Financial Interdependence of International Stock Markets: A Literature Review

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Abstract

In financial literature, interdependence of capital markets is synonymous with the measure of co-movement between them. Hence, the necessity to understand the genesis of interdependence of stock markets arises from its consequences on monetary and trade policies, resource allocation, capital requirements, and risk hedging. The co-movement of stock indices has been the subject of study since 1970s, and researchers have studied the time-varying correlations and impact of new information on stock returns. This study surveyed the existing literature on linkages between international stock markets. We provided an up-to-date coverage of studies on importance and drivers of stock market linkages. The paper also provided a review of contemporary methodologies to evaluate the level of integration between international stock markets. Our study provided an appendage to the existing literature on how the area of research on interdependence of stock markets has evolved with a focus on its cause and effect on the level of market integration and also highlighted the scope for further research in this area.

Keywords **: stock market linkage, interdependence, integration, uncovered asset return parity, international CAPM, volatility models**

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In the last few years, globalization of capital markets have led to their dependence on one another. On the one hand, liberalization of capital markets have improved economic ties among countries through policy coordination and have promoted economic integration by means of trade and investments. Emergence of regional trade blocs, monetary unions, and free trade zones have fostered cooperation and thereby increased inter-dependency among economies. On the other hand, deregulation of capital markets, financial innovations, and advances in information flow and mode of communication have intensified the inter-dependencies between capital markets of various countries. Evolution of international portfolio management (especially hedge funds), cross-listing of companies in stock exchanges of different countries, and allowance to foreign investment in financial markets have elevated the linkages between national and international financial markets. The literature on capital market interdependence has mainly focused on investigating the extent and manner in which international stock markets are integrated.

Literature Review

Importance of Stock Market Linkages

This section reviews the literature on understanding the extent to which financial markets are linked and gives

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insights to policymakers on how best to amplify the potential benefits of financial integration such as effective utilization of capital, trade, and collective economic growth while simultaneously finding appropriate policy responses aimed at finding financial stability, thereby minimizing the resultant economic vulnerability that market interdependence exposes.

↳ **Macro-Economic Benefits :** A well drafted monetary policy regulates the financial system in a manner that ensures low rate inflation, stability of interest and exchange rates, higher employment, and overall growth of the economy. Mishkin (2007), while articulating the importance of stock markets in the transmission of monetary policy, identified three channels through which monetary policy gets transmitted to financial assets and their relative prices. The first channel [1] emphasized on monetary policy affecting the economy through its effects on the valuation of equities and investment spending. An expansionary monetary policy increases expenditure on stocks, thereby bidding their prices upwards. This means that firms can issue shares and raise capital to finance projects less expensively, thereby increasing spending, employment, and output in the economy. The second channel showed the effect of monetary policy on consumer spending through its effect on the wealth of households [2]. An expansionary monetary policy will increase the price of stocks, thus raising the wealth of households, which, in turn, results in an increase in consumption, spending, and output. The third channel highlighted the transmission of monetary policy on the exchange rates and its effect on capital flows and net exports for an open and liberalized economy having a floating exchange rate regime.

Through a reduction in interest rates, an expansionary monetary policy will lower the value of the domestic currency, relative to other foreign currencies, thereby causing flow of capital from the domestic country (having lower interest rates) to other foreign markets. This will help to raise the competitiveness of domestic goods and services in international trade (as compared to foreign goods and services), thereby increasing the net export position of the domestic country, and thus, its aggregate output. On the other end, Bernanke and Gertler (1999, 2001) argued that monetary policy should continue to focus on achieving sustainable growth and that responses of monetary policy to stock market volatility must be confined to an extent that such asset price volatility is perceived to exert expected inflationary pressure on the economy.

As financial economies around the world become more interdependent, interest rate fluctuations in major countries may tend to induce important effects on other countries (Hall, Robertson, & Wickens,1992). Interest rate fluctuations can cause stock market instability and irrational pricing of stocks. The implication of this is that stock prices cease to be aligned with economic fundamentals in the domestic markets (Frankel, Schmukler, & Serven, 2004). In view of the possible destabilizing effects of financial integration, Cecchetti, Genberg, Lipsky, and Wadhwani (2000) asserted that policymakers should react to mis-alignments in stock prices to reduce the probability of the occurrence of asset price bubbles.

