

Stock market Integration--An Overview¹

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Abstract

This paper has reviewed an extensive literature examining stock market integration. Recent empirical studies of market integration have shown increasing interest in emerging stock markets. The results from the studies of market integration have important implications for international portfolio diversification and market efficiency. If stock markets are integrated the scope of international diversification benefits might be limited, and also the weak form of market efficiency will be violated. Econometric techniques such as cointegration test, factor analysis and GARCH models provide a useful tool to investigate the relationship among economic variables. In the context of stock market integration, these techniques can be used to examine whether international stock markets have a tendency to move together.

JEL Classification: E44, G14, G15

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1. Introduction

International capital flows have gradually increased over the past three decades. The extraordinary increase in capital flows starting in 1990 was truly phenomenal in Asia. For example, international portfolio investments have steadily flown into all emerging countries rose from 30 billion U.S. dollars in the 1970s to about 180 billion U.S. dollars in the 1990s. While most developed countries opened their financial markets in the early 1970s, many emerging countries liberalized their markets in the late 1980s and early 1990s (Kaminsky and Schmukler, 2002). This liberalization process allowed investors to extend their investment opportunity set to include multiple financial markets.

The increased capital flows between economies is likely to intensify the interdependence of economies and, therefore, the heightened possibility of contagion. This was clearly illustrated by the Asian financial crisis which first began with the floating of the Thai baht in July 1997. It thereafter spread rapidly to the Philippines, Malaysia, Indonesia and Korea. Following this crisis, relatively small depreciations also engulfed Singapore and Japan. A noteworthy aspect of the crisis is how rapidly it spread from one country to

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another in the region, the so-called contagion effect, and further to Russia and some South American countries.

There is a growing interest in the international transmission of stock market shocks among economies since the 1997 Asian financial crisis. A number of studies have shown that global stock markets have become increasingly integrated and co-movements among stock markets have been on the rise through time. The main reasons are financial deregulation in emerging stock markets and new technology developments that facilitate the information transfer across global stock markets.

Stock market integration studies were originally motivated by the intention to examine the diversification benefits gained by investing across global stock markets. Some recent studies, such as Richards (1995), Kanas (1998a), Chang (2001), Ng (2002) and Phylaktis and Ravazzolo (2005), found no evidence of stock market integration, on the other hand others (Kasa, 1992; Choudhry, 1996a; Chaudhuri, 1997; Syriopoulos, 2004) have indicated an increased degree of stock market integration over time. Therefore, the empirical findings are mixed. In addition, earlier market integration studies were based on various versions of asset pricing models while more recent studies have tended to rely on econometric techniques. Thus, this thesis focuses on stock market integration in the region as well as globally by using econometric techniques.

The main purpose of this paper is to review the general literature on stock market integration. As mentioned in the first chapter, a growing interest in the integration of international stock markets is evident in the number of empirical studies that examine various aspects of stock market integration. This research area has drawn great attention because the degree of stock market integration has important implications for investor diversification strategy and market efficiency. If stock markets are integrated, then diversification benefits might be limited according to modern portfolio theory. In addition, stock market integration may contradict the weak form of market efficiency if movements in one stock market can be used to predict changes of another stock market.

The paper is divided into six sections. Section 2 presents early work on stock market integration. Section 3 provides a more extensive review of empirical work relating to stock market integration using various econometric techniques. Section 4 sheds some light on the Asian financial crisis and stock market integration. Finally, Section 5 identifies a statement of the problem which this thesis will focus upon and conclusions.

2. Stock Market Integration Based on the Asset Pricing Models

Early work on stock market integration was based on the asset pricing models with different treatment of international investment barriers such as taxes, transaction costs and ownership restrictions. Most theoretical models generalized the domestic version of the asset pricing model with reference to the international framework, taking into account international investment barriers.

