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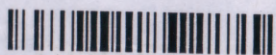
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INTER-LINKAGES BETWEEN CAPITAL, MONEY AND FOREIGN EXCHANGE MARKETS IN INDIA : PRELIMINARY FINDINGS

Anamitra Saha¹

The article examines the changing pattern of inter-linkages between equity, money and foreign exchange markets in India during the 1990s. Analysis of the policy and institutional changes during the 1990s suggests that a flexible interest rate regime, progressive removal of restrictions on flow of funds across various segments and the emergence of new financial intermediaries have been instrumental in forging greater inter-linkages between these financial markets. Preliminary empirical analysis suggests that various asset price movements were consistent with theoretical expectations. Granger causality test, however, suggests that linkages between various markets were often asymmetric and limited.

I

Introduction

As an economy matures, greater inter-linkages within the various segments of the financial system play a crucial role in efficient allocation of resources. Inter-linkage between various financial markets is an important pre-requisite for efficient operation of a market mechanism. When markets are not inter-linked, liquidity conditions in different segments of financial markets fail to move in tandem having implications for efficient allocation of resources.

In India, the financial markets in the post-reform period has supplied sufficient evidence to suggest significant inter-linkages between foreign exchange market, money market, capital market and government securities market². However, the process is far from complete and linkages amongst certain segments remain weak due to institutional, regulatory and other reasons. The present paper attempts to examine the factors that have led to increased integration of financial markets in India during the nineties and make a preliminary attempt towards empirical examination of the emerging pattern. The paper is organised as follows: Section II presents a brief analytical outline of some of the issues relating to inter-linkages amongst various financial markets. Section III discusses relevant policy developments in India having bearing on inter-linkages during post 1985 period with special focus on the reforms initiated since 1991. Factors facilitating or restricting the inter-linkages between certain segments are presented in Section IV. Section V is devoted to a preliminary empirical exercise to ascertain the nature and extent of

1 The author is a Research Officer in the Department of Economic Analysis and Policy. He is indebted to Shri D. Anjaneyulu, Officer-in-Charge, DEAP, Shri Janak Raj, Smt. Kumudini Hajra and Dr. Tapas Chakrabarty for their useful advice on the topic. He also acknowledges the help of Shri Rajib Das in econometric exercise and services of Smt.U.P. Kusurkar and Shri R.Y. Karmarkar of the Staff Studies Section. He is, however, solely responsible for the views expressed in the paper and for any errors that may remain.

2 Annual Report of RBI (1997-98), for instance, noted greater inter-linkages among money, foreign exchange and Repo markets in India, particularly during the financial crisis in East-Asian economies. Bhoi and Dhal (1998) also examine the emerging pattern of integration of financial markets

inter-linkages between equity market, short-term money market and foreign exchange market in India using monthly data. Section VI examines some future policy measures while section VII concludes.

II

An Analytical Framework

Short-term money market, Government securities market, capital market, foreign exchange market and the organised credit market constitute major segments of the Indian financial system. In the money market, short-term assets (generally less than 1 year) are traded. While part of the funds traded in this segment is in the form of money balance (i.e., the amount traded in the call-money market), all other transactions generally take place by way of debt instruments of short maturities (e.g., CP, CD, commercial bills, units of the money market mutual funds, TBs etc.). In the Government securities market, bonds of varying maturities are traded. In capital market, both equities and bonds are traded. The equity represents the real capital stock of the corporate sector. Commercial banks and term lending institutions are major players in the organised credit market. From the point of view of inter-linkages, balance sheet items of these institutions are important. Whereas, operations of the banking sector influence the stock of money, increased reliance of the financial institutions and corporate bodies on bond financing increases the supply of bonds in the economy.

Thus, three broad instruments viz., money, bond and equity (or real capital) constitute the entire gamut of the financial transactions. In these three markets, two relevant asset prices viz., price of equity and rate of interest on bond are determined. Interdependence among these important financial variables, however, depends crucially on how these markets are integrated. Institutional mechanism for flow of funds among these three broad segments is the single most important factor governing their degree of integration.

In the absence of any impediments to free flow of funds across various segments of the financial system, asset holders will diversify their portfolio depending on the risk and return profile of each asset. Given a real rate of return, an increase in price of equity will render holding of bonds or money relatively more attractive. Similarly, a reduction in interest rates on bond instruments (following, say, an easy money policy) will make investment in equity more attractive. Price of equity, despite being sensitive to day to day development or market sentiment is not devoid of economic fundamentals in the medium to long run. Inter-linkages between the equity market and other segments of the financial system play an important role in the determination of equity prices.

The developments in the foreign exchange market may also have tractable influence on the domestic debt and equity markets. When the domestic currency tends to depreciate forward premium also shoots up and this puts upward pres-

sure on the interest rates on short-term debt instruments in the money market. Higher interest rate, in turn, facilitates substitution of equity by debt instruments, thereby putting downward pressure on stock prices. The presence of foreign institutional investors (FIIs) in the secondary market adds another dimension to this integration in that their operations directly impact foreign exchange market. For example, when the market expects the domestic currency to depreciate there will be selling pressure by FIIs and stock prices will decline. Selling pressure by FIIs may facilitate actual depreciation of the domestic currency. Therefore, stock price and exchange rate (defined as Rs./US\$) will be negatively related.

Operations of FIIs also add new dimensions to macro-management. When investment by FIIs is restricted only to equity capital, an increase in FII investment will mean more assets (domestic and foreign) competing for a given stock of real capital. In the first round of effect, as share prices shoot up some domestic holders of equity capital will find bonds more attractive instrument to invest in, thereby putting a downward pressure on interest rates. The final effect, however, depends on the nature of monetary accommodation following the inflow of FII funds. In case of complete monetisation, the stock of money increases and downward pressure on interest rate continues. In case of sterilisation, part of the increased stock of money will be replaced by increased supply of (Government) bonds, which will raise interest rate. Thus, while FII investment impacts the exchange rate and stock prices in a definite manner, its impact on interest rate depends on the stance of the monetary authority.

Again, when mobility of funds between these three asset markets (viz., money, bond and equity) is free from impediments, monetary policy will influence real economic activity through two channels. Firstly, the immediate impact of monetary policy will be transmitted through the credit market channel either by changes in CRR, reserve money and/or changes in the deposit or lending rates of the banks. The equity market effect of changes in monetary policy is the second potential channel through which monetary policy influences real economic activity. For example, with free flow of funds, an easy money policy will increase relative attractiveness of equities vis-à-vis bonds. This will lead to a rise in equity prices in the secondary market and this, according to Tobin's q investment theory, will lead to increased investments by the corporate entities. According to Tobin's q theory, an increase in prices of the stocks will reduce the replacement cost of capital and encourage corporate investment. In other words, an easy money policy will lead to a buoyant secondary market of stocks and thereby encourage both the existing and new entrepreneurs to expand business by floating new equity issues in the primary market.

III

Inter-linkage between Financial Markets: Policy Environment in India

III. a: Policy Environment in pre-Reform Period

Greater integration of financial markets has always remained an important objective of the economic reform process initiated in India. Before examining the post 1991 developments in this regard, it will be useful to summarise the policy and institutional framework that governed the degree and nature of inter-linkages amongst various segments of the financial markets in India prior to 1991.

