“Can market volatilities ripple across nations? An investigation using exchange traded funds”

AUTHORS	Fahimeh Rezayat Burhan F. Yavas Prakash L. Dheeriya

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Fahimeh Rezayat (USA), Burhan F. Yavas (USA), Prakash L. Dheeriya (USA)

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Abstract

This paper studies volatilities across different equity markets. If equity markets are integrated, an unexpected event in one market may influence not only returns but also volatility in other markets. The analysis of volatility is particularly important because of the information it provides for riskiness of assets. Our sample includes national ETFs from the following regions: USA and Canada from North America; Germany from Europe and China from Asia. This study uses data for the period of January 2008-2012 to ascertain Granger causality between international equity markets. Our results suggest that there is bidirectional flow of causality from all of our equity markets under study.

Keywords: co-integration, Granger causality, exchange-traded funds, volatility spillovers.
JEL Classification: C22, F21, F36, G15.

Introduction

Volatility characteristic of equity markets has increasingly becoming more popular in mainstream media ever since the "flash crash" occurred in 2008. There is always a concern among policy makers if such an event can repeat, and if so, with what frequency, and whether it can be global in scope. This paper addresses the latter part, as several studies have already discussed volatility predictions.

The growing international integration of financial markets has given rise to many studies that investigate the mechanism through which equity market movements are transmitted around the world. The main issue was how returns in one market affect the returns of other markets. In an earlier paper, Rezayat and Yavas (2006) concluded that even though interdependencies among the major markets are significant there is still room for investors to diversify their portfolios to reduce risk. Like many other studies, the Rezayat and Yavas article utilized broad market indices, like S&P 500, DAX 30, CAC 40 and FTSE 100 to reach their conclusions. In their subsequent study using ETFs (Yavas & Rezayat, 2008), they arrived at similar conclusions.

After the great recession of 2008-2010, media interest shifted to the concept of return volatility. Closer observers of the equity markets have been paying a lot of attention to volatility measures such as VIX index. On average, investors turn bullish when they think a stock is headed higher and bearish when they fear that all is lost. The trouble with this strategy is that during these extremes in sentiment they often lose. While standard financial theory suggests that markets behave rationally (efficient market hypothesis), not accounting for the emotional aspect of the trade often leads to the wrong entry and exit points. That is the reason traders turn their attention on the VIX indicator to assess whether or not the current market sentiment is excessively bullish or bearish. The VIX indicator informs the trader (investor) whether or not the markets have reached an extreme position. Thus, if a market has reached an extreme position, reversals may be highly likely. Hence, volatility is beginning to play an important role in investor decisions.

In this paper, we study volatilities across different equity markets. If equity markets are in fact integrated, an unexpected event in one market may influence not only returns but also volatility (measured by standard deviation) in the other markets. The analysis of volatility is particularly important because the information it provides for the riskiness of assets. It is also possible that the markets are integrated only in terms of equity returns but not volatility. To shed further light on these issues, our sample includes the USA and Canada from North America; Germany from Europe and China from Asia. We have chosen these countries because: (1) they represent the major markets in their respective continents; and (2) previous research has indicated that they tend to move together (especially, the US, Canada and Germany), that is, they are highly correlated. We investigate whether the co-movements of volatilities across the sample countries are significant, whether they are changing (increasing or decreasing) over time and the implications for international investors for such movements. The main objective is to contribute to and expand upon the literature on cross-national volatilities.

Relationship between volatilities of equity markets is of particular interest in this study because policymakers may need to know the impact of other countries' volatilities on their market volatilities, perception of riskiness of equity markets, and investors' expectations of returns from such markets. At first, factors affecting volatility of equity markets are discussed. After the theoretical discussion, empirical analysis is

conducted to determine if the data are stationary and co-integrated. This is done by testing for unit roots in the data using Augmented Dickey-Fuller Tests. Based on the testing for unit roots, we test for Granger causality among our market volatility variables.

In the next section, after the relevant review of the literature, the methodology is discussed along with the data used. This is followed by a discussion on analysis of results. The final section contains conclusions and directions for future research.

