

Financial Integration for Indian Stock Market

Sadhan Kumar Chattopadhyay
&
Samir Ranjan Behera[†]

Abstract

The Indian stock market is considered to be one of the earliest in Asia, which is in operation since 1875. However, it remained largely outside the global integration process until 1991. A number of developing countries in association with the International Finance Corporation and the World Bank took steps to establish and revitalize their stock markets as an effective way of mobilizing and allocation of funds. In line with the global trend, reform of the Indian stock market also started with the establishment of Securities and Exchange Board of India (SEBI), although it became more effective after the stock market scam in 1991. With the establishment of SEBI and technological advancement Indian stock market has now reached the global standard. The major indicators of stock market development show that significant development has taken in the Indian stock market during the post-reform period. This paper seeks to examine in this context whether reform in the Indian stock market has led to integration with the developed stock markets in the world. The study finds that contrary to general belief, Indian stock market is not co-integrated with the developed market as yet. Of course, some short-term impact does exist, although it is found to be unidirectional for obvious reasons. That is to say, the developed stock markets, viz., USA, UK and Hong Kong stock markets Granger cause the India stock market but not vice versa. However, the study does not find any causality between the Japanese stock market and Indian stock market. It is derived from the study that although some positive steps have been taken up, which are responsible for the substantial improvement of the Indian stock market, these are perhaps not sufficient enough to become a matured one and hence not integrated with the developed stock markets so far.

Keywords: unit roots test, cointegration, Vector Autoregression Model, Variance Decomposition, Impulse Response Function.

JEL Classification: G12, G15

Address for Correspondence

Sadhan Kumar Chattopadhyay

Research Officer

Department of Economic Analysis and Policy

Reserve Bank of India (2nd Floor)

Maratha Mandir Marg

Mumbai - 400 008

E-mail: skchattopadhyay@rbi.org.in

[†] Shri Chattopadhyay and Shri Behera are the Research Officers in the Department of Economic Analysis and Policy of the Reserve Bank of India. Views expressed here are those of the authors and do not necessarily reflect the views of the Organization there are working with.

Section I: Introduction

One of the most important national policy decisions during the late twentieth century and forepart of this century has been the financial liberalization of equity markets across the world. Equity market liberalization gives foreign investors the opportunity to invest in domestic equity markets and domestic investors the right to transact in foreign equity market. However, it is important to distinguish between the concepts of liberalization and integration. For example, a country might pass a law that seemingly drops all barriers to foreign participation in domestic capital markets. This is liberalization, but it may not be an effective liberalization that results in market integration.

The main objective of this paper is to investigate the issue of stock market integration in India in the light of financial liberalization. Following the global trend financial liberalization has also started in India since 1992. Increasing globalisation of the world economy should obviously have an impact on the behaviour of domestic stock markets (Cerny 2004). The relaxation of all types of economic barriers and developments in information technologies are, among others, expected to induce stronger stock market integration as opposed to stock market fragmentation. As well-developed and large financial markets contribute significantly to economic growth [see Arestis, Demetriades and Lunitel (2001) and Beck, Levive and Loeyssa (2000)], the development and integration of Indian financial markets is of particular importance. Further, the nature and extent of equity market integration is of importance for corporate managers as it influences the cost of capital, and for investors as it influences international asset allocation and diversification benefits (e.g. Sentana (2000)). Since the work of Grubel (1968) on expounding the benefits from international portfolio diversification, the relationship among national stock markets has been widely studied. Hence the relationship among different stock markets has great influence on investment because diversification theory assumes that prices of different stock markets do not move together so that investors could buy shares in foreign as well as

domestic markets and seek to reduce risk through global diversification. Under this backdrop, it is worth examining whether Indian stock market has really integrated with the world markets. The study finds that in the short run, while US, UK and Hong Kong stock markets Granger cause the Indian stock markets, the Indian stock does not Granger cause the above markets which appears to be plausible. However, the study finds that the Indian stock market (BSE Sensex) is not cointegrated with the developed markets and hence not sensitive to the dynamics in these markets in the long run.

The rest of the paper is organized as follows. As a prelude to our statistical investigation **Section II** explains the liberalization measures adopted in the Indian stock markets since 1991 and the development of the stock market, which has taken place so far. **Section III** presents the survey of literature on stock market integration, **Section IV** discusses the data and gives the methodology being employed, **and Section V** ends with the concluding observations.

Section II: Stock Market Reform in India and its aftermath

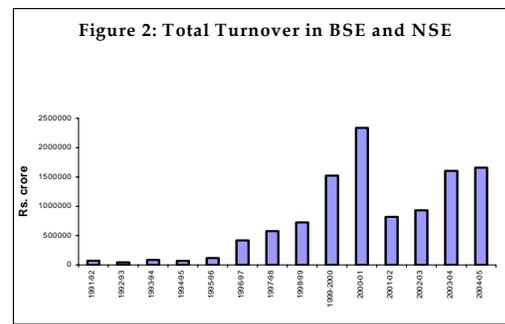
The Indian stock market is one of the earliest in Asia being in operation since 1875, but remained largely outside the global integration process until the late 1980s. A number of developing countries with the initiative of International Finance Corporation and the World Bank started the reform process in the stock markets in order to mobilize finance in an effective way. In line with the global trend, Indian stock market also initiated the reform process in the financial market in general and stock market in particular. However, the critics argue that the stock market reform of the 1990s in India is an offshoot of the crisis erupted in 1992 owing to the infamous stock market scam (Shah and Thomas 2001). Thus, it is claimed that although reform process in India started with the establishment of Securities and Exchange Board of India in 1988 to frame rules and guidelines for various operations of the stock exchange in India it was not that active as it became after the post-scam period. Over the decade of 1990s, a series of measures in the stock

markets were taken. The stock markets introduced the best possible systems practised in advanced stock markets, viz., electronic trading system, dematerialisation of shares, replacement of the Indian carry forward trading system called '*badla*' by the index-based and scrip-based futures and options; rolling settlement in place of the account period settlement; adoption of risk management through 'novation' at the clearing corporation etc. With the introduction of these advanced practices transparency has also increased in the stock market. Further, among the significant measures of opening up of capital market, portfolio investment by foreign institutional investors (FIIs) such as pension funds, mutual funds, investments trusts, asset management companies, nominee companies and incorporated portfolio managers allowed since September 1992 have made the turning point for the Indian stock markets. As of now, India is allowed to invest in all categories of securities traded in the primary and secondary segments and in the derivative segment. On the other hand, the ceiling on aggregate equity of FIIs including NRIs (non-resident Indians) and OCBs (overseas corporate bodies) in a company engaged in activities other than agriculture and plantation has been enhanced in phases. Further, with the financial sector reforms initiated in 1991, not only FIIs and NRIs are allowed to invest in Indian stock markets, Indian corporate have also been allowed to tap the global market with global depository receipts (GDR), American depository receipts (ADR) and foreign currency convertible bonds (FCCB) since 1993. However, the company with good track record is required to obtain prior permission from the Government of India in order to issue GDR/ADR/FCCB¹.

