Integration of Financial Markets in India: An Empirical Evaluation

B.K. Bhoi & S.C. Dhal*

This paper attempts to empirically evaluate the extent of integration of India's financial markets in the post-liberalisation period. The major findings of the paper are the following: a) although fully competitive environment is yet to emerge, several segments of the financial market have achieved operational efficiency; b) the 91-day Treasury Bill rate has the potential to emerge as a reference rate in the Indian context; c) India's financial markets are getting increasingly integrated at the short-end of the market, such as, money market, credit market, Government securities market since April 1993. However, capital market is least integrated with the rest of the financial sector; d) there are early indications about integration of money market and forex market. However, integration of domestic and overseas financial markets is not robust.

Introduction

India's financial sector was regulated for a long period. Interest rates were administered. Deployment of credit was largely directed by the authorities. Banks were the captive subscribers to the Government securities under statutory arrangement. The secondary market of Government securities was dormant. Both the money and capital markets were underdeveloped. Foreign exchange market was extremely thin, mainly due to stringent restrictions under Foreign Exchange Regulation Act (FERA). Moreover, the basket-linked exchange rate was administered and the financial markets stood segmented. Although financial sector grew considerably in the regulated environment, it could not achieve the desired level of efficiency. The weaknesses of India's financial markets were recognised in the *Report of the Committee to Review the Working of the Monetary System* (Chairman, S. Chakravarty, 1985). Subsequently, Vaghul Working Group (1987) examined in detail the problems of Indian money market and recommended several remedial measures.

A comprehensive package of reform measures recommended by the Narasimham Committee in 1991[1] became the starting point of gradual deregulation of the financial sector. The reform process since then has rolled forward in several directions. An important objective of reform has been to develop the various segments of the financial market into an integrated one, so that their inter-linkages can reduce arbitrage opportunities, help achieve higher level of efficiency in market operation and increase the effectiveness of monetary policy in the economy. Some of the precise policy reforms pursuing these objectives have been the gradual process of dismantling of various price and non-price controls in the financial system, developing and strengthening an active market for government securities, and putting in place an appropriate institutional and legal system that would supervise various segments of financial market operations. During the past six years, significant progress has been achieved in terms of policy and institutional reforms. A question that needs to be addressed is: how far have these initiatives resulted in narrowing the inter-market divergences and achieved a reasonable degree of market integration? This paper looks at the issue from an empirical perspective and attempts to provide some evidence on market integration in India.

The rest of the paper is structured as follows: Section I deals with certain conceptual issues relating to the integration of financial markets and factors contributing to such integration. Section II outlines the design of the empirical analysis. Section III examines the behaviour of interest rates/returns pertaining to the alternative markets, and draws inferences on the efficiency

of each segment. The extent of market integration is studied in Section IV. Section V offers concluding observations.

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* Dr. B.K. Bhoi is Director, and Dr. S.C. Dhal is Research Officer in the Department of Economic Analysis & Policy of the Bank. Authors express their deep sense of gratitude to Dr. A. Vasudevan, Executive Director for giving a number of meaningful suggestions on the earlier version of the paper. The views expressed in the paper are those of the authors only.

Section I

Conceptual Issues

Financial sector plays a crucial role in promoting overall growth of the economy. This has been recognised extensively in the literature since the early 1970s[2]. Precisely, a well-developed financial sector performs the following important functions:

(a) it promotes overall savings of the economy by providing alternative instruments;

(b) it allocates resources efficiently among the sectors; and

(c) it provides an effective channel for the transmission of policy impulses.

While the first two issues relating to promotion of savings and allocative efficiency are important, given the scope of this study, we, however, concentrate on the third issue. The financial sector can be used as an effective channel for the transmission of policy impulses provided the financial markets are competitive, efficient and integrated. A typical competitive financial market has the following characteristics:

(a) there should be large number of buyers and sellers of the financial product;

(b) the price of the product is determined by the market forces of demand and supply;

(c) there should be a secondary market for the instrument;

(d) turnover of the instruments in both primary and secondary markets should be fairly large; and

(e) agencies involved in the process of intermediation between buyers and sellers should provide intermediation services at a minimum spread.

The efficiency of a market has been discussed in the literature at various levels of sophistication. In simple language, a market is said to be efficient if the rate prevailing at any point of time contains all information about the market. If the realised rate contains all information, then the future rate cannot be appropriately predicted. In fact, the future rate may move either way; it can go up, remain steady, or it can go down depending on the information that would be available at that point of time. In other words, the future rates may adapt a path of

random walk. There are several technical methods of studying the random walk hypothesis which are not discussed here[3]. However, one can verify the random walk hypothesis simply by plotting the changes in the rate against time. If the rate variables follow random walk, one would expect the changes in rate variables to move around zero over a period of time. In other words, changes in the interest rates are stationary around a mean, which may be zero or close to zero.

Apart from efficiency of individual markets, effective integration of financial markets depends on a few characteristics such as:

(a) financial markets are efficient and the rates are market determined;

(b) across-the-board differences in returns on the financial products are based on the risk and maturity profile of the instruments;

(c) the rates or returns are related to a benchmark-rate or a reference rate;

(d) there is free flow of resources from one segment of the market to the other and thereby the arbitrage opportunity is wiped out; and

(e) the rates of various segments of the financial sector move in tandem.

If a financial market is competitive, it is also efficient but an efficient market may not necessarily be competitive. Moreover, if all the segments of a financial sector are competitive, there is a greater probability that they are fairly integrated. It may be difficult to achieve competitive conditions in all the segments at a particular point of time. Nevertheless, there could be high degree of integration among the segments provided the markets are at least efficient.

Since an integrated financial market facilitates monetary transmission process (Vasudevan and Menon 1978), several developing countries have undertaken reform measures especially to remove government-induced controls on allocation of credit and interest rate variables. In India too, a large number of measures have been undertaken in the process of financial liberalisation during the 1990s[4]. The overall package of structural reforms in India has been designed to enhance the productivity and efficiency of the economy as a whole and thereby make the economy internationally competitive. It is, therefore, logical to expect that the whole gamut of structural reform measures have contributed directly or indirectly to the reduction of market segmentation in India. These reforms include, *inter alia*, deregulation of interest rate; reduction of pre-emptions of resources from the banks through CRR and SLR; issue of government securities at market related rates; increasing reliance on the indirect method of monetary control; participation of the same set of players in the alternative markets; move towards universal banking; development of secondary markets for several instruments, particularly Government securities; dilution of Foreign Exchange Regulation Act (FERA); convertibility of rupee in the current account; cross-border movement of capital and world-wide acceptance of the flexible exchange rate; and investors' protection and curbing of speculative activities through wide ranging reforms in the capital market.

Section II

Design of the Empirical Analysis

India's financial sector can be broadly divided into organised and unorganised markets. Due to paucity of reliable data/information, it is not possible to study the behaviour of the unorganised financial markets in India. There is, however, a general belief that activities in the unorganised markets are on the decline. It is also claimed that the activities in the unorganised sector may shrink further if a high degree of integration of the organised financial markets is achieved.

