DLSU Business & Economics Review 22.1 (2012), pp. 1-26

The Role of Global Production Networks (GPN) in Understanding the Impacts of the United States' and China's Macroeconomic Stimulus on the ASEAN Economies[1]

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The economic performance of the Association of Southeast Asian Nations (ASEAN) has been growing fast due to the utilization of Global Production Networks (GPNs) facilitated by liberalization, deregulation, and impact of information and communication technology (ICT). In the midst of the global financial crisis, ASEAN is affected by the downturns in the global economy especially with the United States (US). As shocks are introduced to global trade, ASEAN will be influenced significantly especially the region's most open economies, whose exports represent a substantial percentage of its Gross Domestic Product (GDP). China, where ASEAN has a trade surplus due to exports of raw materials and component electronics and computer parts for re-export is deemed to be the key in sustaining the region's economies. This suggests that nations are really interdependent with each other and that no single economy can decouple from the rest of the world in terms of economic performance. For instance, a drop in China's exports to the rest of the world will have negative consequences on the ASEAN economies that supply the necessary raw materials that China will require for exports to the rest of the world specifically in US.

Vector Autoregression (VAR) was implemented to investigate the vulnerability of trade between US, China, and ASEAN. It generally revealed that these economies are indeed interdependent of each other especially in trade, responsible for their economic growth. Results also show that the economic growth experienced by ASEAN brings about positive effects to China's exports sector since ASEAN is the major supplier of raw materials and one of the major importers of China's exports. Therefore, ASEAN needs to open up further for trade and ensure that the strong linkages within the region are not weakened by trade barriers. There is also a need to deepen the regional cooperation efforts in macroeconomic coordination, deepening of development cooperation initiatives in capacity building, human resource development, research and development, and trade and investment facilitation.

Keywords: global production networks, Vector Autoregression, macroeconomic stimulus

INTRODUCTION

The economic performance of the Association of Southeast Asian Nations (ASEAN) region has been registering a fast economic growth attributable to increase in exports. The increase in exports can be traced from the utilization of Global Production Networks (GPNs), which is facilitated by forces of liberalization, deregulation, and impact of information and communication technology (ICT). GPN is a nexus of interconnected functions and operations in which goods and services are produced, distributed, and consumed that can provide perspectives to pattern of trade and investments (Tullao, Conchada, & Aguinaldo, 2005).

With the global crisis resulting to declining exports volume and tight liquidity squeezed by foreign capital outflow, the ASEAN has not yet decoupled itself from the downturns in the economy of the United States (US). According to Crispin (2008), as global trade collapses, ASEAN will be hit harder especially the region's most open economies, namely Singapore and Malaysia, where merchandise exports represent around 200% and 100% of Gross Domestic Product (GDP) respectively. Likewise, Thailand, Indonesia, and the Philippines, whose exports represent a substantial percentage of GDP, can also experience declining growth.

China, where ASEAN has a trade surplus due to exports of raw materials and component electronics and computer parts for re-export to third world nations, might sustain the region's economies but have faltered with recent softening in their export figures. Meanwhile, as cited in Crispin (2008), economists say that the stimulus package coming from China has been customized to cushion the domestic economy but has no indications of lifting the region's sinking economies. China can be a positive factor for ASEAN commodity exporters in 2009.

Credit Suisse's research revealed that recent growth of ASEAN exports to China were largely intermediate goods intended for final exports to US, Europe, and Japan. It investigated how much ASEAN has really decoupled from US demand, noting that 70% of intra-Asian trade was in intermediate goods and that more than half of China's total imports were destined for re-export to mainly Western markets. As such, slackening commodity demand, including from China, will impact adversely on several ASEAN economies.

Hence, it is interesting to inquire on the extent to which the trade-geared economies of ASEAN members will fall in line with the global economy specifically with the US and China's extensive utilization of GPNs. Moreover, is the drop in US's GDP adversely affects China's exports to US and China's imports from the ASEAN? Given such key questions and using GPN as the focus, the objectives of this study is to determine whether the ASEAN manufacturing sector's exports to China is sensitive to China's exports, US GDP, and European Union (EU) GDP; and is less sensitive to China's GDP. Results will have implications on stimulating large economies. For instance, stimulating China's economy may or may not be as effective relative to stimulating the US economy to mitigate the impact of an economic crisis in the ASEAN.

ECONOMIC STIMULUS FROM DEVELOPED ECONOMIES

Current account imbalances

The rapid expansion of economies and liberalization measures in trade and investment policies enabled ASEAN economies to experience expansion in merchandise trade over the last three decades. Consequently, the phenomenal growth of trade in ASEAN builds up trade surpluses with the leading economic blocs of the world. In 1991, East Asia posted a trade surplus with the US as shown in Table 2.1. The region's trade surplus with the US came primarily from Japan, South Korea, China, and Singapore with Japan accounting for USD 47.67 billion and China with USD 14.01 billion of the region's trade surplus with the US.

Trade expansion in East Asia continued in recent years and the trade surplus with US stretched further. However, in recent years, China emerged as the leading trade partner of US in East Asia accounting for 48.5% of the total US imports from the region and 24.8% of the US exports to the region in 2006 as shown in Table 2.2. Consequently, China has replaced Japan as the East Asian economy with the largest trade surplus with US. China's trade surplus with US in 2006 registered at USD 249.18 billion while Japan has only USD 92.26 billion. Even after the global financial crisis, China continued to post a trade surplus of USD 291.06 billion in the year 2010 as shown in Table 2.3. China's exports grew to USD 627.5 billion in 2010 from USD 574.9 billion in 2006. Japan's exports, on the other hand continued to slow down in 2010 with only USD 123.6 billion as the country fell into a recession.

The region's expansion of trade was likewise seen in the European market. In 2000, East Asian registered trade surplus with EU amounting to USD 120 billion as seen in Table 2.4. Although Japan has greater share than China of the European trade in 2000, its trade surplus with EU amounting to USD 42.96 billion was smaller compared with China's USD 44.95 billion trade surplus. South Korea and Singapore also exhibited trade surpluses with EU.

In 2006, from Table 2.5, China has overtaken Japan as the leading East Asian trade partner of

Table 2.1

Share of East Asian Exports/Imports to/from the United States Selected Countries for 1991

Country	Exports		Imports	
	Percent of Exports	Amount of Exports (in Billion USD)	Percent of Imports	Amount of Imports (in Billion USD)
Japan	55.1	95.76	48.7	48.12
South Korea	10.2	17.73	15.7	15.51
China	11.7	20.33	6.4	6.32
Singapore	5.9	10.25	8.9	8.79
Total East Asian Exports	173.8 Billion		USD 98.8 Billion	

Source: United Nations Comtrade Database

Table 2.2

Share of East Asian Exports/Imports to/from the United States Selected Countries for 2006

Country	Exports		Imports	
	Percent of Exports	Amount of Exports (in Billion USD	Percent of Imports	Amount of Imports (in Billion USD
Japan	24.2	151.86	26.8	59.60
South Korea	7.6	47.69	14.6	32.47
China	48.5	304.34	24.8	55.16
Singapore	2.9	18.20	11.1	24.69
Total East Asian Exports	627.5 Billion		USD 222.4 Billion	

Source: United Nations Comtrade Database

the EU. China registered USD 164.41 billion trade surplus with the EU representing almost 65% of the total trade surplus of East Asia with the EU. Japan, on the other hand, has registered USD 40.61 billion while South Korea has USD 22.59 billion in trade surplus with EU. The trade of Singapore with Europe is almost balance. After the global financial crisis, China's trade surplus of USD 223.79 billion continued to strengthen jumping ahead of the other East Asian countries. The exports of China grew to USD 373.54 billion in 2010 from USD 244.52 billion in 2006.

From these statistics, East Asia has generated trade surplus with an increasing and significant magnitude made by China over time and across the two major trading blocs in the world. Aside from the change, it is apparent in the data that these countries exhibited huge trade surplus that have persisted over several years, from 1991 until 2010. Consequently, several economies in the East Asian region have Balance of Payment (BOP) surpluses.

Table 2.3

Share of East Asian Exports/Imports to/from the United States Selected Countries for 2010

Country	Exports		Imports	
	Percent of Exports	Amount of Exports (in Billion USD	Percent of Imports	Amount of Imports (in Billion USD
Japan	21.5	123.56	27.5	60.54
South Korea	8.8	50.59	17.6	38.84
China	66.6	382.95	41.7	91.88
Singapore	3.1	17.75	13.2	29.15
Total East Asian Exports	574.9 Billion		USD 220.4 Billion	

Source: United Nations Comtrade Database

Table 2.4

Share of East Asian Exports/Imports to/from the European Union Selected Countries for 2000

Country	Exports		Imports	
	Percent of Exports	Amount of Exports (in Billion USD	Percent of Imports	Amount of Imports (in Billion USD
Japan	32.8	84.82	30.2	41.86
South Korea	9.6	24.83	11.1	15.38
China	26.6	68.79	17.2	23.84
Singapore	6.2	16.03	10.5	14.55
Total East Asian Exports	USD 258.6 Billion		USD 138.6 Billion	

Source: United Nations Comtrade Database

Table 2.5

Share of East Asian Exports/Imports to/from the European Union Selected Countries for 2006

Country	Exports		Imports	
	Percent of Exports	Amount of Imports (in Billion USD)	Percent of Imports	Amount of Imports (in Billion USD)
Japan	19.1	96.89	22.2	56.28
South Korea	10.1	51.24	11.3	28.65
China	48.2	244.52	31.6	80.11
Singapore	4.8	24.35	9.6	24.34
Total East Asian Exports	USD 507.3 Billion		USD 253.5 Billion	