Extending Markowitz's (1952) portfolio selection theory, the Capital Asset Pricing Model (CAPM), developed by Sharpe (1964) and Lintner (1965), is the classic basis for early

theoretical work on stock market integration. The CAPM suggests a linear and positive relationship between a security's expected return and its systematic risk. In addition, it is assumed in the CAPM that capital markets are highly efficient, investors are well informed, transaction costs are zero, there are insignificant restrictions on investment, there are no taxes and no investor is large enough to affect the market price of stocks.

Ross (1976) developed the Arbitrage Pricing Theory (APT) which is an equilibrium model like the CAPM, and is used to examine how stock prices are determined. The APT is based on the idea that in competitive financial markets, arbitrage will ensure that riskless assets provide the same expected return. Unlike the CAPM, which requires market equilibrium and restrictions on the stock return distribution and investor's utility functions, the APT reveals that individuals eliminating arbitrage profits across factors drive the stock market equilibrium process. The model does not identify factors that could be economically or behaviorally relevant in determining stock returns.

Stehle (1977) was the first to test market integration using the asset pricing models. The test was based on both the domestic asset pricing model and the international asset pricing model. Stehle finds that risk, which could only be diversified away through international diversification, should be priced if international markets are integrated. Moreover, the results obtained indicated that international risk factors are not significant and thus showed that international markets are segmented.

Jorion and Schwartz (1986) investigated the relationship between Canadian stock market and the global North American market, by using the consumption-based asset pricing model. The results obtained suggested that the international CAPM is not a good description of the pricing of Canadian stocks. In addition, the empirical evidence rejected the joint hypothesis of the specification of the asset pricing model employed and the hypothesis of market integration between the Canadian stock market and the global North American market.

Wheatley (1988) provides tests of international stock market integration using a simple version of the consumption-based asset pricing model. The main objective of this study was to predict if there is an asset pricing line for each country, that related a representative individual's expected real return on each asset to the covariance of this return with growth in the individual's real consumption. Monthly data were collected during the period between January 1960 and December 1985. The results provided evidence in favor of supporting market integration between the United States and 17 international stock markets, Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Italy, Japan, the Netherlands, Norway, Singapore, Spain, Sweden, Switzerland and the United Kingdom.

In a more recent study, Bekaert and Harvey (1995) extend the conditional regime-switching model, which is essentially a combination of the asset pricing model for completely segmented international stock markets. The results indicate that a number of emerging stock markets displayed time-varying integration. Some stock markets, such as Chile, Greece, India, Mexico, Nigeria, Taiwan, Thailand and Zimbabwe, appeared more integrated than one might expect based on previous knowledge of investment restrictions.

Other stock markets, namely Colombia, Jordan, Korea and Malaysia, appeared segmented even though foreigners have relatively free access to their markets.

In summary, early theoretical work on stock market integration approached this issue by incorporating international investment barriers, such as taxes, transaction costs and ownership restrictions, into the asset pricing models. More recently, development of the conditional regime-switching model allows probabilistic transactions between domestic and international asset pricing models such that changes in the degree of stock market integration can be observed over time. The empirical results are mixed, however, differing by the stock markets examined, the time period covered and the models employed in the study.

3. Empirical Work on Stock Market Integration Based on Econometric Techniques

While most of the previous studies of stock market integration are based on certain asset pricing models, since the 1990s a number of studies have utilized different econometric techniques to examine stock market integration issues. Econometric techniques such as Granger causality analysis, cointegration test, factor analysis and the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models have been widely employed in empirical studies of stock market integration.

3.1 Granger Causality and Cointegration Test

Kasa (1992) examined the co-movement of five stock markets, the United States, Japan, the United Kingdom, Germany and Canada using monthly and quarterly data from January 1974 to August 1990. Morgan Stanley Capital International (MSCI) indices are employed to compute the multivariate cointegration test. The results reveal that there are four cointegrating vectors and one common stochastic trend among the stock markets. Kasa found that further estimation of the factor loadings from this trend is most important in the Japanese stock market and least important in the Canadian stock market. The major conclusion from this study is that the gains from international diversification might have been overstated because of the existence of a common stochastic trend within these stock markets.

