Emerging trends in financial markets integration: the Indian experience

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Abstract

Purpose – Financial sector reform measures, which were initiated in 1991, have provided some degree of maturity and integration of different segments of India's financial markets. The purpose of this paper is to articulate the impact of financial sector reform measures on integration of various segments of financial markets in India.

Design/methodology/approach – The paper surveys various methodologies for measurement of financial integration and uses the recently developed technique of co-integration in a VAR framework to assess the extent of integration of various segments of India's financial markets.

Findings – The paper concludes that the financial market integration is inconclusive in India. Only a few segments of money market, Gilt market and foreign exchange market are integrated. Interest rate parity does not hold in India's case, which indicates poor evidence in support of international integration of domestic financial markets. Similarly, the analysis of the relationship between domestic saving and domestic investment does not support international integration. The study of co-integration of Nasdaq and Bombay sensitive index (BSE), also revealed absence of international integration.

Research limitations/implications – Owing to non-availability of time series data, the paper could not consider the mutual fund market, pension market and various derivatives markets in the overall process of assessment of financial integration. However, the impact on the findings is minimal, as these markets are not so far developed in India.

Practical implications – The findings have significant practical implications particularly in the formulation of policies on management and interventions in the money market, foreign exchange and equity markets and in the overall formulation of monetary policy for the economy.

Originality/value – This paper presents a quite comprehensive research study on financial integration in India and is original, particularly in the area of application of the co-integration technique for assessment of financial integration.

Keywords India, Financial markets, Interest rates, Capital markets, Econometrics

Paper type Research paper

1. Introduction

Integration is a process by which segmented markets open up and unified so that participants enjoy the same unimpeded access to international trade and finance. It occurs through the removal of domestic and international controls on trade in financial assets, goods or services. Integration of markets is a tendency for prices of goods, services and financial assets of different markets to converge. Financial integration

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leads to rapid flows of funds from "less returns markets" to "high returns markets" and, in this process, it brings about equality in returns.

The process of financial sector reform has been continuing in India since 1991. Deregulation of interest rates and market-based allocation of resources have infused competition in the financial markets. Similarly, opening of current accounts and significant liberalization of capital accounts has increased capital flow to the country. In the light of these developments, it is expected that financial markets in India have achieved some degree of maturity and integration. The paper gives a theoretical perspective to financial markets integration and empirically investigates both domestic and international integration of various segments of India's financial markets.

2. Financial market integration: a theoretical perspective

The Law of One Price (LOOP), advocated by Cournot and Marshall, is the fundamental principle of financial market integration. As per the LOOP principle, in the absence of administrative and informational barriers, risk-adjusted returns on identical assets should be comparable across markets. While the LOOP provides a generalized framework for financial market integration, the finance literature provides alternative principles, which establish operational linkages among different financial market segments. First, the term structure of interest rates, deriving from paradigms of unbiased expectations, liquidity preference, and market segmentation, establishes integration across the maturity spectrum, i.e. short, medium and long ends of the financial market (Blinder, 2004). In the monetary economics literature, it is recognized that the term structure of interest rate contains useful information about future paths of inflation and growth, which characterize the objective function of policy in most countries. Second, the capital asset pricing model of Sharpe (1964) establishes linkage between market instruments and risk-free instruments such as government securities. Beyond economic and financial principles, financial markets integration could also occur owing to information efficiency, as economic agents form expectations about the future course of policy and real sector developments.

3. Survey of literature

Financial markets integration has been extensively researched. Fase (1976) studied the degree of market integration in 11 European countries, using principal component analysis on monthly short-term interest rate data for the period of 1961-1972. Mishkin (1985) studied the commonality of real interest rates and interest rates parity conditions for the UK, West Germany, The Netherlands and Switzerland and found evidence that real interest rates are not equal in these countries. Cumby and Mishkin (1984), Kasa (1992), Chung and Liu (1994) and Cheung and Mark (1992) investigated the relationship between stock prices of the USA and Japan and eight Asian-Pacific markets and found that the US market leads the stock markets of most of these countries. Corhey *et al.* (1993), Harvey (1991) and Korajczyk Robert (1996) studied the long-run relationship among five major European markets (France, Germany, The Netherlands, Italy and UK) and found evidences of strong integration among these countries. Choudhary (1996) examined the stochastic trend of individual stock markets of the USA, UK, Japan, Canada, Italy, France and Germany using the Johansen method of co-integration and found no evidence of common stochastic trend among these stock

markets. Ghosh *et al.* (1998) and Huang *et al.* (2000) examined the integration and causality of nine Asia Pacific markets with the US and/or Japanese stock markets and found no such evidence of market integration.