Prior to 1991, the market for short-term debt instruments had not developed sufficiently. It was during the second half of 1980s, following the recommendations of Working group on Money Market (Chairman: Shri N. Vaghul) in 1987, that new instruments such as certificate of deposit (CD) and commercial paper (CP) were introduced to pave the way for market determined interest rates on short term funds.

Transactions in Government securities, which accounted for the largest share of total transactions in bonds, had a captive market as banks were required to invest in government securities to meet SLR requirements. Interest rates on government securities were abnormally low and reflected perception of the issuer and not that of their holders. In 1989, limited progress was made in imparting interest rate flexibility with introduction of auction on 182-day treasury bills. Interest rates on private sector debt instruments were regulated and there were little or no arbitrage opportunities available between corporate and government debt instruments and there was no alignment of rates of interest.

Equity market, too, operated in relative isolation from other segments of the financial system. In particular, banks were not permitted to invest in equity instruments. Only investment institutions, such as, UTI, LIC, etc. were able to take advantage of any arbitrage opportunity that arose between equity and bonds. However, due to large size of these institutions and lack of depth in the secondary stock market it was not always possible for them to reap large gains through such arbitrage.

In the pre-reform period, foreign exchange market was marked by a system of daily official exchange rate fixed by the Reserve Bank and the current account transactions had to be made on the basis of the official exchange rate. Banks, which were the main players in the foreign exchange market, were required to maintain 'square' or 'near square' position at the end of each trading day, thereby limiting the scope of arbitrage activities. As the call money and government securities markets were also not well integrated, the flow of funds between these markets and the foreign exchange market was limited and the markets remained seg-

mented. In other words, movement in the daily exchange rate was accompanied by corresponding adjustments in reserves without significantly influencing the prices of other financial assets (i.e., interest rates and equity prices).

III. b: Policy Developments in the post-Reform Period

We have already noted that certain initiatives to free interest rates on short term instruments were already taken during the late eighties following the recommendations of Working group on Money Market (Chairman: Shri N. Vaghul). However, it was in the post-1991 period that a decisive policy shift in favour of liberalisation of the financial markets took place. The overall thrust of the policy reforms has been to allow prices of financial assets to be determined by the demand and supply of each financial asset, to allow greater flow of funds amongst various segments and to introduce new instruments and intermediaries to increase the depth of the markets. All of these developments have significantly influenced the nature and extent of inter-linkages amongst various financial markets.

In the equity market, with the removal of the office of the Controller of Capital Issues (CCI), issuers of equity are now free to price the issues based on the market conditions. The entry of the foreign institutional investors (FIIs) in the secondary equity market since 1992 has been one of the significant developments for Indian capital market. Entry of FIIs in the Indian capital market has also forged an important linkage between the capital market and the foreign exchange market.

Since March 1, 1993 the process of determination of foreign exchange rate has been left to the market forces. Authorised dealers (ADs) are now permitted to provide forward cover on a wide range of foreign exchange exposures. There has also been a significant addition in the types of instruments used by the ADs for risk management. Also, banks are now free to determine their aggregate gap limit (AGL). In a significant development, banks are now permitted to borrow from the overseas markets and invest into overseas money market instruments up to a maximum of 15 per cent of their Tier-I capital. This, together with FIIs' participation in the Indian secondary capital market have become important element in the determination of exchange rate.

Various segments of the bond market have seen far-reaching changes in the post-reform period. Interest rates on the government securities are now closely aligned to the market rates and are increasingly determined through process of auctioning. Introduction of the market-related rates of interest on government securities has been single most important measure aimed at deepening and widening the debt market. FIIs have also been permitted to invest in government securities under certain restrictions. Depth of the government securities market has improved significantly with introduction of market makers, such as, primary dealers (PDs), who are offering two-way quotes. Freeing of interest rates on debentures and pub-

lic sector bonds (except tax-free bonds) with effect from August 1991 has been an important step in the direction of developing private corporate debt market. Infrastructural improvements, such as, operation of the wholesale debt market (WDM) segment at the National Stock Exchange (NSE), has also given a boost to the secondary market transactions in the debt instruments in general.

At the shorter end, money market has also seen new intermediaries and participants such as, money market mutual funds (MMMFs) and PDs. MMMFs are also permitted to invest in private corporate debt instruments with remaining maturity of one year. Also, a select group of corporate entities have been permitted to participate in the call money market. The minimum size of transaction in respect of CP and CD has been progressively reduced to improve depth of these segments of the market. In respect of repos, banks and PDs are permitted to both lend and borrow. In a move to give more flexibility to fund management operations, the development financial institutions were allowed to issue CDs, large term deposits and borrow from the term money market subject to some terms and conditions. Subsequently, instrument-wise limits on investment were replaced by an 'umbrella' limit linked to their net owned fund.

The existing institutional set up crucially influence the extent of inter-linkages between the equity market, bond market and foreign exchange market. A classification of economic entities in India by their involvement in transactions of various financial instruments as presented in Table 1 gives a bird's eye view of the various participants operating in various segments of the Indian financial system.

Table 1: Principal Financial Entities and their Participation in Financial Markets.

	Banks	AIDBs\$	Invt Inst*	MMMF	PD	Corporate	FII	Household
Call Money	√	√ a, f	√ a	√	√	a, e		
Commercial Papers	√	√ f	√	√		√		
Certificate of Deposit	√	√ f	√	√		√		
Commercial Bills	√	√ f	√	√	√	√		
Treasury Bills	√	√	√	√	√		d	
Dated Govt. Securities	√	√	√	√ b	√		√	
Debenture/Bonds of FIs, Corporates and PSUs.	√ c	√	√	√ b			√	√
Equity	√ c	√	√			√	√	√
Foreign Exchange	√	√				√	√	

Notes: * = UTI, LIC, GIC and its subsidiaries; a = as lenders only; b= with remaining maturity of one year; c = subject to overall limit and valuation norms; d= RBI has given permission in principle. e = restricted to a select 17 corporate entities; f = AIDBs has an umbrella limit on their operations in the money market. FII= Foreign Institutional Investor; MMMF = Money Market Mutual Fund; PD = Primary Dealer; \$ AIDB= All India Development Banks (viz., IDBI, IFCI, ICICI, SIDBI, IIBI)

IV

Inter-linkages in Indian Financial Markets: Emerging Trends

Linkages between Money Market and Foreign Exchange Market: In India, money market or, what is called the shorter end of the debt market, has become very closely linked with the foreign exchange market in the post-reform period. Stronger linkages between these two important segments of the financial system were greatly facilitated by the following factors. Firstly, determination of the interest rates on the money market instruments has been left to the market forces. Secondly, banks are now permitted to both borrow from and invest in money market abroad under certain conditions. As a result, interest rate differential between domestic and international money market is increasingly playing an important role in determining the opportunity cost of funds for banks while providing forward cover. Also, commercial banks being the most important intermediary in both money and foreign exchange markets, any arbitrage opportunity that arises between these two markets is immediately exploited. As a result, the premium in the forward market has increasingly being linked to the call money rate. A low (high) call money rate puts downward (upward) pressure on the forward premium.

