debt Ratio (%)	113.7	138.0	112.1	106.8	99.7	85.2	74.9	95.6
Openness Indicators								
Export plus Imports of Goods/GDP	30.5	34.5	41.0	36.7	37.5	43.8	43.8	18.8
Export plus Imports of Goods & Services/GDP	40.9	46.0	53.7	46.8	49.4	55.0	56.2	22.9
Current Receipts plus Current Payments/GDP	46.7	52.5	60.5	55.2	56.0	61.5	61.5	26.8
Financial Market								
Interest Rates (%)								
Call / Notice Money rate	5.6	6.1	7.1	3.2	5.8	8.2	8.1	6.1
10 year G-Sec yield	7.0	7.9	7.6	7.2	7.9	8.4	8.2	7.5
91-Days T-bill yield	5.8	7.1	7.1	3.6	6.2	8.4	8.2	6.1
Weighted Average Interest rate on Central Government Borrowings	7.2	8.1	7.7	7.2	7.9	8.5	8.4	7.8
Commercial Paper	7.7	9.8	10.8	5.1	8.6	9.8	9.2	8.2
Liquidity (Rs billion)								
LAF Outstanding@	-	(503.5)	14.9	9.9	(1,060.1)	(1,691.6)	(1,236.4)	-
MSS Outstanding	-	1,683.9	880.8	27.4	0.0	0.0	0.0	-
Average Daily Call Money Market Turnover	184.9	21,393.0	224.4	159.2	177.3	267.0	323.6	-
Average Daily G-Sec Market Turnover	77.1	8,104.0	108.8	139.4	142.4	171.3	325.1	-
Policy Rates (%)								
Cash Reserve Ratio	5.6	7.5	5.5	5.8	5.75-6.00	6.00-4.75	4.75-4.00	5.8
Repo Rate	6.3	7.8	5.0	5.0	5.00-6.75	7.25-8.50	8.00-7.50	6.8
Reverse Repo Rate	4.8	6.0	3.5	3.5	3.75-5.75	6.25-7.50	7.00-6.50	5.2
Source: RBI Annual Reports								

Table 10: Macroeconomic and Financial Indicators (Pre Crisis, Crisis, and Post Crisis)
Source: (RBI, Reserve Bank Of India Annual Report, 2012)