Source: *United Nations Comtrade Database*

Table 2.6

Share of East Asian Exports/Imports to/from the European Union Selected Countries for 2010

Country	Exports		Imports	
	Percent of Exports	Amount of Imports (in Billion USD)	Percent of Imports	Amount of Imports (in Billion USD)
Japan	16.0	85.90	20.9	57.86
South Korea	9.6	51.14	13.4	37.04
China	69.8	373.54	54.2	149.75
Singapore	4.6	24.71	11.2	31.75
Total East Asian Exports	USD 535.3 Billion		USD 276.4 Billion	

Source: United Nations Comtrade Database

Table 2.7

Balance of Payment (BOP) (In Million US Dollars)

Country	2003	2004	2005	2006	2007	2008	2009	2010
United States	-1,529.00	-2,804.00	-14,100.00	-2,392.00	125.00	118.89	-261.59	-433.51
European Area	-32,802.00	-15,560.00	-22,912.00	2,562.00	5,956.00	-3,359.50	-10,131.2	23,148.78
China	116,586.00	206,153.00	207,342.00	246,855.00	461,691.00	-41,736.00	82,849.34	119,520.30
Japan	187,150.00	160,850.00	22,330.00	31,980.00	36,520.00	-104,672.00	-39,734	32,923.64
Singapore	6,703.28	12,193.00	12,314.70	17,007.50	19,640.10	1,780.66	-4,576.65	649.28
South Korea	25,791.10	38,675.00	19,864.00	22,090.10	15,109.10	4,087.04	-3,607.04	5,609.27
Malaysia	10,180.60	22,050.00	3,619.61	6,863.78	13,143.70	17,155.60	10,398.86	42,715.10

Source: International Financial Statistics (IFS)

The trend shown in Table 2.7 is consistent with the temporal and geographical variations in the trade balance of the region. Although Japan has a higher BOP surplus registered in 2003 with USD 187 billion, it was overtaken by China in 2007 when it recorded USD 461 billion compared with USD 36 billion registered by Japan. Over the years, US and EU have experienced BOP deficit although EU registered BOP surpluses in 2006 and 2007. US also recorded a BOP surplus in 2007. However, compared with the surpluses generated by Malaysia and Singapore, these BOP surpluses of US and EU are relatively small. The global financial crisis had a negative impact on the balance of payments of China, Japan, Singapore, and South Korea. By the end of 2008, the BOP of China and Japan dropped significantly to negative values. China registered a negative BOP of USD 41.74 billion while Japan experienced the biggest drop to negative BOP of USD 104.67 billion in 2008.

Adjustments in current account imbalances

Accommodating transactions in the current account

A deficit or net outflow of monetary assets in the current account must be offset by a surplus or a net inflow of monetary and financial assets in the capital account to achieve balanced national accounts. Similarly, a surplus or net inflow of monetary assets in the current account must be offset by a deficit or net outflow in the capital account in the BOP. If the current account deficit is not financed wholly by a surplus in the capital account, there will be changes in the official transactions.

The country can decrease its international reserves, sell gold, or use its special drawing rights (SDRs) allocation at the International Monetary Fund (IMF) in order to lessen the imbalance in its BOP. On the other hand, if the current account surplus is not fully covered by a deficit in the capital account, the country will accumulate more international reserves and gold or increase its allocation of SDRs.

On the other hand, if a country chooses to lessen its reserves, it becomes more vulnerable to contagion effects and attacks on its currency as seen in Asian countries during the 1997 Asian Financial Crisis (AFC). China was able to insulate itself from the currency devaluing effects of this crisis largely due to its reserves. With the global financial crisis, it may more likely hold on to its reserves in case a contagion effect on Asian investments occurred again.

Changes in the exchange rate

A current account deficit may also be addressed by devaluing the domestic currency. An increase in the domestic currency value of foreign goods will discourage imports and encourage exports, since this renders the foreign currency price of exports relatively cheaper. Similarly, a current account surplus can be addressed by an appreciation of the domestic currency.

Notions that China's currency is undervalued have sparked debates on whether or not to appreciate its currency with respect to the USD. Rogoff (2006), together with Kim and Yang (2008), postulated that greater exchange rate flexibility in Asia can help reduce the imbalances in the BOP accounts of the US and China. Cooper (2006) mentioned two arguments for adjusting China's undervalued currency. First, it will help reduce global imbalances. Second, it will help avoid the overheating of China's rapidly growing economy. Moreover, greater monetary flexibility in the face of economic shocks can be obtained from a more flexible exchange rate regime (Kim & Yang, 2008).

However, a real appreciation in China's domestic currency can lead to inflation since this triggers economic activity (Kim & Yang, 2008). Aside from this, Kim and Yang (2008) warned that huge adjustments and regulatory mechanisms are to be put in place if a change from a managed to a more flexible exchange rate regime is to be made, or else the country might experience a crisis due to an un-orderly shift in exchange rate policy. On the other hand, Rogoff (2006) also warned that the effects of autonomous exchange rate adjustments

must not to be counted on as the main drivers of bringing balance to BOP accounts but adjustments in savings and investment imbalances should also be looked at instead. Devereux and Genberg (2007) deemed that an appreciation in China's currency even improves the current account balance at low trade elasticity, and lowers the current account balance by only 1.5% of GDP, assuming a high level of trade elasticity.

Changes in domestic expenditure

A current account deficit implies excessive domestic demand that cannot be met by domestic production. Hence, there is a need to curb domestic demand including consumption through higher taxes, investments through higher interest rates, and government expenditure through reduced fiscal deficit and through a budget surplus. On the other hand, a current account surplus implies that domestic demand is deficient in meeting domestic production. Such, there is a need to expand domestic consumption through lower taxes, investments through lower interest rate, and government expenditure through deficit spending.

A contractionary fiscal policy is an option to cool down overheating economies since it also has the effects of contractionary monetary policy without the additional inflow of capital and increased exchange rates (Kim & Yang, 2008). Salvatore (2007) suggested that the US deficit may be lessened through a contractionary fiscal policy and that the surplus of emerging economies like China be reduced by fiscal expansion. These, together with a contemporaneous restructuring of other economies like Japan and Europe, should be able to bring balance to the current accounts of these economies (Salvatore, 2007). Devereux and Genberg (2007) agreed that fiscal policy is an effective measure in bringing balance to the BOP, and compared to a nominal adjustment in the exchange rate, it is not so much affected by elasticities in trade between two countries. However, Salvatore (2007) warned that fiscal policy must be used with caution because rapid shocks in one country's expenditure could render other countries to slow to adapt, thus putting them to a disadvantage, reducing their economic growth, and driving them to be less likely to trade with other nations. With respect to the US–China relationship between their respective BOPs, Eichengreen and Park (2006) suggested a contemporaneous adjustment in fiscal policy between the two countries such that the US must decrease its spending so that it lessens demand and imports as well as to adapt to the slowing down of their demand. On the other hand, China should increase domestic spending in order to create a buffer that would absorb the lost demand for its products.

GLOBAL PRODUCTION NETWORKS

Concept of global production networks.

Trade and investments pattern in the international market is partly characterized by GPN. Tullao et al. (2005) described that GPN is one of the trends in today's competitive world. Multinational corporations (MNCs) create production networks in various countries comprising of factories that manufacture products and research centres, and other aspects of a business. GPNs replaced trans-national corporations (TNCs) as the most effective form of industrial organization. This is a shift that has emerged in response to three constituent processes of globalization, namely, the ascendancy of liberalization policies, the rapid uptake of ICT, and the onset of global competition. Moreover, it is the networks that combine concentrated dispersion of the value chain across firms and national boundaries, with a parallel process of integration of hierarchical layers of network participants (Tullao et al., 2005).

Drivers of global production network

There are three major driving forces that shifted the contour of industrial organization from TNCs towards global network flagships namely liberalization, ICT, and competition. These forces

pressured global flagships to emerge and integrate their dispersed supply, knowledge, and customer bases into GPN (Ernst & Kim, 2002).

First, liberalization or institutional changes consist of four elements including trade liberalization, liberalization in capital flows, liberalization in foreign direct investments (FDI) policies, and privatization. These institutional changes permitted the integration of the domestic markets with the global markets for goods, services, and capital through changes in domestic regulations and policies. The impact of liberalization is to decrease the cost and risks in international transactions by providing an even playing field, minimizing uncertainties, and providing various choices for market access. Liberalization made it easier for TNCs to identify locational specialization among competing countries (Tullao et al., 2005)

Second, globalization of production has been likewise promoted significantly by the demand and supply impacts of ICT. International production, rather than exports, is perceived to be a primary source of competitive advantage. In this manner, ICT enables better linkages in the international market. In effect, ICT reinforces globalization by increasing the demand for it, and by creating new opportunities. Although segments of production are dispersed across countries, ICT provides a network infrastructure that allows for greater coordination among all players in the GPN (Tullao et al., 2005)

Lastly, with liberalization and rapid developments in ICT, competition in the global arena becomes complex, fierce, and dynamic. Because competition cuts across national boundaries, firms are forced to have some presence in all major markets and must be able to integrate activities across countries to reap the benefits of coordination. Since competition also cuts across sectors and market segments, it has become more difficult to develop and nurture niches for a long time. This complexity forces firms to be on guard and always on the lookout for advantages that they can exploit using liberalization and ICT as main conduits (Tullao et al., 2005)

The role of global production networks in ASEAN

The ASEAN region has benefited from GPN. MNCs such as Ford Motor Corporation saw the region as a successful GPN. Using the provisions for trade in ASEAN, Ford was able to build complementary products at their facilities in Thailand and Philippines. They specialize in producing cars in the Philippines and trucks in Thailand. Likewise, Malaysia is harnessing its competitive advantage to make it more exciting for FDIs in terms of minimal costs, good infrastructure, highly skilled workforce, stable socio-political environment, and attractive tax incentives. With their number of industrial zones, it has attracted numerous firms in electronics, computer peripherals, and semiconductors like Acer, Alcatel, Canon, Fujikura, Hewlett Packard, Intel, Motorola, Sony, and many others (Tullao et al., 2005).

