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REAL GDP GROWTH RATES OF THE ASEAN REGION: EVIDENCE OF SPILLOVERS AND ASYMMETRIC VOLATILITY EFFECTS

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ABSTRACT

This paper identifies economic relations using real gross domestic product (GDP) within the five Associations of South-east Asian Nation economies namely: Indonesia, Malaysia, Philippines, Singapore and Thailand. Utilizing ARMA-GARCH, ARMA-EGARCH, ARMA-APARCH models, the study captures the presence of the leverage effect, and spillover of returns and volatility. Most economies except for Singapore are consistent with leverage effects, while the Philippines showed economic resilience with having symmetric volatility response. On one hand, Thailand's economy has consistent negative one-way relationship on Malaysia's economy for the three models. This paper suggests that ASEAN economies work together to improve bilateral relations and market integration by trading and investing; and cooperation in terms of food production and migrant workers condition. This will help to reinforce their economic and political relationships that can help boost their respective economies, and sense of regionalism. ASEAN should help each other by sharing their ways to improve the standards of living of their citizens, promotion of safer security and anti-terrorism activities, provide a safer place for the national and overseas workers, trade goods and sell in competitive prices, improve the level of education inside the country. Future studies can further extend data to include other ASEAN countries and also consider other political and economic organizations. A perceived limitation of the paper is the uncertainty of these five ASEAN-5 economies impact within the other major countries but to also other regional groupings and specific economies. In general, this paper can help policy-makers and researchers alike in better understanding economic relations and spillover effects of growth rates and volatility of real GDP. The paper offers further examination of the potential for further connection among the major ASEAN economies and to support existing integration policies.

***JEL classification**: F4, G15.*
***Keywords**: ASEAN economies, asymmetric volatility, leverage effects, real GDP, spillover effects.*

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1. INTRODUCTION

1.1 Background: The ASEAN as an economic community

The Association of Southeast Asian Nations (ASEAN) is considered to be the strongest and successful regional grouping in the developing world, and sturdy economic performance has made ASEAN one of the world's most active regions. The association was formed on August 8, 1967 in Bangkok, Thailand with signing of the member countries, namely, Indonesia, Malaysia, Philippines, Singapore and Thailand. The ASEAN started to move towards the economic cooperation and integration, which initially focused on merchandise trade, and started to expand in the 1990s on services, investment, and labor. The ASEAN also embarked on initiatives towards regional economic convergence. In 1992, the first major move was to have the ASEAN Free Trade Agreement (AFTA). The goal is to promote the region's competitive advantage as a single production unit. The AFTA commits members to free trade within a 15-year timeframe through the elimination of tariff and non-tariff barriers to encourage greater economic efficiency, productivity and competitiveness.

A grand initiative within the past decade was made in 2002 with the creation of an ASEAN Economic Community (AEC), which is planned to be integrated by 2015. The AEC was reinforced by numerous considerations, including: the aspiration to create a post-AFTA agenda; and the importance to deepen economic integration within the region in light of the increasing dominance of free trade areas (FTAs). AEC envisions the following key characteristics: (a) a single market and production base, (b) a highly competitive economic region, (c) a region of equitable economic development, and (d) a region fully integrated into the global economy. To sum it up, the AEC plans to transform the ASEAN into a region with free movement of goods, services, investment, skilled labor, and open flow of capital.

Trade measures under the AEC are expected to lead an increase in output that by 2025, the GDP in the ASEAN region can be higher than the baseline of 7.1%.Generally for the ASEAN economies, high-skilled labor can grow up to 41%, which may lead to having increased productivity and higher quality in education and training. This trend has already boosted the standards of living between 1991 and 2013, making 83 million workers become part of the middle class. The region also has one of the world's highest foreign investment inflows enticed by its workforce of 300 million, increasing consumer markets and expanding networks of infrastructure.

The potential of greater integration will require deeper understanding of ASEAN's asset of skilled labor and regional partnerships to support it. This includes implementing landmark ASEAN agreements such as the ASEAN Declaration on the Protection and Promotion of the Rights of Migrant Workers and the ASEAN Declaration on Strengthening Social Protection. Other priorities for regional cooperation contains expanding mutual recognition arrangements, completing the ASEAN Qualifications Reference Framework and strengthening labor market information and analysis to help monitoring the influence of the AEC on labor markets. Such regional cooperation efforts need to be consistent with national policies. Each Member State needs to identify the most

suitable structure of policies for their own circumstances, while making a level field for competition, such as through ratification of international labor standards. In the long run, the success of ASEAN regional integration will depend on how it affects the labor market and how it improves the quality of life of the people in the region.

1.2 Background: International trading profile of major ASEAN countries

This section provides the trading profile of the ASEAN-5 economies as of 2013 to demonstrate the degree of their connections with the global community. Indonesia is the largest economy in Southeast Asia and also a member of the G20 major economies. The country's GDP reached $867.5 billion, and its gross national savings is at 31.5% of GDP. Indonesia's major exports are oil, gas, electrical equipment and machinery, and their top three major trading partners are Japan (15% of total trading volume), China (12%) and Singapore (9.1%). The next biggest economy in the ASEAN is Thailand. The economy's GDP reached $400.9 billion, and its gross national savings is at 30.8% of GDP. Thailand's major exports are agricultural products mainly rice and rubber, manufactured goods, electronics, vehicles and machinery. The country's major trading partners are China (14% of total trading volume) Japan (10%), and the US (9.7%). Among the ASEAN economies Indonesia holds 5.2% of the total trading volume and Malaysia has 5.0%. The third largest economy is Malaysia with a GDP of $312.4 billion and a gross national savings of 32.3% of GDP. Malaysia's main exports are electrical and electronics products, palm oil, petroleum products, liquefied natural gas, timber and natural rubber; and its top trading partners are Singapore (13% of total trading volume), Japan (12%) and China (12%). Among the ASEAN economies Thailand is the top trading partner and holds 5.1% of the total trading volume.

Singapore is the 4th biggest economy with a GDP of $297.9 billion with a gross national savings of 44.6% of GDP. The country's main exports are electronics, fuels and chemicals; and its major trading partners are China (14% of total trading volume), Malaysia (12%) and Indonesia (12%). The Philippines is next and has a GDP of $278 billion, and its gross national savings is at 22.9% of GDP. The Philippines is a leading exporter of electronic products including processors, chips and hard drives as well as of agricultural products including coconut, pineapple and abaca. The countries major trading partners are China (23% of total trading volumes), Japan and (13%) the US (12%). Among the ASEAN economies Singapore is the top trading partner and holds 5.4% of the total trading volume.

Figure 1 shows the constantly increasing yearly GDP of the 5 ASEAN countries for the past 10 years from year 2005 to 2014. From 2005 to 2008 Thailand consistently has the highest GDP among the ASEAN-5 countries. In 2009, Indonesia experienced the highest boost in the economy. Amazingly, for 2010, all real GDP of the ASEAN-5 economies are equal at 100 (unit of measure). From 2011 to 2013, Indonesia experienced the highest consistent real GDP growth among, while the Philippines top all of the countries with the highest GDP in 2014.

1.3 Integration through growth rates/return and volatility models

The particular interest of this research are the spillover effects of the growth that the ASEAN region is experiencing through its real GDP using the ASEAN-5 economies of Indonesia, Malaysia, Philippines, Singapore and Thailand. This topic is important given

the enormous growth experienced in Asia, and the growing degree of positive (i.e., economic growth as a result of trading) and negative (i.e., default risk as a result of financial crises) contagion experienced in the region. This research tests the connection of each ASEAN economy with the other using the autoregressive moving average (ARMA) models combined with three autoregressive conditional heteroskedasticity (ARCH) models. This has enough reasons to believe that these relationships exist, because of the massive and expanding integration among ASEAN economies. This phenomenon was already proven in the literature of Ardliansyah (2012), which found that Indonesia, Malaysia, Singapore and Thailand have market co-integrations in the short-run horizon. Indonesia, Malaysia, Singapore and Thailand have made some development in the degree of market integration, however interdependencies of the Philippines can be considered as a second level of market integration towards Indonesia, Malaysia Singapore and Thailand markets. Vietnam market, on one hand doesn't share a common market trend with any of the ASEAN economies. Liu (2007) identified the market relations of ASEAN with the major economies. The author found that US' negative shocks have greatly affected the ASEAN stock markets and China's negative. A study using quarterly real GDP as data was done by Ho and Tsui (2004), which examined the Greater China region using GARCH model to capture the probable existence of asymmetrical conditional volatility. The study discovered that negative real GDP shocks may bring a greater impact on future volatilities compared to positive shocks of the same magnitude.

