Review of Economics & Finance
Submitted on 07/10/2013
Article ID: 1923-7529-2014-01-44-13
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Relations between Volatility and Returns of Exchange Traded Funds of Emerging Markets and of USA

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Abstract: This paper investigates linkages between equity returns and transmission and persistence of volatilities between US and selected key emerging countries during 2012. The data set consists of daily returns of exchange traded funds (ETF) of Brazil, India, Indonesia, Mexico, Russia, S. Korea, Turkey and US. The results of the analysis indicate the existence of significant co-movement of returns among all ETFs, as well as transmission and persistence of volatilities of most emerging markets, with the exception of Turkey and Russia, where the volatilities were unaffected by volatilities of other markets. Turkey's volatility was only transmitted to Indonesia. The findings also indicate that the US market volatility was only transmitted to Indonesia and not to any other market, and the only market whose volatility was transmitted to the US was that of Mexico. The presence of spillovers among stock markets' return series and persistence of volatilities is indicative of efficiency (or inefficiency) in stock markets, and therefore, is useful to investors interested in diversifying their portfolios.

JEL Classifications: C32, C52, E44, F15, F21

Keywords: Economic integration, Volatility transmission, GARCH, Emerging markets, ETFs

1. Introduction

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 returns of other markets. After the great recession of 2008-2010, interest in volatility has increased, primarily because international stock markets have become increasingly volatile. Closer observers of markets have noted a high degree of persistence and time dependence in conditional variances of asset returns.

If equity markets are integrated, an unexpected event in one market may influence not only returns, but also volatility (measured by standard deviation) in other markets. Analysis of volatility is particularly important because of the information it provides for determining riskiness of assets. It is also possible that markets may be integrated only in terms of equity returns but not volatility.

There are some linkages between real economic conditions and equity market performance across countries. However, the performance of equity markets in any country will vary based on both domestic and international factors, so that market performance will not be perfectly correlated across countries. It may be 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 growing international financial transactions. Perhaps, the catch-all term "globalization" describes declining barriers between countries. As a result, short-term equity performance may have less to do with expected fundamentals of individual countries. Most observers agree that emerging markets as a group have better growth prospects and sounder public finances compared to those of the developed nations of North America and Europe.

It is important to study 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 (Harrison & Moore, 2009). Second, equity market co-movement also gives a measure of the level of market integration between countries (Kim & Langrin, 1996; Rezayat & Yavas, 2006; Yavas & Rezayat, 2008). 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 have impact on the stability of the international monetary system (Harrison & Moore, 2009). 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).

Much of earlier research in international stock market returns and volatility concentrated exclusively on spillover of the first moment, that is, co-movement between returns. However, other research (e.g. Kyle, 1985) has demonstrated that more information is revealed in the volatility of stock prices, which is measured by second moment. 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 among stock markets are another significant aspect of international investments.

Academic research on volatilities has not been conclusive. Focusing on emerging markets, Schleicher (2001) studied regional and global integration of equity markets in terms of return and volatility in Hungary, Poland, and Czech Republic. His results indicated that equity markets' return co-movements were significant but not their volatilities. On the other hand, a study by Chou, et al. (1999) found that both volatility and return spillovers from United States to Taiwan were significant. Li (2007) examined linkages between Shanghai and Shenzhen stock exchanges of China, Hong Kong and the United States, and found no spillover return and volatility between stock exchanges in China and U.S. markets, although unidirectional volatility spillover from Hong Kong to those in Shanghai and Shenzhen markets was significant.

Other studies examining the spillover of information both in terms of return and volatility include Kumar and Mukhopadyay (2002), Kim (2005) and Yavas and Rezayat (2013). They found intra-regional volatility spillovers to be more significant than the inter-regional spillovers. Studies like Pretorius (2002), Johnson and Soenen (2003) have also focused on factors affecting the spillover of information across national equity markets. Pretorius (2002) found that bilateral trade,

inflation rate differential, industrial production growth differential, interest rate differential, stock market size and volatility, region are some of the important factors that can affect the spillover of information among stock markets.