Organised financial markets can be further classified into two categories - short-term and long-term. The notable segments within the short-term category are: (a) Money Market; (b) Credit Market; (c) Gilt Market and (d) Forex Market. Within the long-term category, the important segments are: (i) Equity and Term Lending Markets; (ii) Corporate Debt Market; (iii) Pension Funds Market; (iv) Insurance Market; (v) Housing Finance Market, (vi) Mutual Funds Market and (vii) Hire Purchase and Leasing Finance Market. It is, however, difficult to obtain high frequency data on several of these markets and particularly term lending, PSU bonds/debenture, insurance funds, pension funds, hire purchase and leasing and mutual funds. On the basis of data availability, we identify Money Market, Credit Market, Government Securities Market, Capital Market and Forex Market for the purpose of testing of market integration hypothesis.

The instruments available for transaction in both the short-term and long-term markets are given in Table 1. On the basis of the availability of monthly data, we have chosen at least two rates from each market. The set of variables includes call money rate (CMR), certificates of deposits rate (CDR), commercial paper rate (CPR), deposit rate (DRT), lending rate (LRT), 91-day Treasury bill rate (G91), 364-day Treasury bill rate (G364), return on capital (RE) consisting of capital gains and dividend yields, price-earning ratio (PERN) of 100-scrip National Index, 3-month forward premium (FRWD3), 6-month forward premium (FRWD6) of the US dollar and the US Treasury bill rate (USTB). The paper examines the movement of monthly rates/returns covering 60 months from April 1993 to March 1998 which excludes first two years of reforms i.e., 1991-92 and 1992-93 due to extreme volatility of rates noticed during those two years on account of problems related to transition. We conduct various tests, including time series analysis to collate evidence on the inter-linkages among various markets and examine whether there could exist significant degree of integration among these markets.

Table 1: List of Instruments

A: Short-term Instruments (Up to one-year maturity)

1. Call Money/ Notice Money / Term Money

2. Certificates of Deposit

3. Commercial Papers

4. Participation Certificates

5. Money Market Mutual Fund Units

6. Credit Market: Deposit & Credit

7. Treasury Bills of various maturities

8. Repurchase Agreements

9. Forex Trading Instruments: Spot, Swap

B: Long-term Instruments (More than one-year maturity)

1. Dated securities of Central & State Governments

2. Special Government securities like Zero Coupon Bonds, Deep Discount Bonds, Tap Stocks, Partly Paid Stocks, Floating Rate Bonds, Capital Index Bond, etc.

3. PSU Bonds

4. UTI Units

5. Mutual Fund units under various Schemes

6. Equities

7. Preference Shares

8. Debentures (convertible, partly convertible, non-convertible)

9. Special instruments, such as, Zero Coupon Bonds, Deep Discount Bonds, Floating Rate Notes, etc., issued by PSUs and Private Sector Units

10. Fiscal incentive induced instruments, such as, NSC, NSS, Indira Vikas Patra, PF, Tax Free PSU Bonds, etc.

Section III

Market Efficiency and Reference Rate Analysis

Most of the empirical studies on integration of financial markets focus on the operating efficiency rather than the allocative efficiency indicator of the financial market [Cole *et al*. 1997]. In the case of operating efficiency, the basic line of argument is whether interest rates of important money market instruments move together with a reference rate. There are several

alternative empirical approaches to quantify the operating efficiency. The elementary way of addressing such an issue is the simple measure of correlation coefficient. However, the statistical correlation coefficient as a measure of market efficiency has been rejected recently in view of non-stationary nature of rate variables. In this context, the time series tools, especially unit root test and co-integration analysis, have proved to be an important framework for analysing market efficiency.

The empirical cointegration exercise entails that one should first identify a reference rate. Theoretically, a reference rate is defined as the price of a short-term low risk instrument in a free liquid market. Usually, a reference rate is chosen among the class of short term interest rates prevailing in the money or gilt market. In addition to these characteristics, it should be statistically well behaving and satisfy certain regularity conditions consistent with the theoretical implications. First, it should follow a random walk process that is consistent with the efficient market hypothesis. In an efficient market, all relevant information pertaining to demand and supply conditions prevailing in the market are supposed to be fully utilised and thus the rate variable follows a random walk process. Secondly, the first difference of the reference rate should exhibit a pattern similar to Gausian distribution i.e., independently and identicallly distributed (i.i.d.) process. This criterion is very important in determining a reference rate when several rate variables are characterised by unit root, and their first differences are also stationary process. Indeed, in practice, a number of statistical properties of interest rates including unit root, and a set of stylised facts i.e., mean, standard deviation, skewness and kurtosis measures are simultaneously taken into consideration while identifying a reference rate.

Market Efficiency

One simple and convenient way to analyse market efficiency is to plot the first difference of the rate variables. Graph 1 shows the changes in interest rates under consideration. Most of the rates moved around zero mean, except return on capital, price-earning ratio and to some extent call rate (Panel 1). The mean cannot be close to zero for these variables. Hence, capital market and call money market seem to have not achieved desired level of efficiency. If these rates are dropped (as shown in Panel 2), the variations in other rates move around zero thus supporting the efficient market hypothesis. These evidences, however, need to be put to more rigorous tests. We conduct Phillips-Perron test to verify if the rates have unit roots (Table 2). The results from Phillips and Perron (PP) unit root test indicate that interest rate variables (excluding call rate) are, indeed, non-stationary and have unit root. Given the fact that call rate has exhibited large volatility, we used a 3-month moving average series of call rate (CMR3) which is found to be an I(1) series.

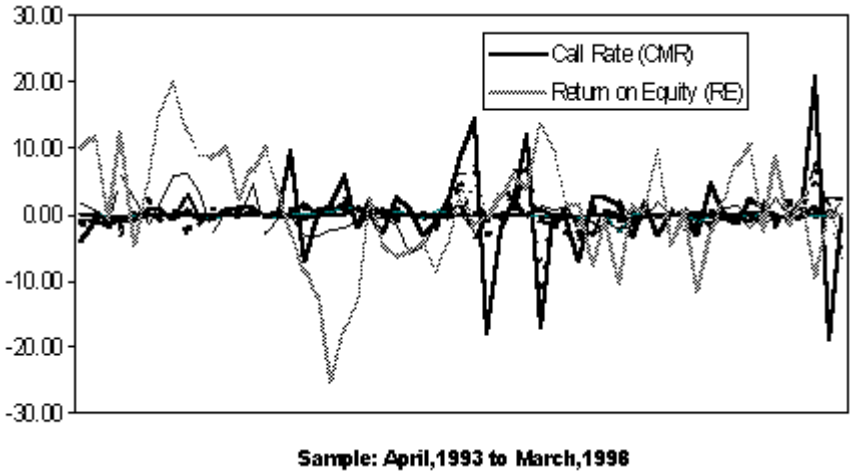
Table 2 : Phillips-Perron Unit Root Test

Variables	Level Form (-2.86)	First Difference (-3.41)
G91	-1.05	-8.04
G364	-0.4	-7.24
CDR	-1.94	-7.64
CPR	-2.61	-7.08
CMR	-4.15	-12.33

CMR3	-1.72	-12.33
DRT	-2.16	-8.32
LRT	-2.29	-7.23
PERN	-0.53	-4.89
PERS	-0.63	-5.48
RE	-1.81	-4.05
RDR	0.31	-6.68
FR3	-2.37	-6.13
FR6	-2.03	-6.02
USTB	-2.16	-5.32

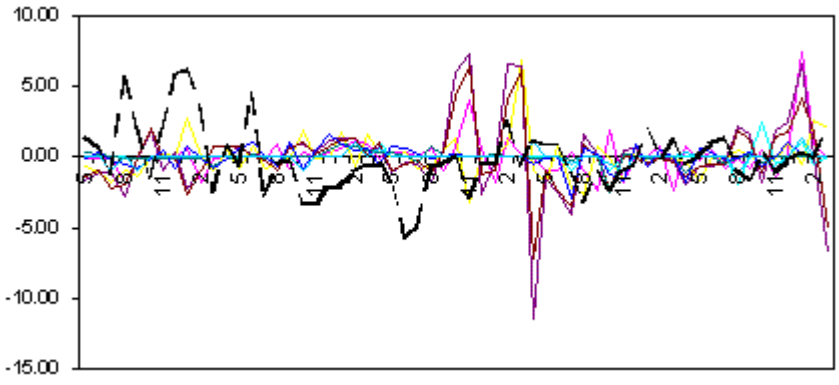
Note : Figures in brackets indicate critical value at 5 per cent level of significance.