With the automation and liberalization of the Indian stock markets there has been a perceptible change in the Indian stock market towards the later part of the 1990s and fore part of the current decade. Trading system in BSE and NSE has no doubt reached a global standard. It has created a nationwide trading system that provides equal access to all investors irrespective of their geographical location. In that sense, technology has

¹ For details of the stock market development see Patil, 2000.

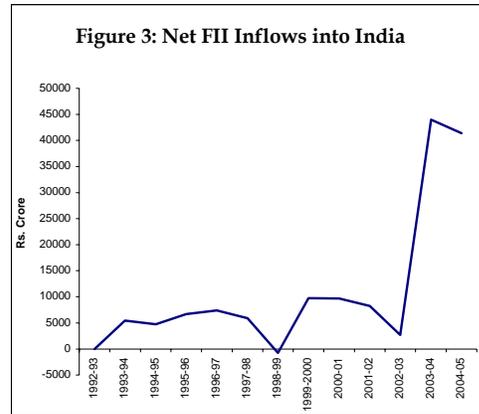
brought about equality among the investors across the country. This has resulted in phenomenal growth of Indian stock market during the post liberalization period. The number of shareholders and investors in mutual funds rose from 2 million in 1980 to 40 million in 1993 (Biswal and Kamaiah 2001). This makes the Indian investors' population the second largest in the world next to US and largest in terms of companies listed, with nearly 7,985 companies listed by the end of 1995 (Misra 1995). Besides, the Bombay Stock Exchange is reported to have the highest density of transactions in the world behind only Taiwan (Biswal and Kamaiah 2001). The daily turnover of shares in BSE increased substantially from Rs. 13 crore in 1980-81 to Rs. 2054 crore in 2004-05. Due to the policy changes listed above, the market capitalization increased from Rs.3,68,071 crore in 1993-94 to Rs.16,98,428 crore in 2004-05 (Figure 1). The total turnover that reflects the volume of business has also increased gradually over the years (Figure 2). Further, the market capitalization ratio, which is considered to be an important indicator of stock market size, gradually increased from 42.8 per cent in 1993-94 to 54.7 per cent in 2004-05² (Table 1). Further, the value traded ratio, the second development indicator which acts as a measure of liquidity of the stock market, also



increased from 9.8 per cent in 1993-94 to 16.7 per cent in 2004-05. Another important indicator of the stock market development is the turnover ratio which complements to the value traded ratio in measuring the stock market liquidity, increased from 23.0 per cent in 1993-94 to 30.5 per cent in 2004-05. The average daily trading volume on the Bombay stock market in the early

² In terms of economic significance, market capitalization as a proxy for market size is positively related to the ability to mobilize capital and diversify risk.

1990s was about the same as that in London – about 45,000 trades a day. The number of FIIs registered with SEBI increased from only 10 in January 1993 to 350 by the end of January 1996 and by end March 2004, the number increased to 540. Consequently, the liberal policies have led to increasing inflow of foreign investment in India in terms of portfolio investment increasing from Rs. 4.3 crore in 1992-93 to Rs. 41416.4 crore in 2004-05 (Figure 3). On the other hand, the process of integration received impetus further when the



Indian companies were allowed to raise funds by issuing euro issues. As a result, starting with issue of Reliance in 1992, around 100 companies have so far taken advantage of global market by raising funds of Rs. 47,337.88 crore as at end 2004.

Table 1: Stock Market Development Indicators

Year	Market-cap Ratio	Value Traded Ratio	Turnover Ratio
1	2	3	4
1993-94	42.8	9.8	23.0
1994-95	43.0	6.7	15.6
1995-96	44.3	4.2	9.5
1996-97	33.9	9.1	26.8
1997-98	36.8	13.6	37.1
1998-99	31.3	17.9	57.2
1999-2000	47.1	35.4	75.0
2000-01	27.4	47.9	175.0
2001-02	26.9	13.5	50.2
2002-03	23.2	12.7	54.9
2003-04	43.5	18.2	41.8
2004-05	54.7	16.7	30.5

Source: Calculated from the data given in Handbook of Statistics on the Indian Economy

From the above analysis it is evident that the stock market in India has witnessed a phenomenal but uneven growth during the post liberalization

period. In other words, the deregulation and market liberalization measures and the increasing activities of multinational companies have accelerated the growth of Indian stock market. Thus, given the newfound interest in the Indian stock markets during the liberalization period, an intriguing question may obviously arise in one's mind as to how far India has gone down the road towards international stock market integration, and whether any linkages have taken place among the stock indices of India and world's major stock indices. To answer these questions, we examine the interrelationship between Indian stock markets and major developed stock markets and study the underlying mechanism through which the Indian stock indices interact with international stock indices by analyzing empirically the long-run pairwise, and multiple cointegration relationship and short-run dynamic Granger causality linkages between the Indian stock market and the major developed markets, viz., USA, UK, Japan and Hong Kong in the post liberalization period.