Linkages between Money Market and Bond Market: The past few years have seen increased alignment of interest rates in the money market and government securities markets. This has been facilitated by two factors. Firstly, development of active secondary market for all types of government securities and certain money market instruments, such as, CPs, CDs and introduction of various intermediaries, like MMMFs and PDs has greatly increased ability of investors to reallocate their portfolio of debt instruments. Operation of WDM segment at NSE also contributed to this development. Increased ability to re-allocate portfolio has helped to align interest rates on debt instruments of varying maturity in a more orderly manner as experienced in the recent past. A second factor contributing to greater inter-linkages between the money and government securities market has been removal of restrictions on flow of funds between these two segments. In particular, PDs and MMMFs are now permitted to participate in both government securities market and money market and take advantage of arbitrage opportunity between them.

However, complete alignment of interest rates across debt-instruments of varying maturity has not yet been achieved in India. Also, depth of the secondary market transaction in bond instruments is relatively low as compared with that in the equity market. For example, at the WDM segment of NSE, market capitalisation of total traded debt instruments as at end-March 1998 at Rs. 3,43,191 crore was much higher than the market capitalisation of equity stocks traded at the capital market segment of NSE (Rs. 1,72,913 crore). However, total turnover of debt instruments traded at the WDM segment of NSE during 1997-98 at Rs. 1,11,263 crore was less than one third of that for equity stocks at NSE

(Rs. 3,70,193 crore). This indicates that although the size of the debt-market is quite large in India, it lacks in depth and liquidity.

Linkages between Equity Market and other Financial Markets: For a variety of reasons, traditionally the linkages between the equity market and rest of the financial markets have remained weak in India. In the present institutional set up, domestic financial institutions (investment institutions and mutual funds) occupy the most important position as far as their ability to take advantage of the arbitrage opportunity between the equity market and other financial markets is concerned. They are permitted to invest in equities (LIC, GIC and its subsidiaries within limits) just as they can invest in debt-market instruments. However, their participation in the call money market involves certain restrictions. While corporate entities are permitted to invest in equity and money market instruments, there are several restrictions in this regard. Commercial banks have only recently been permitted to invest in the equity market and there are restrictions on such investments. Further, banks will take time to achieve expertise to invest in the equity market. As a result, flow of funds between the equity market, money market and debt market is not smooth although mobility of funds among them is certainly increasing. Also, lack of liquidity in a large number of stocks traded in the Indian secondary equity market is yet another barrier to successful arbitrage opportunities amongst alternative forms of assets. Even when bonds become attractive or money market rates are high, investment institutions, mutual funds and retail investors often do not find ready buyers of their stocks, which they might otherwise prefer to substitute for more attractive assets.

In India, one can identify two possible channels, which are responsible for greater linkages between equity and foreign exchange market. Firstly, as already noted, an increase in the flow of FII investment in the equity market is likely to be associated with appreciation of the Indian rupee and vice-versa. Since FIIs have become an important determinant of stock price movements in India, particularly in view of FIIs' involvement in index-heavy liquid scrips, exchange rate movement is likely to bear a negative relationship with domestic stock prices. The second channel operates through the money market route. As already noted, there has been a significant liberalisation of the interest rates in the short-term money market and mobility of funds between this segment and the foreign exchange market is also relatively free in India. Thus, when Rupee tends to depreciate, forward premia, treasury bill rates and call money rate tend to move up to clear the short term money market. This will induce institutional investors and banks to divest equity holding and invest the proceeds in the short-term money market instruments. Thus the second channel reinforces the first one to put a downward pressure on stock prices following a downward pressure on the Rupee. It will, therefore, be interesting to examine the actual empirical evidence in this respect.

Insofar as the impact of equity market impact on monetary policy is concerned, one could intuitively feel that this impact, operating through Tobin's 'q'

channel, has remained weak in India due mainly to institutional arrangements (as banks which hold sizeable stock of debt instruments do not participate on a large scale in the equity market), underdeveloped secondary debt market, illiquidity in a large number of scrips and risk averse behaviour of investors. The weak linkages between equity market and rest of the financial markets have important implications for the conduct of monetary policy. For example, an easy money policy may not lead to an increase in stock prices in the secondary market due to the existing restrictions on investors and financial intermediaries to successfully substitute real (equity) capital for bonds. Since a buoyant secondary market positively encourages companies to float primary issues for expansion of their activities, these restrictions may entail lost opportunities to real capital formation. In other words, with greater integration between the equity and rest of the financial markets, monetary policy will be able to influence the real investment activity through both the capital market channel and traditional credit market channel.

V

A Preliminary Empirical Analysis

We undertook a preliminary empirical analysis of the emerging pattern of integration of various financial markets in India in the post-reform period. The analysis was confined to foreign exchange market, short-term money market and secondary equity market. In particular, the market for dated government securities was excluded due to lack of uniform monthly yield series prior to introduction of SGL transactions in 1996. The analysis was based on the information for the period January 1993 to March 1999. Data set includes yield on 91 day treasury bills (primary market), yield on CDs, call money rate, spot exchange rate for US Dollar (US\$), forward premium on US Dollar (3 months) and BSE Sensex. While simple measure of correlation coefficient was utilised to examine the emerging pattern of movements of financial variables in different segments, it was followed by time series analysis to identify the nature of causality amongst them.

V.a: Direction of Movements of Financial Variables

Alignment of interest rates: An important indicator of the degree of integration of various financial markets is alignment of interest rates on various instruments. This seems to have been achieved in the post-reform period to a great extent. Graph 1 indicates movement of 3-months forward premium (3MPREM), call money rate, CD rate and yield on 91 day treasury bills. It may be noted that while call money rate and dollar premia show significant volatility interest rates on 91 day TBs and CDs are relatively smooth. However, all of these short-term rates moved in tandem during the period under consideration. Correlation coefficients among these four interest rates, computed for the entire period (January 1993-March 1999), as presented in Table 2 were also positive.

**Table 2 : Correlation Co-efficient between Various Interest Rates
(Jan 1993 - March 1999)**

3MPREM	1			
CALL	0.67*	1		
CD	0.68*	0.43	1	
TB91	0.46*	0.65	0.56	1
	3MPREM	CALL	CD	TB91

* Relates to the period March 1993 to March 1999.

Linkages between equity market and other segments: It has been already discussed that operations of FIIs in the secondary equity market forge a link between the foreign exchange market and the equity market. In this regard, the emerging pattern can be summarised by following observations:

Firstly, investment by FIIs has become an important determinant of stock price movement. A positive correlation of 0.34 between Sensex and FII investment was found for the entire period. However, the correlation coefficients for the most recent period, i.e., 1996-97 and 1997-98 were found to be 0.57 and 0.58, respectively, showing that FIIs operators now have greater influence on domestic stock prices as compared with their operations in the initial years. However, due to very low level of activities by FIIs during 1998-99 the correlation coefficient came down to 0.39.