4. Experience from India

Since 1991 the process of financial sector reform programme has been continuing in India. Prior to that, the Chakravarty Committee (1985) recognized the major weaknesses of the Indian money market and recommended, *inter alia*, the setting up of a working group to study the weaknesses of the Indian money market in detail. Accordingly, the Vaghul Working Group was appointed by the Reserve Bank of India, which recommended the introduction of new instruments, such as, commercial papers certificates of deposits and 182-day treasury bills, besides the revival of inter-bank participation certificates. In accordance with the recommendations of the Committee on Financial System (1991), Chaired by M. Narasimham, banking sector reforms and reforms in the money market and capital market have been undertaken. Deregulation of interest rates has led to co-movements of various interest rates in a uniform direction, which is an encouraging sign of the growing integration of financial markets in India. Bhoi and Dhal (1998) have found convergence of short-term markets – money, credit and gilt markets – but the capital market deviated from the integration path. The Reserve Bank of India (2000, 2005), in its *Reports on Currency and Finance*, extensively studied the process of liberalization of Indian financial markets and integration of various segments of domestic financial markets and the overall integration of domestic financial with the international financial market. The paper has found evidence for the gradual integration of call money market and the foreign exchange markets. The other segments of Indian money market, particularly the Gilt market, is found to be integrated with the call money market. The paper has found that the Bombay sensitive index (BSE-100 scripts) Index and the NASDAQ Index are highly correlated. In the case of India, term structure interest rates do not prevail, as yields of various maturities are still not perfectly correlated (Ghose, 2000). Using multiple co-integration Jain and Bhanumurthy (2005) found that there is a strong integration of the domestic call money market with the London Interbank Offered Rate (LIBOR). However, integration between the Treasury bills market and international financial markets could be established.

The present paper has carried out an extensive analysis of integration of various segments, i.e. the money and gilt, equity, debt, foreign exchange markets and commercial banks' loans and deposits market, have been considered for domestic financial markets integration. US Treasury Bills, US Fed Fund, NASDAQ Index and LIBOR Rates have been considered for analysis of international integration of India's financial markets.

5. Financial integration: an econometric approach

Financial integration can be measured by analyzing the co-movements of financial ratios/prices/interest rates of different parts and sub-parts of financial markets. There are several methods of testing for market integration. In the past, static high price correlations, across markets, were considered to reflect market integration. However, the correlation coefficient as a measure of market efficiency has been rejected on the ground of the non-stationary nature of variables under consideration. To circumvent

the said problem, the regression analysis has been suggested. A relatively less restrictive approach to market integration is the co-integration and error correction technique. If prices in two different markets bear a long-run relationship, the prices are said to be cointegrated and the markets are integrated. The co-integration approach to market integration has been considered as an alternative to the Ravallion model.

5.1 Partial adjustment analysis

The partial adjustment model (PAM) shows the degree and speed of integration of different segments of the financial market. It also gives an estimate of the long-run elasticity and mean-lag response of the variables with respect to the reference rate. The equation of partial adjustment analysis can be written as:

$$Y = F[C, Y\{-1\}, X]$$

where Y is the dependent variable (i.e. financial market variables under study), X is the reference variable and C is the intercept. Nerlove's PAM, which is given below, is used here to carry out PAM tests:

$$Y_t = \delta\beta_0 + \delta\beta_1 X_t + (1 - \delta)Y_{t-1} + \delta U_t \tag{1}$$

In double log specification, the coefficient of X_t in equation (1) gives the impact elasticity with respect to each explanatory variable and δ is the adjustment coefficient which indicates the speed of adjustment.

