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Policy Coordination among the ASEAN-5: A Global VAR analysis

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Abstract

This paper aims to analyse the feasibility of policy coordination among the ASEAN-5 economies. This is done by determining whether they experience symmetric responses to common shocks. Given that the problem of dimensionality plagues large-scale macroeconomic modelling, a Global VAR model by Pesaran et al. (2004) and Dees et al. (2007) is used. This approach has the added advantage of accounting for the relative importance of trade and financial flows in influencing the size of the spillovers between countries. The results provide evidence of symmetric responses to the common (global) shocks of interest: a US monetary policy shock, a US output shock, a Chinese output shock; an oil price shock. This evidence suggests that the cost of coordinating policies among the ASEAN-5 is not onerous and that this next step in further regional integration may be feasible. In trying to understand the pattern of their responses, they are likely underpinned by their market linkages and best explained by the regional production network, their respective degrees of oil reliance and the importance of domestic consumption.

Keywords: Global VAR, policy coordination, ASEAN, shock symmetry, common shocks
JEL Codes: F42, F47, R11

1 Introduction

The ASEAN[1] economies have already reaped some of the benefits of greater access to foreign capital and larger markets of their goods as observed in their stellar growth rates in the past two decades. Their efforts at furthering regional integration have focused on the creation of a stable production base in the region and single market known as the ASEAN Economic Community. However, the Asian Financial Crisis (AFC) in 1997 is a constant reminder of the risks associated with liberalising their trade and financial sectors. Greater openness produces vulnerabilities in their domestic economies to external shocks through the same channels that provide the desired foreign capital and demand for goods that have fuelled their economic growth.

Eichengreen & Bayoumi (1996) and Glick & Rose (1999) show that crises patterns are often regional. The transmission of the AFC was no different. The ASEAN-5 economies are significantly interdependent through trade and financial linkages which were highlighted particularly through the unfolding of the Asian Financial Crisis. The adverse country-specific shock was transmitted and possibly even amplified through their trade and financial channels. The interdependence also has implications for policy externalities and effectiveness of domestic macroeconomic management. As a result, greater integration through exchange rate coordination has been suggested. Coordinating exchange rates would limit exchange rate volatility which would have the desired effect of promoting greater intra-regional trade which is a driver of growth for these five economies.

The use of an anchor currency or a peg to a basket of currencies such as the Asian Currency Unit (ACU) that has been suggested implies that economies will lose independence over their national monetary policies, according to the Mundell-Fleming model. Therefore, the ASEAN-5 economies will need to cooperate on monetary policy matters as well if they are to coordinate exchange rate policies.

This paper aims to analyse the feasibility of policy coordination among the ASEAN-5 economies. This is done by determining whether they experience symmetric responses to common shocks. Given that the problem of dimensionality plagues large-scale macroeconomic modelling, a Global VAR model by Pesaran et al. (2004) and Dees et al. (2007) is used. This approach has the added advantage of accounting for the relative importance of trade and financial flows in influencing the size of the spillovers between countries. The results provide evidence of symmetric responses to the common (global) shocks of interest: a US monetary policy shock, a US output shock, a Chinese output shock; an oil price shock. This evidence suggests that the cost of coordinating policies among the ASEAN-5 is not onerous and that this next step in further regional integration may be feasible. In trying to understand the pattern of their responses, it is likely that they are underpinned by their market linkages and best explained by the regional production network, their respective degrees of oil reliance and the importance of domestic consumption.

This paper is organised into five sections. Section 2 describes the Global VAR approach, section 3 specifies the estimated model, section 4 describes the results while section 5 discusses the findings. Finally, section 6 concludes.

[1] Association of Southeast Asian Nations (ASEAN) includes Brunei, Cambodia, Lao PDR, Myanmar, Vietnam and the founding five countries also known as the ASEAN-5: Indonesia, Malaysia, Philippines, Singapore and Thailand.

1.1 Measuring the feasibility of policy coordination

The optimum currency area (OCA) literature is informative about conditions that make this possible even though it is often used to address the feasibility of a common currency or a rigidly fixed exchange rate regime. This is because it addresses the issues related to the loss of autonomous monetary policy and domestic exchange rates as adjustment mechanisms for economies. At the present levels of interdependence coupled with the possible use of an anchor currency, the ASEAN-5 economies face these similar issues described by the OCA literature.

The empirical literature on this topic started in the wake of the Asian Financial Crisis. Discussion regarding possible preventive strategies included the suggestion of a common currency which is unsurprising because the timing coincided with the successful launch of the Euro. Since the most quantifiable measure of feasibility for a common currency is expressed in the degree by which these economies experience similar shocks, studies in the early literature have sought to determine whether the ASEAN-5 economies experience similar shocks. Kouparitsas (1999) organises these measurable criteria suggested in the OCA literature into four categories: common shocks, symmetric shocks, symmetric responses and quick adjustments to idiosyncratic shocks. The OCA meta-criterion of shock similarity encompasses the first three categories.

There are generally two approaches that have been taken to establish whether this criterion has been satisfied or not in the empirical literature. The first assesses the degree of business cycle synchronisation because it encompasses all four categories suggested by Kouparitsas (1999). The second approach takes a more detailed look by analysing the shocks experienced among a group of economies with some studies identifying how quickly they are able to adjust to shocks. Unlike the European Monetary Union (EMU), the regional integration process in the ASEAN-5 group is driven by market forces rather than political ones. However, the results from these studies are still informative for the discussion on how to best manage their interdependence.

The empirical literature that has attempted to determine whether the ASEAN-5 countries satisfy the OCA meta-criterion of shock similarity have either determined whether the economies observe synchronised business cycles or experience common and symmetric shocks. Buiter (1997) suggests that the lack of symmetry often found could be due to either of two conditions, that the economies experience different shocks (impulses) or that they possess different economic characteristics (responses). To determine whether the ASEAN-5 economies can feasibly coordinate policies, it needs to be shown that they respond symmetrically to a common shock.

It is problematic to do so because it would require modelling these interconnected economies. Such attempts would quickly face the "curse of dimensionality" described by Bellman (1957) where a substantial number of parameters will need to be estimated in order to incorporate the different ways that their economies are linked. Exacerbating this further, the available data for the ASEAN-5 economies is also limited. The Global VAR (GVAR) model by Pesaran et al. (2004) and Dees et al. (2007) provide a way around this dimensionality issue by allowing for the influence of foreign factors to be informed by their bilateral trade and financial flows.

The empirical literature that analyses the OCA meta-criterion of similarity of shocks and business cycles can be broadly categorised into two streams. The first decomposes shocks from a structural VAR model and determines whether the cross-country correlation of shocks are positive

in order to conclude that symmetry exists.

The second stream in the empirical literature approaches the analysis by establishing whether there exists a long-run equilibrium in the output fluctuations of the respective economies. This approach often utilises the Johansen cointegration method such as in Sato & Zhang (2006) and Sato et al. (2009). Related to the second stream, are the empirical studies that identify a common unobserved factor which can be understood as a common cycle among the output variables in the ASEAN-5 economies. This method employs state-space models. The dynamic factor model from Stock & Watson (1991) is a popular choice. Moneta & Ruffer (2009) and Nguyen (2010) employ this to determine if the ASEAN-5 business cycles are synchronised. Positive identification of a dynamic common factor or a common cycle points to a common driver of their individual business cycles and as such these common drivers would be a source of synchronisation.

However, the studies in the empirical literature focus on finding a result of common and symmetric shocks or business cycle synchronisation only. Although similar business cycles would indicate a greater likelihood that the economies experience similar shocks and respond in a symmetric way, there is no explicit link between a common shock and each economy responding in a symmetric manner which would make policy coordination more feasible. It is possible that modelling the ASEAN-5 economies in order to find evidence for this is complicated by the dimensionality problem. The extent of the literature on macroeconometric modelling shows the weight of this issue.

1.2 Macroeconometric Modelling

The Global VAR model by Pesaran et al. (2004) has been particularly useful in understanding the linkages present among economies due to globalisation. According to Chudik & Pesaran (2014), this approach facilitates a simple way of expressing large interconnected systems such as the world economy while still allowing for their interactions internally and externally. The Global VAR model is able to circumvent the problem of dimensionality in a coherent and statistically consistent way. Chudik & Pesaran (2014) states that solutions are often incomplete with alternative approaches. These solutions are specifically problematic for simulation analysis since they do not present the necessary closed system.

To date, the GVAR has been used to answer several questions that account for the degree of global economic interdependence but the scope of these questions have mainly been US and Euro-centric. Studies that have analysed the Asian context using the GVAR so far have yet to apply it to elucidate the discussion on monetary policy coordination by determining whether these economies respond in a symmetric manner to a common shock. However, the model has been used to answer several questions on the periphery of this policy discussion. With regards to using the GVAR model to represent the ASEAN-5 economies, the study by Han & Ng (2011) attempt to do this but it is used to forecast macroeconomic variables in these five economies. The results from this study are encouraging though since the authors find that the GVAR out-of-sample forecasts performed significantly better than the forecasts generated based on country-specific models alone.

Greenwood-Nimmo et al. (2012) attempt probabilistic forecasting of the balance of trade globally, including the ASEAN-5 economies. On the topic of trade as well, Bussiere et al. (2009) use a GVAR model but the research question analyses factors that drive the dynamics of trade in

East Asia (including the ASEAN-5 economies). The GVAR model was used to take into account the interdependence among the economies and has the added benefit of being able to model both exports and imports. The scope of this study includes the impact of a shock to US output and Chinese imports on East Asian exports and imports. The closest study to the scope of this paper is Dees et al. (2007). This study uses a GVAR to determine whether the US business cycle is transmitted to the rest of the world. The evidence indicates that the US business cycle leads cycles of many global regions but this influence does not extend to the East Asian economies, including that of the ASEAN-5. It is suggested that this result could be due to the increased influence of China (Dees et al., 2007). Within a GVAR model, Cesa-Bianchi et al. (2011) use time-varying weights instead of the usual set of pre-determined static weights to reflect this evolution. Their results provide compelling evidence for China's increasing influence on the ASEAN-5 economies and on the global economy too. Osorio & Unsal (2013) use the GVAR model to determine the drivers of inflation in Asia and how China's output movements directly affect the respective inflation rates in the ASEAN-5 economies and also indirectly through its increased influence on world commodity prices.

The analysis will therefore consider the responses of the ASEAN-5 to global shocks from the US and China in addition to a world oil price shock.

2 The Global VAR Approach

The GVAR model circumvents the dimensionality problem by using a two-step approach. First, the country-specific models are estimated using aggregate foreign variables based on a weighted average of other non-domestic variables included in the full model. In the second stage, the estimates are stacked to build the full global model. The weights used in the construction of the aggregate foreign variables for each country-specific model estimation are pre-determined which makes this estimation strategy possible.