Secondly, there is a growing evidence of inter-relationship between investment by FIIs and exchange rate movements. The correlation coefficient between FII investment and spot exchange rate for US dollar was found to be -0.30 for the entire period. It may be recalled that between April 1993 and March 1995, the nominal exchange rate for US Dollar was almost stable at Rs.31.37 per dollar. Excluding this period, the correlation coefficient for the period April 1995 and August 1998 was found to be -0.49. This suggests that an increase (reduction) in FII investment result in appreciation (depreciation) of the Rupee. This could be attributed to the fact that in the post-reform period, quite an increased proportion of foreign exchange transactions has been on account of FIIs' operations. Since expectations about the future movement in exchange rate is likely to be one of the factors that guide FIIs investment decision, a revision in expectation induced by actual movement may give rise to a dynamic relationship between exchange rate and FIIs investment. Such dynamics can result in exchange rate overshooting/under-shooting, although given the present volume of capital account transactions in India's foreign exchange market, over/under-shooting of this kind is not expected to pose a major threat to the exchange rate stability.

Thirdly, exchange rate movements are likely to be linked to movements in stock prices on account of two factors. Firstly when Rupee depreciates (appreciates) there would be a downward (upward) pressure on stock prices due to selling (buying) pressure by FIIs, thereby giving rise to a negative association between exchange rate (expressed as Rupees per US dollar) and BSE Sensex. Secondly, even apart from the operations of FIIs, exchange rate movement through its impact on call money rates is also likely to influence equity prices. This, as already noted in section IV, reinforces the first channel. Prima facie evidence based on correlation coefficient supports some relationship between exchange rate and equity prices (also see Graph 2 and Graph 3). Disregarding the period up to March 1995 for reason already stated, a correlation coefficient of -0.17 was found between the two for the remaining period. However, when correlation coefficient between the two was calculated for each year, the negative relationship appeared to have strengthened over time: correlation coefficient of -0.28 for 1995-96, -0.64 for 1996-97, -0.59 for 1997-98 and -0.83 for 1998-99. This probably indicates that a relationship between exchange rate and stock prices is developing over time.

Finally, we have already pointed out the factors hindering the linkages between the equity and debt market. This is also reflected in the movements in the stock prices and interest rates on debt instruments. The movement of Sensex and interest rates on two short-term debt instruments (i.e., CD rate and yield on 91-day Treasury bill) is presented in Graph 4. Since an increase in interest rate encourages a substitution of equity capital by debt instruments a negative relation between the two may be expected. Evidence based on correlation coefficient lends support to this. The correlation coefficient between Sensex and 91-day Treasury bill yield was found to be -0.29 and that between Sensex and CD rate was -0.39.

Our preliminary analysis based on correlation coefficient indicates that the movements in financial variables in different segments are not inconsistent with theoretical expectations. Analytical rigour demands that one should establish and empirically verify economic relationships between financial variables by specifying functional relationships on the basis of theoretical premises. This, however, is beyond the limited scope of the paper. Instead, we have limited ourselves to identify the direction of causation between markets.

V.b: Causality Analysis

Empirical tests for causality between economic variables are widely used in the literature. Of the various tests available for the purpose the one based on definition suggested by Granger (1969) has gained immense popularity. The idea underlying Granger test is simply: a variable x is a Granger cause of another variable y , if present y can be predicted with better accuracy by using past values of x rather than by not doing so, other information being identical.

To examine the emerging pattern of interdependence between equity market

and other financial markets we attempted to test for pair-wise Granger causality between stock price index (SENSEX) and other variables (viz., FII, SPOT, CALL and TB). But all these variables were found to be non-stationary and we could not test for causality at the levels. Instead, denoting $(x_t - x_{t-1})$ and $(y_t - y_{t-1})$ by Δx and Δy , respectively, we could test whether (a) Δx Granger causes Δy and (b) whether Δy Granger causes Δx . The inferences were based on whether we could reject the null hypothesis of no causality (see Technical Appendix for details). The summary of the causality tests is reported below in Table 3. For reasons already stated causality test involving spot Rupee-Dollar exchange rate was confined to the period between April 1995 and March 1999 with results shown in the shaded region.

Results of the causality tests as reported in Table 3 are interesting in many respects. Firstly, it was found that variation in investment by FIIs (ΔFII) Granger caused changes in stock prices ($\Delta SENSEX$) significantly. This confirms that activity of FIIs has become an important determinant of stock price movement in India. The reverse causation from $\Delta SENSEX$ to ΔFII was also confirmed albeit with a lesser degree of statistical significance.

Secondly, it was found that variation in investment by FIIs (ΔFII) Granger caused variation in Rupee-Dollar spot exchange rate ($\Delta SPOT$) at 5 per cent level of significance. The opposite causation, however, was not established. This suggests that while changes in the level of investment by FIIs influenced exchange rate movement, influence of exchange rate variation of FIIs' inflow was not significant. In other words, during the period under consideration, we found that FIIs inflow was insensitive to exchange rate movement.

Table 3 : Summary of Granger Block Causality Tests
(Period: January 1993 to March 1999)

Case	Remarks	Order of VAR	Likelihood Ratio
ΔFII Causes $\Delta SENSEX$	Significant (1%)	2	14.7
$\Delta SENSEX$ Causes ΔFII	Marginally significant (5%)	2	6.7
$\Delta SENSEX$ Causes $\Delta TB91$	Significant (1%)	3	14.9
$\Delta TB91$ Causes $\Delta SENSEX$	Insignificant	3	2.8
$\Delta SENSEX$ Causes $\Delta CALL$	Insignificant	3	4.6
$\Delta CALL$ Causes $\Delta SENSEX$	Marginally significant (5%)	3	8.2
$\Delta SENSEX$ Causes $\Delta SPOT\#$	Insignificant	3	3.9
$\Delta SPOT$ Causes $\Delta SENSEX\#$	Marginally significant (10%)	3	6.5
$\Delta SPOT$ Causes $\Delta CALL\#$	Significant (1%)	1	25.0
$\Delta CALL$ Causes $\Delta SPOT\#$	Marginally Significant (10%)	1	3.2
ΔFII Causes $\Delta SPOT\#$	Marginally significant (5%)	1	4.8
$\Delta SPOT$ Causes $\Delta FII\#$	Insignificant	1	0.001

Note: # refers to the period April 1995 to March 1999. The period January 1993 to March 1995 saw an unusually stable exchange rate of Rupee and was removed from empirical analysis. Percentages in the brackets indicate level of significance.

Thirdly, we found that exchange rate variation (Δ SPOT) Granger caused changes in the stock prices (Δ SENSEX) at 5 per cent level of significance. We have already noted that variation in exchange rate did not Granger cause variation in FII investment, which, as we have seen, Granger caused variation in stock prices. Hence the observed causality from Δ SPOT to Δ SENSEX is likely to be other than that due to operations of FIIs. The causality from Δ SPOT to Δ SENSEX is possibly transmitted through the money market. It was found that variation in exchange rate (Δ SPOT) Granger caused variation in call rate (Δ CALL) significantly (the reverse causation, however, was not significant). Further we found that variation in call money rate (Δ CALL) also Granger caused variation in stock prices (Δ SENSEX) at 5 percent level. This supports our contention that call money market has played an important role in forging integration between foreign exchange market and equity market in India during the 1990s.