In the Philippines, rapid growth of the telecommunications industry is attributed, to a certain extent, to the domination of the call centres. These are networks of national and international connections regarding customer consultations and logistical support. It is usually composed of technical or product support, customer care or service, billing collections, reservation services, fund raising, survey, direct mail follow-ups, product testing, customer acquisition, and customer activation. Language proficiency, inexpensive labor, cultural characteristics, mature telecommunication infrastructure, and the strong western orientation of the Filipinos have made the Philippines one of the popular destinations of call centres in the world (Tullao et al., 2005).

The state of global production networks has contributed so much to the diverse trade relations of countries around the world. In particular, it has changed the status of Asia and has been one of the driving forces of growth for several newly industrialized countries in the region. Kimura (2006) mentioned that the international trade pattern in Asia has started to shift worldwide since the 1990s. The constant policy movements

toward trade liberalization and networking have turned Asia into a globally-oriented continent. Yeung (2008), on the other hand, stated that Asian companies are considered "latecomers" when it comes to GPN which works to their advantage. Despite the fact that Asia has just started growing recently, especially with China loosening up their trade barriers, it has been successful in the global production network. The recent success in East Asia can be attributed to the movement from captive value chains to a higher-value-added form of exporting. (Gereffi, Humphrey, & Sturgeon, 2005) With a specific focus on East Asia, Ando, Arndt, & Kimura (2006) stated that this area of Asia is definitely the best evidence of intra-firm trade growth in the continent.

On the down side, developing countries in Asia are not that optimistic regarding global production networks. As stated by Ando et al. (2006), these countries consider foreign direct investments as "resource- exploiting" and "import-substituting" (p. 25). It is noticeable how some developing countries in Asia still value their independence; not wanting help from external sources. Given the right investment climate, FDIs can definitely work miracles in the growth of economies.

The West has always taken the lead in terms of economic movement. Asia basically uses the same pattern with the United States wherein they maximize international division of labor (Ando et. al., 2006). Furthermore, according to Yeung (2008), the technological advancements undergone by the lead countries force the Southeast Asian countries to also improve their technological status being in partnership with them. As the concepts of demand and supply work, Asia has definitely shown potential in working hand in hand with the demands of the West.

Japan has always been considered as the giant of Asia due to its advanced economic status and rapid technological development since the early years. According to Kimura (2006), Japan received the most foreign direct investments, which concentrated on manufacturing; the reason why a sudden surge in machinery parts and components trade since the 1990s. Japan has indeed been the central motivation of GNP ever since. Kimura (2006) said that companies from the West who are affiliated with Japan also moved to trade with other East Asia countries. Because of this, Kimura (2006) identified other countries that went into production networks: China, Malaysia, and Thailand.

In 2008, a financial crisis erupted in the United States and generally affected the whole world. Having had foreign direct investments from the West, Asia has indeed suffered from this crisis. According to Shah (2009), "…this crisis has shown that in an increasingly inter-connected world means there are always knock-on effects and as a result, Asia had more exposure problems stemming from the West" (par. 3). Shah (2009) further discussed that the growth of China and India has slowed down after the crisis and Japan's production has decreased by 10% in only a month. Thorbecke (2009) said that at present, the production networks in Asia are slowly catching up with a 85% recovery of imports for processing losses and a 75% for processed exports. Thorbecke (2009) further analyzed that there may be problems with production networks in Asia if they do not fix their exchange rate, especially China which has its currency pegged to the US dollar.

The 2008 global financial crisis affected production networks and trade flow in East Asia. Athukorala (2010) highlighted the impact of the crisis on trade through the vertical integration of global production. Vertical integration pertains to the production process divided into several parts and subcontracted in various countries. The contraction in demand for a final assembled good has an impact on trade flows from other countries that took part in the production chain. East Asia's trade contraction was more significant than in other countries because of its role in the vertical integration of global production (Athukorala, 2010). In table 2.3, total exports of East Asia contracted to USD 574.9 billion in 2010 from USD 627.5 billion in 2006. Japan was the worst hit by the global crisis since a large share of its

exports consisted of capital goods and high-end durable consumer goods. Most of these exports are heavily concentrated in the US and Europe. In addition, China's imports from most countries in East Asia and the ASEAN have also contracted. Mostly, imports of China of supply of parts and components to information and communications technology were affected due to less demand from the US (Athukorala, 2010).

In recent developments regarding GPN, Yeung (2008) found out that venture capitalism boosts global production networks. Venture capitalism basically focuses on investing on other firms with potential. This basically is not a policy for GPN but something new that has helped bolster the economic movement in Asia. Furthermore, Thorbecke (2009) imposed a new policy that could help the recovery of the wounded Asia: a stable intra-regional exchange rate. This would indeed aid and strengthen the already formed global production networks in the region. This can be supported by regional trade agreements such as the ASEAN.

One cannot deny the fact that GPN has served as a channel by which knowledge and technology was transferred from the home country to the ASEAN region. This is manifested through a more educated labor force, in terms of the acquired skills and work habits, and an enhanced infrastructure in the areas of telecommunication and transportation.

VULNERABILITY TO THE ECONOMIC PERFORMANCE OF UNITED STATES, EUROPEAN UNION, AND CHINA

Vector autoregression and Preliminary tests

In examining the sensitivity of the ASEAN trade sector to external factors such as the economic performance of US, EU, and China, together with the existence of GPNs, a Vector Autoregressive (VAR) model will be utilized. It utilizes a dynamic multivariate time series, which is widely used in analyzing the dynamic behavior of time series variables with a purpose for forecasting, structural inference, and policy analysis (Enders, 2004). VAR resembles simultaneous or structural equation except that several endogenous variables are considered together. Each endogenous variable is explained by its lagged values of all other endogenous variables in the model (Gujarati, 2003). Thus, the VAR methodology is a-theoretic, in which the data generation of the process determines the model.

Before implementing time series analysis such as VAR, the data must be subjected to unit root testing to verify stationarity. According to Gujarati (2003), stationarity is necessary in order to guard against spurious regressions wherein there would exist nonsensical relationship when one non-stationary time series endogenous variable is regressed against one or more exogenous non-stationary time series variables. In addition, the Johansen Cointegration Test was conducted to establish how many cointegrating vectors the system has. Cointegration is an econometric property of time series variables wherein if two or more series are non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated. It is the presence of long run co-movement among the variables of interest and can be determined using this test.

Data requirements

The data requirements for this study are time series quarterly data for the GDP of US (*USGDP*), EU (*EUGDP*), China (*PRCGDP*), Japan (*JAPGDP*), and ASEAN (*ASEANGDP*) from the first quarter of 1991 until the fourth quarter of 2010. The time series data for China's import from the ASEAN (*PRCM*) or ASEAN exports to China (*ASEANX*) will also be required. Likewise, the imports of US (*USM*), EU (*EUM*), and Japan (*JAPM*) will also be needed. Lastly, other necessary variables such as inflation (*ASEANINF*) and nominal exchange rate (*ASEANNEER*) for ASEAN will be included. Such datasets will be sourced from the International Financial Statistics (IFS) and from the ASEAN Secretariat database.

Model specification

The VAR (p) model to be estimated will determine the susceptibility of ASEAN to shocks from its major trading partners such as US, EU, Japan, and China. The specific VAR (p) models of interest are shown by Equations 1 to 3. Note that the optimal lag structure p of the VAR model is determined by the lowest Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) (Gujarati, 2003).

$$PRCX_t = f(USGDP_t, EUGDP_t, PRCGDP_t, JAPGDP_t, ASEANGDP_t, USM_t, EUM_t, JAPM_t, ASEANX_t, ASEANINF_t, ASEANNEER_t) \quad (1)$$

$$ASEANX_t = f(USGDP_t, EUGDP_t, PRCGDP_t, JAPGDP_t, ASEANGDP_t, PRCX_t, ASEANINF_t, ASEANNEER_t) \quad (2)$$

$$ASEANGDP_t = f(USGDP_t, EUGDP_t, PRCGDP_t, JAPGDP_t, ASEANX_t, ASEANINF_t, ASEANNEER_t) \quad (3)$$

Based on equations above, the variance decompositions and impulse response functions can be generated, which will serve as bases for inferences. Variance decompositions partition the variations in a variable of interest to shocks in other variables in the system including its own innovations (Gujarati, 2003). It provides measures of relative importance of various shocks in explaining the concerned variable. Meanwhile, the impulse-response functions trace the responses of the variables in the system to one standard deviation shocks in other variables by capturing the directions, magnitudes, and persistence of a variable's responses to impulses in the system (Enders, 2004).

In line with existing studies, a Reduced Form VAR will be implemented to examine the extent to which the trade-geared economies of ASEAN members will fall in line with the global economy specifically with the US and China's extensive utilization of GPNs. VAR expresses the current value of each m series as a weighted average of the past of all series plus a disturbance term ε_t that represents all factors that affect the series but is not taken account explicitly. To begin, a VAR model is specified by Equation 4:

$$Y_t = A_0 + \sum_{k=1}^{p} A_k Y_{t-k} + \varepsilon_t \quad (4)$$

Where Y_t is a vector of n variables specified earlier, A_0 is an $n \times 1$ vector of constant terms, A_k is an $n \times n$ matrix of coefficients, ε_t is an $n \times 1$ vector of stochastic error terms*, and p is the order of autoregression. However, there is uncertainty about ε_t because the past observations of Y_t are unknown and it will have to be estimated from the available data. However, such uncertainty is lessened, assuming that ε_t is a random vector having a zero mean, the error covariance matrix S is positive definite, and ε_t is uncorrelated with past observations of Y_t (Robertson & Tallman, 1999). Hence, the lag order of the VAR (p) is set such that the error terms are serially uncorrelated.

