

# Have U.S. and ASEAN Equity Markets Become More Integrated?

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## Abstract

In this paper, we find that U.S. and ASEAN equity return correlations increased post-Great Recession and that innovations in U.S. and other foreign equity markets explain a larger proportion of ASEAN return volatility after the Great Recession. The United States is increasingly cointegrated with each ASEAN member country and equity returns in the U.S. affect equity returns in ASEAN equity markets but not vice versa. Using an EGARCH-M and DCC-GARCH approach, we find that lagged U.S. weekly returns affect subsequent weekly returns in ASEAN equity markets and we find a positive equity risk premium with asymmetric volatility response to innovations in ASEAN equity markets. Our study concludes that increasing integration may be due to the increase in economic trade pacts and capital market integration initiatives between the U.S. and ASEAN member states.

## I. Introduction

The study of equity market integration across the world has increased as a result of the October 1987 collapse of equity markets across the world. There was little to no relationship between the international stock markets prior to the October 1987 and Asian stock market crash of 1997 (Cheng 1997, Sheng and Tu 2000). After the precipitous 1987 decline in global equity markets, the authors concluded that increasing globalization contributed to closer interrelations between equity markets across the world. As a result, investors' perceptions of the importance of foreign financial news became more prevalent which led to an increase in the correlation of equity returns and return volatility across markets (Hamao, Masulis, Ng 1991). Since then, major stock market crashes such as those in the U.S. from 2000-2001 and 2007-2009 have had an impact on equity market correlations across the world. Correlations are vital to many tasks in financial management such as portfolio hedging and forecasting. In addition, portfolio asset allocation relies on correlation and volatility estimates to develop efficient portfolios. Thus, it is vital to study why the relationship between equity markets change over time across regions in the world because investment portfolios require periodic adjustments that depend of market expectations. In particular, this paper seeks to study the equity return and volatility behavior, cointegration, and correlation structure between the United States and member-states of the Association of Southeast Asian Nations (ASEAN) between 2001 and 2017 and the possible factors contributing to the increasing integration between the two regions. ASEAN consists of ten developing economies in Southeast Asia with a combined GDP of \$2.4 trillion. A focus of this paper is the economic and

financial integration between the United States and ASEAN over time given the enhancements to the trade agreements and capital market integration initiatives within the region.

The study reveals several important features of ASEAN equity markets and provides significant implications for international portfolio investors with exposure to ASEAN equity markets. First, ASEAN equity returns are non-normal; however, the evidence suggests equity returns are random and weak-form efficient in the majority of ASEAN equity markets. Furthermore, the results suggest that most ASEAN equity market returns are affected by lagged U.S. equity returns per the DCC-GARCH and Johansen cointegration analysis. Results from Granger causality tests indicate that U.S. equity returns influence the equity returns in ASEAN countries. Conversely, ASEAN equity returns have no major impact on U.S. equity returns indicating that major financial news and information from the U.S. has more impact on ASEAN equity market returns than financial and economic information coming from ASEAN nations.

Granger causality tests indicate that U.S. equity returns influence the equity returns in ASEAN countries. Conversely, ASEAN equity returns have no major impact on U.S. equity returns indicating that major financial news and information from the U.S. has more impact on ASEAN equity market returns than financial and economic information coming from ASEAN nations. In addition, this paper studies the equity market relationships between the U.S. and ASEAN<sup>2</sup> member-states before and after the Great Recession to determine if the financial crisis had an impact on the correlation between the equity markets of the two regions. The findings indicate that correlations between the United States and ASEAN and among ASEAN countries increased after the Great Recession and persisted at the increased levels for years after the financial crisis. Similarly, the paper finds that innovations, or volatility shocks, in foreign country equity returns explain more of ASEAN countries' equity returns after the Great Recession as compared to before. For example, foreign country innovations explained 20.76% of Indonesia's returns before the Great Recession and foreign country innovations explain 52.27% of Indonesia's returns after the Great Recession suggesting that Indonesia's equity markets have become more integrated within the region and with the United States. The evidence provides a similar pattern for each ASEAN country in the sample. These results suggest that financial and economic news had more impact on equity market returns and volatility well after the financial crisis as compared to before the financial crisis providing some evidence of closer ties between the two regions' equity markets. Overall, the results suggest that there is increasing economic and financial integration between the U.S. and ASEAN countries and among ASEAN countries and, despite the higher levels of correlation between the two regions' equity markets, there are still plenty diversification benefits available for portfolio investors.

This paper is organized as follows. Section II provides an overview of the literature. Section III describes the sample data and provides descriptive statistics. Section IV discusses the

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<sup>2</sup> The Association of Southeast Asian Nations (ASEAN) consists of 10 member states: Malaysia, Philippines, Thailand, Singapore, Indonesia, Cambodia, Vietnam, Laos, Brunei, and Myanmar. Daily equity index data is not available for Brunei and Myanmar. Brunei's stock exchange is scheduled to open in late 2017 and Myanmar's Yangon Stock Exchange was founded in 2015 with 4 listed companies

methodology for our analyses. Section V describes the results and contributing factors to our findings. Section VI concludes the paper.

## II. Prior Literature and Contribution

Much of the extant literature focuses on the interdependence between Asian-Pacific and major global capital markets to provide meaningful knowledge on Asian-Pacific financial markets and to provide portfolio investors information on potential investment opportunities for diversification benefits. For example, Chowdhury (1994) examines the interrelationship among the equity markets in four newly industrialized economies in Asia. The author finds that there is a significant relationship between the stock markets of Hong Kong, Singapore, Japan, and the United States. However, the author finds that equity markets with severe restrictions on cross-country investing such as South Korea and Taiwan are not affected by innovations in foreign equity markets. Elyasiani, Perera, and Puri (1998) study the interdependence between Sri Lanka and its trading partners using a vector auto regression (VAR) approach. The authors find no significant relationship between the Sri Lankan equity market and the equity markets of the U.S. and the other Asian markets. Liu, Pan, and Shieh (1998) find that the degree of interdependence between stock markets increased after the 1987 stock market crash, that U.S. equity markets influence the Pacific-Basin equity markets, and that Japan and Singapore both have a persistent impact on other Asian markets.