Finally, all segments of the money market are not equally integrated with the equity market. Whereas we have already noted that causation from call money market to equity market was significant, there was no such impact of the 91-day treasury bill market on the equity market. But there was evidence to support that 91-day treasury bill market was influenced by price movements in the equity market. In particular, it was found that changes in stock prices (Δ SENSEX) Granger caused changes in the primary market yield on 91-day treasury bills (Δ TB) significantly. But the reverse was not statistically significant. This suggests that there are still significant asymmetries in the interaction between equity and money market.

It may be noted that tests for causality do not provide us the precise nature of the dynamics between the variables concerned. Enquiry into such dynamic aspects must be based on prior specification of economic relationship between variables. This is an important area of future research in Indian context and has not been attempted here.

VI

Some Policy Options

While institutional restrictions certainly have the potential for limiting the degree of inter-linkages between financial markets, their existence is not always without reasons. Every financial intermediary has its own area of specialisation or 'core competence' and institutional restrictions are ways to reinforce them. Greater inter-linkage among the various segments of the financial system, on the other hand, demands some degree of 'universality' on the part of its intermediaries. It demands of an intermediary to expand its operations into new areas and new markets involving new instruments. The policymaking has to bear the burden of striking a delicate balance between social gains from permitting an institution to venture into new activities and the potential risks in doing so.

In Indian context, important areas where active policy intervention is called for are the following:

- (a) *Improvement in Debt Market Liquidity:* A large part of the stock of debt instruments in India still does not have an active secondary market. In particular, amount raised through private placement of bonds, debentures etc. are not listed in any stock exchanges. Investment in these instruments has been significant in the recent past and an active secondary market is an essential requirement for greater integration of debt market segments with the rest of the financial system. An active secondary market for privately placed debt instrument will also help to achieve a meaningful term-structure of interest rate.
- (b) *Liquidity in Secondary Equity Market:* Increasing the depth and liquidity of the secondary equity market is another important requisite to take advantage of arbitrage opportunities between the equity and other financial instruments. SEBI needs to take necessary steps in this direction.
- (c) *Removal of Restrictions on Inter-sectoral Flow of Funds:* There are still some major impediments to flow of funds between segments of the Indian financial system. Commercial banks, Provident and pension funds, which mobilise the largest proportion of household savings, are, by and large, not permitted to invest in non-debt instruments. While concern for safety may be overwhelming in this regard, some long-term agenda to enable these institutions to diversify their investment need to be considered.

VII

Concluding Remarks

A flexible interest rate regime, emergence of new market intermediaries together with progressive removal of restrictions on inter-sectoral flow of funds during the 1990s have increased the linkages between various segments of Indian financial market. One direct off-shoot of this process is that demand and supply conditions in a particular segment is now in consonance with the overall liquidity scenario. Exogenous shocks in one segment, therefore, may have immediate reflections in the entire financial system and, in turn, calls for a unified multi-market approach to policy responses.

Empirical evidence using monthly data for the 1990s suggests that operations of the FIIs have played a significant role in the movement of stock prices as well as of exchange rate. The directions of these effects were found to be theoretically consistent. Exchange rate movement also had indirect influence on stock prices through its impact on the call money market. Also, interest rate movement in both the call money and treasury bills markets were found to be associated with the

movement in stock prices in a consistent way. However, our evidence indicates that causality between financial variables is often one way. This is consistent with the fact that institutional set up of various segments differs significantly.

Reference

Bhoi, B.K. and S. C. Dhal (1998) Integration of Financial Markets in India: An Empirical Evaluation, Reserve Bank of India Occasional Papers, Vol. 19. No. 4, December.

Reserve Bank of India Annual Report (1997-98).

Technical Appendix on Causality Test

The variables TB91, CALL, FII, SENSEX and SPOT were found to be integrated of order one I(1) using augmented Dicky-Fuller (ADF) test for stationarity so that their first differences were stationary I(0). Since the variables were found to be non-stationary meaningful tests for causality could be done only on their first differences and not at the levels. In other words, we could test whether a change in one variable Granger causes changes in the other. A vector autoregression process (VAR) was estimated to test for Granger causality. The order of the VAR was selected using Akaike information criteria (AIC). The estimated system of equation was of the following form:

$$\Delta y_t = a_{10} + \sum_{i=1}^k b_{1i} \Delta x_{t-i} + \sum_{i=1}^k c_{1i} \Delta y_{t-i} + u_{1t} \quad (1)$$

$$\Delta x_t = a_{20} + \sum_{i=1}^k b_{2i} \Delta x_{t-i} + \sum_{i=1}^k c_{2i} \Delta y_{t-i} + u_{2t} \quad (2)$$

To see whether Δx Granger causes Δy the null hypothesis $H_0: b_{11} = b_{12} = \dots = b_{1k} = 0$ was tested using a likelihood-ratio test with respect to equation (1). Similarly, the testing of null hypothesis $H_0: c_{21} = c_{22} = \dots = c_{2k} = 0$ in equation (2) would establish whether Δy Granger causes Δx . The null hypothesis is tested using a likelihood ratio statistic that follows a χ^2 distribution with k degree of freedom.