Appendix 2

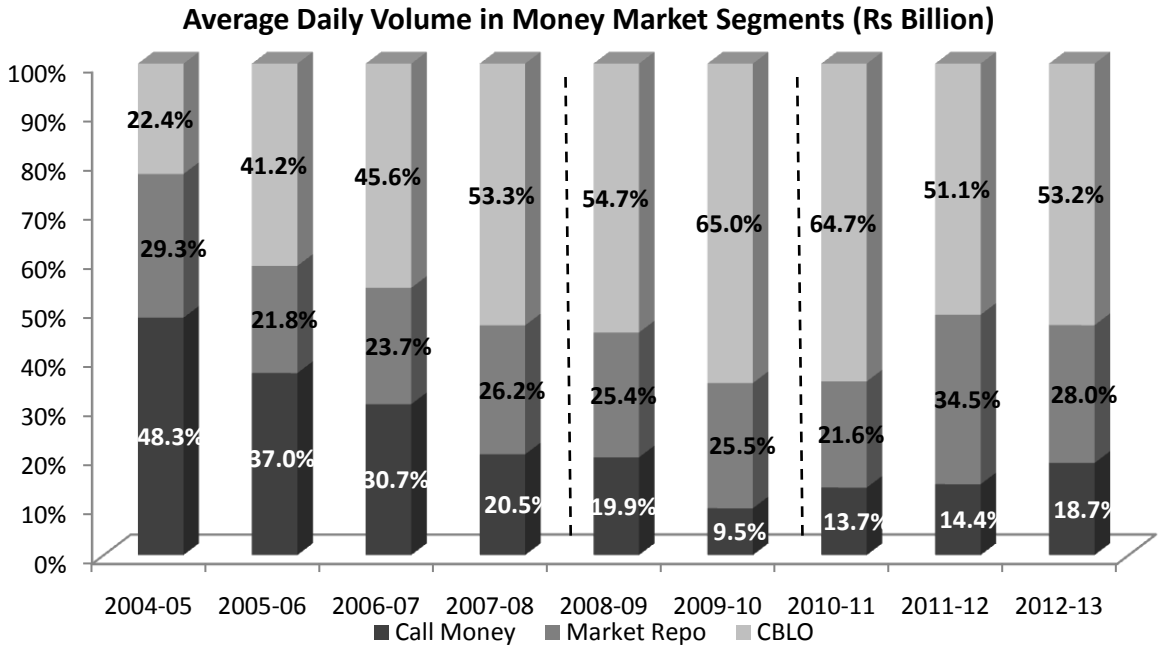

Figure 1: Liquidity Measure—Money Market Daily Turnover

Total (₹ Bn.)	147	243	355	522	563	840	648	1505	667

Appendix 3

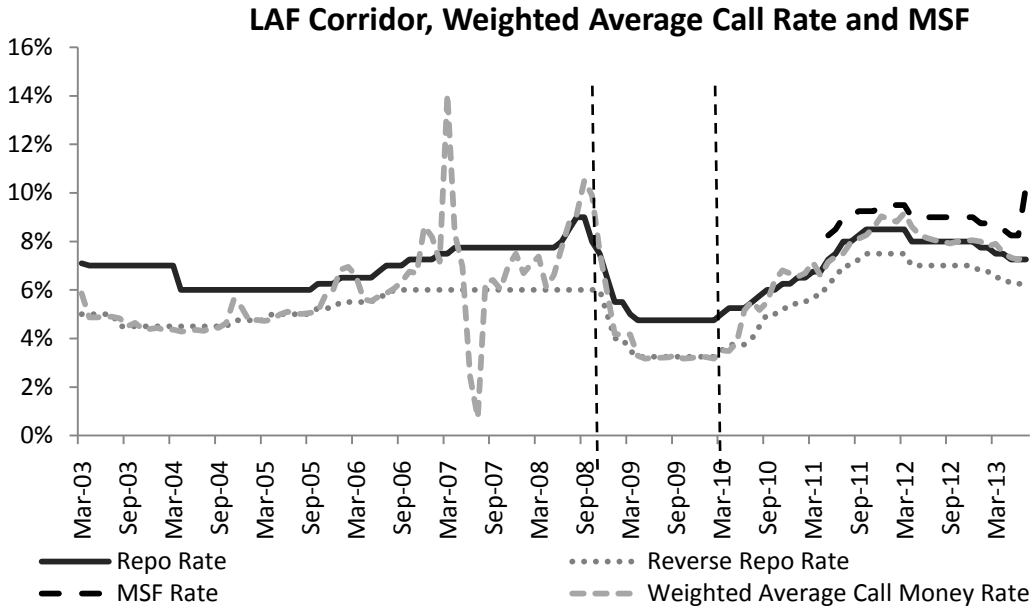

Figure 2: LAF Corridor, Weighted Average Call Rate, and MSF

Appendix 4

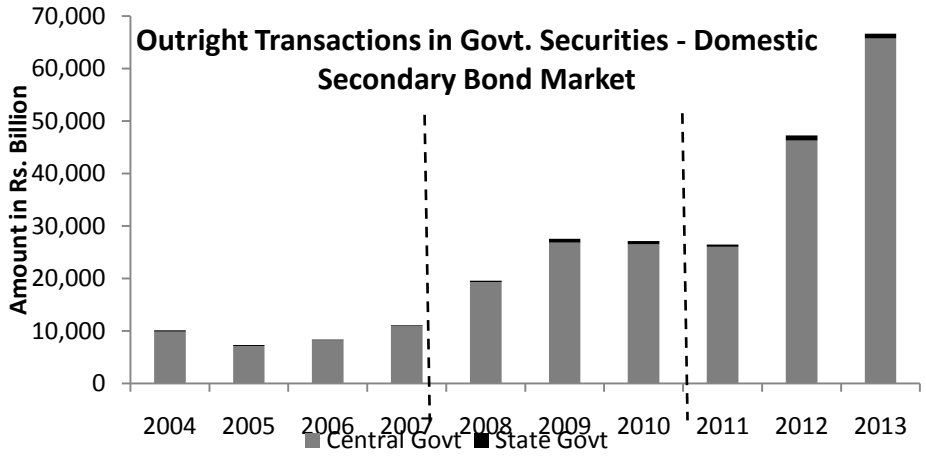

Figure 3: Secondary GSM—Outright Transactions