To shed further light on these issues, we analyze equity returns of country specific ETFs of following 8 countries: Brazil, India, Indonesia, Mexico, Russia, S. Korea, Turkey and the USA. We selected these countries because there were very few studies that focused on emerging markets. Even though there are many different lists of "emerging markets" the eight largest emerging economies by either nominal or inflation adjusted GDP are the BRIC countries (Brazil, Russia, India and China) as well as MIKT (Mexico, Indonesia, S. Korea and Turkey). We investigate whether co-movements of returns as well as transmission and persistence of volatilities across the sample countries are significant, whether they are changing (increasing or decreasing) over time, and the implications for such movements. The main objective of this paper is to contribute to, and expand upon the literature on the linkages among international equity markets. In examining the co-movements, transmission and persistence of volatilities of American and selected emerging county equity markets, we seek to understand if there are opportunities for international investors/traders to earn a better return for a unit of risk, and if the relationships among these markets are stable.

Our paper is divided into the following sections: immediately following is the section that describes the data. We follow that by a description of the methodologies employed in this paper and analysis of results. Finally, we end the paper with the conclusions and suggestions for future research.

2. Data

The present study uses data on country specific Exchange Traded Funds (ETF). ETF are arguably one of the most versatile of financial instruments introduced since "futures" came on the scene over thirty years ago. 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. Introduced in the late eighties by the Toronto Stock Exchange, ETF now number 1128 and account for over $ 2 trillion of assets, close to total assets of the hedge fund sector.

By concentrating our analysis on ETF data, we can avoid or reduce some substantial problems that arise in traditional academic research (such as 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, and transaction costs). Designed to mimic the movements of MSCI indices, ETFs provide an easy pool of international diversification products for an 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.

In this study, we employ the Exchange Traded Funds (ETF) data from February 3rd, 2011 to December 24th, 2012, giving us a sample of 223 days of data. The choice of the data period was based on the availability of ETF data on all of the 8 countries in the sample. The selected ETFs represent emerging countries and the US. The ETFs that were used in this study are EWZ (Brazil), INDA (India), EIDO (Indonesia), EWW (Mexico), RERUS (Russia), EWY (S. Korea), ETUR (Turkey) and SPY (US). Our study is restricted to these emerging markets due to data availability conditions. The main goal is to study linkages among them and US equity market.

3. Methodology

3.1 Multivariate Auto Regressive Moving Average

To study co-movement of daily returns, we utilized the Multivariate Auto Regressive Moving Average (MARMA). MARMA models combine some of the characteristics of the univariate autoregressive moving average models and, at the same time, some of the characteristics of regression analysis. A MARMA model deals with an output time series Y_t, which is presumed to be influenced by a vector of input time series X_t, and other inputs (factors) collectively grouped and called "noise", e_t. The input series X_t exerts its influence on the output series via a transfer function, which distributes the impact of X_t over several future time periods. The objective of the transfer function modeling is to determine a parsimonious model relating Y_t, to X_t, and e_t (Makridakis, *et al*., 1998). The transfer function model, in general, may be represented as:

$$\varphi(L)Y_t = \omega(L)X_t + \theta(L)e_t \qquad (1)$$

where $\varphi(L), \omega(L), \theta(L)$ are polynomials of different orders in L. Polynomial $\varphi(L) = (1 - \varphi_1 L^1 - \varphi_2 L^2 - \cdots . \varphi_p L^p)$ represents autoregressive part of order p, "L" denotes lag, and $L^1 Y_t$ represents Y_{t-1}, and polynomial $\theta(L) = (1 - \theta_1 L^1 - \theta_2 L^2 - \cdots . \theta_q L^q)$ represents moving average part of order q.

To study co-movements of returns among ETFs of countries in our sample in a systemic manner, we employed Vector Autoregression on the returns of those ETFs. The objective of undertaking this exercise is to determine if hedge funds can isolate any arbitrage opportunities with our sample by looking at ETF returns simultaneously.

3.2 Garch

Volatility of a process is measured via variance. To measure the dynamic relationship of the volatility of a process, we can use models such as exponential smoothing, ARCH and GARCH models. ARCH models were introduced by Engle (1982) and generalized as GARCH by Bollerslev (1986). ARCH and GARCH models, which stand for autoregressive conditional heteroskedasticity and generalized autoregressive conditional heteroskedasticity, respectively, have become widespread tools for dealing with time series heteroskedasticity. The goal of such models is to provide a volatility measure like standard deviation that can be used in financial decisions concerning risk analysis, portfolio selection and derivative pricing. (Engle, 1982; Engle & Patton, 2001).

ARCH or GARCH models are fitted when errors of AR or ARMA, or, in general, a regression model, have variances which are not independent, or the variance of the current error term is related to the value of the previous periods' error terms, as well as past variances. The coefficients on the past squared error terms (ARCH effect) capture the short run persistence of innovations and is an indication of the strength of the shocks in the short term, and the coefficient on the past variances (GARCH effect) measures the contribution of these innovations to long run persistence (Grosvenor & Greenidge, 2010).