The interpretation of the VAR (p) shown by Equation 4 is normally based on its moving average representation. By successive substitution, Equation 4 has a moving average representation shown by Equation 5:

$$Y_t = B_0 + \sum_{k=1}^{q} B_k \varepsilon_{t-k} + \varepsilon_t \quad (5)$$

* In VAR, the vector of stochastic error terms is also called impulses, innovations, or shocks (Gujarati, 2003).

Where Y_t is a vector of n variables to be specified later, B_0 is an $n \times 1$ vector of constant terms, B_k is an $n \times n$ matrix of coefficients, ε_t is an $n \times 1$ vector of error terms, and q is the moving average order. The lag order of the VAR (q) is set such that the stochastic disturbance terms are non-autocorrelated.

Variance decomposition and impulse response analysis.

Given the aforementioned backdrop on VAR, Y_t is expressed as a linear combination of contemporaneous and previous innovations. Based on Equation 5, the variance decompositions and impulse response functions can be generated that will serve as basis for statistical inferences. Basically, variance decompositions partition the variations in a variable of interest to shocks in other variables in the system including its own innovations (Gujarati, 2003). Thus, they provide natural measures of relative importance of various shocks in explaining the concerned variable (Enders, 2004). Meanwhile, the impulse-response functions trace the responses of the variables in the system to one standard deviation shocks in other variables (Gujarati, 2003). They capture the directions, magnitudes, and persistence of a variable's responses to impulses in the system (Enders, 2004).

One important aspect that needs to be pointed out, which pertains to the generation of variance decompositions and impulse-response functions, is that innovations in Equation 5 may be contemporaneously correlated. This means that a shock in one variable may work through the contemporaneous correlation with innovations in other variables. Since isolated shocks to individual variables can not be identified due to contemporaneous correlation, the responses of a variable to innovations in another variable of interest can not be adequately represented (Enders, 2004). To solve this identification problem, Sims' (as mentioned in Enders, 2004) suggested an empirical strategy that orthogonalizes the innovations using the Cholesky factorization (Enders, 2004).

The results of the variance decomposition in Equation 1 are shown in Figure 4.1. It plots the variations, shown in Appendix 3.1, in *PRCX* accounted by innovations coming from the other variables of interest. The variations are plotted together with two standard deviation bands. Generally stated, if the bands do not encompass zero, then the variations are significantly different from zero. Notice that *PRCX*, *PRCGDP*, and *USGDP* cause significant variations in *PRCX* reaching up to approximately 30%. Comparatively, the disturbances coming from *JAPGDP, ASEANGDP*, *USM*, *EUM*, *JAPM*, and *ASEANX* are relatively the same. Domestic variations coming from *ASEANINF* and *ASEANNEER* have a relatively small impact on *PRCX* explaining only approximately 1% of the variation. Note that the influences of the economic performance of China's major trading partner, US, brings about variations in China's exports over the period studied. Indeed, it shows that China's trade performance is not decoupled with US. Such finding is consistent with the findings of Park (2009).

The results of the impulse-response function, as seen in Figure 4.2, show that the shocks in *PRCX* are mainly generated by *PRCX* itself and the GDPs of US, EU, Japan, and ASEAN but at initial periods only. This supports the initial results that the economic performances of China's major trading partners seem to be the major source of China's export fluctuations. Note that the response of *PRCX* to one standard deviation shock in domestic variables such as *ASEANINF* and *ASEANNEER* are insignificant. Therefore, given the variance decomposition results, the effect of *USGDP, EUGDP, JAPGDP*, and *ASEANGDP* on China's exports are relatively more important. Such results imply that the economies are highly coupled. Likewise, this reinforces the findings of Park (2009).

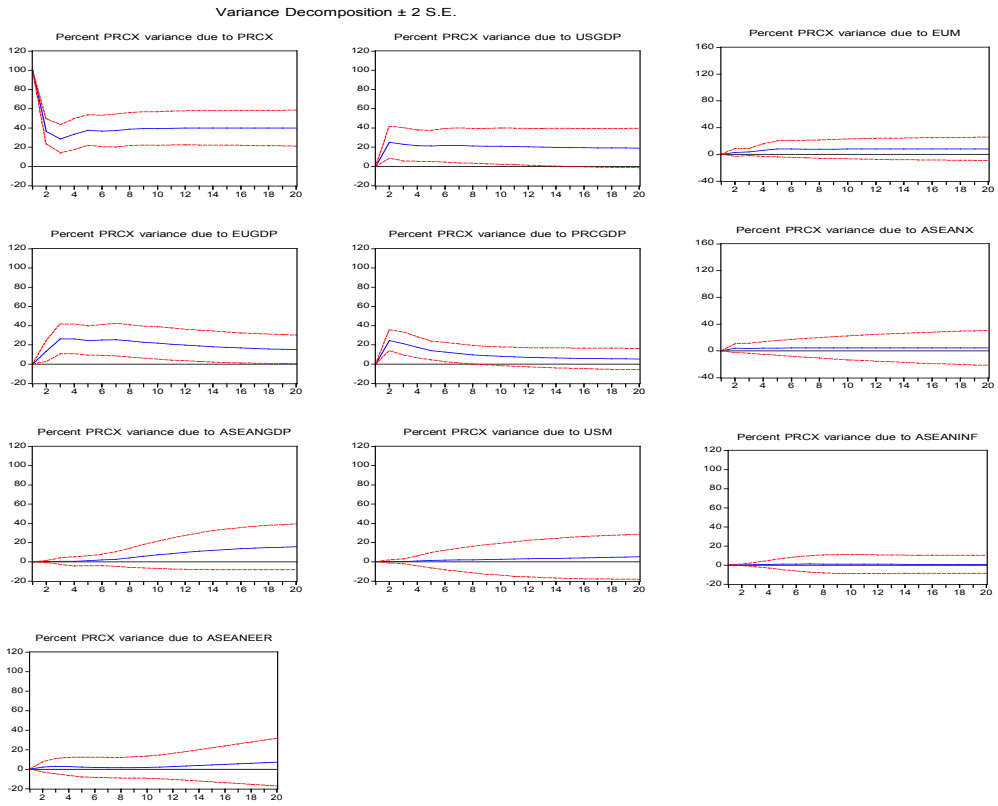

Figure 4.1. Variance decomposition for equation 1

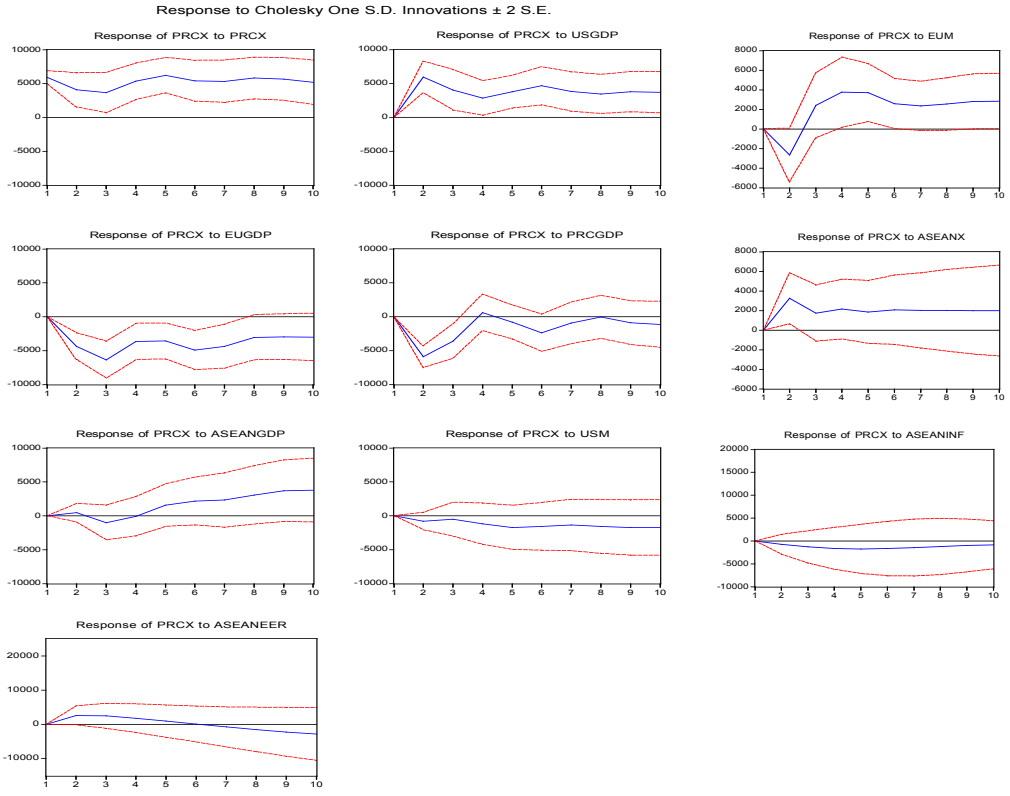

Figure 4.2. Impulse-response for equation 1

Results of the variance decomposition in Equation 2 are shown in Figure 4.3 plotting the variations, shown in Appendix 3.2, in *ASEANX* accounted by innovations from the other variables. Note that *ASEANX* and *USGDP* cause significant variations in *ASEANX* up to 30% also. Likewise, the disturbances from *PRCGDP*, *JAPGDP, ASEANGDP*, *USM*, *EUM*, *JAPM*, and *PRCX* are relatively same. Domestic innovations from *ASEANNEER* and *ASEANINF* have a minimal contribution to variations in *ASEANX*. Indeed, the demand for ASEAN's products by China and then by US is significant. The US stimulates China's demand for ASEAN's raw materials due to their increased demand for final goods. Thus, the economies of ASEAN, China, and US are highly coupled. Again, it reinforces initial results presented and the results of Park (2009).