Data Set Used in the Study

Date	TB	SENSEX	FII	CALL	SPOT	PREM	CD
1993M1	9.24	2532.86	0.56	10.95	30.88	-	15.00
1993M2	9.96	2708.72	0.29	10.25	32.65	-	15.11
1993M3	10.75	2398.27	3.42	11.58	31.53	10.74	14.67
1993M4	9.73	2205.37	4.71	11.62	31.31	9.43	14.88
1993M5	9.62	2248.02	41.39	6.58	31.33	7.76	14.25
1993M6	9.93	2281.95	95.94	5.93	31.41	6.65	14.00
1993M7	9.77	2190.34	148.54	5.43	31.37	5.46	13.81
1993M8	9.21	2556.16	298.67	4.75	31.37	2.55	12.53
1993M9	8.73	2708.39	166.76	4.58	31.37	2.45	11.50
1993M10	8.13	2688.57	195.27	5.52	31.37	4.37	11.21
1993M11	8.28	2850.35	1087.27	5.93	31.37	3.30	11.13
1993M12	7.99	3301.85	565.30	5.05	31.37	3.54	10.43
1994M1	7.95	3813.72	1233.60	5.70	31.37	1.31	11.68
1994M2	8.26	4039.42	787.13	5.23	31.37	0.23	10.44
1994M3	7.27	3811.25	820.00	3.95	31.37	0.86	9.55
1994M4	7.18	3824.75	525.39	4.83	31.37	1.65	9.71
1994M5	7.38	3756.10	882.00	6.25	31.37	2.13	9.63
1994M6	8.14	4135.67	816.37	7.28	31.37	2.33	9.63
1994M7	8.74	4106.95	328.24	5.90	31.37	2.38	10.15
1994M8	8.01	4407.40	424.65	6.17	31.37	1.35	10.06
1994M9	8.40	4511.34	442.94	16.25	31.37	1.95	10.32
1994M10	8.59	4351.16	544.29	8.03	31.37	2.79	9.88
1994M11	8.37	4139.06	61.88	8.30	31.39	3.12	9.88
1994M12	9.49	3949.78	26.16	8.88	31.39	4.26	9.88
1995M1	10.71	3651.59	232.32	14.43	31.37	5.47	10.33
1995M2	11.25	3474.92	293.10	13.65	31.38	6.74	11.51
1995M3	11.78	3408.29	199.26	14.30	31.65	6.89	11.83
1995M4	11.74	3359.29	186.58	11.28	31.41	7.52	12.06
1995M5	11.97	3206.09	203.03	13.27	31.42	6.30	12.50
1995M6	12.42	3336.46	360.37	13.74	31.40	5.90	12.88
1995M7	12.81	3334.86	647.88	12.24	31.38	5.39	12.94
1995M8	12.55	3402.81	548.19	9.76	31.58	3.44	13.13
1995M9	12.54	3396.37	410.18	11.55	33.20	3.99	12.46
1995M10	12.73	3528.10	320.98	15.26	34.54	10.05	12.88
1995M11	12.96	3172.02	191.45	26.93	34.74	17.21	15.50
1995M12	12.97	3060.05	412.60	17.02	34.96	14.42	17.50
1996M1	12.95	2979.30	738.50	15.55	35.74	13.98	15.50
1996M2	12.97	3405.56	1619.43	13.31	36.63	20.66	16.38
1996M3	12.97	3327.33	1092.29	26.24	34.39	27.06	16.88
1996M4	12.65	3599.66	1471.34	10.67	34.24	15.57	16.75
1996M5	12.35	3732.20	1033.13	10.82	35.01	14.00	16.00
1996M6	12.40	3906.72	1046.30	10.73	34.98	11.44	15.69
1996M7	9.89	3668.21	879.93	5.10	35.51	7.34	15.19
1996M8	9.02	3449.17	150.09	6.01	35.70	8.83	13.42
1996M9	10.01	3390.11	373.24	7.68	35.73	8.95	12.69
1996M10	9.70	3159.79	404.37	8.76	35.64	6.58	13.25
1996M11	7.44	3044.28	402.91	6.72	35.74	6.98	12.50
1996M12	8.09	2918.68	423.37	4.77	35.84	7.56	12.00
1997M1	7.97	3410.30	343.23	5.82	35.87	6.95	12.00

Contd..

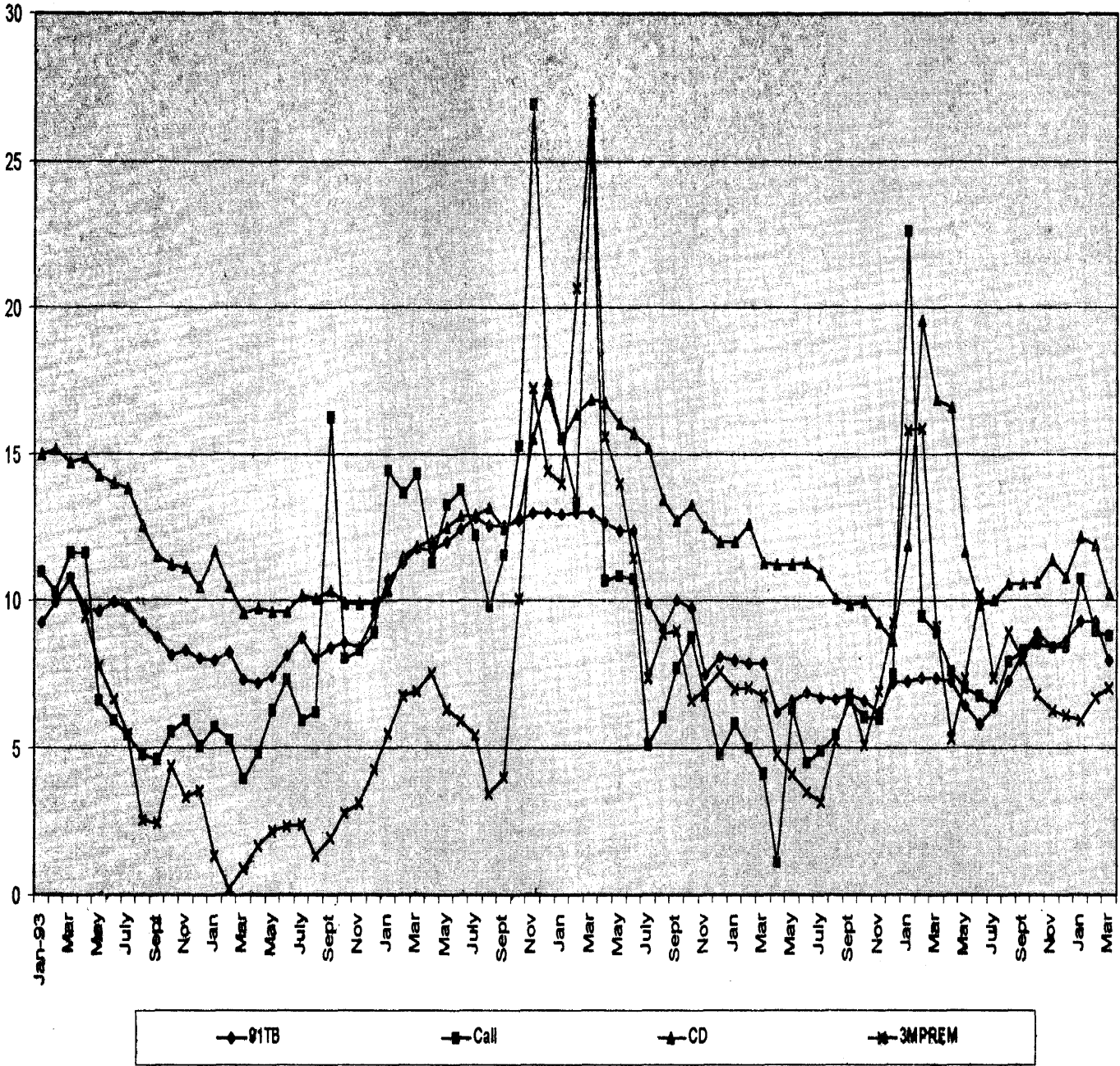
Date	TB	SENSEX	FII	CALL	SPOT	PREM	CD
1997M2	7.85	3453.24	424.97	4.98	35.89	6.99	12.60
1997M3	7.87	3762.52	491.20	4.08	35.87	6.72	11.25
1997M4	6.21	3681.50	624.85	1.13	35.81	4.74	11.19
1997M5	6.59	3740.95	888.97	6.32	35.81	4.11	11.19
1997M6	6.85	4001.47	1404.08	4.48	35.81	3.47	11.25
1997M7	6.67	4256.11	1003.01	4.84	35.74	3.13	10.86
1997M8	6.60	4276.31	501.36	5.44	35.92	5.19	10.08
1997M9	6.80	3944.79	598.59	6.58	36.43	6.82	9.81
1997M10	6.60	3991.75	644.40	6.01	36.23	5.08	9.94
1997M11	6.22	3611.83	-293.82	5.98	37.24	6.90	9.25
1997M12	7.16	3515.54	-182.80	7.47	39.22	9.22	8.63
1998M1	7.23	3472.87	-373.38	22.58	39.38	15.82	11.88
1998M2	7.33	3413.49	627.56	9.43	38.89	15.85	19.56
1998M3	7.33	3816.87	471.48	8.90	39.50	9.10	16.86
1998M4	7.24	4114.66	167.75	7.55	39.66	5.31	16.56
1998M5	6.39	3911.95	-559.49	7.03	40.47	7.37	11.63
1998M6	5.80	3317.49	-897.49	6.74	42.24	10.23	9.85
1998M7	6.36	3271.73	104.67	6.40	42.51	7.34	10.01
1998M8	7.24	2988.40	-409.90	7.92	42.76	8.87	10.56
1998M9	8.24	3089.88	95.03	8.31	42.52	7.95	10.53
1998M10	8.87	2866.55	-566.90	8.50	42.33	6.80	10.63
1998M11	8.41	2912.39	43.42	8.38	42.38	6.24	11.36
1998M12	8.61	2945.99	306.95	8.42	42.55	6.10	10.75
1999M1	9.29	3275.05	360.35	10.75	42.51	5.93	12.14
1999M2	9.26	3289.24	349.96	8.94	42.47	6.69	11.89
1999M3	7.95	3689.42	197.76	8.78	42.45	6.99	10.20

