Chapter 3

Copula-VAR Analysis of the Relation between GDP, Imports, Exports: ASEAN Case

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This study concentrates on the causal relationship among output, imports, and exports in ASEAN economies for the period 1980–2010. The investigation is conducted in a time series framework using a vector autoregressive model with copula approach, and impulse response function to test the trade variables of exports and imports for exogenous or endogenous induced growth. Moreover, results suggest there is no causal relation among imports, exports, and output in Malaysia, Thailand, and Brunei. In contrast, the study found empirical evidence in support of bi-directional causal relationship between exports and GDP growth for Laos and The Philippines. Furthermore, the results of Indonesia, Singapore, and Vietnam support only ELG hypothesis, not GLE hypothesis. Empirical results also suggest that there is evidence in support of ILG hypothesis for The Philippines, Indonesia, Singapore, and Vietnam. Thus, it is reasonable to conclude that for several ASEAN countries, both exports and imports play a very important role in stimulating economic growth.

1. Introduction

International trade is often considered to be a main determinant of economic growth in several countries, especially the Association of Southeast Asian Nations, or ASEAN, countries, for which their growth rate of exports and imports have been grown faster and higher than their GDP growth during the past thirty years. Table 1 shows evidence that export growth and import growth are more than GDP growth from 1990 to 2010 in the ASEAN countries (except Vietnam, Laos, Thailand, and Cambodia in 1990), which implies that exports and imports could be main factors to determine output in the ASEAN economies. Table 1 also shows the trend of export growth and import growth. Export growth in ASEAN has continually increased since 1990 in most countries, which arises from export-oriented market-based policies and free trade area agreements. Moreover, import growths also increased from 1990 to 2010, and were mainly due to imports of raw materials, capital goods, and machinery to produce for domestic and exports sector. Furthermore, in 2015, ASEAN aims to integrate ten countries to be one regional economic community called the ASEAN Economic Community (AEC), and AEC considers 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 (ASEAN (2012)). This mean the economic integration will encourage trade in the ASEAN countries and could be lead to increases in GDP in the future.

Therefore, the primary purpose of this study is to investigate the relationship between trade and economic growth in the ASEAN countries which is important for policymakers and governments in the ASEAN countries to decide direction or appropriate policy for trade in their countries, and to decide whether the policies should be the same or different in each country after economic integration.

Moreover, in recent years, many research projects have studied the relationship between trade and economic growth, and a large volume of empirical research has confirmed that trade is crucial and necessary for growth and development (Kababie (2010)). However, most studies are interested only in exports factor and attempt to test two hypotheses, which are Exports Lead Growth and Growth Lead Exports, but ignore the imports factor. Reizman, Summers, and Whiteman (1996) argued that exports are not only one factor to determine growth, but imports are also important, and the result will be incomplete and spurious if analyzing a system without including imports. In addition, Awokuse (2008) states that exports in some countries are not an important engine or condition to drive the economy, and Kababie (2010) has established that imports are valuable to economic growth for three primary reasons: (1) they are a source of technology transfers; (2) they promote innovation through imports competition; and (3) they provide factors of production, which are used in both domestic and export sectors.

TABLE 1. GDP growth, Exports growth, and Imports growth of 10 ASEAN countries from 1990-2010.

Country	1990			2000			2010		
	GDP growth	Exports growth	Imports growth	GDP growth	Exports growth	Imports growth	GDP growth	Exports growth	Imports growth
Brunei	20.95	17.51	16.50	0.54	23.90	7.49	17.26	28.06	22.86
Vietnam	2.84	2.12	-6.27	8.62	25.49	33.16	11.17	22.07	19.18
Malaysia	13.34	17.44	29.15	16.73	16.09	25.50	23.25	26.45	33.13
Indonesia	12.79	17.07	33.61	17.87	27.67	39.63	31.49	35.43	39.93
The Philippines	3.82	5.69	16.33	-2.38	7.70	12.12	18.46	30.64	19.27
Singapore	23.66	17.96	22.67	11.11	20.37	21.21	22.49	30.50	26.37
Thailand	18.53	14.28	31.69	0.08	17.90	22.99	20.93	28.55	36.91
Lao PDR	19.30	-32.44	15.43	15.33	-15.40	-14.72	15.42	44.37	23.61
Cambodia	159.83	101.25	8.00	4.13	7.95	14.61	8.08	11.84	25.55
Myanmar	N/A	N/A	N/A	4.93	42.13	20.26	28.83	9.96	40.60

Source: IMF (2012)

Note: N/A = data are not available

Therefore, this study investigates the causal relationship among exports, imports, and economic growth for the ASEAN economies within an integrated concept that investigates the role of both exports and imports. The contributions of this paper are the following: 1) export growth and import growth are included in the model as endogenous variables which previous empirical studies specify as exogenous variables. 2) We employ copula-VAR model (suggested by Bianchi, et. al (2010)). The advantage of copula approach is to build flexible multivariate distributions and to consist in representing the joint probability distribution by separating the impact of the marginals from the association structure, explained by the copula functional form. Moreover, there are no empirical studies using copula-VAR model to investigate causality among exports, imports, and GDP.

The rest of this article is organized as follows: Section 2 provides a brief empirical overview of the exports, imports, and output growth relationship. Section 3 discusses the analytical framework and some methodological issues. Section 4 presents empirical findings, and Section 5 contains the concluding remarks.

2. Literature review

The role of exports and imports in promoting growth is perhaps the most discussed topic as far as the role of trade in the economy is concerned. Although there are vast empirical studies that emphasize the positive relationship between trade and economics, Rodriguez and Rodrik (1999) highlight that the controversy between the relationship of trade and economic growth has yet to be resolved. They mention the problem of endogenous relations between income and trade. For example, recent studies have observed that countries with high incomes tends to trade more, and when the trade (especially exports) rises, the income also increases. Therefore, to consider only one direction from trade to economic growth will lead to incomplete results.

According to Awokuse (2008), there are three dominant hypotheses proposed to the economic literature: 1) Export-Led Growth (ELG), 2) Growth-Led Export (GLE), and 3) Imports-Led Growth (ILG). Of the three hypotheses, most empirical testing has been carried out on the ELG and GLE. However, the empirical evidence on the relationship among exports growth, imports growth, and GDP growth is rather mixed, and the results of different regions or countries in different periods of time provide different conclusions.

Several pieces of empirical evidence on the ELG hypothesis have shown that there is a link between economic growth and export growth. But debates still surround the direction of causality. While some researchers have found evidence in support of the ELG hypothesis (Ramos (2001), Sato and Fukushige (2011)), others (Reppas and Christopoulos (2005)) either found reverse causal flow from economic growth to exports growth, or support the alternative GLE hypothesis. Moreover, in some cases, the empirical evidence indicated a bi-directional causal relationship (Khan, et al. (1995), Zang and Balmbridge (2012)).

Moreover, on the context of ILG, endogenous growth models show that imports can be a channel for long-run economic growth because it provides domestic firms with access to needed intermediate factors and foreign technology (Coe and Helpman, 1995). Thangavelu and Rajaguru (2004) found that there is no export-led productivity growth for Hong Kong, Indonesia, Japan, Taiwan, or Thailand. However, significant causal effects were found from imports to productivity growth in India, Indonesia, Malaysia, The Philippines, Singapore, and Taiwan, which similarly result as Marwah and Tavakoli (2004) who consider the effect of foreign direct investment (FDI) and imports on economic growth in four Asian countries (Indonesia, Malaysia, The Philippines, and Thailand) and the result shows FDI and imports are important factors to determine economic growth. In Awokuse (2008), they suggest that economic growth could be driven primarily by growth in imports, and Çetinkaya and Erdoğan (2010) also found imports influenced GDP in Turkey. Pistoresi and Rinaldi (2012) found exports were not the only or the main driver of economic growth in Italy from1863 to 2004.