The results of the impulse-response function, as seen in Figure 4.4, show that the shocks in *PRCX* are mainly generated by *PRCX* itself and the GDPs of US, EU, Japan, and ASEAN but at initial periods only confirming that the economic performance of China's major trading partners is the major source of their export fluctuations. Note that the response of *PRCX* to shocks in domestic variables such as *ASEANINF* and *ASEANNEER* are insignificant. Thus, the effects of *USGDP, EUGDP, JAPGDP*, and *ASEANGDP* on China's exports are relatively more important.

Results of the variance decomposition in Equation 3 are shown in Figure 4.5 plotting the variations, shown in Appendix 3.3, in *ASEANGDP* accounted by innovations from the other variables. Note that *ASEANGDP*, *PRCGDP*, and *JAPGDP* cause significant variations in *ASEANGDP* up to 50%. The disturbances from the other variables are relatively same. Domestic innovations from *ASEANNEER* and *ASEANINF* have a minimal contribution to variations in *ASEANX*. Indeed, the demand for ASEAN's products by China and Japan is significant in stimulating the ASEAN economy. Likewise, the economies of ASEAN, China, and Japan are highly coupled.

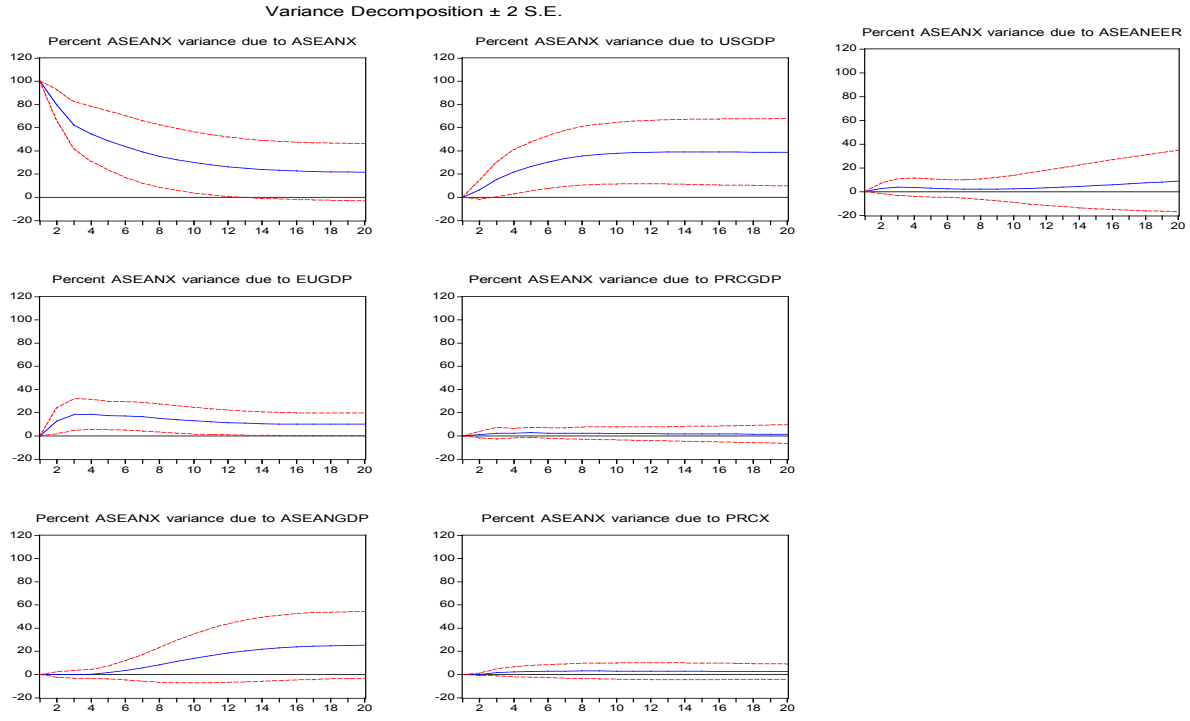

Figure 4.3. Variance decomposition for equation 2.

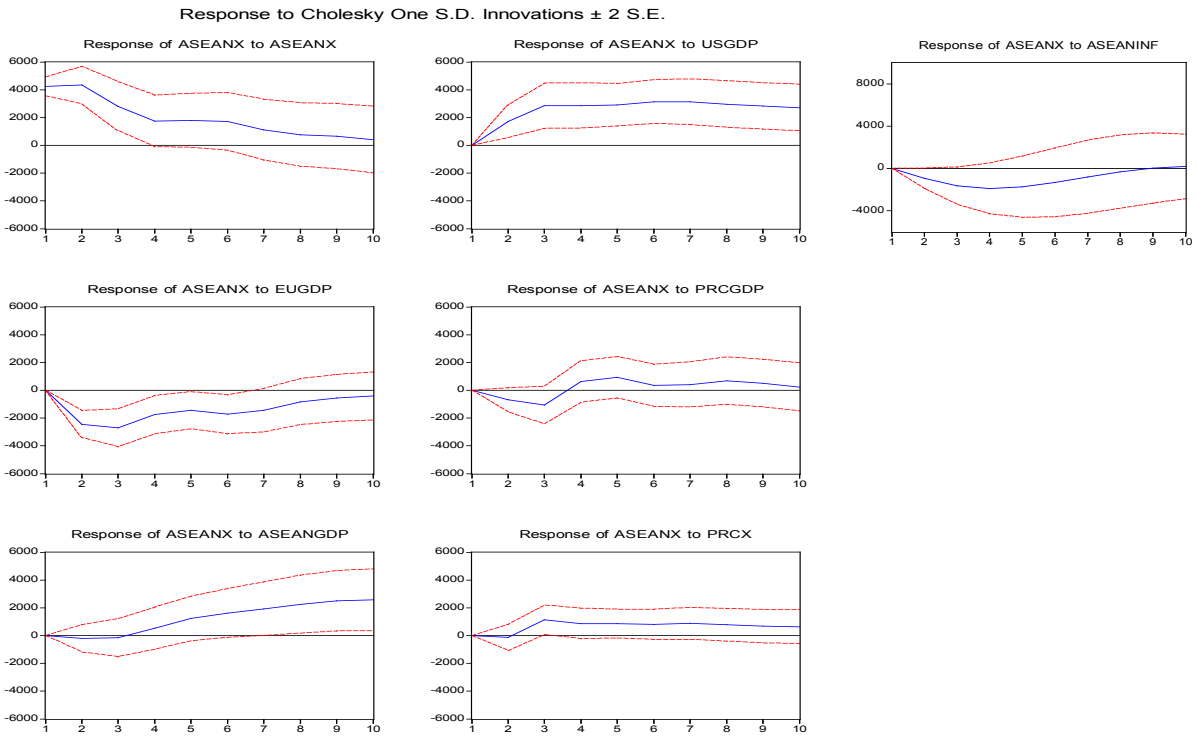

Figure 4.4. Impulse-response for equation 2.

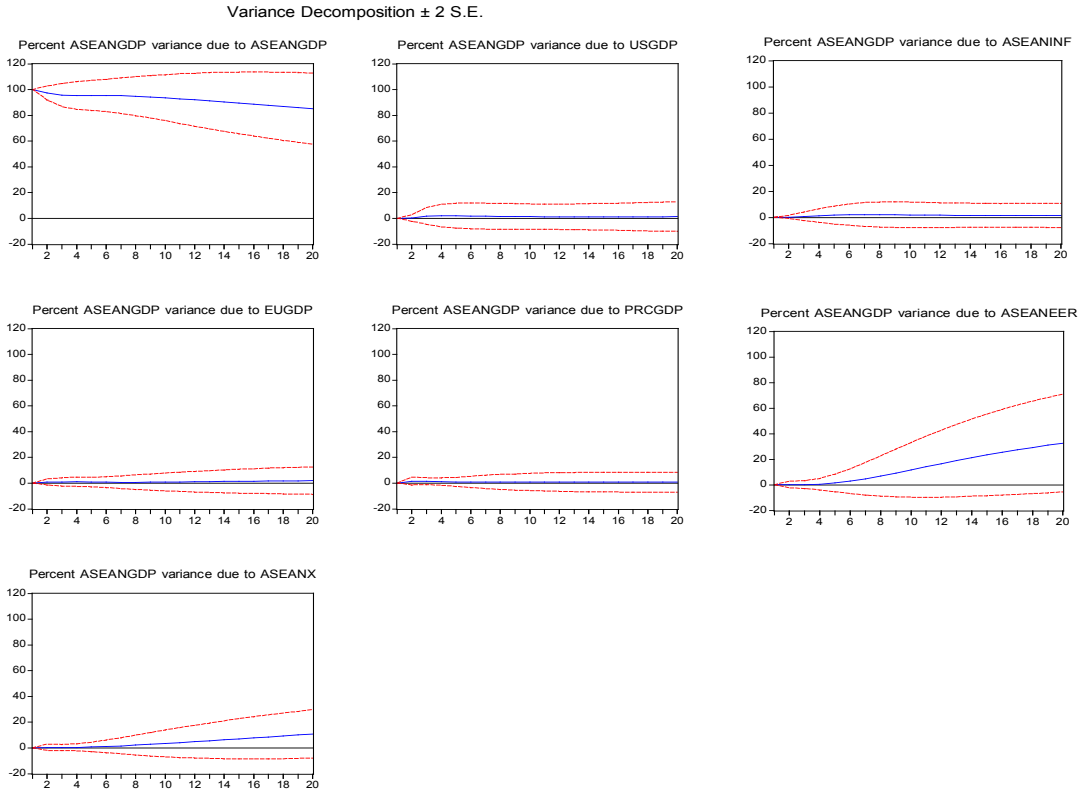

Figure 4.5. Variance decomposition for equation 3.

