THE CONTAGION EFFECTS ON CHINA AND ASEAN COUNTRIES
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ABSTRACT

This study aims to fill a gap in the current literature by studying dynamic and interdependent relationship among real economic sectors and financial markets with the country and across countries, and determining which channels of contagion are the most significant in transmitting crises among countries. The question of this research is to investigate whether the recent crisis have the fundamental effects, the contagion effects or through China market in the case of 2nd round effects on ASEAN economy. And examining further how the fluctuation in China can transmits the fundamental effects or contagion effects to ASEAN economy.

This study attempts to answer the questions by multivariate methods using Vector Autoregressive (VAR) models with simple Cholesky decomposition as a restriction and Structural Vector Autoregressive (SVAR) models with contemporaneous restriction, then, solve for the existent of contagion effect. This paper tests for the presence of non-linearity in propagation of contagion among countries by using the heteroskedasticity and non-normality of the residuals. The residuals are from that VAR model to identify unexpected shocks that may be transmitted across countries, which are consider as the evidence of contagion. There are the evidence of financial contagion in US and EU stock market in two-way causality. ASEAN stock market is influenced by US, China and EU stock market also. The result reveals the existence of trade contagion effects among China and ASEAN countries in two-way causality, US and EU countries in two-way causality.

Keywords – Contagion effect, financial contagion, trade contagion, VAR, SVAR
JEL Classification: C58, F15, F36, G01

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1. INTRODUCTION

1.1 Statements of the problem

The issue of contagion has been one of the most interested topics in international finance. Contagion is an expression of the phenomenon that the crises or shock are spread to other countries which is borrowed from epidemiology where it’s defined as transmitting a disease by direct or indirect contact. Hence, Financial Contagion refers to the transmission of a disease, that is, the shocks of the financial market in one country are transmitted to financial markets in other countries.

There are several studies that tried to explain the reasons of these financial setbacks and the mechanisms of their spread across the globe. The negative effects were induced by the subprime crisis may wonder about the existence of a contagion phenomenon across different financial markets worldwide. It is necessary to define the notion of contagion which remains hard and complex to identify. Indeed, contagion may be defined as the spread of markets’ turmoils from one country to other financial markets. Economics literature succeeded in identifying several possible mechanisms causing the spread of turmoils from one market to another.

This study aims to fill a gap in the current literature by determining which channels of contagion are the most significant in transmitting crises among countries. The fundamental question of this research is how financial crises are transmitted into ASEAN’s markets and what the main transmission channel that plays an important role for ASEAN economy is. Another question is how crises transmits to ASEAN economy, is that through China market in the case of 2nd round effect which the contagion effect affects China economy and then ASEAN economy. This study attempts to answer the questions by performing the empirical tests.

1.2 Objective of the study

The events unfolding in the past year remind us that we are living in a highly globalized world. And the events that occur in one part of the world can have tremendous impact on market oceans away. This raises important questions about the nature of spillovers and contagion.

1. Investigating whether the recent crisis have the fundamental effects, the contagion effects or the 2nd round contagion effects on Thai economy and ASEAN economy.

2. Examining further how the fluctuation in China can transmits the fundamental effects or contagion effects to ASEAN economy.
2. REVIEW LITERATURE

As noted, the definition of contagion has varied considerably across paper. From the broad definition of contagion by World Bank, contagion can take place both during “good (tranquil)” and “bad (crisis)” times. Nevertheless, the studies of contagion have been emphasized on the during crisis periods. Berg and Pattilo (1998) is defined the financial contagion as a set off unexpected and negative changes in the major macroeconomic fundamentals considered. Eichengreen et al. (1996), Glick and Rose (1998), Kaminsky, Reinhart and Vegh (2003) tend to define contagion as a case of a financial crisis on the rest of the world increasing the probability of a domestic crisis. According to Masson (1998) and Forbes and Rigobon (1999), contagion refers to the spread of market disturbances, mostly on the downside, from one country to other and observed through co-movements of different financial indices such as in exchange rates, stock prices, sovereign spreads and capital.