The specification of ARCH(p) is given by:

$$\sigma^2 = \omega + \alpha(L)\eta_t^2 \qquad (2)$$

where α(L) is the polynomial lag operator and $\eta_t^2 | \psi_{t-1} \sim N(0, \sigma^2_{t-1})$ is the innovation in the asset return and $\psi_{t-1} = \{y_{t-1}, e_{t-1}, y_{t-2}, e_{t-2} \ldots\}$, where y_{t-i}, represent the return at time t-i and e_i is the error resulted of a regression or an ARMA model to returns.

For GARCH models, the specification is

$$\sigma_t^2 = \omega + \beta(L) + \alpha(L)\eta_t^2 \quad (3)$$

where $\beta(L)$of order p is the autoregressive term and polynomial $\alpha(L)$ of order q is the moving average term.

GARCH process has a tail that is heavier than that of normal distribution. This property makes the GARCH process attractive because the distribution of asset returns frequently display tails heavier than the normal distribution.

In most empirical applications with finitely sampled data, the simple ARCH(1) or GARCH(1, 1) is found to provide a fair description of the data. ARCH(1) model is as follows:

$$\sigma_t^2 = \omega + \alpha\eta_{t-1}^2 \quad (4)$$

and a sufficient condition for the conditional variance to be positive is that the parameters of the model satisfy the following constraints: $\omega > 0$ and $\alpha_i > 0$.

GARCH(1, 1) model is specified as:

$$\sigma_t^2 = \omega + \alpha\, \varepsilon_{t-i}^2 + \beta\, \sigma_{t-1}^2 \quad (5)$$

where $\omega > 0, 0 < \beta \leq 1, 0 < \alpha \leq 1, \alpha + \beta \leq 1, \alpha$ is the coefficient that measures the extent to which a volatility shock today feeds through into the next periods' volatility, while α + β is usually considered to be a measure of persistence of shock to volatility, and it measures the rate at which this effect dies over time.

4. Volatility Persistence

Volatility persistence deals with the nature of volatility, and whether current period's volatility is affected by past periods' volatility, and to what extent. If volatility is "persistent," it implies that today's volatility arising out of new information today, is likely to influence tomorrow's volatility, and future volatilities. One can also make inferences about efficiency or otherwise of financial markets if volatility is found to be "persistent" in the markets. For instance, Malhotra, *et al.* (2013) conducted a study on bonus stock announcements in the Indian stock market and noticed that volatility persisted for some time, and eventually, faded away. Other recent studies such as Hai, *et al*. (2013) find volatility persistence in GDP growth series in Hong Kong, Taiwan and Singapore.

To analyze short term and long-term persistence in volatility, GARCH(1,1) specification is commonly used.. Volatility persistence is one of the statistical properties of time stock returns and exchange rates. Volatility occurs in clusters, in other word, major swings in asset prices do not suddenly stop after major news breaks, and instead they tend to persist. This volatility persistence means that the market participants' volatility expectations are influenced by their perception of high volatility (Poterra & Summers, 1986).

Anderson and Bollerslev (1997) indicate that shocks to volatility decay rapidly and therefore can affect require returns for only short intervals. That implies that volatility shocks can have only a small impact on stock market prices. They also indicated that the other noteworthy statistical

property of volatility is its tendency to revert to the mean which implies that even though shocks lead to large variations in prices and an increase in volatility, their effects eventually wear off. These properties raise several problems when analyzing the current situation, since the time required for volatility to revert to the mean is unknown.

The literature indicates that the sum of the ARCH and GARCH effects is a measure of volatility persistence. If that sum is closer to one, it means that effects of shocks fade away very slowly. The lower the values of GARCH & ARCH effects, the faster the effects fade away. In this study, we analyze whether volatility shocks tend to "persist" in our return series in various countries.

To detect transmission of volatility between stock markets, we use the Augmented GARCH model as developed by Duan (1997):

$$\sigma_t^2 = w + \alpha\, \varepsilon_{t-i}^2 + \beta\, \sigma_{t-1}^2 + \theta X_t \qquad (6)$$

where X_t is the residual squared of ARMA model, and θ is the term that measures the magnitude of volatility transmission across the markets (Zouch, *et al*., 2011).

Augmented GARCH model is considered to be a very versatile, univariate, volatility model. Its superiority over standard GARCH model in the presence of ARCH effects has been very well documented in Specht (2000) and Specht and Gohout (1998).