Table 2: Number and Quantum of Euro Issues

Month	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05
April	279.98 (1)	4.49 (1)	612.5 (2)	1842.94 (1)			1200.65 (2)			71.01 (1)	155.34 (1)
May	221.48 (2)		52.50* (2)	385 (2)		7.28 (1)	649.35 (2)		99.53 (1)		614.5 (3)
June	625.54 (3)	277.2 (1)	125.6 (2)					1480.31 (3)		153.42 (1)	
July	1113.64 (4)		402.5 (1)		63.1 (1)		774.86 (2)			128.04 (2)	
August	936.42 (5)		700 (1)				348.08 (1)	813.33 (1)		1309.06 (1)	596.78 (2)
September			455 (2)	40.18 (1)		1373.28 (1)	52.4 (1)	91.17 (1)		157.54 (2)	
October	529.79 (2)		945.39 (2)			375.24 (1)	80.03 (1)		1147.31 (4)		
November	958.82 (6)		1425.99 (2)							578.95 (3)	1003.29 (2)
December	1636.7 (7)		150.25 (2)	1614.04 (2)		130.47 (1)			1921.2 (2)	434.93 (3)	
January	2.35* (1)	105 (1)	112.04 (1)	127.3 (1)			13.46 (1)		145.52 (2)	64.53 (1)	235.87 (3)
February	6.30* (1)					948.84 (1)	462.84 (1)			200.07 (4)	
March	432.19 (1)	910 (2)	612.5 (1)		1084.68 (2)	652.1 (1)	615.4 (2)		112.86 (2)		747.47 (4)
Total	6743.23 (31)	1296.69 (5)	5594.27 (16)	4009.46 (7)	1147.78 (3)	3487.21 (6)	4197.07 (13)	2384.81 (5)	3426.42 (11)	3097.55 (18)	3353.25 (15)

Notes: '-' indicates nil * represents warrants exercised by the investors attached to original GDRs issued and not to a fresh GDR issue.
 Figures in brackets indicate number of issues.

Source: Handbook of Statistics on the Indian Economy, RBI, 2004-05

Section III: Stock Market Integration - A Select Review of Literature

Although the study of financial integration dates back to late '70s, the number of study was scanty during that time due to conservativeness of the stock markets. However, the financial markets, especially the stock markets, for developing and developed markets have now become more closely interlinked despite the uniqueness of the specific market and country profile. This has happened specifically due to financial liberalization adopted by most of the countries around the world, technological advancement in communications and trading systems, introduction of innovative financial products and creating more opportunities for international portfolio

investments. This has intensified the curiosity among the academics in exploring international market linkages.

Earlier studies by Ripley (1973), Lessard (1976) and Hillard (1979) found low correlation between national stock markets supporting the benefits of international diversification. Applying the VAR models, Eun and Shim (1989) found the evidence of co-movements between the US market and other world equity markets. Cheung and Ng (1992) examined the dynamic properties of stock returns in Tokyo and New York and found that the US market is an important global factor from January 1985 to December 1989. Lee and Kim (1994) examined the effect of the October 1987 crash and concluded that national stock markets became more interrelated after the crash and found that the co-movements among national stock markets were stronger when the US stock market is more volatile. Applying the VAR approach and the impulse response function analysis, Jeon and Von-Furstenberg (1990) show that the degree of international co-movement in stock price indices has increased significantly since the 1987 crash. On the other hand, Koop (1994) used Bayesian methods and concluded that there are no common trends in stock prices across countries. Further, Corhay, et al (1995) study the stock markets of Australia, Japan, Hong Kong, New Zealand and Singapore and found no evidence of a single stochastic trend for these countries.

Although there is no dearth of literature on financial integration, there are only a few studies existing on this area in case of India. Not only that most of the studies are very old and carried out during the time when Indian stock markets were not open to the world. For instance, Sharma and Kennedy (1977) examined the price behaviour of Indian market with UK and US markets and concluded that the behaviour of Indian market is statistically indistinguishable from that of the US and UK markets and found no evidence of systematic cyclical component or periodicity for these markets. Applying Cross-Spectral analysis Rao and Naik (1990) found that the relation between Indian stock market and international markets are weak. Ignatius (1992)

compared returns on the BSE Sensex with those on the NYSE S&P 500 Index and found no evidence of integration. Agarwal (2000), with a correlation coefficient of 0.01 between India and developed markets, concluded that there is a lot of scope for the Indian stock market to integrate with the world market. Hansda and Ray (2002) found that Nasdaq and other technology-oriented indices of the NYSE have their influence on the domestic stock prices. By using the BSE 200 data, Wong, Agarwal and Du (2005) have found that the Indian stock market is integrated with the matured markets of the World. As mentioned above that some of the studies are age-old and have lost relevance especially after the opening up the economy to the rest of the world since early 1990s, from which the relationship between the Indian stock market and international markets may have changed. Some other studies except Wong et al (2005) which are relatively new have not done any co-integration analysis to examine the long-run relationship. Although Wong et al (2005) have studied the stock market integration they have taken BSE 200 data and also they have dealt with monthly data which have its own limitation³. Hence our paper revisits the issue of nature of co-movement between the developed and emerging markets.

Section IV: Data and Methodology

We have taken daily BSE Sensitive Index (SENSEX) comprising 30 most sensitive scrips. BSE Sensex is considered as the 'core barometer' of the Indian stock market for a number of reasons, viz., i) oldest stock exchange in Asia, ii) it is the premier bourse with the largest listing, iii) it attracts a major chunk of the foreign institutional investment and iv) popularity (Hansda and Ray 2002). In contrast, Wong, Agarwal and Du (2005) have used BSE 200 instead of BSE Sensex data, although the latter is more representative for the Indian stock markets and it does not have the problem of non-trading as mentioned in Wong et al (2005). We have used daily data in order to capture potential interactions, for example, impulse responses, because a month or

³ The main limitation is BSE 200 data is not the representative of Indian stock market.

even a week may be long enough to obscure interactions that may last only a few days (Cotter, 2004)⁴. Our sample covers the period from January 1999 to April 2005, a total of 1650 observations. We have taken the data for those days where markets were open in all the markets.

To test for Granger causality and cointegration, we use the standard methodology proposed by Granger (1969, 1986) and Engle and Granger as described in Enders (1995). All tests are performed on natural logarithm of the indices' time series using OLS estimation procedure.

In order to test for Granger causality among stock market indices y_t^l and y_t^f , we estimate the equation

$$\Delta y_t^l = \alpha_0 + \sum_{i=1}^n \alpha_{1i} \Delta y_{t-i}^l + \sum_{i=1}^m \alpha_{2i} \Delta y_{t-i}^f + \varepsilon_{1t}$$

$$\Delta y_t^f = \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta y_{t-i}^f + \sum_{i=1}^m \beta_{2i} \Delta y_{t-i}^l + \varepsilon_{2t}$$

and perform an F test for joint insignificance of the coefficients. The null hypothesis claims that y_t^f does not Granger cause y_t^l or vice versa. Therefore, a rejection of the null hypothesis indicates a presence of Granger causality. For each pair of stock market indices, we perform two Granger causality tests so that we can decide whether y_t^f Granger causes y_t^l or y_t^l Granger causes y_t^f or both, or none.