Other main interesting of contagion studies is the transmission channels of financial contagion that can occur in different causes. The transmission channels of financial contagion can divide into fundamental based contagion and pure contagion. This discrimination was presented by Kaminsky and Reinhart (2000). Fundamental based contagion implies a spread of shocks due to trade links, macroeconomic similarities or financial links. Pure contagion implies to a spread of shocks with another cause such as the behavior of investors or other financial agents.

The first category, Fundamental based contagion, emphasizes spillovers resulting from the normal interdependence among market economics. It’s mean that the shocks will transmit across countries because of their real and financial linkages. There are several analyses of specific transmission channels for contagion which is try to explain the degree of co-movements and mechanisms of transmitting contagion base on some fundamental relationship. The empirical researches attempted to answer why crises spread, how and under what condition crises on a single currency is propagated to other currencies.

There are trade links among countries when they are connected through international trade. An example from The World Bank Group (2001) said that “when two countries trade among themselves or compete in the same foreign markets, a devaluation of the exchange rate in one country deteriorates the other country’s competitive advantage”.

Glick and Rose (1998), Eichengreen and rose (1999) investigated the 1992-1993 European Exchange Rate Mechanism (ERM) crisis, the 1994 Mexican crisis, the 1997 Asian crisis, and the 1999 Brazilian crisis and argued that trade links are the primary channel through which crises transmitted to other countries, mean that, the countries with trade links easily transfer cries to each other. On the other hand Didier, Mauro and Schmukler (2008) argued that although the trade linkage seems to have played a role in the 1990s crises, it does not explain the contagion observed in the 1998 Russian crisis. In conclusion, most empirical studies of previous financial crises agree that trade linkages are important explanatory factors for crisis spillover, especially among developing countries.
In the case of similar macroeconomic structure, investors may rethink before investing in a country that has resemblances with a country in crisis since it is interpreted as an increased risk for their invested capital. Radelet and Sachs (1998), and Kaminsky and Reinhart (2000) found similarities in macroeconomic fundamentals being of particular importance when explaining contagion patterns. If two countries experience weak fundamentals and one of them experiences a financial crisis, there are strong indications that the second country will be the next victim.

There are financial links among countries when they are connected through international financial system. An example from The World Bank Group (2001), “financial links can be distinguished if open-end mutual funds foresee future redemptions after there is a shock in one country. Mutual funds need to raise cash and, consequently, they sell assets in third countries. This mechanism propagates the shock to other economies.” According to Caramazza et al (2004), argued that contagion arises when two countries have the same lender. The authors claim that financial links formed the main channel of transmission of shocks across countries during 1990s. Didier, Mauro and Schmukler (2008) found that financial links appear to be the main transmission channel of the Mexican 1994 crisis. Kaminsky and Reinhart (2000) also advocated financial linkages as a cause of contagion but they state that due to high correlation between trade and financial links, it is a hard task isolating one cause from other.

Many authors found that the fundamental based contagion do not fully explain the relationship among countries. That is the case of pure contagion. There is co-movement that cannot be explained on the basis fundamentals. This type of contagion is caused by irrational phenomena, such as financial panic, herd behavior and loss of confidence which is the result of the behavior of investor or other financial agents.

3. METHODOLOGY

3.1 The set of variable

The set of variables, selected into the model, are mainly from fundamental economic indicator. The selection may not be based on theories but are chosen from observation of phenomenon in the real world. This study attempts to estimate the correlation coefficients between key financial variables across domestic and regional markets, and determines whether the contagion qualifies the pattern of the correlation.

This paper selects the set of variables which are the index of financial markets by using the trade between countries as an economic indicator. Monthly data of 12 endogenous variables and 3 exogenous variables are observed from January 1994 to December 2013 from Datastream. There are 4 variables of stock indices which representing the financial sectors. There are 4 variables of weighted-average of trade volume which representing the real sector. There are 4 variables of the coincident index which representing the macroeconomic similarity. There are 3 variables of the time dummy variables.
3.2 VAR Analysis

The VAR\((p)\)-process is then defined as:

\[
y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + u_t
\]  

(3.2.1)

With \(A_i\) are \((K \times K)\) coefficient matrices for \(i = 1, \ldots, p\) and \(u_t\) is a \(K\)-dimensional process with \(E(u_t) = 0\) and time invariant positive definite covariance matrix \(E(u_t u_t^T) = \Sigma_u\) (white noise).