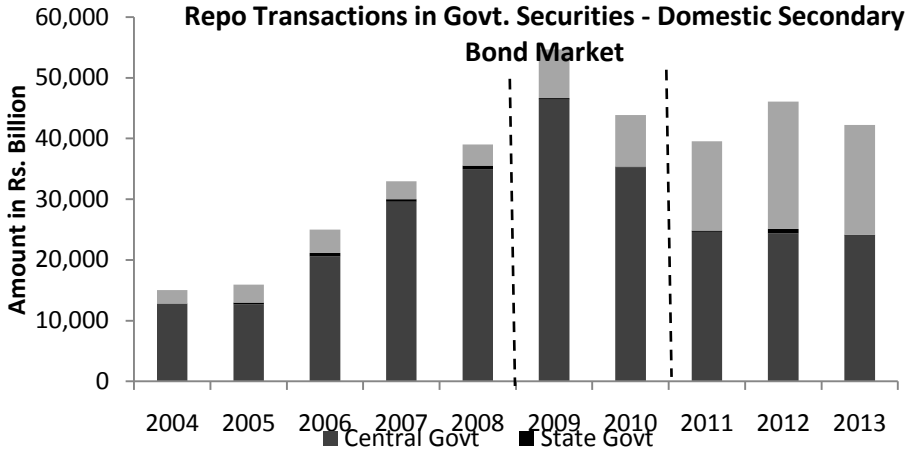

Figure 4: Domestic GSM—Repo Transactions

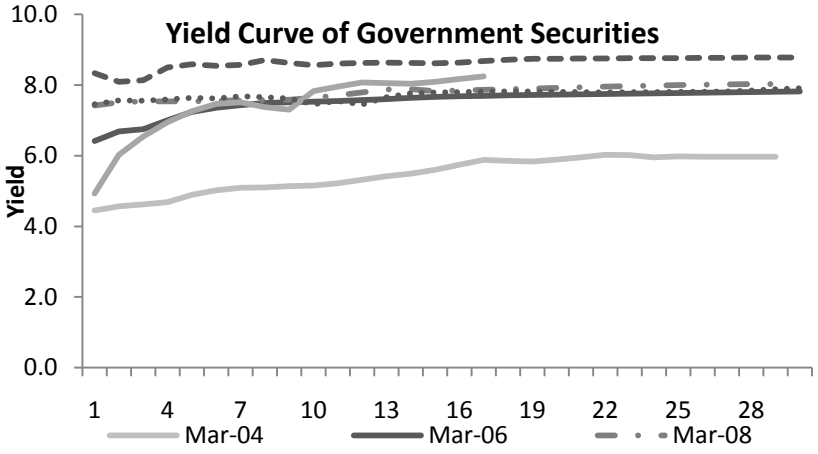

Figure 5: Yield Curve of Government Securities

Yield-turnover relationship of GSM alludes the market turnover becoming increasingly less sensitive to interest rate cycles – depth and liquidity in market (Gopinath, Financial Markets in India: Recent Developments and Challenges, January 2008).