1. Literature review

There is a body of empirical evidence that indicates that a diversified portfolio of securities, for example 20 *randomly* selected stocks, holds much less risk (measured by the standard deviation of returns) than an individual security. This follows because: (1) the standard deviation of returns from a single stock in a portfolio is much larger than the standard deviation of the entire portfolio; and (2) the standard deviation of returns on a portfolio declines as the number of stocks in the portfolio rises towards 20.

An important result of holding a diversified portfolio is that a diversified portfolio follows the market very closely, while an individual stock or a portfolio of stocks from a single industry may not closely follow the overall market.

In a similar manner, worldwide diversification, adding some international stocks to the portfolio, may further reduce risk, if movements in international stock markets are not perfectly correlated.

There are some linkages between real economic conditions and stock market performance across countries. However, performance of these markets in any country will vary based on both domestic and international factors, so that market performance will not be perfectly correlated across countries. This creates potential for benefiting from international diversification. However, when we examine recent data on stock market indices, it appears that global equity markets have steadily become more volatile and inter-related. In fact, anyone who follows financial headlines closely may note that on any given day a sell-off in the US the day before has spread to Asia and Europe. It is argued that national economies have recently become more closely linked, not only because of growing international trade and investment flows, but also in terms of international financial transactions. The volume of world trade is now about 30 percent of the World GDP, up from 24 percent in 2001. Influences contributing to an increased general level of correlation among markets and markets integration include the following:

1. The development of global and multinational companies and organizations. Many of the world's leading companies have operations scattered around the globe. Declining incomes and consumption spending in the US and Europe has provided motivation behind their expansion to Asia, Middle-East and South America. Similarly, emerging market players like Tata Motors, Mittal Steel, Samsung or Cemex need consumers in the US and Europe. While revenue growth of many US multinationals in the last decade came mainly from emerging markets, emerging market multinational players have also been gaining market shares in the US and Europe.
2. Advances in information technology.
3. Deregulation of the financial systems of the major industrialized countries.
4. Explosive growth in international capital flows.
5. Abolishment of foreign exchange controls.
6. The fundamental rationale for international portfolio diversification is that it expands the opportunities for gains from portfolio diversification beyond those that are available through domestic securities. However, if international stock market correlations are higher than normal in bear markets, then international diversification will fail to yield the promised gains just when they are needed most. The motivation to study volatility relationships stems from the fact that global financial crisis that started in 2008 in the USA has spread to the rest of the world during the period under study in this paper resulting in considerable volatility in international equity markets.

It is important to study the co-movements between equity markets for several reasons. First, international portfolio diversification is beneficial only if returns from international equity markets are not significantly correlated. Bekaert (1995) found that the emerging market returns are higher, and more predictable, with low correlations with the markets in developed countries but higher volatility than developed markets, providing attractive hedging opportunities for investors in developed markets. Second, equity market co-movement also gives a measure of the level of market integration between the countries. Policy makers are also interested in whether equity markets move together because in a world of free capital flows, the degree of equity market co-volatility can impact on the stability of the international monetary system. Finally, analyzing price volatility can give market participants an assessment of the risk associated with various financial products and thus facilitate their valuation along with the development of different hedging techniques (Ng, 2000). From an academic perspective, the changes in volatility reveal the arrival of new information (Ross & Stephen, 1989).

Much of the earlier research concentrated exclusively on spillover of the first moment, that is, co-movement among the returns. However, more recent research have demonstrated that much of the information would be revealed in the volatility of stock prices, which is in the conditional second moments of the price, rather than in the price itself. In other words, studying the transmission of stock market movements is a joint study of the spillover of prices as well as the volatility of prices. Therefore, volatility linkages are another significant aspect of international financial relations. Several studies, such as Kyle (1985) have pointed out that much of the information would be revealed in the volatility of stock prices.

Scheicher (2001) studied the regional and global integration of equity markets in terms of return and volatility in Hungary, Poland, and Czech Republic. His results indicated that these countries equity markets' return co-movements were significant but not their volatilities. On the other hand, a study by Chou, Lin, and Wu (1999) found that both volatility and return spillovers from the United States to Taiwan were significant.

Li (2007) examined the linkages between Shanghai and Shenzhen stock exchanges of China, Hong Kong and the United States and found no spillovers return and volatility between the stock exchanges in China and U.S. markets although unidirectional volatility spillover from Hong Kong to those in Shanghai and Shenzhen was significant.