Description of Variables

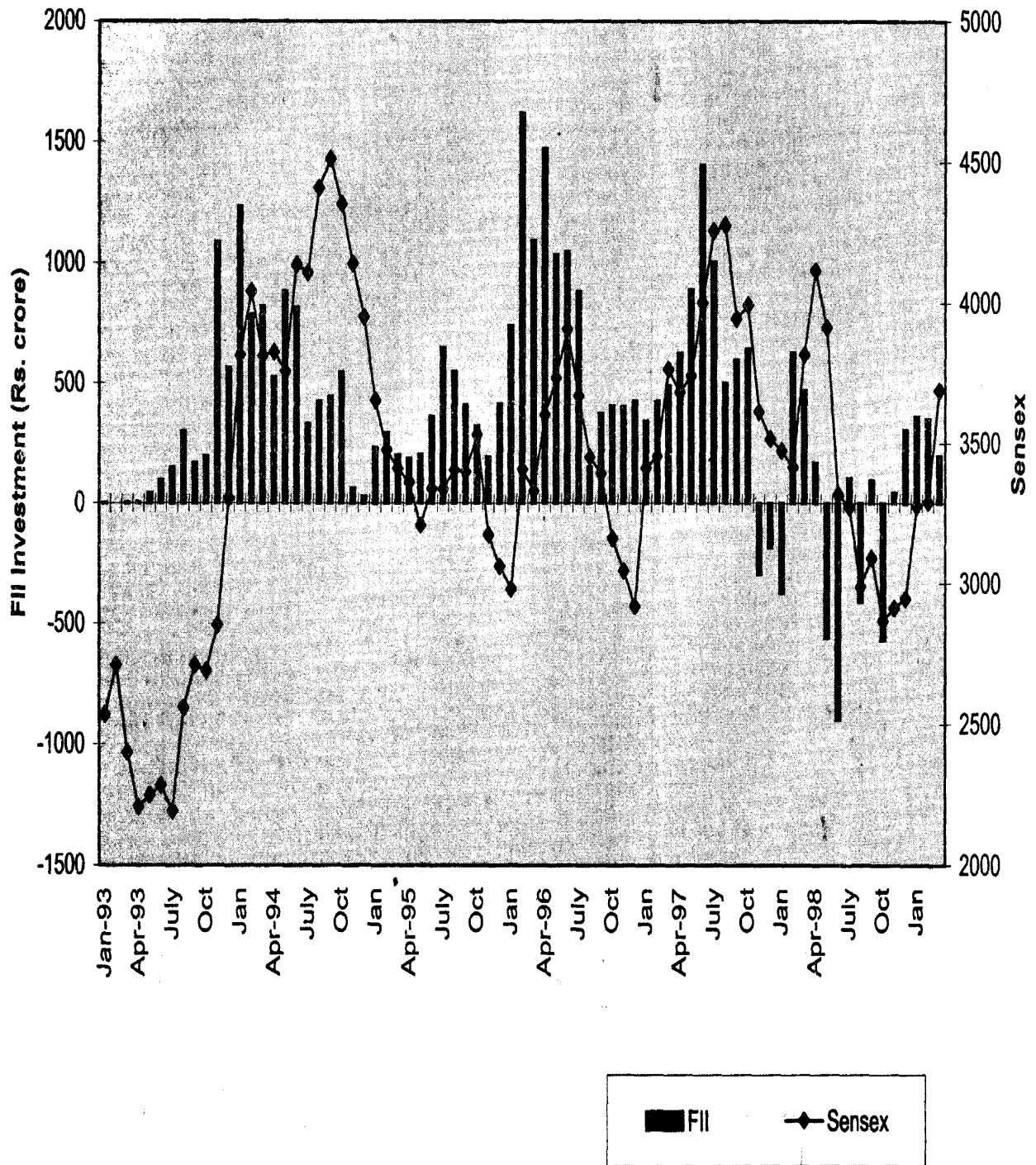
- TB** - Monthly average yield of 91-day treasury bill in the Primary Market (per cent).
- CALL** - Monthly average call money rate (per cent).
- PREM** - Monthly average of premium on three month forward US\$ (per cent)
- SPOT** - Monthly average of spot rate of US\$ (Rs./US\$).
- FII** - Net monthly investment by foreign institutional investors (FII) in Indian equity market (Rs. Crore).
- SENSEX** - Monthly average of 30-scrip BSE Sensitive index (Base: 1978-79=100)
- CD** - Monthly average of interest rate on certificate of deposit issued by scheduled commercial banks (per cent).
- Note** : In case of CD and CALL, average of fortnightly maximum and minimum was taken. Monthly average was then calculated as simple average of relevant fortnightly averages. In case of TB, monthly average was calculated as average of weekly yield at cut-off price.

Graph 1 : Movement of Short-term Interest Rates
(Jan 1993 to March 1999)