Graph 1 : First Differences of Interest Rates
Panel 1



Sample: April,1993 to March,1996

Panel 2 First Differences of Interest Rates
(without call money and return on equity)



In order to ascertain whether any short-term rate has the potentiality to emerge as a reference rate, the basic statistics of various rates in their first difference form have been

analysed in Table 3.

Table 3 : Basic Statistics of Various Rates (First Difference)

Series	Mean	SD	SK	Kts	JB
G91	-0.04	0.75	-1.17	2.95	34.28
	(0.01)	(0.63)	(-0.45)*	(0.75)*	(0.00)
G364	-0.06	0.45	-2.80	13.98	557.55
	(-0.02)	(0.28)	(-0.92)	(3.88)	(41.60.)
CMR	0.01	6.25	-0.30	-3.95	39.24
CMR3	0.10	2.28	0.84	4.15	49.28
	(0.17)	(1.70)	(1.71)	(5.74)	(114.00)
CDR	0.06	1.44	2.56	11.68	399.82
CPR	-0.04	1.48	1.72	7.33	161.17
DRT	-0.01	0.55	0.86	9.49	228.67
LRT	-0.05	0.43	-0.20	2.88	20.17
RDR	0.13	0.56	-0.01	6.57	106.11
FRWD3	0.14	2.83	-0.34	4.84	58.72
FRWD6	0.12	2.15	0.26	2.89	21.20
RE	0.57	8.69	-0.37	0.25	1.50
PERN	-0.26	2.33	0.66	1.24	8.06

Note : Figures in the brackets refer to summary statistics after 1 per cent trimming of the series. In case of G91, the skewness (SK) and kurtosis (Kts.) measures are not significantly different from zero.

Going by the basic features of a typical reference rate, the choice of reference rate boils down to the choice between G91and G364. Table 3 shows that standard deviation of G364 is somewhat smaller than G91. However, in terms of skewness and kurtosis measures, G91 has an edge over the G364. The JB test statistics based on skewness and kurtosis measures of first difference series indicates that none of the series could pass through normality assumption i.e., the series could not be approximated as an independently and identically distributed (i.i.d.) process. Interestingly, the JB tests carried out on the basis of skewness and kurtosis measures after adjusting the series for extreme values (trimmed by 1 per cent) indicate that G91 is an i.i.d. process but not G364. In the case of G364, the extreme values need to be trimmed by as much as

10 per cent so as to arrive at an i.i.d. process. Thus, G91 could qualify as a reference rate[5].

Causal Analysis

Although some of the stylized statistics enable us to identify a reference rate among a class of short-term rates, this is not a sufficient condition to derive meaningful inferences on the integration of financial markets. The sufficient condition requires that the chosen reference rate should substantially induce changes in several other rate variables. In other words, the causal relationship and the size of long-run elasticity are important facts for any meaningful study of integration of different segments of the financial market. Accordingly, Granger's causal analysis was carried out within a bi-variate framework. The results of 'F' tests as reported in Table 4 indicate that there is bi-directional causality between G91 on the one hand and money market rates (CDR, CPR and CMR3) on the other. The bi-directional causality can be established between call rate (CMR3) and CDR. Between call money rate and commercial paper (CPR), a unidirectional causality is identified, but this occurs at a higher level of significance. Between CDR and CPR, the unidirectional causality runs from CDR to CPR implying that the banks treat certificate of deposits as cost of funds while investing in CPR.

In the credit market, bi-directional causality could be established between DRT and LRT, although, at a 10 per cent level of significance. The causality between gilts and credit market revealed that G91 causes DRT uni-directionally. The causality between LRT and G91 is, however bi-directional. When call rate is taken, it causes DRT and LRT uni-directionally.

In case of exchange market, causal link runs bi-directionally between call rate and forward premia. The same pattern of causal link could also exist between gilts and forward premia but at a higher level of significance. Finally, no causal link could be established between capital market and money and credit market.

Table 4 Granger's Causality

	F TEST	SIGNIFICANCE LEVEL
CDR-G91	3.45	A
G91-CDR	2.81	B
CPR-G91	5.92	A
G91-CPR	3.98	A
CMR3-G91	5.52	A
G91-CMR3	4.82	A
G364-G91	7.36	A
G91-G364	2.89	A
FRWD3-G91	2.58	B
G91-FRWD3	2.18	B
FRWD6-G91	2.58	B
G91-FRWD6	2.21	B
DRT-G91	5.11	A
G91-DRT	1.26	NS
LRT-G91	3.28	A
G91-LRT	2.45	B

DRT-LRT	2.10	B
LRT-DRT	2.33	B
CPR-CDR	1.98	B
CDR-CPR	0.15	NS
CDR-CMR3	13.10	A
CMR3-CDR	3.91	A
CPR-CMR3	7.30	A
CMR3-CPR	1.39	NS
DRT-CMR3	3.26	A
CMR3-DRT	0.48	NS
LRT-CMR3	2.36	B
CMR3-LRT	0.90	NS

Note : 'A' & 'B' indicate level of significance at 5 per cent and 10 per cent, respectively. 'NS' is not significant at the usual 1 or 5 per cent levels.