One important characteristic of VAR\((p)\)-process is its stability. This means that it generates stationary time series with time invariant means, variances and covariance structure, given sufficient starting values. One can check this by evaluating the characteristic polynomial:

\[
\det(I_K - A_1 z - \cdots - A_p z^p) \neq 0 \text{ for } |z| \leq 1.
\]  

(3.2.2)

If the solution of the above equation has a root for \(z = 1\), then either some or all variables in the VAR\((p)\)-process are integrated of order one, i.e., \(I(1)\). It might be the case, that cointegration between the variables does exist.

In practice, the stability of an empirical VAR\((p)\)-process can be analyzed by considering the companion form and calculating the eigenvalues of the coefficient matrix. A VAR\((p)\)-process can be written as a VAR\((1)\)-process:

\[
\xi_t = A \xi_{t-1} + \nu_t
\]  

(3.2.3)

Whereby the dimensions of the stacked vectors \(\xi_t\) and \(\nu_t\) is \((KP \times 1)\) and the dimension of the matrix \(A\) is \((Kp \times Kp)\). If the moduli of the eigenvalues of \(A\) are less than one, then the VAP\((p)\)-process is stable.

For given sample of the endogenous variable \(y_1, \ldots, y_T\) and sufficient presample values \(y_{-p+1}, \ldots, y_0\) the coefficients of a VAR\((p)\)-process can be estimated efficiently by least-squares applied separately to each of the equations.

Assuming interdependent and dynamic relationships among the regional markets, this study employs both VAR methodologies as econometric models in determining their contagion effects. The model is stated as follow:

\[
A_0 X_t = \Gamma_0 + \sum_{i=1}^{p} \Gamma_i X_{t-i} + B \epsilon_t
\]  

(3.2.8)

Pre-multiplying by \(A_0^{-1}\), we get

\[
X_t = A_0^{-1} \Gamma_0 + \sum_{i=1}^{p} A_0^{-1} \Gamma_i X_{t-i} + A_0^{-1} B \epsilon_t
\]  

or

\[
X_t = C_0 + \sum_{i=1}^{p} C_i X_{t-i} + \epsilon_t
\]  

(3.2.9)

\(X_t\) is a \(n \times 1\) vector of variables in the system.
\(A_0\) is a \(n \times n\) invertible matrix of coefficients of contemporaneous variables, which normalizes the elements on main diagonal to 1.

\(B\) is a \(n \times n\) matrix of coefficients that allow some of structural innovations to affect various endogenous variables in the system.

\(\Gamma_0\) is a \(n \times 1\) vector of constants.

\(\Gamma_1\) is a \(n \times n\) matrix of coefficients on lagged variables.

\(\varepsilon_t\) is a \(n \times 1\) vector of uncorrelated white-noise structural innovations.

\(\varepsilon_t\) is a \(n \times 1\) vector of reduced from residuals.

\(p\) is a optimal lag length.

where \(X_t\) is vector of endogenous variables, including fourth macroeconomic variables and fourth financial variables of the fourth regional markets, \(A\) is the coefficient matrix of imposed structural form, and \(\Gamma_1\) is the coefficient matrix of lag endogenous variables. By imposing the structural matrices \(A\), we can visibly study the interdependent and dynamic effects between real economic market and financial markets among three regions both direction and magnitude. For example, this study imposes the effects from real economic sectors of Eurozone countries to ASEAN real economic sectors and financial market, and the effects from real economic sectors of Eurozone countries to ASEAN real economic sectors and financial market.

The structural information of the primitive system can be identified if the appropriate restrictions are imposed in the system. This argument can be shown by examining the variance-covariance matrix of the residual of reduced form model.