Note that when y_t , the rate of return on an asset, and there is no regressor (that there is no regression component in the model), then y_t is identical to e_t and becomes a pure GARCH process. In this study, we use GARCH(1, 1) to analyze the persistence and transmission of volatility of the returns. Daily stock returns are calculated by 100*logarithmic difference of daily closing index values.

5. Findings

5.1 Bi-variate Co-movements

While checking autocorrelations and partial autocorrelations for returns, we did not find coefficients of autocorrelations and partial autocorrelations for returns to be significant except for India (RINDA), which demonstrated a significant autocorrelation and partial autocorrelations at lag 1. Consequently, we could not fit an ARMA model to any of the returns with the exception of India which we could fit AR(1). The summary co-movements of ETFs' returns are presented in Table 1.

Table 1. Summary of the Bi-variate Relationship Between Daily ETFs' Returns

$r_{t(reido)} = \underset{(0.000)}{0.482}\, r_{t(rerus)} + e_t$	$r_{t(rerus)} = \underset{(0.000)}{0.818}\, r_{t(reido)} \underset{(0.0612)}{-0.127}\, r_{t-1(reido)} + e_t$
$r_{t(reido)} = \underset{(0.000)}{0.793}\, r_{t(reww)} + e_t$	$r_{t((rerus)} = \underset{(0.000)}{1.125}\, r_{t(reww)} + e_t$
$r_{t(reido)} = \underset{(0.000)}{0.734}\, r_{t(rewy)} + e_t$	$r_{t(rerus)} = \underset{(0.000)}{0.991}\, r_{t(rewy)} + e_t$
$r_{t(reido)} = \underset{(0.000)}{0.564}\, r_{t(rewz)} + e_t$	$r_{t(rerus)} = \underset{(0.000)}{0.952}\, r_{t(rewz)} + e_t$