Arshanapalli, Doukas, and Lang (1995) further study the relationship of Asian stock markets and provide evidence of a common stochastic trend between the U.S. and Asian stock market movements after the October 1987 crash. The authors find that the cointegrating structure that ties these stock markets together has increased since October 1987. The authors provide evidence that Asian equity markets are less integrated with Japan's equity market as compared to the U.S. equity market. Hassan and Naka (1996) examine the dynamic linkages among the U.S., Japan, U.K., and German stock market indices using daily data from 1984 to 1991. The authors examine the long-run and short-run relationships among these four stock market indices. The authors find that the U.S. stock market leads the other equity markets in the short- and long-run using a vector error correction model (VECM) and conclude that portfolio investors may be limited in their ability to diversify their long-term holdings.

Click and Plummer (2005) consider stock market integration after the Asian financial crisis between the original five member states of ASEAN; Indonesia, Malaysia, Philippines, Singapore, and Thailand. The results suggest that the ASEAN-5 equity markets are cointegrated and are not completely segmented by national borders. Choudhry, Lu, and Peng (2007) study the change in the long-run relationships between the stock prices of eight Far East countries before, during, and after the Asian financial crisis of 1997-1998. The authors provide evidence that U.S. equity market influences increase before, during, and after the crisis. Chancharat and Valadkhani (2007) investigate the cointegration and causality between equity prices in Thailand and its major trading partners using monthly data between 1987 and 2005. The authors find potential long-run

diversification benefits and find bidirectional causality between the equity returns of Thailand and Malaysia, Singapore, and Taiwan.

Majid and Kassim (2009) examine the impact of the 2007 U.S. financial crisis on the equity markets of Indonesia and Malaysia and find a stronger relationship between the equity markets during the crisis which makes it more difficult for international portfolio investors to diversify their holdings and manage their portfolio's risk. Khan (2011) studies the cointegration of the U.S. equity markets and twenty-two developed and developing countries using daily equity market data. The author finds that China, Malaysia and Austria are highly favorable diversification opportunities as they are not cointegrated with the US and are unresponsive to the global equity index. Ali, Butt, and Rehman (2011) examine the co-movement of Pakistan's equity markets with the equity markets of India, China, Indonesia, Singapore, Taiwan, Malaysia, Japan, the U.S., and the U.K. by using monthly stock prices from July 1998 to June 2008. The authors provide no evidence of a relationship between Pakistan's equity market and the markets of the U.K, the U.S., Taiwan, Malaysia and Singapore and concludes that portfolio investors may reduce portfolio risk by investing in the equity markets of these countries.

Palamalai, Kalaivani, and Devakumar (2013) examine stock market integration among major stock markets of emerging Asia-Pacific economies and find evidence of short-run diversification benefits from significant equity market fluctuations. Bala and Takimoto (2017) investigate stock return volatility spillovers in emerging and developed markets and the impacts of the global financial crisis on stock market volatility interactions. The authors find evidence that correlations increase during the financial crisis for emerging and developed markets but the correlations are higher among developed markets. Kuper and Kuper (2016) employ a multivariate DCC-GARCH to study the relationship between foreign exchange and equity markets in six East Asian countries and find evidence of time-varying correlations between the countries, including stronger correlations during the Asian financial crisis and the U.S. financial crisis. Bekaert and Harvey (2017) analyze various dimensions of capital market integration between emerging and developed markets. The authors find increased correlations which they attribute to increased economic liberalization policies, especially during the 1990s, in emerging markets. The authors point out similar findings as those found in this paper such as non-normality and higher variance in equity market returns. In addition, the authors discuss that importance of financial and economic openness to capital market integration, especially openness in current account factors.

One focus of this paper is the weekly equity return behavior of ASEAN member states and the cointegration between the U.S. and ASEAN equity markets before and after the Great Recession, especially given observed correlation increases and volatility spillovers during the Great Recession [Chakrabarti (2011)]. This paper contributes to the extant literature by including the developing equity markets of Cambodia and Laos in the study of ASEAN markets. This is beneficial because it provides updated insight into the correlations between the equity markets of Cambodia, Laos, other ASEAN member states and the United States, provides insight into whether or not the markets are more closely integrated, and explains how much of those countries' returns are explained by news and volatility spillovers from the U.S. equity markets. Additionally, this

study carefully considers the time-varying correlation and volatility between the equity markets using a DCC-GARCH framework to model ASEAN equity return behavior. Moreover, this paper contributes to the literature by providing evidence that weekly equity market correlations increased and persisted after the Great Recession and that U.S. and ASEAN equity markets have become more integrated with each other over time which may be due to the expansion of economic and financial agreements between ASEAN countries and with the United States. This study further provides evidence that despite higher correlations post-financial crisis, the ASEAN equity markets provide diversification benefits for U.S. international investors.

### III. Data

This study uses U.S. dollar-adjusted daily equity index data available from Bloomberg L.P. for the years 2001-2017. Thus, the indices are adjusted for foreign exchange fluctuations relative to the U.S. dollar. Country-specific equity indices and data availability time ranges for each index is provided in Appendix A. The equity indices are available from the United States and eight of the ten ASEAN member countries including: Malaysia, Philippines, Thailand, Singapore, Indonesia, Cambodia, Vietnam, and Laos. Equity index data is available for 6 ASEAN countries from January 2001 through 2017 (Singapore, Malaysia, Indonesia, Philippines, Thailand, and Vietnam). Equity index data is available for Laos and Cambodia from 2011 and 2012, respectively. Thus, Laos and Cambodia are excluded from pre- and post-Great recession analysis or analyses that require a longer time frame. Weekly logarithmic returns using daily closing prices are computed per Eq. 1 to minimize the effect of equity market closures due to holidays or non-trading weekdays. In addition, Tiwari, Dar, Bhanja, and Shah (2013) study Asian stock market integration and find that higher frequency time horizons, such as weekly, provide international investors with more diversification benefits than lower frequency time horizons such as monthly or quarterly.

$$\ln(1 + r_{i,t}) = \ln\left(\frac{p_{i,t}}{p_{i,t-1}}\right) = \ln(p_{i,t}) - \ln(p_{i,t-1}) = \Delta \log P_{i,t} \quad (1)$$

Table I provides summary statistics of the weekly stock returns from 2001-2017 of the eight ASEAN member countries in our sample. All countries' equity returns are stationary, and thus, do not vary over time, and exhibit significant deviations from normally distributed returns with varying degrees of kurtosis and skewness which is consistent with the prior literature on emerging market return behavior [Bekaert and Harvey (2017)].