Other studies examining the spillover of information both in terms of return and volatility include Hamao et al. (1990), Christofi & Pericli (1999), Kumar & Mukhopadyay (2002), Kim (2004). They found intra-regional volatility spillovers to be more significant than the inter-regional spillovers. Studies like Bracker (1999), Pretorius (2002), and Johnson (2003) have focused also on the factors affecting the spillover of information across the national equity markets. Pretorius (2002) has found that bilateral trade, inflation rate differential, industrial production growth differential, interest rate differential, stock market size and volatility, region etc. are some of the important factors that can affect the spillover of information among the markets.

There is a body of literature which has also focused on the impact of some special events such as market crisis, market liberalization etc. on the spillover of information across the markets in addition to studying equity market interdependence. There are also some studies that focused on the determinants of such information spillover across the markets. They include Elyasiani et al. (1998), Janakiramanan & Lamba (1998), Gilmore & McManus (2002), Hsiao et al. (2003), Leong & Felmingham (2003), Nath & Verma (2003), Mukherjee & Mishra (2005), and Bessler and Yang (2003). Apart from examining only the degree of integration among the markets, studies like Sheng & Tu (2000), Hashmi & Xingyun (2001), Ratanapakorn & Sharma (2002), Jang & Sul (2002), Yang et al. (2002), and Melle (2004) have also examined the effect of market crisis on the information spillover across the borders. Although they varied in their methods (simple correlation, Granger causality, VAR, GARCH etc), almost all studied the degree of inter-linkages before, during and after the crisis. Almost all the studies confirmed that there is a change in the pattern of return/ volatility transmission during a crisis period and some studies have shown the persistence of such effect even after the crisis.

Unlike only return co-movement, studies examining the spillover of information both in terms of return and volatility include Hamao et al. (1990), Christofi & Pericli (1999), Kumar & Mukhopadyay (2002). They found intra-regional volatility spillovers to be more significant than the inter-regional spillovers. Studies like Bracker et al. (1999), Pretorius (2002), Johnson & Soenen (2003) have focused also on the factors affecting the spillover of information across the national equity markets. Also, Pretorius (2002) has found that bilateral trade, inflation rate differential, industrial production growth differential, interest rate differential, stock market size and volatility, region etc. are some of the important factors that can affect the spillover of information among the markets. The results of Johnson & Soenen (2003) revealed that the high share of trade with the US shows positive effect, while the increased bilateral exchange rate volatilities shows reverse effect on the equity market co-movements.

2. Data and methodology

2.1. Data. The aim of the paper is to utilize volatilities derived from ETFs from 4 different countries and investigate the relationship between country volatilities. To our knowledge, there has not been significant development in research on cross-national volatilities using ETFs.

ETF are arguably the most versatile among the financial instruments introduced since the "futures" came on the scene some thirty years ago. Some examples are: SPDRS shares of a unit trust that holds an S&P 500 portfolio; iShares, NASDAQ 100 QQQ and sector SPDRS. ETF are similar to mutual funds in that they allow investors to diversify and allocate their assets and manage risk. However, they are much more flexible and generally less

expensive than mutual funds. First launched in 1993, ETFs now number 1128 and account for over 955 billion dollars in the US alone.

On a practical extent, to concentrate the analysis on the data from the ETFs permits to avoid or reduce some substantial problems that arise when the portfolio diversification profitability is empirically verified (like the exchange rates volatility, differences in expected and unanticipated inflation, divergences in the national tax systems, diversities in stock exchange trading times and bank holidays, restrictions on cross-border trading and investments, transaction costs).

Designed to mimic the movements of MSCI indices, these securities provide an easy pool of international diversification products for the investor. As such they allow us to conduct an analysis of the sample equity markets volatility devoid of problems associated with trading restrictions, exchange rates fluctuations and non-synchronous trading.

