Volatility Spillovers between ETFs and Their Constituent Stocks: Empirical Study for Vietnam, Indonesia, and the Philippines

by

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Abstract

This study examines the volatility spillovers of three exchange traded funds (ETFs) from Vietnam, Philippines and Indonesia on their respective 10 largest component stocks due to the introduction of the ETF trading in these countries. To measure volatilities of the underlying stocks caused by ETFs, as well as their directional effects and magnitude, three models, i.e. GARCH (1, 1), Andersen et al. (2001)'s, and Diebold and Yilmaz (2009, 2012)'s models, are employed. Both intra-day and daily data for ETFs and their respective 10 largest component stocks from the three countries are collected for this study. Results show that (1) volatilities of components stocks from the three countries increase significantly after the introduction of their ETFs; (2) ETF-to-stock spillovers are found to be larger than stock-to-ETF spillovers in all of the three countries, regardless of how the variance shares are normalized. It is also found that different traded volumes of ETFs may lead to different percentages of volatility transmitted from individual ETFs to their component stocks. Findings of this study are expected to be beneficial to investors, market practitioners, and regulators, who are attracted to the growing demand of ETFs in Vietnam, Indonesia, the Philippines, and other Asian equity markets.

JEL Classifications: G12, G14.

Key words: ETF, Volatility Spillover, Realized Volatility, GARCH

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Introduction

In recent decades, ETFs have been becoming more popular as an investment vehicle in Southeast Asia capital markets. And their presence could be found in most countries in the region, such as iShares MSCI Singapore Index ETF from Singapore, iShares MSCI Malaysia Index from Malaysia, MVV VNM ETF from Vietnam, iShares MSCI Philippines ETF from the Philippines, and iShares MSCI Indonesia ETF from Indonesia.

However, among the above-mentioned ETF markets, there are noticeably increases in ETFs from three countries: Vietnam (16.8%), Indonesia (15.9%), and the Philippines (6.3%) in the year 2014. As explained in Tran (2014), with the competitively low manufacturing costs present in Vietnam, the Philippines, and Indonesia, investors may prefer seeking for investment opportunities in these three countries, most likely through ETFs.

The May 6, 2010 Flash Crash phenomenon has given a real concern for both regulators and investors around the world about the future potential rise in the market systematic risk that may be also caused by exchange traded funds (ETFs) (Ramaswamy, 2011). Furthermore, according to Lerman (2002), the volatility of an ETF depends on its underlying index; however, the volatility of the underlying index depends on its underlying stock components. Thus, with the popularity gained recently by ETFs in Southeast Asia capital markets, it would be interesting to explore on whether the introduction of those ETFs can lead to volatility spillovers to their respective equity markets. In most past studies, volatility-spillover phenomenon was mostly studied for futures, options and equity securities, and fewer studies have been done for ETFs. To the best of our knowledge, the above issue remains unexplored for ETFs in Vietnam, Indonesia and the Philippines.

In this paper, we attempt to examine whether there is a volatility spillovers caused by ETFs to their respective 10 largest constituent stocks in Vietnam, the Philippines and Indonesia as the result of the introduction of ETF trading in these three countries. If the answer is positive, further investigation will be carried out to see whether this phenomenon leads to an increase or a decrease in volatility of the constituent stocks, and also whether the phenomenon exists bi-directionally in each of the three countries.

To measure volatilities of the underlying stock markets caused by ETFs, as well as their directional effects and magnitude, three models, i.e. GARCH (1, 1), Andersen et al. (2001)'s, and Diebold and Yilmaz (2009, 2012)'s models, are employed in this study. The adopted methodology in this study has a two-step procedure: (1) in the first step, volatility spillover is examined for two sample periods, which are before and after the introduction of each of the three ETFs from Vietnam, Philippines, and Indonesia; (2) in the second step, volatility transmission between the ETF from each of these three countries and its 10 largest component stocks is examined for only the post-ETF- introduction sample period to confirm the presence and direction of the volatility spillover. Both intra-day and daily data for ETFs and theirs respective 10 largest component stocks from the three countries are collected for this study from July 1st, 2011 - June 30th, 2014. According to Andersen et al. (2001), using intra-day and daily data series gives a minimal micro-structure biases and a minimal measurement error in the computation of their realized volatilities, respectively

Our findings show that: (1) volatilities of components stocks from the three samples for Vietnam, Indonesia, and the Philippines increase significantly after the introduction of ETFs; (2) ETF-to-stock spillovers are found to be larger than stock-to-ETF spillovers in all of the three countries, regardless of how the variance shares are normalized. It is also found that different traded volumes of ETFs may lead to different percentages of volatility transmitted from individual ETFs to their component stocks. Findings of this study are expected to be beneficial to investors, market practitioners, and regulators, who are attracted to the growing demand of ETFs in Vietnam, Indonesia, the Philippines, and other Asian equity markets.