ASEAN economies may have similar patterns of development; however, they still have different reactions to the impact of varying macroeconomic and financial factors. ASEAN members have become part of the fastest growing emerging economies in the world, and are expected to continue because of increasing integration and improvements in their international trade and economic performance.

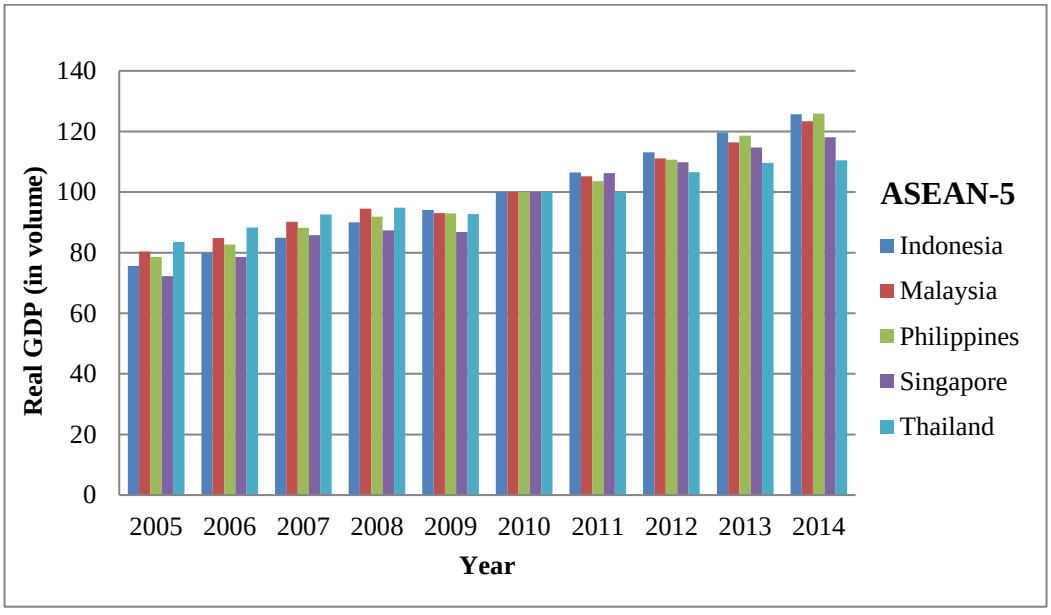

Figure 1: Annual real GDP of the ASEAN-5 economies.

1.4 Research motivation, contribution and objectives

Undoubtedly, the evident deepening integration of ASEAN economies has attracted considerable research on the economic performance of the region. However, studies examining the return and volatility spillovers in the real GDP growth rates of the ASEAN region are non-existent. The primary motivation of this research is the dearth in literature regarding real GDP growth rates characterization and connection in the ASEAN region, particularly in determining their leverage effects and volatility asymmetry properties. This paper proves this possible relationship by applying the autoregressive moving average (ARMA) models combined with the generalized autoregressive conditional heteroskedasticity (GARCH), exponential generalized autoregressive conditional heteroskedasticity (EGARCH), and asymmetric power autoregressive conditional heteroskedasticity (APARCH) models. GARCH models proposed by Engle (1982) and Bollerslev (1990) and its extensions are very useful in modeling the dynamic behavior of investment instruments, as well as based on the survey made by Bollerslev et al. (1992); and the EGARCH and APARCH models can likewise capture these tendencies as well as the presence of leverage effects and volatility asymmetry, respectively. Despite of the emergence of new types of multivariate GARCH and fractionally-integrated GARCH models, univariate GARCH remains very useful because they converge faster to a local maximum in quasi-maximum likelihood estimation, while providing accurate forecasting performance (Andersen and Bollerslev, 1998; and Wang and Wu, 2012).

This paper contributes to the literature by being a pioneer in applying three combinations of models, namely, a) ARMA-GARCH, b) ARMA-EGARCH, and c) ARMA-APARCH models in examining growth rates and volatility relationships among the ASEAN-5 economies. In line with the motivation and contributions, the research paper essentially differs from the previous studies through these four main objectives:

a) identify the presence of growth rates and volatility transmissions among the ASEAN-5 real GDP rates;
b) determine the existence of leverage effects and volatility asymmetry in the real GDP time-series of the major ASEAN economies;
c) examine the presence of unilateral and bilateral growth rates and volatility influences, and also identify positive or negative effect among the real GDP rates.

The research is driven by the fact that providing new understanding on the growth properties of the major ASEAN economies will offer considerable knowledge to serve as a stepping stone for both the government and academic communities to create possible policy intervention and offer additional future channels of research.

This research is divided in four main sections. Section 2 presents the data and explains the methodologies of the paper; Section 3 discusses the empirical results and the last section conclusion and limitations.

2. LITERATURE REVIEW

This paper offers an overview of literature examining growth rates and volatility relations between several time-series data, and the degree of ASEAN integration. The papers cited are based on two major groups of literature: 1) covers literature that established the

interdependence of ASEAN economies; and 2) features the growth rates, return and volatility transmissions among macroeconomic and financial market instruments.

2.1 ASEAN integration literature

This set of literature discusses existing study on ASEAN integration, and causal effects of certain macroeconomic and financial factors on economic growth. The paper written by Hussin and Saidin (2012) found that economic variables have a positive relationship to GDP. The authors also proved that all variables play a role as a cause of economic growth in the ASEAN-4 countries using three panel estimation models, namely, pooled model, fixed effects model, and random effects model. Yoo (2006) examined the relationship between electricity consumption and economic growth among four major ASEAN economies, and showed bi-directional causality between electric consumption and economic growth in Malaysia and Singapore, while there is uni-directional causality from economic growth to electricity consumption in Indonesia and Thailand. Furthermore, Kueh et al. (2010) investigated the causal direction of economic integration through real GDP among ASEAN economies together with other five neighboring countries specifically Australia, China, Japan, New Zealand and South Korea. The empirical results showed that ASEAN economies are moving towards higher degree of economic integration and strengthening their relationship with their neighboring countries.

Click and Plummer (2005) studied the stock markets of the ASEAN-5, namely, Indonesia, Malaysia, Philippines, Singapore and Thailand. The research found that the markets positively reacts with policy initiatives to boost the ASEAN integration, which support the idea that stock markets of ASEAN-5 countries are integrated in the economic sense but the integration is far from completion. Wongbangpo and Sharma (2002) examined the relationship between stock prices and a set of selected macroeconomic variables (GNP, the consumer price index, the money supply, the short term interest rate, and the exchange rate) in the short and long run of five ASEAN countries namely Indonesia, Malaysia, Philippines, Thailand and Singapore. The findings using Granger causality test showed that the past values of macroeconomic variables in these ASEAN countries are capable of predicting future changes in stock price indices. In another related study, Yu et al. (2010) focused on the equity market integration in Asia and determined that differences in economic structure and development, maturity level of individual equity market and infrastructures pose challenges in the better integration of markets. The study also suggested that coordinated strategies for promoting the stability and efficiency of financial intermediation across jurisdictions in Asia are needed in order to clean the obstacles and facilitate the integration process. Janor et al. (2007) examined the regional and global integration in five major ASEAN countries namely Malaysia, Singapore, Thailand, Philippines and Indonesia using both bivariate and multivariate cointegration framework. Findings showed the increasing influence of Japanese market as risk factor in ASEAN markets' asset pricing; also, the Asian crisis has produced a structural break that caused a shift in the regional integration.

Moreover, Azman-Saini et al. (2002) used Granger noncausality test and showed that the Singapore's equity market is not affected by other markets except by the Philippines in the long run. Furthermore, The ASEAN-5 markets are not all inclusive, and investors with long run perspective may gain from an investment that is across countries in this

region. Phuan et al. (2009) examined the relationship of financial liberalization and stock market integration among the five ASEAN countries namely Indonesia, Philippines, Singapore Malaysia and Thailand. Using Granger-causality test and variances decomposition analysis, the result indicated that financial liberalizations have heightened the interaction and integration between the stock markets in the Asia-Pacific region. Laurenceson (2003) measured the international parity conditions to analyze the current level of economic integration between China and the ASEAN-5. The study found that China and the ASEAN-5 have already strong linkages with respect to goods and services markets, and suggested that external financial liberalization must be accompanied by regulatory reforms to improve the risk-management practices of financial institutions.

