A Research on India's Stock Market: A Fractional Economic Integration Method

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Abstract – 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 in concert with the International Finance Corporation and the World Bank took steps in the 1980s to establish and revitalize their stock markets as an effective way of mobilizing and allocation of finance. In line with the global trend, reform of the Indian stock market began with the establishment of Securities and Exchange Board of India in 1988. This paper empirically investigates the long-run equilibrium relationship and short-run dynamic linkage between the Indian stock market and the stock markets in major developed countries (United States, United Kingdom and Japan) after 1990 by examining the Granger causality relationship and the pairwise, multiple and fractional cointegration between the Indian stock market and the stock markets from these three developed markets. We conclude that Indian stock market is integrated with mature markets and sensitive to the dynamics in these markets in a long run. In a short run, both US and Japan Granger causes the Indian stock market but not vice versa. In addition, we find that the Indian stock index and the mature stock indices form fractionally cointegrated relationship in the long run with a common fractional, no stationary component and find that the Johansen method is the best reveal their cointegration relationship.

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.

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INTRODUCTION

National stock markets have emerged as the major channel for financial integration of emerging market economies amid globalization, deregulation and advances in information technology. Among the factors contributing to growing financial integration is a rapid increase in the cross-border mobility of private capital inflows due to investors seeking portfolio diversification and better yields, a growing reliance of nations on the savings of other nations, and a shift in the leverage preference of companies from debt to equity finance. It is generally perceived that financial integration can be associated with several benefits, including development of markets and institutions and effective price discovery, leading to higher savings, investment and economic progress. At the same

time, linkages among financial markets can pose various risks, such as the contagion and associated disruption of economic activities that were evident during the crisis in Asia in the late 1990s. More recently, in January 2008, national stock markets declined sharply in the wake of credit market developments in the United States. Economists have thus realized that it is useful for countries to monitor the progress of interdependence among financial markets for the sake of policy as well as market participants.

Recognizing the critical importance of financial assets to economic agents and policy, numerous studies in the applied finance literature have concentrated on measuring the international integration of national stock markets across several developed and emerging market economies. In the copious literature, however, studies focused on India's stock market are rather scarce,2 despite various stylized facts suggesting, prima facie, the growing linkage of the Indian market with global and major regional markets in Asia during the reform period beginning in the early 1990s.3 Illustratively, the Bombay Stock Exchange (BSE) of India has emerged as the largest stock exchange in the world in terms of the number of listed companies, comprising many large, medium-sized and small firms. With a market capitalization of US$ 1.8 trillion in 2007, the BSE has become the tenth largest stock exchange globally and come closer to advanced economies in terms of the ratio of market capitalization to gross domestic product. As regards transaction cost, the Indian stock market compares with some of the developed and regional economies. With the objective of internationalization, several Indian companies have opted for listing on the stock exchanges of other countries, especially the United States and the United Kingdom. Ten major Indian companies listed on the New York Stock Exchange (NYSE) account for a 19 per cent weight in the benchmark 30-scrip stock price index of the BSE. Fifty Indian companies are listed on the London Stock Exchange. Foreign capital flows have made a crucial contribution to the growth of India's stock market. India has become a major destination, representing about a fourth of total portfolio capital inflows to the emerging market economies (EMEs) group.

There are 1,247 foreign institutional investors participating in India's stock market. The purchase and sales activities of such investors account for three fourths of the average daily turnover in India's stock market.4 Since foreign investors operate in a number of countries at the same time, their operations can be expected to have contributed to the integration of the Indian stock market with other markets. Moreover, India has engaged in various bilateral trade and economic cooperation agreements with several countries and regional groups across Asia, Europe and the western hemisphere.

One of the most profound and far-reaching financial phenomenon in the late twentieth century and the forepart of this century is the explosive growth in international financial transactions and capital flows among various financial markets in developed and developing countries. This phenomenon in international finance is not only a result of the liberalization of capital markets in developed and developing countries and the increasing variety and complexity of financial instruments, but also a result of the increasing relativity of the developing and developed economies as developing countries become more integrated in international flows of trade and payments. More freedom in the moving of capital flows improves the allocation of capital globally, allowing resources to move to areas with higher rates of return. Contrarily, attempts to restrict capital flows lead to distortions of capital structure that are generally costly to the economies imposing the controls. Thus, the boost in international capital flows and financial transaction is an underway and, to certain extent, irreversible process.