The rest of the paper is structured as follows: Section 2 provides a literature review related to volatility spillover; Section 3 provides details of data and methodologies adopted in this study; Section 4 discusses main findings; and Section 5 provides some key conclusions.

Literature Review

Lin and Chiang (2005) examined the impact of Taiwan's Top-50-Tracker Fund (TTT) on the volatility of financial and electronic component stocks over a period from 4/1/03 to 9/30/03. Their results show that significant increase in volatility of the financial and electronic component stocks as a result of the introduction of TTT in the Taiwan capital market.

One of the earliest studies that investigated the effect that ETFs have on their component stocks is Madura and Ngo (2008). Using the standard event study method to test on a sample of 124 ETFs traded on the AMEX from the period from January 1996 to December 2004, the authors found that the 124 ETFs in their sample have significantly positive effects on the component stocks.

Ben-David, Franzoni, and Moussawi (2012) in their study from US market examine these issues relative to ETFs specifically. While the underlying intuition of their paper (that ETFs provide an additional source of volatility in component stocks) is quite similar to our study, they employ alternative empirical techniques and as well as high frequency data during the "Flash Crash" of May 6, 2010. They also find evidence of price shocks in component stocks that stem from ETF trading activity, and they link these shocks to ETF order imbalances and bid-ask spreads.

Chen and Malinda (2013) explored the bi-directional volatility spillovers between financial and non-financial ETFs and their benchmark indices in capital markets of a number of countries: America, Canada, China, Brazil, and other emerging markets. Using both EGARCH and GARCH models, their findings provide evidences of the above-mentioned bi-directional volatility spillovers, from which the volatility spillover effect appears to be significantly stronger and positive for non-financial ETFs. Similar results were also found in Krause et al. (2013). Using model used in Diebold and Yilmaz (2009, 2012), Krause et al. (2013) found that the bi-directional volatility spillover between each of the four ETFs, i.e. S&P500 ETF, SPDR XLE, SPDR XLF and SPDR XLI, and its largest component stocks is significant, and that the volatility spillovers transmited from the ETFs to their stocks are significantly stronger.

Methodology

Three Adopted Models:

In measuring volatility of the underlying stock markets caused by ETFs and its direction, three models , i.e. GARCH model, Andersen et al. (2001)'s model, and Diebold and Yilmaz (2009, 2012)'s model, are adopted in this study.

The GARCH model

The GARCH (1, 1) model presented below is used to investigate the changes in the variance of the 10 largest component stocks of each ETF from the three countries in our sample.

$$R_{S,t} = a + bR_{M,t} + e_t \quad (Equation\ 1)$$

$$e_t \mid I_{t-1} \sim N\,(0, H_t) \quad (Equation\ 2)$$

$$H_t = c + c_d D_t + \alpha e_{t-1}^2 + \alpha_d D_t e_{t-1}^2 + \beta H_{t-1} + \beta_d D_t H_{t-1} \quad (Equation\ 3)$$

Where:

$R_{S,t}$ *and* $R_{M,t}$ refer to as the five-minute return for the average bid and ask prices of stock S and the five minute return for the stock index M at time t, respectively;

I_{t-1} refers to as the information available at time *t* -1;.

D_t represents the dummy variable at time t; it has a value of 0 and 1 for the pre-ETF-introduction period and the post-ETF-introduction period, respectively.
Ht is the conditional variance

The unconditional variance (UV) for the post- ETF-introduction period is computed for each market as follows.

$$UV_{post} = \frac{c + c_d}{1 - (\alpha + \alpha_d + \beta + \beta_d)} \quad (Equation\ 4)$$

Where: c , α , β ,c_d, α_d and β_d are the coefficients of the independent variables in the conditional variances equation. If one of these parameters is significant, it can be concluded that ETFs have a significant impact on the volatility of its constituent stocks.

<u>Andersen et al. (2001)'s model</u>

Follow Andersen et al. (2001), five-minute intraday data is used to measure the realized volatility of ETFs and their respective constituent stocks from Vietnam, the Philippines and

Indonesia. According to Andersen et al. (2001), the use of five-minute intraday data can prevent possible microstructure biases and ensure minimal measurement error.

The model assumes that a continuous time stochastic volatility is followed by log price p.

Furthermore, they apply the quadratic valuation theory as shown in Equation 5:

$$\sum_{j=1,2,..,[h/\ \Delta]} r^2_{t+j\ \Delta,\Delta} - \int_0^h \sigma^2_{t+\ \tau}\ \mathrm{d}\tau \rightarrow 0$$

(*Equation 5*)

In Equation (5), h represents the period, Δ represents the fixed interval between 2 observations in the period h, the number of observations for the period h are given by *[h/Δ]*. The real h period volatility called as the volatility of the latent period, can also be measured by the integrated volatility, shown by $\int_0^h \sigma^2_{t+\ \tau}\ d\tau$.