5.2 Co-integration and market integration

Co-integration technique identifies the long-run structural relationship among the variables under consideration. It indicates that, in the long run, the variables under study would move in the same direction without drifting apart from each other. Prior to the estimation of the model, the stationarity of the processes, which can be checked using augmented Dicky Fuller (ADF) and Philip-Perron tests, needs to be examined. If the linear combination of two non-stationary variables is stationary, the regression becomes meaningful and it can be inferred that the two variables are co-integrated and thus, they have a long-run relationship with common trend. Since the study is primarily focused on market integration, it intends to find out a number of cointegrating vectors among various combinations of different market segments. Both bi-variate and multivariate co-integration analysis have been carried out using the standard Johansen (1991, 1994) methodology to measure the process of market integration. The Johansen test uses the trace statistic to find out the number of cointegrating vectors in the system. Minimum Akaike information criteria have been used to determine the optimum lag length.

5.3 Savings – investment correlation

One of the important properties of financial integration is that if the domestic financial markets are integrated with the world financial market, then the domestic investment will be independent of domestic savings. On the basis of this argument, it is possible to empirically test the capital market integration by considering saving rates as a function investment rates:

$$S/Y = a + b(I/Y) + \in \tag{2}$$

Here, S/Y and I/Y are savings and investment rates, respectively. If the economy is closely linked with the world capital market via flows of capital, then there will be no relationship between the above two ratios. In other words, domestic investments will be independent of domestic savings. In the above equation, if the value of the parameter b comes to zero, then it can concluded that domestic capital market is integrated with the world capital market.

5.4 Interest rate parity hypothesis

International parity conditions provide criteria for measuring the degree of integration between different world markets. The covered interest parity (CIP) theory postulates that spot and forward exchange rates quoted at the same instance in time, tend, in general, to diverge exactly in line with the short-term interest rate differential on identical assets across countries. The equilibrium condition implied by the hypothesis is expressed as:

The equation estimated to test for CIP is in the following form:

$$Y = \alpha + \beta \mathrm{FD} + \upsilon \tag{3}$$

where Y is the interest rate differential between India and the USA, FD is the forward premia between Indian rupee and US Dollar, and υ is the stochastic error term with zero mean and constant variance $(0,\sigma^2)$. For interest rate differential, Indian Call Money Rates (CMRs) and US Fed Fund Rates (USFRs) have been considered. The CIP will hold if the coefficient of interest rate differential is unity and the intercept is zero. To test the joint hypothesis ($\alpha = 0$; $\beta = 1$), Wald test of restrictions has been imposed on the parameters.

The uncovered interest parity (UIP) hypothesis equates interest rates differential with expected change in spot rate. In other words, if the market is efficient then current forward rate, which reflects the interest rate differential, should be equal to the future spot rate. The equilibrium condition for UIP can be expressed as:

$$Y = \alpha + \beta(\Delta S^{\mathrm{e}}) + \upsilon \tag{4}$$

where Y is the interest rate differential and ΔS^{e} is expected change in the spot rate. Since it very difficult to know the expected depreciation, actual depreciation has been considered for the analysis. UIP hypothesis will hold if the coefficient of expected depreciation is one and intercept is zero. To test the joint hypothesis ($\alpha = 0$; $\beta = 1$), Wald test of restriction has been imposed on the parameters.

The real interest parity (RIP), however, states that expected exchange rate depreciation equates with the real interest rates differential between countries under consideration. For arriving at RIP, in place of expected inflation, following the rational expectation, one period lag of actual inflation is considered. In equation form it can be written as:

$$Y^* = \alpha + \beta(\Delta S^{\mathrm{e}}) + \upsilon_{\mathrm{t}} \tag{5}$$

where Y^* is the real interest rate differential between India and the USA and υ_{t} is the stochastic error term with zero mean and constant variance. RIP hypothesis holds, if, coefficient of expected depreciation is one and intercept is zero ($\alpha = 0$, $\beta = 1$).

5.5 Variables, data sources and period of study

On the basis of data availability, various segments of money market, credit market, government securities market, capital market and foreign exchange market have been considered for the present paper. The variables are listed below, with the symbols used in parentheses:

- US Fed Fund Rate (USFR).
- US Treasury Bill Rate (USTR).
- Government of India Treasury Bill Rate-364 (G364).
- LIBOR (LIBOR).
- Call Money Rate (CMR).
- Three-month Forward Premia (FRW3).
- Six-month Forward Premia (FRW6).
- Price-Earning Ratio (PER).
- Commercial Paper Rate (CPR).
- Certificate Deposit Rate (CDR).
- Government of India Treasury bill Rate-91 (G91).
- BSE Sensitive Index (BSE).
- NASDAQ Index (NASDAQ).
- Deposit Rate (DRT).
- Lending Rate of Bank (LRT).
- Return on Capital (ROC).
- Spot Rate Rupee-US$ Rate (SPOT).