**Table I. Descriptive Statistics, Weekly Returns 2001-2017**

Singapore	Thailand	Malaysia	Philippines	Indonesia	Cambodia	Vietnam	Laos
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N	898	841	896	891	884	224	840	314
Mean	-3.3E-4	1.6E-3	5.1E-4	8.0E-4	2.0E-3	-4.0E-4	1.1E-3	3.7E-4
SD	0.0251	0.0294	0.0186	0.0275	0.0291	0.0339	0.0359	0.0305
Skew	-0.6605	-1.1202	-0.6449	-0.5033	-0.5420	-0.9021	-0.1237	2.9940
Kurt	5.4794	10.9938	4.7169	5.6372	2.4761	6.6337	3.5633	20.9910
JB	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BG	0.3024	<0.0001	0.0472	0.0165	0.0803	0.8788	<0.0001	0.001
ADF	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
PP	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

This table includes the descriptive statistics of logarithmic weekly stock returns. *JB* is the p-value that corresponds to the Jarque-Bera normality test. *BG* is the p-value that corresponds to the Breusch-Godfrey serial correlation test. *ADF* is the p-value of the Augmented Dickey-Fuller test for stationarity. *PP* is the p-value of the Phillips-Perron test for stationarity.

Table II presents the weekly stock return correlations between all countries in the entire sample period. In general, U.S. equity markets returns do not appear to be highly correlated with the ASEAN member countries, except Singapore with a correlation of approximately 0.52. In fact, U.S. equity markets typically have a positive correlation of less than 0.40 with ASEAN equity markets and is negatively correlated with the equity markets of Cambodia and Laos. Thus, based on the unconditional weekly return correlations, the equity markets between the two regions appear to offer some diversification benefits to international investors.

Appendix B provides 52-week rolling correlations between the U.S. and six ASEAN member countries from 2001-2017, given data availability. Thus, the graphs begin 52 weeks into the data set in 2002 and each week provides an additional data point. The graphs in Appendix B indicate a varying degree of correlation over time between the U.S. and each ASEAN country and there appears to be a structural shift around the time of the Great Recession. The graphs indicate an increase in weekly return correlations during the Great Recession which persist until the end of the sample period. In Appendix B, graph A, the weekly return correlation between the U.S. and the Philippines is largely below 0.30 prior to 2008 (week 364) but the correlation remains above the 0.30 for several years after 2008. A similar result is shown in graph B (Singapore) and graph D (Malaysia). The results are more mixed in graphs C (Thailand), E (Indonesia), and F (Vietnam). For example, Thailand appears to exhibit higher, persistent correlations with the U.S. around 2009 (week 416) whereas correlations between the U.S. and Indonesia and Vietnam increased around 2006 to above 0.30 from negative correlations prior to 2006. Thus, the graphs highlight the variation in the correlation between the U.S. and various ASEAN countries over time and indicate at least some shift in the correlation structure at the start of the Great Recession

**Table II. Weekly Return Correlations, 2001-2017.**

	USA	Thailand	Malaysia	Philippine s	Singapore	Indonesia	Cambodia	Vietnam	Laos
USA	1	0.3990	0.2870	0.3540	0.5230	0.2960	-0.0470	0.2130	-0.0620
Thailand		1	0.4280	0.4530	0.4930	0.4420	-0.0770	0.1700	-0.0640
Malaysia			1	0.3850	0.4920	0.4430	0.0290	0.1390	0.0260
Philippine s				1	0.4480	0.4590	-0.0270	0.1780	0.0410
Singapore					1	0.4850	-0.0240	0.2140	0.0410
Indonesia						1	-0.0360	0.1680	0.0620
Cambodia							1	-0.0160	0.0910
Vietnam								1	0.0670
Laos									1

This table provides the weekly stock return correlations between each country-pair for all available observations.

#### IV. Methodology

For the analysis in this paper, several models are used to account for various return and volatility characteristics. The return-generating process of each ASEAN country is examined for weak-form efficiency using a random walk and whether the returns are independent and identically distributed using the Brock, Dechert, Scheinkman (BDS) (1987) test for nonlinearities and the Engle-LM test for GARCH effects. The random walk model is given by

$$\Delta \log P_{i,t} = \mu + \varepsilon_{i,t} \quad (2)$$

where  $P_{i,t}$  is the price of the equity index at time  $t$  and  $\Delta \log P_{i,t}$  is the logarithmic (log) difference in the equity index level between time  $t$  and time  $t-1$ . The log difference between the equity index levels is  $I(0)$ , or stationary, and the estimated coefficient  $\mu$  should be statistically insignificant from zero if returns exhibit random walk behavior. We test for stationarity using the augmented Dicker-Fuller (ADF) (1981) test and the Phillips-Perron (PP) (1988) test.

Prior literature has found evidence of volatility clustering, leverage effect, and deviations from the normal distribution in equity market return time series which linear models cannot account for effectively. Additionally, a return-generating process should consider the autocorrelation present in financial data. As a result, the return-generating process of ASEAN countries is expanded from the random walk model by using an exponential GARCH-in-Mean

(EGARCH-M) model which combines the ARCH-M model of Engle, Lilien, and Robins (1989) and the EGARCH model of Nelson (1991) to account for autocorrelation in the return-generating process, test for time-varying risk premiums, volatility clustering, and asymmetric shocks to volatility. The EGARCH-M models the return-generating process as

$$\Delta \log P_{i,t} = \mu + \varphi_1 \Delta \log P_{i,t-1} + \delta \sqrt{h_{i,t}} + \varepsilon_{i,t} \quad (3)$$

where the parameter  $\varphi_1$  is included to account for autocorrelation in the return-generating process or mean equation. The mean equation also models the equity index returns as a function of its conditional variance which allows us to study whether investors are compensated for the additional risk they take. The parameter  $\delta$  is often interpreted as a risk premium. Thus, a positive and significant  $\delta$  means that returns are positively related to the equity market risk premium. The volatility process for the mean equation also considers asymmetric shocks to volatility and clustering. The asymmetric EGARCH model of Nelson (1991) is able to capture such effects to volatility. The volatility process is

$$\ln(h_{i,t}) = \omega + \sum_{i=1}^1 \alpha_i g(Z_{t-i}) + \sum_{j=1}^1 \beta_j \ln(h_{i,t-j}) \quad (4)$$

$$g(Z_t) = \theta Z_t + \{|Z_t| - E[Z_t]\}$$

where the conditional variance  $h_{i,t}$  depends on the size and sign of the normalized innovations as parameterized using  $\theta$ . As an example, if  $\theta$  is equal to zero then large shocks to returns increase the conditional variance if  $\{|Z_t| - E[Z_t]\} > 0$  and vice versa. If  $\theta < 0$ , then negative innovations in returns cause the innovation to the conditional variance to be positive. Thus, the model is better able to account for the fact that negative returns tend to increase volatility more than positive returns.