On the other hand, Richards (1995) used a sample of 16 developed stock market indices to investigate their long-run relationships. Quarterly data for Australia, Austria, Canada, Denmark, France, Germany, Hong Kong, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States covering the period December 1969 to December 1994 from MSCI was employed. The Johansen and Engle-Granger methodologies are utilized to test for the existence of cointegration between the stock markets. The cointegration tests indicate that stock markets are not cointegrated around the common component.

In a similar approach to Kasa (1992), Choudhry (1996a) employed the Johansen methodology of multivariate cointegration to examine the long-run relationships between the stock markets of six European countries which are Spain, France, Italy, Sweden, Czechoslovakia and Poland. The cointegration tests show a long-run relationship between

these stock markets during the longest period (1925-1936) and also during the pre-October 1929 stock market crash period (1925-1929). However, the results fail to indicate a long-run relationship during the post-crash period (1929-1936). The extensive international financial integration and cooperation that took place between European countries after the First World War up until 1929 might be the reason behind the long-run relationship between these stock markets.

Chan, Gup and Pan (1997) test and examine the long-run relationships among 18 stock market indices, including developed and emerging stock markets. They use monthly stock market indices in these markets and the sample period covered was from January 1961 to December 1992. Johansen's cointegration tests indicate that only a small number of stock markets show evidence of long-run co-movement with others. However, the number of significant cointegrating vectors increased before the October 1987 stock market crash. The results also imply that international diversification among stock markets might be effective, because the stock markets do not have long-run relationships.

Chaudhuri (1997) investigated the long-run relationships among stock market indices in six Latin American emerging markets, Argentina, Brazil, Chile, Colombia, Mexico and Venezuela. Monthly stock market indices were collected from January 1985 to December 1993. The bivariate cointegration tests found evidence of a long-run relationship among all of these countries. Granger causality indicated the presence of bidirectional rather than unidirectional causality, and suggested the absence of weak exogeneity among stock prices.

Kanas (1998a) employed the multivariate approach to test for pairwise cointegration between the United States and each of the six largest European stock markets namely the United Kingdom, Germany, France, Switzerland, Italy, and the Netherlands. The results are robust and consistent in suggesting that the United States stock market is not pairwise cointegrated with any of the major European stock markets. This finding implies that there exist potential long-run benefits in risk reduction from diversifying in the United States and any of the major European stock markets. That is in sharp similarity to Ahlgren and Antell's (2002) study who found no evidence of long-run relationship among the United States and the European stock markets.

Masih and Masih (1999) examined the long- and short-run relationships among international and Asian emerging stock markets. Using multivariate cointegration analysis and causality test, the results confirmed the leading role of the United States, and the existence of a significant long- and short-run relationship between the established OECD and emerging Asian stock markets. At the regional level, the results indicated the leadership of Hong Kong. Consistent with the contagion effect hypothesis, their results supported the view that stock market fluctuations in all these Asian stock markets were generally linked to other regional stock markets.

Syriopoulos (2004) investigated the long-run relationship among stock market indices of major emerging Central European countries, namely Poland, Czech Republic, Hungary and Slovakia and developed stock markets, specifically Germany and the United States. The multivariate cointegration test results found a stationary long-run relationship among

these countries, and the individual Central European stock markets were likely to display stronger linkages with their mature international counterparts rather than their neighbors.

A recent study by Phylaktis and Ravazzolo (2005) examined the linkages between Pacific-Basin markets. Their results were robust and consistent in that no evidence was found to indicate a long-run relationship among the stock markets under study. The results were also consistent with those obtained in previous studies such as Chang (2001) and Ng (2002). These findings indicate that international investors have opportunities for portfolio diversification by investing in most Asian stock markets.

3.2 Factor Analysis

Hui and Kwan (1994) examined the systematic covariation in stock market indices among the United States and Asia Pacific countries during the 1980s. Using factor analysis, the results indicated that the first factor had relatively high positive weights for Australia, Hong Kong and Singapore, while the second factor was dominated by Taiwan alone. The third factor belonged to Korea and Japan, and the fourth factor had a relatively large weight on the United States alone. They also suggested that if investors were to select stock markets for risk diversification, then Japan, Taiwan and the United States would certainly be more appropriate.