2.2 Growth rates and volatility literature

This section shows different journals that have been using the same methodology of examining different countries relationship in terms of volatility and spillover effects. Jiranyakul and Opiela (2010) used an AR-EGARCH model to assess conditional variance series for ASEAN-5 countries. The study found strong evidence showing that inflation uncertainty also affects inflation positively in all countries, which supports the idea that an emerging market country with low to moderate inflation can experience inflation uncertainty. Ho and Tsui (2004) examined the conditional volatility in the quarterly real GDP of the Greater China region using GARCH model to capture the probable existence of asymmetrical conditional volatility. The study discovered that negative real GDP shocks may bring a greater impact on future volatilities compared to positive shocks of the same magnitude. On one hand, Liu (2007) examined how the volatility in the US and the Chinese stock markets transfer to the five ASEAN markets using GARCH model. The study found that both the mean and the volatility spillover of US have appeared to be essential, while Chinese volatility spillover effects has been reliant on the fluctuation of exchange rate.

Narayan et al. (2009) used an augmented version of EGARCH model to investigate the relationship between inflation and output of China. The study found that inflation volatility reduces economic growth, and the higher output volatility increases economic growth. Hossenidoust et al. (2013) assessed the influence of oil and gold price volatility on the volatility of the ASEAN-5 stock markets. Applying GARCH and EGARCH model on monthly data stock returns, crude oil and gold prices, the results showed that the impact of oil price on the mean equation of all stock market index are positive and significant indicating that any increase in crude oil will increase the return of market index, while investments in the gold market can be a good hedge against the stock price fluctuations. Naseem et al. (2008) examined the relationship of exchange rates misalignment and volatility on Malaysian import flows using GARCH model. The results showed that real imports, domestic income, price of import, exchange rate misalignment and volatility are co-integrated, implying that these macroeconomic variables do not drift apart in the long run. Moreover, Daal et al. (2005) examined the relationship between inflation and inflation uncertainty for both developed and emerging countries using the asymmetric power GARCH model. The study found proof that positive inflationary shocks have stronger impacts on inflation uncertainty for Latin American countries. A recent study of Balli et al. (2014) investigated the return and volatility spillover effects of local and global shocks on the ASEAN sector and national indices using AR-GARCH model. The

research found that volatility spillover effects of local and global shocks on ASEAN sectors equity returns have been decreasing, whereas the effects on the production and industries group sectors and the food and beverage sectors have been increasing.

The above literature review demonstrated that growth rates and volatility transmissions happen in global and regional markets, and confirmed the contributions that the paper earlier stated. Please see Appendix for the tabulated summary.

3. DATA AND METHODOLOGY

This paper uses quarterly figures of real GDP of the ASEAN-5 economies, namely, Indonesia, Malaysia, Singapore, Philippines and Thailand. This paper uses the real GDP instead of the nominal GDP, because real GDP better measures the value of the output of the economy because it accounts adjustments on the price changes of goods and services that are produced in the country. Data were retrieved from the Taiwan Economic Journal (TEJ) database starting from September 1987, or the quarter when the ASEAN was established until December 2014. First, the growth rates were calculated as the logarithm of quarterly values, and are denoted as follows (Wright et al., 2010):

$$R_{i,t}^{m} = \ln\left(\frac{GDP1_{t}}{GDP1_{t-1}}\right)*100, \tag{1}$$

$$R_{i,t}^{e} = \ln\left(\frac{GDP2_{t}}{GDP2_{t-1}}\right)*100 \tag{2}$$

where $R_{i,t}^{m}$ and $R_{i,t}^{e}$ are the real GDP growth rates of ASEAN country 1 and country 2 at time *t*, respectively. *GDP*1 is the real GDP growth rate of ASEAN country 1 and *GDP*2 is the real GDP growth rate of ASEAN country 2.

The basic models for country 1 and 2's real GDP growth rate will take the form:

$$R_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{g} \alpha_i R_{i,t-i}^{e} + \varepsilon_{i,t}^{e} + \sum_{i=1}^{s} \theta_i \varepsilon_{i,t-i}^{e}, \tag{3}$$

$$h_{i,t}^{e} = a_0 + \sum_{i=1}^{q} a_i \varepsilon_{i,t-1}^{e^2} + \sum_{i=1}^{p} \psi_i h_{i,t-i}^{e} \text{ , for GARCH} \tag{4}$$

$$h_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{q} \alpha_i (\left|\varepsilon_{i,t-i}^{e}\right| - \delta_i \varepsilon_{i,t-i}^{e}) + \sum_{i=1}^{p} \psi_i h_{t-1}^{e} \text{ , for APARCH} \tag{5}$$

$$\log\left(h_{i,t}^{e^2}\right) = a_0 + \sum_{i=1}^{q}\left(a_i \left|\frac{\varepsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}}\right| + \delta_i \frac{\varepsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}}\right) + \sum_{i=1}^{p} \psi_i \log\left(h_{i,t-i}^{e^2}\right), \text{ for EGARCH} \tag{6}$$

$$\varepsilon_{i,t}^{e} \mid \psi_{t-1} \sim N(0, h_{i,t}^{e}),$$

where $R_{i,t}^{e}$ represents the *i*th real GDP growth rate at time *t*; $\sum_{i=1}^{g} \alpha_i R_{i,t-i}^{e}$ is the higher order of the autoregressive AR(*g*); and $\varepsilon_{i,t}^{e}$ corresponds for the real GDP growth rate residual

$\varepsilon_{i,t}^{e} + \sum_{i=1}^{s} \theta_i \varepsilon_{i,t-i}^{e}$ at time *t*. represents to the higher order moving average mean process MA (*s*) for $R_{i,t}^{e}$; $\sum_{i=1}^{p} \psi_i h_{i,t-i}^{e}$ stands for the *p* order conditional heteroscedasticity of the GARCH term for real GDP growth rate at time *t*; $\sum_{i=1}^{q} a_i \varepsilon_{i,t-1}^{e^2}$ is the *q* order of the ARCH term at time *t*, while ϕ_{t-1} stands for all the information set at time *t-1*; and θ_i captures the parameter that is not known.

The residual series equation is represented by the equation below, to check if the residual possesses heteroscedasticity,

$$\varepsilon_t^2 = \alpha_0 + k_1 \varepsilon_{t-1}^2 + k_2 \varepsilon_{t-2}^2 + \cdots + k_p \varepsilon_{t-p}^2 + z_t \tag{7}$$

One can reject the null hypothesis of the correlation among $p = n$ periods, because the residual series will not move towards zero. This suggests that there's the existence of heteroscedasticity.

To examine the spillover and leverage effects for real GDP growth rate, the subsequent equations are computed:

$$R_{i,t}^{m} = \beta_0 + \sum_{i=1}^{g} \beta_i R_{i,t-i}^{m} + \varepsilon_{i,t}^{m} + \sum_{i=1}^{s} \gamma_i \varepsilon_{i,t-i}^{m}, \tag{8}$$

$$h_{i,t}^{m} = b_0 + \sum_{i=1}^{q} b_i \varepsilon_{i,t-i}^{m^2} + \sum_{i=1}^{p} \zeta_i h_{i,t-i}^{m}, \text{ for GARCH} \tag{9}$$

$$h_{i,t}^{m} = \alpha_0 + \sum_{i=1}^{q} \alpha_i \left(\left| \varepsilon_{i,t-i}^{m} \right| - \delta_i \varepsilon_{i,t-i}^{m} \right) + \sum_{i=1}^{p} \psi_i h_{t-1}^{m}, \text{ for APARCH} \tag{10}$$

$$\log\left(h_{i,t}^{m^2}\right) = b_0 + \sum_{i=1}^{q} \left(b_i \left| \frac{\varepsilon_{i,t-i}^{m}}{h_{i,t-i}^{m}} \right| + \delta_i \frac{\varepsilon_{i,t-i}^{m}}{h_{i,t-i}^{m}} \right) + \sum_{i=1}^{p} \zeta_i \log\left(h_{i,t-i}^{m^2}\right), \text{ for EGARCH} \tag{11}$$

$$\varepsilon_{i,t-j}^{m} \mid \phi_{t-1} \sim N\left(0, h_{i,t}^{m}\right),$$

where $R_{i,t}^{m}$ is the *i*th real GDP growth rate at time *t*; $\varepsilon_{i,t}^{m}$ stands for the residual of real GDP growth rate residual at time *t*; $h_{i,t}^{m}$ represents the conditional variance of real GDP growth rate at time *t*; and ϕ_{t-1} captures all the information set at time *t-1*. In addition, δ_i stands for the leverage term and γ_i is the unknown parameter. Noted that $h_{i,t}^{e^2}$ and $h_{i,t}^{m^2}$ are the conditional variance of country 1 and 2's real GDP growth rate, respectively.