Moreover, this paper provides an analysis of cointegration between ASEAN member countries and the United States over the sample time period to determine if equity markets have become more closely integrated over time. Johansen cointegration (1991) and Granger causality (1969) tests are implemented between the United States and each individual ASEAN country using a vector autoregressive (VAR) model with 1 lag for the country pairs. The VAR(1) model is

$$\Delta \log P_{t,1} = \alpha_1 + \varphi_{1,1} \Delta \log P_{t-1,1} + \varphi_{1,2} \Delta \log P_{t-1,2} + \varepsilon_{t,1} \quad (5)$$

$$\Delta \log P_{t,2} = \alpha_2 + \varphi_{2,1} \Delta \log P_{t-i,1} + \varphi_{2,2} \Delta \log P_{t-i,2} + \varepsilon_{t,2}$$

where the log returns of country 1 and country 2 is a function of the prior log returns of country 1 and country 2. The VAR(1) model provides a variance decomposition of the equity market returns between each country-pair.

In addition, this paper examines the correlation in equity markets between the United States and ASEAN countries before and after the Great Recession given the appearance of a structural shift from Appendix B. The National Bureau of Economic Research (NBER) reports the Great Recession began in December 2007 and ended in June 2009.<sup>3</sup> Thus, equity weekly return correlations are computed from January 2001 through November 2007 and from July 2009 through January 2017 to compare pre- and post-recession equity return correlations. A panel VAR model is used to analyze the proportion of weekly return changes caused by shocks within the country, shocks from other markets within the region, and shocks from the United States. Thus, the tests will be able to shed light on the proportion of a country's stock return movements due to innovations from other countries for pre- and post-recession time periods to determine if equity markets became more closely linked after the Great Recession. Since the results of the variance decomposition model are sensitive to ordering, the countries are ordered by equity market capitalization because large indices tend to be more influential than indices with less market capitalization.

A salient feature of equity returns is that correlations and volatility are generally time-varying processes due to various factors. The previous return-generating model considered time-varying volatilities and accounted for properties such as volatility clustering and asymmetric responses to innovations. In order to simultaneously account for time-varying volatility and correlation, a dynamic conditional correlation GARCH (DCC-GARCH) model is implemented for the equity return, volatility, and correlation structure. The model is helpful given the volatility in correlation estimates over time per Appendix B and the increase in correlation around 2007. The weekly equity return, variance, and correlation processes are

$$r_{i,t} = \alpha_0 + \alpha_1 r_{i,t-1} + \alpha_2 r_{t-1}^{U.S.} + \varepsilon_t$$

(6)

$$h_{i,t} = \beta_0 + \beta_1 \varepsilon_{i,t}^2 + \beta_2 h_{i,t-1}^2$$

<sup>3</sup> Dates for U.S. business cycle expansions and contractions are available on the NBER's website. <http://www.nber.org/cycles.html>

$$Q_t = \bar{Q}(1 - a - b) + av_{t-1}v'_{t-1} + bQ_{t-1}$$

where this model is run in a bivariate setting between the United States and each ASEAN country. The matrix  $Q$  produces a more accurate weekly stock return correlation between the United States and each ASEAN country as compared to static measures which do not account for the time-varying characteristics of correlation processes.

## V. Results

Table III reports the results from the random walk model and runs test. The mean is insignificant for every country except Indonesia and Cambodia indicating some evidence for weak-form efficiency in weekly stock returns. The results suggest that equity indices in ASEAN countries do not depend on past information and are driven by future performance expectations. Additionally, the runs test of weekly stock returns confirms evidence that the return-generating process is random for each ASEAN country except Vietnam. The results are positive for potential investors in ASEAN equity markets because it suggests that fundamental analysis provides greater value and insight than technical analysis to determine investment opportunities. Table III provides the parameter estimates of the random walk model for each ASEAN member state. *Runs Test* provides the p-value of the Wald-Wolfowitz runs test. *JB* is the p-value that corresponds to the Jarque-Bera normality test. *BG* is the p-value that corresponds to the Breusch-Godfrey serial correlation test. Note: a, b, and c denote significance at the 1%, 5%, and 10% level, respectively

**Table III. Random Walk Model**

	Singapore	Thailand	Malaysia	Philippine	Indonesia	Cambodia	Vietnam	Laos
$\mu$	-0.000336	0.001558	0.000509	0.000800	0.00201 <sup>b</sup>	-0.00397 <sup>c</sup>	0.001107	0.000368
Runs Test	0.3478	0.8319	0.2758	0.5931	0.4770	0.1140	<0.0001	0.8909
JB	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BG(4)	0.3024	<0.0001	0.0472	0.0165	0.0803	0.8788	<0.0001	0.001

Although the random walk seems to perform sufficiently well for most countries in our sample period, the results in Table IV indicate that the random walk model may fail to capture the nonlinearities present in the data due to evidence of autocorrelation presented in Table 1. In addition, Table IV reports significant nonlinear and GARCH effects for every lag up to lag 5 indicating a GARCH model may be better suited to model the return-generating process of

ASEAN countries and account for the serial correlation in the time series. Thus, a more parsimonious model is needed to capture the nature and structure of equity returns and volatility for the ASEAN equity indices.