Section IV

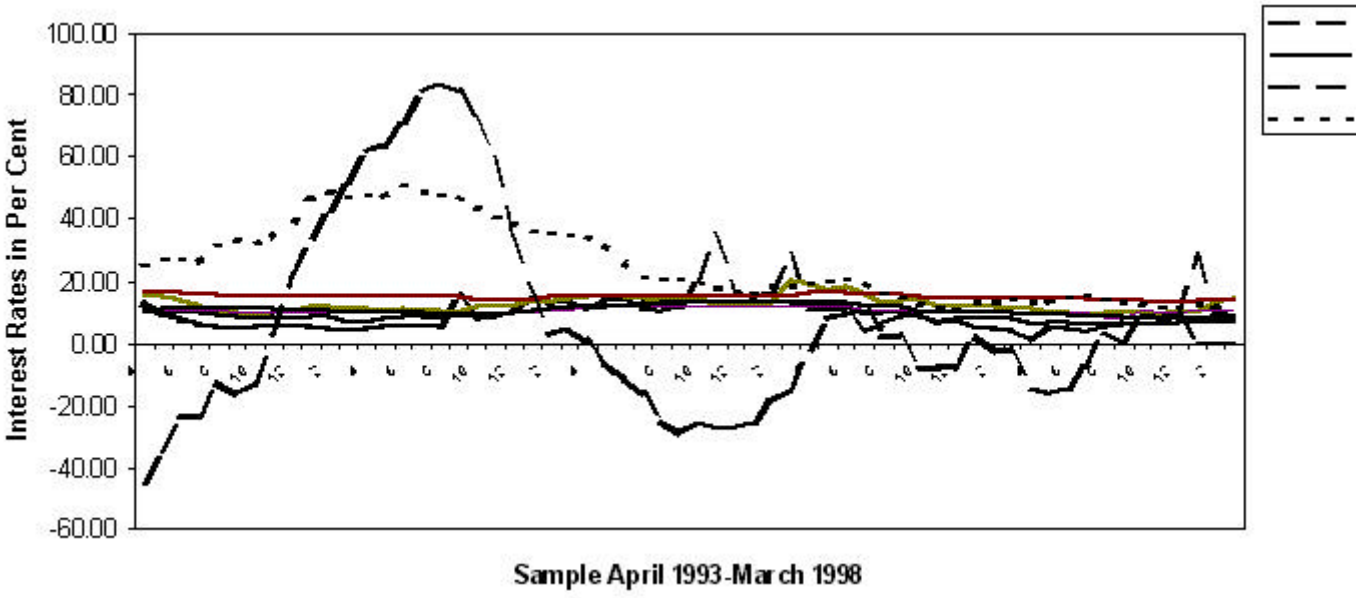
Integration of Markets

The overall integration of the financial markets can be seen from Graph 2. Excepting return on capital, price-earning ratios and (to some extent) call money rate, all other rates under consideration moved in tandem. The degree of co-movement seems to have increased since 1996. *Prima facie*, one can expect that capital market is least integrated with the other segments. The variability of the series under consideration measured by standard deviation as shown in Table 5 supports this observation. It is evident from the Table that the variability is the highest in the case of return on capital, followed by price earning ratio and call money rate. Thus, the two extreme ends of the financial markets i.e., the long and the short ends are relatively more volatile.

Table 5: Mean and Standard Deviation of Various Rates

Series	Mean	Standard Deviation
1	**2**	**3**
CALL	9.55	6.06
CDR	12.38	2.28
CPR	12.83	2.45
DRT	10.66	1.00
LRT	15.21	0.80
G91	9.69	2.17
G364	11.06	1.46
RE	6.45	33.26
PERN	27.20	12.71
FRWD3	6.67	5.17
FRWD6	6.93	4.61

Graph 2 : Interest Rate Movement in the Post Reforms Period in India



Another way of looking at the integration of financial markets is to examine the cross-correlation coefficients (Table 6). Broadly speaking, the cross correlation coefficients give us the degree of association of various rates. As is evident from Table 6, return on capital and price earning ratios are moving almost in the opposite direction compared to those for other rate variables. All other rates display positive correlation among them, indicating varying levels of co-movement.

Table 6 : Cross-Correlation Coefficients

	Call	CDR	CPR	DRT	LRT	G91	G364	RE	PERN	FRWD3	FRWD6
Call	1	0.58	0.39	0.57	0.15	0.62	0.40	-0.27	-0.16	0.70	0.65
CDR		1	0.59	0.69	0.54	0.60	0.59	-0.57	-0.47	0.82	0.85
CPR			1	0.70	0.61	0.75	0.71	-0.25	-0.10	0.53	0.59
DRT				1	0.64	0.85	0.80	-0.44	-0.20	0.54	0.58
LRT					1	0.61	0.77	-0.28	0.09	0.19	0.26
G91						1	0.89	-0.35	-0.05	0.49	0.52
G364							1	-0.46	-0.21	0.62	0.65
RE								1	0.77	-0.49	-0.50
PERN									1	-0.53	-0.58
FRWD3										1	0.99
FRWD6											1

Partial Adjustment Analysis

The most conventional analysis of degree and speed of integration of different segments of financial market is the partial adjustment model that enables us to derive the long-run elasticity and mean lag response of the rate variables with respect to a reference rate. In the

partial adjustment model, the size of the lagged dependent variable indicates the speed of market adjustment and the long-run elasticity and mean lag response indicates the nature of comovement between the rate variables. The estimated results are reported in Table 7. The estimates of long-run elasticity measure (**F1**) indicate that most of the money market rates have high elasticity with respect to G91 as compared to CMR3. The mean lag response (**F2**) varies from 1 to 3 months when G91 is taken as independent variable compared to 3 to 6 months in case of call rate, thus indicating fairly quick speed of adjustment with respect to G91. In all the cases, the Wald restriction of zero elasticity can be rejected. However, unit elasticity of money market rates, CDR and CPR, with respect to G91 could not be rejected. In case of call rate, although the long-run elasticity coefficient seems to be high or close to unity, the Wald restriction, however, rejects this hypothesis. Thus, most of the short term rates have substantial relationship with the G91. The value of the lagged dependent variable of the partial adjustment model turned significantly different from zero and reflected the low degree of adjustment in the market. The estimated coefficient indicated that, on an average, interest rates in other markets adjust about 30 per cent within a month with reference to call rate and about 40 per cent with reference to G91. Thus, the speed of adjustment is not very high in the Indian context.

Table 7.1 : Partial Adjustment Model
Y = F[Y{1}, G91, G91{1}]

REGRESSORS	CDR	REGRESSORS	CPR	REGRESSORS	CMR
CONSTANT	1.38	CONSTANT	1.79	CONSTANT	0.81
	(1.92)		(2.31)		(0.54)
CDR(-1)	0.56	CPR(-1)	.61	CMR3(-1)	0.89
	(7.51)		(4.92)		(9.78)
G91	-0.062	G91	0.37	G91	0.65
	(-0.34)		(2.93)		(2.18)
G91(-1)	0.48	G91(-1)	-0.05	G91(-1)	-0.61
	(2.415)		(-0.24)		(-1.90)
$\overline{R}^2$ / DW	0.84, 1.91	$\overline{R}^2$ / DW	0.73, 1.90	$\overline{R}^2$ / DW	0.82, 1.54
F1	0.93		0.86		1.31
	(6.59)		(4.30)		(2.70)
F2	2.40		1.40		0.50
	(4.36)		(1.81)		(1.85)
F2=0, F2=1	43.40, 0.21		18.44, 0.53		5.23, 0.31

REGRESSOR	DRT		LRT		FRWD3	FRWD6
CONSTANT	4.08	CONSTANT	2.57	CONSTANT	-1.49	-0.73
	(4.67)		(2.92)		(-0.65)	(-0.53)
DRT(-1)	0.42	LRT(-1)	.77	FRWD	0.65	0.85
	(3.56)		(11.57)	3/6(-1)	(6.40)	(16.40)
G91	0.14	G91	0.11	G91	0.86	0.74
	(1.74)		(1.63)		(1.85)	(2.84)
G91(-1)	0.08	G91(-1)	-0.02	G91(-1)	-0.45	-0.55
	(0.91)		(-0.30)		(-0.93)	(-2.12)

$\bar{R}^2$ / DW	0.79, 1.83	$\bar{R}^2$ / DW	0.84, 2.01	$\bar{R}^2$ / DW	0.75, 1.85	0.80, 1.66
F1	0.39		0.39		1.20	NS
	(8.35)		(3.71)		(1.76)	
F2	1.08		3.09		0.80	NS
	(2.49)		(2.73)		(0.56)	
F2=0, F2=1	69.071,176.78		13.77, 33.11		3.11, 0.09	NS

Note: Figures in the brackets indicate 't' values. Y is dependent variable.
The models were checked for residual autocorrelation in terms of Durbin's h statistics. In such cases, the models were corrected for serial correlation by using maximum likelyhood method.