In order to examine the co-movement between the Indian stock market and the developed markets, we strictly follow the standard methodology available in the literature. We first study the relationship between the Indian stock markets and foreign markets by the simple regression:

$$y_t^l = \alpha + \beta y_t^f + e_t \quad [1]$$

⁴ Cotter, John (2004): "International Equity Market Integration in a Small Open Economy: Ireland January 1990-December 2000", *International Review of Financial Analysis*, 13(2004) 669-685.

where the endogenous variable y_t^I represents the India's stock index; the exogenous variable y_t^f is the stock index of the foreign markets; e_t is the error term. In order to examine the joint effect from all important markets on the Indian market, we study the multiple regression:

$$y_t^I = \alpha + \beta_1 y_t^{f1} + \beta_2 y_t^{f2} + \beta_3 y_t^{f3} + \beta_4 y_t^{f4} \quad [2]$$

where y_t^{fi} are the stock indices for the USA, the UK, Japan and Hong Kong, for $i=1, 2, 3$ and 4 , respectively.

The validity and reliability of the regression relationship require the examination of the trend characteristics of the variables and cointegration test as the presence of unit root processes in the stock indices results in the spurious regression problem. Before testing for cointegration, we need to go for stationary test. In order to do so, we apply the Dickey-Fuller (1979, 1981) (DF) and augmented Dickey-Fuller (ADF) unit root tests based on the following regression

$$\Delta y_t = b_0 + a_0 t + a_1 y_{t-1} + \sum_{i=1}^p b_i \Delta y_{t-i} + \varepsilon_t \quad [3]$$

where $\Delta y_t = y_t - y_{t-1}$ and y_t can be y_t^I , y_t^f or y_t^{fi} , ε_t is the error term. Regression [3] includes a drift term (b_0) and a deterministic trend ($a_0 t$).

In addition, we apply the PP test developed by Phillips and Perron (1988) to detect the presence of a unit root. The PP test is nonparametric with respect to nuisance parameters and thereby is suitable for a very wide class of weakly dependent and possibly heterogeneously distributed data.

If both y_t^I , y_t^f (y_t^{fi}) are of the same order, say $I(d)$, $d > 0$, we then estimate the cointegrating parameter in (1) or (2) by OLS regression. If the residuals are stationary, the series, y_t^I and y_t^f (y_t^{fi}) said to be cointegrated. Otherwise, y_t^I and y_t^f (y_t^{fi}) are not cointegrated.

Cointegration exists for variables means despite variables are individually non-stationary, a linear combination of two or more time series

can be stationary and there is a long-run equilibrium relationship between these variables. If the error term in (1) or (2) is stationary while the regressors are individually trending, there may be some transitory correlation between the individual regressors and error term. However, in the long run, the correlation must be zero because of the fact that trending variables must eventually diverge from stationary ones. Thus the regression on the level of the variables is meaningful and not spurious.

The most common tests for stationarity of estimated residuals are Dickey-Fuller (CRDF) and Augmented Dickey-Fuller (CRADF) tests based on the regression:

$$\Delta \hat{e}_t = \gamma \hat{e}_{t-1} + \sum_{i=1}^p \gamma_i \Delta \hat{e}_{t-i} + \xi_t \quad [4]$$

where \hat{e}_t are residuals from the cointegrating regression (1) or (2) and p is chosen to achieve empirical white noise residuals for CRADF and set to zero for CRDF test.

We further apply the multivariate cointegrated system developed by Johansen (1988a,b). Assume each component $y_{i,t}$ $i=1, \dots, k$, of a vector time series process y_t is a unit root process, but there exists a $k \times r$ matrix β with rank $r < k$ such that $\beta' y_t$ is stationary. Clive Granger has shown that under regularity conditions we can write cointegrated process y_t as a Vector Error Correction Model (VECM):

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \dots + \Gamma_{p-1} \Delta y_{t-(p-1)} - \Pi y_{t-p} + \varepsilon_t \quad [7]$$

where $\varepsilon_t \sim \text{iid}(0, \Omega)$. The basic idea of the Johansen procedure is simply to decompose Π into two matrices α and β , both of which are $k \times r$ such that $\Pi = \alpha \beta'$ and so the rows of β may be defined as the distinct cointegrating vectors. Then a valid cointegrating vector will produce a significantly non-zero eigenvalue and the estimate of the cointegrating eigenvector. Johansen proposes a trace test for determining the cointegrating rank r , such that:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^k \ln(1 - \hat{\lambda}_i), \quad r=0,1,2,\dots,n-1$$

[8]

and proposes another likelihood ratio test whether there is a maximum of r cointegrating vectors against $r+1$ such that:

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad [9]$$

with critical values given in Johansen (1995).

Section V. Empirical Findings

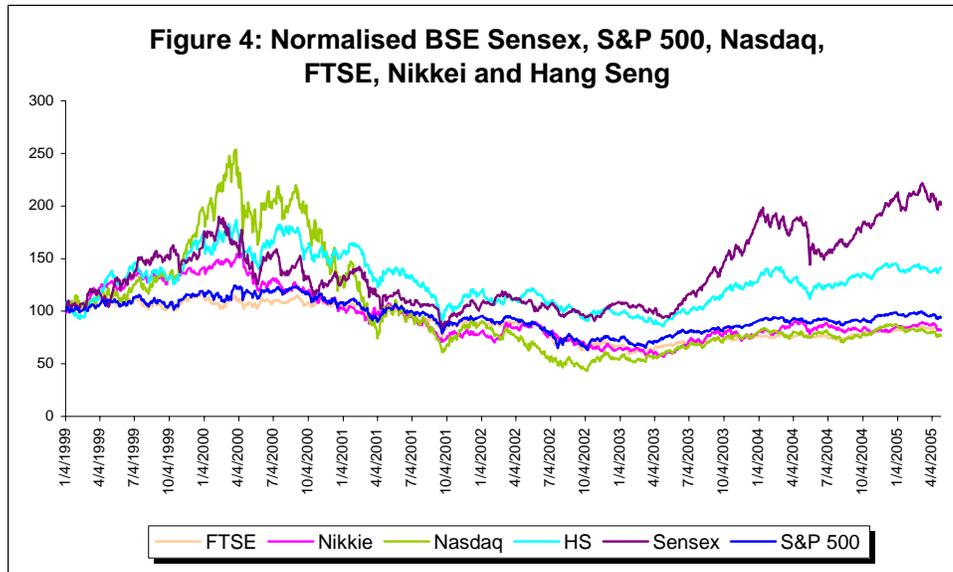
Some preliminary statistics are reported in Table 3, which shows that positively daily returns averaged approximately 0.5 per cent over the full period for the Sensex with a volatility of 1.8 per cent. There is evidence of excess skewness and kurtosis relative to the normal distribution. Cross-correlations provide a preliminary indicator of equity integration, with positive correlation exhibited for the period of analysis. The markets are most closely linked with US equities, although this is weakest for the Sensex, which has relatively strong links with the Hong Kong and Japan.