Results of the impulse-response function, as seen in Figure 4.6, show that the shocks in *ASEANGDP* are mainly generated by *ASEANGDP, PRCGDP,* and *JAPGDP*. Note that the response of *PRCX* to shocks in domestic variables such as *ASEANINF* and *ASEANNEER* are insignificant. Thus, the effects of *USGDP, EUGDP, JAPGDP*, and *ASEANGDP* on ASEAN exports are relatively more important than the other variables.

Therefore, across all equations estimated together with its accompanying variance decomposition and impulse-response functions, it can be seen that the economic performance of the US indeed affects the economic growth in the ASEAN region as well as China's trading activities. Likewise, China's economic performance, when it comes to international trade with its major trading partners, affects the economy of the ASEAN region. Such results are consistent with Park (2009) wherein China has a vital role in intra-regional trade that is destined to external markets other than the Asian markets. Indeed, China's exports to US, Japan, and Europe are indeed correlated with China's imports from ASEAN. Most importantly, results demonstrated that the ASEAN region is indeed tied to the economic performance of developed countries specifically US.

The global financial crisis that started in the US heavily affected the economies of the ASEAN region as reflected in the variance decomposition and impulse-response. The impact was evident in the exports (mostly of semi-finished goods) of the ASEAN region to its major trading partner, China. The slowdown in the economies of the US and the EU negatively affected their demand for goods coming from China, who in return imports from the ASEAN region.

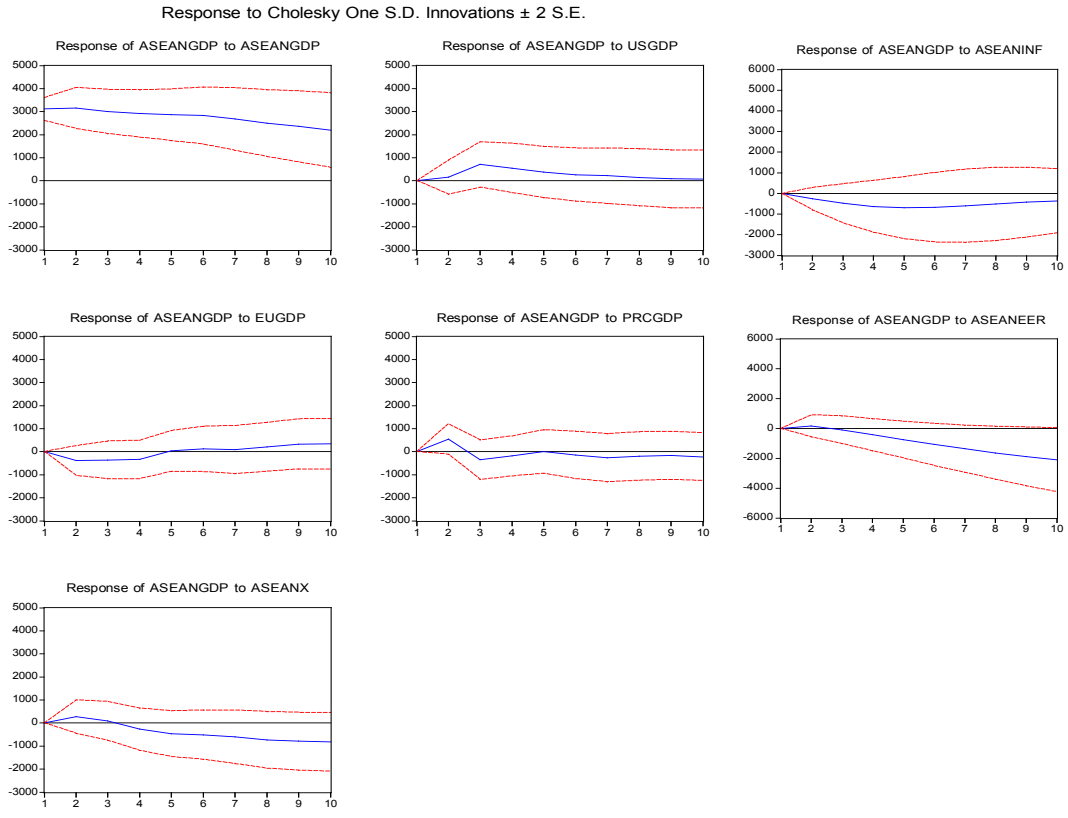

Figure 4.6. Impulse-response for equation 3.

CONCLUSION AND POLICY IMPLICATIONS

ASEAN indeed has a vital role in global trade due to its increasing trade volume in and out of the region, specifically on manufactured goods such as electronics. Hence, this resulted to the utilization of GPN wherein raw materials and work-in-progress goods are sourced from ASEAN's developing economies. In turn, these countries will export the semi-finished goods to China for the production of the final good for domestic consumption and for export to the rest of the world. Thus, it is the huge demand of the world, especially developed countries, that fuels trade between China, ASEAN, and the rest of the world. This suggests that countries are really interdependent with each other and that no single economy can decouple from the rest of the world in terms of economic performance. For instance, a drop in China's exports to the rest of the world will have negative consequences on the ASEAN economies that supply the necessary raw materials that China will require for exports to the rest of the world.

Using VAR to investigate on the impacts of trade between China and ASEAN revealed that China and ASEAN economies are indeed interdependent in trade. Results show that the economic growth experienced by ASEAN brings about positive effects to China's exports sector since ASEAN is the major supplier of raw materials and one of the major importers of China's exports. Moreover, the shocks coming from China to ASEAN comes through ASEAN exports which will eventually affect ASEAN's GDP. Also, the impact of China's GDP on ASEAN exports occurs at several lags implying that the shocks have delayed effects distributed across time.

Also, variations in ASEAN's exports and GDP are dominated by previous variations of ASEAN's exports and GDP itself. Internal variation exists because ASEAN is a large economy. Likewise, disturbances from China that impacted ASEAN exports will continue further in the more recent variations in ASEAN exports. Also, despite the linkages of ASEAN with China, US, and the rest of the world, ASEAN is susceptible to disturbances within itself.

Furthermore, innovations coming from China's GDP significantly affect ASEAN's GDP. Hence, China's economic growth affects ASEAN exports, which in turn affect ASEAN's economic growth showing that there is a direct effect of China's economic growth to ASEAN's exports growth. Eventually, China's economic growth will bring about economic growth in the ASEAN. Similarly, this reflects that fact that the share of international trade to GDP in China is so much higher than other large economies in the world is indicative of the remarkable role that international trade has played in China's growth process. Hence, due to this effect, ASEAN needs intensive efforts in maintaining economic stability. Moreover, the region's growth based on the global production network depends highly on extra-regional trade due to the demand for finished goods in the US and other developed countries.

The global economy is still under a cloud of the negative impact of the global financial crisis and the region is far from being exempted. Some countries such as the Philippines have started to strengthen the foundations of financial stability as a short term response to the crisis. There is a need to ensure adequate and timely foreign and domestic liquidity by making credit, for instance, available to trade activities. Crisis management frameworks such as an institutional arrangement for emergency liquidity should also be set in place. In the event that the eurozone crisis worsens into a full-blown economic crisis coupled with the slow recovery of the US economy, fiscal policy could cushion the impact in the ASEAN's growth. Since the 2008 crisis, many economies have started consolidating public finance leading to better fiscal positions. This could put the region in a better position to reintroduce fiscal stimulus for sustained growth (Asian Development Bank [ADB], 2011) to protect vita industries included in the global production network.

Given all the results, ASEAN needs to promote trade further. As the results suggest, China and ASEAN's economic conditions are correlated with each other. Hence, it is important that the strong economic linkages within the region are not weakened by the rise in tariffs or non-tariff barriers by individual countries as a means of protecting domestic producers.

Finally, there is a need to deepen regional cooperation efforts for the promotion of macroeconomic coordination and deepening of cooperation initiatives in capacity building, human resource development, research and development, trade facilitation, and investment generation. The regional approach to trade and investment policymaking is more important than a global approach as it is easier and less time consuming to mobilize. However, free trade agreements could pose difficulties for non-member countries because of the rules of origin (ROO). Rules of origin in the free trade agreements could have trade-distorting effects that could be detrimental to the global production network (Athukorala, 2010) due to administrative concerns. One policy implication is for regional trading blocs to recognize open regionalism. This implies that the rules of origin could be relaxed and made uniform across regions.

NOTES

[1] Culled from Tullao, Conchada, & Rivera. (2009). *The Role of Global Production Networks in Understanding the Impacts of the Fiscal Stimulus in the United States and China on ASEAN Economies*. Asia-Pacific Trade Economists' Conference. United Nations ESCAP-ARTNet. Bangkok, Thailand.