**Table IV. Nonlinearity Tests**

	Singapore	Thailand	Malaysia	Philippine	Indonesia	Cambodia	Vietnam	Laos
LM								
1	<0.0001	0.0620	0.0177	0.1307	<0.0001	<0.0001	<0.0001	<0.0001
2	<0.0001	0.1623	0.0045	0.0377	<0.0001	<0.0001	<0.0001	<0.0001
3	<0.0001	0.2206	0.0012	0.0381	<0.0001	<0.0001	<0.0001	<0.0001
4	<0.0001	0.0015	0.0006	0.0588	<0.0001	<0.0001	<0.0001	<0.0001
5	<0.0001	<0.0001	0.0013	0.1047	<0.0001	<0.0001	<0.0001	<0.0001
BDS								
2	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
3	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
4	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0012	<0.0001	<0.0001
5	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0003	<0.0001	<0.0001

This table provides the p-values of both the Engle-LM test (LM) for GARCH effects and the Brock-Dechert-Scheinkman test to detect nonlinear serial dependence in a time series up to lag 5.

Table V reports the results of the EGARCH-M model which attempts to capture the GARCH effect present in the weekly stock return data and other effects present in return time series such as asymmetric responses to volatility as a result of return innovations. Singapore, Thailand, Malaysia, Philippines, and Indonesia have a negative and significant theta parameter which indicates that volatility responds asymmetrically to negative innovations in returns. Thus, in the latter countries, negative shocks to weekly stock returns cause return volatility to increase more than positive shocks to weekly stock returns. For example, a financial report below market expectations tends to increase return volatility more than results above market expectations. On the other hand, Cambodia and Vietnam have insignificant theta parameters signifying that the response to volatility depends on the size of the innovations. Interestingly, Laos has a positive and significant theta parameter less than one which suggests that positive return shocks increases volatility more than negative return shocks. The model also allows us to examine the risk premium hypothesis to determine if investors are appropriately compensated for the risk in equity returns. The results suggest that every ASEAN country has a positive risk premium except Indonesia, Cambodia, and Laos. However, it is possible the results for the latter two countries may be

driven by index composition, lack of market volume, and/or age of the index. In general, investors in countries with positive risk premiums are rewarded for the risk in their equity positions which suggests that at least the largest ASEAN equity markets appropriately compensate investors for a given risk level. Additionally, the results indicate that the previous week's return is negatively related to the current week's return for all countries except Indonesia. The parameter for the previous week's return is negative and significant for Singapore, Malaysia, Vietnam, and Laos. This suggests that weekly returns tend to fluctuate between positive and negative performance which is consistent with the evidence of randomness in ASEAN equity markets provided in Table III. Additionally, the model indicates that previous shocks to the conditional variance process, as indicated by the beta parameter, seem to persist for some time after innovations for all ASEAN countries. That is to say, volatility tends to remain high for some time as a result of a previous shock to volatility. Thus, taken altogether, negative innovations in the equity markets of Singapore, Thailand, Malaysia, Philippines, and Indonesia tend to increase volatility to a higher level and remains elevated for some time.

**Table V. EGARCH-M Model**

	Singapore	Thailand	Malaysia	Philippines	Indonesia	Cambodia	Vietnam	Laos
$\mu$	-0.0082 <sup>a</sup>	-0.0060	-0.0053	0.0002	0.0056	-0.0022	-0.0126 <sup>c</sup>	0.0086
$\phi_1$	-0.1057 <sup>a</sup>	-0.0054	-0.0813 <sup>b</sup>	-0.0295	0.0414	-0.0263	-0.2150 <sup>a</sup>	-0.2885 <sup>a</sup>
$\omega$	-0.8588 <sup>a</sup>	-1.6635 <sup>a</sup>	-1.2400 <sup>a</sup>	-1.8221 <sup>a</sup>	-1.6230 <sup>a</sup>	-4.0045 <sup>a</sup>	-1.9534 <sup>a</sup>	-3.9256 <sup>a</sup>
$\alpha_1$	0.1024 <sup>a</sup>	0.2221 <sup>a</sup>	0.1428 <sup>a</sup>	0.2419 <sup>a</sup>	0.2165 <sup>a</sup>	0.5625 <sup>a</sup>	0.2735 <sup>a</sup>	0.5213 <sup>a</sup>
$\beta_1$	0.8876 <sup>a</sup>	0.7679 <sup>a</sup>	0.8472 <sup>a</sup>	0.7481 <sup>a</sup>	0.7735 <sup>a</sup>	0.4275 <sup>a</sup>	0.7165 <sup>a</sup>	0.4687 <sup>a</sup>
$\Theta$	-1.5047 <sup>a</sup>	-0.4294 <sup>a</sup>	-0.7219 <sup>a</sup>	-0.5099 <sup>a</sup>	-0.6494 <sup>a</sup>	0.1657	-0.0951	0.4289 <sup>a</sup>
$\delta$	0.3899 <sup>a</sup>	0.2772	0.3539	0.0309	-0.1292	-0.0400	0.4358 <sup>c</sup>	-0.4108
AIC	-4259.39	-3589.06	-4677.75	-3888.05	-3758.60	-829.41	-3282.24	-1406.43
SBC	-4225.83	-3556.00	-4644.22	-3854.58	-3725.25	-806.18	-3249.35	-1380.34
LL	2136.70	1801.53	2345.88	1951.03	1886.30	421.70	1648.12	710.21

This table provides the parameter estimates of the EGARCH-M model for the return and variance processes of each ASEAN member state. *AIC* and *SBC* refer to the Akaike and Schwartz criterion, respectively. *LL* is the log-likelihood of each model.

Note: a, b, and c denote significance at the 1%, 5%, and 10% level, respectively.

A feature of the VAR(1) model is that it allows the study of causality and cointegration between two time series. This study examines whether there is a long-run link between the U.S. and ASEAN equity market returns and whether the equity markets influence each other. Table VI provides the results of the Johansen cointegration and Granger causality tests. The Johansen

cointegration test examines the null hypothesis that two sets of time series are not cointegrated. The results provide strong statistical evidence of a strong relationship between equity markets in the United States and equity markets in ASEAN countries. Thus, although the individual characteristics of each equity index may change over time, there is evidence to suggest that the long-run relationship between the U.S. and the ASEAN equity markets remains significant. Moreover, the Granger causality analysis provides evidence that the previous week's return in the United States has a significant effect on the current week's returns for each ASEAN country except Cambodia.