The combined latent volatilities' realized (ex-post) volatility can be constructed by the sum of the squared returns, if $\Delta \rightarrow 0$ or the sampling is appropriately frequent.

Using five minute data of constituent of the indices of Vietnam, the Philippines and Indonesia, the volatility is estimated. Hence, the number of observations per day for Vietnam, Indonesia, and the Philippines are 33 906, 4 237, and 4 980, respectively.

The volatility of stock i at time t is computed as follows. (Andersen et al., 2001) $RV_{i,t} = \sum_{j=1,2,\ldots,[1/\ \Delta]} r^2_{i,t,j}$

$(Equation\ 6)$

Where, $\Delta=$ The fixed interval between 2 observations in each period. And $r_{i,t,j}$ is the 5 minute return of stock i at time t, and interval j.

Martinez et al. (2005) raised the issue of non-synchronous trading and bid–ask bounce which could lead to biased conclusions, this study uses the average of the bid and ask prices as the price in order to avoid a biased conclusion.

The variance difference ratio (VDR) is used in this study to define the relative change in volatility for stock i; hence, the following Equation 7 is adopted to measure the effect of volatility generated from the selected ETFs in the sample.

$VDR_i = \frac{\bar{X}_{i,post}}{\bar{X}_{i,pre}}$ and $VDR_i = \frac{Xi,post}{X_{i,pre}}$

(Equation 7)

Where: $\bar{X}$ and X represents the unconditional volatility of GARCH model as defined by Andersen et al. (2001)

The average VDR for all stocks equals to 1 when the volatilities of constituent stocks are not systematically generated during the trading of ETFs. Thus, the null hypothesis in this study is "the average VDR equals to 1", which will be tested with the Z-statistics test. In the event that the null hypothesis is rejected due to a more-than-one VDR on average, the volatilities of the constituent stocks are said to increase in overall.

Diebold and Yilmaz (2009, 2012)'s Model

To measure the two-way interaction of volatility spillovers among the ETFs and their largest component stocks in each of the three countries, i.e. Vietnam, Indonesia and the Philippines, . Diebold and Yilmaz (2012)'s model is adopted.

To test directional volatility spillovers, 11 variable VARs are estimated for the returns of each ETF and its 10 largest component stocks and we choose five lags to replicate trading activity in a week. This is shown in Equation 8 below.

$x_t = \sum_{i=1}^{5} \emptyset_i \, x_{t-i} + \varepsilon_t$ Where $\varepsilon \sim (0, \sum)$ *(Equation 8)*

Changing this expression to a moving average representation, the following Equation 9 is used.

$x_t = \sum_{i=0}^{\infty} A_i \, \varepsilon_{t-i}$ *(Equation 9)*

and

$A_i = \emptyset_1 A_{i-1} + \emptyset_2 A_{i-2} + .. + \emptyset_5 A_{i-5}$ *(Equation 10)*

Variance decompositions are then constructed by using the moving average coefficients. A_0 is an 11 by 11 identity matrix, and $A_i = 0$ for *i* < *0*. The H step-ahead error variance's fractions can be evaluated by these variance decompositions, in order to forecast x_i caused by shocks to x_j. In this study, H is set at 10 in order to generate forecasts 10 days ahead from the variance decompositions. Hence, a H-step-ahead variance decomposition for a stock is computed as follows.

$$\theta_{ij}^{g}(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (e_i' A_h \sum e_j)^2}{\sum_{h=0}^{H-1} (e_i' A_h \sum A_h' e_i)} \qquad (Equation\ 11)$$

The error vector is denoted by ε, and $\sum$ shows the variance matrix for ε.

The standard deviation (S.D.) of the error term for the j^{th} equation is given by σ_{jj}.

The selection vector has 1 as the i^{th} element and a 0 in other cases, and is denoted by e_i.

However, the innovations from the error term are not orthogonalized in this framework. Hence, every entry in the decomposition matrix must be normalized. This is shown in Equation 12 below.

$$\tilde{\theta}_{i\,j}^{g}(H) = \frac{\theta_{i\,j}^{g}(H)}{\sum_{j=1}^{N} \theta_{i\,j}^{g}(H)} \qquad (Equation\ 12)$$

And

$$\sum_{j=1}^{N} \tilde{\theta}_{i\,j}^{g}(H) = 1$$

And

$$\sum_{i,j=1}^{N} \tilde{\theta}_{i\,j}^{g}(H) = N$$

The volatility contributions from this variance decomposition are used by Diebold and Yilmaz (2009, 2012) to construct the total volatility spillover index. This is shown in Equation 13.

$$S^{g}(H) = \frac{\sum_{\substack{i,j=1 \\ i \neq j}}^{N} \tilde{\theta}_{i\,j}^{g}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{i\,j}^{g}(H)} \,.100 = \frac{\sum_{\substack{i,j=1 \\ i \neq j}}^{N} \tilde{\theta}_{i\,j}^{g}(H)}{N} \,.100 \qquad (Equation\ 13)$$