In addition, the ever closer relationship among international capital markets and the increasing international portfolio investment have important implications for macroeconomic policies. While contributing to build-up of foreign exchange reserves, international portfolio investments can influence the exchange rate and could lead to appreciation of local currency. Thus, it has great influence on trade and fiscal imbalances among countries. Also, foreign portfolio investments are amenable to sudden withdrawals and therefore these have the potential for destabilizing an economy, with good examples from the Mexican and East Asian financial crisis in 1990s. Moreover, supported by technological advances in information and transaction, the growing internationalization of finance and the tremendous increase in the speed and volume of international capital flows have allowed much more rapid assessment of and response to the real growth possibilities in many countries.

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 globalization of the world economy should obviously have an impact on the behavior 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, 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.

Since its independence in 1947, a multitude of social and political problems have stood in India's way of realizing its true economic potential. However, it has recently made tremendous strides in the economic field through both economic and political reforms. The most significant policy should be the opening of the economy to foreign investment on very liberal terms for the first time in independent India's history. The policy soon harvested positive results as its industrial exports and foreign investment today are growing at the country's fastest rate ever. The country's foreign exchange reserves rose to US$51 billion in March 2002 from less than US$1 billion in June 1991.

As now the globalization of capital flows has led to the growing relevance of emerging capital markets, India is one of the countries with an expanding capital market that is increasingly attracting funds from the foreign countries. Actually, in line with the global trend, reform of the Indian stock market began with the establishment of Securities and Exchange Board of India (SEBI) in 1988 to frame rules and guidelines for various operations of the stock exchange in India. Nevertheless, the reform process gained momentum only in the aftermath of the external payments crisis of 1991 followed by the securities scam of 1992.

STOCK MARKET INTEGRATION

In the theoretical literature, financial market integration derives from various postulates such as the law of one price (Cournot (1927), Marshall (1930)), portfolio diversification with risky assets (Markowitz (1952)), capital asset price models (Sharpe (1964), Lintner (1965)) and arbitrage price theory (Ross (1976)). Despite distinguishing features, these postulates share a common perspective: if risks command the same price, then the correlation of financial asset prices and the linkage among markets comes from the movement in the price of risks due to investors' risk aversion. Based on these theoretical postulates, financial integration at the empirical level is studied using several de jure and de facto measures, although the latter, reflecting the actual degree of market linkages, have been more popular (Prasad et al (2006), Yu et al (2007)). Following the seminal works of Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990), numerous studies beginning with Taylor and Tonks (1989), Kasa (1992) and, subsequently, Masih and Masih (2005), Chowdhury (1997) and Chowdhury et al (2007), among several others in the applied finance literature, have used the cointegration hypothesis to assess the international integration of financial markets. Until Taylor and Tonks (1989) and Kasa (1992), studies relied on correlation and regression analyses to gauge the nature of price convergence and international portfolio diversification across markets (Levy and Sarnat (1970), Agmon (1972), Solnik (1974) and Panton et al (1976)). Taylor and Tonks (1989) showed that the cointegration technique is useful from the perspective of the international capital asset price model. Kasa (1992) suggested that the short-term return correlation between stock markets is not appropriate from the perspective of long-horizon investors driven by common stochastic trends. A cointegration model is useful since it not only distinguishes between the nature of long-run and of short-run linkages among financial markets, but captures the interaction between them as well. Given the wide popularity of the cointegration hypothesis, we refrain from rehashing the algebra of this methodology. What is striking about the empirical literature is that studies on the subject have brought to the fore various useful perspectives relating to price equalization, market equilibrium, market efficiency and portfolio diversification (Chowdhury et al (2007)).

The cointegration hypothesis: The cointegration hypothesis has a generalized and statistical perspective

on equilibrium dynamics among economic and financial variables. It begins with non-stationary variables with time-varying mean and variance properties. If the non-stationary variables are integrated within the same order – typically, the random walk or first-order integrated processes – then they may follow the path of equilibrium in the long run or share a cointegration relation, ie, a linear combination of them could be a stationary process. Within the multivariate vector error correction (VECM) framework of Johansen and Juselius (1990), the cointegration space may not be unique; there can be *r* cointegration relationships among *n* non-stationary variables. In the extreme case, if *r* = 0, then the variables are not cointegrated and they do not follow a long-run equilibrium path. Similarly, if *r* = *n*, then the cointegration and error correction dynamics are redundant for the system of variables. In practice, there can be a single or multiple but less than *n* number of cointegration relations. According to Gonzalo and Granger (1995), the evidence of cointegration among national stock indices implies equilibrium constraints, which preclude the cointegrated indices from diverging too much in the long run.