**Table VI. Johansen Cointegration & Granger Causality Tests**

	Singapore	Thailand	Malaysia	Philippines	Indonesia	Cambodia	Vietnam	Laos
<b>Johansen Cointegration</b>								
	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
<b>Granger Causality</b>								
Does Not Influence U.S.	0.5433	0.5727	0.3336	0.0251	0.0882	0.9875	0.3946	0.2210
U.S. Does Not Influence	<0.0001	<0.0001	<0.0001	0.0024	<0.0001	0.8226	0.0432	0.0930

This suggests that the macroeconomic and financial factors from the United States have a strong impact on the expectations of the ASEAN equity markets. Similarly, the results suggest that the previous week's returns in the Philippines and Indonesia have a weak effect on the current week's returns in the United States indicating bidirectional causality. This result could be driven by the economic and financial relationship between the countries that may adversely impact certain sectors or industries in the United States.

Table VII reports the variance decomposition of all sample countries over the entire sample period to explain how much of the variance in one country's equity returns is explained by equity market innovations of the other countries. The innovations in U.S. equity returns explain a significant portion of return volatility in all ASEAN countries except Vietnam, Cambodia, and Laos. For example, U.S. innovations can account for 10.22% of the variance in equity returns in the Philippines and 18.08% in Singapore but accounts for less than 1% of the variance in Laos and Cambodia. In fact, equity markets in Cambodia and Laos have the smallest market capitalization and are among the youngest equity markets in ASEAN, which may help explain why innovations in foreign countries do not explain much of the volatility in their stock returns. Relatively more

experienced and developed markets may be more integrated with other regional and global markets.

Tables VIII and IX report the findings for correlations and variance decomposition between sample countries before and after the Great Recession. Comparisons of panels (a) and (b) in Table VIII indicate that correlations increased between the United States and each ASEAN country after the Great Recession. For example, the correlation between the U.S. and Thailand before December 2007 is 0.2110 and it increased to 0.5020 after the Great Recession.

**Table VII. Variance Decomposition of All Member States**

	USA	Singapore	Thailand	Malaysia	Indonesia	Philippines	Vietnam	Laos	Cambodia
USA	1	18.08%	15.01%	12.55%	11.28%	10.22%	5.04%	0.95%	0.11%
Singapore		81.92%	18.75%	16.93%	24.85%	12.34%	9.54%	0.21%	0.13%
Thailand			66.24%	4.34%	13.64%	2.93%	1.65%	0.66%	0.17%
Malaysia				66.17%	9.19%	3.51%	1.93%	0.01%	1.11%
Indonesia					41.05%	3.25%	6.24%	2.16%	0.45%
Philippines						67.75%	0.11%	1.35%	5.69%
Vietnam							75.49%	1.98%	0.96%
Laos								92.69%	0.49%
Cambodia									90.90%
<i>All Foreign</i>	0.0%	18.08%	33.76%	33.83%	58.95%	32.25%	24.51%	7.31%	9.10%

This table provides the variance decomposition for all member states. The variance decomposition explains how much of a country's weekly stock return variance is explained by innovations from other countries in our sample. *All Foreign* is the total percentage of a country's weekly stock return variance explained by the innovations of all other countries in the sample.

**Table VIII(a). Correlation Matrix Pre-U.S. Financial Crisis**

	USA	Thailand	Malaysia	Philippines	Singapore	Indonesia	Vietnam
USA	1	0.2110	0.2520	0.2050	0.4550	0.1640	0.1090
Thailand		1.0000	0.3790	0.3880	0.4180	0.3240	-0.0470
Malaysia			1.0000	0.3380	0.4950	0.3930	0.0310

Philippines	1.0000	0.3640	0.4170	0.0130
Singapore		1.0000	0.3600	0.0740
Indonesia			1.0000	0.0480
Vietnam				1.0000

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**Table VIII(b). Correlation Matrix Post-U.S. Financial Crisis**

	USA	Thailand	Malaysia	Philippines	Singapore	Indonesia	Vietnam
USA	1	0.5020	0.4000	0.3720	0.5620	0.4080	0.1930
Thailand		1.0000	0.5200	0.4670	0.5880	0.5880	0.2620
Malaysia			1.0000	0.4890	0.5760	0.6140	0.2770
Philippines				1.0000	0.4710	0.5020	0.1550
Singapore					1.0000	0.5860	0.2820
Indonesia						1.0000	0.1970
Vietnam							1.0000

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This pattern is consistent between the United States and each ASEAN country in the sample and is consistent with the graphs of Appendix B. Additionally, weekly return correlations among ASEAN countries all increased. For example, the correlation between Thailand and Vietnam shifted from -0.0470 to 0.2620 when comparing the pre- and post-Great Recession periods. The correlation among ASEAN country-pairs all increased after the U.S. financial crisis.

Moreover, panels (a) and (b) in Table IX indicate that innovations in foreign countries' equity returns explain more of the return volatility in ASEAN countries after the Great Recession. For example, the percentage of equity return variance explained by all innovations in foreign countries increased from 17.10% to 39.49% and from 20.76% to 52.27% for Thailand and Indonesia, respectively. These results are consistent for all ASEAN countries in our study.

**Table IX(a). Variance Decomposition Pre-U.S. Financial Crisis**

	USA	Singapore	Thailand	Malaysia	Indonesia	Philippines	Vietnam
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USA	100.00%	22.04%	4.27%	6.58%	3.35%	4.61%	1.30%
Singapore		77.96%	12.83%	17.65%	8.28%	9.46%	0.05%
Thailand			82.90%	3.92%	4.73%	7.46%	0.90%
Malaysia				71.85%	4.40%	0.85%	0.01%
Indonesia					79.24%	5.63%	0.03%
Philippines						71.99%	0.33%
Vietnam							97.38%
<i>All Foreign</i>	0.00%	22.04%	17.10%	28.15%	20.76%	28.01%	2.62%

After the Great Recession period, U.S. return innovations explained a greater amount of ASEAN's equity volatility. For example, U.S. innovations accounted for 22.04% and 4.27% of Singapore's and Thailand's equity volatility before the Great Recession whereas those figures increased to 33.66% and 24.46%, respectively, after the financial crisis.