3. Methodology

This article attempts to capture the causality among exports, imports and GDP via the vector autoregressive (VAR) framework of Sims (1980). Moreover, traditional approach assumed the joint distribution of error term is normality. However, Bianchi et.al (2010) proposes to use of copula to construct the joint distribution and their result show that the copula-Vector Autoregression (VAR) model outperforms or at worst compares similarly to normal VAR models, keeping the same computational tractability of the latter approach. Therefore, in our paper, we employ copula approach to construct VAR model and compare with normal VAR model. This section provides a brief discussion of the copula-VAR model adopted in this study. Since the vector autoregressive (VAR) is fairly commonplace and well-document elsewhere, only a brief overview is provided here.

Let $Y_t = (y_{1t}, y_{2t}, ..., y_{nt})'$ denote an $(n \times 1)$ vector of n endogenous variables. The general p-lag vector autoregressive $(VAR(p))$ model has the form

$$Y_t = c + B_1 Y_{t-1} + B_2 Y_{t-2} + \ldots + B_p Y_{t-p} + \sqrt{h}\eta_t, t = 1, \ldots, T \quad (1)$$

where B_i are $(n \times n)$ coefficient matrices and η_t is standard innovation which has an $(n \times 1)$ unobservable zero mean and variance one.

Moreover, their conditional joint distribution is $H_t(\eta_{1,t}, ..., \eta_{n,t}; \theta)$ with the correlation parameters vector θ. From the Sklar Theorem (1959), the joint distribution can be written in the copula as

$$H_t(\eta_{1,t}, ..., \eta_{n,t}; \theta) = C\left(F_1(\eta_{1,t} : \alpha_1), ..., F_n(\eta_{n,t} : \alpha_n) : \gamma\right) \quad (2)$$

where $F_i(\eta_{i,t} : \alpha_i)$ is marginal distribution functions of $\eta_{i,t}$ with marginal parameter α_i and $C(: \gamma)$ is the copula function which copula parameter γ. A copula is a function that links together univariate distribution functions to form a multivariate distribution function. Joe (1997) and Nelsen (2006) provide a complete monograph of an introduction to the theory of copulas and a large selection of related models. Another reviews such as Frees and Valdez (1998) and Cherubini et al. (2004) provide more detail about the application in actuarial and financial settings.

From (2) the expression of the corresponding densities can be derived. By taking derivatives to equation (2) we have:

$$\begin{aligned} f(\eta_1, ..., \eta_n) &= \frac{\partial^n [H(\eta_1, \ldots, \eta_n)]}{\partial \eta_1 \ldots \partial \eta_n} = \frac{\partial^n C(F_1(\eta_1), \ldots, F_n(\eta_n))}{\partial \eta_1 \ldots \partial \eta_n} \\ &= \frac{\partial^n C(F_1(\eta_1), \ldots, F_n(\eta_n))}{\partial F_1(\eta_1) \ldots \partial F_n(\eta_n)} \prod_{i=1}^{n} \frac{dF_i(\eta_i)}{d\eta_i} \\ &= c(F_1(\eta_1), \ldots, F_n(\eta_n)) \prod_{i=1}^{n} f_i(\eta_i) \end{aligned} \quad (3)$$

From inverse Sklar's theorem which provide

$$C(u_1, \ldots, u_n) = F\left(F_1^{-1}(u_1), \ldots, F_n^{-1}(u_n)\right) \quad (4)$$

where $u_i = F_i(\eta_i) \Leftrightarrow \eta_i = F_i^{-1}(u_i), i = 1, 2, ..., n$.

Therefore, equation (4) becomes:

$$c(u_1,\ldots,u_n) = \frac{f\left(F_1^{-1}(u_1),\ldots,F_n^{-1}(u_n)\right)}{\prod_{i=1}^{n} f_i\left(F_i^{-1}(u_i)\right)} \quad (5)$$

where $c(u_1,\ldots,u_n)$ is the multivariate copula density.

By using equation (5), we can derive the Normal-copula, whose probability distribution and density function is:

$$C^G(u_1,\ldots,u_n) = \Phi_\Sigma\left(\Phi^{-1}(u_1),\ldots,\Phi^{-1}(u_n):\Sigma\right) \quad (6)$$

and

$$c^G(u_1,\ldots,u_n) = \frac{\phi_\Sigma\left(\Phi^{-1}(u_1),\ldots,\Phi^{-1}(u_n)\right)}{\prod_{i=1}^{n} \phi_i\left(\Phi^{-1}(u_i)\right)} \quad (7)$$

where Φ^{-1} is the univariate Gaussian inverse distribution function ($u_i = \Phi_i(\eta_i)$),while Σ is the correlation matrix.

Moreover, there are alternative copula families which are called Archimedean copulas (such as Clayton's copula ,Rotated Clayton copula, Plackett copula, Frank copula, Gumbel copula, Rotated Gumbel copula and Symmetries Joe-Clayton copula) are provided to model the joint distribution. However, these copulas can become inflexible in high-dimensions and do not allow for different dependency structure between pairs of variables.

Moreover, Aas et.al(2009) presented a method to build high dimension copulas using pair-copulas as building blocks and they show that the pair-copula decomposition treated in their studies are more flexible to build higher dimension copula. This decompositions are called vine copulas. Initially proposed by Joe (1996) and developed in more detail in Bedford and Cooke (2001, 2002) ,Kurowicka and Cooke(2006) and Brechmann ans Schepsmeirer (2011), vines are a flexible graphical model for describing multivariate copulas built up using a cascade of bivariate copulas, so-called pair-copulas. According to Aas, et.al(2009) ,they described statistical inference techniques for the two classes of canonical (C-) and D-vines. Moreover, in this study, we provide C-vines copula in 3-dimensions and the tree of C-vine show as Figure 1

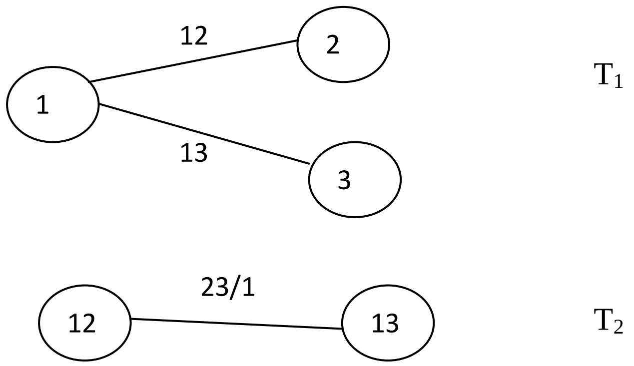

Figure 1. A canonical vine with 3 variables ,2 trees and 3 edges.

The general expression for the canonical structure in the 3-dimensions case is

$$f(\eta_1,\eta_2,\eta_3) \quad = \quad f(\eta_1)\,f(\eta_2)\,f(\eta_3)\,c_{12}\left(F(\eta_1),F(\eta_2)\right)c_{23}\left(F(\eta_2),F(\eta_3)\right)$$

$$c_{23|1}\left(F(\eta_2|\eta_1),F(\eta_3|\eta_1)\right) \tag{8}$$

or in the n-dimensions case we can write the general expression as follow:

$$f(\eta)=\prod_{i=1}^{n} f_i(\eta_i)\times\prod_{i=1}^{n-1}\prod_{j=1}^{n-i} c_{i,i+j|1:(i-1)}\Big(F(\eta_i|\eta_1,\ldots,\eta_{i-1}),\big(F(\eta_{i+j}|\eta_1,\ldots,\eta_{i-1}\big)\Big|\gamma_{i,i+j|1:(i-1)}\Big) \tag{9}$$

where $f_i, i=1,\ldots,n$ denote the marginal densities and $c_{i,i+j|1:(i-1)}$ bivariate copula densities with parameter(s) $\gamma_{i,i+j|1:(i-1)}$.