Related to the discussion on the effect of monetary policy and financial system regulation on the stock market in the wake of financial integration of global markets is the issue of financial stability and policy signaling. Agénor (2003) and Agénor and Montiel (2008) observed that by rewarding good policies and penalizing the bad ones, enhancement of financial integration - in the form of relaxing the barriers to allow free flow of capital across borders - may impel countries to adopt more disciplined macroeconomic policies, thus instilling financial stability. Bartolini and Drazen (1997) argued that financial liberalization plays a 'signaling' role - hinting that a country is ready to cooperate with other economies, willing to adopt sound economic policies to encourage trade and investment, and participate in global economic welfare while ensuring sustainable growth.

In financial literature, while there is an agreement regarding the growing financial integration of national capital markets and its potential economic benefits, there is, however, little consensus on whether financial integration leads to economic growth or vice-versa, or whether the causality is both ways. On the issue of

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[1] The first channel is an offshoot of the Tobin's *q* theory (Tobin, 1969).

[2] Here, a major component of household wealth is assumed to be an investment in securities.

economic benefits emanating from financial integration, there are two views, which are rather complementary to each other. The first view points out the growth effects of financial integration, where pooling of risks facilitates the inter-temporal smoothing of risk and consumption as well as enhances the efficiency with which the savings are allocated (Cole & Obstfeld, 1991; Lee & Shin, 2008). Levine (2001) found that closer financial ties with international markets have the potential to strengthen domestic financial systems, which, in turn, lead to more investment, more efficient allocation of capital, and eventually greater economic growth. At a global level, Obstfeld (1994) proposed a continuous-time stochastic model wherein increase in financial integration enhances efficient capital allocation, which helps to facilitate international risk sharing, thereby having a positive impact on economic growth.

The second view highlights the benefits due to financial integration in a manner in which it enables capital accumulation, skill, and technology transfer primarily through foreign direct investment (FDI). This view got further support from the works of Grossman and Helpman (1991) and Barro and Sala-i-Martin (2004), who took into account the role played by technology transfer in economic growth. Levine (1996, 1997, and 2001) argued that easing restrictions on entry of the foreign banks in the domestic market may improve the quality, price, and availability of banking services since foreign banks may bring with them new and better skills, management techniques, and products, which will stimulate competition and thereby enhance efficiency in the domestic financial system.

The above theories are particularly evident in case of India. Since the economic liberalization which started in the year 1991, the country has seen a surge in foreign investment both in the banking sector in the form of foreign banks and in the stock market through foreign direct investment. As a result, it has been found that foreign banks' penetration in India has improved profitability, overall asset quality (Ghosh, 2012), and has helped to bring in technological development in the banking sector (Sharda, Swamy, & Singh, 2014). With respect to stock markets, Majumdar and Nag (2013) found that in emerging economies like India, increase in stock market returns amplify the volume and volatility of the FII flows. However, they found no evidence to the contrary.

↳ **International Portfolio Management :** With globalization and the increasing interdependence of financial markets, there has been a surge in the finance literature about the potential and benefits of international portfolio diversification. The fundamental objective of diversification of portfolio of assets is to minimize systematic risk inherent in every asset. Diversification is achieved by choosing portfolios that are mean-variance efficient, that is, a portfolio that maximizes returns for a given level of risk or vice-versa, minimizes risk for a desired level of return (Markowitz, 1952). Portfolio diversification mostly happens in two forms: (a) investors' diversify their portfolios across different asset classes or sectors in the domestic market, (b) apart from (or along with) the domestic market, the investors may diversify their portfolios across various asset classes or sectors in other foreign markets. The latter is referred to as international portfolio management.

As an investor, diversification of portfolio in the international market is justifiable if and only if the gains from it exceed those from diversification in the domestic market. The argument behind it is quite intuitive. Capital markets of different countries are geographically distant, have different market structures and functioning, and possess distinct trading norms with disparate legal environments unique to the country. In addition, assimilation of market information of foreign countries in real time is an arduous task. Realization of price based on delayed (and imperfect) information may be quite different from the true price of the asset in the place of origin [3], and thus, bear an additional risk due to information asymmetry. This, along with the cost involved in trading (such as transaction costs, tax, etc.), may not be rewarding at the end of the day. As a rational investor, one would prefer to choose known risks (familiar to domestic market) rather than unknown risks emanating from foreign markets [4]. However, there is theoretical, empirical, and factual evidence that not only diversification in the international

[3] It should be kept in mind that the price of an asset at any given point of time reflects all the available information (efficient market hypothesis, Fama, 1970).