Table 7.2 Partial Adjustement Model
Y = F [Y{1}, CMR, CMR{1}]

REGRESSORS	CDR	REGRESSORS	CPR	REGRESSORS	G91
CONSTANT	1.84	CONSTANT	2.51	CONSTANT	0.60
	(2.43)		(2.71)		(1.45)
CDR(-1)	0.72	CPR(-1)	0.72	G91 (-1)	0.88
	(10.56)		(9.25)		(16.38)
CMR3	0.14	CMR3	0.05	CMR	0.06
	(5.37)		(1.54)		(3.34)
CMR3(-1)	0.04	CMR3(-1)	0.06	CMR(-1)	-0.01
	(1.22)		(1.73)		(-0.64)
$\bar{R}^2$ / DW	0.84,2.15	$\bar{R}^2$ / DW	0.72,1.88,0.56	$\bar{R}^2$ / DW	0.91, 2.17
F1	0.62		0.38		0.40
	(4.65)		(3.04)		(2.61)
F2	2.80		3.07		7.42
	(3.46)		(3.20)		(1.94)
F2=0, F2=1	21.63,8.33		9.26, 24.03		6.83, 14.89

REGRESSOR	DRT		LRT		FRWD3	FRWD6
CONSTANT	2.72	CONS-	1.76	CONS-	-0.85	-0.70
	(3.38)	TANT	(2.12)	TANT	(-1.66)	(-1.65)
DRT(-1)	0.70	LRT(-1)	0.86	FRWD	0.76	0.78
	(8.5)		(15.62)	3/6(-1)	(11.15)	(13.83)
CMR3	0.03	CMR3	0.02	CMR3	0.39	0.28
	(2.37)		(1.82)		(8.30)	(7.69)
CMR3(-1)	0.01	CMR3(-1)	0.01	CMR (-1)	-0.12	-0.05
	(1.11)		(0.91)		(-2.06)	(-1.10)
$\bar{R}^2$ / DW	0.76, 2.10	$\bar{R}^2$ / DW	0.83, 2.03	$\bar{R}^2$ / DW	0.87, 1.94	0.90, 2.02
F1	0.15		0.19		1.09	1.08
	(3.61)		(1.95)		(4.73)	(4.75)
F2	2.71		6.62		2.63	3.40

	(2.98)	(2.29)	(2.77)	(2.14)
F2=0, F2=1	13.02, 437.16	3.81, 69.91	22.36, 0.14	22.55, 0.14

Note : Figures in the brackets indicate 't' values. The models were checked for residual autocorrelation in terms of Durbin's h statistics. In such cases, the models were corrected for serial correlation by using maximum likelihood method.

Co-integration Analysis

When several rate variables are characterised by integrated processes i.e, I(1) series, the appropriate way of looking at the integration of financial markets is to examine whether there exists co-integrating relationship between different segments of the market. However, in order to draw meaningful policy implications, it would be necessary to see if a co-integrating relationship exists between the reference rate on the one hand and several money market rates on the other.

Money Market and Gilt Markets

The co-integration analysis requires that the set of variables should be integrated of the same order, in particular, I(1) process and their linear combination must be stationary. Within a bi-variate framework, the residuals emerging from various short-term rates as the dependent variable and the G91 as an explanatory variable must be stationary process. Following Johansen (1988), the co-integrating vector(s) could be estimated within a vector error correction framework after setting an appropriate lag order. The appropriate lag order was chosen in terms of AIC criterion. The AIC values suggested that a maximum of 3 to 4 months lag order could be chosen.

The co-integration results are summarised in Table 8. While Tables 8.1 and 8.2 present the bi-variate results, 8.3 shows the results relating to multivariate specification. Moreover, Table 8.1 depicts the relationship among rates in the money market while Table 8.2 allows interaction between money and gilt markets.

In case of money market, three pairs are found to be cointegrated. They are CPR-CMR3, CDR-CMR3 and CPR-CDR. Between money and gilt markets (Table 8.2) the long-run elasticity of CPR with respect to G91 turned out to be 0.74 whereas the elasticity of CDR with respect to G91 was somewhat low at 0.56. The homogenous restrictions of zero and unit elasti-city are rejected for CPR and CDR. In case of call money rate, its long-run elasticity with respect to G91 is estimated at 1.52. Both the zero and unit restrictions are rejected. The long-run elasticity of CPR and CDR with respect to CMR3 (Table 8.1) was estimated around 0.30 i.e., nearly half the effect of G91, although, both zero and unit restrictions could be rejected.

TABLE 8.1 : COINTEGARTION RESULT: MONEY MARKET

(a) CPR = F (CONSTANT, CMR3)

REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=4, r =1*

CONSTANT	10.39 (17.11)	ADF (3)	9015
CDR3	0.23 (4.10)		0.37
$\overline{R}^2$ / DW	0.23, 0.47		
CDR3 = 1.0			24.15 (a)**
CDR3 = 0.0			24.32 (a)
(b) CDR = F (CONSTANT, CMR3)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=4, r =1
CONSTANT	9.40 (17.40)	DF	9.87
CDR	0.30 (6.16)		0.27
$\overline{R}^2$ / DW	0.39, 0.56		
CDR3 = 1.0			4.72 b
CDR = 0.0			1.27 NS
(c) CPR = F (CONSTANT, CDR)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=4, r =1
CONSTANT	5.39	DF ADF (1)	3.90
	(9.15)		
CDR	0.58 (5.73)		0.72
$\overline{R}^2$ / DW	0.35, 0.75		
CDR = 1.0			2.59 (c)
CDR = 0.0			8.48 (a)

Note: * k and r indicate lags and number of cointegration relations, respectively.
** χ^2 statistics, a for 5% level, b for 10% and c for 15% level of significance and NS - not significant.

TABLE 8.2 : COINTEGRATION RESULT: MONEY MARKET AND GILT MARKET

(a) CPR = F (CONSTANT, G91)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=3, r=1
CONSTANT	5.31 (5.46)	ADF (1)	5.58
G91	0.78 (7.80)		0.74
$\overline{R}^2$ / DW	0.50, 0.70		
G91 = 1.0			3.51 (a)
G91 = 0.0			9.06 (a)
(b)CDR = F (CONSTANT, G91)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR

			K=3, r=1
CONSTANT	5.67 (5.59)	DF	6.71
G91	0.61 (4.93)		0.56
$\overline{R}^2$ / DW	0.28, 0.50		
G91 = 1.0			9.49 (a)
G91 = 0.0			6.84 (a)
(c) CPR = F (CONSTANT, G91)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=3, r=1
CONSTANT	5.31 (5.46)	DF ADF (1)	-5.28
G91	0.78 (7.80)		1.52
$\overline{R}^2$ / DW	0.50, 0.70		
CDR = 1.0			2.56 (a)
CDR = 0.0			8.48 (a)

When the model was extended to multivariate three-variable framework, results were interesting for the two alternative combinations i.e., CPR,CDR and G91 and CPR, CDR and CMR3. In case of the former, the long-run coefficient of G91 was estimated at 0.52 whereas the coefficient of CMR3 was 0.16 in the later model (Table 8.3). Thus, G91 has a substantial effect on the long-run movement of the money market rates.