2.1 The Global model

There are $(N+1)$ countries in the model, indexed $i = 0, \ldots, N$ and t time observations. Country $i = 0$ is assumed to be strictly exogenous in that it influences the other $i = 1, \ldots, N$ countries but not the other way around. There are m_y endogenous variables in each country $i = 1, \ldots, N$ and m_x exogenous variables in country $i = 0$. This means that there are Nm_y endogenous variables and m_x exogenous variables contained in the global vector of variables, y_t. $m = m_x + Nm_y$ is the total number of variables in the global model. This global vector of variables, y_t is formed by stacking each of the country-specific vectors, $y_{i,t}$:

$$y_t = \begin{bmatrix} y_{0,t} \\ y_{1,t} \\ \vdots \\ y_{N,t} \end{bmatrix}$$

where,

- $y_{i,t}$ is an $m_y \times 1$ vector of endogenous variables for each country $i \; \forall \; i = 1, \ldots, N$;
- $y_{0,t}$ contains the m_x exogenous variables in the model which are allowed to influence each other but none of the variables in country $i \; \forall \; i = 1, \ldots, N$ can influence the variables in this vector.

The global model is:

$$Fy_t = h_0 + h_1 t + Gy_{t-1} + Hy_{t-2} + \eta_t \tag{1}$$

where:

- y_t is an $m \times 1$ vector of all the variables included in the model;
- t represents the time trend included in the regression;
- F is the $m \times m$ contemporaneous matrix;
- G is an $m \times m$ matrix that describes the effect of the first lag of y_t, y_{t-1};
- H is an $m \times m$ matrix that describes the effect of the second lag of y_t, y_{t-2};
- h_0 is the intercept and is $m \times 1$;
- h_1 is the coefficient describing the effect of the trend, t.

Ideally, F, G and H can be estimated directly. However, due to the dimensionality problem, this is not possible. Therefore, these coefficients, F, G and H which represent the contemporaneous, first and second lag effects are defined as the weighted coefficients from each country-specific model. Each equation for country $i = 1, \ldots, N$ will contain the contemporaneous, first and second lag values of the endogenous variables and the contemporaneous, first and second lag values of the m^* weakly exogenous foreign variables which are aggregated based on a set of pre-determined weights, w_i. Let $k = m_y + m^*$ be the number of variables in the country-specific models in country $i = 1, \ldots, N$. The weighting matrix, w_i is a $k \times m$ matrix.

Owing to this set up, the coefficients across the countries are linked to each other through the weighting matrices, w_i at the global level. Since country $i = 0$ is a special case in that it is treated as exogenous, its weight matrix, $w_{i=0}$ is merely a selection matrix, $w_{i=0} = s_{m_x \times m}$. It does not have any foreign aggregate variables in its country-specific model.

These global coefficients therefore, look as follows:

$$F = \begin{pmatrix} P_0 \\ P_1 w_{i=1} \\ \vdots \\ P_N w_{i=N} \end{pmatrix} \; G = \begin{pmatrix} Q_0 \\ Q_1 w_{i=1} \\ \vdots \\ Q_N w_{i=N} \end{pmatrix} \; H = \begin{pmatrix} R_0 \\ R_1 w_{i=1} \\ \vdots \\ R_N w_{i=N} \end{pmatrix}$$

where,

P_i, Q_i, and R_i are the contemporaneous, first lag and second lag coefficients estimated from each country-specific model, described in the next section. These are the coefficient matrices that will be used to construct the global model in Equation 1.

2.2 The country-specific models

With the exception of the exogenous country $i = 0$, all other country-specific models have a set of endogenous (domestic) variables included in an $m_y \times 1$ vector, $y_{i,t}$ and a set of foreign variables which are aggregated based on a set of pre-determined weights. These foreign variables are included in an $m^* \times 1$ vector, $y^*_{i,t}$ such that $y^*_{i,t} = \tilde{w}_i y_t$. The weight matrix $\tilde{w}_i$ is informed by the respective bilateral trade and financial flows. $\tilde{w}_i \; \forall \; i = 1, \ldots, N$ is set up so that flows to itself are equal to zero, $\tilde{w}_{ii} = 0$, and are normalised, $\sum_{j=0}^{N} \tilde{w}_{ij} = 1 \; \forall \; i = 1, \ldots, N$.

Let $z_{i,t}$ be a $k \times 1$ vector containing both these vectors, $z_{i,t} = \begin{bmatrix} y_{i,t} \\ y^*_{i,t} \end{bmatrix}$. The weighting matrix can be modified so that $w_i = \begin{bmatrix} s_i \\ \tilde{w}_i \end{bmatrix}$ where s_i is a selection matrix for domestic variables in country i, $z_{i,t} = w_i y_t$. Here, w_i is a $k \times m$ matrix $\forall \; i = 1, \ldots, N$.

The country-specific model with these weakly exogenous foreign variables is based on a VARX(2,2)[2] where both domestic and foreign variables are of lag order 2. These weakly exogenous foreign variables affect the domestic variables in the country-specific model contemporaneously but they are not strictly exogenous in the sense that the lagged changes of both the domestic and foreign variables are still able to affect them. However, these weakly exogenous foreign variables are "long-run forcing" because they are not affected by disequilibria in the country-specific model. Weak exogeneity in these foreign variables allows the other variables in the global model to influence the domestic variables based on the weights used to construct these foreign variables which vary across countries. At the same time, the lagged effects, or feedback of these domestic variables on the foreign variables facilitates the endogeneity at the global level, with the exception of country $i = 0$.

Garratt et al. (2006) discusses in depth how the country-specific model can be separated into a conditional and a marginal model, required for efficient estimation. The model used in this paper is expressed in error-correction form consistent with the one described in Garratt et al. (2006). The VARX(2,2) is re-parameterized into a VECMX(1,1).

There may be a structural break in the long-run relationship and a dummy variable may need to be included to account for it. Dees et al. (2007) demonstrate that partitioning the cointegrating relations matrix β_i to include a constant, trend and dummy is possible[3].

Partitioning $\tilde{\beta}'_i$ this way allows for cointegration to be present among the endogenous variables, $y_{i,t}$ and also between $y_{i,t}$ and the weakly exogenous foreign variables, $y^*_{i,t}$ in the model (Dees et al., 2007). Notice also that the country-specific intercept shift dummy, $d_{i,t}$ is assumed to be subject to the same lag order as $y_{i,t}$ which is how Greenwood-Nimmo et al. (2012) and Shin (2009) have handled the dummy variable included in their model.

Therefore, the model used is as follows where the marginal model is:

[2]While the GVAR circumvents the issue of dimensionality, the estimation of each country-specific model is still constrained by the available degrees of freedom. In this case, the data span is a limiting factor. The number of lags was restricted to a maximum of 2 for this reason in each of the country-specific models estimated. Autocorrelation and partial correlation of the residuals were checked and it does not appear that this is a problem at the 5% significance level. The correlograms for the residuals can be found in the appendix.

[3]Let the following matrices be modified to include a trend and dummy: $\tilde{\beta}'_i = \left[\beta'_{i,y} \; \beta'_{i,y^*} \; (\beta'_{i,trend}\gamma) \; (\beta'_{i,d}\mu_i)\right]$ and $\tilde{z}_{i,t-1} = \left[y_{i,t-1} \; y^*_{i,t-1} \; (t-1) \; D_{i,t-1}\right]$. If $b_{i,1} = \beta'_{i,trend}\gamma_i$ and $b_{i,2} = \beta'_{i,d}\mu_i$, $\tilde{\beta}'_i \tilde{z}_{i,t-1} = \beta'_{i,y} y_{i,t-1} + \beta'_{i,y^*} y^*_{i,t-1} + b_{i,1}(t-1) + b_{i,2} d_{i,t-1}$

$$\Delta y^*_{i,t} = h_{i0,y^*} + a_{i1,y^*}t + \psi_{i1,y^*}\Delta z_{i,t-1} + \delta_{i0,y^*}\Delta d_{i,t} + \delta_{i1,y^*}\Delta d_{i,t-1} + u_{i,y^*t} \tag{2}$$

And the conditional model is:

$$\begin{aligned}\Delta y_{i,t} = \quad & c_{i0} + \tilde{c}_{i0,y}\Delta d_{i,t} + \tilde{c}_{i1,y}\Delta d_{i,t-1} + \Lambda_i \Delta y^*_{i,t} + \psi_i \Delta z_{i,t-1} \\ & + \alpha_{i,y}\beta_i'(z_{i,t-1} - \mu_i d_{i,t-1} - \gamma_i(t-1)) + \eta_{i,t}\end{aligned} \tag{3}$$

The estimation strategy is employed in two stages. Once the long-run β_i's have been identified, Dees et al. (2007) states that it is possible to estimate the short run parameters in the conditional model α_i, c_{i0}, $\tilde{c}_{i0,y}$, $\tilde{c}_{i1,y}$, Λ_i and ψ_i directly by OLS regression.
Let:

- $P_i = \left[I_{m_y \times m_y} - \Lambda_i\right]$ is the contemporaneous matrix with dimension $m_y \times k$;
- $\Pi_{i,y} = -\alpha_{i,y}\beta_i'$ is the long-run matrix which is $m_y \times k$ in size;
- $Q_i = P_i + \Pi_{i,y} + \psi_i$ is an $m_y \times k$ coefficient matrix for the first lag;
- $R_i = -\psi_i$ is an $m_y \times k$ coefficient matrix for the second lag;
- $\tilde{h}_{i0} = c_{i0} + \tilde{c}_{i0}\Delta d_{i,t} + \tilde{c}_{i1}\Delta d_{i,t-1} + (-\Pi_{i,y}\mu_i)d_{i,t-1}$ is $m_y \times 1$ contains the deterministic terms;
- $h_{i1} = -\Pi_{i,y}\gamma_i$ is $m_y \times 1$ that captures the effect of the time trend.

Recall also that $z_{i,t} = \begin{bmatrix} y_{i,t} \\ y^*_{i,t} \end{bmatrix} = w_i y_t$. This estimated country-specific model looks as follows:

$$P_i z_{i,t} = \tilde{h}_{i0} + h_{i1}t + Q_i z_{i,t} + R_i z_{i,t} + \eta_{i,t} \; \forall \; i = 1, \ldots, N \tag{4}$$

As can be seen in the following equation, this gives the coefficients from each country i needed to construct the global model's coefficients, F, G and H:

$$(P_i w_i)y_t = \tilde{h}_{i0} + h_{i1}t + (Q_i w_i)y_t + (R_i w_i)y_t + \eta_{i,t} \; \forall \; i = 1, \ldots, N \tag{5}$$

While Equations 3 and 4 are employed for countries $i = 1, \ldots, N$ the country-specific model for country $i = 0$ is different since it is treated as exogenous and does not receive any influence from countries $i = 1, \ldots, N$. Country $i = 0$ is modelled as a simple VECM(1):

$$\Delta y_{0,t} = c_{00} + \alpha_{0,y}\beta_0' y_{0,t-1} + \psi_{01}\Delta y_{0,t-1} + \eta_{0,t} \tag{6}$$

To allow for dynamic analyses using a GVAR, Generalised Impulse Response Functions (GIRFs) by Pesaran & Smith (1998) and Generalised Forecast Error Variance Decompositions (GFEVDs) are generated. These GIRFs can be used to show the response of each variable to a shock[4] GFEVDs complement the analysis of GIRFs because they help to determine the main drivers of variables in the model.