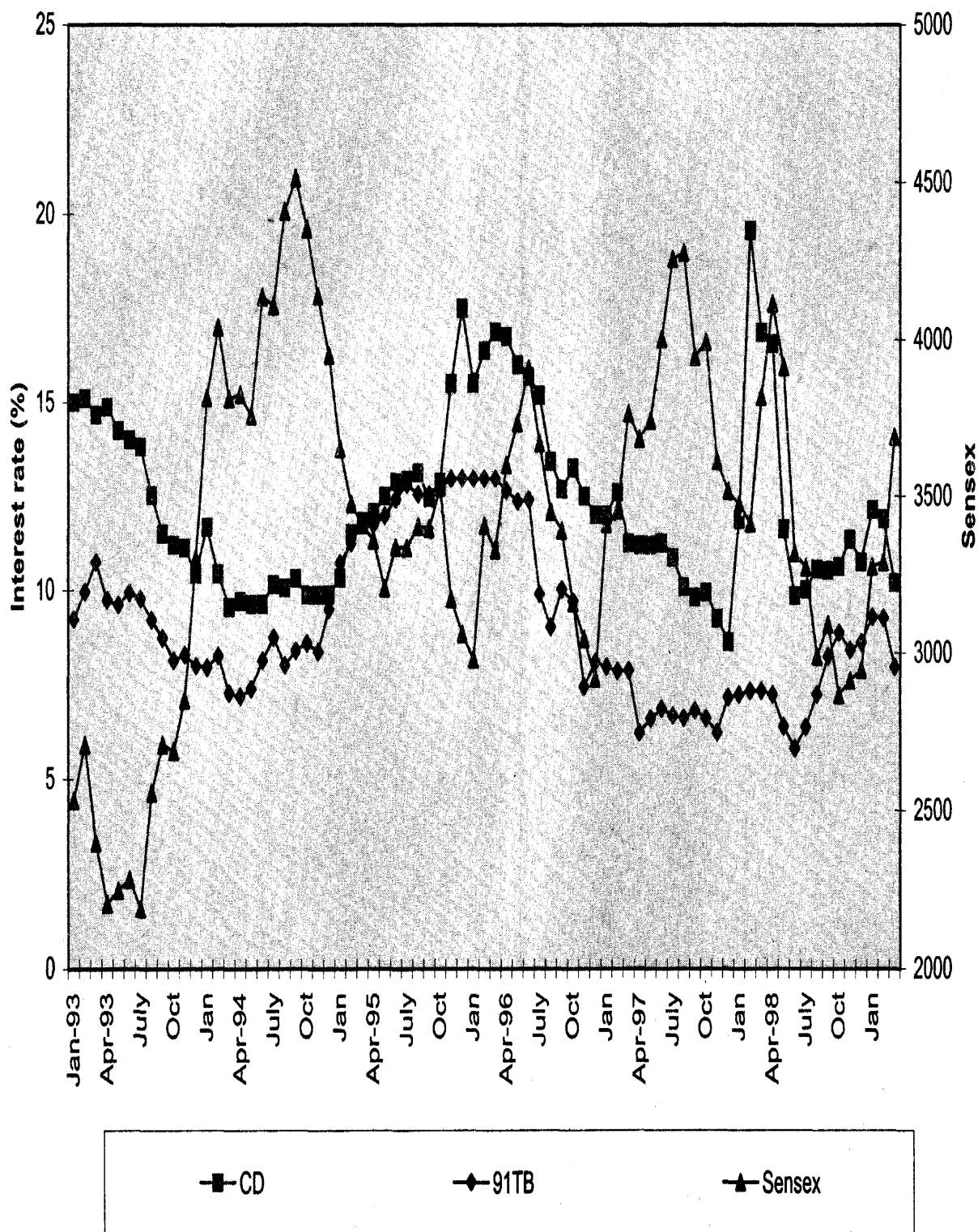
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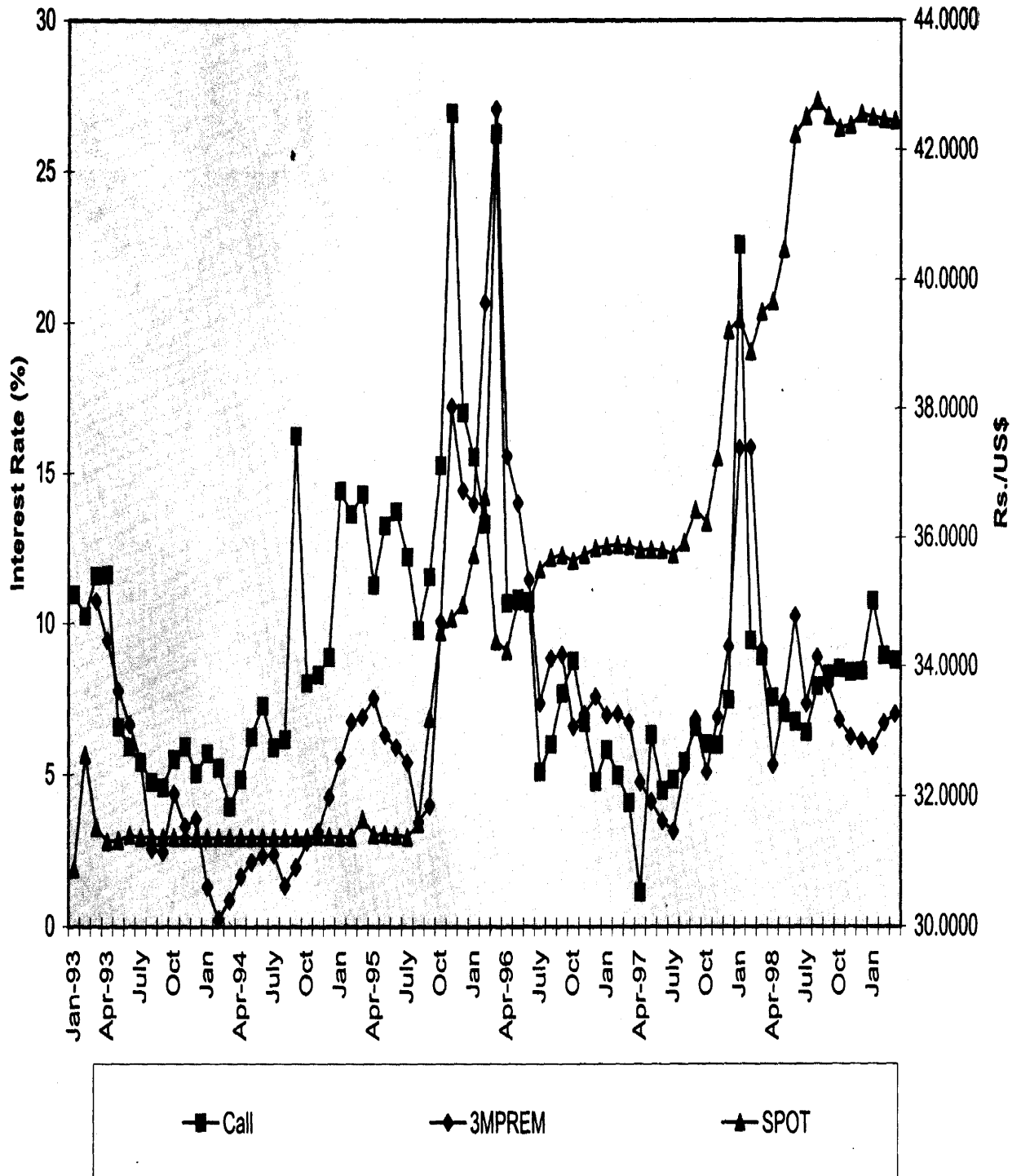
Graph 2: Movement of BSE Sensex and FII Investment
(Jan 1993 to March 1999)



Graph 4: Movement of BSE Sensex, Interest rates on 91 Day Treasury Bill (91TB) and Certificate of Deposits(CD)- (Jan 1993 to March 1999)



Graph 3: Movement of Exchange rate (US\$ Spot), Forward Premium (3 Months) and Call Money rate (Jan 1993 to March 1999).



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