The following ETFs are used in this study:

1. For US: SPY. The SPDR S&P 500 ETF represents ownership in the SPDR Trust Series 1, a unit investment trust established to accumulate and hold a portfolio of the equity securities that comprise the Standard & Poor's 500 Composite Stock Price Index. SPDRs seek investment results that, before expenses, generally correspond to the price and yield performance of the Standard & Poor's 500 Composite Stock Price Index.
2. For Canada: EWC. The iShares MSCI Canada Index Fund seeks to provide investment results that correspond generally to the price and yield performance, before fees and expenses, of publicly traded securities in the Canadian market, as measured by the MSCI Canada Index.
3. China: GXC. China Index Fund seeks investment results that correspond generally to the price and yield performance of the MSCI China Index.
4. Germany: EWG. The iShares MSCI Germany Index Fund seeks to provide investment results that correspond generally to the price and yield performance, before fees and expenses, of publicly traded securities in the German market, as measured by the MSCI Germany Index.

This study uses daily data for the period of January 17, 2008-February 8, 2012. To calculate the daily volatility we employed the Garman-Klass historical volatility estimator. Garman-Klass is an unbiased estimator of the variance per unit time of a zero- drift and this metric is a more efficient mesaure of the degree of volatility during a given day (Garman-Klass, 1980). It assumes Brownian motion with zero drift. This is currently the preferred version of open-high-low-close volatility estimator for zero drift.

$$V_t = (LN(C_{t-1}/O_t))^2 + 0.5(LN(H_t/L_t))^2 -$$
$$-(2LN(2)-1)((LN(C_t/O_t))^2,$$

where O_t, H_t, L_t, C_t are respectively open, high, low and close price for the day t.

2.2. Methodology. Before conducting any tests on Granger causality, it is important to study the time series properties of our variables. Granger and Newbold (1974) posit that spurious regression problems occur if there is non-stationarity in data, and this leads to unreliable correlations within regression analysis. Specifically, we test the following equation:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t, \quad (1)$$

where Y_t is the log of a series and u_t is the white noise error term, i.e., non-autocorrelated stochastic error term with zero mean and constant variance σ^2. The null is $\delta = 0$. To test for the presence of unit roots, we compare the Augmented Dickey-Fuller (ADF) statistic and Philip Perron (PP) statistics with the MacKinnon (1996) critical values. We expect the PP statistics to be larger than MacKinnon values in absolute number and also be negative for the series to be stationary. Results of unit root tests for our 4 ETFs are given in Tables 1-4.

Table 1. Results of unit root tests for GXC (assuming a constant and no trend)

Null hypothesis: D(VOLATILITYGXC) has a unit root			
Exogenous: Constant			
Lag length: 8 (automatic − based on SIC, maxlag = 21)			
		t-statistic	Prob.*
Augmented Dickey-Fuller test statistic		-18.9817	0
Test critical values:	1% level	-3.43652	
	5% level	-2.86415	
	10% level	-2.56821	

Note: *MacKinnon (1996) one-sided p-values.

Table 2. Results of unit root tests for SPY (assuming a constant and no trend)

Null hypothesis: D(VOLATILITY_SPY) has a unit root			
Exogenous: Constant			
Lag length: 7 (Automatic − based on SIC, maxlag = 21)			
		t-statistic	Prob.*
Augmented Dickey-Fuller test statistic		-19.7405	0
Test critical values:	1% level	-3.43651	
	5% level	-2.86415	
	10% level	-2.56821	

Note: *MacKinnon (1996) one-sided p-values.

Table 3. Results of unit root tests for EWG (assuming a constant and no trend)

Null hypothesis: D(VOLATILITY_EWG) has a unit root			
Exogenous: Constant			
Lag length: 9 (automatic − based on SIC, maxlag = 21)			
		t-statistic	Prob.*
Augmented Dickey-Fuller test statistic		-17.7398	0
Test critical values:	1% level	-3.43652	
	5% level	-2.86415	
	10% level	-2.56821	

Note: *MacKinnon (1996) one-sided p-values.

Table 4. Results of unit root tests for EWC (assuming a constant and no trend)**

Null hypothesis: D(EWC_VOLATILITY) has a unit root			
Exogenous: Constant			
Lag length: 6 (automatic − based on SIC, maxlag = 21)			
		t-statistic	Prob.*
Augmented Dickey-Fuller test statistic		-20.3585	0
Test critical values:	1% level	-3.43651	
	5% level	-2.86415	
	10% level	-2.56821	

Notes: *MacKinnon (1996) one-sided p-values. **Data are daily and covers the period from January 17, 2008 to February 8, 2012. All variables are significant at 1% level. The procedure, done in Eviews 7.0, automatically selects the optimum number of lags by minimizing the Schwarz Information Criterion.