$r_{t(reido)} = \underset{(0.000)}{0.398}\, r_{t(rinda)} + e_t$	$r_{t(rerus)} = \underset{(0.000)}{0.606}\, r_{t(rinda)} + \underset{(0.0622)}{0118} r_{t-1(rinda)} + e_t$
$r_{t(reido)} = \underset{(0.000)}{1.159}\, r_{t(rspy)} + e_t$	$r_{t(rerus)} = \underset{(0.000)}{1.719}\, r_{t(rspy)} + e_t$
$r_{t(reido)} = \underset{(0.000)}{0.599}\, r_{t(rtur)} + \underset{(0.0361)}{0.109} r_{t-1(rtur)} + e_t$	$r_{t(rerus)} = \underset{(0.000)}{0.807}\, r_{t(rtur)} + e_t$
$r_{t(reww)} = \underset{(0.000)}{0.562}\, r_{t(reido)} + e_t$	$r_{t(rewz)} = \underset{(0.000)}{0.623}\, r_{t(reido)} + e_t$
$r_{t((reww)} = \underset{(0.000)}{0469}\, r_{t(rerus)} + e_t$	$r_{t(rewz)} = \underset{(0.000)}{0.620}\, r_{t(rerus)} + e_t$
$r_{t(reww)} = \underset{(0.000)}{0.595}\, r_{t(rewy)} + e_t$	$r_{t(rewz)} = \underset{(0.0269)}{-0.0015} + \underset{(0.000)}{0.891} r_{t(reww)} + e_t$
$r_{t(reww)} = \underset{(0.0359)}{0.113} + \underset{(0.000)}{0.572}\, r_{t(rewz)} + e_t$	$r_{t(rewz)} = \underset{(0.000)}{-0.818}\, r_{t(rewy)} + e_t$
$r_{t(reww)} = \underset{(0.000)}{0352}\, r_{t(rinda)} + e_t$	$r_{t(rewz)} = \underset{(0.000)}{0.480}\, r_{t(rinda)} + e_t$
$r_{t(reww)} = \underset{(0.000)}{1.111} r_{t(rspy)} + e_t$	$r_{t(rewz)} = \underset{(0.0297)}{-0.132} + \underset{(0.000)}{1.349}\, r_{t(rspy)} + e_t$
$r_{t(reww)} = \underset{(0.000)}{0.534}\, r_{t(rtur)} + e_t$	$r_{t(rewz)} = \underset{(0.0156)}{-0.172} + \underset{(0.000)}{0.707}\, r_{t(rtur)} + e_t$
$r_{t(rewy)} = \underset{(0.000)}{0.697}\, r_{t(reido)} + e_t$	$r_{t(rinda)} = \underset{(0.0212)}{-0.137}\, r_{t-1(rinda)} + \underset{(0.000)}{0.542}\, r_{t(reido)} + e_t$
$r_{t(rewy)} = \underset{(0.000)}{0.554}\, r_{t(rerus)} + e_t$	$r_{t(rinda)} = \underset{(0.029)}{-0.167} r_{t-1(rinda)} + \underset{(0.000)}{0.494}\, r_{t(rerus)} + e_t$
$r_{t(rewy)} = \underset{(0.000)}{0.798}\, r_{t(reww)} + e_t \underset{(0.066)}{-0.123} e_{t-1}$	$r_{t(rinda)} = \underset{(0.00064)}{-0.159}\, r_{t-1(rinda)} + \underset{(0.000)}{0.684}\, r_{t(reww)} + e_t$
$r_{t(rewy)} = \underset{(0.0361)}{0.901} + \underset{(0.000)}{0.714}\, r_{t(rewz)} + e_t \underset{(0.0003)}{-0.123} e_{t-1}$	$r_{t((rinda)} = \underset{(0.0147)}{-0.135} + r_{t-1(rinda)} + \underset{(0.000)}{0.676}\, r_{t(rewy)} + \underset{(0.0260)}{0.178} r_{t-1(rewy)} + e_t$
$r_{t(rewy)} = \underset{(0.000)}{0.471}\, r_{t(rinda)} + e_t \underset{(0.0825)}{-0.117} e_{t-1}$	$r_{t(rinda)} = \underset{(0.0096)}{-0.146} r_{t-1\,(rinda)} + \underset{(0.000)}{0.584}\, r_{t(rewz)} + \underset{(0.006)}{0.394}\, r_{t-1(rewz)} + e_t \underset{(0.0580)}{+0.470} e_{t-1}$
$r_{t(rewy)} = \underset{(0.000)}{1.276}\, r_{t(rspy)} + e_t \underset{(0.0061)}{-0.183} e_{t-1}$	$r_{t(rinda)} = \underset{(0.0138)}{-0.142}\, r_{t-1(rinda)} + \underset{(0.000)}{0.979}\, r_{t(rspy)} + e_t$
$r_{t(rewy)} = \underset{(0.000)}{0.565}\, r_{t(rtur)} + e_t$	$r_{t(rinda)} = \underset{(0.0568)}{-0.115}\, r_{t-1(rinda)} + \underset{(0.000)}{0.498}\, r_{t(rtur)} + e_t$
$r_{t(rsp)} = \underset{(0.000)}{0.420}\, r_{t(reido)} + e_t$	$r_{t(rtur)} = \underset{(0.000)}{0.612}\, r_{t(reido)} \underset{(0.0014)}{-0.172}\, r_{t-1(reido)} + e_t$
$r_{t(rspy)} = \underset{(0.000)}{-0.368}\, r_{t(rerus)} + e_t$	$r_{t((rtur)} = \underset{(0.000)}{0.494}\, r_{t(rerus)} \underset{(0.007)}{-0.104}\, r_{t-1(rerus)} + e_t$
$r_{t(rspy)} = \underset{(0.000)}{-0.570}\, r_{t(reww)} + e_t$	$r_{t(rtur)} = \underset{(0.000)}{0.791}\, r_{t(reww)} \underset{(0.0249)}{-0.139} r_{t-1(reww)} + e_t$
$r_{t(rspy)} = \underset{(0.000)}{0.488}\, r_{t(rewy)} + e_t$	$r_{t(rtur)} = \underset{(0.000)}{0.617}\, r_{t(rewy)}) \underset{(0.0535)}{-0.109}\, r_{t-1(rewy)} + e_t$
$r_{t(rspy)} = \underset{(0.0486)}{0.069} + \underset{(0.000)}{0.445}\, r_{t(rewz)} + e_t$	$r_{t(tur)} = \underset{(0.0238)}{0.153} + \underset{(0.000)}{0.670}\, r_{t(rewz)} \underset{(0.010)}{-0.122}\, r_{t-1(rewz)} + e_t$
$r_{t(rspy)} = \underset{(0.000)}{0.260}\, r_{t(rinda)} + e_t$	$r_{t(rtur)} = \underset{(0.000)}{0.612}\, r_{t(rinda)} + e_t$
$r_{t(rspy)} = \underset{(0.000)}{0.392}\, r_{t(rtur)} + e_t \underset{(0.0081)}{+0.179} e_{t-1}$	$r_{t(rtur)} = \underset{(0.000)}{1.113}\, r_{t(rspy)} \underset{(0.0008)}{-0.286}\, r_{t-1(rspy)} + e_t$

Our results indicate that all equity markets' return co-movements are significant. In addition, return of Turkey ETF (RTUR) demonstrated not only to have concurrent relationship with all, it also showed to be related to past period returns of all except India. Russian ETF returns showed also to be dependent on lagged return of Indonesia and India, and return of Indian ETF (RINDA) showed to be linked to past period returns of Brazil and S. Korea's returns.