The crucial question for inference is how to obtain the conditional distribution functions $F(\eta|\nu)$ for an m-dimensional vector ν. For a pair-copula term in tree m+1, this can easily be established using the pair-copulas by sequentially applying the relationship

$$h(\eta|\nu,\gamma)=F(\eta|\nu)=\frac{\partial C_{\eta\nu_j|\nu_{-j}}\left(F(\eta|\nu_{-j}),F(\nu_j|\nu_{-j})\middle|\gamma\right)}{\partial F(\nu_j|\nu_{-j})} \tag{10}$$

where ν_j is an arbitrary component of ν and ν_{-j} denotes the $(m-1)$-dimensional vector ν excluding ν_j (Joe 1996). Further $C_{\eta\nu_j|\nu_{-j}}$ is a bivariate copula distribution function with parameter(s) γ specified in tree m. The notation of the h-function is introduced for convenience (cp. Aas et al. 2009).

Copula and marginal estimation

The estimate the mariginal and copula parameter, Bianchi (2010) provided multi-step procedure is known as the method of Inference Functions for Margins (IFM). According to the IFM method, the parameters of marginal distributions are estimated separately from the parameters of the copula. The estimation following two steps:

(1) Estimate the parameters α_i, $i = 1,...,n$ of the marginal distributions F_i using the Maximum Likelihood (ML) method:

$$\hat{\alpha}_i = \arg\max l^i(\alpha_i) = \arg\max \sum_{t=1}^{T} \log f_i(\eta_{i,t};\alpha_i) \quad (11)$$

where l^i is the log-likelihood function of the marginal distribution F_i;

(2) Estimate the copula parameters γ, given the estimations performed in Step 1:

$$\hat{\gamma} = \arg\max l^c(\gamma) = \arg\max \sum_{t=1}^{T} \log\left(c\left(F_1\left(\eta_{1,t};\hat{\alpha}_1\right),..., F_n\left(\eta_{n,t};\hat{\alpha}_n\right);\gamma\right)\right) \quad (12)$$

where l^c is the log-likelihood function of the copula.

4. Empirical Analysis and Results

4.1 Data and unit root properties

Data was obtained for eight ASEAN countries[1]: Brunei, Vietnam, Malaysia, Indonesia, Philippines, Singapore, Thailand and Laos. The data set consists of observations for GDP growth (GDP), exports growth (EXPORT), imports growth (IMPORT). Our estimates are based on annual data for the sample period 1980-2010. Data are drawn from two main sources: (a) the International Monetary Fund (IMF, various issues) and the World Development Indicator (World Bank, various issues).

[1] We cut Cambodia and Myanmar out of sample data because data are unavailable.

TABLE 2. Trends in GDP growth, exports and imports from 1990 to 2010

Country	GDP Growth (%)			Exports (% of GDP)			Imports (% of GDP)		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
Brunei	20.95	0.54	17.26	59.14	73.51	63.12	26.74	33.19	23.96
Vietnam	2.84	8.62	11.17	39.01	46.46	67.41	43.91	50.16	80.49
Malaysia	13.34	16.73	23.25	66.83	104.66	83.66	66.27	87.66	69.33
Indonesia	12.79	17.87	31.49	22.58	37.66	22.28	19.34	20.31	19.16
Philippines	3.82	-2.38	18.46	16.74	47.18	25.87	26.54	42.57	27.42
Singapore	23.66	11.11	22.49	136.10	146.50	155.53	156.98	142.76	136.72
Thailand	18.53	0.08	20.93	26.94	56.19	61.26	39.03	50.46	57.89
Laos	19.30	15.33	15.42	7.04	23.86	33.99	16.24	42.06	55.34

Source: IMF and World Bank

The trends in GDP growth, share of exports to GDP and share of imports of GDP are shown in Table 2. Across ASEAN countries, the trends in GDP growth do not show any similarly trends. GDP growth in Brunei, Philippines, Singapore, Thailand and Laos decrease from 1990 to 2000 and increase from 2000 to 2010 while GDP growth in Vietnam, Malaysia and Indonesia continuously increase from 1990 to 2010. The data clearly show the highly share of exports and imports on these countries GDP. Compare to GDP growth, there are upward trend for exports and imports from 1990 to 2010 across all the ASEAN countries under study.

Before estimate the VAR model, we have to check whether each time series variable is stationary in levels or stationary after first differencing. Two univariate unit root tests (the augmented Dickey–Fuller (ADF) and Phillips–Perron (PP)) were examined for each of the variables and were shown in Table 3.

TABLE 3. Tests for unit root

	ADF	**PP**	**Jarque-Bera**	**Prob**	**Skewness**	**Kurtosis**
Brunei						
GDP	-4.811***	-4.811***	2.345	0.310	0.148	4.572
Exports	-6.647***	-6.647***	0.377	0.828	0.812	3.588
Imports	-4.338***	-4.338***	106.020***	0.000	-0.787	4.662
Vietnam						
GDP	-5.088***	-6.330***	6.608**	0.037	0.105	5.290
Exports	-5.505***	-11.965***	122.658***	0.000	2.849	11.104
Imports	-4.781***	-7.386***	463.091***	0.000	4.010	20.497
Indonesia						
GDP	-6.014***	-6.242***	47.954***	0.000	-1.491	8.428
Exports	-5.143***	-5.146***	0.648	0.723	-0.338	2.752
Imports	-5.280***	-5.295***	0.749	0.688	0.320	3.436
Malaysia						
GDP	-4.707***	-4.652***	3.227	0.199	-0.795	2.767
Exports	-4.977***	-4.989***	1.076	0.584	-0.421	2.609
Imports	-3.898**	-3.774**	17.529***	0.000	-1.524	5.176

	ADF	PP	Jarque-Bera	Prob	Skewness	Kurtosis
Philippines						
GDP	-4.342***	-4.346***	1.828	0.401	-0.603	2.915
Exports	-3.636**	-3.611**	1.034	0.596	-0.439	2.760
Imports	-3.700**	-3.684**	1.332	0.514	-0.483	2.636
Singapore						
GDP	-3.241**	-3.289**	2.806	0.246	-0.745	2.846
Exports	-4.234**	-4.116**	0.464	0.793	-0.240	2.626
Imports	-4.520***	-4.515***	2.279	0.320	-0.674	2.932
Thailand						
GDP	-3.190**	-3.251**	14.856***	0.001	-1.444	4.883
Exports	-3.999***	-3.886**	1.220	0.543	-0.214	2.110
Imports	-4.173***	-3.913**	0.121	0.941	-0.104	2.767
Loas						
GDP	-3.959***	-3.758**	3.200	0.202	0.148	4.572
Exports	-5.017***	-7.741***	3.730	0.155	0.812	3.588
Imports	-5.365***	-5.286***	6.547**	0.038	-0.787	4.662

Source: Computation

Notes: ** and *** denotes rejection of the null hypothesis of unit roots for the ADF tests and PP tests at the 5% and 10% significance levels.

** and *** denotes rejection of the null hypothesis of normality for the Jarque-Bera tests at the 5% and 10% significance levels.

The combination of the unit root tests results (see Table 3) suggest that the GDP growth, imports growth and exports growth are integrated of order zero (i.e., I(0)) or stationary at level and so we can construct VAR model without take the differentiate. Table 3 also provides the normality test for all of variables and the Jarque-Bera on some of variables reject normality implied that not all marginal of the variables are normal distribution. Therefore, we can not assume the joint distribution of them is multivariate normality.