[4]Unlike Orthogonalised Impulse Response functions (OIRFs) by Sims (1980), these GIRFs are particularly useful because they are invariant to the ordering of variables. Since there is no meaningful way for each of these variables to be stacked in the GVAR, the GIRFs provide a way to analyse the effect of a unit shock to the the ith structural error. The impact of the system-wide shock is scaled. GIRFs use the observed distribution of all the shocks and integrates out the effects of the other shocks.

3 The GVAR Model

The ASEAN-5 economies are interdependent through trade and financial linkages. Accounting for these fundamental relationships would involve estimating a substantial number of parameters. For $N+1$ countries with m_y endogenous variables each in a country-specific model which uses p lags to address any serial correlation present, would involve estimating $(N+1)m_y p$ parameters. This number increases exponentially with each additional country included in the analysis. In the case of the ASEAN-5 countries, data is limited to 74 quarterly observations (1993Q1-2011Q2) at the time of the analysis which compounds the dimensionality problem further. Therefore, the GVAR model would be particularly beneficial if applied to the ASEAN-5 context.

The ASEAN-5 economies are small but relatively open economies that are export-driven. From Table 1, these economies' trade (exports and imports) account for at least half to almost three times its domestic output in real terms. The five countries included are: Indonesia, Malaysia, Philippines, Singapore and Thailand and are indexed from $i = 1, \ldots, 5$, respectively.

Table 1: Trade (exports and imports) as a share of output

	Indonesia	Malaysia	Philippines	Singapore	Thailand
Mean	0.4558	1.6864	0.7431	2.8952	1.0164
Median	0.4417	1.7052	0.7511	2.8200	1.0769
Maximum	0.8289	2.0290	1.1689	3.6427	1.4600
Minimum	0.3348	1.2985	0.4555	2.3447	0.6438
Std. Dev.	0.0993	0.1666	0.1727	0.3176	0.2243

Economies outside the ASEAN-5 region are modelled as a "rest-of-world" economy. These countries, especially China and the US, have an influence on the global economy and so this model essentially represents the global forces that affect the ASEAN-5 countries. This "rest-of-world" model is treated as exogenous to the ASEAN-5 economies to reflect the real-world scenario; this is country $i = 0$ in the Global VAR. There are only $m_x = 5$ variables in vector $y_{0,t} = x_t = \left\{R_t^{US}, P_t^{US}, Y_t^{US}, Y_t^{CN}, P_t^{oil}\right\}$ where R_t^{US}, P_t^{US} and Y_t^{US} refers to the short-term nominal interest rate, consumer price index and the real output per capita for the US economy, Y_t^{CN} is the real output per capita for China and P_t^{oil} is the world crude oil price.

Countries $i = 1, \ldots, 5$ each have $m_y = 6$ domestic variables in $y_{i,t}$ and $m^* = 4$ weakly exogenous foreign variables in $y_{i,t}^*$. $y_{i,t} = \{Y_{i,t}, P_{i,t}, EX_{i,t}, IM_{i,t}, E_{i,t}, R_{i,t}\}$ and $y_{i,t}^* = \{Y_{i,t}^*, P_t^*, R_{i,t}^*, P_t^{oil}\}$. $Y_{i,t}$ refers to the real output per capita, $P_{i,t}$ the consumer price level, $EX_{i,t}$ the real per capita exports, $IM_{i,t}$ the real per capita imports, $E_{i,t}$ the real exchange rate (local currency unit per US dollar), $R_{i,t}$ the short-term nominal interest rate and P_t^{oil} the world crude oil price. All variables are used in logarithmic form for an easier interpretation of the estimates.

The foreign variables in $y_{i,t}^*$ are constructed using three different weighting schemes. The $Y_{i,t}^*$ variables are constructed using weights $w_{1,ij}$, based on trade and FDI flows to all 7 countries: the individual ASEAN-5 countries, US and China.

$$Y^*_{i,t} = \sum_{j=0}^{7} w_{1,ij} Y_{j,t}$$

The $P^*_{i,t}$ variables are a weighted average of prices in the ASEAN-5 economies only:

$$P^*_{i,t} = \sum_{j=0}^{5} w_{2,ij} P_{j,t}$$

The $R^*_{i,t}$ variables are constructed using information on trade and FDI flows for the ASEAN-5 economies and the US only since China's interest rate was not included in the model. This is the third weighting scheme, $w_{3,ij}$:

$$R^*_{i,t} = \sum_{j=0}^{6} w_{3,ij} R_{j,t}$$

Oil prices, P^{oil}_t are used as is without weighting it with any other variables. The weight matrix component associated with oil prices can be thought of therefore, as a selection matrix. Although each country $i = 1, \ldots, 5$ has the same variables in its foreign vector $y^*_{i,t} = \{Y^*_{i,t}, P^*_t, R^*_{i,t}, P^{oil}_t\}$, these aggregate foreign factors are different since it varies with the country's relative importance of their bilateral trade and FDI flows with other economies in the model, with the exception of oil prices.

The weight matrix for each country i, $\tilde{w}_i$ combines the different weighting schemes to construct $y^*_{i,t} = \tilde{w}_i y_t$ where y_t is an $m \times 1$ vector of all the variables included in the global model. The full description of these weights $\tilde{w}_i$ for each country are described in the appendix.

$$w_{ij} = \frac{1}{2}\left[\left(\frac{imports_{ij} + exports_{ij}}{\sum_{j=1}^{n}(imports_{ij} + exports_{ij})}\right) + \left(\frac{inflows_{ij} + outflows_{ij}}{\sum_{j=1}^{n}(inflows_{ij} + outflows_{ij})}\right)\right] \;\forall\, i, j \neq i$$

- $imports_{ij}$ = imports of i from country j
- $exports_{ij}$ = exports of i to country j
- $inflows_{ij}$ = FDI inflows of i from country j
- $outflows_{ij}$ = FDI outflows of i to country j
- $\sum_{j=1}^{n}(imports_{ij} + exports_{ij})$ = sum of all exports and imports of country i to and from all other countries in the global levels

The values of the different weight schemes are reported in Table 2. These bilateral trade and financial flows are retrieved from the IMF Direction of Trade Statistics database. From the values seen in this table, Singapore and US are focal points of trade and financial flows for the ASEAN-5 countries across the three different weighting schemes. Interestingly, while it is expected that the US economy is an important economic partner for the ASEAN-5 economies, Singapore outweighs China as a combined trade and financial partner for the ASEAN-5 countries.

Table 2: Weights for Constructing the Weakly Exogenous Foreign Variables

Weight Scheme 1 (ASEAN-5, China and US), w_{ij}^1					
j=partner \ i=main	Indonesia	Malaysia	Philippines	Singapore	Thailand
Indonesia	0.000	0.040	0.024	0.120	0.040
Malaysia	0.112	0.000	0.055	0.247	0.084
Philippines	0.016	0.020	0.000	0.025	0.032
Singapore	0.347	0.375	0.208	0.000	0.352
Thailand	0.062	0.056	0.043	0.055	0.000
China	0.182	0.088	0.102	0.103	0.119
US	0.281	0.421	0.569	0.450	0.373
TOTAL	1.000	1.000	1.000	1.000	1.000

Weight Scheme 2 (ASEAN-5 only), w_{ij}^2					
j=partner \ i=main	Indonesia	Malaysia	Philippines	Singapore	Thailand
Indonesia	0.000	0.081	0.067	0.297	0.090
Malaysia	0.210	0.000	0.150	0.545	0.187
Philippines	0.031	0.041	0.000	0.048	0.068
Singapore	0.643	0.767	0.671	0.000	0.655
Thailand	0.117	0.112	0.112	0.110	0.000
TOTAL	1.000	1.000	1.000	1.000	1.000

Weight Scheme 3 (ASEAN-5 and US only), w_{ij}^3					
j=partner\ i=main	Indonesia	Malaysia	Philippines	Singapore	Thailand
Indonesia	0.000	0.047	0.028	0.132	0.051
Malaysia	0.138	0.000	0.063	0.283	0.106
Philippines	0.021	0.024	0.000	0.030	0.039
Singapore	0.421	0.407	0.230	0.000	0.379
Thailand	0.077	0.066	0.049	0.065	0.000
US	0.344	0.456	0.630	0.489	0.425
TOTAL	1.000	1.000	1.000	1.000	1.000

3.1 Long-Run Relationships from Theory

The cointegrating VAR with weakly exogenous regressors (CVARX) used in the country-specific models is able to distinguish between short-run and long-run dynamics. More than that, the long-run relationships can be informed by theory and restricted accordingly if it matches the data. Based on the variables included for each country, three long-run relationships from theory are considered:

1. PPP: Productivity-biased Purchasing Power Parity (Harrod-Balassa-Samuelson)
2. GAP: Conditional output convergence
3. UIP: Uncovered interest parity condition

These three potential long-run theories that will be used can be summarised as follows:

$$PPP: \quad P_{i,t} - P^*_{i,t} - E_{i,t} = b_{i0,1} + b_{i1,1}t + b_{i2,1}d_{i,t} + \varepsilon_{i1,t+1}$$

$$GAP: \quad Y_{i,t} - Y^*_{i,t} = b_{i0,2} + b_{i2,2}d_{i,t} + \varepsilon_{i2,t+1}$$

$$UIP: \quad R_{i,t} - R^*_{i,t} - E_{i,t} = b_{i0,3} + b_{i2,3}d_{i,t} + \varepsilon_{i3,t+1}$$

3.2 Structural and Preliminary Test Considerations

Theory can provide the desired structural interpretation if these long-run relationships are built into the model. In order to do this, it must first be verified that there exists at least one long-run relationship among the variables in the respective CVARX models. The presence of cointegrating relationships among the domestic variables in $y_{i,t}$ as well as with the weakly exogenous foreign variables in $y^*_{i,t}$ indicates that there are long-run relationships that can be incorporated. These long-run relationships form the system's steady-state. A modified Johansen cointegration test by Pesaran et al. (2000) is used to determine the long-run relationships present in the data.

Since the $y*$ variables are treated as weakly exogenous, these constructed variables are also formally tested for with sufficient evidence that this condition is met to proceed with the Global VAR approach. Testing for structural breaks is another consideration that needs to be made especially for the ASEAN-5 context. A CUSUM squared test was run and the following structural breaks were identified.