(1) We noted that the return of Indonesian Market as represented by its ETF (REIDO) has a strong and positive relationship with the ETF's return of the following countries: Russia (RERUS), Mexico (REWW), S. Korea (REWY), Brazil (REWZ), India (RINDA) and the US (RSPY). In the case of bi-lateral relations between Indonesia and Turkey (RTUR), we observed positive relationship between both in current as well as one lagged period.

(2) When Russian market is studied with other markets, we observe positive relationships of ETF returns with the following countries: Indonesia, Mexico, S. Korea, Brazil, India, US and Turkey. Note, however, that one-period lagged returns from India also appear (though not significant at 5%) in the equation.

(3) Mexican market (REWW) returns move together with the returns from all of the other countries included in the sample.

(4) Brazilian returns (REWZ) are also similar in that they are positively related to the returns from other countries with the exception of returns from S. Korea (REWY). There is a significant negative relationship of returns between Brazil and S. Korea. The implication is that investors from Brazil and S. Korea could invest in each other's market to diversify.

(5) South Korean returns are significantly and positively related to other countries in the sample.

(6) Indian returns (RINDA) follow the same pattern and are positively related to other country returns. One interesting observation is that Indian returns are negatively related to past own returns.

(7) Turkish market returns (RTUR) exhibit somewhat different pattern from others. While they indicate positive relationship with returns from all other countries, lagged relations with all other countries except India are negative. This may present opportunities for investors for diversification purposes.

(8) Finally, the US market returns (RSPY) have a positive relationship with all of the markets included in the sample except with Russia and Mexico.

5.2 Volatility Persistence

In order to estimate the best GARCH model, it is necessary to know the distribution of the returns. Thus, it is a common practice to calculate descriptive statistics, especially the skewness and kurtosis of the distributions and to test whether the distribution is normal.

Except for REIDO, RERUS, and REWW which are negatively skewed, the other ETF returns are positively skewed. Additionally, the kurtosis of all returns are between 3.0698 and 5.404. More formally, Jarque-Bera tests could not reject the hypothesis of normal distribution for US (RSPY), Mexico (REWW), S. Korea (REWY), and Turkey (RTUR) at a significance level of 0.05. (See Table 2 below). The information provided by the normality tests is used in fitting GARCH for studying volatility persistence and volatility transmission.

Table 2. Descriptive Statistics- Daily Return of ETFs March 2012-December 2012

	REIDO	RERUS	REWW	REWY	REWZ	RINDA	RSPY	RTUR
Mean	-0.027701	-0.043294	0.057242	0.018600	-0.098311	-0.017628	0.025304	0.101780
Median	-0.164935	-0.121433	0.016596	0.033795	-0.147907	0.000000	0.021198	0.076584
Maximum	5.426687	5.004760	3.308821	4.515693	5.220993	6.264905	2.462098	4.446810
Minimum	-6.084425	-6.727318	-3.459711	-3.507829	-5.528999	-5.275057	-2.549921	-3.584187
Std. Dev.	1.358026	1.769027	1.141724	1.323231	1.424612	1.593523	0.817951	1.381681
Skewness	-0.046302	-0.271337	-0.006498	0.130014	0.065907	0.232475	0.019952	0.157860
Kurtosis	5.404317	4.353489	3.190440	3.370567	4.335231	4.116849	3.793488	3.069880
Jarque-Bera	53.79239**	19.75805**	0.338552	1.904181	16.72701**	13.59864**	5.865045	0.971557
Probability	0.000000	0.000051	0.844276	0.385933	0.000233	0.001115	0.053263	0.615218
Observations	223	223	223	223	223	223	223	223

** indicates that Jarque-Bera tests reject the normal distribution for returns at $\alpha = .05$

By looking at the standard deviations in Table 2, we notice the highest volatility during the period of our study is exhibited by Russia, followed by India, and the US has the lowest volatility.