Data on all variables have been collected from various issues of *Handbook of Statistics on Indian Economy* published by the Reserve Bank of India. The period of study is spread over April 1993 to March 2008 and data are primarily on a monthly interval.

6. Result and discussion

6.1 Identification of reference rate

Reference rate is the rate which influences all rates/interest rates of various parts and sub-parts of financial markets. Reference rate should be a stable, low volatility, short-term interest rate.

Various domestic interest rates/returns, mentioned in Table I, are put to various statistical tests to find out a domestic reference rate. Results in Tables I and II indicate that G91 variable has a remarkably low standard deviation, kurtosis and skewness. Further, except for the US Fed Fund rate, which is found to be stationary at the level, all other variables are stationary at their first difference (Table II).

The reference rate is supposed to have causal relationship with other rates. For this reason, the Granger's non-causality test has been carried out in a bivariate framework for the identification of the reference rate.

Results of the Granger non-causality test (Table III) indicate that the G91-days is influencing almost all variables of money market, credit markets and foreign exchange

Variable	Standard deviation	Mean	Skewness	Kurtosis
G364	1.87	10.41	−1.76	9.34
CMR	5.13	9.28	2.60	8.8
FRW3	4.37	6.47	1.95	5.24
FRW6	3.91	6.68	1.50	3.07
PER	9.67	18.31	0.89	0.31
CPR	2.44	12.35	1.10	0.64
CDR	108.84	22.98	9.54	88.92
G91	1.84	9.24	0.68	−0.39
BSE	418.57	1714	1.20	2.34
DRT	1.49	6.46	0.93	0.51
LRT	1.78	14.02	0.19	−1.12
ROC	8.32	1.94	0.21	−0.63

Table I. Stylised facts

Variable	ADF	Phillips-Perron	Inference
USFR	−3.22	−7.27	I(0)
USTR	−3.16	−5.81	I(1)
G364	−8.94	−12.56	I(1)
LIBOR	−2.98	−8.01	I(1)
CMR	−4.04	−6.33	I(1)
FRW3	−3.23	−8.43	I(1)
FRW6	−3.22	−7.09	I(1)
PER	−4.47	−15.90	I(1)
CPR	−6.42	−10.92	I(1)
CDR	−5.45	−10.34	I(1)
G91	−6.47	−11.02	I(1)
BSE	−5.52	−7.78	I(1)
NASDAQ	−4.80	−9.35	I(1)
DRT	−6.51	−14.19	I(1)
LRT	−5.24	−26.34	I(1)
ROC	−5.90	−9.14	I(1)
SPOT	−6.75	−6.98	I(1)

Notes: I(1), integrated by order one; I(0), integrated at level

Table II. Unit-root test of variables

market. Hence, G91 can be treated as the standard reference rate for the present study of market integration.

6.2 Domestic financial integration

After identifying the reference rate, tests of integration of domestic financial markets are carried out using partial adjustment analysis and co-integration technique. Since almost all variables under study are integrated at their first difference, test of correlation among them would be spurious and hence it is not considered in the paper.

6.2.1 Partial adjustment model. In an integrated market, rates/ratios influence each other and change in one rate/ratio leads to rapid change in other rates/ratios so as to remove the arbitrage opportunities. Partial adjustment analysis has been employed, primarily, to estimate the speed of adjustment in the study. The variables, which are

Table III. Granger's non-causality test

Variables	*F*-statistic	Significant level (%)
G91-CMR	5.21	5
G91-CPR	4.76	5
G91-CDR	3.25	5
G91-DRT	1.22	NS
G91-LRT	2.89	10
G91-FRW3	2.52	10
G91-FRW6	2.41	10
LRT-DRT	2.39	10
DRT-LRT	2.26	10
LRT-G91	3.43	5
DRT-G91	5.67	5
LRT-G364	0.92	NS
DRT-G364	0.77	NS
LRT-CMR	2.57	10
DRT-CMR	3.45	5
CDR-G91	3.89	5
CPR-G91	6.02	5
CMR-G91	5.89	5
FRW3-G91	2.76	10
CPR-CDR	1.98	10
CDR-CPR	0.19	NS
CDR-CMR	16.78	5
CPR-CMR	7.98	5
CMR-CPR	1.23	NS
CMR-DRT	0.94	NS
CMR-LRT	0.96	NS