TABLE 8.3 : MULTIVARIATE COINTEGRATION RESULT

(a) CPR = F (CONSTANT, CDR, CMR3)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=1, r=1
CONSTANT	4.61 (2.91)	ADF (3)	-2.94
CDR	0.64 (4.19)		1.12
CMR3	0.02 (0.26)		0.16
$\overline{R}^2$ / DW	0.40, 0.68		
(b) CPR = F (CONSTANT, CDR, G91)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=1, r = 1
CONSTANT	3.38 (2.94)	DF, ADF (1)	1.81
CDR	0.29 (2.94)		0.29
G91	0.60		0.69

	(5.36)		
$\overline{R}^2$ / DW	0.56, 0.87		

TABLE 9 : COINTEGARTION RESULT: CREDIT MARKET AND MONEY MARKET

(a) LRT = F (CONSTANT, DRT)

REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=3, r =1
CONSTANT	8.54 (8.02)	ADF (2)	8.78
DRT	0.61 (6.13)		0.59
$\overline{R}^2$ / DW	0.38, 0.23		
DRT= 1.0			7.46 (a)
DRT = 0.0			11.35 (a)

(b) DRT = F (CONSTANT, CMR3)

REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=2, r =1
CONSTANT	9.38 (45.74)	ADF(1)	9.01
CMR3	0.13 (6.93)		0.17
$\overline{R}^2$ / DW	0.46, .70		
F1=0			10.43
F1=1			12.21

(c) LRT = F (CONSTANT, CMR3)

REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=1, r = 1
CONSTANT	14.84 (69.92)	ADF (2)	14.05
CMR3	0.04 (1.98)		0.09
$\overline{R}^2$ / DW	0.07, 0.33		F1=0: 2.47(NS) F1=1 : 7.87

NS: X^2 statistics *is n*ot significant at 5 per cent level.

(d) LRT = F(constant, G91)

REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=3, r =1
CONSTANT	12.65 (29.47)	ADF(2)	12.31
G91	0.25 (5.71)		0.27
$\overline{R}^2$ / DW	0.36, 0.30		
F1=0			12.42
F1=1			19.91

(e) DRT = F (constant, G91)

REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=2, r =1
CONSTANT	7.17 (24.65)	DF ADF(1)	7.02
G91	0.37 (12.23)		0.38
$\bar{R}^2$ / DW	0.72, 1.20		
F1=0			15.39
F1=1			17.11

(f) CDR = F (CONSTANT, DRT)

REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=3, r =1
CONSTANT	-5.86 (-2.15)	DF	-12.12
DRT	1.72 (6.75)		1.87**
$\bar{R}^2$ / DW	0.43, 0.67	F1=1	4.56

Credit Market

The results of cointegration among credit market rates, summarised in Table 9, indicated that deposit and lending rates are co-integrated. The long-run elasticity of lending rate LRT with respect to DRT is the order of 0.59. The residual from OLS model of DRT and CMR3 did not yield a stationary series, thus ruling out possibility of long-run association between the two rates. Although, a co-integrating relationship could be established between LRT and CMR3, the long-run elasticity of the former with respect to the latter could not pass through zero restriction. On the contrary, DRT and LRT have cointegrating relationship with G91. The long-run elasticity was, however, low at 0.30 but statistically different from zero. There was a strong long-run relationship between the two deposit rates, CDR and DRT. The long-run elasticity indicates that one percentage point increase in DRT would trigger 1.7 percentage point increase in CDR.

Capital Markets

The CD and CP rates together with return on capital and price-earning ratio of 100-Scrip National Index were considered for testing of capital market integration with money market rate. A mere casual look at the trends in these rates rules out a strong long-run relation among them. However, if we consider price-earning ratio alone, there is some evidence of convergence since 1996. The cross correlation coefficients also point to negative association of these rates. It is not surprising to have a negative correlation as Indian stock indices have often moved in opposite direction to the fundamentals of the economy. No co-integration could be established among these rates[6].

Money and Forex Markets

There is a high degree of co-movement among the call rate and forward premia of the US

dollar for 3 and 6-months. The correlation coefficients shown in Table 6 further vindicate the view that money and forex markets are integrated. Under the partial adjustment model (Table 7.2), the long-run elasticity of forward premia with respect to changes in the call rate is close to unity and Wald restriction also could not reject this hypothesis. The mean lag response is about two to three months. However, the speed of adjustment was not high on an average. The availability of arbitrage opportunities between call and forex markets, is in fact, an important factor for integration of both these markets.

In terms of co-integration analysis, the long run elasticity of three months forward premia in response to call money rate was close to unity (Table 10). The LR test also could not reject such a hypothesis. These results remain largely unaltered for six months forward premia. Thus, the domestic money market and forward exchange market seem to be integrated to a great extent.

Table 10 : Cointegration Result: Forward Premia and Inter Bank Rate

(a) Frwd3 = F(Constant, CMR)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=1, r =1
CONSTANT	-.23 (-0.22)	DF	7.52
CMR3	0.74 (7.83)		0.93
$\overline{R}^2$ / DW	0.52, 0.46		
b2=1, b2=0			0.08, 7.02
(b) Frwd6 = F(Constant, CMR)			
REGRESSORS	OLS	RESIDUAL	JJ-LR VECTOR K=1, r =1
CONSTANT	-0.05 (-0.24)	DF	7.58
CMR3	0.73 (7.79)		0.91
$\overline{R}^2$ / DW	0.53, 0.48		
b2=1, b2=0			0.08, 6.98

Note : b2 is long run coefficient of right hand side variable.