Such constraints emerge because these indices share common stochastic trends or driving forces underlying their mutual growth over extended time horizons. In contrast, a lack of cointegration suggests that stock markets have no long-run link and stock prices in different markets can diverge without constraint or without a trend. Stock market integration implies that the markets are exposed to similar risk factors and thus a common risk premium (Ahlgren and Antell (2002)). The existence of single long-run cointegration among stock market prices would imply that the unique long-run equilibrium path constrains markets. The cointegration test results are stronger, stable and more robust when there is more than one significant long-run vector (Johansen and Juselius (1990), Dickey et al (1991)). This is because for *r* cointegrating vectors, there are (*n* – r) common stochastic trends or factors underlying the dynamic linkages among the variables. The existence of multiple cointegrating vectors is consistent with the multifactor international capital asset pricing model (Bachman et al (1996)).

LITERATURE REVIEW

The financial markets, especially the stock markets, for developing and developed markets have now become more closely interlinked despite the uniqueness of the specific markets or the country profile. Literature has shown strong interest on the linkages among international stock markets and the interest has increased considerably after the loose of financial regulations in both mature and emerging markets, the technological developments in communications and trading systems, and the introduction of innovative financial products, creating more opportunities for international portfolio investments.

The interest can also be attributed to the globalization which gives another impetus to the higher intertwinement of international economies and financial markets. In recent years, the new remunerative emerging equity markets have attracted the attention of international fund managers as an opportunity for portfolio diversification. This intensifies the curiosity of academics in exploring international market linkages.

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.

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 cointegration 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.

CO-INTEGRATION ANALYSIS

Unit root test : The results of the Augmented Dickey-Fuller (ADF) unit root test in Table 1 suggest that all the representative stock price indices in their natural logarithm level are non-stationary series, with the deterministic trend including both the intercept and the time trend. In first difference form, however, these stock price indices are stationary, plausibly with an intercept only trend component. Thus, the chosen stock price indicators are

first-order integrated series, or I(1) processes.

	In level form (with intercept and trend)		First difference (with intercept)	
	ADF statistic (daily)	ADF statistic (weekly)	ADF statistic (daily)	ADF statistic (weekly)
LNYSE	–1.72	–1.55	–60.05	–24.80
LUK	–1.81	–1.60	–62.68	–24.29
LJP	–1.99	–2.00	–60.71	–23.06
LSNG	–1.42	–1.49	–54.47	–22.21
LHK	–2.35	–2.41	–33.45	–22.22
LBSE	–0.75	–1.05	–54.88	–20.63

Note: MacKinnon critical values are 3.4 and 3.1 for 5 per cent and 10 per cent level of significance, respectively.

Table 1 : Augmented Dickey-Fuller (ADF) unit root test of stock price indices in US dollars

Cointegration rank test : Empirical results of the cointegration rank test derived from Johansen's multivariate VECM involving the six stock prices chosen in the study. The tests were conducted for natural logarithm-transformed stock price indices measured in both US dollars and local currency over sample periods pertaining to the long sample (31 March 1993 to 18 January 2008 and two phases from 1 April 1993 to 31 March 2003) and the more recent period from April 2003 to 18 January 2008, using daily and weekly data and allowing

two alternative types of linear deterministic trends, referring to the intercept only and to the intercept as well as the time trend stock index component. There are two broad findings on the evidence of stock market integration. First, the cointegration test is sensitive to the underlying trend assumption. For stock price indices measured in US dollars for the long sample 1993–2008 and two alternative phases of the sample involving daily and weekly data, both the trace and the maximum Eigen value tests of Johansen's VECM support the evidence of a single cointegration relation with the linear trend component that includes the intercept as well as the time trend in stock market indices. Second, the currency denomination of stock prices plays an important role. Cointegration among stock markets could be supported for stock prices in US dollars for both weekly and daily data. However, for stock price indices measured in local currency, the evidence of cointegration among stock prices is not robust. Daily data could not support cointegration among stock prices in local currency for the whole sample, but could for two subsamples. On the other hand, weekly data on stock prices in local currency do not support cointegration of stock markets.