The variance-covariance matrix of reduced from of VAR residuals is: 
\[
\Sigma_e = \varepsilon_t \varepsilon_t' = A_0^{-1} B \varepsilon_t \varepsilon_t' (A_0^{-1})' \\
\Sigma_e = A_0^{-1} B \Sigma \varepsilon B' (A_0^{-1})' \\
\Sigma_e = A_0^{-1} BB'(A_0^{-1})' \quad \text{where} \quad \Sigma \varepsilon = \varepsilon_t \varepsilon_t' = I
\]

The variance-covariance matrix of residuals has \(\frac{n^2}{2}\) known values (\(n\) variance and \(\frac{n^2-n}{2}\) covariance). Matrix \(A_0^{-1} BB'(A_0^{-1})'\) has known values on the diagonal (\(n\) values) while the unknown ones are off-diagonal (\(2n^2 - n\) values). This causes the matrix to be identified. To solve this under-identification problem, the restrictions should be added into the system which is not including in the diagonal parameters. Thus, at least \(2^n - n - \frac{n^2+n}{2} = \frac{3n(n-1)}{2}\) restrictions are necessary to be imposed.

4. EMPIRICAL RESULTS

The contagion effect is defined by the presence of nonlinearities in the transmission of country-specific shocks. As Favero and Giavazzi (2002) said test for nonlinearities in the propagation mechanism of country-specific shocks. The first step is to estimate a reduced-form vector autoregressive model and to identify, using dummy variables, large residuals as country-specific shocks. Then, we can test for the existence of contagion.
The estimation of the reduced-form model is the first step of the methodology. Then, large residuals are defined as events and represented by dummy variables. Again, this allows to filter out heteroscedasticity and non-normality. The residuals obtained from VAR model for financial market and real market are analyzing in the table below.

### 4.1 Financial linkage

There are the evidence of heteroskedasticity problem and autocorrelation problem. The residuals of VAR model are heteroskedastic and non-normality since the sample includes episodes of high financial market turbulence. Since I analyzing VAR and consider on financial linkages which is stock indices. There are 4 stock indices that are S&P50, FTSE100, SHAINGHAI SE COMPITE and FTSE AW ASEAN. Also include the all macroeconomic condition of those 4 regions into the model. Then, I use the heteroskedasticity and non-normalities of the residual from VAR model to identify unexpected shocks that may be transmitted across countries which are considered as evidence of contagion.

According to the result, the residuals are heteroskedasticity, as $\chi^2(480)$, takes a value of 677.7565(0.000). The Lagrange-multiplier test for stock market has the null hypothesis that there are no autocorrelation. There are significant in 2 lag order, as 0.01660 and 0.01108. The results of the residuals confirm that there are some autocorrelation.

<table>
<thead>
<tr>
<th>lag</th>
<th>chi2</th>
<th>df</th>
<th>Prob&gt;chi2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.2799</td>
<td>16</td>
<td>0.01660*</td>
</tr>
<tr>
<td>2</td>
<td>31.6578</td>
<td>16</td>
<td>0.01108*</td>
</tr>
<tr>
<td>3</td>
<td>24.5925</td>
<td>16</td>
<td>0.07734</td>
</tr>
<tr>
<td>4</td>
<td>15.201</td>
<td>16</td>
<td>0.50997</td>
</tr>
<tr>
<td>5</td>
<td>7.7414</td>
<td>16</td>
<td>0.95620</td>
</tr>
<tr>
<td>6</td>
<td>11.8418</td>
<td>16</td>
<td>0.75480</td>
</tr>
</tbody>
</table>

H0: no autocorrelation at lag order

Note * indicates the rejection of null hypothesis at 5% significance level, respectively.

Source: Author’s calculation

The residuals obtained from VAR that includes the dummies show neither apparent evidence of correlation, nor the heteroskedasticity which is confirmed by the tests report in Table 4.3.4. These are captured by dummy variables, thereby eliminating heteroskedasticity and non-normality. The relevant evidence to test for non-linearity is the analysis of the significance of the dummies.

The test of the null hypothesis of linearity was obtained by restricting to zero. The effect of dummies for local shocks in all countries rejects the null. The test, distributed as $\chi^2(32)$, takes a value of 400.61(0.000). The test reports the significant results among several dummy variables used as we can see in appendix table 4.3.3. The result shows that there is non-linearity in the propagation of contagion among those members in the past few decades. This confirms the apparent of contagion effect via financial linkages.
Table 4.3.5 reports the results of Granger Causality test on stock market. The result shows that the shock on stock market of US propagated to all other indices except China, which confirmed by the non-linearity of the model. The significant of S&P500 index are on FTSE100 index and AW ASEAN index which support the financial relationship among US, EU and ASEAN. As the table 4.3.5 reports, China is not influenced by anyone.