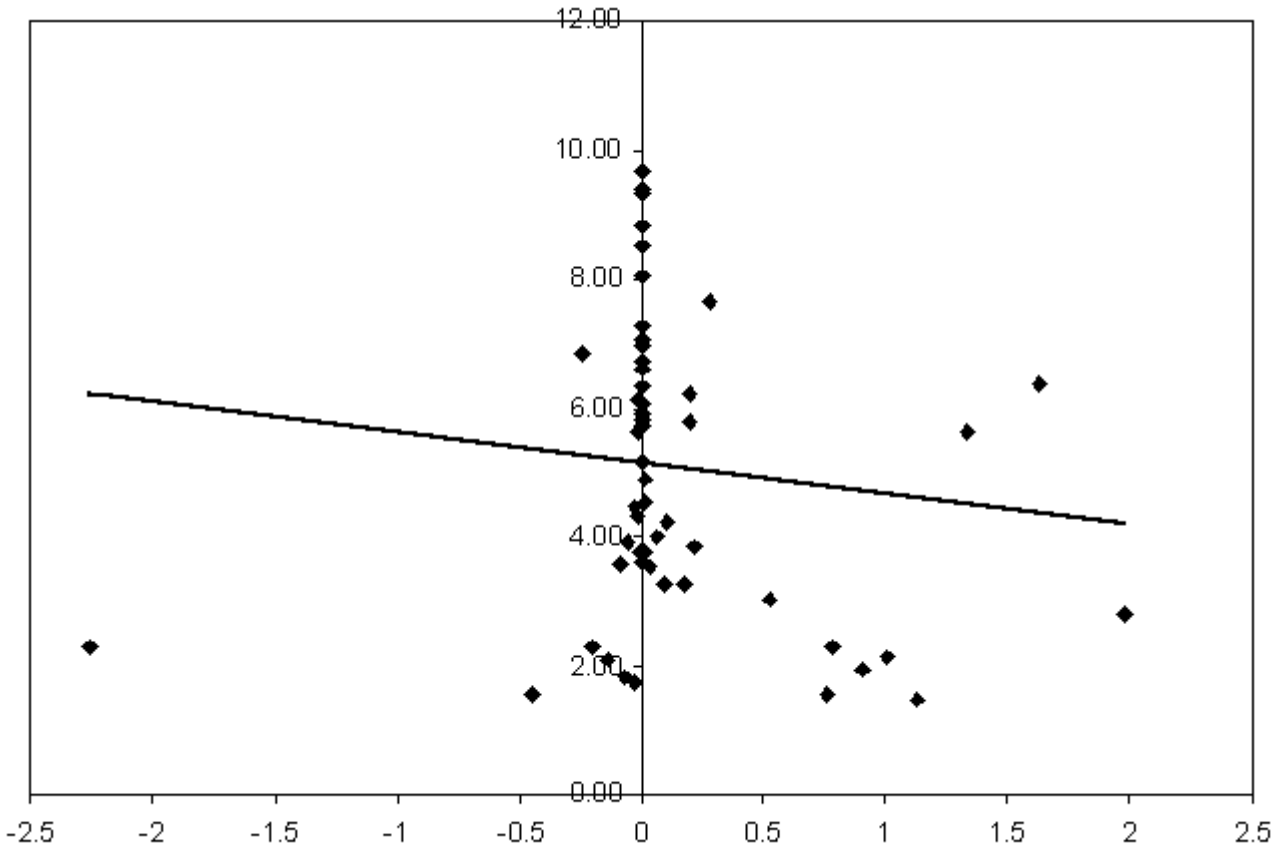
Degree of Integration between Domestic and Overseas Markets

Integration of domestic and overseas markets needs rigorous investigation. For these markets to be integrated, the following conditions must be satisfied. First, the Purchasing Power Parity (PPP) condition should hold, so that same price prevail for identical products in both the markets. In such cases, the real effective exchange rate would remain steady. Secondly, according to Fisher's condition, if the real interest rates remain same in both the markets, then inflation rate differential will be exactly same as the nominal interest rate differential. Thirdly, nominal interest rate differential should be reflected in the forward premia under what is known as covered interest parity. When forward premium are the best predictor of the future spot rate, market is said to be efficient and integrated (Frankel, 1993).

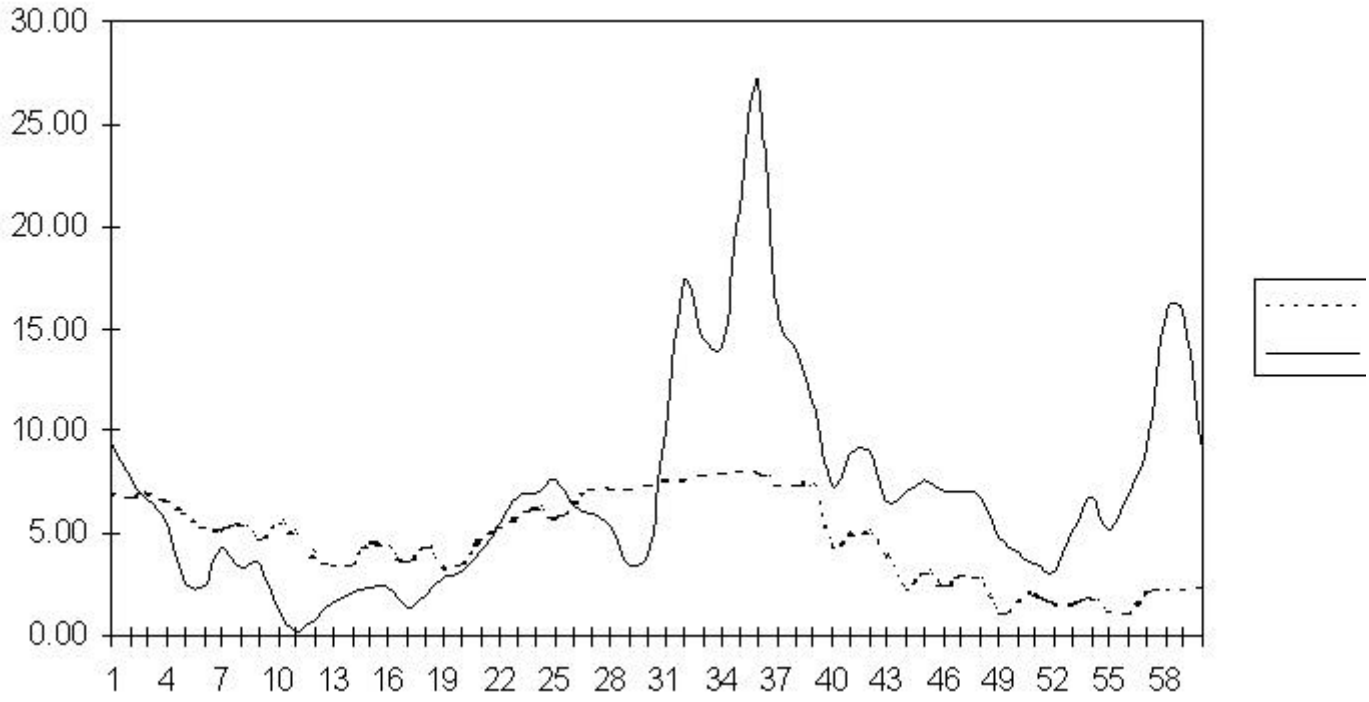
None of these conditions seems to be satisfied in respect of Indian markets. The spot exchange rate is determined by the demand and supply conditions at any particular time. Besides, capital inflows and central bank intervention may lead to a situation where forward rates considerably diverge from future spot rates. Above all, rupee is not convertible in the capital account for domestic residents. On the empirical plane also inflation rate and interest rate differential do not seem to have strong impacts on the spot and forward rates in India. As a test case, inflation rate differential between India and the USA and expected change of rupee-dollar rate are plotted in Graph 3. When inflation rate differential rises, the rupee-dollar rate is expected to rise indicating depreciation of Rupee. If depreciation of Rupee completely offsets the inflation rate differentials, then the slope of the PPP curve should be positive and inclined at 45°. Obviously, this does not seem to be the case in India as revealed by the Graph. A large divergence is noticed between the interest rate differential and the forward premia (Graph 4).

At the empirical level, a large number of studies have found evidence of unbiased forward premium (UFP) in country specific situations.

Graph 3 : Inflation Differential and Exchange Rate Depreciation



Graph 4 : Interest Rate Differential and Forward Premia (3 Months)



The UFP in the formal form is given by:

$S_{t+k} - S_t = a + b\ (F_{k,t} - S_t)$

where, 'S_{t+k}' is future spot rate, 'S_t' is current spot rate and '$F_{k,t}$' is forward exchange rate. If the restriction on the parameters i.e., a = 0, and b = 1 holds, then forward premium is an unbiased predictor of future spot rate. In view of expectation errors involved with parametric estimation techniques, there have been some attempts to use non-parametric tests to collect evidence on UIP.