Short-run market linkage : The nature of short-run integration of stock markets is evident from the coefficient of the error correction term in the VECM error correction equations pertaining to the six stock price indices. First, for daily stock prices, it is clear that the Hong Kong, Singapore and US stock markets have an inverse response, whereas the Japanese and UK stock markets have a positive response to the short-term increase in the Indian stock market during 1993–2002. Second, the coefficient of the error correction term provides another important insight about the speed of adjustment of stock markets to the underlying long-run equilibrium path during the same period. Given an unanticipated positive shock, which would cause the Indian market to deviate from the long-run path, about half a year would be required by the Indian market to revert to its potential long-run trend path during 1993–2002. As regards the response of other markets to short-term changes in the Indian market, the Singapore and US markets would adjust at a relatively faster rate than the Hong Kong, Japanese and UK markets. Third, weekly stock price data show a much higher adjustment response than daily data for all markets, excluding the United Kingdom.

Some reflections on sample sensitivity : India's stock market witnessed a substantial jump from the second half of 2007, especially during the period between October 2007 and 18 January 2008. This had a significant impact in terms of strengthening India's long-run integration with global and regional markets, as evidenced by the cointegration relation estimated for the sample periods (i) from April 2003 to end-June 2007 and (ii) from April 2003 to 18 January 2008, based on daily stock price data in US dollars. The strengthening of India's integration was significant with respect to Hong Kong, Japan and the United Kingdom.

Another interesting finding emerges from the variance decomposition results of the VECM. Between April 2003 and September 2007, about 43 per cent of the total variation in the Indian stock market over a one-year horizon (250 trading days) could be attributable to global and regional markets, with the United States and Singapore playing a major role (25 per cent and 11 per cent, respectively). In other words, domestic factors had a large impact on the Indian stock market during this period. However, for the extended sample (April 2003–18 January 2008), the variance decomposition results showed that global and regional markets could have accounted for the major component (56 per cent) of the total variation in the Indian stock market, with the United States (38 per cent) and Singapore (9 per cent) making up the largest share.

METHODOLOGY

Weekly indices of the stock exchanges from DataStream for India and the three most developed countries including the United States, the United Kingdom and Japan are used as proxies to measure the stock market for each country, specifically, BSE 200 (India)2, S&P 500 (the United States), FTSE 100 (the United Kingdom) and Nikkei 225 Stock Average (Japan). Our sample covers the period from January 1, 1991 through December 31, 2003,

a total of 13 years and the indices are adjusted to be in terms of US dollars for better comparison. The weekly indices as opposed to daily data is used to avoid representation bias from some thinly traded stocks, i.e., the problems of non-trading and non-synchronous trading and to avoid the serious bid/ask spreads in daily data. In addition, we use Wednesday indices to avoid the day-of-the-Week effect of stock returns (Lo and MacKinlay 1988).

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 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.

If the Indian stock market and the other markets are not cointegrated, one can adopt the bivariate VAR model, see Granger *et al* (2000), to test for the Granger causality. When a set of variables is cointegrated, Engle and Granger (1987) point out that a vector auto regression in first difference will be misspecified because first differencing of all the no stationary variables imposes too many unit roots and any potentially important long-term relationship between the variables will be obscured. Thus inferences based on this model may lead to incorrect conclusions (Granger 1981, 1988 and Sims et al. 1990). Nevertheless, there exists an alternative representation, an error correction model (ECM) to test for the Granger causality between these variables by taking account of a long-run equilibrium relationship shared by the variables.

CONCLUSION

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 baring 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 pr-requisites, which are required for long-run relationship has not been achieved by India so far. This study investigated the nature of the financial integration of India's stock market with global and major regional markets. The empirical analysis provides various applied finance perspectives on cointegration among stock markets, checking the sensitivity of results to sample periods in an environment of structural shifts, to the currency denomination of stock prices, and to the frequency of daily and weekly data. Empirical evidence supports the international integration of India's stock market in terms of stock prices measured in US dollars but not in local currency, a finding attributable to investment decisions of foreign investors. The differential nature of stock market cointegration arising from US dollar- and local currency-denominated stock prices also has implications for the efficiency of national stock markets. At the same time, it was found that India's stock market provides opportunities for higher returns than other regional and global markets.

From a policy perspective, cointegrated stock markets would contribute to financial stability, since they cannot deviate too far from the long-run equilibrium path. From the standpoint of their portfolio diversification objective, investors cannot benefit from arbitrage activities in the long run. However, in the short run, markets would continue to be influenced by the portfolio diversification objective of foreign investors. The lack of evidence of integration of stock markets in terms of local currency gives rise to a concern that India's stock market integration may not be complete, a finding attributable to the inadequate role of domestic investors.

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