From examining the results in Table 1, we see that all of our series (EWC, EWG, SPY & GXC) are stationary. We reject the null hypothesis that all of our series has a unit root at 1% level.

Since we reject the hypothesis that there is a unit root in all of our series, we can conclude that all of our series are stationary and are integrated of order 1.

Having determined the order of integration, the next step is to determine if there is any association between any of volatilities of our country ETFs. This is undertaken by performing pair-wise Granger causality tests.

2.2.1. Granger causality tests. Given any two stationary series (y_1) and (y_2), we can test if y_1 causes y_2 by checking how much of the current y_2 can be explained by past values of y_2 and then checking to see whether addition of lagged values of y_1 can help improve the explanation. In other words, if the coefficients on the lagged y_1's are statistically significant, y_2 is said to be Granger-caused by y_1[1].

We employ the standard Wald test statistic obtained from pair-wise Granger causality regressions to determine if there is any statistical relationship between volatility measures of our country ETFs. Table 5 reports the estimated values for pair-wise Granger causality tests between our four volatilities of country ETFs[2].

Table 5. Results of pair-wise Granger causality tests for 4 country volatilities

Null hypothesis	F-statistic	Prob.
EWC_VOLATILITY does not Granger cause VOLATILITY_EWG	31.9486	4.00E-25
VOLATILITY_EWG does not Granger cause EWC_VOLATILITY	3.34161	0.0099
EWC_VOLATALITY does not Granger cause VOLATILITY_SPY	8.74874	6.00E-07
VOLATILITY_SPY does not Granger cause EWC_VOLATILITY	31.1816	2.00E-24
EWC_VOLATILITY does not Granger cause VOLATILITYGXC	12.3893	8.00E-10
VOLATILITYGXC does not Granger cause EWC_VOLATILITY	7.93755	3.00E-06
VOLATILITY_EWG does not Granger cause VOLATILITY_SPY	12.207	1.00E-09
VOLATILITY_SPY does not Granger cause VOLATILITY_EWG	39.2275	1.00E-30
VOLATILITYGXC does not Granger cause VOLATILITY_EWG	1.5139	0.1959*
VOLATILITY_EWG does not Granger cause VOLATILITYGXC	7.80047	3.00E-06
VOLATILITY_SPY does not Granger cause VOLATILITYGXC	15.6514	2.00E-12
VOLATILITYGXC does not Granger cause VOLATILITY_SPY	2.49964	0.0411

Note: Not statistically significant at 5 % confidence level.

It is clear that, in almost all cases but one that the direction of causality is in both directions between volatilities of the countries under study. We find no evidence of Granger causality between China's GXC and Germany's EWG. In other words, China's GXC volatility does not cause Germany's EWG volatility. Given that the Chinese ETF represents a market that is still evolving, it is no surprise that its volatility is rather muted. But that result does not explain why the volatility transmission is bi-directional for the remaining countries (the US, Canada and Germany).

There is a Granger causal relationship flowing from all volatilities of ETFs under study, implying that the world markets are highly integrated and correlated. Direction of causality between our equity markets is two-way, that is, effects of one market are felt in the other markets, and vice versa. It leads to the credence that the world is growing small.

Conclusions

The paper presents empirically the impact of volatilities of national ETFs. Using pair-wise Granger causality tests, we noted that volatilities of all major countries are very important in explaining volatili-

[1] See DeLurgio (1998, pp. 470-471) or any standard econometric textbook for an explanation of Granger causality test procedure.

[2] We employ a lag structure of $p = 4$ in our estimation of Granger causality regressions since the values of AIC & SC criteria are the lowest at that lag level.

ties of other countries in the sample. An important weakness of the Granger causality approach is that it does not guarantee causality. All we can infer is that there is a strong association between volatilities of our 4 countries under study. Another weakness of this approach pertains to the determination of optimal lags. Even though we selected lags based on the established procedure of minimizing the information criteria (Akaike or Schwarz), there is no sound basis for those lags in reality. Consequently, econometricians may come up with a different set of results if they chose to use another method for selecting lags. It has been shown that the number of lags included in the unrestricted VAR regression can affect the level of significance of the F statistic (Delurgio, 1998, p. 473). Despite these shortcomings, this study provides an interesting look at factors influencing volatilities of major equity markets.