Table 3: Structural Break dates

Indonesia	1998Q1
Malaysia	1997Q4
Philippines	1998Q1
Singapore	1998Q1
Thailand	1997Q3

These structural breaks were accounted for in each CVARX model by including a dummy variable.

4 Results

4.1 Generalised Impulse Response Functions (GIRFs)

Figures 1 - 4 summarise the GIRFs for the ASEAN-5 domestic variables over 40 quarters (10 years). It was verified that these responses to shocks eventually settle to an equilibrium value. While most responses stabilise by the 40th quarter, Malaysia's responses, especially its exchange rate responses, take approximately 60 quarters to do so. This can likely be attributed to the short period during which it was pegged to the US dollar after the Asian Financial Crisis. 95% confidence intervals were bootstrapped with 1000 replications using non-parametric re-sampling methods. Mean bootstrapped estimates and their confidence intervals are reported in Figures 1 - 4. There is no clear ordering specified by economic theory. Hence, all these impulse response functions describe the net effect of a system-wide shock on a particular variable, on each of the variables after all the interactions and spillovers have taken place. The following subsections describe the pattern of responses to each global shock explored: a US monetary policy shock, a US output shock, a Chinese output shock and a world oil price shock.

4.1.1 Shock to US interest rate

Since the US interest rate variable is the very first variable in the GVAR, these GIRFs are equivalent to its OIRFs according to Pesaran & Smith (1998) so a shock to US interest rates can equivalently be understood as a US monetary policy shock. Figure 1 shows how a one standard error shock to US interest rates affects the ASEAN-5 economies. A one standard error shock causes US interest rates to increase by 45 basis points.

Although a US interest rate increase acts as contractionary monetary policy, only US prices fall by 0.03% as a result of this interest rate increase. US output however, continues to be positively affected by this change, increasing by 0.1% in the long-run. One explanation of this result might be due to foreign investment inflows owing to the higher interest rate. There is a flight to safety mechanism that goes from capital markets in developing economies into the US because the perceived risk in developed markets such as the US is significantly lower. Therefore, an increase in US interest rates would provide an incentive for foreign investments to flow into the US financial market, raising income as a result.

In addition to this, there is the possible role of the US economy as a common lender and the effect that could have in the context of contagion. This credit channel may create financial linkages. As the cost of borrowing increases with a rise in US interest rates, so too does the cost of credit in each of the ASEAN-5 economies. This gets reflected in the interest rate response for each of the five economies in response to a US monetary policy tightening in the form of an interest rate increase.

Therefore it is quite clear that the financial connection between the US and each of the ASEAN-5 economies specifically, is strong. The FDI statistics in Table 4 supports this explanation of the US economy as a common lender and investor in these economies. The US is one of the top sources of FDI for the ASEAN-5 economies. Mackowiak (2007) notes that the interest rate in emerging economies such as the ASEAN-5, increase as a result of tighter monetary policy in the US. In fact,

Figure 1: Generalised Impulse Responses from a 1 s.e. shock to US Interest Rates

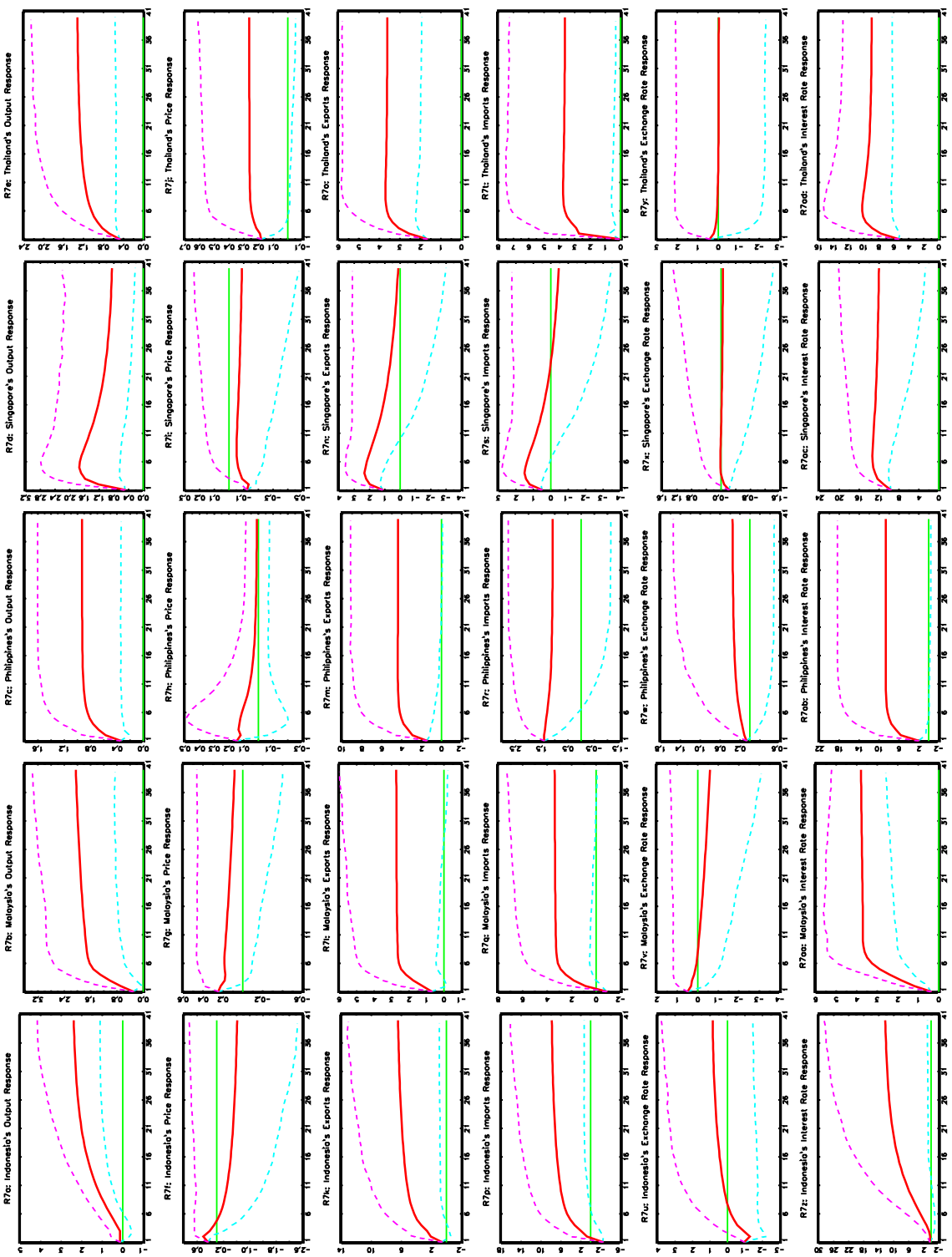


Table 4: ASEAN FDI by Source Country as Percentage of Total Regional FDI

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
EU	18.0	24.6	18.7	25.1	36.0	56.8	33.7	21.0	27.8	32.0	25.7	20.0	26.8	20.6
Japan	20.1	17.7	15.4	17.8	6.2	2.1	10.7	17.0	16.2	16.1	17.1	19.2	12.2	12.7
ASEAN	16.6	14.3	15.4	12.3	6.6	3.2	12.2	21.4	11.2	8.4	10.8	14.2	13.7	18.3
USA	15.4	17.3	14.6	14.5	21.8	30.7	23.3	-1.2	6.2	12.5	10.1	6.4	9.3	5.6
Asian NIE	10.1	7.5	10.4	8.7	6.0	6.2	9.9	6.2	5.6	4.7	2.8	6.2	8.2	5.6
Other EU	4.2	7.1	5.9	5.9	8.2	1.5	0.9	4.7	7.7	4.7	11.0	10.0	4.8	4.2
Canada	2.2	0.7	3.3	-0.9	-0.1	-1.7	-0.4	2.1	0.4	2.4	2.0	0.9	1.4	1.3
Australia	1.9	1.1	0.7	-1.4	-3.4	-1.3	-0.6	0.5	0.7	1.4	0.5	0.6	1.5	1.6
India	0.4	0.2	0.3	0.4	0.2	0.3	0.1	0.5	0.4	0.2	1.0	-0.8	0.8	0.7
China	0.5	0.4	0.2	1.3	0.2	-0.6	0.7	-0.4	0.8	2.1	1.4	1.9	1.8	2.5
NZ	0.1	0.1	0.1	0.1	0.3	0.2	0.1	0.6	0.4	-0.1	1.2	-0.4	0.2	0.2
All Others	10.6	9.1	15.1	16.2	18.1	2.5	9.3	27.5	22.6	15.6	16.4	21.9	19.3	26.7

ASEAN Secretariat, ASEAN Statistical Yearbook 2005 (Data for 1995-1999) and 2008 (Data for 2000-2008)

the results in the study show that the effects of this tightening explains a larger proportion of output and price variation in emerging economies than its own domestic output and prices[5]. Mackowiak (2007) finds that the channel of transmission occurs through the exchange rates in the emerging economies. Their local currencies depreciate in response to a contraction in US monetary policy and induces inflation in these economies. Although not significant according to the 95% bootstrapped confidence intervals, the responses observed in Figures 1z - 1ad reflects this mechanism especially in Philippines that sees its exchange rate depreciate, inflation rise and interest rates increase as a result of a US monetary policy contraction. Singapore's economy fits this description the least mainly because of its exchange rate target as a means to manage its inflation and output gap, unlike the other ASEAN-5 economies. The exchange rate target means that the response in their exchange rate to this common shock is minimal. The lack of response in Figure 1x, which contains Singapore's exchange rate response to a US interest rate rise, reflects this exactly.

The increase in US interest rates or equivalently a US monetary policy tightening causes interest rates for all the ASEAN-5 economies to rise even though the responses in their exchange rates and prices are more muted due to other effects at work. The size of this increase ranges from a minimum of 4 basis points in Malaysia to a maximum of 13 basis points in Singapore. Although this increase is not significant for Philippines according to the 95% bootstrapped confidence intervals, the size of the change observed is substantial.

Similar to the observation from the descriptive graphs, contractionary US monetary policy only had an effect on controlling domestic prices based on estimates in the "rest-of-world" model. It is not surprising then, that the shock to US monetary policy produced similar responses in the ASEAN-5 economies to the effects of this US output shock. This is especially true in their trade and output responses. An explanation regarding the pattern of their trade responses through the regional production network is reserved for the discussion section.