Naughton (1996) analyzed the relationship between Asian and developed stock markets. The results indicated low correlation between Asian emerging markets and between these markets and developed markets. Factor analysis confirmed a developed market grouping which included Australia, Hong Kong and the United States, but excluded Japan. Korea and Japan formed a separate group. The Philippines and Taiwan were both separated to different factors. This means, according to this study, a good range of diversification potential appeared to exist in Asian emerging markets.

Meric and Meric (1997) studied the co-movements among the 12 largest European stock markets. Monthly data covering the period February 1975 to February 1994 from MSCI was employed. The principle component analysis test results indicated that the co-movement of those stock markets changed significantly after the 1987 stock market crash. Their findings showed that the correlations among the 12 largest European stock markets were low but increased significantly after the crash. Thus, the benefit of international portfolio diversification with stock markets decreased considerably.

More recently, Illueca and Lafuente (2002) employed a sample of 15 international stock market indices to investigate any possible linkages. Factor analysis was utilized to test the factor structure of stock markets. The empirical results revealed four factors that could be identified with four geographic areas: Europe, Asia, North and South America. They also suggested that such a portfolio diversification strategy needed to consider a number of assets that were negotiated in most stocks around the world.

3.3 GARCH Model

Hamao, Masulis and Ng (1990) investigated the extent of financial integration and international efficiency across stock markets of the United States, the United Kingdom and Japan using a GARCH-M model. Daily opening and closing data covering the period

between 1 April 1985 and 31 March 1988 were used. They examined the effect that global news generated overnight had on opening price, and additional transmission of risk between the markets. The results indicated statistically significant spillovers in close-to-open returns and variances in all three markets. This suggested non-instantaneous adjustments to news, however they attributed these findings to overlapping trading between the stock markets.

Using a similar approach to Hamao, Masulis and Ng (1990), Lin, Engle and Ito (1994) examined volatility spillovers between the stock markets of the United States and Japan. Their daily data covered the period from 1 October 1985 to 29 December 1989. The empirical results found bidirectional spillovers between daytime returns in one market and overnight returns in the other. The findings suggested that these two stock markets were integrated with the global news relevant for both market being generated both in the United States and Japan. The results were consistent with the findings of other studies such as Bae and Karolyi (1994), who found that the degree and persistence of shocks originating in the stock markets of the United States or Japan that spread to other markets were extensively understated.

In contrast to previous studies, Susmel and Engle (1994) studied the stock markets of the United States and the United Kingdom. Daily data was collected for the period 2 January 1987 to 29 February 1989. Using several GARCH models to examine volatility spillovers between both stock markets under study, the results found that there was no significant evidence of volatility spillovers between these stock markets. In addition, the inclusion of the October 1987 crash period did not support the existence of spillovers between the stock markets.

Choudhry (1996b) investigated the volatility, time-varying risk premium and persistence of volatility in six emerging stock markets, namely Argentina, Greece, India, Mexico, Thailand and Zimbabwe. A GARCH-M model was utilized using monthly data spanning from January 1976 to August 1994. The empirical results revealed evidence of changes in the ARCH parameters, the risk premium and volatility persistent in these stock markets. However, these changes were not consistent and they fluctuated between individual markets.

Kanas (1998b) provided an empirical investigation of volatility spillovers across the three largest European stock markets. The investigation was conducted using the multivariate exponential GARCH model applied to daily stock returns from the United Kingdom, France and Germany from 1 January 1984 to 7 December 1993. Kanas found evidence of volatility spillovers between these stock markets. The results showed that spillovers were asymmetric in the sense that bad news in one market had a larger effect on the volatility of another market in comparison to that of good news.