In a similar fashion, we can calculate the directional volatility spillover received by market *i* from all other markets *j*, as shown in Equation 14 below.

$$S_{i.}^{g}(H) = \frac{\sum_{\substack{j=1 \\ j\neq i}}^{N} \tilde{\theta}_{ij}^{g}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{ij}^{g}(H)}.100 = \frac{\sum_{\substack{j=1 \\ j\neq 1}}^{N} \tilde{\theta}_{ij}^{g}(H)}{N}.100 \qquad (Equation\ 14)$$

And the transmission of the directional volatility spillover can be calculated from market i to market j. This is shown in Equation 15.

$$S_{.i}^{g}(H) = \frac{\sum_{\substack{j=1 \\ j\neq i}}^{N} \tilde{\theta}_{ji}^{g}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{ji}^{g}(H)}.100 = \frac{\sum_{\substack{j=1 \\ j\neq 1}}^{N} \tilde{\theta}_{ji}^{g}(H)}{N}.100 \qquad (Equation\ 15)$$

To analyze the volatility spillover obtained from Diebold and Yilmaz (2012)'s model, daily price variances are estimated based on daily high and low prices. For individual ETF and stock *i*, on day *t*, their daily price variances are computed as follows:

$$\widehat{\sigma_{it}^{2}} = 0.361\left[ln\left(P_{i,t}^{High}\right) - ln\left(P_{i,t}^{Low}\right)\right]^{2}.$$

Where $P_{i,t}^{High}$ and $P_{i,t}^{Low}$ are the high and low prices for stock i or ETF on day t$P_{i,t}^{Low}$. The summary statistics is on an annualised percentage basis such that $\widehat{\sigma_{it}} = 100\sqrt{255\widehat{\sigma_{it}^{2}}}$,

According to Parkinson (1980), Alizadeh, Brandt, and Diebold (2002), and Chan and Lien (2003), the high-low volatility computation is very sensitive to variations in dispersion. In Table 3, we provide summary statistics for this calculation on an annualized percentage basis such that $\widehat{\sigma_{it}} = 100\sqrt{255\widehat{\sigma_{it}^{2}}}$ while the mean values for annualized standard deviation are generally in the twenty to thirty percent range for these high capitalization companies.

In short, using the normalized forecasted variance shares obtained from Equation 15, approximated directional volatility spillovers transmitted by ETF or stock *i* to ETF or stock *j* are computed in Diebold and Yilmaz (2012)'s model. These spillovers are approximated since the generalized variance decompositions may not sum up to one, as noted above. Diebold and Yilmaz (2012) normalize by row, so the directional spillovers "from others" can sum up to unity across rows, but the spillovers "to others" may not be able to sum up to one by columns. In this study, this methodology is adopted to each of the three ETFs and their respective ten largest component stocks in the three chosen countries to compute total and directional volatility spillovers among them.

Data Sample

To examine the volatility change that has taken place due to the introduction of the ETFs, five-minute intraday data of ETFs and stock indices from three countries. i.e. Vietnam, Indonesia, and the Philippines is collected. A study period of 6 months which consists of 3 months before and after the inception date of ETF in each country is chosen. Due to the difference in the introduction date, i.e. on14th August 2009, 5th May 2010, and 29th September 2010, the Market Vectors Vietnam ETF , the iShares MSCI Indonesia ETF, and the iShares MSCI Philippines - from Vietnam, Indonesia, and the Philippines, three different study periods are then selected for this study, i.e. (1) 14/5/2009 - 13/11/2009, (2) 5/2/2010 to 5/8/2010, and (3) 29/6/2009 - 29/12/2009, respectively. As a result, the total number of 5-minute observations for data series of ETFs from Vietnam, Indonesia, and the Philippines are 33,772 and 33,906, 211 and 4026, and, 2690 and 2290, for the pre- and post-introduction of ETFs in Vietnam, Indonesia and Philippines. As the Market Vectors Vietnam ETF was launched on14th August 2009, the study period for ETFs and underlying stock index in Vietnam is chosen from 14/5/2009 to 13/11/2009, from which the two sub sample-periods, i.e. the pre introduction period and the post introduction period of the ETF, are constructed from 14/5/2009 -13/8/2009 and 14/8/2009 - 13/11/2009, respectively. The total number of five-minute observations for the pre- and post- introduction periods of the Market Vector Vietnam ETF are 33,772 and 33,906 observations, respectively.

To analyze the directional volatility spillovers, daily price data of the three ETFs and their respective10 largest component stocks are collected from Bloomberg Professional database for a period of July 1st 2011 - 30th June 2014. A summary of weights for each ETF and its 10 largest components stocks are presented in Table 6.