Note: NS, not significant at 10 per cent level

highly correlated with G91, are only considered as dependent variables for partial adjustment analysis. Since most of the variables in the study are first order of integration, first order difference of these variables are considered for the PAM analysis. Following seven partial adjustment equations have been estimated against the independent variable G91:

(1) Commercial Paper Rate (CPR) against G91.
(2) Call Money Rate (CMR) against G91.
(3) Certificate Deposits Rate (CDR) against G91.
(4) Commercial Bank's Deposits Rate (DRT) against G91.
(5) Commercial Bank's Lending Rate (LRT) against G91.
(6) Three-month Foreign Exchange Forward Premia (FRW3).
(7) Six-month Foreign Exchange Forward Premia (FRW6).

Results (Table IV) indicate CDR has the highest speed of integration (0.95) followed by CMR (0.38). Impact elasticity is significant only in case of CMR (1.16). In the case of LRT, it is significant, but with only perverted value of the coefficient (−0.08). The long-run elasticity is 3.01 for CMR and −4.15 for commercial bank lending rate. An important observation the can be made from the above analysis is that while CMR

shows less degree of adjustment with itself, it is more responsive to the reference rate (G91). On the other hand, although CDR shows very high speed of adjustment process, it is not sensitive to the reference rate. From the above analysis, it can be inferred that financial integration is not significantly widespread according to PAM.

6.2.2 Co-integration and market integration.

6.2.2.1 Co-integration of various segments of money market. Money market integration is articulated in bivariate and multivariate cointegrating framework. All variables under consideration are found to be stationary at their first difference. The money market integration process was analyzed by estimating the alignment of different instruments of this market. The following pairs of co-integration were estimated to evaluate the possible intra-money market integration:

- Commercial paper market with call money market.
- Certificate deposits market with call money market.
- Commercial paper market with certificate deposits market.
- Together, certificate deposits, commercial paper and call money markets.

The results of intra-money market integration are provided in Table V. From the table, the following points can be inferred:

- Number of cointegrating vector is one in all cases, indicating unidirectional relationship.

Select dependent variable	Adjustment coefficient (δ)	Impact elasticity	Long-run elasticity
CPR	0.11	0.19	–
CMR	0.38	1.16*	3.01
CDR	0.95	−2.32	–
DRT	0.08	0.13	–
LRT	0.02	−0.08*	−4.15
FRW3	0.15	0.45	–
FRW6	0.10	0.35	–

Note: *Indicates significant at 5 per cent level

Table IV. Partial adjustment model (independent variable: G91)

Variable pair (group) Dept. & Indpt.	Order of VAR	Nature of significance of coefficient No. of cont. vector	OLS	Co-integration
CPR & CMR	4	1	NS	S
CDR & CMR	1	1	S	S
CPR & CDR	1	1	S	S
CPR, CDR & CMR	6	1	CDR-S CMR-NS	CMR-S CDR-S

Notes: NS, not significant; S, significant; number of vectors at 5 per cent level of significance, first variable is dependent variable

Table V. Intra-money market integration

- It is found that commercial paper market follows in all cases, while call money market leads.
- All segments of money markets have long-run co-movements among each other.

6.2.2.2 Co-integration of money and gilt market. Commercial banks are the prime players in the government securities and money markets and they arbitrage between the markets to wipe out any surplus return. Therefore, it is expected that interest rates on different instruments, in both the markets, have long-run relationship. The alignment of various instruments of money and gilt markets is considered in a cointegrating framework and cointegrating relations, as below:

- Commercial paper market, certificate deposits market and government's 91-days treasury bills.
- Commercial bank's lending rate and government's 91-days treasury bills.
- Commercial bank's deposits rate and government's 91-days treasury bills.
- Certificate deposits market and government's 91-days treasury bills.
- Call money market and government's 91-days treasury bills.

The results of money and gilt markets integration are presented in Table VI. Altogether, one multivariate and five bivariate alignments of variables are considered. The following observations can be made from the results:

- Number of cointegrating vector is one for four cases (commercial paper in case of both multivariate and bivariate analysis; certificate of deposits and call money). Thus, long-run unidirectional relationship is present for the four cases. It can be noticed that wherever it has been considered as part of analysis, G91 was generated as the independent variable.
- In case of bank's lending rates and deposits rates, the number of cointegrating vector is zero and hence there is no long-run relationship between them.
- All four cases of co-integration relationship are significant, both under ordinary least squares (OLS) and cointegrating framework.