2.1. Spillover effect of growth rates

This part of the paper refers to the interdependence among ASEAN economies. The equations are shown below:

$$R^e_{i,t} = \alpha_0 + \sum_{i=1}^{g} \alpha_i R^e_{i,t-i} + wR^m_{i,t-1} + \varepsilon^e_{i,t} + \sum_{i=1}^{s} \theta_i \varepsilon^e_{i,t-i} \tag{12}$$

$$h^e_{i,t} = a_0 + \sum_{i=1}^{q} a_i \varepsilon^{e^2}_{i,t-i} + \sum_{i=1}^{p} \psi_i h^e_{i,t-i} \text{ , for GARCH}$$

$$h^e_{i,t} = \alpha_0 + \sum_{i=1}^{q} \alpha_i (\left|\varepsilon^e_{i,t-i}\right| - \delta_i \varepsilon^e_{i,t-i}) + \sum_{i=1}^{p} \psi_i h^e_{t-1} \text{ , for APARCH} \tag{13}$$

$$\log\left(h^{e^2}_{i,t}\right) = a_0 + \sum_{i=1}^{q} \left(a_i \left|\frac{\varepsilon^e_{i,t-i}}{h^e_{i,t-i}}\right| + \delta_i \frac{\varepsilon^e_{i,t-i}}{h^e_{i,t-i}} \right) + \sum_{i=1}^{p} \psi_i \log\left(h^{e^2}_{i,t-i}\right), \text{ for EGARCH} \tag{14}$$

$$\varepsilon^e_{i,t} \mid \psi_{t-1} \sim N(0, h^e_{i,t}),$$

$$R^m_{i,t} = \beta_0 + \sum_{i=1}^{g} \beta_i R^m_{i,t-i} + dR^e_{i.t-1} + \varepsilon^m_{i,t} + \sum_{i=1}^{s} \gamma_i \varepsilon^m_{i,t-i} \tag{15}$$

$$h^m_{i,t} = \alpha_0 + \sum_{i=1}^{q} \alpha_i (\left|\varepsilon^m_{i,t-i}\right| - \delta_i \varepsilon^m_{i,t-i}) + \sum_{i=1}^{p} \psi_i h^m_{t-1} \text{ , for APARCH} \tag{16}$$

$$\log\left(h^{m^2}_{i,t}\right) = b_0 + \sum_{i=1}^{q} \left(b_i \left|\frac{\varepsilon^m_{i,t-i}}{h^m_{i,t-i}}\right| + \delta_i \frac{\varepsilon^m_{i,t-i}}{h^m_{i,t-i}} \right) + \sum_{i=1}^{p} \zeta_i \log\left(h^{m^2}_{i,t-i}\right), \text{ for EGARCH} \tag{17}$$

$$\varepsilon^m_{i,t} \mid \psi_{t-1} \sim N(0, h^m_{i,t}),$$

where w and d are the spillover effects from the growth rates of ASEAN countries *e* and *m,* respectively. The assessments of spillover effects can be applied to the null hypothesis of no spillover effects of growth rates ($w = 0; d = 0$). Country E's (or Country M's) lagged growth rates has an effect to Country M's (or Country E's) if the *w* coefficient is significantly different from zero, and vice versa; same is the case with the testing of the *d* coefficient.

2.2. Spillover effect of volatilities

This part deliberates the possible spillover effects of ASEAN economies' real GDP volatilities by examining the influence of cross-market dynamics. The equations are illustrated below:

$$R^e_{i,t} = \alpha_0 + \sum_{i=1}^{g} \alpha_i R^e_{i,t-i} + \varepsilon^e_{i,t} + \sum_{i=1}^{s} \theta_i \varepsilon^e_{i,t-i} \tag{18}$$

$$h^e_{i,t} = a_0 + \sum_{i=1}^{q} a_i \varepsilon^{e^2}_{i,t-1} + \sum_{i=1}^{p} \psi_i h^e_{i,t-i} + v\varepsilon^{m^2}_{i,t-1}, \text{ for GARCH,} \tag{19}$$

$$h_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{q} \alpha_i (\left|\varepsilon_{i,t-i}^{e}\right| - \delta_i \varepsilon_{i,t-i}^{e}) + \sum_{i=1}^{p} \psi_i h_{t-1}^{e} + v\varepsilon_{i,t-1}^{m}, \text{ for APARCH}$$

$$\log\left(h_{i,t}^{e^2}\right) = a_0 + \sum_{i=1}^{q} \left(a_i \left|\frac{\varepsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}}\right| + \delta_i \frac{\varepsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}} \right) + \sum_{i=1}^{p} \psi_i \log\left(h_{i,t-i}^{e^2}\right) + v\varepsilon_{i,t-1}^{m^2}, \text{ for EGARCH} \quad (20)$$

$$\varepsilon_{i,t}^{e} \mid \psi_{t-1} \sim N(0, h_{i,t}^{e}),$$

$$R_{i,t}^{m} = \beta_0 + \sum_{i=1}^{g} \beta_i R_{i,t-i}^{m} + \varepsilon_{i,t}^{m} + \sum_{i=1}^{s} \gamma_i \varepsilon_{i,t-i}^{m}, \quad (21)$$

$$h_{i,t}^{m} = b_0 + \sum_{i=1}^{q} b_i (\left|\varepsilon_{i,t-i}^{m}\right| - \delta_i \varepsilon_{i,t-i}^{m}) + \sum_{i=1}^{p} \zeta_i h_{t-1}^{m} + l\varepsilon_{i,t-1}^{e}, \text{ for APARCH} \quad (22)$$

$$\log\left(h_{i,t}^{m^2}\right) = b_0 + \sum_{i=1}^{q} \left(b_i \left|\frac{\varepsilon_{i,t-i}^{m}}{h_{i,t-i}^{m}}\right| + \delta_i \frac{\varepsilon_{i,t-i}^{m}}{h_{i,t-i}^{m}} \right) + \sum_{i=1}^{p} \zeta_i \log\left(h_{i,t-i}^{m^2}\right) + l\varepsilon_{i,t-1}^{e^2}, \text{ for EGARCH} \quad (23)$$

$$\varepsilon_{i,t}^{m} \mid \psi_{t-1} \sim N(0, h_{i,t}^{m}),$$

where v and l are the spillover effect from country *e* and *m*'s volatilities, respectively. The absence of spillover effects of volatility (v =0; l =0) is tested against the alternative hypothesis of having the spillover effects of volatility ($v \neq 0$; $l \neq 0$). Country E's lagged real GDP residual (or Country m's lagged real GDP residual) affects the Country M's current real GDP residual (or Country e's lagged real GDP residual) if the alpha value is larger than the p-value of v (or l).

4. EMPIRICAL RESULTS

Table 1 shows real GDP growth rate descriptive statistics of the five ASEAN countries under study. Beginning data of each country differs and ends in 4th quarter of 2014: Indonesia starts from the year 1997 with 66 observations; Malaysia begins from year 1991 with 92 quarterly data points; Philippines starts from 1981 with 131 observations; Singapore starts from year 1984 with 117 quarterly data points; lastly Thailand starts from 1993 with 84 observations. The table illustrates that all of the real GDP growth rates of each country have a positive average returns. Singapore experienced the highest growth rate with 1.439, while Thailand experienced the lowest at 0.758. This is not surprising because still has the most vibrant economic position among the ASEAN-5, while Thailand has been plagued by political crises recently, which negatively affected its development. The average real GDP growth rate for the five countries is 0.991. Among the five countries, the Philippines experienced the largest standard deviation with 9.472, while Malaysia has the lowest with 1.988. Most of the countries are negatively skewed with the exception of Singapore, while all of the countries have a positive kurtosis. The Jarque-Bera statistic for residual normality illustrates that the real GDP growth rates were not equal to zero, demonstrating that the normal distribution assumption of the residual was not accepted.