Table 3: Summary Statistics for Equity Index Returns

	Mean	Std. Dev.	Skewness	Kurtosis	Correlation						
					SENSEX	S&P	NASDAQ	FTSE	HS	NIK	
Sensex	0.511	1.81	-0.67	12.89	SENSEX	1.00					
S&P 500	-0.004	1.30	0.08	4.63	S&P	0.05	1.00				
Nasdaq	-0.019	2.61	0.09	4.31	NAS	0.06	0.83	1.00			
FTSE	-0.015	1.30	0.03	5.45	FTSE	0.12	0.48	0.36	1.00		
HS	0.025	1.56	-0.34	6.24	HS	0.33	0.19	0.19	0.37	1.00	
Nikkie	-0.015	1.52	-0.02	4.47	NIK	0.25	0.17	0.15	0.29	0.51	1.00

Note: The first two moments are expressed in percentage form

The daily stock indices of India (BSE Sensex), US (S&P 500 and Nasdaq), UK (FTSE), Japan (Nikkei) and Hong Kong (Hang Seng) are plotted in Figure 4. Figure 4 shows that basically all series are moving together in a long run. Prima facie it appears that there may have a common trend for all the series.



Apparently the figure shows that Indian stock market is moving along with US, UK, Japan and Hong Kong markets in the long run. However, before going to study the long-run relationship we would like to study the short-run relationship by examining the Granger causality relationship between India and any of the five developed stock markets. The results of this test are shown in Table 4. The results in Table 4 show that there is unidirectional causality in all the markets excluding one market. Unidirectional causality runs from S&P 500, Nasdaq, FTSE and Hang Seng. However, it is interesting to note that there is no causality between BSE Sensex and Nikkei.

Therefore, it may be concluded that there are unidirectional causality runs from the US stock market, UK stock market and Hong Kong stock markets but not from the Japan stock market to the Indian stock market and further there is no causality run from the Indian market to any of the market from the US, Japan or Hong Kong.

Table 4: Granger Causality Results for BSE Sensex Vs. Five Developed Stock Indices

Variable	Causality	F-Statistic	P-value
S&P 500	$S \& P500 \rightarrow BSESENSEX$	15.69*	0.00000018
	$BSESENSEX \rightarrow S \& P500$	0.31	0.73081
NASDAQ	$NASDAQ \rightarrow BSESENSEX$	14.39*	0.00000005
	$BSESENSEX \rightarrow NASDAQ$	0.22	0.80078
FTSE	$FTSE \rightarrow BSESENSEX$	12.09*	0.00000063
	$BSESENSEX \rightarrow FTSE$	0.62	0.53570
NIKKEI	$NIKKEI \rightarrow BSESENSEX$	1.43	0.23924
	$BSESENSEX \rightarrow NIKKEI$	1.03	0.35634
HANG SENG	$HANGSENG \rightarrow BSESENSEX$	3.53*	0.02946
	$BSESENSEX \rightarrow HANGSENG$	1.02	0.36193

Note: Figures in the brackets represent the t statistics.

*Denotes significant at 1 % level of significance.

The results between the US and Indian stock markets are obvious since the US market is the world's foremost securities market and has heavy influence on other stock markets. Hence one may not be surprised that US stock markets Granger cause the Indian stock market in the short run (Table 4). More rationally, several macroeconomic factors may give good explanation to the causal relationship between two stock markets. They include economic connection, regulatory structures similarity, exchange rate policy and trade flows. Coincided with the start of the liberalization of the Indian economy, there is a steady improvement in India-US trade relations during the last decade. US government has identified India as one of the 10 major emerging markets (Wong et al, 2005). The volume of India-US bilateral trade also started growing at a steady pace with the export from India to the US grows from US \$1209.5 million in 1980 to US \$13752.2 million in 2003.

On the other hand, the India-US trade volume still remains a small fraction of US's global trade. While US's export to India account for over 10% of India's non-oil imports and US is the destination of one-fifth of India's exports, US's trade turnover with India constitutes less than 1 % of its global trade. India's percentage share in US imports has remained stable over the last few years; it was 0.9% during 2003. In 2000, India ranked 21st among countries that export to the US. These figures show that US economy is very

important to Indian economy, though reverse is not true. This seems to be consistent with our result of unidirectional causality from S&P 500 to BSE Sensex.

The results in Table 4 also reveals the evidence of short-run impact of UK stock market to Indian stock market. It may be noted that after the opening up of the Indian economy since 1991 the bilateral trade between India and UK has been constantly increasing. UK continues to be India's second largest trading partner after US and continues to be the largest cumulative investor in India, and third largest investor in the post-1991 period. As Indian economy is linked with UK's economy closely, it is not surprising that UK stock market does have an impact on the Indian stock market.

However, no evidence of short-run impact from Japan stock market to Indian stock market can be found from the Table 4. Simultaneously Indian stock market dose not appear to influence the Japanese market. It may be mentioned that although there has been an increase in the volume of trade between India and Japan in absolute term in percentage it has gone down. The export from India to Japan has gone down from 3.3% in 1980 to only 3.1% in 2003. Although FII investment from Japan has increased, it is a very recent phenomenon and it is too early to make any conclusion in this respect.