Empirical Findings

Summary statistics of changes in volatility of the constituent stocks after the introduction of ETFs are shown in Table 1. Andersen et al. (2001)’s realized volatilities and GARCH’s unconditional volatilities are computed for all constituent stocks of the three selected samples for Vietnam, Indonesia, and the Philippines.

As shown in Table 1, based on the maximum values, i.e. 2.789, 1.741, and 1.515, of realized volatility, the maximum increases in realized volatility are estimated as 178.9% (= 2.789 -1) , 74.1% (=1.741 – 1), and 51.5% (=1.515 – 1) for Vietnam, Indonesia, and the Philippines, respectively. Similarly, based on the minimum values, i.e. 0.814, 0.914, and 0.957, of realized volatility given in Table 1, the maximum decreases in realized volatility are estimated as 18.6% (=1- 0.814), 8.6% (=1-0.914)and 4.3% (=1-0.957) in Vietnam, Indonesia and the Philippines respectively.

Furthermore, the average realized volatilities of 1.10, 1.071, and 1.031 (Table 1) suggests that the average increases in volatility during the post-ETF periods for Vietnam, Indonesia, and the Philippines are 10%, 7.1%, and 3.1%, respectively, in comparison with the pre-ETF periods.

In addition, as shown in Table 2, out of 10 (100%) component stocks from the three selected samples for Vietnam, Indonesia, and the Philippines, more component stocks, i.e. 8 (80%), 6 (60%), and 6 (60%), with higher volatilities are found as compared to those, i.e. 2 (20%), 4 (40%), and 4 (40%), with lower volatilities during the post-ETF periods, respectively. The p-values of Z-statistics (Table 1), i.e. 0.00, 0.00, and 0.06, also confirm that the numbers of companies with increasing volatilities during the post-ETF periods in the three countries are significantly higher than those with decreasing volatilities at the 1%, 1%, and 10% level, in Vietnam, Indonesia, and the Philippines, respectively. This suggest that there are significant increases in volatility in Vietnam, Indonesia, and the Philippines during the post-ETF periods.

Using GARCH model, unconditional volatilities are estimated for all constituent stocks of the three samples for both pre- and post-ETF periods to measure the constituent volatilities. As shown in Table 1, the maximum VDRs (increasing volatilities) for Vietnam, Indonesia, and the Philippines are 4.377, 3.555, and 2.157 respectively, and their respective minimum values (decreasing volatilities) are 0.317, 0.517 and 0.691. On average, unconditional volatilities for all constituent stocks of the three samples for Vietnam, Indonesia, and the Philippines, are 1.417, 1.314 and 1.102, implying 41.7%, 31.4% and 10.2% increases in volatility of constituent stocks in the three samples during the post-ETF periods in the comparison with the pre-ETF periods.

Similarly, results obtained for GARCH's unconditional volatilities (Table 2), out of 10 (100%) component stocks from the three selected samples for Vietnam, Indonesia, and the Philippines, more component stocks, i.e. 7 (70%), 8 (80%), and 7 (70%), with higher volatilities are found as compared to those, i.e. 3 (30%), 2 (20%), and 3 (30%), with lower volatilities during the post-ETF periods, respectively. The p-values of Z-statistics (Table 1), i.e. 0.06, 0.00, and 0.08, also confirm that the numbers of companies with increasing volatilities during the post-ETF periods in the three countries are significantly higher than those with decreasing volatilities. Results obtained from GARCH model suggest strongly that volatilities of components stocks from the three samples for Vietnam, Indonesia, and the Philippines increase significantly after the introduction of ETFs.

Using the Diebold and Yilmaz framework, bi-directional spillover contributions from ETFs to their respective 10 largest component stocks for the three countries' samples during the period of July 1st, 2011 - June 30th, 2014 are shown in Table 4.

As shown in Table 4, it is observed that the total directional spillovers from each ETF to its 10 largest component stocks are consistently higher than from those component stocks to the ETF.

The contribution from the three ETFs, i.e. VNM (Vietnam), EIDO (Indonesia) and EPHE (the Philippines), to their respective 10 largest component stocks are approximately 95 %, respectively. However, the opposite directional contributions from the respective component stocks to the three ETFs are only 60%, 59% and 92% (Table 4) for Vietnam, Indonesia and the Philippines, respectively. This finding may suggest that more information obtained from an ETF trading allows a better forecast made on its component stocks' volatilities, but not the other way around.

Further information regarding the volatility transmission process can be found from Table 4 by looking at individual directional volatility spillovers shown in the first column and first row, which are in gray, of each sub-table. In the first column of each table, volatility spillovers from each ETF to its 10 largest component stocks are shown. The list of stocks are arranged in a descending order according to their percentages held in the ETF. It is noticeable in each sub-table that that the spillovers shown in the first column are larger as compared to those in other columns and their magnitudes are proportional to the percentages of the 10 component stocks composed of that ETF.