Variable pair (group) Dependent and independent	Order of VAR	No. of cont. vector (CV)	Nature of significance of coefficient OLS	Co-integration
CPR, G91& CDR	2	1	CDR-S G91-S	CDR-S G91-S
LRT & G91	1	0	S	–
DRT & G91	5	0	NS	–
CPR & G91	1	1	S	S
CDR & G91	1	1	S	S
CMR & G91	1	1	S	S

Notes: NS, not significant; S, significant; vectors at 5 per cent level of significance; first variable is dependent variable

Table VI. Integration of money and gilt markets

6.2.2.3 Co-integration of money and credit market. Through the alignment of interest rates of different instruments of money market with the commercial bank lending rate and DRTs, it is possible to know the integration of money and credit markets. The following pairs of co-integration relationship have been considered in the analysis of money and credit markets integration:

- Commercial bank's lending rate and deposits rate.
- Commercial bank's lending rate and CMR.
- CDR and commercial bank's deposits rate.

Table VII provides a comparative analysis of the results of money and credit markets integration. The table reveals that:

- Cointegrating vector in case of all the pairs of variables is one. The long-run relationship between the paired variables is therefore established. However, the same is at 10 per cent significance level in the case of the pair CDR and DRT.
- As far as the significance of relationship is concerned, in the case of the pair LRT and CMR, it is significant both under OLS and cointegrating framework. In the case of the pair LRT and DRT, the relationship is not significant under OLS analysis. On the other hand, in the case of the pair CDR and DRT the test is not significant under co-integration approach.

6.2.2.4 Co-integration of money and foreign exchange market. Since interest rate differentials are the price for the foreign exchange contract, it is expected that there could be some inherent and casual relationship between money and foreign exchange forward markets.

The cointegrating relationship (Table VIII) between CMR and FRW3 has a VAR of order one with a single cointegrating vector. The indicated long-run relationship is

Variable pair (group) Dependent and independent	Order of VAR	No. of cont. vector	Nature of significance of coefficient OLS	Co-integration
LRT & DRT	5	1	NS	S
LRT & CMR	1	1	S	S
CDR & DRT	1	1*	S	NS

Notes: NS, not significant; S, significant; vectors at 5 per cent level of significance; *only at 10 per cent level of significance

Table VII. Money and credit market integration

Independent variable	OLS Cochrane-Orcutt AR(2)	T-ratios	JJ-LR, K = 1, R = 1
CMR coefficient	0.3094	7.47(0.000)	0.0267
INPT	3.3129	2.49(0.014)	0.1471
R(bar square) = 0.824			
$F(3,88) = 143.2681(0.000)$			
DW = 1.999			
CMR coefficient = 0		$\chi^2(1) = 131.056(0.001)$	
INPT = 0		$\chi^2(1) = 18.0836(0.001)$	

Table VIII. Estimation of Frwd3 F (Constant, CMR)

significant both under OLS and cointegrating approach. The results of the Granger non-causality test (Table IX) conducted under bivariate framework imply that the variables cause each other, thereby revealing that both are co-integrated.

6.2.2.5 Co-integration of money and capital market. The CDR and CPRs along with ROC and PER of BSE are considered for the testing of money and capital markets integration. The co-integration results are provided in Table X.

It is revealed from the analysis that co-integration exists only in the case of the CDR and PER pair. However, the cointegrating vector (one) is only significant at 10 per cent level. The test for the relationship is not significant both under OLS and cointegrating relationship, thereby revealing that money and capital markets are not integrated.

6.3 International integration of financial markets

To study the integration of domestic financial markets in international financial markets, the US financial market has been considered as the representative of world financial markets. In this respect, US-treasury bill rate, US-Fed Fund rate and NASDAQ index have been considered to measure the degree of international integration of the Indian financial market. Domestic saving-investment correlation and the interest parity hypotheses have also been analysed. Besides, these aspects, select indicators of international integration of the Indian economy are also highlighted.