Let 'I(t)' is defined such that it takes a value of unity when $(S_{t+k} - S_t)$ and $(F_{k,t} - S_t)$ have same sign and zero otherwise. Then the Fisher's sign test, defined as $S = \sum I(t)$, follows a binomial distribution. The corresponding 'Z' statistics, in the limit as 't' tends to infinity, is defined as :

$Z = (S - p*T)/[p(1-p)*1/2]$

with null probability 'p' at 0.5. The forward premium is unbiased when 'z' is statistically significant.

The regression result reported in Table 11 indicates that coefficient of forward exchange rate is close to unity and statistically significant. The constant term is not significantly different from zero. The Wald test on the joint hypothesis that a = 0 and b = 1 with χ^2 statistics at 3.24 could not be rejected. However, further post estimation diagnostics of the regression model indicated that there is serial auto-correlation problem in the residuals. Interestingly, when the regression model was corrected for the first order serial correlation of residuals, the constant

term turned out to be statistically different from zero. On the contrary, the coefficient of the forward rate drastically decreased to 0.22, although it remained statistically different from zero at 5 per cent level of significance. The Wald test could reject the joint hypothesis that a = 0 and b = 1. Similarly, the non-parametric approach yielded the estimate of 'Z' at 1.19 which is not significant at 5 per cent level. These evidences show that forward premium is not an unbiased predictor of future spot rate in the Indian situation.

The second part of the empirical exercise is related to covered and uncovered interest rate parity condition or informational efficiency of the market. The uncovered interest rate parity condition implies that the expected depreciation or appreciation of exchange rate (ΔS^e) is fully covered in the interest rate differential. On the other hand, the covered interest rate parity relates interest rate differential to forward premia.

$(r_{d,t} - r_{f,t}) = a + b\ (\Delta S^e)$
$(r_{d,t} - r_{f,t}) = a + b\ (FRWD3)$

Where, '$r_{d,t}$' is domestic interest rate and '$r_{f,t}$' foreign interest rate on similar instruments, preferably the interbank rate. If the joint hypothesis on parameters a = 0 and b = 1 holds, then interest rate parity condition prevails in the forex market. The crux of empirical testing depends upon the measure of expected depreciation of exchange rate. Several studies have used actual depreciation as an indicator of expected depreciation. In the Indian case, the regression results reported in Table 12(a) indicate the relationship between interest rate differential between domestic interest rate G91 and foreign inter-bank rate i.e. federal funds rate and actual depreciation of currency i.e. $(S_t-S_{t-3})/S_{t-3}$ adjusted to annual rate in per cent. The results point out that the constant term is highly significant and different from zero. But the coefficient of depreciation (DS) is not statistically different from zero. The regression model suffers from auto-correlation of residuals. The coefficient of the DS term (0.56) turned significantly different from zero after the residuals were corrected for the first order auto-correlation. The Wald test rejected uncovered interest rate parity hypothesis.

Table 11 : Unbiased Forward Premium :LRDR = a + b LFRDR

Regressors	OLS	AR1
Constant	0.26	2.76
	(1.34)*	(6.35)
LFRDR	0.92	0.22
	(16.87)	(1.84)
$\bar{R}^2$ / DW	0.84, 0.48	0.95,1.55
Wald Test χ^2 (2) a=0, b=1	3.24**	41.57*

Table 12 (a) : Uncovered Interest Rate Parity: DIR = a + b DS

Regressor	OLS	AR1(ML)
Constant	4.35	4.01
	(5.30)	(2.44)
DS	0.17	0.56
	(0.64)	(1.93)
$\bar{R}^2$ / DW	0.01, 0.76	0.38, 2.01

Wald Test χ^2 (2) a=0, b =1	28.30*	6.98 *

Table 12 (b) : Covered Interest Rate Parity:

DIR = a + b FRWD3

Regressor	OLS	AR1(ML)
Constant	-0.62	-2.23
	(-0.63)	(-1.45)
FRWD3	0.78	1.01
	(6.79)	(6.33)
$\overline{R}^2$ / DW	045, 1.19	0.55, 2.26
Wald Test χ^2 (2) a=0, b =1	18.28*	4.77**

Notes: * significant about 5%, ** about 10% and *** not significant.

On the contrary, the coefficient of the forward premium taken as a proxy for the expected depreciation of currency is close to unity and statistically significant at 5 per cent level of significance as shown in Table 12(b). The constant term, however, could not be statistically different from zero. The low Durbin-Watson (DW) statistics at 1.19 pointed to the serial correlation of residuals. The Wald test yielding χ^2 statistics at 18.28 could reject the covered interest parity hypothesis. However, after correcting for first order serial correlation of residuals, the Wald test χ^2 statistics at 4.77 do not reject covered interest rate parity hypothesis at 5 per cent level of significance.

These results lead to two major findings. First, there is some evidence of covered interest parity in the Indian case. However, as the forward premium is not an unbiased predictor of future spot rate, the uncovered interest parity condition does not hold and the domestic and international markets show divergent behaviour.

Section V

Concluding Observations

The attempt to find convergence of various financial markets in the study has yielded mixed results. While there exists a fair degree of convergence of interest rates among the short term markets - money, credit and gilt markets - the capital market exhibits fairly isolated behaviour. Given the current stage of development of financial market and the sensitivity of individual markets to tax regime, institutional setting in the form of restriction to entry, and notably, investors preference for non-price features of certain financial products, the low degree of price convergence in Indian financial market is not very much unexpected. The movement of various interest rates in uniform directions, nevertheless shows an encouraging sign of the growing maturity of the financial markets and their sensitivity to monetary policy. This has significant implications for the transmission of monetary policy, in so far as the quantum channel is becoming increasingly obsolete in view of the rising importance of interest rate and asset price channels. Since the degree of integration of domestic market is dependent on policy and institutional setting facing such market segments, the ongoing financial reform programme needs to be accelerated to further widen and deepen various markets towards achieving a higher degree of convergence.

Notes :

1. In 1991, the Union government had set up a *Committee on the Financial System* headed by Shri M. Narasimham. On the basis of the recommendations of the Narasimham committee (1991), wide-ranging reforms of the financial sector have been implemnted. On December 26, 1997, the government once again set up a *Committee on Banking Sector Reform* under the Chairmanship of Shri M. Narasimham to make a review of the progress made on financial sector reforms and recommend second phase of banking sector reform. The Committee has since submitted their report in April 1998 which is under consideration.

2. The role of financial sector in promoting economic growth has been emphasised by several authors, prominent among them being McKinnon (1973, 1976).

3. Random walk hypothesis owes its origin to Irving Fisher (1907). Since our analysis is done within a bivariate VAR framework, it reflects weak efficiency.

4. For a comprehensive survey of reform measures one can refer to Trend and Progress of Banking (1996-97), and Reddy (1998).

5. Ideally, a reference rate should emerge from the secondary market. As SGL transactions on 91-day Treasury bills are available from September 1994, we relied upon the cut off yield on 91-day auction Treasury bills. For the period for which both cut off yields and secondary market yields are available, their corelation coefficient was found to be as high as 0.96 and therefore, cut off yield could be a good substitute of secondary market yield.

6. A comprehensive survey of the weakness of Indian capital market is available in L.C. Gupta (1998).

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