To further evidence that ETF volatility spillovers play an important part in the variance innovations of component stocks, net pairwise volatility spillovers are then computed and presented in Table 5. These spillovers are obtained by subtracting ETF-to-stock spillovers from stock-to-ETF spillovers as shown in the first column and row of each sub-table (Table 4), respectively. As shown in Table 5, ETF-to-stock spillovers are found to be larger than stock-to-ETF spillovers in all of the three countries, i.e. Vietnam, Indonesia, and the Philippines, for most cases.

It is also found that there are slight differences in the percentages of volatility transmitted by ETFs in the three countries, which may be attributed by the different traded volumes of the ETFs. It is observed that VNM ETF in Vietnam has the highest average daily traded volume as compared to other two ETFs from Indonesia and the Philippines, and it has also transmitted the highest percentage of volatility to its 10 largest component stocks. This finding is consistent with the phenomenon of trading-induced-volatility.

Conclusion

This study investigates the impacts of individual ETF on the volatility of its 10 largest constituent stocks in each of the three selected countries, i.e. Vietnam, Indonesia, and the Philippines. The realized volatility proposed by Anderson (2001) and the unconditional variance of GARCH (1, 1) are used to measure the volatilities of the constituents. Results obtained from both Anderson (2001) model and GARCH (1, 1) model confirm that the numbers of companies with increasing volatilities during the post-ETF periods in the three countries are significantly higher than those with decreasing volatilities. In overall, results obtained from these two models suggest strongly that volatilities of components stocks from the three samples for Vietnam, Indonesia, and the Philippines increase significantly after the introduction of ETFs. Using Diebold and Yilmaz (2009, 2012)'s model to measure bi-directional spillover contributions from ETFs to their respective 10 largest component stocks from the three countries over the period of July 1st, 2011 - June 30th, 2014, results show that

ETF-to-stock spillovers are found to be larger than stock-to-ETF spillovers in all of the three countries, regardless of how the variance shares are normalized. It is also found that different traded volumes of ETFs may lead to different percentages of volatility transmitted from individual ETFs to their component stocks. Findings of this study are expected to be beneficial to investors, market practitioners, and regulators, who are attracted to the growing demand of ETFs in Vietnam, Indonesia, the Philippines, and other Asian equity markets.

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Table 1: Summary Statistics of Changes in Volatility after the Introduction of ETFs

	Vietnam		Indonesia		Philippines	
	Realized Volatility	**Unconditional Volatility**	**Realized Volatility**	**Unconditional Volatility**	**Realized Volatility**	**Unconditional Volatility**
Average	1.100	1.417	1.071	1.314	1.031	1.102
Std. Dev.	0.317	1.279	0.217	1.111	0.177	1.103
Minimum	0.814	0.317	0.914	0.517	0.957	0.691
Maximum	2.789	4.377	1.741	3.555	1.515	2.157
No of VDR <1	2 (20%)	3 (30%)	4 (40%)	2 (20%)	4 (40%)	3 (30%)
No of VDR >1	8 (80%)	7 (70%)	6 (60%)	8 (80%)	6 (60%)	7 (70%)
Z-Value	3.16***	2.12*	4.60***	7.87***	2.09*	2.03*
P-Value	0.00	0.06	0.00	0.00	0.06	0.08

VDR is the relative change in the volatility of stock i after the introduction of ETFs. VDR > represents the volatility increase in the stock following ETF introduction. The null hypothesis of Z-test is that the average VDR = 1. *, and *** represents significance at 10, 5 and 1 %respectively.

Table 2: Summary Table of Changes in Volatility

Volatility Measure	Average VDR	% of Companies with Increased Volatility	Volatility Direction
<u>Vietnam</u>			
Realised Vol.	1.111	80%	↑
Unconditional Vol.	1.413	70%	↑
<u>Indonesia</u>			
Realised Vol.	1.012	60%	↑
Unconditional Vol.	1.272	80%	↑
<u>Philippines</u>			
Realised Vol.	1.071	60%	↑
Unconditional Vol.	1.213	70%	↑

Figures are obtained from Table 1.

Table 3: Summary Statistics of Annualized Volatility for ETFs & 10 Largest Component Stocks (annualized percentage)

VIETNAM

Symbol/Statistics	VNM	VIC VN	MSN VN	VCB VN	STB VN	105630 KS	CPF- R	HAG VN	PMO LN	DPM VN	DNA
Mean	26.50	21.21	19.56	16.89	19.56	23.56	19.56	18.66	15.89	12.34	10.12
Std. Dev.	18.45	21.43	19.56	18.56	21.45	28.57	21.21	16.78	13.45	10.45	09.34
Minimum	6.12	3.65	2.67	1.45	6.56	3.33	1.12	2.56	1.23	1.12	1.01
Maximum	134.67	178.56	98.56	78.78	79.43	112.65	67.42	69.54	45.73	23.56	14.65

Table 3 (Cont.)