On the other hand, the share of Hong Kong in export has gone up from 2.1 per cent in 1980 to 4.6 per cent in 2003. The evidence of short-run impact can be found from Table 4, although it is unidirectional. Hong Kong stock market is found to influence on the Indian stock, but not the reverse.

Cointegration

The issue to be addressed now is the nature of the long run relationship between the Indian equity market (SENSEX) and other markets. For the cointegration analysis, stationarity is first verified with estimates in Table 5. The results are consistent across the markets and support the previous studies. The hypothesis that each index contains a unit root is not

rejected, the markets are integrated of order 1, $I(1)$. Dickey-Fuller (DF and ADF) and Phillips-Perron (PP) statistics provide weak support for no cointegration. However, from Table 6 we find that both CRDF and CRADF statistics are not significant for any of the pairs. This led us to conclude that the Indian stock market is not integrated with US, UK, Japan and Hong Kong stock markets. Although CRDF and CRADF are significant at 1% level of significance for all variables taken together, this may not be justified to conclude that they are integrated. This is because cointegration test is based on the ADF test, which is known to have a low power (Cerny 2004)⁵. Not only that, testing cointegration with the help of ADF with more than two variables may not give the correct result. In such a situation, Johansen's cointegration test is the best measure for cointegration. As Johansen (1988) is a powerful way of analyzing complex interaction of causality and structure among variables in a system, this process is further applied to determine whether any cointegration relationship exists among India, US, UK, Japan and Hong Kong stock markets as all the markets are integrated of order one (Table 2). Lag structures are chosen according to Akaike's information criteria (AIC) and the results are shown in Table 7. From the Table, the hypothesis of zero cointegrating vectors against the alternative of one or more cointegrating vectors is not rejected. Therefore, it may be concluded that there are no cointegrating vectors. Thus the results in table show that the Indian stock market is not cointegrated with any of the markets. Absence of a cointegrating relationship suggests that in the long-run, stock prices are not driven by a common international risk factor in all markets.

⁵ Cerny, Alexandr (August 2004): "Stock Market Integration and the Speed of Information Transmission", Working paper series (ISSN 1211-3298), Center for Economic Research and Graduate Education, Academy of Sciences of the Czech Republic, Economic Institute.

Table 5: Unit Root Tests for the Daily Stock Indices of India, USA, UK, Japan and Hong Kong

Variable	DF	ADF	ADF Lag	$Z(\hat{\alpha})$
BSE Sensex	-1.14	-1.12	4	-1.17
S&P 500	-1.56	-1.50	4	-1.46
Nasdaq	-1.10	-1.02	4	-1.00
FTSE	-1.39	-1.32	4	-1.24
Nikkei	-1.10	-1.08	4	-1.07
Hang Seng	-1.78	-1.78	4	-1.85
Δ BSE Sensex	-36.36*	-15.79*	4	-36.36*
Δ S&P 500	-37.11*	-18.18*	4	-37.21*
Δ Nasdaq	-38.14*	-18.31*	4	-38.30*
Δ FTSE	-38.01*	-18.86*	4	-38.39*
Δ Nikkei	-36.86*	-17.05*	4	-36.88*
Δ Hang Seng	-35.30*	-16.48*	4	-35.30*

* $p < 1\%$

Note: DF is Dickey-Fuller t-statistic; ADF is the augmented Dickey-Fuller statistic; and $Z(\hat{\alpha})$ is the Phillips-Perron test statistic. All series are in log form. Δ is the differencing operator.

Table 6: Cointegration Analysis for Equity Indices

Equation ⁶	R ²	CRDF	CRADF
SENSEX = 3.70 + 0.66 (S&P 500)	0.19	-1.48	-1.17
SENSEX = 6.82 + 0.20(NASDAQ)	0.13	-1.17	-0.95
SENSEX = 6.54 + 0.21(FTSE)	0.03	-1.16	-1.07
SENSEX = 5.19 + 0.33(NIKKIE)	0.12	-1.10	-0.90
SENSEX = 0.40 + 0.84(HANG SENG)	0.42	-1.53	-1.37
SENSEX = -0.19 + 2.69 (S&P) - 0.46(NAS)-2.48(FTSE) + 0.69(NIKKEI) + 0.80(HANG SENG)	0.80	-6.49*	-4.66*

CRDF and CRADF are cointegrating regression Dickey-Fuller and Augmented Dickey-Fuller statistics. All equations are in log form.

*Significant at the 1% level.

⁶ He heteroskedasticity consistent matrix estimator developed by White (1980) are used to correct estimates of the coefficient covariances in the presence of heteroskedasticity unknown form.

Table 7: Johansen Cointegration Tests for the US, UK, Japan, Hong Kong and Indian Stock Markets

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.024367	85.91271	94.15	103.18	None
0.015855	52.28937	68.52	76.07	At most 1
0.014043	30.50546	47.21	54.46	At most 2
0.006197	11.22873	29.68	35.65	At most 3
0.001625	2.756572	15.41	20.04	At most 4
0.000396	0.540528	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. rejects any cointegration at 5% significance level

Since there are no linear combinations of the stock indices that are stationary there is no error correction representation. This brings us to the issue of dynamic relationship between the Indian equity markets and the other market. The dynamic relationship is broken into two areas of investigation. First, variance decomposition is examined with results presented in Table 8. The variance decompositions which show the proportion of the movements in the dependent variables that are due to their 'own shocks, versus shocks to the other variable, seem suggest that the US, UK, Japan and Hong Kong markets are to a certain extent exogenous in the system. That is little of the movement of the US, UK, Japan and Hong Kong stock markets can be explained by movements other than its own stock. After 10 days only 76% of movements in Indian stock markets are explained by its own stock. It seems mostly influenced by US (12.9% after 10 days) and Hang Seng (6.3% after 10 days) shock.

Turning to the impulse response estimates, Table 9 provides normalized responses for the Sensex for a typical shock to and from the Indian market. These responses represent unit shocks measured standard deviations. As can be seen from the results, the shock in one market does not have any impact on the Indian stock market. Such a result implies that possibility of making excess returns by trading in one market on the basis of 'old news' from another market appears very unlikely.