[4] Mainly, country risk, political risk, exchange rate or currency risk, (Adler & Dumas, 1984) and tax risk.

portfolio transpires, but there is growing evidence that over the years, such practices are prospering.

Seminal works by Solnik (1974) and Errunza (1977) affirmed the existence of gains from diversification into the international portfolio. Very recently, Sharma, Mahendru, and Sanjeet (2013) found that there exist opportunities for diversification of the investors among the stock exchanges of BRICS. However, on the contrary, Bekaert and Harvey (2003) argued that there will be an increase in correlations among financial markets due to the removal of price segmentation by the relaxation of policies to restrict the free flow of capital across national borders, which, in turn, may lower the benefits of international portfolio diversification. Lately, there has been a shift in emphasis from country to domestic diversification, especially in the developed and integrated financial regions such as those of the European Union (Isakov & Sonney, 2004). This is because as national equity markets become increasingly integrated, the gains from international diversification will tend to diminish due to the positive and increasing correlation among them.

It, therefore, follows that an understanding of the nature and extent of international financial market linkages will enable policymakers to informatively design policy proposals aimed at cushioning the destabilizing effects and the adverse shocks to the domestic economy that may emanate from increasing financial globalization.

Drivers of Stock Market Linkages

This section reviews the literature on factors that are commonly considered as fundamental drivers responsible for the intensification of international equity market linkages. Numerous factors, identified in the literature, cause geographically distant, structurally, and functionally distinct financial markets to become more interdependent and integrated. Some of these factors relate to trade and commerce linkages, the adoption of financial generalization policies, and the exchange rate regime which an economy pursues.

↳ **Financial Liberalization Policies :** Bekaert and Harvey (2003) noted that financial liberalization broadly takes two forms. One, it may refer to those policies aimed at deregulating the domestic economy, such as privatization of government owned businesses and banking sector reforms [5]. Two, it may also refer to those progressive policies aimed at facilitating the inward and outward flow of foreign investment by relaxation and lifting of capital controls to facilitate free capital mobility. The study emphasizes on financial liberalization realized by promoting an unrestricted cross-border flow of capital and encouraging greater international participation in domestic financial markets. Although this may not result in full capital market integration owing to causes like the "home-bias" puzzle in equity holdings among other factors; nevertheless, financial liberalization should bring about substantial integration in international equity markets through the equalization of domestic and foreign market expected returns (Bekaert & Harvey, 1995, 1997, 2003; Darrat & Benkato, 2003 ; Kearney & Lucey, 2004 ; Ng, 2000). Ahmad and Sarver (1994) found that the progressive withdrawal of interest rate and exchange rate controls combined with lower restrictions on cross-border capital movements are the major reasons for the integration of international financial markets. Thus, a high degree of international financial integration can be achieved if policies aimed at receding of controls on capital flows are binding.

↳ **Economic Cooperation and Trade :** The extent to which the equity markets of two countries are interdependent is largely influenced by the degree in which their economies depend on each other in terms of bilateral trade and investments. The stronger are the bilateral trade and investment ties between countries, the higher will be the magnitude of co-movement of their respective stock markets. A study of the literature in this regard shows that there are a number of ways in which bilateral trade in goods and services may have a bearing on cross-border mobility of capital and thereby affect capital markets. Lane and Milesi-Ferretti (2003) observed that

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[5] A thorough discussion of these policies was undertaken by Gelos and Werner (2002) and Beim and Calomiris (2001).

openness in goods markets may increase the willingness to conduct cross-border financial transactions, thus gradually reducing the equity home-bias [6]. Also, Pretorius (2002) demonstrated that if a significant proportion of country A's exports constitute a substantial portion of country B's imports, then, an economic downturn in country B will result in a slump in B's stock market as well as a decline in country A's stock market due to reduction in A's exports to the country B. Such co-movement of stock markets in both countries is due to the convergence in the business cycles brought about through openness of economy, trade, and investments.

In spite of the intuitive appeal of the notion that countries that trade more with each other may have synchronized business cycles, the matter got validated only recently. Authors such as Frankel and Rose (1998), Lane and Milesi-Ferretti (2003), among several others [7], found that pairs of countries that trade more with each other exhibit a higher degree of business cycle co-movement. Given the relationship between cross-border trade in goods and services and investment in financial assets, one would reasonably anticipate that countries having strong bilateral trade linkages would not only exhibit synchronicity in terms of business cycles, but also in their stock markets. In other words, trade and macroeconomic linkages act as a major driving force for stock market linkages.