Christofi and Pericli (1999) turned their attention to examine short-run dynamics in returns and volatility between five major Latin American stock markets using an exponential GARCH model. Daily indices in these markets were collected during the period between 25 May 1992 and 16 May 1997. They provided evidence of first and second moment interactions among the stock markets examined. In addition, the results

indicated that volatility spillovers were more common in these stock markets than other regional stock markets.

Fratzscher (2002) investigated the integration process among European stock markets using a trivariate GARCH model and daily data covering the period from 2 January 1986 to 2 March 2000. The empirical results revealed that the European stock markets had increased in importance in the world financial markets since the mid-1990s, while the degree of integration has been highly volatile over the years.

Following this line of research, Kim and In (2002) analyzed the impact of major stock market developments and macroeconomic news announcements for Australian investors. Daily data collected during the period 1 July 1991 and 18 December 2000 and they employed a bivariate GARCH model to examine dynamic integration between Australian stock markets and other major global stock markets. Their results indicated that the movements of these three major stock markets, and some macroeconomic news, had significant effects on the Australian stock markets.

4. The Asian Financial Crisis and Stock Market Integration

The 1997 Asian financial crisis is considered to be the first emerging stock market crisis with a global impact. It first began with the floating of the Thai baht in July 1997. The crisis spread rapidly to the Philippines and Malaysia. In August, Indonesia's currency, the rupiah, depreciated by more than other Asian currencies. Relatively small depreciations occurred in Singapore in August and Taiwan in October. Korea devalued the won significantly on November. Japan also had a moderate devaluation between July 1997 and January 1998 (Barro, 2001). The global impact of the 1997 Asian financial crisis has been investigated by a number of studies discussed below.

Tuluca and Zwick (2001), using a sample of 13 stock market indices, including Asian and non-Asian markets, investigated the effects of the Asian financial crisis on global stock markets. Tests were conducted in two sub-periods, one before and one after the 1997 Asian financial crisis. For individual pairs of markets, Granger causality analysis revealed a seven-fold increase in bidirectional causality. The uncertainty surrounding the crisis considerably increased the transmission of disturbances from one market to another, and this transition was clearly global. Factor analysis test results showed that the non-Asian stock markets were characterized in one factor, however Asian stock markets were grouped by two, rather than four, additional factors. In short, it is concluded that the importance of such changes for long-term international portfolio diversification is less than previously believed.

In *et al.* (2001) studied three Asian stock markets, Hong Kong, Korea and Thailand. They searched for dynamic interdependence, volatility transmission and market integration across these markets. They used daily data covering the period from 3 February 1997 to 30 June 1998. A multivariate exponential GARCH model was used to capture lead-lag relationships and volatility interactions among the three Asian stock markets under study. During the crisis period empirical evidence of bidirectional volatility transmissions was

found between Hong Kong and Korea, and unidirectional volatility transmission from Korea to Thailand. Thus, Hong Kong played an important role in the transmission of volatility to other Asian stock markets.

Sharma and Wongbangpo (2002) analyzed the degree of long- and short-run relationships among five ASEAN stock markets. Monthly indices in these markets were collected during the period between January 1986 and December 1996. The empirical results found a long-run relationship between the stock markets of Indonesia, Malaysia, Singapore and Thailand with the exception of the Philippines. The cointegrated remaining four stock markets indicate evidence of market inefficiency. However, in the short-run, these four countries can be characterized into two groups, *i.e.*, the first group consisted of Malaysia and Singapore and the rest were classified into another group.

Climent and Meneu (2003) investigated the effect of the 1997 Asian financial crisis on the short- and long-run relationships among the stock markets of Southeast Asia and a group of international stock markets. Daily stock price indices covering the period 4 January 1995 to 15 May 2000 from MSCI were employed. Within this sample, two sub-periods were identified. The pre-crisis interval runs from 4 January 1995 to 1 July 1997. The post-crisis interval covered from 1 November 1997 to 15 May 2000. The bivariate causality test results showed that the United States best predicted the Asian stock markets and this became stronger after the crisis. However, using the multivariate cointegration test the results revealed no long-run relationship across these stock markets.