Collectively the findings imply that investment and fund managers with access to news on other markets may react to changes faster than those who do not. In addition, the results also imply that investors should not only rely on current news to guide their investment decisions but also take into consideration international news for there are spillovers. Since volatilities can proxy for risk, there are implications for both individual and institutional investors in terms of further examining pricing securities, hedging, other trading strategies, and framing regulatory policies.

As hedging becomes another area of interest for investors, its importance is growing as a vehicle as important as asset allocation. Societe Generale recently constructed a hedge against a risk of market meltdown by creating an exchange traded fund based on VIX, a measure of market volatility. The ETF invests in VIX futures contracts. It shifts from long-term to short-term contracts (and vice versa) when the VIX moving average reaches a certain threshold. The main idea behind this strategy is to allow investors to benefit from sudden spikes in volatility while keeping the ETF's overall costs down (Economist, February 25-March 2, 2012). Clearly, ETFs are no longer the plain-vanilla products that they were when they were first introduced. While such new products expose investors to counterparty risk (when yields are low and uncertainty is high), there is strong demand for products that take more risk but limit potential losses. Equity market volatility can be used by investors as an opportunity to improve returns. By extension of the Society Generale ETF product mentioned above, one could foresee structuring products that use results of this study (relationships among volatility spillovers) for hedging purposes. Given the results of our study, policy makers may benefit from abstaining from taking hands off approach to controlling market behavior, as markets are increasingly becoming tightly integrated.

References

1. Bekaert, G. (1995). "Market Integration and Investment Barriers in Emerging Equity Markets", *World Bank Economic Review*, 9, pp. 75-107.
2. Bessler David A. and Yang J. (2003). "The Structure of Interdependence in International Stock Markets", *Journal of International Money and Finance*, Vol. 22 (2), pp. 261-287.
3. Bracker K.A., Docking D.S., Koch P.D. (1999). "Economic Determinants of Evolution in International Stock Market Integration", *Journal of Empirical Finance*, Vol. 6, pp. 1-27.
4. Chou, R.Y., Lin, J., & Wu, C. (1999). Modeling the Taiwan stock market and international linkages, *Pacific Economic Review*, 4, pp. 305-320.
5. Christofi A. and Pericli A. (1999). "Correlation in Price Changes and Volatility of Major Latin American Stock Markets", *Journal of Multinational Financial Management*, Vol. 9, pp. 79-93.
6. DeLurgio, Stephen A. (1998). *Forecasting Principles and Applications*, Irwin McGraw-Hill: New York.
7. Elyasiani E., Perera P. and Puri T.N. (1998). "Interdependence And Dynamic Linkages Between Stock Markets of Sri Lanka and Its Trading Partners", *Journal of Multinational Financial Management*, Vol. 8, pp. 89-101.
8. Garman, M.B. & Klass, M.J. (1980). On the estimation of security price volatilities from historical data, *Journal of Business*, 53, pp. 67-78.
9. Gilmore C.G. and McManus G.M. (2002). "International Portfolio Diversification: US and Central European Equity Markets, *Emerging Markets Review*, Vol. 3, pp. 69-83.
10. Granger, C.W.J., and P. Newbold (1974). Spurious Regressions in Econometrics, *Journal of Econometrics*, 2, pp. 111-120.
11. Hamao Y., Masulis R.W. and Ng V. (1990). "Correlations in Price Changes and Volatility across International Stock Markets", *The Review of Financial Studies*, Vol. 3 (2), pp. 281-307.
12. Hashmi A.R. Xingyun L. (2001). "Interlinkages among South East Asian Stock Markets (A Comparison Between Pre- and Post-1997-Crisis Periods)".
13. Hsiao Frank S.T., Hsiao M.W. and Yamashita A. (2003). "The Impact of The US Economy on The Asia-Pacific Region: Does It Matter?", *Journal of Asian Economics*, Vol. 14, pp. 219-241.
14. Janakiramanan S. and Lamba A.S. (1998). "An Empirical Examination of Linkages Between Pacific-Basin Stock Markets", *Journal of International Financial Markets, Institutions and Money*, Vol. 8, pp. 155-173.