Appendix 5

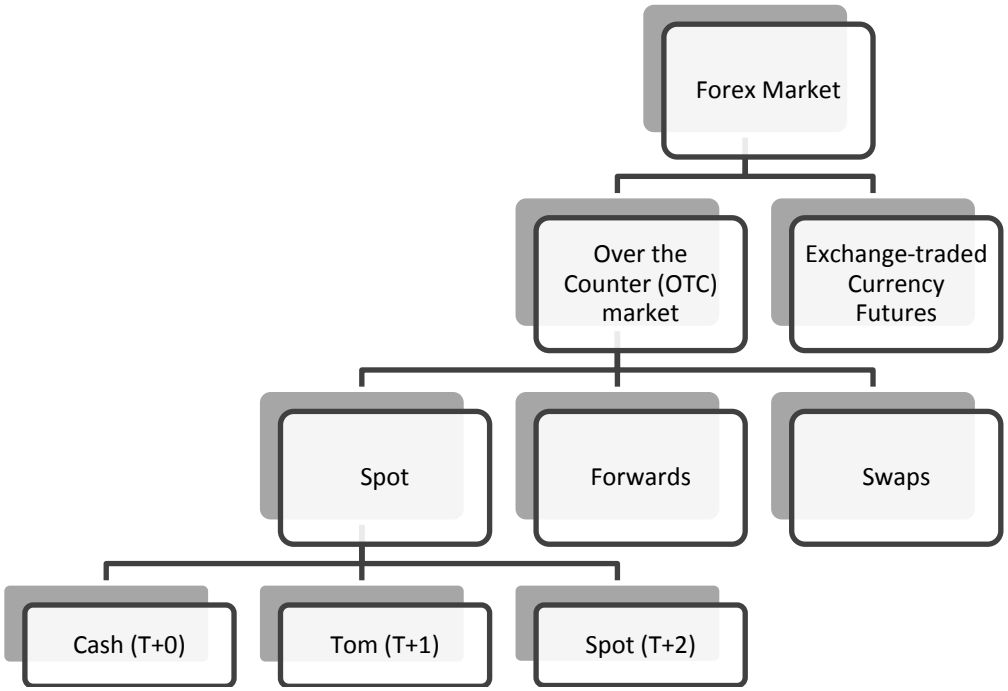

Figure 6: Classification of Forex Market

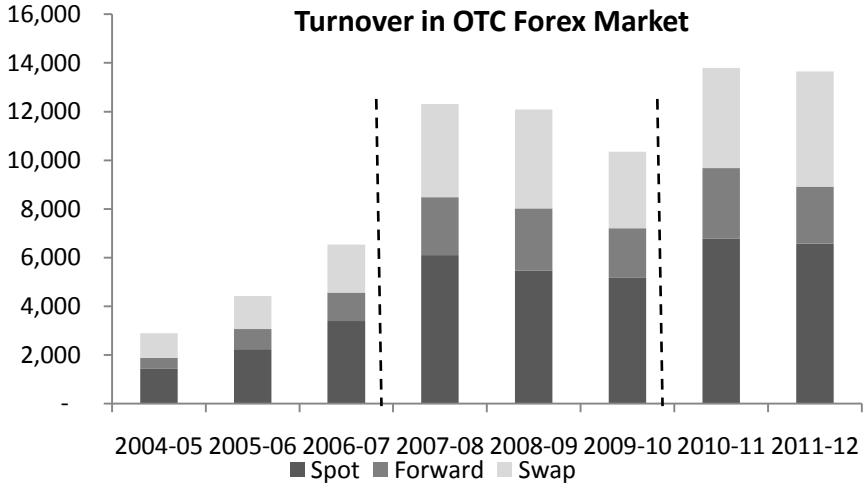

Figure 7: OTC Forex Market Turnover

Appendix 6

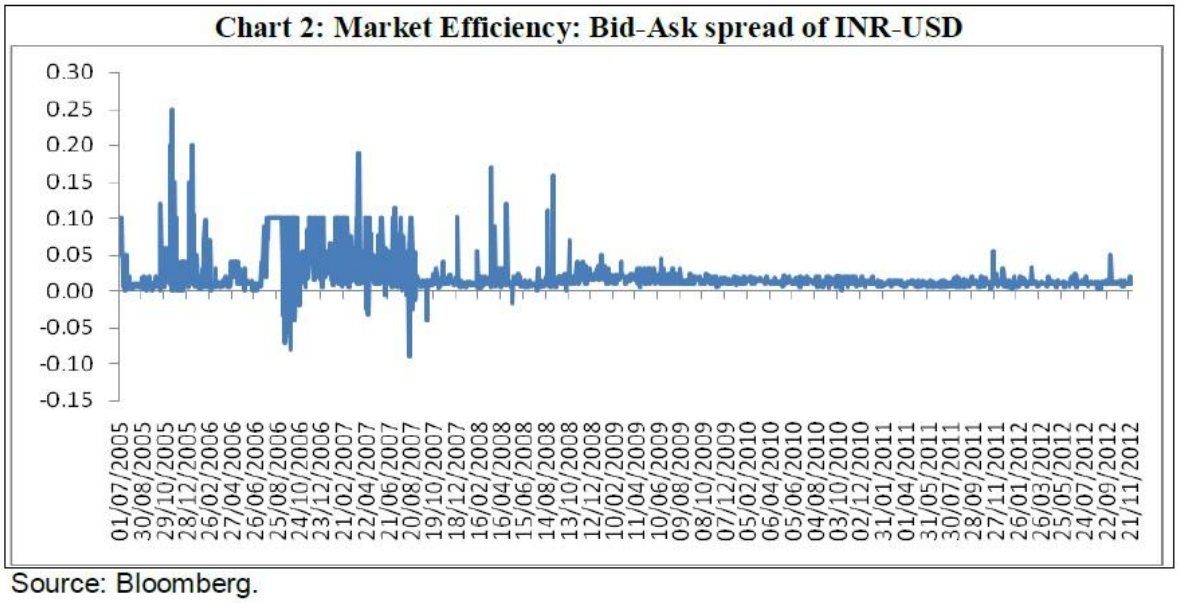

Figure 8: Bid-Ask Spread for USD/INR

Appendix 7

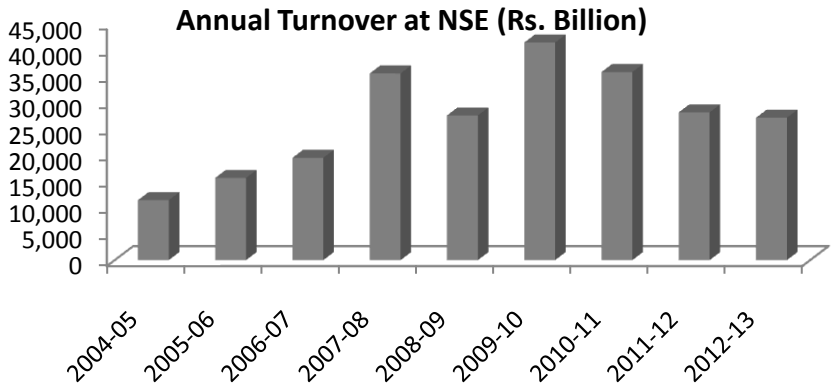

Figure 9: Equity Market (NSE) Turnover

Appendix 8

Particulars	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon approximate p-value for Z(t)	Number of Observations	Result
Fiscal Deficit/GDP	-4.751	-3.709	-2.983	-2.623	0.0001	31	Stationary
CAD/GDP	-4.771	-3.709	-2.983	-2.623	0.0001	31	Stationary
Lagged Yield Value	-2.985	-3.716	-2.986	-2.624	0.0363	30	Stationary with 95%

of 10-year GOI bond							confidence level
WPI Change	-5.005	-3.716	-2.986	-2.624	0.0000	30	Stationary
Lagged Nominal USD/INR value	-0.765	-3.716	-2.986	-2.624	0.8292	30	Non-stationary
Weighted Average Call rate	-3.421	-3.502	-2.888	-2.578	0.0103	122	Stationary with 95% confidence level
10-year GOI bond	-2.142	-3.503	-2.889	-2.579	0.2280	122	Non-stationary
USD/INR Exchange Rate	0.682	-3.502	-2.888	-2.578	0.9895	123	Non-stationary
Nifty Level	-1.543	-3.503	-2.889	-2.579	0.5121	122	Non-stationary

Table 11: Stationarity Results

Appendix 9

Particulars	Dependent Variable	Independent Variable	Regression Equation	p-Value (ANOVA Table)