PHILIPPINES

Symbol/Statistics	EPHE	ALI	TEL	URC	BDO	JGS	AC	SMBH	SM	AEV	JFC
Mean	24.76	23.11	20.56	19.56	18.45	19.56	15.42	13.42	19.56	21.34	23.76
Std. Dev.	12.56	18.56	21.67	16.77	19.56	14.34	12.22	12.45	18.53	17.45	15.55
Minimum	1.13	4.34	10.54	08.56	1.54	1.45	1.11	2.12	1.43	2.53	2.87
Maximum	189.56	123.54	123.65	86.73	69.56	53.67	45.67	75.45	73.34	87.45	87.77

Table 3 (Cont.)

INDONESIA

Symbol/Statistics	EIDO	BBCA	ASII	BBRI	TLKM	BMRI	UNVR	PGAS	SMGR	BBNI	KLBF
Mean	24.20	36.89	26.20	36.20	33.16	43.13	33.12	44.76	46.30	41.50	26.32
Std. Dev.	15.28	23.35	19.75	25.73	28.71	28.38	31.19	58.75	36.20	29.12	18.90
Minimum	8.11	13.79	10.31	20.51	16.82	22.09	18.20	6.71	10.31	19.30	6.20
Maximum	87.77	115.80	110.20	142.34	99.67	150.34	193.62	81.12	89.78	253.44	110.76

Summary statistics for the volatility estimates for our three ETFs and their ten largest stocks for the sample period of September 3, 2011 to June 28, 2014. Daily volatility is estimated using daily high and low prices. For each ETF and stock I, on day t, the volatility is calculated where is the high price for stock or OTF I on day t, and is the low price. The summary statistics is on an annualized percentage basis such that

Table 4: Directional Volatility Spillovers

VIETNAM

	Contribution from											
Symbol	VNM	VIC	MSN	VCB	STB	105630	CPF	HAG	PMD	DPM	BVH	From OTHERS
VNM	40.12	16.71	13.50	7.31	6.19	3.07	2.18	1.97	5.91	1.56	1.48	**60**
VIC	17.00	32.00	15.16	9.16	12.16	1.16	7.28	0.71	0.60	1.16	3.71	68
MSN	17.19	8.16	33.00	12.14	10.16	1.01	6.17	1.01	3.15	2.16	5.61	67
VCB	19.34	18.71	16.76	26.00	10.19	1.20	1.81	0.10	2.86	1.16	1.71	74
STB	10.71	9.46	8.16	9.16	56.00	1.07	1.16	0.04	1.95	1.14	1.16	44
105630	6.15	4.46	5.20	6.16	3.16	68.00	1.01	1.01	0.10	1.12	3.16	32
CPF	5.10	4.20	9.16	4.16	2.69	1.09	71.00	0.02	0.71	0.60	1.01	29
HAG	3.20	1.12	1.16	2.17	1.16	1.05	0.71	89.00	0.11	0.04	0.16	11
PMD	9.29	1.07	1.00	1.16	1.01	1.01	0.10	0.01	85.00	0.16	0.21	15
DPM	4.20	1.01	1.76	1.01	1.17	1.00	0.04	0.03	0.17	89.00	0.78	11
BVH	2.70	1.10	1.12	0.16	1.09	0.80	0.02	0.08	0.01	0.16	93.00	7
Contribution to others	**95**	66	73	53	49	12	20	5	16	9	19	417

Table 4 (Cont.)

INDONESIA

	Contribution from											
Symbol	EIDO	BBCA	ASII	BBRI	TLKM	BMRI	UNVR	BBNI	PGAS	SMGR	KLBF	From OTHERS
EIDO	41.10	14.26	10.16	7.90	6.20	9.11	2.81	4.16	2.81	1.31	0.70	**59**
BBCA	17.20	25.00	6.29	9.16	5.30	11.16	4.26	10.95	3.16	1.11	1.01	75
ASII	12.61	5.16	50.00	8.20	9.80	6.76	1.16	7.93	1.04	0.70	0.40	50
BBRI	9.16	8.16	5.71	50.00	6.12	8.71	1.07	9.16	1.71	0.10	0.12	50
TLKM	11.12	4.28	17.16	6.34	42.00	7.77	1.17	7.28	1.07	0.72	0.60	58
BMRI	13.98	10.71	7.14	11.20	6.46	38.00	5.29	9.16	2.24	1.12	0.30	62
UNVR	3.12	2.72	1.12	3.12	0.71	3.78	77.00	4.16	3.27	0.70	0.10	23
BBNI	6.17	8.14	1.09	4.24	1.16	4.79	1.16	74.00	1.10	0.81	0.20	26
PGAS	2.98	1.76	1.34	1.71	1.03	1.31	2.16	1.10	84.00	2.16	0.11	16
SMGR	2.16	1.23	0.11	1.31	0.11	1.11	0.25	1.03	1.71	92.00	0.01	8
KLBF	2.22	1.31	0.77	1.78	0.07	0.31	0.03	0.63	1.02	1.10	91.00	9
Contribution to others	**81**	58	51	55	37	55	19	56	19	10	4	445