4.2 Estimation of copula-VAR model

The next step is to formulate the appropriate VAR model. The variables in the VAR models are used on their stationary level. The initial task in estimating the VAR model is to determine the optimum order of lag length. Moreover, in the real world economy, GDP, exports and imports always will delay for recognized the external and internal impact including the impact of changing in value of GDP, exports and imports on other side of economy were not immediately exist. In order to select the lag length of VAR model, sequential modified LR test statistic (LR), Akaike information criterion (AIC), Schwarz information criterion (SIC) and Hannan-Quinn information criterion (HQ) are used. Table 4 presents selected lag length of each country VAR model.

TABLE 4 Selected Lag Lengths

Country	selected lag lengths
Brunei	0
Indonesia	2
Laos	1
Malaysia	0
Philippines	6
Singapore	6
Thailand	0
Vietnam	6

Source: Computation

Table 4 shows that there is no causality among exports, imports and GDP in three countries (Brunei, Malaysia and Thailand). In the case of Laos, there is 1 lag length while 2 lag lengths exist in Indonesia. In addition, the proper lag order for Philippines, Singapore and Vietnam are 6.

After chose the appropriate lag length for each country, we estimate the parameters in VAR model and copula parameter and results of each country are separately presented.

1) Long-run relationship among exports, imports and GDP via copula-VAR model for Indonesia

Table 5 shows that imports and exports are important factors to determined economic growth in Indonesia at 5 percent significant level or better. The coefficient of EXPORT(t-1) on GDP growth shows that increase in 1 percent of exports growth will lead GDP growth increase 0.301 percent. Moreover, the coefficient of IMPORT(t-1) on GDP growth is 0.758 means the 1 percent increase of imports growth will increase GDP growth 0.758 percent. This result indicates the impact of imports on GDP is larger than impact of exports on GDP in the case of Indonesia.

Furthermore, there is relationship between exports growth and imports growth and Table 5 shows that exports led imports in Indonesia (at 10 percent significant level) but there is no causal relationship from imports to exports and there is also no causality from GDP to imports or exports. This result implies that imports and exports policy can encourage growth in Indonesia and imports are relatively more important than exports to GDP growth. We can write the relation in the functional form as follow:

GDP growth = f(EXPORT(t-1), IMPORT(t-1))

Imports growth = f (EXPORT(t-2))

Since the joint copula model requires the correct specification of the marginal models and their probability transforms will be iid uniform(0,1), so we provide the KS Test for if the probability transforms are uniform(0,1) and Box-Ljung Test for

Autocorrelation. The null hypothesis of KS Test is variable has uniform distribution and the result from Table 6 rejects the null hypothesis for all 3 margins which implied that GDP growth, exports growth and imports growth have uniform distribution in the case of Indonesia. The Ljung–Box tests on the standardized residuals in levels reported in Table 6 highlight no autocorrelation. These results provide significant evidence that our marginal models are correctly specified.

TABLE 5 Causality relationship between Exports, imports and GDP in Indonesia

Variables	EXPORT		IMPORT		GDP	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Constant	5.085*	1.919	7.208	1.563	7.785**	2.111
EXPORT(t-1)	0.036	0.138	-0.103	-0.706	0.301**	2.012
IMPORT(t-1)	-0.451	-0.996	-0.117	-0.463	0.758***	2.915
GDP(t-1)	0.242	0.668	-0.082	-0.406	-0.104	-0.499
EXPORT(t-2)	-0.104	-0.378	0.247*	1.840	-0.130	-0.774
IMPORT(t-2)	0.378	0.788	-0.177	-0.755	0.154	0.527
GDP(t-2)	0.273	0.712	0.184	0.983	-0.329	-1.405
Log-Likelihood	-351.280					
AIC	756.559					
BIC	794.392					

Source: Computation

Notes: *,** and *** denote 10%, 5% and 1% levels of significance respectively.

TABLE 6 testing the assumptions of i.i.d and Test for Autocorrelation

KS test for uniform distribution			
Null Hypothesis: Variable has uniform distribution			
	statistic	**pValue**	**Hypothesis**
Margins of GDP growth	0.0936	0.9448	0 (acceptance)
Margins of exports growth	0.0827	0.9823	0 (acceptance)
Margins of imports growth	0.1351	0.6124	0 (acceptance)
Box-Ljung Test for Autocorrelation			
Null Hypothesis: No autocorrelation			
	Q-Stat	**pValue**	**Hypothesis**
Margins of GDP growth	5.9429	0.9990	0 (acceptance)
Margins of exports growth	9.0467	0.9824	0 (acceptance)
Margins of imports growth	10.9125	0.9485	0 (acceptance)

Source: computation

Next, we estimate the copula parameter and we consider pairwise dependence, so we model bivariate distributions of returns for computational tractability. To each pair of variables, we fit the following copulas: Normal copula, Clayton's copula, Rotated Clayton copula, Placket copula, Frank copula, Gumbel copula,and Rotated Gumbel copula . We fit the copulas to the pairs of standardized residuals, obtained after fitting VAR models to each returns series, transformed to uniform distribution by their empirical distribution functions. The copula selection is done on the basis of AIC and BIC perspective. Table 7 shows the optimal copulas and their estimated parameters.

TABLE 7 Copula correlation matrix

	Family	Copula parameter	Kendall's tau
GDP and Export	Frank	4.817	0.45
GDP and Import	rotated Gumbel copula (180 degrees; "survival Gumbel")	1.676	0.4
Export and Import condition on GDP	Frank	8.002	0.6

Source: Computation

Table 7 shows that, in the case of GDP-export pair and Export-Import pair, the Frank copula are the most appropriate to model the dependence structure. In the case of GDP-Import pair is given to the rotated Gumbel copula. The Kendall's tau shows the positive dependence of each pair.

2) Long-run relationship among exports, imports and GDP via copula-VAR model for Laos

The result of Table 8 indicates that lag of exports and GDP are important factors to determined GDP growth in Laos. In addition, there is bidirectional relation between exports and GDP which support ELG and GLE hypotheses. The result also shows that exports led imports in Laos. However, all coefficients of imports are insignificant which can imply unimportant of imports policy. We can write this relation in the functional form as follow:

GDP growth = f(EXPORT(t-1), GDP(t-1))

Imports growth = f (EXPORT(t-2))

Exports growth = f (GDP(t-1))

Table 8 Causality Relationship between Exports, Imports and GDP in Laos

	EXPORT		IMPORT		GDP	
Variables	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Constant	31.461***	3.588	15.906**	2.422	1.653	0.319
EXPORT(t-1)	-0.223	-1.288	0.450**	1.649	0.947***	3.391
IMPORT(t-1)	0.006	0.044	0.019	0.092	0.205	0.981
GDP(t-1)	0.194**	1.898	-0.057	-0.351	0.453***	2.740
Log-Likelihood	880.028					
AIC	917.860					
BIC	-413.014					

Source: Computation

Notes: ** and *** denote 5% and 1% levels of significance respectively.

Next, we provide the KS Test for if the probability transforms are uniform(0,1) and the null hypothesis of KS Test is variable has uniform distribution and the result from Table 9 rejects the null hypothesis for all 3 margins which implied that GDP growth, exports growth and imports growth ,in the case Laos, have uniform distribution. We also employ the Ljung–Box tests on the standardized residuals in levels reported in Table 9 and the result highlights no autocorrelation. These results provide significant evidence that our marginal models are correctly specified and hence copula model will not be mispecified.