6.3.1 Indicators of openness. Openness of an economy relates to its cross-border movements of goods, services and factors of production. The basic indicators of openness in case of India (given in Table XI) are:

- *Trade* – the GDP ratio has been increasing and staying above 15 per cent, which is a good indicator of an open economy.
- The sharp increase in the inflows of foreign private capital into India in the 1990s, has increased the cross-border financial integration.

Table IX. Granger non-causality test

Hypothesis	χ^2 statistics	Significance level (%)	Inference
Call money rate does not cause forward premia	$\chi^2(3) = 10.0989$	5	Call money rate causes forward premia
Forward premia does not cause call money rate	$\chi^2(3) = 10.8620$	5	Forward premia cause call money rate

Table X. Money and capital market integration

Variable pair (group) Dependent and independent	Order of VAR	No. of cont. vector	Nature of significance of coefficient OLS	Co-integration
CDR & PER	1	1*	NS	NS
CPR & PER	2	0	NS	–

Notes: NS, not significant; S, significant; vectors at 5 per cent level of significance; *only at 10 per cent level of significance

Year	Foreign direct investment (US $million)	Foreign portfolio investment (US $million)	Trade GDP (%)
1993-1994	586	3,567	22.62
1994-1995	1,314	3,824	23.28
1995-1996	2,144	2,748	24.70
1996-1997	2,8121	3,312	22.65
1997-1998	3,557	1,828	21.54
1998-1999	2,462	−61	18.57
1999-2000	2,155	3,026	19.05
2000-2001	4,029	2,760	19.45
2001-2002	6,130	2,021	17.95
2002-2003	5,035	979	19.97
2003-2004	4,322	11,377	22.08
2004-2005	6,051	9,315	26.83
2005-2006	7,722	12,492	30.41
2006-2007	19,531	7,003	33.03

Table XI. Indicators of openness of Indian economy

6.3.2 The co-movement of domestic and international stock indices. Another way to measure degree of financial openness is to gauge the co-movements of indices in the domestic and international stock markets. The ongoing process of reforms in trade, industry and finance, India's openness to cross-border trade and private capital has increased considerably since 1993-1994, indicating thereby the progressive integration of domestic financial markets with the international financial markets.

The correlation between domestic stock (Bombay Stock index) and NASDAQ (Table XII) has been increasing since 1994, which an encouraging sign of gradual integration of the domestic stock market with the international stock market.

6.3.3 Correlation between overnight interest rates and foreign exchange forward premium. In India, the inter-bank CMR, which is an overnight rate, is highly volatile in nature and significantly affected by the development of foreign exchange market, which, in turn, is influenced by the international financial developments. The

Year	BSE-NASDAQ	CMR-FRW3	CMR-FRW6
1993-1994	0.24	0.28	0.18
1994-1995	0.34*	0.37*	0.17
1995-1996	0.42*	0.36	0.21
1996-1997	0.39	0.45*	0.27
1997-1998	0.38*	0.49*	0.26
1998-1999	0.41*	0.47*	0.31*
1999-1900	0.47	0.52*	0.36
2000-2001	0.32	0.55*	0.36*
2001-2002	0.29	0.58*	0.42*
2002-2003	0.36*	0.61*	0.44*
2003-2004	0.58*	0.59*	0.47*
2004-2005	0.67*	0.63*	0.48*
2005-2006	0.72*	0.72*	0.46*
2006-2007	0.76*	0.76*	0.44*

Note: *Significant at 5 per cent level

Table XII. Correlation coefficient

correlation between CMRs and "three month" and "six month" forward premia are given in Table XII. The significant correlation indicates co-movements of rates, which is an encouraging sign of market integration.

6.3.4 Relationship domestic interest rates and international interest rates. When domestic financial markets integrate with world financial markets, domestic interest rates lose their autonomous character and become influenced by international pulls and pressures. To test this in the Indian context, very short-term interest rate (CMRs) is regressed against USA Fed Fund rates and outstanding domestic liquidity.

The regression results (Table XIII) indicate that CMR is influenced both by the domestic liquidity and Fed Fund rate. From the above analysis, it can be generally inferred that the very short-term domestic financial market (call money market) is integrated with the short-term financial market of the USA.

6.3.5 Savings-investment correlation. The financial liberalization has opened up the way for domestic industries to tap the global financial markets and thus, domestic investment would be independent of domestic saving. If this happens, then the domestic capital market would be integrated with that of World capital market. Following the Feldstein and Harioka (1982) and Feldstein and Bacchetta (1991), an empirical analysis has been carried out to test the capital market integration.