Since, in our study, partial autocorrelations and autocorrelations of all returns were statistically insignificant except for the returns of India, to study volatility persistence, we fitted GARCH(1,1) model to squared returns (except for India where we used squared error of the AR(1)). As noted in Table 3 below, we find that only Indonesia (RIDO) and South Korea (REWY) demonstrated short-term volatility dependence. The degree of volatility persistence, ranges from a low of 0.8475 in case of Russia to a high of 0.9697 for Indonesia; Note that during the period under study, the volatility of ETF for Turkey was not a significant function of its past volatility, or in another words, it did not show significant persistency during the period under study.

Table 3. Volatility Persistence for Return of ETFs

Coefficient	RIDO	RERUS	REWW	REWY	REWZ	RINDA**	RSPY	RTUR
Constant	0.0497 (0.256)	0.4802 (0.5509)	0.1277 (0.412)	0.0705 (0.418)	0.3082 (0.689)	0.372 (0.6425)	0.0322 (0.0725)	
ARCH(-1) α	0.0630 (0.0158)			0.0977 (0.0831)				
Garch(-1) β	0.9067 (0.000)	0.8475 (0.0021)	0.9048 (0.000)	0.8635 (0.000)	0.8510 (0.0235)	0.8517 (0.0084)	0.9555 (0.000)	
$\alpha + \beta$	0.9697	0.8475	0.9048	0.9612	0.8510	0.8517	0.9555	
AR(-1)						-0.156 (0.0258)		

*Number in the parentheses are p-values (significant levels);

** Almost all constant values are not statistically significant but The E-view software could not allow us to omit them.

*** RINDA –for this return GARCH was fitted to the error term of AR(1).

5.3 Volatility Transmission

To detect transmission of volatility between stock markets, we used the Augmented GARCH model. This study employed square of returns for X_t, except for returns of Indian ETF, because as mentioned above, we could not fit AR or ARMA. Results of Augmented GARCH model for our return series are provided in Table 4. We performed similar analysis using squared return series but we could not find any significant results, hence those results are not reported. Those results are available from the authors upon request.

Table 4. Volatility Transmission between the Daily ETFs' Returns

$\sigma^2_{t(reido)} = \underset{(0.3598)}{0.0422} + \underset{(0.0000)}{0.727}\,\sigma^2_{t-1(reido)} + \underset{(0.003)}{0.1409}\,r^2_{t\,(rerus)}$	$\sigma^2_{t(reww)} = \underset{(0.0583)}{0.218} + \underset{(0.0006)}{0.4504}\sigma^2_{t-1(reww)} + \underset{(0.0139)}{0.1589}\,r^2_{t\,(rerus)}$
$\sigma^2_{t(reido)} = \underset{(0.0007)}{0.522} + \underset{(0.0000)}{0.330}\,e^2_{t-1(reido)} + \underset{(0.0007)}{0.6889}\,r^2_{t\,(reww)}$	$\sigma^2_{t(reww)} = \underset{(0.0026)}{0.306} + \underset{(0.0962)}{0.1607}\,\sigma^2_{t-1(reww)} + \underset{(0.0002)}{0.4898}\,r^2_{t\,(rewy)}$
$\sigma^2_{t(reido)} = \underset{(0.0007)}{0.4672} + \underset{(0.0000)}{0.2779}\,e^2_{t-1(reido)} + \underset{(0.0003)}{0.5506}\,r^2_{t\,(rewy)}$	$\sigma^2_{t(reww)} = \underset{(0.0006)}{0.365} + \underset{(0.0458)}{0.2163}\,\sigma^2_{t-1(reww)} + \underset{(0.0001)}{0.3104}\,r^2_{t\,(rewz)}$
$\sigma^2_{t(reido)} = \underset{(0.0000)}{0.837} + \underset{(0.0007)}{0.3295}\,e^2_{t-1(reido)} + \underset{(0.0044)}{0.23254}e^2_{t\,(rinda)}$	
$\sigma^2_{t(reido)} = \underset{(0.0000)}{0.617} + \underset{(0.0003)}{0.2362}\,e^2_{t-1(reido)} + \underset{(0.0019)}{1.353}\,r^2_{t\,(rspy)}$	$\sigma^2_{t(rewy)} = \underset{(0.0000)}{0.459} + \underset{(0.0603)}{0.1384}\,\sigma^2_{t-1(rewy)} + \underset{(0.0008)}{0.8216}\,r^2_{t\,(reww)}$
$\sigma^2_{t(reido)} = \underset{(0.0002)}{0.602} + \underset{(0.0033)}{0.2608}\,\sigma^2_{t-1(reido)} + \underset{(0.0002)}{0.3913}\,r^2_{t\,(rtur)}$	$\sigma^2_{t(rewy)} = \underset{(0.0496)}{0.163} + \underset{(0.0002)}{0.2713}\,\sigma^2_{t-1(rewy)} + \underset{(0.0001)}{0.6019}\,r^2_{t\,(rewz)}$
$\sigma^2_{t(rewz)} = \underset{(0.0348)}{0.292} + \underset{(0.0022)}{0.3366}\,\sigma^2_{t-1(rewz)} + \underset{(0.0027)}{0.3182}\,r^2_{t\,(rerus)}$	$\sigma^2_{t(rinda)} = \underset{(0.0436)}{0.781} + \underset{(0.0456)}{0.3964}\,\sigma^2_{t-1(rinda)} + \underset{(0.0136)}{0.4226}\,r^2_{t\,(reido)}$
$\sigma^2_{t(rewz)} = \underset{(0.0001)}{0.493} + \underset{(0.0962)}{0.124}\,\sigma^2_{t-1(rewz)} + \underset{(0.0002)}{0.9156}\,r^2_{t\,(reww)}$	$\sigma^2_{t(rinda)} = \underset{(0.0595)}{0.526} + \underset{(0.0264)}{0.3768}\,\sigma^2_{t-1(rinda)} + \underset{(0.0042)}{0.3463}\,r^2_{t\,(rerus)}$
$\sigma^2_{t(rewz)} = \underset{(0.0001)}{0.373} + \underset{(0.0645)}{0.0828}\,\sigma^2_{t-1(rewz)} + \underset{(0.0000)}{0.8602}\,r^2_{t\,(rewy)}$	$\sigma^2_{t(rinda)} = \underset{(0.0034)}{0.910} + \underset{(0.0780)}{0.2492}\,\sigma^2_{t-1(rinda)} + \underset{(0.0011)}{0.4817}\,r^2_{t\,(rewz)}$
	$\sigma^2_{t(rspy)} = \underset{(0.0010)}{0.847} + \underset{(0.0293)}{0.0888}\,\sigma^2_{t-1(rspy)} + \underset{(0.0000)}{0.4071}\,r^2_{t\,(reww)}$