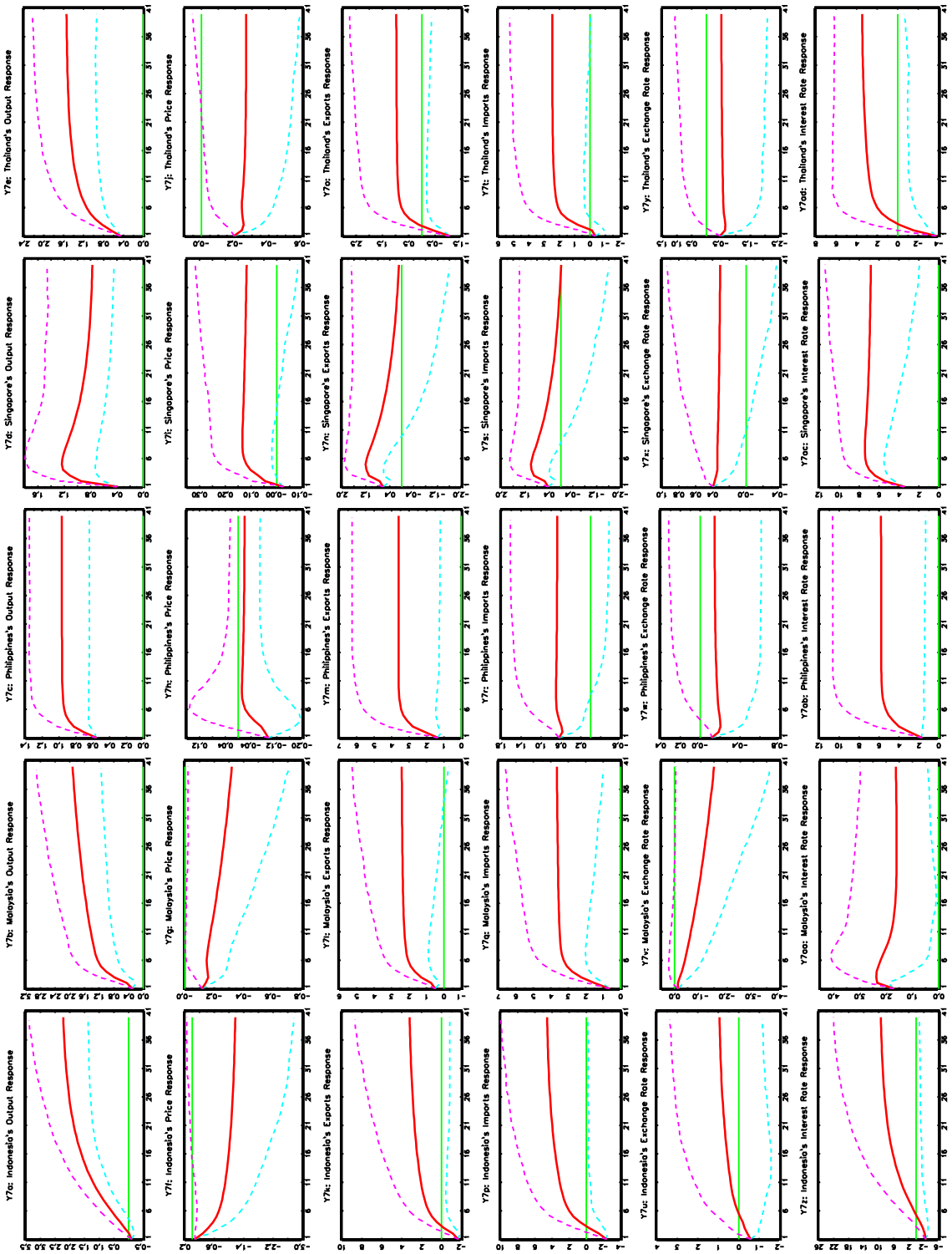
4.1.2 Shock to US output

Note that the responses in the ASEAN-5 economies to a system-wide shock that increases US output by one standard error, or approximately 0.9% is summarised in Figure 2. From a trade perspective, an increase in US output is equivalently an increase in US income and therefore, reflects greater demand for consumption as well. The bulk of final goods bound for the US is produced in the East Asian region. Since many of the intermediate goods needed in its production are manufactured in the ASEAN-5 economies, such an increase in US output would therefore also raise the demand for goods produced in these five economies. This shock would be propagated through the regional production network.

The responses to a one standard error shock to US output which are summarised in Figure 2 supports this explanation. Their exports and output can be seen as having increased significantly in response to this common shock. The influence of the regional production network can be noted in the magnitude of their imports response as well. The pattern of trade via the regional production network is mainly intra-industry and so these economies would import needed inputs for the production of its exports. Consequently, if this occurs, the magnitude and pattern of responses in

[5]This analysis looked at a handful of emerging economies as a cluster including the ASEAN-5 economies but does not include Indonesia.

Figure 2: Generalised Impulse Responses from a 1 s.e. shock to US Output



their imports and exports should be similar. Based on Figure 2, this was observed for Malaysia, Singapore and Thailand. Relative to these economies, Philippines is not as heavily involved in trade through the network and so, the pattern in their exports and imports responses differ slightly from each other.

Even though Indonesia is part of the regional production network, its responses are dictated by another economic characteristic that is specific to its economy, namely the strength of its domestic consumption. A large portion of Indonesia's economic growth is driven by its domestic consumption (IMF, 2012; ADB, 2013). As such, as exports increase and domestic income also rises, the income effect encourages imports for consumption. Although its exchange rate response is not significant, it helps to substantiate this explanation. On impact, the exchange rate is seen to appreciate. Exports are larger than imports in the short run. However, as the income effect unfolds, imports increase to fuel consumption and it eventually exceeds the level of exports. Figure 2u shows that exchange rates start to depreciate while at the same time, output continues to rise in Figure 2a. The bootstrap confidence intervals are wide however, and so it indicates that this change in net exports is not significant, but it is informative.

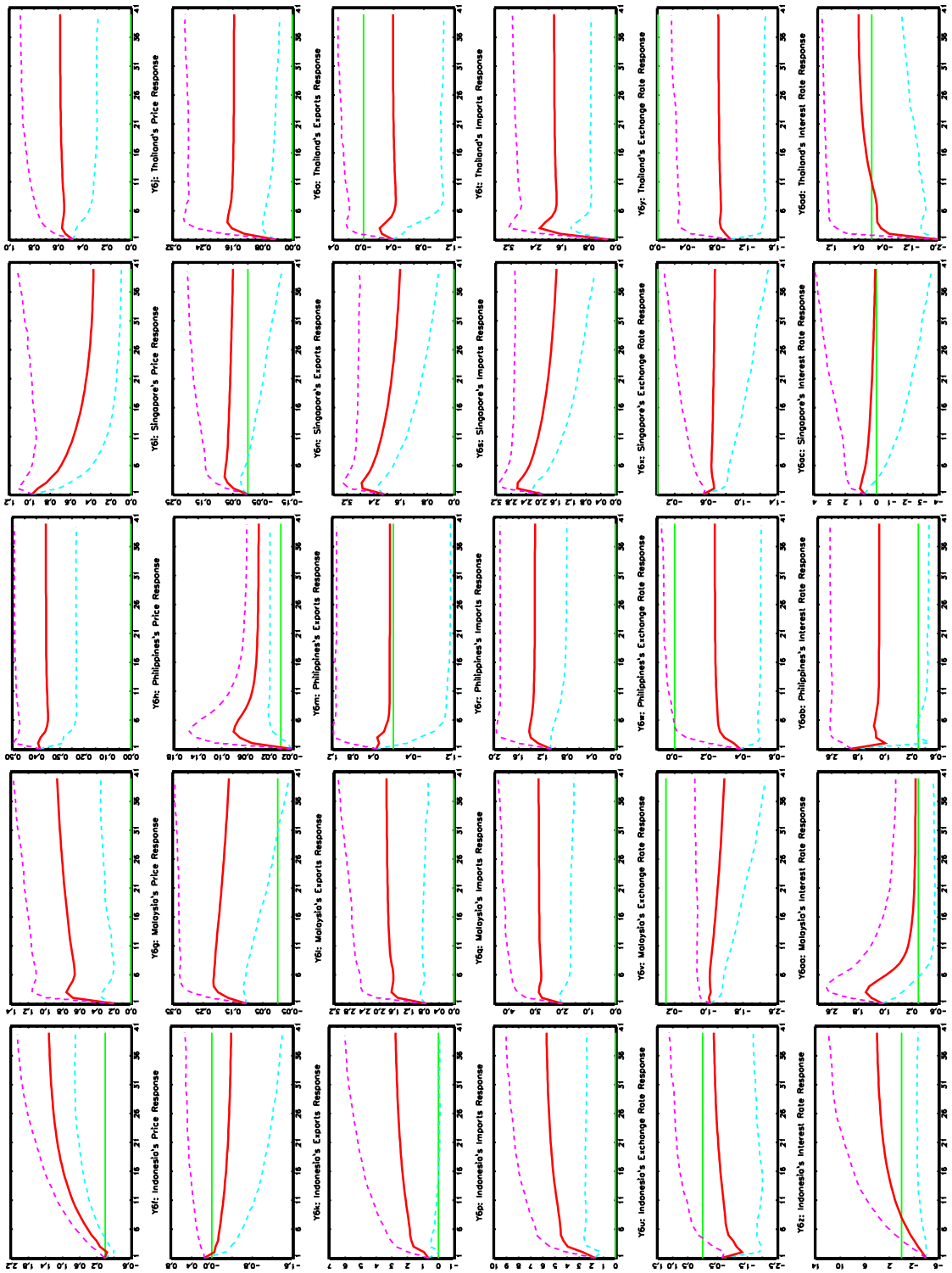
4.1.3 Shock to China's output

Figure 3 shows the responses of the ASEAN-5 economies to a system-wide shock which increases China's output by one standard error, or approximately 1.6%. In response to this shock, their exchange rates appreciate. The exchange rate in Philippines appreciates but unlike the other four economies, the bootstrap confidence intervals suggest that its response is not significant. This result encourages the possibility of exchange rate coordination since it corroborates the results in Girardin (2011) which finds that these economies already target a regional currency basket according to de facto measures.

Coupled with this, the symmetry in their exchange rate responses here is also likely due to the presence of the East Asian regional production network. China and the ASEAN-5 economies form part of the network. Abonyi (2012) finds that 60% of imports in China are used for exports whether directly or indirectly, and less than 15% of this is consumed domestically. Therefore, if the output shock in China is due to a demand shock from one of the final goods markets (e.g. US, EU or Japan), exports in the ASEAN-5 economies should also see an increase as well to cater for the higher demand for inputs into China's processing-exports sector. This would subsequently create an appreciation in each of their local currencies. Out of these economies, Philippines is the least involved in the product fragmentation chain which makes up this production network in the East Asian region. This could explain the muted response in its exports and exchange rates in response to an output shock in China.