Table 1: The sample size and period of ASEAN quarterly real GDP.

List of ASEAN-5 Countries	Start of Data	Quarterly	Growth Rate	Std. Dev.	Skew.	Kurt.	J-Bera
Indonesia	1997	66	0.997	3.102	-1.585	6.224	56.213*** (0.000)
Malaysia	1991	92	0.886	1.988	-0.630	4.503	14.733*** (0.000)
Philippines	1981	131	0.873	9.472	-0.073	1.882	6.937*** (0.000)
Singapore	1984	117	1.439	2.992	0.015	2.531	1.075*** (0.000)
Thailand	1993	84	0.758	2.022	-0.386	3.055	2.093*** (0.000)

Source: Yahoo Finance; http://www.yahoo.com/finance.

Table 2 illustrates statistics of time-series data using ARMA and GARCH filters. The Augmented Dickey-Fuller (ADF) test examined the stationarity of the ASEAN-5's real GDP growth rate.

Table 2: Summary statistics of ARMA and GARCH filtering.

List of ASEAN-5 Countries	ADF	ARMA	AIC	LM test	ARCH-LM	GARCH	AIC	ARCH-LM
Indonesia	-6.357*** (0.000)	(2,2)	4.734	1.788 (0.181)	11.229** (0.024)	(2,0)	4.168	1.598 (0.450)
Malaysia	-7.153*** (0.000)	(1,2)	4.102	0.291 (0.990)	19.218*** (0.001)	(2,2)	4.001	0.895 (0.925)
Philippines	-3.507** (0.043)	(0,2)	6.202	3.379 (0.185)	17.518*** (0.002)	(2,1)	6.109	5.747 (0.219)
Singapore	-4.574*** (0.000)	(0,2)	5.046	0.000 (1.000)	17.651* (0.061)	(1,1)	4.975	23.132 (0.145)
Thailand	-3.835** (0.020)	(0,2)	4.167	0.163 (0.686)	9.835** (0.043)	(1,2)	4.085	4.318 (0.229)

Note: *, ** and *** are significance at 10, 5 and 1% levels, respectively; p-values are in parentheses

This means that the alternative of no unit roots is not rejected in all data samples, thus, supporting a stationary time-series data. The minimum value of the Akaike Information Criterion (AIC) was applied for identifying the orders of the ARMA models. The Lagrange Multiplier (LM) test was also utilized to determine serial correlation, and results showed that the null hypothesis cannot be rejected for all of the returns, which means that all real GDP growth rates have no serial correlation. Furthermore, the autoregressive conditional heteroscedasticity LM test (ARCH-LM) was also used for testing the ARCH effect in the model (Engle, 1982). Initially, the null hypothesis of no ARCH effects for all data samples was not rejected, which requires the application of GARCH filters to solve the problem of heteroscedasticity. The minimum values of the AIC were also applied for identifying the orders of GARCH models. The final test determined that all real GPD growth rate of the ASEAN-5 are free from heteroscedasticity, because the last ARCH-LM tests yield insignificant results.

4.1 Lagged innovations, volatility clustering and leverage effects

Appendix A, B, and C compare the findings of ARMA-GARCH, ARMA-EGARCH and ARMA-APARCH in determining the effects of lagged returns and volatilities, and the presence of leverage asymmetric volatility effects. Majority of the estimated values show that significant lagged mean returns of a_n and θ_n and lagged conditional variance values of a_n and ψ_n. These outcomes suggest that both the models agree on the existence of the effect of previous growth rates on current innovations. The ARMA-EGARCH models determined the leverage effects phenomenon with the significant negative values of the delta (δ) parameters, except for the growth rates of Singapore. The study concludes that real GDP growth rates are prone to slower growth in greater uncertainty brought about by increased volatility in times of negative economic fundamentals. The results are also consistent with the findings of Fama (1965), Engle (1982) and Koutmos et al. (1994) in their study of volatility clustering. However, this was not strongly corroborated by the ARMA-APARCH models where almost all of the data were insignificant with the exception of the Philippines. The real GDP growth rate of the country has a negative gamma (γ) coefficient, which implies that the economy is resilient to negative shocks. According to Bloomberg, Philippines post the strongest of GDP growth, which rose 7.2 percent in 2013 after gaining 6.8 in the previous year. And base on the reports of the Wall Street journal, the country's growth is racing ahead of its neighbor. The Philippines' economy is outpacing others with the fastest growth rate among major economies in East Asia after China, because the country is becoming more attractive for investments. Philippines grew its domestic production, and has outplayed India as the leading destinations for contact centers. Filipinos speak English fluently with low-wage workers that appeals to the large multinational companies to expand their operations inside the country.

4.2 Spillover effect or returns result

This research through ARMA-GARCH, ARMA-EGARCH and ARMA-APARACH models determine whether the real GDP growth rate of one country positively or negatively affects the other country, and vice versa. Appendix D found that Indonesia has a negative unilateral effect on Malaysia's growth using the ARMA-APARCH models. This paper posits that Indonesia is a huge competitor of Malaysia in terms of tourism. Both countries have a number of disputes regarding cultural claims. For example, just recently in 2009, the Pendet Controversy sparked, wherein a tourism advertisement promoting Malaysia featured Balinese Pendet dancers, which caused anger in Indonesia. For example, just recently in 2009, the Pendet Controversy sparked, wherein a tourism advertisement promoting Malaysia featured Balinese Pendet dancers, which caused anger in Indonesia. Indonesia and Malaysia's relationship is rocky due to issues on overseas worker issues and migration concerns. Also, the two countries are having territorial disputes, however Panda (2015) stated that Indonesia and Malaysia will appoint Special envoys to help resolve the issue on the maritime borders. According to Dominguez (2015), both countries are trying to solve these problems and improve their relationship through the Indonesia-Malaysia bilateral trade relations, which focuses on economic relationships on trade and investments. Indonesia and Malaysia's relationship is rocky due to issues on overseas worker issues and migration concerns. According to Dominguez (2015), both countries are trying to solve these problems and improve their relationship

through the Indonesia-Malaysia bilateral trade relations, which focuses on economic relationships on trade and investments.

Indonesia and the Philippines have strong positive bilateral relations on each other's growth rates based on the specifications of the three models applied. Bartolome (2012) explains this phenomenon as the product of 62-year long standing economic and diplomatic relations between the two countries. Indonesia and Philippines cooperate with each other in different fields such as tourism, terrorism, education, food, energy and protection of migrant workers. Both countries continue to strengthen their cooperation in formulating strategies to mitigate extremist Islamic terrorism that are plaguing both countries for decades. This paper recommends that Indonesia and the Philippines continue to strengthen this relationship, to further promote tourism and investments that can help to boost the economy of both countries.

The economy of Indonesia consistently has a one-way positive effect on the growth rate of Singapore based on the three models. The paper posits that Indonesia's non-oil and gas exports to Singapore, which is the highest in the Asian region, has a great help in fueling the Singaporean economy. According to the Asia News Network, Indonesia is trying to enhance its cooperation and partnership with Singapore, and trying to increase more foreign direct investments from Singapore, which is currently at $2 billion. Based on the Observatory of Economic Complexity (OEC), Indonesia serves one of the top 5 export destinations of Singapore with trading volume reaching $26 Billion. It is recommended that both countries maintain good economic trading relations with each other, in particular, Indonesian government can provide incentives like reduced tariffs and tax holidays for Singaporean investments.

Thailand's real GDP growth rate consistently has one-way positive return relationship on Indonesia for the three models. According to the economic website OEC, Indonesia is one of the major export destinations of Thailand, which amounts to $11 billion. Over the past three years, Indonesia and Thailand's average annual trading volume increases by as much as 53.79% with Thailand achieving a surplus of over $1.67 billion. According to Battaya Mail, Thailand and Indonesian trade relations can be further strengthened by bilateral cooperation through trade and investments. On one hand, based on the specifications of ARMA-GARCH and ARMA-APARCH models Indonesia has a negative return relationship on Thailand's real GDP growth. This paper thinks that this is because of strong competition that's existing between the two economies. For example, James et al. (2004) explored the implications of Free Trade Agreement (FTAs) between Thailand and the United States and Thailand and Japan for Indonesian's trade. The findings showed that in the apparel sector, Indonesia is relatively more competitive than Thailand in the period of the financial crisis, while Thailand has a comparative advantage on office and computing machinery as well as electrical machinery than Indonesia. Thailand competes directly with Indonesia in many products for U.S. and Japan. Japan's imports from both countries are relatively concentrated in natural-based resources. Both countries compete in six textile and apparel products. These products are accounted for $371.9 million for Indonesia while $215 million for Thailand in 2003. While for U.S, it is heavily concentrated in textile and apparel manufacturers. These products are accounted for $2.75 billion in export for Indonesia while $2.8 billion in export for Thailand.