Table 9 testing the assumptions of i.i.d and Test for Autocorrelation

KS test for uniform distribution			
Null Hypothesis: Variable has uniform distribution			
	statistic	**pValue**	**Hypothesis**
Margins of GDP growth	0.112	0.826	0 (acceptance)
Margins of exports growth	0.082	0.984	0 (acceptance)
Margins of imports growth	0.094	0.945	0 (acceptance)
Box-Ljung Test for Autocorrelation			
Null Hypothesis: No autocorrelation			
	Q-Stat	**pValue**	**Hypothesis**
Margins of GDP growth	0.729	15.803	0 (acceptance)
Margins of exports growth	0.717	15.990	0 (acceptance)
Margins of imports growth	0.963	10.292	0 (acceptance)

Source: Computation

Table 10 Copula correlation matrix

	Family	**Copula parameter**	**Kendall's tau**
GDP and Export	Clayton	0.141	0.066
GDP and Import	Independence	0.000	0.000
Export and Import condition on GDP	Frank	9.021	0.637

Source: Computation

Table 10 shows that, in the case of GDP-export pair is given to the Clayton copula and the Export-Import pair is given to the Frank copula while there is no relation between GDP and Import which support our VAR model. Moreover, the Kendall's tau of GDP-export pair and Export-Import pair are positive indicate positive dependence of each pair.

3) Long-run relationship among exports, imports and GDP via copula-VAR model for Philippines

In the case of the Philippines, the result indicates that exports and imports led economic growth. Table 11 shows that the elasticity of IMPORT(t-5) is greater than the elasticity of other variables that and a 1% increase in IMPORT(t-5) leads to a gain in GDP growth of 2.575%.

Table 11 Causality Relationship between Exports, Imports and GDP in the Philippines

Variables	EXPORT		IMPORT		GDP	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Constant	5.681**	2.249	2.972	1.096	4.009*	1.915
EXPORT(t-1)	-0.035	-0.149	0.698***	2.687	-0.616**	-2.184
IMPORT(t-1)	0.087	0.343	0.224	0.802	0.826***	2.728
GDP(t-1)	0.323*	1.655	-0.367*	-1.707	0.791***	3.382
EXPORT(t-2)	-0.583**	-2.012	0.579*	1.859	-0.498	-1.405
IMPORT(t-2)	-1.230***	-3.954	1.458***	4.365	-1.030***	-2.708
GDP(t-2)	-0.769***	-3.202	0.859***	3.328	-0.232	-0.791
EXPORT(t-3)	-0.571*	-1.842	0.496*	1.626	0.163	0.425
IMPORT(t-3)	-0.477	-1.432	0.268	0.819	-0.694*	-1.681
GDP(t-3)	-0.121	-0.469	-0.039	-0.156	-0.422	-1.324
EXPORT(t-4)	0.419*	1.942	-0.360	-1.441	-0.057	-0.149
IMPORT(t-4)	0.650***	2.804	-0.508*	-1.896	-0.241	-0.583
GDP(t-4)	0.362**	2.022	-0.438**	-2.114	0.089	0.278
EXPORT(t-5)	-0.218	-0.990	-0.624**	-2.399	1.823***	4.269
IMPORT(t-5)	-0.318	-1.346	-0.740***	-2.653	2.575***	5.618
GDP(t-5)	-0.407**	-2.230	0.309	1.433	0.580	1.640
EXPORT(t-6)	-0.242	-1.131	0.408	1.486	0.557	1.029
IMPORT(t-6)	0.195	0.848	-0.153	-0.518	1.218**	2.100
GDP(t-6)	0.154	0.865	-0.123	-0.541	0.146	0.325
Log-Likelihood	-285.905					
AIC	625.810					
BIC	663.643					

Source: Computation

Notes: *,** and *** denote 10%, 5% and 1% levels of significance respectively.

For imports growth equation (second column), Table 11 shows exports growth, GDP growth and its own lag are important factors to determine imports growth. The results indicate that the elasticity of IMPORT(t-2) is greater than the elasticity of other variables; and that a 1% increase in IMPORT(t-2) leads to a gain in imports growth of 1.458%. The exports growth is also determined by imports, GDP and its past values. The result indicates that the elasticity of IMPORT(t-2) is greater than the elasticity of other variables; and that a 1% increase in IMPORT(t-2) increases exports growth by 1.230%. Therefore, our result supports the ELG, GLE and ILG in Philippines.

From Table 11 above, we can write this relation in the functional form as follow:

GDP growth = f(EXPORT(t-1), IMPORT(t-1), GDP(t-1),

IMPORT(t-2), IMPORT(t-3), EXPORT(t-5),

IMPORT(t-5), IMPORT(t-6))

Imports growth = f (EXPORT(t-1), GDP(t-1), EXPORT(t-2), IMPORT(t-2), GDP(t-2), EXPORT(t-3), IMPORT(t-4), GDP(t-4), EXPORT(t-5), IMPORT(t-5))

Exports growth = f(GDP(t-1), EXPORT(t-2), IMPORT(t-2), GDP(t-2),EXPORT(t-3),EXPORT(t-4), IMPORT(t-4), GDP(t-4), GDP(t-5))

Next, we provide the KS Test for whether the probability transforms are uniform(0,1) and the null hypothesis of KS Test is variable has uniform distribution. The result rejects the null hypothesis for all 3 margins which implied that GDP growth, exports growth and imports growth, in the case Philippines, have uniform distribution. We also employ the Ljung–Box tests on the standardized residuals in levels reported in Table 12 and the result highlights no autocorrelation. These results provide significant evidence that our marginal models are correctly specified and hence copula model will not be mis-specified.

Table 13 shows the optimal copulas and their estimated parameters. The Gaussian copula is appropriate family to capture the dependence structure of GDP-export pair and GDP-Import pair while Export-Import pair is given to the Clayton copula. Moreover, the Kendall’s taus of all pairs are positive represent that the ranks of both variables in each pair increase together.

Table 12 Testing the assumptions of i.i.d and Test for Autocorrelation

KS test for uniform distribution			
Null Hypothesis: Variable has uniform distribution			
	statistic	**pValue**	**Hypothesis**
Margins of GDP growth	0.1343	0.6198	0 (acceptance)
Margins of exports growth	0.0642	0.9995	0 (acceptance)
Margins of imports growth	0.0826	0.9825	0 (acceptance)
Box-Ljung Test for Autocorrelation			
Null Hypothesis: No autocorrelation			
	Q-Stat	**pValue**	**Hypothesis**
Margins of GDP growth	11.9896	0.9164	0 (acceptance)
Margins of exports growth	22.4147	0.3184	0 (acceptance)
Margins of imports growth	13.6220	0.8491	0 (acceptance)

Source: Computation

Table 13 Copula correlation matrix

	Family	Copula parameter	Kendall's tau
GDP and Export	Gaussian copula	0.607	0.39
GDP and Import	Gaussian copula	0.780	0.54
Export and Import condition on GDP	Clayton copula	1.176	0.39

Source: Computation

4) Long-run relationship among exports, imports and GDP via copula-VAR model for Singapore

In the case of Singapore, the result indicates that exports and imports led economic growth. In contrast, GDP does determine neither imports nor exports. This result implies that ELG and ILG but not GLE in Singapore and highlights imports on GDP growth and exports policy to encourage economic growth.