The goods market responses in the ASEAN-5 economies are significantly affected by an increase in China's output. Their imports are affected more than exports are. This could be attributed to the appreciation observed in their exchange rates which makes foreign goods relatively cheaper. While the regional production network facilitates an increase in demand for intermediate goods produced in Malaysia, Singapore and Thailand which become inputs, the exchange rate appreciation further adds to the demand for imports, which could be the reason the net effect of this shock produces

Figure 3: Generalised Impulse Responses from a 1 s.e. shock to China's Output



more pronounced increases in each of their imports.

Interestingly, the response in exports for Thailand is different from the exports responses seen in the other four economies. Instead of rising since it is a node in the regional production network, Thailand's exports fall instead. This observation lends support to the understanding that there is potential for the trade relationship between China and the ASEAN-5 economies to be competitive and not just complementary through the regional production network. Even though exports fall in Thailand, output still increases in response to this shock. Intra-ASEAN portfolio investments may be at work here. Their interest rate response hints at this possibility. On impact, the Thailand's interest rate falls but with time, it rises.

4.1.4 Shock to Oil Prices

Figure 4 summarises the responses in the ASEAN-5 economies from a system-wide shock that increases world crude oil prices by one standard error, which is approximately 14%. The price responses observed are consistent with the findings in Osorio & Unsal (2013) which suggest that domestic prices are significantly influenced by oil prices in these economies. An oil price increase raises the domestic price level across each of the ASEAN-5 economies; however, the size of this change is not significant in Indonesia, according to the 95% bootstrapped confidence intervals. Regardless, the pattern of the responses across all five economies suggest that the effect of this shock is permanent. Although the effect fades in Philippines it settles to a long-run equilibrium level that is still significantly higher according to the 95% bootstrapped confidence intervals.

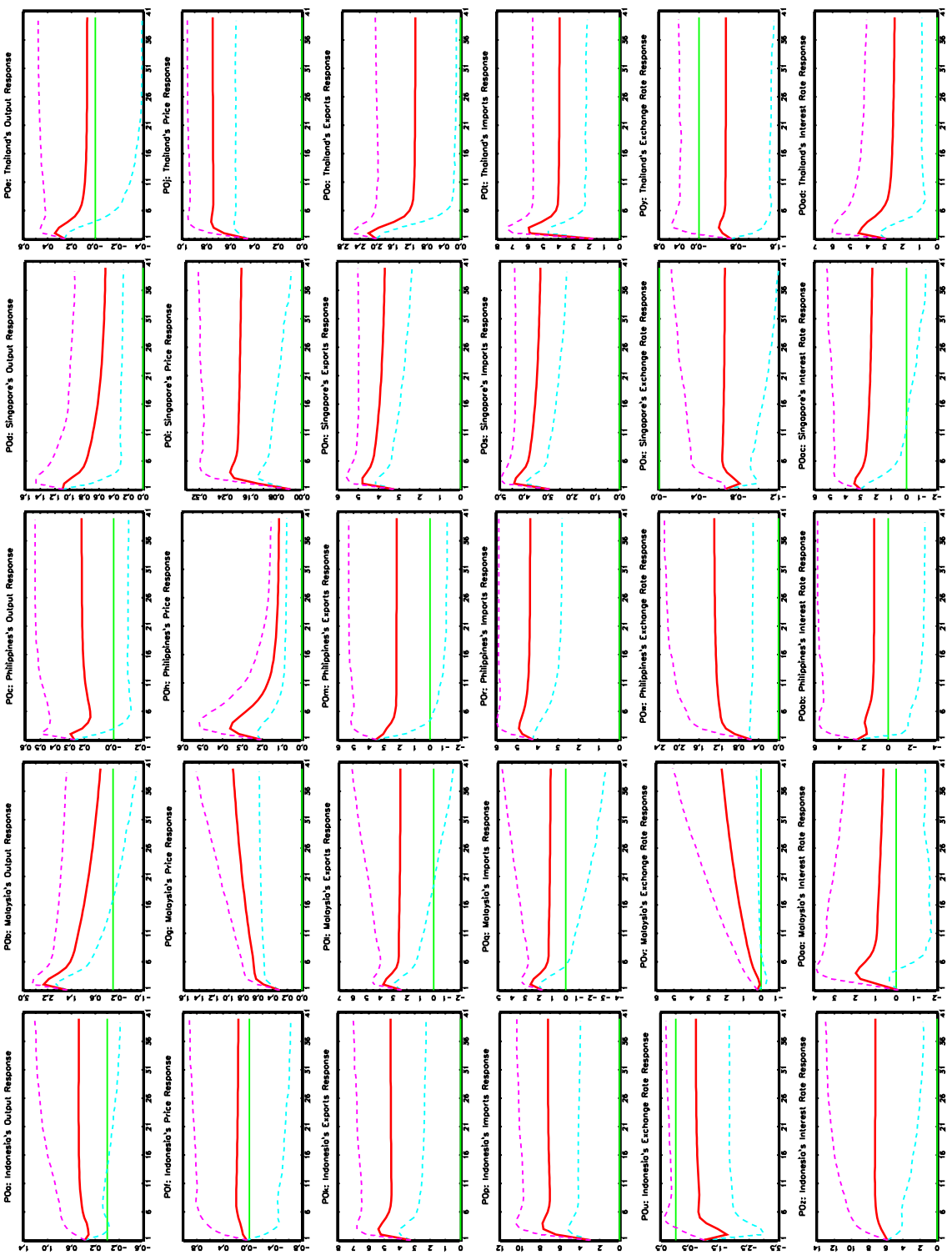
Table 5: Oil Usage Statistics for ASEAN-5

	Oil intensity*	Oil Production**	Oil Imports	Oil Exports	Net Imports/Exports
Indonesia	4.45	1,030,000	767,400	404,100	363,300
Malaysia	3.52	716,000	355,300	644,900	-289,600
Philippines	3.31	33,110	338,400	60,460	277,940
Singapore	6.76	10,910	2,052,000	1,374,000	678,000
Thailand	5.40	406,800	807,100	269,100	538,000

*million barrels of oil equivalent per GDP in billions of 2005 U.S. dollars
** barrels of oil per day
Source: Oil intensity statistics from IMF's WEO Oct 2010 report
Oil Imports and Exports from CIA World Factbook, 2009 figures

The output responses in Malaysia and Singapore can best be explained by their relationship to oil. In referring to Singapore's oil usage statistics in Table 5, one would expect the output in this economy to be adversely affected by an oil price increase. These statistics suggest that Singapore is the most reliant on foreign oil out of all the ASEAN-5 economies; Singapore's oil intensity is the highest, its oil production levels almost negligible, and its oil imports are approximately twice that of its oil exports. However, what these statistics conceal is the fact that this economy is a major oil refining hub in the region and in fact, is one of the top three export refining hubs globally (Singapore Economic Development Board, 2013). Therefore, a price increase in crude oil could very easily be passed on to the price of refined oil which Singapore exports and as such, the adverse price shock would not impact too much on the level of output produced in this economy.

Figure 4: Generalised Impulse Responses from a 1 s.e. shock to Oil Prices



Since the system is non-structural except for a US interest rate shock, an oil price increase may not necessarily reflect a pure supply shock. Rather, it could be the result of demand changes captured in the system. In this case, the increase in oil prices could be a symptom of higher demand for crude and refined oil. The response observed in Singapore's exports, Figure 4n support this explanation since it is significantly and permanently affected by this change as well. Given that Singapore has to import crude oil to be refined, it is not surprising that imports respond in a similar manner. This conclusion is supported by the similar size in its exports and imports responses.

While the effect of an oil price increase raises the level of output in Singapore permanently, the increase in output that it produces in Malaysia dwindles with time. As a producer and net exporter of oil, it makes sense that Malaysia's output would increase a result of this oil price hike; there is potential for higher revenue. However, since this economy also possesses a sizeable manufacturing sector[6], it has to absorb the higher cost of oil as an input eventually and as a result, production levels can be seen to fall in the longer run.

This same explanation should also apply to Indonesia since it is an oil producer according to these statistics. However, the situation in Indonesia is more complicated because it was a net exporter of oil that has recently become a net importer of oil[7] and a significant net exporter of oil, its role reversed in 2005 when it became a net importer of oil instead. As a result, the pattern of response to an oil price shock is less marked relative to that seen in Malaysia as a net exporter of oil.

4.2 Generalised Forecast Error Variance Decomposition

To determine what the main drivers of output and prices are, Generalised Forecast Error Variance Decompositions (GFEVDs) were computed. Table 6 summarises the contribution of regional prices and global factors to each of their domestic price levels.

4.2.1 Price Variance Decomposition

Domestic factors drive price variation in Indonesia and Philippines. Specifically, imports account for 11% of price variation in Indonesia by the 5th year, and domestic exchange rates is the main driver of prices in Philippines explaining 10 % of its variation in the longer-run. These results are not surprising since household consumption takes up a large proportion of their output as can be seen in Table 7. The measure of household consumption as a share of total output shows the importance of consumption in each economy. The average household consumption share of output was largest in Philippines, accounting for 73% of output over the period of the data span, 1993-2011. Indonesia's share of private consumption was the second largest, taking up 60.75% of its total output. These ratios are large compared to the same measures for consumption in Malaysia, Singapore and Thailand that take up only 40-55% of their respective total output.