Table 4.3.5: Granger Causality Wald Test of stock market

<table>
<thead>
<tr>
<th>Equation</th>
<th>Excluded</th>
<th>chi2</th>
<th>df</th>
<th>Prob&gt;chi2</th>
</tr>
</thead>
<tbody>
<tr>
<td>logs_p2</td>
<td>logftse2</td>
<td>16.153</td>
<td>6</td>
<td>0.013*</td>
</tr>
<tr>
<td>logs_p2</td>
<td>logchcomp2</td>
<td>9.8302</td>
<td>6</td>
<td>0.132</td>
</tr>
<tr>
<td>logs_p2</td>
<td>logasean2</td>
<td>8.857</td>
<td>6</td>
<td>0.182</td>
</tr>
<tr>
<td>logftse2</td>
<td>logs_p2</td>
<td>15.191</td>
<td>6</td>
<td>0.019*</td>
</tr>
<tr>
<td>logftse2</td>
<td>logchcomp2</td>
<td>7.1058</td>
<td>6</td>
<td>0.311</td>
</tr>
<tr>
<td>logftse2</td>
<td>logasean2</td>
<td>9.1156</td>
<td>6</td>
<td>0.167</td>
</tr>
<tr>
<td>logchcomp2</td>
<td>logs_p2</td>
<td>8.6443</td>
<td>6</td>
<td>0.195</td>
</tr>
<tr>
<td>logchcomp2</td>
<td>logftse2</td>
<td>3.5873</td>
<td>6</td>
<td>0.732</td>
</tr>
<tr>
<td>logchcomp2</td>
<td>logasean2</td>
<td>8.2102</td>
<td>6</td>
<td>0.223</td>
</tr>
<tr>
<td>logasean2</td>
<td>logs_p2</td>
<td>14.241</td>
<td>6</td>
<td>0.027*</td>
</tr>
<tr>
<td>logasean2</td>
<td>logftse2</td>
<td>23.738</td>
<td>6</td>
<td>0.001*</td>
</tr>
<tr>
<td>logasean2</td>
<td>logchcomp2</td>
<td>13.029</td>
<td>6</td>
<td>0.043*</td>
</tr>
</tbody>
</table>

Note * indicates the rejection of null hypothesis at 5% significance level, respectively.

Source: Author’s calculation

Table 4.3.6: Granger Causality Test of Stock market between Countries

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>EU</th>
<th>China</th>
<th>ASEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>Yes</td>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>EU</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>No</td>
<td>No</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>ASEAN</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Note: Suppose “X Granger-causes Y”. If “Yes” is in the box, then it says that “X Granger-causes Y”. If “No” is in the box, then it says that “X does not Granger-causes Y”.

The results of chi-statistics are listed in the Appendix.

4.2 Real linkage

The residuals of VAR model are heteroskedastic and non-normality since the sample includes episodes of high financial market turbulence. Since I analyzing VAR and consider on real linkages which is trade of US, EU, China and ASEAN countries. I include the variable of macroeconomic condition in to the model which is aggregate macroeconomic variables for US, EU, China and ASEAN. Then, I use the heteroskedasticity and non-normalities of the residual from VAR model to identify unexpected shocks that may be transmitted across countries which are considered as evidence of contagion. According to thr
result, the residuals are heteroskedasticity, as $\chi^2(1152)$, takes a value of 1369.705(0.000). The Lagrange-multiplier test for trade market, as table 4.3.7, has the null hypothesis that there are no autocorrelation. There are significant in 3 lags order, as 0.006, 0.02065 and 0.00029. The results of the residuals confirm that there are some autocorrelation.