Moreover, Table 14 shows that the elasticity of imports is greater than the elasticity of the exports and a 1% increase in imports leads to a gain in GDP growth of 1.941% at 5 percent significant level. We can write this relation in the functional form as follow:

GDP growth = f(EXPORT(t-2), IMPORT(t-2), GDP(t-2),
EXPORT(t-6), IMPORT(t-6), GDP(t-6))

Imports growth = f (EXPORT(t-5), IMPORT(t-5))

Exports growth = f (EXPORT(t-1), IMPORT(t-1))

Table 14 Causality Relationship between Exports, Imports and GDP in Singapore

Variables	EXPORT		IMPORT		GDP	
	Coefficient	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Constant	4.087	0.653	4.312	0.651	7.694*	1.667
EXPORT(t-1)	1.273*	1.879	-1.689	-1.517	1.321	1.361
IMPORT(t-1)	1.247*	1.740	-1.758	-1.493	1.387	1.351
GDP(t-1)	0.179	0.359	-0.238	-0.290	0.590	0.824
EXPORT(t-2)	0.390	0.356	0.009	0.006	1.354*	1.690
IMPORT(t-2)	0.262	0.226	0.568	0.377	1.941**	2.291
GDP(t-2)	-0.295	-0.365	1.068	1.017	-1.245**	-2.108
EXPORT(t-3)	0.061	0.072	-0.329	-0.262	0.518	0.625
IMPORT(t-3)	0.196	0.220	0.074	0.056	-0.180	-0.206
GDP(t-3)	-0.626	-1.005	0.577	0.624	0.234	0.383
EXPORT(t-4)	1.189	0.925	-1.310	-1.331	0.462	0.351

Variables	EXPORT		IMPORT		GDP	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
IMPORT(t-4)	0.595	0.438	-1.317	-1.265	1.361	0.980
GDP(t-4)	0.223	0.235	-0.616	-0.848	0.803	0.829
EXPORT(t-5)	0.594	0.878	-1.419*	-1.724	0.608	0.730
IMPORT(t-5)	0.953	1.332	-1.596*	-1.834	0.862	0.978
GDP(t-5)	0.123	0.247	-0.940	-1.549	0.958	1.560
EXPORT(t-6)	1.170	1.411	-0.059	-0.096	-1.273*	-1.759
IMPORT(t-6)	1.377	1.571	-0.456	-0.698	-1.586**	-2.072
GDP(t-6)	0.860	1.406	-0.282	-0.618	-1.181**	-2.212
Log-Likelihood	-243.356					
AIC	540.712					
BIC	578.544					

Source: Computation

Notes: *,** and *** denote 10%, 5% and 1% levels of significance respectively.

Table 15 presents the KS Test for if the probability transforms are uniform(0,1) and the null hypothesis of KS Test is variable has uniform distribution and the result from Table 15 rejects the null hypothesis for all 3 margins which implied that GDP growth, exports growth and imports growth ,in the case Singapore, have uniform distribution. We also employ the Ljung–Box tests on the standardized residuals in levels reported in Table 15 and the result highlights no autocorrelation. These results provide significant evidence that our marginal models are correctly specified.

Table 15 Testing the assumptions of i.i.d and Test for Autocorrelation

KS test for uniform distribution			
Null Hypothesis: Variable has uniform distribution			
	statistic	**pValue**	**Hypothesis**
Margins of GDP growth	0.1343	0.6198	0 (acceptance)
Margins of exports growth	0.0642	0.9995	0 (acceptance)
Margins of imports growth	0.0826	0.9825	0 (acceptance)
Box-Ljung Test for Autocorrelation			
Null Hypothesis: No autocorrelation			
	Q-Stat	**pValue**	**Hypothesis**
Margins of GDP growth	11.9896	0.9164	0 (acceptance)
Margins of exports growth	22.4147	0.3184	0 (acceptance)
Margins of imports growth	13.6220	0.8491	0 (acceptance)

Source: Computation

Next we estimate the copula correlation and from the AIC and BIC perspective, the Rotated Gumbel copula was the best among parameter copula to capture the dependence structure of EXPORT –GDP pair, IMPORT- GDP pair and EXPORT – IMPORT pair (Table 16). Moreover, the Kendall's taus of all pairs are positive suggests that the ranks of both variables in each pair increase together.

Table 16 Copula correlation matrix

	Family	**Copula parameter**	**Kendall's tau**
GDP and Export	rotated Gumbel copula (180 degrees; "survival Gumbel")	3.124	0.68
GDP and Import	rotated Gumbel copula (180 degrees; "survival Gumbel")	5.283	0.81
Export and Import condition on GDP	rotated Gumbel copula (180 degrees; "survival Gumbel")	3.336	0.7

Source: Computation

5) Long-run relationship among exports, imports and GDP via copula-VAR model for Vietnam

The result of Table 17 indicates that exports and imports are important factors to determined GDP growth in Vietnam. Moreover, there is bidirectional relation between imports and GDP which support ILG. In contrast, there is no evidence suggests the causal direction from GDP to exports. The result also shows that exports led imports and imports led exports in Vietnam. We can write this relation in the functional form as follow:

GDP growth = f(IMPORT(t-1),EXPORT(t-2),IMPORT(t-2), EXPORT(t-3), IMPORT(t-3),GDP(t-3), EXPORT(t-4), GDP(t-4) , EXPORT(t-6), IMPORT(t-6))

Imports growth = f (EXPORT(t-2), IMPORT(t-2), GDP(t-5) ,EXPORT(t-6)**)**

Exports growth = f (EXPORT(t-2), EXPORT(t-3), IMPORT(t-3), IMPORT(t-6))

Table 17 Causality Relationship between Exports, Imports and GDP in Vietnam

	EXPORT		IMPORT		GDP	
Variables	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**	**Coefficient**	**t-stat**
Constant	14.389**	2.189	4.728	0.563	17.589**	2.068
EXPORT(t-1)	0.505	1.554	-0.483	-1.565	0.050	0.281
IMPORT(t-1)	0.469	1.131	-0.558	-1.417	0.657***	2.894
GDP(t-1)	0.247	0.588	0.132	0.332	-0.105	-0.456
EXPORT(t-2)	0.814**	2.485	-0.918***	-2.963	0.391*	1.648
IMPORT(t-2)	0.682	1.631	-1.035***	-2.614	0.794***	2.620
GDP(t-2)	0.295	0.695	-0.003	-0.007	-0.183	-0.597
EXPORT(t-3)	0.889***	3.331	-0.378	-1.313	1.044***	4.027
IMPORT(t-3)	1.176***	3.450	-0.551	-1.496	1.421***	4.293
GDP(t-3)	-0.043	-0.124	-0.597	-1.603	-0.793**	-2.366
EXPORT(t-4)	-0.245	-0.995	-0.187	-0.621	-0.627**	-2.069
IMPORT(t-4)	-0.169	-0.537	-0.627	-1.626	-0.452	-1.168
GDP(t-4)	0.393	1.233	0.227	0.582	0.879**	2.244
EXPORT(t-5)	0.270	1.090	0.105	0.345	0.524	1.458
IMPORT(t-5)	-0.030	-0.094	0.387	0.998	0.190	0.413
GDP(t-5)	-0.188	-0.585	-0.679*	-1.728	-0.565	-1.216
EXPORT(t-6)	-0.225	-1.126	-0.482*	-1.692	-0.468**	-1.791
IMPORT(t-6)	-0.449*	-1.758	0.087	0.240	-0.563**	-1.688
GDP(t-6)	0.289	1.116	-0.214	-0.582	0.194	0.573
Log-Likelihood	-354.725					
AIC	763.451					
BIC	801.283					

Source: Computation

Notes: *,** and *** denote 10%, 5% and 1% levels of significance respectively.

Table 18 presents the KS Test for if the probability transforms are uniform(0,1) and the null hypothesis of KS Test is variable has uniform distribution and the result from Table 18 rejects the null hypothesis for all 3 margins which implied that GDP growth, exports growth and imports growth ,in the case Vietnam, have uniform distribution. We also employ the Ljung–Box tests on the standardized residuals in levels reported in Table 18 and the result highlights no autocorrelation. These results provide significant evidence that our marginal models are correctly specified.