**Table IX(b). Variance Decomposition Post-U.S. Financial Crisis**

	USA	Singapore	Thailand	Malaysia	Indonesia	Philippines	Vietnam
USA	100.00%	33.66%	24.46%	17.46%	19.73%	14.73%	2.96%
Singapore		66.34%	15.03%	15.29%	16.58%	9.96%	3.21%
Thailand			60.52%	4.43%	9.68%	3.52%	1.95%
Malaysia				62.82%	6.29%	4.42%	1.26%
Indonesia					47.73%	3.08%	0.15%
Philippines						64.29%	0.10%
Vietnam							90.38%
<i>All Foreign</i>	0.00%	33.66%	39.49%	37.18%	52.27%	35.71%	9.62%

Table X provides the results of the DCC-GARCH model which takes into account time-varying volatility and correlation processes. The evidence suggests that lagged weekly U.S. returns have a positive and significant impact on the subsequent weekly returns for all countries except Singapore. This suggests that positive (negative) U.S. returns in the previous week have a positive (negative) effect on the subsequent week's equity returns in most ASEAN countries. Thus, good

U.S. economic and financial data is likely to have a positive effect on ASEAN equity returns. Additionally, the lagged weekly return within each country seems to weakly impact subsequent returns, or not statistically impact returns, except for Vietnam. This result suggests that previous positive (negative) returns within Vietnam help to explain future return performance. The latter is consistent with the variance decomposition findings that Vietnam's equity volatility is largely explained [90.38% per Table IX(b)] by innovations within the country. The correlation estimates between the U.S. and each ASEAN country indicate that there are still substantial diversification benefits with correlation measures ranging from about 0.19 in Vietnam to 0.51 in Singapore. The dynamic correlations are largely below 0.40 and well below the documented equity return correlations between the U.S. and other developed markets.

**Table X. DCC-GARCH Model**

	$\alpha_0$	$\alpha_1$	$\alpha_2$	$\beta_0$	$\beta_1$	$\beta_2$	a	b	$\rho$
Singapore	0.0060	-0.0342	0.1944	0.0004	0.1878	0.0314	0.0000	0.0900	0.5121
Thailand	0.0025 <sup>a</sup>	-0.0927 <sup>b</sup>	0.1801 <sup>a</sup>	0.0004	0.1114 <sup>a</sup>	0.8410 <sup>a</sup>	0.0752 <sup>a</sup>	0.1085	0.3660
Philippines	0.0030 <sup>a</sup>	-0.0362	0.0782 <sup>c</sup>	0.0001	0.1195 <sup>a</sup>	0.9097 <sup>a</sup>	0.0526	0.0491	0.3314
Malaysia	0.0012	0.0403	0.0591 <sup>b</sup>	0.0002	0.1927 <sup>a</sup>	0.1214	0.0000	0.1035	0.2970
Indonesia	0.0040 <sup>a</sup>	-0.0747 <sup>c</sup>	0.1297 <sup>a</sup>	0.0001	0.1485 <sup>a</sup>	0.7292 <sup>a</sup>	0.0308	0.1578	0.2889
Vietnam	-0.0005	0.1801 <sup>a</sup>	0.1255 <sup>a</sup>	0.0009	0.1823	0.0073	0.0000	0.0998	0.1857

Note: a, b, and c denote significance at the 1%, 5%, and 10% level, respectively.

The pre- and post-crisis cointegration and correlation results may be driven by at least two factors. First, there is empirical evidence to suggest that correlation increases were caused by the Great Recession. Chakrabarti (2011) reports that the effects of volatility spillover were greatest during the Great Recession for eight Asia-Pacific equity markets suggesting that increases in the correlation between stock markets was due to the equity market selloff across global markets. Narayan, Srikanthakumar, and Islam (2014) study the causes of stock market integration in select emerging Asian nations. The authors find higher correlations during the 2007-2009 financial crisis which is consistent with correlation increases presented in Appendix B. Furthermore, the authors also conclude that the increase in correlation is also a function of underlying economic and financial trends such as globalization and financial liberalization. This is consistent with the idea that the United States and ASEAN countries have become more closely integrated over time due to economic and financial liberalization. The Association of Southeast Asian Nations (ASEAN) is the United States' fourth largest trading partner. The partnership between the regions has undergone several advancements. In 2006, the U.S. and ASEAN agreed on the ASEAN-U.S. Trade and Investment Framework Agreement (TIFA) which has led to a significant increase in U.S. exports to the region. Furthermore, in 2012, the U.S. and ASEAN created the Expanded Economic

Engagement (E3) framework under TIFA which focuses on the cooperation on trade and standardization of trade practices.<sup>4</sup> These enhancements to U.S. and ASEAN trade relationships may be partly responsible for the increased integration between equity markets. Our analysis indicates that equity return correlations and cointegration both increased after the Great Recession ended in 2009 and persisted well beyond that time period.

Moreover, not only have ASEAN countries become more integrated with the United States, they have also become more integrated with each other. In addition to closer economic integration as a result of the TIFA and E3 enhancements, ASEAN governments have sought increases to capital market integration within the region. In 2011, seven ASEAN stock exchanges signed an initiative called the ASEAN Exchanges which seeks to promote the growth of ASEAN capital markets by streamlining capital market access and creating financial products that focus on regional countries' needs. In 2014, a further advancement in the initiative developed the ASEAN Trading Link which allows investors within the region to route orders from their domestic stock exchange to other participating ASEAN exchanges for execution.<sup>5</sup> Thus, the results provide evidence that economic and trade initiatives between the United States and ASEAN, as well as capital market integration initiatives within ASEAN, may be contributing factors to the increasing equity market integration after 2009 with the United States and within the ASEAN region, especially given that most of the initiatives have been fully implemented after the U.S. financial crisis.

## **VI. Conclusion**

The return behavior of equity markets and correlations between stock markets is important for investors in order to maintain well-diversified portfolios and an acceptable level of risk. This paper studies the equity markets of ASEAN member countries and their relationship with U.S. equity markets given the strengthening trade and economic ties between the two regions. The empirical results suggest that U.S. equity markets impact the majority of ASEAN equity markets and explain a larger portion of ASEAN equity return volatility after the Great Recession as

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<sup>4</sup> Information on TIFA and E3 is provided by the Office of the U.S. Trade Representative and Center for Strategic and International Studies.

<https://www.csis.org/analysis/e3-initiative-united-states-and-asean-take-step-right-direction>

<https://ustr.gov/countries-regions/southeast-asia-pacific/association-southeast-asian-nations-asean>

<sup>5</sup> Information on ASEAN Exchanges and ASEAN Trading Link is provided by FTSE Russell.