The real GDP growth rates of the Philippines and Singapore consistently have unilateral positive return relationship on Malaysia's economy for the three models. According to the Manila Bulletin, Philippines and Malaysia have strong trading relations with each other. Malaysia is Philippines' 11th largest trading partner with a total trade value of $3.5 billion and also 10th largest import source for Philippines. On one hand, Kok (2013) states that Singapore and Malaysia's bilateral relations are getting better. Both countries have been each other's core trading partners for many years. Singapore is one of the largest trading partners of Malaysia and vice versa. By improving the relationship of both countries, each can benefit in maximizing the economic advantages that each country can offer. This also brings more global competitiveness in the region, and lessens impacts of global economic uncertainties. Malaysia, however, has a negative return relationship on Philippines' real GDP growth based on the ARMA-EGARCH models. The research again posits that this is because of competition existing between the two economies. Suntharalingam et al. (2011) assessed the competitiveness of Malaysia's fruits against other ASEAN exporters (Philippines, Thailand, Indonesia and Singapore) to China and India in the global market. Their findings show that Malaysia has more advantage in exporting watermelon and papaya, while Philippines has more competitive advantage in exporting banana and pineapple over the other ASEAN countries.

Thailand's economy has consistent negative unidirectional relationship on the real GDP growth rate of Malaysia for the three models. The paper believes that this is because of the dominance of Thailand in the rice exports, which they share with Vietnam; while Malaysia experienced rice crisis in 2008. Malaysian authorities also are keeping their protectionist policies on rice through price controls, subsidies and tariffs. Vengedasalam et al. (2011) analyzed the welfare effects of eliminating the major government interventions in Malaysia's rice sector, and found that despite the decline in consumer and producer welfare, the net welfare increased as well as the government revenue as the result of removing of the subsidies and trade barriers.

The paper recommends that the Malaysian government strengthen their rice production sector in order to compete or completely rely on rice imports, and use the land originally designated to rice production on other agricultural products like palm oil. On the other hand, Malaysia has a one-way positive return on Thailand's real GDP growth rate based on the ARMA-EGARCH models. Sarmidi and Salleh (2011) explained that this is because of the dynamic relationship between trade, tourism and economic growth for Malaysia and Thailand, and other ASEAN countries.

Singaporean real GDP growth rate consistently has a positive one-way relationship on the real GDP growth rates of the Philippines according to the specifications of the three models. According to a Philippine newspaper Philstar, Singapore and Philippines are going to strengthen bilateral ties with each other, particularly on security and defense cooperation. The two countries are also discussing about the Philippines- Singapore Action Plan which strengthens economic cooperation by including trade and investments, information technology, education, tourism facilities and agri-business. The Philippine economy on the other hand consistently has a negative one-way relationship on the real GDP growth rates of Singapore based on the three models. The paper believes that although, the two countries has good economic relations, it can't reach its full potential due to the political tensions that happened in the past regarding the treatment of Filipino

migrant workers in Singapore, aggravated by the execution of a Filipino worker in Singapore.

Philippines' has a constant one-way positive effect on the growth rate of Thailand for the three models. Nopakun (2011) stated that aside from the economic relations of the Philippines and Thailand, the two economies are also strengthening their cultural relations through education. Thai students are pursuing their education in Philippine universities to experience English-taught courses, and to learn about new agricultural techniques. If Philippines and Thailand can improve their relationship through education, Philippine schools will have steadier supply of enrollees, while Thai students are learning relatively cheaper English curriculum compared to western countries. On one hand, Thailand has a one-way negative relationship with the Philippines for ARMA-EGARCH models. The paper posits that Thailand is the biggest threat and competition of any ASEAN country like the Philippines in terms rice exports. Thailand is enjoying a relatively bigger market share in its rice export industry. According to Bloomberg (2012) Thailand is the world's biggest rice exporter. Thailand started to buy rough rice from farmers at above market rates to lift the domestic prices and rural incomes. Thailand will export 8 million tonnes of milled rice in 2012 to 2013 that surpasses India and Vietnam.

Thailand has a consistent unidirectional positive relation to Singapore's real GDP growth rate for three models. The research thinks that this is because of the stronger institutional links such as the Civil Service Exchange Program (CSEP) and the Singapore-Thailand Enhanced Economic Relations (STEER) program. Singapore is Thailand's fifth trading partner and is one of the most important among Southeast Asian countries; and for Thailand, Singapore is the second largest labor market for Thai workers. The paper recommends that economic and trading relations continue, and the Thai government should improve the training on Thai workers for them to be more competitive in the Asian and global markets.

4.3 Spillover effect or volatilities results

Appendix E shows the volatility relationship of each of the ASEAN-5 countries' real GDP through the ARMA-GARCH, ARMA-EGARCH and ARMA-APARACH models. The paper found that there were no positive nor negative significant relations for all of the countries in the ARMA-APARCH models. However, for both ARMA-GARCH and ARMA-EGARCH models, the Philippines has a negative volatility relationship to Indonesia. Indonesia has a positive volatility impact on the Philippines using the ARMA-EGARCH models, which is more expected because of the 62-year long standing economic and diplomatic relations between the two countries as explained by Bartolome (2012).

Indonesia has a negative volatility relation with Singapore for ARMA-GARCH models, while Singapore has a positive volatility relationship with Indonesia for ARMA-EGARCH models. The paper posits that this is because Indonesia serves as one of the top 5 export destinations of Singapore based on the study of the OEC. The real GDP growth of Indonesia, on one hand has a consistent positive volatility relationship with Thailand's economy for both ARMA-GARCH and ARMA-EGARCH models. This can be attributed to the consistent increase in the amount of trading volume between Indonesia and Thailand as per the observations made by the OEC.

Malaysia's positive volatility relationship with Singapore for ARMA-EGARCH models, and its positive volatility relationship with Thailand for ARMA-GARCH models are a product of strong economic relations between these economies. On the other hand, Singapore has a negative volatility relationship with Philippines for ARMA-EGARCH models. The paper posits that this can be due to the tainted political relationship of the two countries because migrant workers concerns. The Philippines has a one-way positive volatility relationship to Thailand based on the ARMA-GARCH models, which is explained by the strong economic and cultural relations between the two countries. However, Thailand's volatility relationship with Philippines for ARMA-GARCH models is negative, which can be attributed to Thailand's strong position on rice export, which threatens rice production of the Philippines. Lastly, Singapore has a consistent one-way negative relation to Thailand for both ARMA-GARCH and ARMA-EGARCH models. Although, past studies regarding volatility relation of Singapore and Thailand are scarce, Wongkhae et al. (2012) explained this negative relationship through tourism growth rate using GARCH model. The study found that both Singapore and Thailand's tourism are a substitute good for each other, which means that Thailand is a competitor of Singapore in the sector much like with other ASEAN economies.

Collectively, the above phenomenon of ASEAN market integration was already proven in the literature of Ardliansyah (2012), which found that Indonesia, Malaysia, Singapore and Thailand have market co-integrations. Yoo (2006) examined the relationship in terms of electricity consumption and economic growth among four major ASEAN economies, and showed both bi-directional and uni-directional causalities. Moreover, Guidi and Gupta (2012) found that the Indonesian stock market's negative shock is the largest among ASEAN-5 stock markets. A recent study of Balli et al. (2014) showed that volatility spillover effects of local and global shocks on ASEAN sectors equity returns have been decreasing, while production and industries group sectors and the food and beverage sectors have been increasing.