As per the results (Table XIV) the coefficient of investment-income ratio is significantly different from zero and thereby implies that domestic investment and domestic savings have significant connectivity. In other words, the capital inflows have not been able to integrate the domestic capital market with the world capital market.

6.3.6 Interest rate parity hypothesis. Since all variables for testing of interest rates parity hypothesis are I(0), OLS is used to estimate the equations. The results of CIP, UIP and RIP hypotheses are presented in Tables XV-XVII, respectively. The results show that the parameters estimated are statistically significant. However, the Wald test of restrictions (joint hypothesis) imposed on parameters ($\alpha = 0$; $\beta = 1$) are rejected for the CIP, UIP and RIP hypotheses. In a nutshell, the interest rate parity hypotheses

Table XIII. Call money rate = F (Fed Fund, domestic liquidity)

Parameter	Domestic liquidity	Fed Fund rate	Intercept
Coefficient *t*-statistic	-0.00007^{*} (-2.7306)	2.885^{*} (2.4158)	1.1666 (0.25676)
$R^{-2} = 0.79$	$F(4,87) = 10.54^{*}$	D-W = 2.0082	

Note: *Significant at 5 percent

Table XIV. Empirical estimation of capital market integration

Parameter	OLS	Cochrane-Orcutt (AR(2))
Investment-income ratio (I/Y)	0.8003^{*} (13.045)	0.7465^{*} (30.69)
Intercept	3.7127^{*} (2.7072)	4.896^{*} (8.3317)
R^{-2}	0.968	0.998
$F(1,15)$	270.181^{*}	289.66^{*}
D-W	0.568	2.014

Note: Dependent variable: saving-income ratio (S/Y); *significant at 5 per cent level

do not appear to hold good under the Indian situation. Imperfect substitutions of assets, trade restrictions, control over capital flows and also high-risk primia are some possible reasons for interest rate parity conditions not holding in India.

7. Conclusion

Economic and financial sector reform measures, which have been continuing in India since 1991, facilitated the process of financial integration. Trade barriers have been declining and tread-GDP ratio and capital inflows have been accentuating. Various segments of the money market are integrated. There is evidence of integration between money and gilt markets. However, money and credit market integration results are not conclusive. Econometric analysis has supported the integration between call money and foreign exchange markets. Capital and money integration is inconclusive. Interest rate parity does not hold in the case of India, which indicates poor evidence in support of international integration of domestic financial markets. Similarly, the analysis of the relationship between domestic saving and domestic investment does not support

Parameter	OLS	Cochrane-Orcutt (AR(2))
α	4.58* (8.25)	5.62* (3.55)
β	0.55* (7.11)	0.81* (6.56)
R^{-2}	0.42	0.82
DW	0.45	1.993
Wald test	CHSQ(2) = 68.6*	CHSQ(2) = 218.2*

Note: Dependent variable: rupee-dollar forward premia

Table XV. Empirical estimation of CIP hypothesis

Parameter	OLS	Cochrane-Orcutt (AR(2))
α	4.6135* (6.697)	4.8654* (3.0439)
β	− 0.40279 (− 2.9793)	− 1.17944* (− 3.1539)
R^{-2}	0.583	0.818
DW	0.927	2.0116
Wald test	CHSQ(2) = 48.321*	CHSQ(2) = 17.576 *

Note: Dependent variable: interest rate differential

Table XVI. Empirical estimation of UIP hypothesis

Parameter	OLS	Cochrane-Orcutt (AR(2))
α	4.6135* (6.697)	4.1512* (3.3086)
β	− 43.027* (− 9.98)	− 2.8024* (− 3.0368)
R^{-2}	0.583	0.3063
DW	0.927	2.0101
Wald test	$\chi^2(2) = 48.321$*	$\chi^2(2) = 24.944$*

Notes: Dependent variable: real interest rate differential, *significant at 5 per cent

Table XVII. Empirical estimation of RIP hypothesis

international integration. The study of co-integration of Nasdaq and BSE also revealed an absence of international integration. A number of impediments in the forms political risk, transaction costs, taxation, capital controls and capital market imperfections prevent complete integration of the domestic and world financial markets. The results revealed that though complete financial integration is not there, the economy has been consistently moving along the path of noticeable degrees of integration with the world financial markets.

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