Thus the statistical results show that although short-term impact of the developed market on the Indian stock market exists, there is no long-run relationship between the Indian stock markets with the developed markets. There is no doubt that the Indian stock market has developed significantly due to various measures initiated by the Government of India after 1991. Then question may arise: why the Indian stock market is not integrated with the world markets? At this point it is important to distinguish between the concepts of liberalization and integration. For example, a country might pass a law that seemingly drops all barriers to foreign participation in local capital markets. This is liberalization, but it might not be an effective liberalization that results in market integration. The same thing happened in case of India. India has liberalized the economy to a larger extent, but we cannot claim that India is fully liberalized. Still now lot of restrictions are there in the country, which perhaps are the main hindrance of stock market integration. Although Tarapore Committee (1997) recommended for capital account convertibility, but it is not fully convertible. That is why individual investors are not allowed to invest in the foreign market. Only a handful of domestic corporates can raise funds by issuing ADR/GDR/FCCB in the foreign market subject to some conditions. In case of FII also, India has lot of restriction still now, which is listed in the Annexure 1. As can be observed from the Annexure 1 that Hong Kong, a developed market, does not have any restriction on foreign investment except the Hong Kong Television Broadcast stock that foreigners cannot hold more than 10 per cent and 49 per cent in aggregate.

Table 8: Forecast Variance Decomposition Analysis for Equity Market

Horizon	S&P 500	NASDAQ	FTSE	HANG		SENSEX
				NIKKEI	SENG	
S&P 500						
1	99.97507	0.000369	0.00284	0.018236	0.002982	0.000504
10	97.9084	0.035875	0.587313	0.267378	0.063754	1.137283
20	94.51368	0.267259	1.826367	0.425212	0.062162	2.905315
NASDAQ						
1	68.16554	31.77609	0.002957	0.000245	0.037645	0.017523
10	64.74624	33.41432	0.390631	0.019629	0.1199	1.309275
20	58.12087	37.73678	1.038757	0.063828	0.138223	2.901546
FTSE						
1	46.61888	0.44052	52.77436	0.082929	0.079285	0.004025
10	60.00424	0.460583	38.44982	0.612883	0.101111	0.371365
20	60.01485	0.278125	37.85565	0.605598	0.440048	0.805728
NIKKEI						
1	17.26589	1.576044	3.195312	77.68513	0.189556	0.088063
10	29.7814	2.459628	4.755255	60.4044	0.694742	1.904575
20	30.82076	2.865642	6.437719	53.75985	1.994363	4.121666
HANG SENG						
1	19.98827	1.964968	6.194870	7.271683	64.58002	0.000188
10	38.82942	2.515386	5.846752	2.359508	49.52425	0.924687
20	40.13109	3.372846	6.727372	1.967061	45.51251	2.289120
SENSEX						
1	0.457231	0.090569	0.708854	3.701469	4.475233	90.56665
10	12.89532	0.485362	0.895310	3.030701	6.272476	76.42083
20	15.66404	0.440617	0.528907	2.825719	5.782255	74.75846

Note: The forecast variance of each market price is broken into portions accounted for by price stocks coming from other markets represented in percentage form

Table 9: Impulse Responses for the SENSEX

No. of days	SENSEX	S&P 500	NASDAQ	FTSE	NIKKEI	HANG SENG
To SENSEX						
0	0.000827	0.001793	0.001208	0.002955	0.004095	0.017794
1	0.000832	0.002279	0.000912	0.003595	0.004199	0.017896
2	0.000988	0.002571	0.000905	0.003664	0.004188	0.017689
3	0.001147	0.002857	0.000924	0.003795	0.00428	0.017524
4	0.001297	0.003131	0.00094	0.003916	0.004367	0.017373
5	0.001438	0.003392	0.000956	0.004031	0.004451	0.01723
6	0.001572	0.003639	0.000972	0.004139	0.004531	0.017093
7	0.001698	0.003873	0.000989	0.004242	0.004608	0.016962
8	0.001817	0.004096	0.001005	0.004339	0.004682	0.016838
9	0.001929	0.004307	0.001021	0.004431	0.004752	0.016719
10	0.002035	0.004508	0.001038	0.004518	0.00482	0.016605
11	0.002135	0.004699	0.001054	0.0046	0.004885	0.016497
12	0.00223	0.004881	0.00107	0.004678	0.004947	0.016393
13	0.002319	0.005054	0.001087	0.004751	0.005007	0.016293
14	0.002403	0.005219	0.001103	0.004821	0.005065	0.016198
15	0.002483	0.005375	0.001119	0.004887	0.00512	0.016106
16	0.002559	0.005525	0.001135	0.004949	0.005173	0.016018
17	0.00263	0.005667	0.001151	0.005009	0.005224	0.015933
18	0.002697	0.005803	0.001167	0.005064	0.005273	0.015852
19	0.002761	0.005932	0.001183	0.005117	0.005321	0.015773
20	0.002821	0.006056	0.001199	0.005167	0.005366	0.015697
From SENSEX						
0	0	0	0	0	0	0.017794
1	0.00285	0.000687	0.000946	-2.11E-07	0.000347	0.017896
2	0.003566	0.00063	0.00042	-6.92E-05	0.000317	0.017689
3	0.003658	0.000579	0.000212	-6.45E-05	0.000283	0.017524
4	0.003873	0.000543	-3.37E-05	-6.73E-05	0.000231	0.017373
5	0.004053	0.000507	-0.00026	-7.32E-05	0.000184	0.01723
6	0.004226	0.000473	-0.00047	-8.23E-05	0.000137	0.017093
7	0.004389	0.00044	-0.00067	-9.44E-05	9.11E-05	0.016962
8	0.004543	0.000408	-0.00085	-0.00011	4.58E-05	0.016838
9	0.004688	0.000378	-0.00103	-0.00013	1.45E-06	0.016719
10	0.004825	0.000349	-0.00119	-0.00015	-4.20E-05	0.016605
11	0.004953	0.000322	-0.00135	-0.00017	-8.46E-05	0.016497
12	0.005075	0.000295	-0.00149	-0.00019	-0.00013	0.016393
13	0.005189	0.00027	-0.00163	-0.00022	-0.00017	0.016293
14	0.005297	0.000246	-0.00176	-0.00024	-0.00021	0.016198
15	0.005398	0.000222	-0.00188	-0.00027	-0.00025	0.016106
16	0.005493	0.0002	-0.00199	-0.0003	-0.00028	0.016018
17	0.005583	0.000179	-0.0021	-0.00033	-0.00032	0.015933
18	0.005667	0.000158	-0.0022	-0.00036	-0.00036	0.015852
19	0.005746	0.000138	-0.0023	-0.00039	-0.00039	0.015773
20	0.005821	0.000119	-0.00239	-0.00042	-0.00042	0.015697

Note: The impulse response coefficients represent the normalized response of a particular market to a shock of one standard error in another market.