Table 18 Testing the assumptions of i.i.d and Test for Autocorrelation

KS test for uniform distribution			
Null Hypothesis: Variable has uniform distribution			
	statistic	**pValue**	**Hypothesis**
Margins of GDP growth	0.0946	0.9404	0 (acceptance)
Margins of exports growth	0.0757	0.9936	0 (acceptance)
Margins of imports growth	0.0950	0.9384	0 (acceptance)
Box-Ljung Test for Autocorrelation			
Null Hypothesis: No autocorrelation			
	Q-Stat	**pValue**	**Hypothesis**
Margins of GDP growth	9.6459	0.9741	0 (acceptance)
Margins of exports growth	17.5550	0.6167	0 (acceptance)
Margins of imports growth	9.5472	0.9757	0 (acceptance)

Source: Computation

Next we estimate the copula correlation and from the AIC and BIC perspective, the Frank copula was the best among parameter copula to capture the dependence structure of EXPORT-GDP and IMPORT-GDP while the Gumbel copula was the best among parameter copula to capture the dependence structure of EXPORT- IMPORT (Table 19).

Table 19 Copula correlation matrix

	Family	**Copula parameter**	**Kendall's tau**
GDP and Export	Frank Copula	3.767	0.37
GDP and Import	Frank Copula	4.977	0.46
Export and Import condition on GDP	Gumbel Copula	3.232	0.69

Source: Computation

4.3 Impulse response function

Next, we will present impulse response function (IRFs) which is tool to analyze dynamic effects of the system when the model received the impulse. IRFs could provide more insight into how shocks to exports and imports affect economic growth (and vice versa). Figure 2-6 provide results for the IRFs for Indonesia, Laos, Philippines, Singapore and Vietnam, respectively.

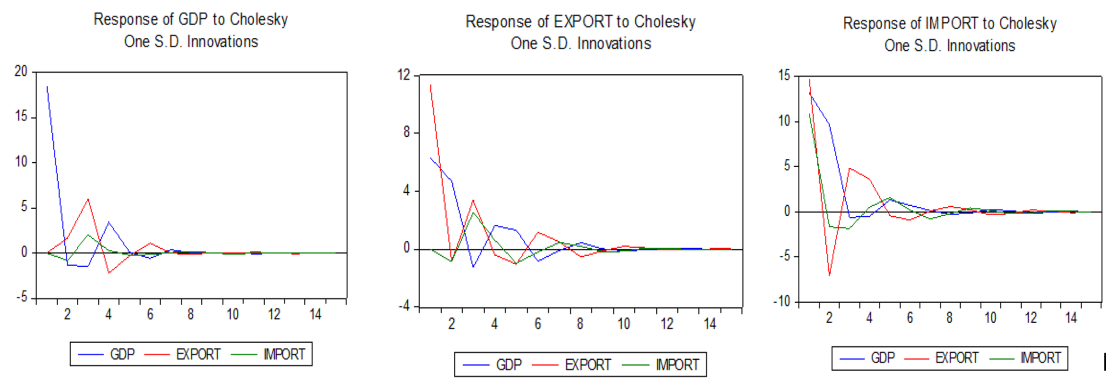

Figure 2 the Impulse Response Analysis for Indonesia

According to Figure 2, the first panel shows the impulse response of GDP growth to exports growth and imports growth for Indonesia. The IRFs shows the response of GDP to shock on exports and the response of GDP on imports are positive in the second to seventh period and then the effect gets weaker and become zero after eight years.

In order to check for reverse causality from GDP to exports and imports the responses of exports and imports are reported. When the impulse is GDP growth, the response of exports growth rate is positive and decrease to zero line after ten years. However, the response of imports growth to GDP shock is insignificantly different from zero.

Finally, the IRFs shows the response of imports to shock of exports is negative in the first and second year and then become a positive after four years and the effect gets weaker after seven years. In contrast, the response of exports to imports is small negative (around 0-4%) and become zero after eight years.

This finding reinforces the result from VAR analysis which provided support for the ELG and ILG argument.

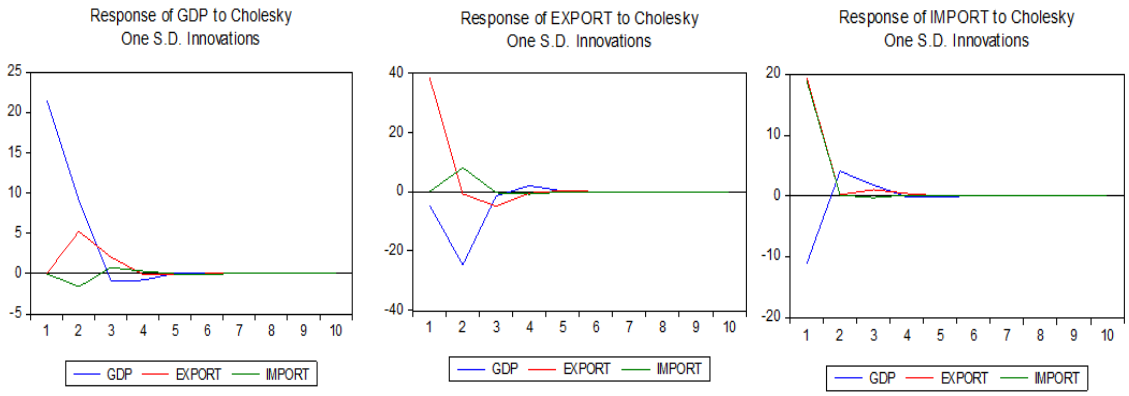

Figure 3 the Impulse Response Analysis for Laos

Figure 3 presents the results from IRFs analysis for Laos. First, there is no evidence in support of ILG as the response of GDP growth due to shocks of imports growth is not significantly different from zero at all horizons. However, IRFs supports ELG as a shock of exports has a positive and significant effect on output growth. Figure 3 also shows output growth has a negative impact on exports while there is positive impact of GDP on imports and the response of exports and imports become fluctuate around zero line after three years. Finally, there is no evidence appear to confirm relationship between imports and exports

Therefore, it supports our VAR findings that exports growth causes GDP and further highlights the significant role of exports in Laos's economic growth.

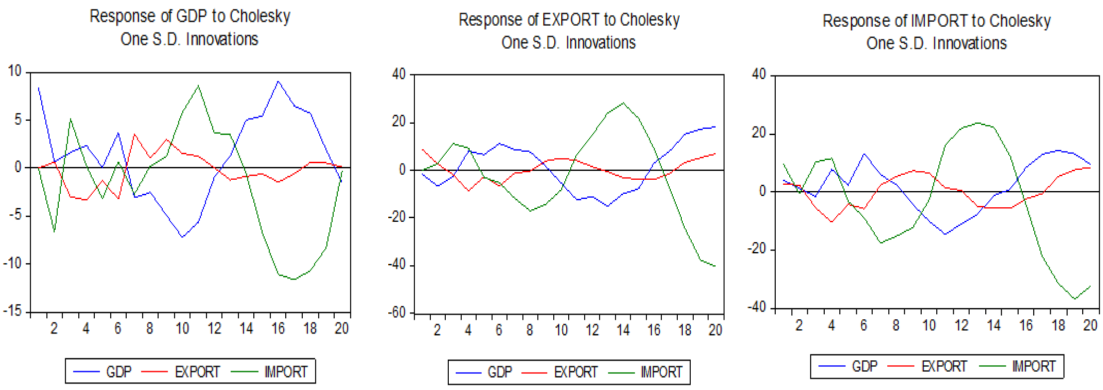

Figure 4 the Impulse Response Analysis for Philippines

According to the Figure 4, first panel presents the impact of GDP growth (GDP) shock, exports growth (EXPORT) shock and imports growth (IMPORT) shock on GDP. Response of GDP to IMPORT obvious fluctuation whiles the response of GDP to EXPORT smooth fluctuation and reach to initial equilibrium. The result also shows that the imports growth (IMPORT) has large effect on GDP growth than exports growth (EXPORT).