PHILIPPINES

	Contribution from											
Symbol	EPHE	ALI	TEL	URC	BDO	JGS	AC	SMBH	SM	AEV	JFC	From OTHERS
EPHE	10.00	13.60	19.21	12.76	7.46	10.98	5.96	5.45	5.25	4.96	4.16	**90**
ALI	14.10	38.00	10.20	6.60	10.20	1.79	6.20	1.78	4.20	3.16	4.20	62
TEL	14.76	5.16	55.00	2.20	4.76	3.20	4.76	2.76	3.60	2.16	1.39	45
URC	9.16	3.20	3.16	68.00	4.16	1.76	3.20	1.06	2.19	2.05	1.78	32
BDO	9.79	13.40	9.76	6.70	22.00	3.20	2.24	4.78	7.94	13.40	6.33	78
JGS	8.49	1.78	2.12	1.78	6.36	60.00	3.14	5.79	6.36	4.33	1.79	40
AC	6.77	17.79	3.20	1.79	6.39	3.16	40.00	9.76	5.46	3.79	1.17	60
SMBH	6.40	3.76	1.11	1.78	8.76	14.16	6.67	44.00	8.79	3.16	1.01	56
SM	5.20	9.49	1.02	1.11	6.20	17.16	10.20	11.78	35.00	2.16	0.71	65
AEV	5.97	8.16	0.78	2.11	5.45	6.66	5.89	8.20	7.40	49.00	0.66	51
JFC	3.98	2.66	1.01	0.21	6.16	0.11	0.21	0.26	4.21	1.79	79.00	21
Contribution to others	**85**	79	52	33	62	58	48	55	41	39	23	575

Table 5: Net Pairwise Volatility Spillovers for ETFs & their 10 Largest Component Stocks

Vietnam		**Indonesia**		**Philippines**	
Symbol	From VNM	Symbol	From EIDD	Symbol	From EPHE
VIC	0.29	BBCA	2.94	ALI	0.40
MSN	3.69	ASII	2.45	TEL	0.55
VCB	12.03	BBRI	1.26	URC	0.40
STB	4.52	TLKM	4.92	BDD	2.33
105630	3.08	BMRI	4.87	JGS	1.51
CPF	2.92	UNVR	0.31	AC	0.81
HAG	1.23	BBNI	2.01	SMBH	0.95
PMD	3.38	PGAS	0.17	SM	-0.05
DPM	2.64	SMGR	0.85	AEV	1.01
BVH	1.22	KLBF	1.52	JFC	-0.18
Mean	3.50		2.13		0.77

The above table provides net pairwise volatility spillovers calculated by: (subtracting the stock to ETF spillovers in column 1 of each country of Table 4 from their respective ETF to stock spillover in row one of each country of table 4). The figures represent the volatility spillover from each ETF to their respective component stocks in excess of the volatility spillover in the opposite direction (stock to ETF).

Table 6: Summary of Weights for the 10 largest Stocks held by individual ETF in Vietnam, Indonesia and the Philippines.

Vietnam			Indonesia			Philippines		
Vingroup JSS	VIC VN	8.19%	Bank Central Asia	BBCA	11.17%	Ayala Land	ALI	9.77%
Masan Group	MSN VN	7.61%	Astra Intern	ASII	9.72%	Ph. Lg Distant	TEL	9.77%
Commercial Bank	VCB VN	7.23%	Bank Rakyat	BBRI	8.80%	Universal Robina	URC	6.56%
Saigon Thuong BK	STB VN	6.41%	Telekom In	TLKM	8.75%	BDO Unibank	BDO	6.41%
Hansae Co Ltd	105630 KS	5.61%	Bank Mandiri	BMRI	6.81%	JG Summit	JGS	6.09%
Charoen Pokphand			Unilever Ind	UNVR	3.87%	Ayala Corp.	AC	5.85%
Foods Public Co	CPF-TB	5.12%						
HAGL JSC	HAG VN	4.72%	BK Negara IN	BBNI	3.23%	SM Prime	SMPH	5.58%
Premier Oil PLC	PMO LN	4.59%	Perusahaan	PGAS	3.12%	SM Invest.	SM	4.84%
Petrovietnam	DPM VN	4.56%	Semen Indonesia	SMGR	2.44%	Aboitiz E.V.	AEV	4.05%
Bao Viet Holdings	BVH VN	4.43%	Kalbe Farma	KLBF	2.42%	Jollibee F.	JFC	3.22%