Section V. Concluding Observations

India is one of the emerging economies, which have witnessed significant development in the stock markets during the recent periods due to the liberalization policy initiated by the government. It is generally believed that due to liberalization policy and the consequent development of Indian stock markets, the latter might have integrated with the developed markets. One may argue that due to this integration, which appears to have taken place after liberalization, Indian stock market will mainly be governed by a common factor as in the case of the developed markets. However, our study does not support this view. Rather, it finds that Indian stock market is not at all integrated with the world markets. Of course, the study finds that barring Japan there is a unidirectional causality from the developed market. Hence we may conclude that Indian stock market is not influenced by other markets. Of course, some short-term sentiment in the world market does have impact but this is short-lived. That means the pre-requisites, which are required for long-run relationship has not been achieved by India so far.

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Annexure -1
Restrictions on Foreign Ownership in Emerging Markets including India

S. No.	Country	Investment Restrictions
1	India	<p>i) Each FII (investing on its own) or sub-account cannot hold more than 10 per cent of the paid-up capital of a company. A sub account under the foreign corporate/individual category cannot hold more than 5 per cent of the paid-up capital of the company.</p> <p>ii) The maximum permissible investment in the shares of a company, jointly by all FIIs together is 24 per cent of the paid-up capital of that company</p> <p>iii) This limit of 24 per cent can be raised to 30 per cent, 40 per cent, 49 per cent or up to the FDI limits specified for that particular sector, subject to approval from the shareholders and the RBI.</p> <p>iv) In the case of public sector banks, the foreign ownership limit is 20 per cent.</p>
2	China	<p>i) Subject to the approved investment quota, QFII can invest on the following financial instruments:</p> <ul style="list-style-type: none"> • Shares listed in China's stock exchanges (excluding B shares); • Treasuries listed in China's stock exchanges*; • Other financial instruments as approved by CSRC**. <p>ii) QFII should observe the following requirements in A shares:</p> <ul style="list-style-type: none"> • Shares held by each QFII in one listed company should not exceed 10 per cent of total outstanding shares of the company • Total shares held by all QFII in one listed company should not exceed 20 per cent of total outstanding shares of the company. <p>iii) No restriction on investment in B shares</p> <p>iv) QFIIs are restricted or prohibited from investing in some industries or businesses (e.g. medicine manufacturing, mining, telecommunications, etc.)</p>
3	Taiwan	<p>1. Foreign institutional investors (FINIs) have no limit on investment while foreign individual investors (FIDIs) are subject to a US \$5 million investment quota.</p> <p>2. Foreign investors may invest up to 100 per cent of</p>

		<p>public-listed companies. However, foreign ownership limitation remains for some listed companies per the regulations and rules of relevant governing authorities e.g. banking industry where individual ownership cannot exceed 25 per cent for a single investor, and telecommunications companies, except the state-run Chunghwa Telecom stayed capped at 20 per cent, the foreign ownership of which cannot exceed 49 per cent.</p> <p>3. Foreign investors are allowed to put 30 per cent of their investment capital in TWD fixed deposits, margins or premiums of futures or options trading, and money market instruments (including bankers' acceptances, commercial papers and repos).</p>
4	South Korea	Foreign ownership limits on listed stocks have mostly been abolished. However, there are now 22 stocks that still have foreign ownership ceilings. Those include stocks issued by public companies and companies in specific industries such as broadcasting, aviation and telecommunications.
5	Hong Kong	There is no restriction on foreign investments except the Hong Kong Television Broadcast stock that foreigners cannot hold more than 10 per cent and 49 per cent in aggregates.
6	Indonesia	Currently, there are no restrictions on foreigners or non-resident investment in listed securities except for media stocks, in which the aggregate foreign ownership limit of 20 per cent applies.
7	Thailand	Foreigners are generally allowed to own up to 49 per cent of a Thai company whether listed or not. Foreign ownership may be limited by laws governing investment promotion licenses, concession permits, a particular company's memorandum/Articles of Association or some specific areas of business, such as commercial banks and finance companies where the limit on foreign ownership is 25 per cent.
8	Malaysia	Foreign investors are allowed to freely invest in any securities listed on the Stock Exchange. There are currently 36 companies listed on the MSEB, which have foreign shareholding limit. Foreign shareholdings limits can range between 25 per cent to 79 per cent although the general limit is 30 per cent. For banks and finance companies, the limit for foreign interest in local companies is 30 per cent.

9	Philippines	<p>Different industries are subject to different limits for foreign ownership. These limits range from zero to 60 per cent of the total equity of the enterprise:</p> <ul style="list-style-type: none"> • No foreign equity participation is allowed in mass media, engineering, medicine & other professional activities, retail trading, small scale mining etc. • Upto 20 per cent foreign equity is allowed in private radio communication. • Upto 25 per cent and 30 per cent foreign equity is allowed in private recruitment, locally funded public works; and advertising respectively. • Upto 40 per cent foreign equity is allowed in Exploration, development and utilization of natural resources, real estate, public utilities, education institutes, Operation of deep sea commercial fishing vessels etc. • Upto 40 per cent foreign equity is allowed in financing companies and investment houses regulated by the SEC.
10	Sri Lanka	<p>Foreign ownership limits are:</p> <ul style="list-style-type: none"> • Banking - 60 per cent • Insurance - 90 per cent • Stock broking Firms Licensed by the SEC - 100 per cent

* On 2nd December 2002, the Shanghai Stock Exchange and Shenzhen Stock Exchange announced in their "Implementation Rules for Securities Trading of Qualified Foreign Institutional Investors" that QFIIs cannot trade in corporate bonds and treasury bond repurchases until further notice.

** According to the CSRS, QFIIs can also invest in open-end or closed-end investment funds approved by the CSRC, initial public offers, rights issues, additional share issues and convertible bond issues.

Source: Report of the Committee on Liberalisation of Foreign Institutional Investment