Table 4.3.8: Lagrange-multiplier test for trade

<table>
<thead>
<tr>
<th>lag</th>
<th>chi2</th>
<th>df</th>
<th>Prob&gt;chi2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.7495</td>
<td>16</td>
<td>0.0006*</td>
</tr>
<tr>
<td>2</td>
<td>29.5214</td>
<td>16</td>
<td>0.02065*</td>
</tr>
<tr>
<td>3</td>
<td>42.8899</td>
<td>16</td>
<td>0.00029*</td>
</tr>
<tr>
<td>4</td>
<td>18.8263</td>
<td>16</td>
<td>0.27777</td>
</tr>
<tr>
<td>5</td>
<td>8.845</td>
<td>16</td>
<td>0.91966</td>
</tr>
<tr>
<td>6</td>
<td>16.352</td>
<td>16</td>
<td>0.42868</td>
</tr>
</tbody>
</table>

H0: no autocorrelation at lag order

Note * indicates the rejection of null hypothesis at 5% significance level, respectively.

Source: Author’s calculation

The residuals obtained from VAR that includes the dummies show neither apparent evidence of correlation, nor the heteroskedasticity which is confirmed by the tests report in Table 4.3.9. As $\chi^2(1728)$, takes a value of 1752.379(0.3358), the test rejected the null hypothesis that the residual of VAR is heteroskedastic. These are captured by dummy variables, thereby eliminating heteroskedasticity and non-normality.

The relevant evidence to test for non-linearity is the analysis of the significance of the dummies. The test of the null hypothesis of linearity was obtained by restricting to zero. The effect of dummies for local shocks in all countries rejects the null. The test, distributed as $\chi^2(32)$, takes a value of 70.43(0.001). The test reports the significant results among several dummy variables used as we can see in appendix. The result shows that there is non-linearity in the propagation of contagion among those members in the past few decades.

Granger-causality may not tell us the complete story about the interactions between the variables of a system. It shows the response of one variable to an impulse in another variable in a system that involves a number of further variables. Table 4.3.10 reports the results of Granger Causality test on real linkages. From the results, there are 2 pairs of two-way causality relation among trade channel which are between US trade and EU trade, between China trade and ASEAN trade. Moreover, there are the influence from US trade to China trade and EU trade to ASEAN trade. We can see from the significance of eucoinin to usto (0.024), uscoinin to eutot (0.012), chcoinin to aseantot (0.030), aseancoinin to chtot (0.047), uscoinin to chtot (0.059) and eucoinin to aseantot (0.041).

It can be found out from table 4.3.10 that ASEAN trade has an obvious affect upon the trade of China. The result directly supports the close economic relationship between US, China and ASEAN countries in the way that there is some contagion effect from China transmitting to ASEAN countries. For the ASEAN countries, they are affected not only from EU trade but also China trade.
Table 4.3.10: Granger Causality Wald Test of trade

<table>
<thead>
<tr>
<th>Equation</th>
<th>Excluded</th>
<th>chi2</th>
<th>df</th>
<th>Prob&gt;chi2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ustot2</td>
<td>eucoinin2</td>
<td>14.567</td>
<td>6</td>
<td>0.024**</td>
</tr>
<tr>
<td>ustot2</td>
<td>chcoinin2</td>
<td>8.9966</td>
<td>6</td>
<td>0.174</td>
</tr>
<tr>
<td>ustot2</td>
<td>ascoinin2</td>
<td>6.4979</td>
<td>6</td>
<td>0.370</td>
</tr>
<tr>
<td>eutot3</td>
<td>uscoinin2</td>
<td>16.307</td>
<td>6</td>
<td>0.012**</td>
</tr>
<tr>
<td>eutot3</td>
<td>chcoinin2</td>
<td>6.0886</td>
<td>6</td>
<td>0.174</td>
</tr>
<tr>
<td>eutot3</td>
<td>ascoinin2</td>
<td>9.4975</td>
<td>6</td>
<td>0.174</td>
</tr>
<tr>
<td>chtot2</td>
<td>uscoinin2</td>
<td>4.6227</td>
<td>6</td>
<td>0.059*</td>
</tr>
<tr>
<td>chtot2</td>
<td>eucoinin2</td>
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<td>6</td>
<td>0.041**</td>
</tr>
<tr>
<td>chtot2</td>
<td>ascoinin2</td>
<td>12.74</td>
<td>6</td>
<td>0.047**</td>
</tr>
<tr>
<td>ascoinin2</td>
<td>uscoinin2</td>
<td>5.3042</td>
<td>6</td>
<td>0.055</td>
</tr>
<tr>
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<td>eucoinin2</td>
<td>13.141</td>
<td>6</td>
<td>0.041**</td>
</tr>
<tr>
<td>ascoinin2</td>
<td>chcoinin2</td>
<td>7.1621</td>
<td>6</td>
<td>0.030**</td>
</tr>
</tbody>
</table>

Note **, * indicates the rejection of null hypothesis at 10%, 5% significance level, respectively.