The second panel of Figure 4 shows the impact of GDP growth (GDP) shock, exports growth (EXPORT) shock and imports growth (IMPORT) shock on exports growth. Response of EXPORT to IMPORT and GDP obvious fluctuation and the affect move out from initial equilibrium in the long-run. The result suggests that the IMPORT has large effect on exports growth than effect of GDP on EXPORT.

The third panel presents the impact of GDP growth (GDP) shock, exports growth (EXPORT) shock and imports growth (IMPORT) shock on imports growth. Response of IMPORT to GDP and the response of IMPORT to EXPORT obvious fluctuation around the zero line and the impact of imports itself have large effect than GDP growth and exports growth.

Thus, IRFs suggests imports in Philippines have large effect on other variables than exports growth and GDP growth which highlight important of imports policy to driving economic growth.

To investigate further the impact of exports growth on GDP growth as compared to imports growth, we then have used impulse response function to trace the time paths of GDP in response to a one-unit shock to the variables such as exports growth and imports growth. The first panel of Figure 5 shows the response of GDP to shock of exports obvious fluctuation. The effect is negative and the response reach minimum when the period of response is 4, then the response extent increase. The response of GDP to shock of imports also fluctuation but the imports growth has less effect than exports growth.

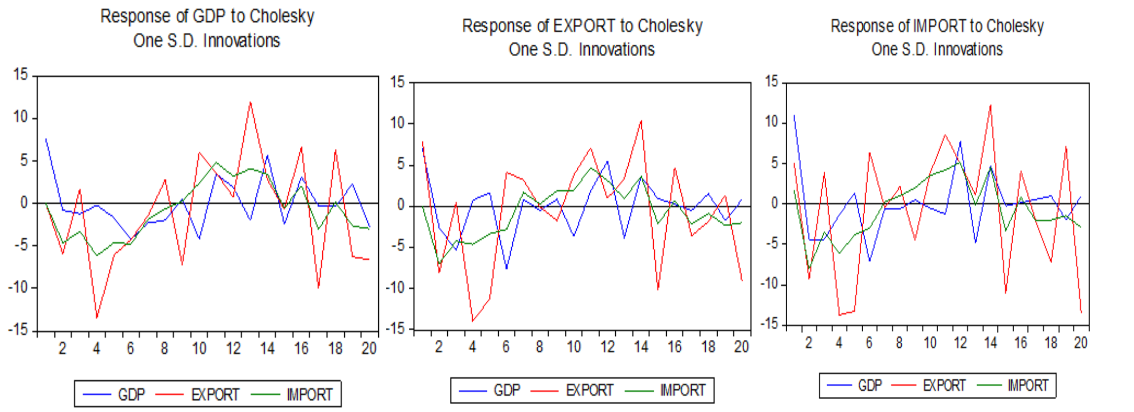

Figure 5 the Impulse Response Analysis for Singapore

The second panel of Figure 5 shows the response of exports growth to shock of GDP and imports growth which obvious fluctuate. Moreover, the response of exports growth to shock of GDP has larger effect than imports growth.

Finally, Figure 5 shows the response of imports to shock of GDP and exports which varies all time horizons. Moreover, the response of imports growth to shock of exports has larger effect than GDP growth.

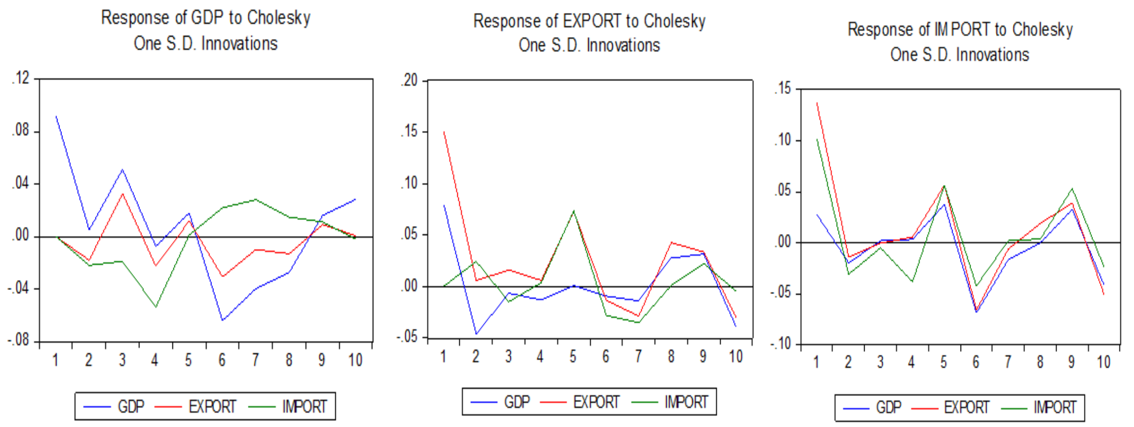

Figure 6 the Impulse Response Analysis for Vietnam

According to the Figure 6, the first panel shows the impact of GDP growth (GDP) shock, exports growth (EXPORT) shock and imports growth (IMPORT) shock on GDP. The response of GDP to one S.D. innovations of imports growth is negative from the first period, then the response reach minimum when the period of response is 4, after that, the response extent increases and reaches to initial equilibrium after ten years. The response of GDP to exports growth fluctuates around zero line and reaches to initial equilibrium after ten years. The result shows that the imports growth has large effect on GDP growth than exports growth.

The second panel of Figure 6 shows the impact of GDP growth (GDP) shock, exports growth (EXPORT) shock and imports growth (IMPORT) shock on exports growth. Response of EXPORT to GDP is negative and the response extent increases when the period of response is 7. The response of EXPORT to IMPORT obvious fluctuates but moves around zero line. The result shows that the imports growth (IMPORT) has large effect on exports growth than GDP growth (GDP).

Finally, Figure 6 shows the impact of shock GDP growth (GDP), exports growth (EXPORT) and imports growth (IMPORT) on IMPORT. Response of IMPORT to GDP and the response of IMPORT to EXPORT obvious fluctuate and move in the same direction.

5. Concluding remarks

In this study, Copula-VAR analysis was applied to investigate the causal relationship among the variables of annual GDP growth, import growth, and export growth belonging to the period 1980–2010 of ASEAN countries (Brunei, Vietnam, Malaysia, Indonesia, The Philippines, Singapore, Thailand, and Laos). The contributions of this paper are the following: 1) export growth and import growth are included in the model as endogenous variables which previous empirical studies specify as exogenous variables. 2) We employ copula-VAR model (suggested by Bianchi, et. al (2010)) and the result suggests that the copula approach are fit to construct the VAR model in ASEAN case.

In particular, these results indicate that relationship among imports, exports, and output have different qualitative relationships in each country. Moreover, results suggest there is a causal relation among imports, exports, and output in Malaysia, Thailand, and Brunei. In contrast, the study found empirical evidence in support of bi-directional causal relationship between exports and GDP growth for Laos and The Philippines. Furthermore, the results of Indonesia, Singapore, and Vietnam support only ELG hypothesis, not GLE hypothesis. Empirical results also suggest that there is evidence in support of ILG hypothesis for The Philippines, Indonesia, Singapore, and Vietnam.

This study's results confirm that the exclusion of imports and the singular focus of many past studies on merely the role of exports as the engine of growth may be misleading or lead to incomplete results. Current empirical evidence from selected ASEAN countries provides empirical support for both ELG and ILG hypothesis, and in some cases there is also evidence to suggest the impact of import growth as larger than export growth on GDP growth, which implies the importance of import policy. Thus, it is reasonable to conclude that for several ASEAN countries, both exports and imports play a very important role in stimulating economic growth.

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