↳ **Exchange Rate Regime :** It is important to acknowledge that international equity markets do not function in isolation more so from the effect of exchange rates. Exchange rate regimes not only have a bearing on the competitiveness of an economy in terms of trade, but also play an effective role in determining the extent and pace with which the domestic economy accommodates and adjusts to external shocks (i.e. financial contagions).

Literature has identified at least three ways in which exchange rates affect the stock market. The first way is via the goods market. Dornbusch and Fischer (1980) argued that changes in the exchange rate affect the competitiveness of multinational firms and hence their earnings and eventually their stock prices [8]. However, this is not only confined to multinational firms; a second way, as Adler and Dumas (1984) observed, even firms that may not have a large market in international trade, but if their input prices, output prices, or demand for products are exposed to exchange rate movements, may display fluctuations in their stock prices in congruence with exchange rate movements. Finally, from the asset pricing perspective, if the economy can be described by a set of pervasive risk factors, one of them being the exchange rate risk, then the price of an asset (or a portfolio of assets) will be sensitive to such risks as some premium has to be accounted for in order to mitigate them (Arbitrage pricing theory; Ross, 1976).

Having substantiated the link between stock prices and exchange rates, the question that remains unanswered is which particular exchange rate regime is best suited for financial integration. On the one hand, proponents of the fixed exchange regime argue that floating exchange rates thwart the formation of strong linkages among markets owing to the uncertainty with regards to currency values. According to Frankel et al. (2004), fixed exchange rates have two benefits: (a) it reduces transaction costs as well as exchange rate risk [9], which discourage trade and investment; and (b) it provides monetary authorities a credible stability for the implementation of monetary policy. The stability argument in favor of fixed exchange rate comes from the concerns about inflation and unfavorable exchange rate fluctuations that affect those sectors of the economy that determine wages, prices, and capital flows. However, in a contradiction, Agénor (2003) cautioned that a fixed exchange rate regime will create external imbalances caused due to pegging and will result in loss in competitiveness, which may precipitate into a currency crisis or increase financial instability.

On the other hand, advocators of a floating exchange regime argue that the changes in fixed exchange rate

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[6] The "home-bias" puzzle refers to a phenomenon where investors exhibit a tendency to hold a disproportionately large share of their equity portfolio in domestic stocks and only a small amount in foreign equity (French & Poterba, 1991).

[7] Clark and Van Wincoop (2001), Otto, Voss, & Willard (2001), Calderon, Chong, & Stein (2007), Kose and Yi (2002).

[8] A depreciation of the local currency will make exports cheaper, which in turn will boost the demand and sales of goods in foreign markets.

[9] By eliminating volatility in exchange rate.

regime, which White and Woodbury (1980) also noted, will, at times, be large enough to retain the same uncertainties that the fixed exchange rate was meant to eliminate. Frankel (2003), in this case, argued that a floating regime enjoys two benefits: (a) A floating exchange rate acts as an automatic self-adjustment mechanism and helps to realign the economy after asymmetric external shocks affecting trade and investments; (b) a country that follows a floating exchange rate maintains its monetary independence. In the event of a recession, when temporarily, the unemployment is high and real growth is low, the central bank has the discretion to ease the economic downturn by lowering interest rates, depreciating the currency, increasing money growth, and raising asset prices.

In order to foster financial integration, a common position in the literature is that in open economies, there should be a convergence of interest rates and synchronization of business cycles (as briefly discussed above).

Common Methodologies in Analyzing Stock Market Linkages

The review of finance literature provides two related yet competing methodologies to test for market integration. On the one hand, where a lot of work has utilized the uncovered asset return parity (UAP) relation derived from the uncovered interest parity (UIP) [10] condition (e.g. Musa & Goldstein, 1993), yet, on the other hand, there are abounding literature where the authors have adopted the good old capital asset pricing model (CAPM) framework to test for financial integration among markets (e.g. Solnik, 1974). However, on observing the recent trend, we found a considerable inclination towards volatility based models, which measure the level of integration by estimating the spillover of volatility between two markets (e.g. Engle & Susmel, 1993). All these approaches are briefly discussed below.