During the period under study, we find there is a strong evidence of:

(1) Transmission of volatility from all returns to Indonesia except from Brazil;

(2) Bilateral volatility transmissions exist between returns of South Korea and Brazil;

(3) Bilateral volatility transmissions are significant between returns of Mexico and Brazil and South Korea;

(4) Bilateral volatility transmissions exist between returns of India and Indonesia;

(5) There also exist volatility spillovers from returns of Mexico to returns of SPY (US) and from returns of Russia to Brazil and India;

(6) Finally, it is interesting to note that Russian and Turkish markets do not show any evidence of volatility transmission from other markets.

We can conclude that during our study, there is evidence of cross-transmission of volatility between emerging stock markets. It could be due to the fact that they have similar capital market structures, or are in similar phase of development. It is difficult to interpret and rationalize why there is no evidence of transmission from S&P (US) to others except Indonesia.

6. Conclusions

The findings of this study indicate that co-movements between daily ETF returns representing the countries under study were significant. We also found evidence of cross-transmission of volatilities between ETF returns of selected emerging market countries. We theorize that such evidence could be related to the stage of development of those emerging markets, or the institutional structure supporting those markets, or merely lack of timely information available to traders of those securities. We also find evidence of weak form inefficiency in most emerging market ETF returns, with the exception of Turkey. There also exists volatility spillover from Mexico to US. More research is needed to investigate possible causes of inefficiencies, or persistence of volatilities.

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

In general it is noted that the stock markets are indeed becoming more and more integrated. As such, it is important that information from both domestic and global markets be studied before investors (institutional and individual) make investment decisions since international spillovers for both returns and their volatilities are significant.

Second, since volatilities indicate risks, volatility transmissions open up a new area for financial products that are tailor-made to allow investors to benefit from (or hedge against) sudden changes in market volatility.

Clearly, ETFs are no longer the plain-vanilla products that they were when they were first introduced. As the example above illustrates, there are some that are used for hedging purposes as well as those that are "synthetic." This means that returns are generated from a swap with counterparty, and that the money is not used to buy the underlying securities. While this exposes the investors to counterparty risk, when yields are low and uncertainty is high, there is strong demand for products that are created to take more risk but limit potential losses. Equity market volatility can be used by investors in such a strategy. Finally, it is reported that innovation in both ETFs and its volatility use continues.

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