Worthington, Katsuura and Higgs (2003) examined the dynamic linkages between Asian stock markets in the period during the Asian financial crisis. Weekly data from MSCI was employed to compute the multivariate cointegration test. Three sub-periods were examined: the first ran before the crisis, covering the period from 1 January 1988 through 25 July 1997, the second covered from 1 August 1997 to 18 February 2000 and the entire sample extended from 1 January 1988 to 18 February 2000. Their empirical results provided evidence of long-run relationships among the Asian stock markets, both before and after the Asian crisis. However, this dynamic interdependency appears to decrease in the period during and after the crisis.

Following this line of research, Yang, Kolari and Min (2003) investigated long- and short-run relationships between the stock markets of the United States, Japan and 10 Asian emerging markets. Daily stock price indices covering the period 2 January 1995 to 15 May 2001 were used. Tests are conducted in three sub-periods, pre-crisis, crisis and post-crisis periods. The results indicated that both long- and short-run relationships among these stock markets were strengthened in the crisis period. In addition, these stock markets have been more integrated after the crisis rather than before the crisis.

Fernandez-Izquierdo and Lafuente (2004) employed a sample of 12 stock market indices to investigate the dynamic linkages between international stock markets. Daily data were collected during the period between 7 January 1997 and 28 December 2001. Using factor analysis, the results indicated that the first factor has a relatively high loading for the European markets, the second one for the Asian markets and the third one for the American market. By examining the transmission of volatility between these stock

markets, they find evidence of the existence of volatility transmission in all regions during the crisis.

In a recent study, Hui (2005) made an attempt to analyze the gain of international diversification for Singaporean investors during the period 1990 to 2001. His data included 10 Asia Pacific stock markets. From the factor analysis tests the results indicated that the first factor had relatively high positive weights on Hong Kong, the Philippines, Korea, Singapore and Thailand, while the second factor was dominated by Australia and New Zealand. Japan, the United States and Taiwan were categorized alone into different factors. Hui also suggested that if Singaporean investors or portfolio managers were to select relatively developed markets for risk diversification, then the United States, Australia and Japan would be considered as better options.

5. Summary and Extension

Although a number of studies have investigated the issue of stock market integration, the focus mainly was on developed markets, such as the United States, the United Kingdom, Germany, Japan and Canada. Nevertheless, in recent years, the fast-growing economic activities and the increasing investment opportunities in emerging stock markets have started to attract the attention of investors and researchers. For example, Hui and Kwan (1994), Masih and Masih (1999) and Phylaktis and Ravazzolo (2005) looked at the relationship between the United States and Asia Pacific stock markets. Bekaert and Harvey's (1995) study examined 12 selected emerging stock markets from Africa, Asia and Latin America. While Chaudhuri (1997) and Christofi and Pericli (1999) focused on Latin American stock markets. Syriopoulos' (2004) study aimed at analyzing the Central European stock markets.

Despite this increasing interest in emerging stock markets, the volume of literature in this area is still far less than that focusing on developed stock markets. This study fills this important gap in the literature, and provides further evidence that has important implications for the portfolio diversification decision of international investors.

Previous studies employed a cointegration test to investigate the long-run relationships among stock markets. However, no previous study has examined the possibility that the long-run relationship between stock markets may have been subject to a structural break. Gregory and Hansen (1996) argue that structural breaks have important implications for cointegration analysis because these breaks can decrease the power of the cointegration tests, and lead to the under-rejection of the null hypothesis of no cointegration.

This paper has reviewed an extensive literature examining stock market integration. Recent empirical studies of market integration have shown increasing interest in emerging stock markets. The results from the studies of market integration have important implications for international portfolio diversification and market efficiency. If stock markets are integrated the scope of international diversification benefits might be limited, and also the weak form of market efficiency will be violated. Econometric techniques such as cointegration test, factor analysis and GARCH models provide a

useful tool to investigate the relationship among economic variables. In the context of stock market integration, these techniques, *inter alia*, can be used to examine whether international stock markets have a tendency to move together.

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