More than that, according to IMF (2012) and ADB (2013), the domestic consumption in Indonesia fuels its economic growth. Therefore, imports drive domestic prices to sustain and add

[6]The manufacturing sector contributes 30% of GDP on average and is the largest employment sector (ILO, 2012)

[7]Indonesia suspended its membership to the Organisation of Petroleum Exporting Countries (OPEC) in January 2009 Organization of Petroleum Exporting Countries (2013)

Table 6: Generalised Forecast Error Variances: ASEAN-5 Prices

Year	P_{IND}	P_{MAS}	P_{PHL}	P_{SNG}	P_{THA}	Y_{CHN}	Y_{US}	P_{OIL}	P_{US}	Max (%)	Source
Indonesia											
0	30.5262	2.9060	3.6032	5.9864	2.7727	0.0758	0.0236	0.0072	0.0003	30.5262	P_{IND}
1	2.8046	2.1114	2.1362	3.1255	2.6488	0.2772	0.1686	0.7621	0.0769	8.3994	Y_{IND}
2	2.4016	2.8539	2.5319	5.9136	4.1546	0.2528	0.2204	4.5143	0.7909	8.4254	IM_{IND}
3	2.1902	2.8478	2.5965	6.9644	4.5157	0.2290	0.4178	4.7304	0.8176	9.8528	IM_{IND}
4	2.1765	2.7608	2.6242	7.9075	4.7282	0.1457	0.7302	4.1954	0.7278	10.6581	IM_{IND}
5	2.2253	2.6702	2.6358	8.7846	4.8717	0.0974	1.0601	3.6640	0.6450	11.1607	IM_{IND}
Malaysia											
0	0.6425	22.5141	5.0767	0.0019	4.8284	0.8663	0.8814	15.8482	10.6983	22.5141	P_{MAS}
1	1.4255	0.2784	0.3738	77.3920	0.4392	0.5149	0.2614	0.4262	0.3319	77.3920	P_{SNG}
2	3.2270	0.2810	0.5065	53.9747	0.6856	1.6674	0.5529	0.9164	0.5929	53.9747	P_{SNG}
3	3.7539	0.3229	0.6425	42.3913	0.8459	2.5017	0.9331	1.3693	0.8649	42.3913	P_{SNG}
4	3.9710	0.3482	0.7304	35.2740	0.9617	3.0356	1.3157	1.7656	1.0998	35.2740	P_{SNG}
5	4.0179	0.3628	0.7915	30.4492	1.0486	3.3904	1.7103	2.1382	1.3178	30.4492	P_{SNG}
Philippines											
0	3.9783	8.5678	30.8307	4.6891	11.2453	0.0067	0.5548	4.6774	1.9466	30.8307	P_{PHL}
1	1.8586	1.4456	1.3118	2.2762	1.3658	11.3471	0.6269	1.7219	1.4213	18.9813	E_{PHL}
2	2.2299	1.2814	0.9747	3.4186	1.1819	8.3473	0.4248	1.9758	1.4109	15.8811	E_{PHL}
3	2.3893	1.3434	0.9839	4.0245	1.2387	9.2549	0.5012	2.1769	1.5672	11.9191	E_{PHL}
4	2.4051	1.3439	0.9678	4.2478	1.2391	9.6967	0.5184	2.2167	1.6053	10.8688	E_{PHL}
5	2.3990	1.3328	0.9491	4.3753	1.2288	9.9748	0.5169	2.2260	1.6164	10.4228	E_{PHL}
Singapore											
0	1.3640	0.1128	0.8936	43.1685	0.6580	0.4174	0.1174	0.1462	0.1626	43.1685	P_{SNG}
1	1.4304	3.9056	2.1228	1.6312	2.1028	5.0941	3.8061	17.4562	0.6657	17.4562	P_{OIL}
2	0.2932	1.5982	1.0366	0.9038	0.8355	7.1547	4.2911	24.3843	1.3287	24.3843	P_{OIL}
3	0.1713	0.9998	0.8391	0.8713	0.5731	7.4297	5.3812	21.6079	1.0894	21.6079	P_{OIL}
4	0.1299	0.7686	0.7775	0.9108	0.4847	7.4409	5.6084	19.7341	0.9491	19.7341	P_{OIL}
5	0.1083	0.6317	0.7494	0.9689	0.4393	7.4141	5.4762	18.3558	0.8583	18.3558	P_{OIL}
Thailand											
0	2.5810	6.2498	8.7803	3.1003	26.5566	0.1747	3.3844	16.5398	7.1303	26.5566	P_{THA}
1	2.3759	3.1558	3.1082	1.9204	3.2584	3.2676	3.4986	3.2351	3.2328	8.0416	IM_{THA}
2	1.3443	3.4657	3.6419	0.7117	4.4742	1.7452	6.2199	4.5774	4.8501	11.9569	Y_{SNG}
3	1.1918	3.6640	3.9890	0.4910	5.1248	1.1043	7.4361	5.1645	5.5636	12.5169	Y_{SNG}
4	1.1542	3.9334	4.3631	0.3803	5.7332	0.8704	8.3481	5.7372	6.1807	11.2106	Y_{SNG}
5	1.1321	4.1577	4.6729	0.3134	6.2471	0.7392	9.0022	6.2222	6.6715	10.5794	Y_{SNG}

Table 7: Household Consumption as a Share of GDP (%)

	Indonesia	Malaysia	Philippines	Singapore	Thailand
1993	53.04	48.29	72.93	44.23	54.67
1994	54.10	48.14	71.41	43.64	53.97
1995	55.82	47.92	71.31	41.39	53.17
1996	56.53	46.03	70.64	40.90	53.78
1997	55.91	45.35	69.99	40.13	54.66
1998	61.44	41.56	72.47	39.43	54.15
1999	69.08	41.58	72.75	42.01	55.96
2000	61.65	43.75	72.20	41.94	56.13
2001	63.15	46.12	73.63	45.66	57.29
2002	67.62	45.01	73.90	46.31	57.24
2003	68.14	44.58	74.35	45.45	57.22
2004	66.77	44.00	74.50	42.11	57.19
2005	64.36	44.19	75.01	40.13	57.25
2006	62.67	44.34	74.59	38.77	55.82
2007	63.54	45.15	73.48	37.27	53.43
2008	60.62	44.71	74.34	40.24	55.06
2009	58.70	48.84	74.67	40.15	55.23
2010	56.61	47.50	71.55	38.39	53.73
2011	54.58	47.50	73.72	39.37	54.49
Average	60.75	45.50	73.02	41.45	55.29

Source: EIU database

variety to its domestic consumption. Ito et al. (2005) finds that there is a large and significant degree of exchange rate pass-through to both inflation and import prices. It is therefore unsurprising that imports, exports and their domestic exchange rate form the top drivers of price variation in Indonesia's economy. In the case of Philippines, the price variance decomposition in Table 6 is consistent with the findings in Cortinhas (2009). Cortinhas (2009) finds that out of all the ASEAN-5 economies, Philippines experiences the largest exchange rate pass-through to domestic inflation. Unsurprisingly, their exchange rate is the top contributor to domestic price variation.

Meanwhile, the price variations in Malaysia and Thailand are best explained by economic variables in Singapore. Since Singapore trades extensively, particularly in its imports of consumables from Malaysia, it is not surprising that the price level in Singapore heavily drives the price variation in Malaysia (CIA, 2012). The contribution is notably large; up to 77% of Malaysia's price variation is accounted for by Singapore's price movements in the 2nd year and this value drops to 30% in the 5th year. The trade linkage between Singapore and Thailand however is not as strong as that between Singapore and Malaysia, but the results indicate that output in Singapore is a main driver of price fluctuations in Thailand. This could possibly be due to global factors at work as well. The observation that US output movements are a close second when it comes to explaining Thailand's price variation hints at this possibility. Even though the size of the US output contribution is not as large, it is close to the proportion by which Singapore output explains price variation in Thailand.

As was previously mentioned, Singapore is an important oil refining centre and therefore, the results that its prices are driven largely by oil prices is not surprising. Singapore targets its exchange rate rather than inflation like most other economies so shocks that change its terms of trade and has an impact on their exchange rate would affect their domestic prices as well; oil prices may be such a factor since oil plays a key role in the Singapore economy.

4.2.2 Output Variance Decomposition

Table 8 highlights results from the output variance decomposition for the ASEAN-5. Once again, Indonesia and Philippines are largely driven by domestic factors; interest rates drive output in Indonesia while exchange rates explain output movements in Philippines. The size of the contributions is approximately equal. These domestic factors contribute the most to output variation in the 2nd year. Interest rate movements in Indonesia account for up to 25% of its output variation while the exchange rate in Philippines explains up to 28.6% of its output variation in the second year. Similar to the explanation of domestic factors driving the economies in Indonesia and Philippines, migrant remittances are likely behind this result.

These GFEVDs show that domestic imports are the largest driver of Malaysia's output variation. Imports form an important source of inputs into its production process especially for the production of exports within the regional production network and therefore would feature heavily in the dynamics of its economy. Since Singapore and Thailand are also part of this regional production network, the main drivers of their output fluctuation can be understood based on this economic characteristic. As was previously mentioned, the regional production network caters for external demand from economies such as the US. Therefore, movements in factors affecting this demand such as US monetary policy (captured in its interest rate) would significantly affect their

Table 8: Generalised Forecast Error Variances: ASEAN-5 Output

Year	Y_{IND}	Y_{MAS}	Y_{PHL}	Y_{SNG}	Y_{THA}	Y_{CHN}	Y_{US}	P_{OIL}	Max (%)	Source
Indonesia										
0	59.9815	0.4754	1.2908	0.0652	0.9228	0.0084	0.1741	2.6041	59.9815	Y_{IND}
1	0.2884	1.0874	0.2273	9.0582	0.2319	1.4883	0.3072	0.2627	29.1639	EX_{SNG}
2	0.2996	0.3555	0.2760	1.1868	2.7493	1.4971	2.3577	0.3449	25.8670	R_{IND}
3	0.2067	0.1837	0.4483	0.6768	4.4405	1.5642	5.4412	0.2170	20.8724	R_{IND}
4	0.1634	0.3396	0.8019	1.3861	5.6635	1.8549	7.6107	0.1849	16.4207	R_{IND}
5	0.1491	0.6201	1.1731	2.1763	6.3840	2.0854	8.7784	0.2086	13.4053	R_{IND}
Malaysia										
0	0.2320	16.9397	4.2208	9.2638	2.1512	1.5622	0.1522	15.3721	16.9397	Y_{MAS}
1	0.8016	2.9127	3.0627	3.1612	3.2853	4.9408	1.2596	3.2304	8.0299	E_{MAS}
2	0.1318	3.0707	3.1950	4.2313	5.1117	5.3594	2.3225	3.0772	7.6178	R_{MAS}
3	0.0746	3.4178	3.6806	5.2501	6.1168	5.3419	4.2698	3.0330	7.8441	IM_{MAS}
4	0.0575	3.7609	4.1653	6.0590	6.6385	5.3769	5.7532	3.0903	8.5692	IM_{MAS}
5	0.0473	3.9867	4.4882	6.6803	6.9491	5.2919	6.9055	3.0687	8.9827	IM_{MAS}
Philippines										
0	0.6315	8.9761	23.6391	11.4919	3.5298	3.5413	8.0938	1.5533	23.6391	Y_{PHL}
1	1.0105	1.2692	1.1943	1.2897	1.4594	1.2793	1.2391	1.4520	24.6533	E_{IND}
2	0.4338	1.1432	1.2077	1.2876	1.8645	1.2250	1.4205	0.8056	28.6183	E_{PHL}
3	0.3699	1.4457	1.5911	1.6855	2.5373	1.5237	1.9283	0.7790	26.5544	E_{PHL}
4	0.3350	1.7183	1.9391	2.0393	3.0804	1.7789	2.3690	0.7775	24.6512	E_{PHL}
5	0.3092	1.9546	2.2494	2.3474	3.5208	1.9880	2.7498	0.7748	23.1120	E_{PHL}
Singapore										
0	0.4883	11.6258	5.4565	19.6281	4.0224	2.8408	2.2186	4.3829	19.6281	P_{SNG}
1	2.1077	3.3721	3.1693	2.9896	3.3413	3.2384	4.1923	4.1008	9.1091	R_{US}
2	1.1263	3.6313	3.3812	2.9842	3.6208	2.8490	6.4643	4.8696	19.9029	R_{US}
3	1.0926	3.6228	3.3330	2.8637	3.5524	2.7128	7.0358	5.1254	21.4765	R_{US}
4	1.1707	3.6204	3.2992	2.8157	3.5097	2.7406	7.0883	5.4351	20.9144	R_{US}
5	1.2532	3.6194	3.2690	2.7808	3.4720	2.8068	7.0409	5.7415	20.2570	R_{US}
Thailand										
0	0.6314	6.4935	4.4820	11.9634	30.8937	3.1273	2.7691	1.5182	30.8937	Y_{THA}
1	2.0973	2.8668	2.5442	2.6616	2.2821	3.0021	2.9712	4.3969	9.6045	P_{SNG}
2	0.7410	2.6904	2.7020	2.5445	1.6431	2.7318	6.4399	2.9688	12.7877	P_{IND}
3	0.3977	3.0309	3.3337	2.9115	1.5096	2.5582	10.4470	2.1023	11.3141	R_{US}
4	0.2568	3.3324	3.7607	3.2107	1.4661	2.4036	13.0517	1.6990	15.1438	R_{US}
5	0.1852	3.5700	4.0606	3.4656	1.4672	2.2877	14.7095	1.4595	17.5616	R_{US}

respective output levels as well. Table 8 shows that the US interest rate is the most important driver of output fluctuations in Singapore.