<http://www.ftserussell.com/files/research/frontier-developed-ftse-asean-index-series>

compared to before the crisis. Additionally, the study provides evidence of strong cointegration between the United States and all ASEAN member countries during the sample period. Although some of the results may be attributed to the effect of the U.S. financial crisis on global equity markets, there is evidence to suggest that the increasing economic and financial ties between the U.S. and ASEAN may be a result of further developments in trade and financial liberalization initiatives between the United States and ASEAN as well as to initiatives within the region to better integrate capital markets with each other and the rest of the world. The closer ties and increase in economic and financial integration benefit investors due to portfolio diversification opportunities, especially given that most U.S.-ASEAN pairwise correlations remain below 0.40. Further research may expand the study by examining if political risk or political ties, corruption, and/or the strength of legal institutions have an effect on economic and financial integration efforts between countries.

**Appendix A.**

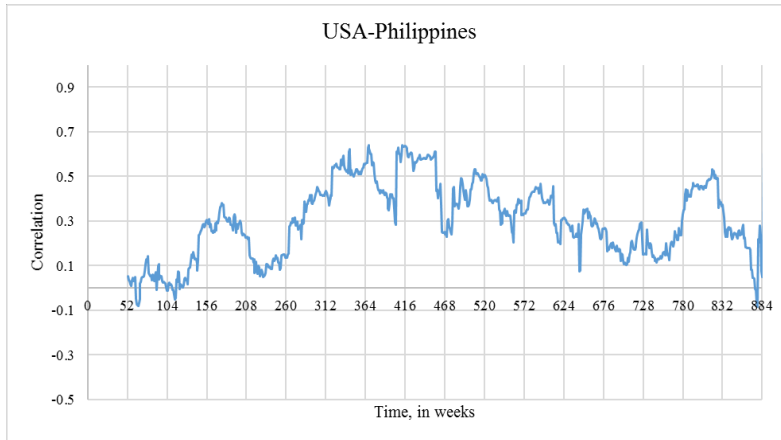
This table provides the name of the equity index used for each country in our sample and the available of the daily closing prices data.

Country	Equity Index	Data Availability
United States	S&P 500	1/3/2001 - 2/7/2017
Singapore	FTSE Straights Times Singapore (STI)	1/3/2001 - 2/7/2017
Malaysia	FTSE Bursa Malaysia KLCI	1/3/2001 - 2/7/2017
Indonesia	IDX Composite	1/3/2001 - 2/7/2017
Philippines	PSEi Composite	1/3/2001 - 2/7/2017
Thailand	SET Index	1/3/2001 - 2/7/2017
Vietnam	VN Index	1/3/2001 - 2/7/2017
Cambodia	CSX Index	4/18/2012 - 2/7/2017
Laos	LSX Composite Index	1/11/2011 - 2/7/2017

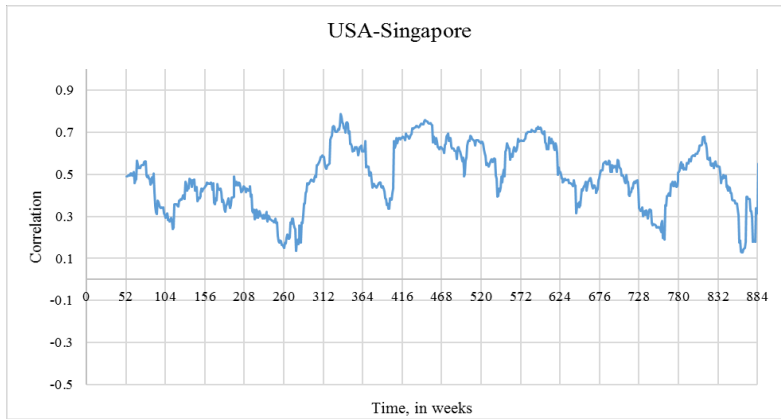
**Appendix B. Rolling 52-Week Correlations**

Graphs (A)-(F) show the rolling 52-week correlations between ASEAN member states and the United States.

**(A)**



**(B)**

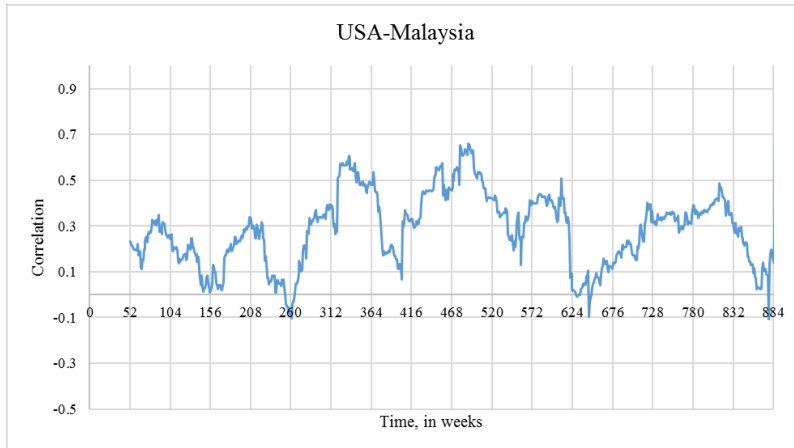


**(C)**



**Appendix B. Continued.**

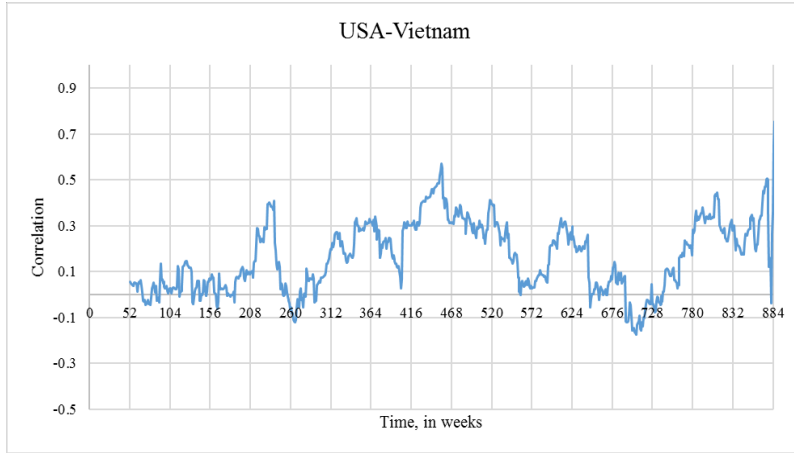
**(D)**



**(E)**



(F)



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