GSM	10-year GOI bond yield	Fiscal Deficit/GDP, Lagged yield value and WPI Change	Yield = 2.4264+0.0334*(FD/GDP)+0.6557*Lagged Yield Value+0.0759*WPI Change	0.0000
Forex Market	USD/INR Nominal Exchange Rate	CAD/GDP and Lagged Nominal Exchange Rate value	Nominal Exchange Rate = 10.3127+0.7586*Lagged Nominal Exchange Rate value-0.3393*(CAD/GDP)	0.0000

Table 12: Behavioural Relationship between Financial Market Instruments and Macroeconomic Environment

Appendix 10

Correlation Among Financial Markets (Apr'93-Mar'00)				
Particulars (Pre-Crisis: Apr'03-	**Call Money Rate**	**10-year G-o-I Bond**	**USD/INR Spot Exchange**	**Natural Logarithm of BSE Sensex**

Jul'08)				
Call Money Rate	1.00	0.46	-0.04	-0.10
10-year G-o-I Bond	0.46	1.00	-0.06	-0.05
USD/INR Spot Exchange	-0.04	-0.06	1.00	-0.30
Natural Logarithm of BSE Sensex	-0.10	-0.05	-0.30	1.00
Correlation Among Financial Markets (Apr'00-Dec'06)				
Particulars (Pre-Crisis: Apr'03-Jul'08)	**Call Money Rate**	**10-year G-o-I Bond**	**USD/INR Spot Exchange**	**Natural Logarithm of BSE Sensex**
Call Money Rate	1.00	0.79	0.06	0.01
10-year G-o-I Bond	0.79	1.00	0.06	-0.11
USD/INR Spot Exchange	0.06	0.06	1.00	-0.56
Natural Logarithm of BSE Sensex	0.01	-0.11	-0.56	1.00

Table 13: Cross Correlation Results from Earlier Study