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REFERENCES

Athukorala, P. (2010). *Production networks and trade patterns in East Asia: Regionalization or globalization* (ADB Working Paper Series on Regional Economic Integration No. 56). Mandaluyong: Asian Development Bank. Retrieved from www.adb.org/publications/category.asp?id=2805

Ando, M., Arndt, S., & Kimura, F. (2006). Production networks in East Asia: Strategic behavior by Japanese and U.S. firms. *Japan Center for Economic Research*, 103. Retrieved from http://www.eaber.org/intranet/documents/40/886/JCER_Ando_06.pdf

Asian Development Bank (ADB). (2011). Asia economic monitor. Retrieved on March 30, 2012, from http://aric.adb.org/pdf/aem/dec11/Dec_AEM_complete.pdf

Cooper, R. (2006). Living with global imbalances: A contrarian view. *Journal of Policy Modeling, 28*(issue 6), 615–627.

Crispin, S.W. (2008, December 25). Down and still coupled. *Asia Times Online*. Retrieved from http://www.atimes.com/atimes/Southeast_Asia/JL25Ae01.html

Devereux, M.B., & Genberg, H. (2007). Currency appreciation and current account adjustment. *Journal of International Money and Finance, 26*(issue 4), 570–586.

Eichengreen, B., & Park, Y.C. (2006). *Global imbalances: Implications for emerging Asia and Latin America*. Paper presented to Fondad, the Hague, 28-29 February.

Enders, W. (2004). *Applied econometric time series* (2nd ed.). New Jersey, U.S.: John Wiley and Sons, Inc.

Ernst, D., & Kim, L. (2002). Global Production Networks, knowledge diffusion, and local capability formation. *Research Policy, 31 (8-9), 1417-1429*. Retrieved from http://www.eastwestcenter.org/stored/misc/Global_production.pdf

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy, 12*(1), 78–104. Retrieved from http://www.global-production.com/scoreboard/resources/sturgeon_2005_governance-of-value-chains.pdf

Gujarati, D.N. (2003). *Basic econometrics* (4th ed.). Singapore: McGraw-Hill Companies, Inc.

Kim, S., & Yang, D.Y. (2008). The impact of capital inflows on emerging East Asian economies: Is too much money chasing too little good? (ADB Working Paper Series No. 15 on Regional Economic Integration). Mandaluyong: Asian Development Bank.

Kimura, F. (2006). International production and distribution networks in East Asia: Eighteen facts, mechanics, and policy implications. *Asian Economic Policy Review, 1*(2), 326–344. Retrieved from http://www1.doshisha.ac.jp/~ccas/eng/Eseminars/e2007-11b.pdf

Mulligan, R.F. (2005). The Austrian business cycle: A vector error-correction model with commercial and industrial loans. *The Journal of Private Enterprise, 21(1),59-91*. Retrieved from http://journal.apee.org/index.php?title=Fall2005_5

Park, C.Y. (2009). Global economic crisis: Impacts and policy options. *Asia-Pacific Social Science*

Review, 9(1), 51-74.

Robertson, J.C. & Tallman, E.W. (1999). Vector autoregressions: forecasting and reality. *Federal Reserve Bank of Atlanta Economic Review.* First quarter, 4–18.

Rogoff, K. (2006). Global imbalances and exchange rate adjustment. *Journal of Policy Modeling, 29*(6), 705–709.

Salvatore, D. (2007). US trade deficits, structural imbalances, and global monetary stability. *Journal of Policy Modeling, 29*(5), 697–704.

Shah, A. (2009). *Global financial crisis*. Retrieved from http://www.globalissues.org/article/768/global-financial-crisis#Asiaandthefinancialcrisis

Thorbecke, W. (2009). *East Asian production networks, global imbalances and exchange rate coordination*. Retrieved from http://www.econbrowser.com/archives/2009/10/east_asia_the_g.html

Tullao, T.S., Conchada, M.I.P., & Aguinaldo, J.P. (2005). *An analysis of trade policy environment and global production networks: Implications on regional agreements.* Manila: De La Salle University – Angelo King Institute.

Tullao, T.S., Conchada, M.I.P., & Rivera, J.P. (2009). *The role of global production networks in understanding the impacts of the fiscal stimulus in the United States and China on ASEAN Economies.* Paper presented at Asia-Pacific Trade Economists' Conference. United Nations ESCAP-ARTNet. Bangkok, Thailand.

Yeung, H. (2008). Industrial clusters and production networks in Southeast Asia: A global production network approach. In I. Kuroiwa & M. H. Toh (Eds.), *Industrial clusters: Integrating economies in Southeast Asia* (pp. 83-120). Singapore: Institute of Southeast Asian Studies.

APPENDIX

Appendix 1: Optimal VAR Lag Selection

Appendix 1.1: For Equation 1

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike criterion, BIC = Schwartz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	-5031.59813		167.341875	172.694020	169.443262
2	-4784.42117	0.00000	164.013586	174.306172	168.054715
3	-4512.20681	0.00000	159.877639	175.110666	165.858510
4	-3973.94154	0.00000	147.159405*	167.332873*	155.080017*

The optimal lag structure is 4 based from the lowest AIC, BIC, and HQC (Gujarati, 2003). Hence, we have a VAR (4) model. Testing for higher order lag structure is infeasible due to lack of observations.

Appendix 1.2: For Equation 2

VAR system, maximum lag order 5

The asterisks below indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike criterion, BIC = Schwartz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	-3239.25221		109.155810	112.270214	110.376374
2	-3119.16220	0.00000	107.874171	113.791538	110.193242
3	-2961.96565	0.00000	105.375923	114.096254	108.793503
4	-2754.03630	0.00000	101.214305	112.737600	105.730392
5	-2554.76549	0.00000	97.336574*	111.662832*	102.951169*

The optimal lag structure is 5 based from the lowest AIC, BIC, and HQC (Gujarati, 2003). Hence, we have a VAR (5) model. Testing for higher order lag structure is infeasible due to lack of observations.

Appendix 1.3: For Equation 3

VAR system, maximum lag order 4

The asterisks below indicate the best (that is, minimized) values of the respective information criteria, AIC = Akaike criterion, BIC = Schwartz Bayesian criterion and HQC = Hannan-Quinn criterion.

lags	loglik	p(LR)	AIC	BIC	HQC
1	-2708.57681		89.696026	92.166247*	90.665897
2	-2617.80982	0.00000	88.832575	93.498547	90.664553
3	-2520.50643	0.00000	87.758272	94.619996	90.452358
4	-2317.43199	0.00000	83.272000*	92.329475	86.828193*

The optimal lag structure is 4 based from the lowest AIC, BIC, and HQC (Gujarati, 2003). Hence, we have a VAR (4) model. Testing for higher order lag structure is infeasible due to lack of observations.

Appendix 2: Johansen Cointegration Test

Appendix 2.1: For Equation 1

Johansen test:
Number of equations = 12
Lag order = 4
Estimation period: 1992:4 - 2008:1 (T = 62)

Case 3: Unrestricted constant

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.99042	1329.5	[0.0000]	288.18	[0.0000]
1	0.98398	1041.4	[0.0000]	256.30	[0.0000]
2	0.97455	785.05	[0.0000]	227.60	[0.0000]
3	0.87596	557.45	[0.0000]	129.41	[0.0000]
4	0.84624	428.04	[0.0000]	116.09	[0.0000]
5	0.78441	311.96	[0.0000]	95.131	[0.0000]
6	0.64050	216.82	[0.0000]	63.429	[0.0000]
7	0.58392	153.40	[0.0000]	54.367	[0.0000]
8	0.50342	99.029	[0.0000]	43.401	[0.0001]
9	0.42274	55.629	[0.0000]	34.067	[0.0002]
10	0.24357	21.562	[0.0045]	17.307	[0.0142]
11	0.066324	4.2548	[0.0391]	4.2548	[0.0391]

Both the trace and λ-max test rejected the null hypothesis that the smallest eigenvalue is 0 so we may conclude that the series are in fact stationary (Enders, 2003). The rejection of the hypothesis denotes the number of cointegrating equations, in this case, is at most 10. Since there is cointegration, OLS estimates of the structural relationships have the property of consistency (Mulligan, 2005).

Appendix 2.2: For Equation 2

Johansen test:
Number of equations = 9
Lag order = 5
Estimation period: 1993:1 - 2008:1 (T = 61)

Case 3: Unrestricted constant

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.88300	533.26	[0.0000]	130.88	[0.0000]
1	0.86020	402.38	[0.0000]	120.02	[0.0000]
2	0.75182	282.36	[0.0000]	85.010	[0.0000]
3	0.69176	197.35	[0.0000]	71.789	[0.0000]
4	0.52580	125.56	[0.0000]	45.514	[0.0006]
5	0.46525	80.045	[0.0000]	38.184	[0.0008]
6	0.36283	41.862	[0.0010]	27.494	[0.0042]
7	0.19631	14.367	[0.0723]	13.331	[0.0684]
8	0.016850	1.0366	[0.3086]	1.0366	[0.3086]

Both the trace and λ-max test rejected the null hypothesis that the smallest eigenvalue is 0 so we may conclude that the series are in fact stationary (Enders, 2003). The rejection of the hypothesis denotes the number of cointegrating equations, in this case, is at most seven. Since there is cointegration, OLS estimates of the structural relationships have the property of consistency (Mulligan, 2005).