15. Jang H. and Sul W. (2002). "The Asian Financial Crisis and the Co-Movement of Asian Stock Markets", *Journal of Asian Economics*, Vol. 13, pp. 94-104.
16. Johnson Robert A. and Soenen L. (2003). "Economic Integration and Stock Market Comovement in the Americas", *Journal of Multinational Financial Management*, Vol. 13, pp. 85-100.
17. Kim S.J. (2004). "Information Leadership in the Advanced Asia-Pacific Stock Markets: Return, Volatility and Volume Information Spillovers From the U.S. and Japan", *Journal of the Japanese and International Economies*.
18. Kumar K.K. and Mukhopadyay C. (2002). "A Case of Us and India", NSE Research Paper.
19. Kyle A.S. (1985). "Continuous Auction and Insider Trading", *Econometrica*, Vol. 53, pp. 1315-1335.
20. Leong S.C. and Felmingham B. (2003). "The Interdependence of Share Markets in the Developed Economies of East Asia", *Pacific-Basin Finance Journal*, Vol. 11, pp. 219-237.
21. Li, H. (2007). International linkages of the Chinese stock exchanges: A multivariate GARCH analysis, *Applied Financial Economics*, 17, pp. 285-295.
22. Li, H. & Majerowaska, E. (2007). Testing stock market linkages for Poland and Hungary: A Multivariate GARCH approach, *Research in International Business and Finance*, 22, pp. 1-20.
23. MacKinnon, J.G. (1996). "Numerical Distribution Functions for Unit Root and Cointegration Tests", *Journal of Applied Econometrics*, 11, pp. 601-618.
24. Melle M. (2004). "The Euro Effect on The Integration of the European Stock Markets", Presented at the EFMA 2004 Basel Meetings.
25. Mukherjee K.N. and Mishra R.K. (2005). "Stock Market Interlinkages: A Study of Indian and World Equity Markets", *Indian Journal of Commerce*, 58 (1), pp. 17-42.
26. Nath G.C. and Verma S. (2003). "Study of Common Stochastic Trend and Co-Integration in the Emerging Markets: A Case Study of India, Singapore and Taiwan", NSE Research Paper, source: http://www.nseindia.com.
27. Nath G.C. and Verma S. (2003). "Study of Common Stochastic Trend and Co-Integration in the Emerging Markets: A Case Study of India, Singapore and Taiwan".
28. Ng, Angela, (2000). "Volatility Spillover Effects from Japan and the US to the Pacific-Basin", *Journal of International Money and Finance*, Vol. 19, pp. 207-233.
29. Pretorius E. (2002). "Economic Determinants of Emerging Stock, Market Interdependence", *Emerging Markets Review*, Vol. 3, pp. 84-105.
30. Ratanapakorna O. and Sharma S.C. (2002). "Interrelationships among Regional Stock Indices", *Review of Financial Economics*, Vol. 11, pp. 91-108.
31. Rezayat, F. and Yavas, B.F. (2006). "International Portfolio Diversification: A Study of Linkages among the U.S., European and Japanese Equity Markets", *Journal of Multinational Financial Management*, 16, pp. 440-458.
32. Ross and Stephen (1989). "Information and Volatility: The No-Arbitrage Martingale to Timing and Resolution Irrelevancy", *Journal of Finance*, Vol. 44, pp. 1-17.
33. Scheicher, M. (2001). The comovements of stock markets in Hungary, Poland and the Czech republic, *International Journal of Finance and Economics*, 6, pp. 27-39.
34. Sheng H.C. and Tu A.H. (2000). "A Study of Cointegration and Variance Decomposition among National Equity Indices Before and During the Period of the Asian Financial Crisis", *Journal of Multinational Financial Management*, Vol. 10, pp. 345-365.
35. Yang J., Kolari J.W. and Min I. (2002). "Stock Market Integration and Financial Crises: The Case of Asia", *Applied Financial Economics*, 13 (7), pp. 477-486.
36. Yavas, B.F. and Rezayat, F. (2008). "Integration among Global Equity Markets: Portfolio Diversification using Exchange-Traded Funds", *Investment Management & Financial Innovations*, 5 (3), pp. 30-43.
37. Yavas, B.F (2007). "Benefits of International Portfolio Diversification", *Graziadio Business Report*, 10 (2). Available at http://gbr.pepperdine.edu/072/diversification.html.