5. CONCLUSION AND LIMITATIONS

This research determines economic relations using real GDP among the ASEAN-5 economies: Indonesia, Malaysia, Philippines, Singapore and Thailand. Using three different combinations of models: ARMA-GARCH, ARMA-EGARCH and ARMA-APARCH models, results show that leverage effects and symmetric volatility are present; and there are existing positive and negative growth rate and volatility spillovers among these countries. Most economies except for the insignificant values of Singapore are consistent with the leverage effects phenomenon, while the Philippines showed strong economic resilience with having symmetric volatility response, which is attributed with the consistent resilient growth rate that the economy is experiencing right now. One specific strong connection was experienced by Indonesia and the Philippines with strong positive bilateral relations on each other's growth rates based on the specifications of the three models applied.

The paper concludes that this phenomenon is the product of long economic and diplomatic relations between the two countries. On one hand, Thailand's economy has consistent negative one-way relationship on Malaysia's economy for the three models. The research believes that this is because of trade competition, wherein Thailand dominates on the rice exports, while Malaysia is lagging on its production of rice and has

for a time experienced rice crisis. The study recommends that the Malaysian government strengthen their rice production sector in order to compete or completely rely on rice imports. These types of positive and negative relations are existing from the other real GDP relations of this study, and supports earlier studies like that of Ardliansyah (2012), which found that Indonesia, Malaysia, Singapore and Thailand have market co-integrations. Findings on the dependence, co-dependence and at times rivalry among ASEAN economies pose huge economic significance by strengthening and expanding economic relations in terms of dependence and co-dependence, or developing local competencies in order to better compete with ASEAN rivals.

This paper suggests that ASEAN economies work together to improve bilateral relations and market integration by trading and investing; and cooperation in terms of food production and migrant workers condition. This will help to reinforce their economic and political relationships that can help boost their respective economies, and sense of regionalism. ASEAN should help each other by sharing their ways to improve the standards of living of their citizens, promotion of safer security and anti-terrorism activities, provide a safer place for the national and overseas workers, trade goods and sell in competitive prices, improve the level of education inside the country. This paper can help policy-makers and researchers alike in better understanding economic relations and spillover effects of growth rates and volatility of real GDP. The paper offers further examination of the potential for further connection among the major ASEAN economies and to support existing integration policies.

This paper only talks about the ASEAN-5 countries and their trade and economic relations. Future studies can further extend their data to include other ASEAN countries like Brunei, Myanmar and Cambodia; and also consider other political and economic organizations like the North American Free Trade Agreement, European Free Trade Association or the Economic Community of West African States. Another limitation is that, although the ASEAN as a whole is one of the successful regional grouping in the developing world, it is still yet to be known if these ASEAN-5 economies will have a great effect not only within the other major countries but to the other regional groupings or to specific countries. Future research can consider the relationship of ASEAN economies to other developed and developing countries or group of countries.

The Asian financial crisis of 1997 and the recent Subprime mortgage crisis of 2008 could have been good opportunities for structural break tests; however, dividing the data would leave the other half unfit for conclusive results because of a very short timeline. In terms of the methodologies used, the study provides an initial step of determining return and volatility characteristic and identifying co-movements, however, this paper did not consider adding forecasting processes and specifically identify the type of forecast (i.e., one-step ahead, two-step ahead forecasts, and its extensions) suitable for the given set of time-series. This can be considered in the future and a viable extension of this paper.

REFERENCES

Andersen, T.G. and Bollerslev, T. (2012) Answering the skeptics: Yes, standard volatility models do provide accurate forecasts. *International Economic Review,* 39, 885-905.

Ardliansyah, R. (2012). Stock market integration and international portfolio diversification between U.S. and ASEAN equity Markets (Master's Thesis). Available from Munich Personal RePEC Archive. (MPRA Paper No. 41958)

Azman-Saini, W. N. W., Azali, M., Habibullah, M. S., & Matthews, K. G. (2002). financial integration and the ASEAN-5 equity markets. *Applied Economics, 34,* 2283-2288. doi: 10.1080/0003684021013936

Baillic, Richard T., & Bollerslev, Tim. (1992). Prediction in dynamic models with time-dependent conditional variances. *Journal of Econometrics,* 52(1-2), 91-113.

Balli, F., Balli, H. O., & Luu, M. N. (2014). Diversification across ASEAN-wide sectoral and national equity returns. *Economic Modelling, 41,* 398-407.

Bollerslev, T. (1990) Modeling the coherence in short-run nominal exchange rates: A multivariate generalized ARCH model. *Review of Economics and Statistics,* 72, 498-505.

Bollerslev, T., Chou, R., & Kroner, K. (1992). ARCH modeling in finance: A selective review of the theory and empirical evidence. *Journal of Econometrics*, 52, 5-59.

Click, R. W., & Plummer, M. G. (2005). Stock market integration in ASEAN after the Asian financial crisis. *Journal of Asian Economics,* 16(1), 5-28.

Daal, E., Naka, A., & Sanchez, B. (2005). Re-examining inflation and inflation uncertainty in developed and emerging countries. *Economics Letters,* 89(2), 180-186.

Engle, R. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation. *Econometrica,* 50, 987-1007.

Guidi, G. (2012). Forecasting volatility of the ASEAN-5 stock markets- a nonlinear approach with non- normal errors 1-18.

Ho, K. Y., & Tsui, A. K. C. (2004). Analysis of real GDP growth rates of greater China: An asymmetric conditional volatility approach. *China Economic Review,* 15(4), 424-442.

Horng, W.J. (2009). A DCC analysis of two stock market returns volatility with an oil price factor: An evidence study of Singapore and Thailand's stock markets. *Journal of Convergence Information Technology,* 4(1), 63-69.

Hossenidoust, E., Janor, H., Yusefi, M., Majid, H. A., & Ja'afar, R. (2013). Volatility spillovers across commodity and stock markets among ASEAN countries. 1401-1412.

Hussin, F., & Saidin, N. (2012). Economic growth in ASEAN-4 countries: A panel data analysis. *International Journal of Economics and Finance,* 4(9), 119-129.

James, N. Associates Inc. (2004). Comparative advantage in Thailand and Indonesia and Thailand's free trade agreements: Potential diversion of Indonesian exports comparative. 1-19.

Janor, H., Ali, R., & Shaharudin, R. S. (2007). Financial integration thorugh equity markets and the role of exchange rate: Evidece from ASEAN-5 countries. *Asian Academy of Management Journal of Accounting and Finance,* 3, 77-92.

Jiranyakul, K., & Opiela, T. P. (2010). Inflation and inflation uncertainty in the ASEAN-5 economies. *Journal of Asian Economics,* 21(2), 105-112.

Kueh, J. S.-H., Puah, C.-H., & Mattias, M. L. (2010). Economic integration between ASEAN+5 Countries: Comparison of GDP (Master's Thesis). Available from Munich Personal RePEC Archive. (MPRA Paper No.31764)

Laurenceson, J. (2003). Economic integration between China and the ASEAN-5. *ASEAN Economic Bulletin,* 20, 103-111.

Liu, L. (2007). Volatility and mean spillover from US and China to ASEAN (Master's Thesis). Available from Lund University Publications

Narayan, P. K., Narayan, S., & Smyth, R. (2009). Understanding the inflation–output nexus for China. *China Economic Review,* 20(1), 82-90.

Naseem, N.A.M, Tan, Hui-Boon, & Hamizah, M.S. (2008). Exchange rate misalignment, volatility and import flows in Malaysia. *Inernational Journal of Economics and Management,* 3(1), 130-150.

Phuan, Sew-Ming, Lim, Kian-Ping, & Ooi, Ai-Yee. (2009). Financial Liberalization and Stock Markets Integration for ASEAN-5 Countries. *CCSE Journals Online,* 2, 100-111.

Sarmidi, S. (2010). Dynamic inter-relationship between trade, economic growth and tourism in Malaysia. *Int. Journal of Economics and Management,* 5(1), 38-52.

Suntharalingam, A., Ali, Rusli, Halim. (2011). Competitiveness of Malaysia's fruits in the global agricultural and selected export markets: Analyses of revealed comparative advantage (RCA) and comapartive export performance (CEP). *Economic and Technology Maagement Review,* 6, 1-17.

Vengedasalam, H., MacAulay. (2011). Malaysian rice trade and government interventions.
1-19.

Wang, Y. and Wu, C. (2012) Forecasting energy market volatility using GARCH models: Can
multivariate models beat univariate models?. *Energy Economics,* 34, 2167-2181.

Wongbangpo, P., & Sharma, S. C. (2002). Stock market and macroeconomic fundamental dynamic interactions: ASEAN-5 countries. *Journal of Asian Economics,* 13(1), 27-51.