Appendix 2.3: For Equation 3

Johansen test:
Number of equations = 8
Lag order = 4
Estimation period: 1992:4 - 2008:1 (T = 62)

Case 3: Unrestricted constant

Rank	Eigenvalue	Trace test	p-value	Lmax test	p-value
0	0.90048	362.14	[0.0000]	143.06	[0.0000]
1	0.71384	219.08	[0.0000]	77.576	[0.0000]
2	0.53856	141.51	[0.0000]	47.951	[0.0033]
3	0.39005	93.555	[0.0001]	30.652	[0.1156]
4	0.34240	62.903	[0.0008]	25.988	[0.0772]
5	0.27563	36.915	[0.0057]	19.992	[0.0712]
6	0.20281	16.923	[0.0286]	14.053	[0.0521]
7	0.045247	2.8707	[0.0902]	2.8707	[0.0902]

Both the trace and λ-max test rejected the null hypothesis that the smallest eigenvalue is 0 so we may conclude that the series are in fact stationary (Enders, 2003). The rejection of the hypothesis denotes the number of cointegrating equations, in this case, is at most seven. Since there is cointegration, OLS estimates of the structural relationships have the property of consistency (Mulligan, 2005).

Appendix 3: Variance Decomposition

Appendix 3.1: For Equation 1

Period	S.E.	PRCX	USGDP	EUGDP	PRCGDP	JAPGDP	ASEANGDP	USM	EUM	JAPM	ASEANX	ASEANINF	ASEANNEER
1	3227.220	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	3812.230	78.54586	1.068951	4.156647	0.755727	0.146202	7.289983	0.015450	0.478213	4.502712	1.260290	1.754094	0.025874
3	4544.228	60.96889	1.325703	9.597045	0.673678	0.562326	6.739138	0.135194	3.378546	7.890383	6.965477	1.684582	0.079038
4	5082.863	49.27332	5.619833	13.99792	1.674375	1.376620	10.57160	0.276143	3.009134	6.309024	5.586643	2.154544	0.150843
5	5882.381	50.17818	4.235187	17.14830	4.286431	1.693880	7.893895	0.454619	3.056673	4.711461	4.435080	1.632218	0.274080
6	6716.620	42.13208	7.945612	20.64898	3.979691	4.438249	8.314954	1.078754	2.350528	3.975602	3.483701	1.396024	0.255826
7	8167.908	33.01570	11.41476	15.41222	3.261305	20.38597	6.097706	1.529326	1.608024	3.006907	2.805115	1.205719	0.257253
8	8978.676	29.26295	12.30221	13.94791	3.522049	22.38783	5.388296	2.583781	1.896559	2.490318	4.435403	1.568945	0.213754
9	10390.06	23.19226	15.36402	10.42682	3.510686	24.35650	6.511895	2.743951	3.163500	1.878185	7.073611	1.601035	0.177528
10	11508.03	19.66233	21.78973	8.591124	2.867592	23.72843	5.576032	2.797920	3.679962	2.502134	7.308865	1.350134	0.145754
11	12407.58	16.99942	25.83086	8.292839	2.617265	24.07540	5.493968	2.602371	3.183066	2.442108	7.061777	1.210175	0.190755
12	13245.29	20.25340	26.61624	7.517994	4.323820	21.30297	4.857657	2.438845	2.793337	2.164110	6.462446	1.101535	0.167647
13	15713.13	31.59615	25.62168	5.546176	7.072371	15.41768	3.489411	1.752965	2.113470	1.537960	4.651540	1.081414	0.119181
14	17492.13	30.40317	27.92622	5.193545	7.522985	13.45817	4.381247	1.510824	2.206852	1.366986	4.153705	1.766175	0.110121
15	18866.13	28.11589	28.55877	5.203118	9.583690	12.20510	4.636476	1.330786	3.047730	1.188148	4.152006	1.873118	0.105167
16	20721.62	29.12271	25.60417	4.476693	12.77435	12.16872	4.474348	1.232140	3.374857	1.136197	3.684792	1.859819	0.091201
17	22819.35	32.28193	24.39434	3.698780	15.36446	10.25804	3.782970	1.078533	3.135633	0.946046	3.245725	1.734816	0.078734
18	23579.95	30.78180	26.09036	3.766872	15.48438	9.702257	3.666234	1.201219	3.132614	1.180215	3.093384	1.825053	0.075613
19	24206.82	29.20924	26.97588	3.688202	15.65666	10.10444	3.574689	1.149773	3.121943	1.749436	2.936800	1.731983	0.100963
20	25060.03	30.09347	26.40898	3.443182	16.21744	9.564164	3.827395	1.103710	2.943155	1.868079	2.817340	1.616055	0.097024
Cholesky Ordering: PRCX USGDP EUGDP PRCGDP JAPGDP ASEANGDP USM EUM JAPM ASEANX ASEANINF ASEANNEER													

Appendix 3.2: For Equation 2

Period	S.E.	ASEANX	USGDP	EUGDP	PRCGDP	JAPGDP	ASEANGDP	PRCX	ASEANINF	ASEANNEER
1	3337.824	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	4824.839	71.53354	4.751167	2.236612	1.516394	1.921910	1.408098	7.375657	3.276106	5.980518
3	6472.481	46.84841	21.44813	1.374291	2.194897	1.068992	3.044783	16.96271	3.073023	3.984761
4	7193.687	45.44681	22.64776	1.252210	2.107874	2.368808	2.520046	17.35999	2.806247	3.490252
5	7472.647	43.25534	21.95507	1.690196	2.012032	5.531267	2.784682	16.10896	2.715999	3.946457
6	7830.864	40.44028	19.99557	2.307855	1.972204	10.17607	3.252869	14.98157	2.496445	4.377123
7	8616.184	36.78142	16.84089	3.815211	1.881419	18.28543	2.850270	13.62144	2.258973	3.664944
8	9350.723	32.69985	15.01684	6.275498	1.605758	20.44699	2.556230	15.21272	1.918033	4.268080
9	9861.616	30.07478	17.89096	5.647081	1.793872	18.52363	2.769611	16.83604	1.774766	4.689252
10	10284.11	27.72575	21.85137	5.341429	2.082325	17.05394	2.844961	16.52040	2.091853	4.487964
11	10487.27	29.14514	21.64417	5.312488	2.065677	16.45296	2.878798	15.95572	2.075978	4.469062
12	11166.51	31.98844	22.47999	4.852045	2.258398	15.13706	3.402154	14.07562	1.853149	3.953141
13	12212.21	28.24907	27.18229	4.753171	3.908507	15.75578	3.175551	11.80570	1.576377	3.593556
14	13514.65	23.47220	30.13963	4.514618	5.447343	15.52760	2.617545	9.793208	1.288832	7.199024
15	14377.91	20.74211	28.23889	4.793401	6.982786	14.16409	2.322782	8.764066	1.143362	12.84851
16	14836.80	19.48606	26.51909	4.501538	10.20588	13.60201	2.194124	8.284893	1.074040	14.13237
17	15546.32	17.91511	24.24028	6.100092	15.15202	12.96666	2.004656	7.741558	0.984905	12.89472
18	16439.92	16.50006	22.08172	8.514835	19.07064	11.59621	1.863785	7.136037	0.959941	12.27676
19	17851.95	14.28638	23.21620	12.38286	18.44919	10.44059	1.744529	7.703336	1.042381	10.73453
20	19856.08	11.74480	26.84395	16.60416	15.55820	9.918597	1.579060	7.727179	1.240170	8.783893
Cholesky Ordering: ASEANX USGDP EUGDP PRCGDP JAPGDP ASEANGDP PRCX ASEANINF ASEANNEER										

Appendix 3.3: For Equation 3

Period	S.E.	ASEANGDP	USGDP	EUGDP	PRCGDP	JAPGDP	ASEANX	ASEANINF	ASEANNEER
1	3322.701	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	3949.528	96.17626	0.882189	0.240216	0.044842	0.081698	0.653164	0.413453	1.508181
3	4349.313	93.51531	0.760781	1.209452	0.036985	0.581339	1.339787	0.995508	1.560839
4	4706.782	87.16180	1.850558	3.497239	0.782969	3.066755	1.204016	0.883787	1.552878
5	5156.435	75.20379	3.247898	3.928923	2.472118	11.34368	1.025542	0.919222	1.858826
6	5698.702	62.64401	3.733217	3.749066	5.261344	21.16532	1.035377	0.755936	1.655731
7	6409.372	49.85688	5.949009	5.487026	8.736929	27.05358	0.831877	0.677151	1.407552
8	7290.788	38.62602	10.60688	7.540349	13.17487	27.75792	0.660711	0.524925	1.108324
9	8292.540	30.28160	14.11639	7.643216	19.45885	26.42912	0.622268	0.525380	0.923171
10	9519.899	23.47427	15.91681	6.971912	26.65663	24.25384	0.812506	0.739097	1.174936
11	11068.54	18.09595	16.96322	7.507491	32.19059	21.04858	1.508334	1.029238	1.656587
12	12901.66	14.36712	17.39447	8.451580	36.51982	17.59355	2.429352	1.287605	1.956496
13	14984.04	11.71547	16.74715	8.519527	41.09694	14.43163	3.627228	1.635349	2.226706
14	17401.01	9.582340	15.33743	8.206683	45.19510	11.90461	5.012585	2.058581	2.702672
15	20278.92	8.007142	13.87962	8.721272	47.34108	9.932288	6.560371	2.331484	3.226742
16	23637.69	6.917142	12.60274	9.566652	48.43370	8.514277	8.020851	2.364151	3.580485
17	27461.10	6.128247	11.32992	9.940118	49.56770	7.574216	9.342084	2.288427	3.829283
18	31851.08	5.493175	10.08010	9.982358	50.53023	7.120696	10.44362	2.170855	4.178957
19	36997.51	5.070423	9.072212	10.38773	50.53602	7.025790	11.36497	1.994477	4.548370
20	42967.15	4.822406	8.368808	10.90337	50.17010	7.165299	12.00527	1.778071	4.786673
Cholesky Ordering: ASEANGDP USGDP EUGDP PRCGDP JAPGDP ASEANX ASEANINF ASEANNEER									