↳ **Uncovered Asset Return Parity Condition :** The UAP model equates the expected changes in exchange rates to the expected changes in the returns on equity securities. From the UIP condition, one may derive a UAP relation to test for the integration of a domestic equity market *i* with any given foreign equity market *g*, such that:

$$E_{t-1}[R_{i,t}] = E_{t-1}[R_{g,t}] + E_{t-1}[\Delta S_{i,t}]$$

where,

$R_{i,t}$ and $R_{g,t}$ are the excess returns on domestic market portfolio in country *i* and foreign market portfolio *g*, respectively. $S_{i,t}$ is the stock exchange rate of the country *i*.

The above UAP relation shows that if the domestic and foreign markets are fully integrated, then the expected asset returns of the domestic market will be equal to those of the foreign markets after taking into account the exchange rate fluctuations. The basic intuition behind the UAP model is that when the equity markets are fully integrated, any disparity between the expected returns of the domestic market and the corresponding foreign market are re-equilibrated through contemporaneous adjustments in the respective expected exchange rates. More specifically, if the domestic expected equity returns exceed those of the foreign equity market, then the exchange rate of the domestic currency is expected to appreciate by an amount proportional to the return differential. Any deviations from this condition will imply the two markets are not fully integrated.

In spite of the intuitive appeal of the models based on the UAP condition to test for equity market integration, several authors such as Fratzscher (2002) have argued against the model and have questioned the feasibility of it

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[10] The UIP model theorizes that when the domestic interest rate is less than that of the foreign country, the domestic currency is expected to appreciate by an amount that is equivalent to the interest rate differential between the two countries. If the domestic and foreign markets are integrated, one implication of this condition is that the return on an uncovered foreign currency deposit should be equal to the return on an equivalent domestic deposit regardless of the national market within which the foreign deposit is placed. Deviations from this relationship signals towards nonalignment or disunion of capital markets of the two countries (Frankel, 1992; Francis, Hasan, & Hunter, 2002).

holding empirically. Two main reason are cited for the criticism. One, the above version of UAP relation does not take into consideration other risk premia such as those related to market risk, market volatility, and interest rates that are priced in the market. Two, there may be other barriers to cross-country investment such as government policies, tax laws, etc. that may prevent markets from being fully integrated.

A more general approach for testing the level of integration between the two equity markets would have to dismiss the assumption of investor's risk-neutrality and factor in other risk premia, such as differentials in the volatility of equity returns, interest rates, foreign exchange rates, etc., which may affect investments in international equity (Cappiello & De Santis, 2005).

↳ **International Capital Asset Pricing Model :** Another model that found its usage in plethora of literature dealing with equity market integration is the capital asset pricing model (CAPM), specifically, international version of the CAPM framework, whose theoretical foundation can be traced from the seminal works of Sharpe (1964) and Lintner (1965). Expected return on asset *i* can be expressed as:

$$E[R_i] = R_f + \beta_{i,m}(E[R_m] - R_f), \qquad \beta_{i,m} = \text{cov}[R_i, R_m] / \text{var}[R_m]$$

where, R_i is the return on the market portfolio, R_f is the return on the risk free asset, and $\beta_{i,m}$ captures the correlation of the return on asset *i* to the excess return earned on the market portfolio.

Sharpe-Lintner (SL) CAPM theorized that the expected return on any risky asset is positively correlated to the excess return on the market portfolio. As per this framework, the market portfolio, which consists of all risky assets, is assumed to be mean-variance efficient in a manner described by Markowitz (1968). The fundamental implication of the SL-CAPM is that in an efficient market, all unsystematic risk can be diversified away such that the only risk that would be priced by market agents on a portfolio is the un-diversifiable systematic risk (Belke & Polleit, 2009 ; Bollerslev, Engle, & Wooldridge, 1988; Fama & French, 2004).