Wongkhae, S., & Chokethaworn, C. (2012). Modeling the tourists demand to Thailand and Singapore: A copula based GARCH approach. 102-124.

Yoo, S. H. (2006). The causal relationship between electricity consumption and economic growth in the ASEAN countries. *Energy Policy,* 34(18), 3573-3582.

Yu, I.-W., Fung, K.-P., & Tam, C.-S. (2010). Assessing financial market integration in Asia – Equity markets. *Journal of Banking & Finance,* 34(12), 2874-2885.

Appendix A: Lagged innovations and volatility asymmetry in ASEAN-5 using ARMA-GARCH models.

List of ASEAN-5 Countries		Model	Mean Equation					Conditional Variance Equation				
			α_0	α_1	α_2	θ_1	θ_2	a_0	a_1	a_2	ψ_1	ψ_2
Indonesia		ARMA(2,2)-GARCH(2,0)	1.310*** (0.000)	-0.703*** (0.000)	0.235 (0.217)	0.532*** (0.001)	-0.618*** (0.000)	0.291*** (0.000)	1.472*** (0.000)	-0.583 (0.166)		
Malaysia		ARMA(1,2)-GARCH(2,2)	0.952*** (0.000)	0.785*** (0.000)		-0.680*** (0.000)	-0.297*** (0.004)	1.230** (0.051)	0.093 (0.757)	-0.041 (0.833)	-0.019 (0.862)	0.650** (0.019)
Philippines		ARMA(0,2)-GARCH(2,1)	0.628*** (0.009)			-1.240*** (0.000)	0.814*** (0.000)	48.243*** (0.000)	0.218** (0.024)	-0.932*** (0.000)	-0.093 (0.147)	
Singapore		ARMA(0,2)-GARCH(1,1)	1.359*** (0.000)			-0.070 (0.362)	-0.096 (0.274)	0.315 (0.211)	1.082*** (0.000)		-0.115** (0.046)	
Thailand		ARMA(0,2)-GARCH(1,2)	0.813*** (0.000)			-0.135 (0.198)	-0.320*** (0.001)	0.200 (0.556)	1.096*** (0.000)		-0.222** (0.015)	0.079 (0.314)

Note: *, ** and *** are significance at 10, 5 and 1% levels, respectively; p-values are in parentheses

Appendix B: Lagged innovations and volatility asymmetry in ASEAN-5 using ARMA-EGARCH models.

List of ASEAN-5 Countries	Model	Mean Equation					Conditional Variance Equation					
		α_0	α_1	α_2	θ_1	θ_2	a_0	a_1	a_2	ψ_1	ψ_2	(δ)
Indonesia	ARMA(2,2)-EGARCH(1,0)	1.313*** (0.000)	-0.378*** (0.000)	-0.602*** (0.000)	-0.752*** (0.000)	0.397*** (0.000)	0.292 (0.177)	0.566*** (0.000)				-1.617*** (0.000)
Malaysia	ARMA(1,2)-EGARCH (1,2)	0.908*** (0.000)	0.733*** (0.000)		-0.758*** (0.000)	-0.227*** (0.007)	0.099 (0.830)	0.252 (0.152)		-0.396 (0.292)	0.985** (0.012)	0.653*** (0.007)
Philippines	ARMA(0,2)-EGARCH (1,1)	0.795*** (0.000)			-1.172*** (0.000)	0.551*** (0.000)	3.084*** (0.000)	0.216 (0.266)		-0.843** (0.029)		-0.840*** (0.000)
Singapore	ARMA(0,2)-EGARCH (2,1)	1.137*** (0.000)			0.179* (0.069)	-0.029 (0.707)	3.526*** (0.000)	-0.210* (0.097)	-0.738*** (0.000)	0.660** (0.012)		-0.145 (0.251)
Thailand	ARMA(0,2)-EGARCH (2,0)	1.054*** (0.000)			-0.074 (0.307)	-0.378*** (0.000)	2.361*** (0.000)	-0.180*** (0.000)	-1.044*** (0.000)			-0.247*** (0.002)

Note: *, ** and *** are significance at 10, 5 and 1% levels, respectively; p-values are in parentheses.

Appendix C: Lagged innovations and volatility asymmetry in ASEAN-5 using ARMA-APARCH models.

List of ASEAN-5 Countries	Model	Mean Equation					Conditional Variance Equation					
		α_0	α_1	α_2	θ_1	θ_2	a_0	a_1	a_2	ψ_1	ψ_2	(γ)
Indonesia	ARMA(2,2)-APARCH (0,2)	1.387*** (0.000)	-0.672* (0.103)	0.303 (0.446)	0.572 (0.116)	-0.427 (0.326)	1.251 (0.618)	5.841 (0.566)		0.001 (0.999)	0.596 (0.546)	0.576 (0.998)
Malaysia	ARMA(1,2)-APARCH(2,2)	0.940*** (0.000)	0.700*** (0.000)		-0.662*** (0.000)	-0.318*** (0.002)	0.991** (0.037)	0.249 (0.498)	-0.133 (0.713)	-0.124 (0.844)	0.548*** (0.005)	0.996 (0.884)
Philippines	ARMA(0,2)-APARCH(1,1)	0.671*** (0.000)			-1.114*** (0.000)	0.497*** (0.000)	2.287*** (0.000)	0.490** (0.019)		-0.339*** (0.002)		-0.977*** (0.000)
Singapore	ARMA(0,2)-APARCH(1,1)	1.263*** (0.000)			-0.063 (0.520)	-0.100 (0.292)	6.755*** (0.003)	-0.494*** (0.000)	-0.860*** (0.000)	0.406*** (0.001)	0.046 (0.675)	0.022 (0.866)
Thailand	ARMA(0,2)-APARCH(1,1)	0.740*** (0.000)			-0.221*** (0.009)	-0.289*** (0.002)	0.827 (0.288)	0.916*** (0.000)		-0.064*** (0.004)		0.747 (0.350)

Note: *, ** and *** are significance at 10, 5 and 1% levels, respectively; p-values are in parentheses.

Appendix D: Spillover effects of returns for ASEAN-5 countries.

List of ASEAN-5 Return Pairings	Spillover Effects of Returns					
	ARMA-GARCH		ARMA-EGARCH		ARMA-APARCH	
	1st country	2nd country	1st country	2nd country	1st country	2nd country
Indonesia/Malaysia	0.068 (0.257)	-0.051 (0.401)	0.018 (0.590)	-0.084 (0.257)	-0.030 (0.685)	-0.083** (0.041)
Indonesia/ Philippines	0.151*** (0.000)	1.690*** (0.000)	0.140*** (0.000)	1.472*** (0.000)	0.170*** (0.000)	0.866*** (0.000)
Indonesia/ Singapore	-0.001 (0.996)	0.236** (0.022)	0.030 (0.141)	0.267*** (0.000)	0.044 (0.555)	0.232** (0.023)
Indonesia/ Thailand	0.319* (0.067)	-0.109* (0.069)	0.323* (0.100)	-0.068 (0.500)	0.326* (0.081)	-0.122* (0.061)
Malaysia/ Philippines	0.041*** (0.002)	-0.119 (0.334)	0.029* (0.061)	-0.178*** (0.000)	0.034** (0.019)	0.001 (0.995)
Malaysia/ Singapore	0.194*** (0.000)	-0.061 (0.670)	0.181*** (0.003)	-0.055 (0.661)	0.172** (0.018)	-0.019 (0.896)
Malaysia/ Thailand	-0.221*** (0.003)	0.037 (0.720)	-0.208*** (0.000)	0.138* (0.079)	-0.221*** (0.001)	-0.040 (0.776)
Philippines/ Singapore	0.591*** (0.000)	-0.152*** (0.000)	0.265*** (0.000)	-0.153*** (0.000)	0.612*** (0.000)	-0.141*** (0.000)
Philippines/ Thailand	-0.017 (0.922)	0.056*** (0.000)	-0.206** (0.011)	0.035** (0.032)	0.377 (0.139)	0.053*** (0.002)
Singapore/ Thailand	0.470*** (0.002)	0.023 (0.782)	0.407*** (0.002)	0.044 (0.541)	0354*** (0.003)	0.029 (0.596)

Note: *, ** and *** are significance at 10, 5 and 1% levels, respectively; p-values are in parentheses.