Table 4.3.11: Granger Causality Test of Trade between Countries

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>US</th>
<th>EU</th>
<th>China</th>
<th>ASEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>EU</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>ASEAN</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Suppose “X Granger-causes Y”. If “Yes” is in the box, then it says that “X Granger-causes Y”. If “No” is in the box, then it says that “X does not Granger-causes Y”.

The results of chi-statistics are listed in the Appendix.

Source: Author’s calculation

5. CONCLUSION

5.1 Summary

This study attempts to answer the questions by multivariate methods using Vector Autoregressive (VAR) models with simple Cholesky decomposition as a restriction and Structural VAR models with contemporaneous restriction, then, solve for the existent of contagion effect. This paper tests for the presence of non-linearity in propagation of contagion among countries by using the heteroskedasticity and non-normality of the residuals. The residuals are from that VAR model to identify unexpected shocks that may be transmitted across countries, which are consider as the evidence of contagion.

The first step for the VAR estimation is to find the optimal lag lengths. After that I aim to estimate the VAR recursive model with the Cholesky decomposition; the ordering of US stock market variable, EU stock market variable, China stock market variable, ASEAN stock market variable, US aggregate macroeconomic condition variable, EU aggregate macroeconomic condition variable, China aggregate macroeconomic condition variable and
ASEAN aggregate macroeconomic condition variable. Another model estimates the Choleski decomposition the ordering of US trade variable, EU trade variable, China trade variable, ASEAN trade variable, US aggregate macroeconomic condition variable, EU aggregate macroeconomic condition variable, China aggregate macroeconomic condition variable and ASEAN aggregate macroeconomic condition variable. And I employ the non-recursive VAR in the same variable of those 2 models. Then, I confirm the contagion effect by testing the heteroskedasticity and autocorrelation problem. There is the heteroskedasticity problem in those 2 models, after that, I apply the time dummy variables which captured the crisis period into the models. I repeat to estimates the models with the dummy variables. Then, large residuals are defined as events and represented by dummy variables. This allows to filter out heteroscedasticity and non-normality. Then, we can test for the existence of contagion.

The results show that there is non-linearity in the propagation of contagion among those countries in the past few decades. There are the evidence of financial contagion in US and EU stock market in two-way causality. ASEAN stock market is influenced by China, US and EU stock market. But China has not the impact from other countries and the Forecast error variance decomposition also shows that the largest part of China stock market is influenced by itself. This implies that the China’s regulation may have more serious role in china stock market.

5.2 Policy Implications

1. The main finding from this study is that shocks from abroad or contagion effect are more important for the ASEAN countries. The real channel is the significant one that the shock can pass through. It is easy to have more effect on real economy which means to the trade import and export. Because our economy rely a lot on the international trade. Moreover, in the financial market of ASEAN countries also has more effect from the other countries.

2. China is the country that has more influence on ASEAN real market and financial market. In spite of the fact that China has not much effect from US or EU financial channel, it may be because of their system is highly regulated.

3. There are the effects that transmitted through China to ASEAN. By the way, there is the impact that transmitted directly to ASEAN.

5.3 Limitations and Suggestions

The limitations of this study are in several aspects. Some limitations deal with the difficulty of the data and some link to caveats of theoretical and methodology in the estimation. This study aims to apply the model in analyzing contagion effect in financial and real linkages. The paper has emphasized on contagion effects across regions which is China and ASEAN economy. On the other hand, the impact from US and Eurozone to financial market is quiet small compared to reality that we can observe. The reason is that pure contagion effect is not included into the model and the effect that we observed is only from fundamental-based contagion. The pure contagion effect is sensitivity and relation with the expectation of investors, which is difficult to measure.
REFERENCES