However, the model has its own share of criticism, the foremost being the failure to capture factors other than market risk and that of being a single-state model (i.e. without a time dimension) such that investor's portfolio choices can be determined with preferences defined over wealth only in one period in the future [11]. Merton (1973) extended the static SL-CAPM to a multi-period, multi-factor model (inter-temporal (I) CAPM) with an added assumption that investors maximize their utility over an extended time horizon.

$$E[r_{i,t} | I_{t-1}] = \beta_{1,t} E[\text{cov}(r_{i,t}, r_{1,t} | I_{t-1}] + \beta_{2,t} E[\text{cov}(r_{i,t}, r_{2,t} | I_{t-1}] + \ldots + \beta_{n,t} E[\text{cov}(r_{i,t}, r_{n,t} | I_{t-1}]$$

where,

$r_{1,t}$, $r_{2,t}$, ..., $r_{n,t}$ are the excess return on the respective risk factors (1, 2, ..., n). $E[\cdot \mid I_{t-1}]$ denotes the expectation operator, which is conditional upon an investor's information set known at period t-1. The above relation, as laid down for individual asset returns r_i also holds true for a portfolio of risky asset r_p .

In so doing, the investors now expect their wealth at time period *t* to vary, given a set of state variables representing various risk factors which are expected to have an effect on their wealth. The basic intuition behind ICAPM is that in a dynamic world, an investor would react to all available news and events perceived to have an effect on future consumption and investment opportunities thereby reflected in the prices of a stock or an asset (Dean & Faff, 2001).

Fama and French (1998 and 2004) showed that if international capital markets are open, and the investors

[11] In order to overcome these drawbacks, numerous extensions to SL-CAPM have been proposed in the literature, foremost being the arbitrage pricing theory (APT) of Ross (1976) and the inter-temporal capital asset pricing model (ICAPM) of Merton (1973).

neglect the assumption of purchasing power parity, then the market portfolio can also include international assets such that:

$$E[r_{p,t} | I_{t-1}] = \ldots + \beta_{g,t} E[\text{cov}(r_{p,t}, r_{g,t} | I_{t-1}] + \ldots + \beta_{n,t} E[\text{cov}(r_{p,t}, r_{n,t} | I_{t-1}]; \text{ and}$$
$$\beta_{g,t} = \text{cov}\ [r_{p,t}, r_{g,t}] / \text{var}\ [r_{g,t}]$$

here, $r_{p,t}$ and $r_{g,t}$ are the expected return on domestic p and global g portfolio respectively at time t.

In this model, an investor with a portfolio of risky assets will not only consider state variables relating to the risky elements in the domestic economy, but also to global risk factors. Consistent with the intuition original SL-CAPM, the global market beta coefficient $\beta_{g,t}$ of international CAPM measures the sensitivity of the return on the domestic portfolio p to innovations in the global market return. The extent to which innovations in the global market are able to explain variations in the portfolio returns in the domestic market would highlight the degree of integration between the domestic and the foreign (or global) market.

Critiquing the theoretical framework of international CAPM (with global state variables), one can note that interdependence between the domestic and global markets imposes restrictions on the asset pricing mechanism, such that purely domestic factors are less important in the pricing of assets (Jorion & Schwartz, 1986). In other words, if markets are integrated, and the global portfolio is mean-variance efficient, then the only risk that should be priced will be the systematic risk with respect to the world market. A similar argument holds true for a regional portfolio as well.

Apart from the above weaknesses, a major drawback of international CAPM is that it is a static model (Ramchand & Susmel, 1998). Works by Engle (1982), Bollerslev (1986), Nelson (1991), and so forth have shown that the expected return is conditional upon volatility, which itself evolves over time. Hence, when considering economic data as time series, the basic international CAPM becomes a totally inadequate measure. Instead, volatility based models such as ARCH, GARCH, and so forth are best suited for performing time-series analysis of stock market integration.

↳ **Volatility Based Models :** Proponents of volatility based models posit that if two stock markets are integrated, then they get affected by each other's volatility. In other words, the innovations in one market are transmitted to other markets. Thus, in order to gauge the level of integration between two markets, one can empirically measure the magnitude of volatility transfer between the given markets.

A study of empirical literature such as Bernard and Durlauf (1996) and St. Aubyn (1999) suggests that one way to assess the convergence (or divergence) in prices of interdependent markets is by performing pairwise stationarity [12] tests on the price differences of the two series. The difference of the price series [13] of the two stock markets should not contain any unit root (i.e. stationary) to meet the convergence criteria. The Augmented Dickey Fuller (ADF) test (Dickey & Fuller, 1979) and the Kwiatkowski Phillips Schmidt and Shin (KPSS) test (Kwiatkowski, Phillips, Schmidt, & Shin,1992) are generally used to test for convergence (or divergence) between the price series of the two stock markets.

However, using stationarity property for testing of price convergence has some drawbacks. For example, the stationarity of price differentials only implies convergence and does not mention the level of market integration. Secondly, the unit root tests lack robustness in the presence of outliers [14] and may wrongly reject the convergence hypothesis (Zachmann, 2008).

Another way to measure market integration involves the detection of cointegration relationships in the price

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[12] A stationary process has the property that the mean, variance, and autocorrelation structure do not change over time.
[13] Generally taken as logarithmic difference which converts the price series into returns series.
[14] Which gives rise to a condition known as heteroscedasticity.

series between two stock markets with direct interconnections. Cointegration analysis allows us to test whether the prices of one stock market persistently differ from the prices of the other stock market taking the arbitrage costs (i.e. transmission charges) into account as a confirmation towards the law of one price (Woo, Lloyd-Zannetti, & Horowitz, 1997). The intuition here is that in markets that are well integrated, the individual markets' imperfections and the resultant friction that pushes the prices towards divergence get offset by the arbitrage opportunities that are created, thus moving towards one price. Johansen's cointegration test (Johansen, 1988 , 1991) or Engle and Granger's (1987) cointegration test are usually used to detect for any evidence of integration between two stock markets [15].

However, one implicit assumption of cointegration methodology is that the cointegrating vector is constant over the period of study (Barret & Li, 2002). But in reality, it is very much possible that the long-run relationship between the underlying variables changes. Shifts in the cointegrating vector can occur due to any systemic change such as socio-political, economic, legal, or environmental. This is particularly likely to be the case if the observation period is long. Hence, while using cointegration tests, care should be taken during interpretation of long run equilibrium relationships.

The third, and in recent times, the most popular way of gauging the level of integration is to measure the magnitude of spillover of volatility between two markets. The rationale for taking spillover of volatility between markets as a proxy for market integration is quite intuitive. When markets are economically integrated via trade and investments, then it is expected that their capital markets, the movement of which is largely governed by economic factors, also show interdependence. Otherwise also, stock markets of two countries can be presumed to be interdependent if their exist firms that are cross listed in both of these stock markets or investors in both countries invest in each other's stock markets. Spillover models such as ARCH, GARCH as developed respectively by Engle (1982) and Bollerslev (1986), and their various extensions test market integration and interdependence by capturing the extent of spillover of volatility from one market to another.

Recent advances in empirical literature in the field of volatility and its spillover for assessing the level of integration between markets presents a strong argument in favor of spillover models as a preferred methodology. Not only these models present a robust methodology, they are also stable in terms of state-space-time dimensions and are fairly generalizable.

Conclusion

In this study, we reviewed the existing theoretical and empirical literature on the interdependence of financial markets, mainly focusing on the transmission mechanism of volatility among international stock markets. The first two sections broadly discussed several issues from a theoretical disposition. The motivation regarding the importance of understanding inter-market linkages in finance is addressed in the first section. It concludes with the notion that such an understanding will help investors to identify international diversification opportunities and help the policy makers to formulate policies that will amplify potential gains from integration, while mitigating the vulnerability that international financial integration may bring. Factors driving equity market linkages are identified and discussed in the second section which broadly includes liberalization policies, economic cooperation and trade ties and exchange rate regimes. Finally, from the empirical literature, some of the common approaches to studying equity market linkages are also discussed briefly .

Research Implications

The present study is a comprehensive review of literature on the importance and drivers of stock market linkages.

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[15] While Johansen's technique is based on the maximizing correlations, the Engle-Granger technique is based on the minimization of variances.

The paper also provides a brief coverage on contemporary methodologies to evaluate the level of integration between international stock markets. Our study provides an appendage to the exiting literature on how the area of research on interdependence of stock markets has evolved with a focus on its cause and effect on the level of market integration and also highlights the scope for further research in this area. The practical implications of the study in the form of scope for further research have been discussed in the following section.

Limitations of the Study and Scope for Future Research

This study only presents a detailed survey of literature on the important aspects of interdependence of international stock markets. However, it does not provide any empirical analysis to substantiate the findings in the literature. However, the study raises certain pertinent questions that can be taken up for future research, such as: which are the factors: global or regional, that are more important for market interdependence? Are innovations occurring globally less important than those occurring regionally for pricing of domestic assets or vice-versa ? One very important inquiry is what proportion of innovations in the domestic market can be attributed to global and regional factors? And finally, is the degree of integration between stock markets stable over time? These are some of the issues that need be to be addressed empirically.

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