US output appears to drive the output movements in Singapore and Thailand as well although not to the extent that the interest rates in the US do. However, not only is the US an important source of demand for final goods, it is also an important foreign investment partner. Therefore, although interest rates can be interpreted as a monetary policy tool, the movements in the US interest rate that induce a change in their output levels could also be due to the changes that are produced in their respective domestic interest rates, which subsequently affect the level of FDI and domestic investment. Changes to either of these investment types would have an effect on their domestic output as well. Based on CPIS statistics, this explanation is not too far-fetched; the US economy is an important source of investment and financing for all five economies.

5 Discussion

Buiter (1997) states that asymmetric responses across the a group of economies can be created due to differences in either shocks experienced (impulse) or economic characteristics (responses). The analysis in this paper controls for the former since it explores the effects of four common sources of shocks individually using GIRFs and GFEVDs. Therefore, after having isolated patterns in their responses to shocks and output and price variation, this section discusses the extent by which differences in their economic characteristics have played a role in creating asymmetries. The three characteristics that define their economies are discussed: the regional production network, oil reliance, and domestic demand size.

5.1 Production Network

The presence of a production network in the East Asian region has been well-documented. Among the ASEAN-5 economies, the degree of vertical specialisation has risen and economic growth is attributed to intra-regional trade mainly as intra-industry trade. The GIRFs for each of the shocks explored indicate that exports and imports respond in tandem. This pattern strongly suggests that product fragmentation is present since imports become an input for the production of exports. Therefore, an increase in the production of exports will require an increase in imports as well.

While the East Asian economies' quick recovery from the Global Financial Crisis heightened discussion regarding the possibility that they may be decoupling from developed economies, approximately 71% of final manufactured goods exported from this region is still bound for developed economies like the US and EU (Abonyi, 2012). As such, output shocks in these economies should continue to affect demand for these exported goods and influence the East Asian economies. The evidence however, is mixed as there are some recent studies such as in Dees & Vansteenkiste (2007) which finds that the East Asian business cycles are now less synchronised with the US business cycle. The East Asian economies will continue to be susceptible to external shocks from these industrialised countries, and the production network that has emerged will likely facilitate shocks transmissions in the form of spillovers through the trade linkages that make up the network. These trade linkages are the intra-industry trade flows.

As a major consumer of final goods produced in the East Asian region, the US economy has been a main source of common demand shocks to this region. Due to the spillovers facilitated by the regional production, economies that previously would not have been affected by a shock in the US will now receive some proportion of it through the network linkages. Any shock that alters US demand for goods as a result affects all the economies along the production chain, and not just the economy that the US directly imports final goods from. Sato et al. (2011) use a structural VAR with block exogeneity and find that US shocks exert a significant influence on East Asian output movements.

Owing to the mild impact of the GFC on the ASEAN-5 and East Asian economies, there is an increasing interest in the possibility that China's influence in the East Asian region is on the rise[8]. This could be attributed to China's role as a hub within the regional production network that processes the parts produced in the ASEAN-5 countries and other economies in the region for re-export as a final good. Therefore, changes in the level of output in China also signals a change in demand for intermediate goods produced in each of the ASEAN-5 economies.

While the US continues to be an important source of demand for final goods produced in this region, the trade relationship between China and the ASEAN-5 economies is less clear. These economies compete or complement each other depending on the labour-skill and technology intensity required in the production of a good according to Holst & Weiss (2004). This is expected since all the ASEAN economies have committed to creating a single market and stable production base among themselves known as the AEC so that they can compete with larger emerging economies such as China and India. Thailand's exports response to an output shock in China in the GIRF analysis in this paper supports this explanation. A one standard error increase in China's output caused Thailand's exports to fall. Holst & Weiss (2004) state that although the ASEAN-5 appear to have an advantage in high-technology intensity goods which complement production in China, there is increased competitiveness in high labour-skill intensity products between China and the ASEAN-5 economies for market share in third party markets.

Using the latest trade weights from 2011 in a GVAR model, Feldkircher & Korhonen (2012) analyse the responses of emerging markets to shocks stemming from China. Their findings indicate that relative to other regions in the world, the Asian region produces smaller responses to a shock to China's output. Given the increasing importance of China in this region, this is a surprising result but the authors reason similarly that it might be due to having both complementary and competitive trade relationships between China and the ASEAN-5 economies. Despite the mixed nature of this relationship, Lau & Lee (2008) find that the income in China and the ASEAN-5 countries are strongly interdependent with the direction of causality running from China to the ASEAN-5 economies. This indicates a dominance of the complementary relationship through the regional production network. Cesa-Bianchi et al. (2011) lend supports to this result as well. The study uses a GVAR model with time-varying weights and finds that China's influence on emerging economies, particularly for emerging Asia has indeed been increasing and is attributed to the strengthening trade linkages between them. The presence of the regional production network which includes China is exemplified in the ASEAN-5 economies' response to a one standard error

[8]Statistics finds that trade between the ASEAN-5 and China has increased from 2.06 % of total trade to 10.8% of total trade between 1993 and 2008 (Secretariat, 2003, 2010)

increase in China's output; all their exchange rates appreciate as a result.

Dungey & Vehbi (2011) assess the competing global forces to see which of the two economies influence the ASEAN-5 economies more, the US or China. They use a structural VECM to analyse whether the effect on the ASEAN-5 from an output shock stemming from the US and compares it with the effect on these economies from an output shock from China. Dungey & Vehbi (2011) find that US output shocks still dominate in these five economies however, China's influence among them is increasing. The GFEVDs found in this paper support this as well in that US interest rates which can be interpreted as US monetary policy as well drives output variation in economies such as Singapore and Thailand. The contribution of China's output to each of the ASEAN-5 economies' output variation however, is not as high.

From this discussion, the trade linkages present as intra-industry trade flows which form the regional production network. These linkages do in fact encourage symmetry in output responses to common shocks. Complementing this understanding, there is evidence in the empirical literature that shows that supply shocks have been driving business cycle synchronisation for the East Asian region. The study by He & Liao (2012) suggests that it might be driven by technology shocks which are transmitted through this production network.

5.2 Oil Reliance

The oil intensity statistics in Table 5 are moderate to high for the ASEAN-5 economies. It is expected based on these statistics that oil price shocks would significantly affect each of their economies. This is found in related studies on the ASEAN-5 economies. Downes (2007) states that an oil price shock increases inflation in the ASEAN-5 economies and the three main groups most affected are: consumers through higher retail fuel prices, businesses from the higher operating costs and companies involved in the production and distribution of oil. Not surprisingly, Osorio & Unsal (2013) find that oil and commodities prices drive inflation dynamics for the Asian region when the economies are modelled within a Global VAR. The results in this paper are consistent with the conclusions from their study. The GIRFs in Figure 4 which show the responses to a one standard error increase in oil prices suggest that domestic price levels in each of the ASEAN-5 countries rise too.

Cunado & de Gracia (2005) observe that although oil price shocks do wield a significant amount of influence on these economies, the effects are temporary only. The present GIRF and GFEVD analysis of their price responses suggests otherwise. The price responses show that this shock has long lasting effects on inflation and only Philippines' price response remotely suggests that the effect is temporary; the initial effect of this dies away but there is still a significantly higher price that persists according to Figure 4h. In addition to this, the GFEVDs for Singapore especially, shows that oil prices drive its domestic price variation and this result holds in the longer-run. Based on the output responses, the effect of this shock on income however, may be temporary in Malaysia and Thailand.

The ASEAN-5 economies' relationships to oil adds an extra layer of complexity to the analysis because it also creates an indirect channel by which global output shocks, particularly China and US output shocks could also affect the ASEAN-5 economies. Roache (2012) compares the influence

of economic activity measured by industrial production growth in both the US and China on oil prices. The results indicate that while the influence of China has been increasing, the US economy still elicits a bigger change in oil prices. According to Roache (2012), a key difference between the two economies' influence on oil prices is in the persistence of the effects; China's economic activity mainly affects oil prices in the short run while the US economic activity has more persistent effects. Adding to this insight, Feldkircher & Korhonen (2012) find that a one standard error shock which comes up to a 1.2% increase in US output within a GVAR model, causes oil prices to increase by 15% in the long run. While this is something that is important to note, it is not easily teased out using the GIRFs and the GFEVDs. However, it does need to be accommodated for in the model especially if the aim is to analyse the effects of global shocks on each of these economies. This was done by including world oil prices in the "rest-of-world" model so that both US and China's output could influence it.

The expectation is that the degree of symmetry in their output responses to an oil price shock will be low because there is heterogeneity among the ASEAN-5 economies in terms of their dependence on foreign oil. Malaysia is the only economy among them that produces oil and exports more than it imports, and although Indonesia does export oil as well, their reliance on oil has changed significantly. It has become a net importer rather than a net exporter since 2005. As such, with economies like Singapore and Thailand that rely heavily on imported oil, the expected response from an increase in oil prices will affect them differently. The differences in oil intensity will also show up because it determines how much this increase in oil prices will translate into a reduction in production and consumption in the economy. Surprisingly, their output and price responses are symmetric which suggests that there are other mechanisms also at work in addition to their direct relationship to oil prices.

The oil usage statistics in Singapore masks the fact that it is an important oil refining hub internationally. Therefore, the higher cost of crude oil could easily be passed on to the sale of refined oil. The exports and imports response in Singapore suggests that this might be at work since the magnitude of these responses are almost equal. Although each of these mechanisms cannot be identified, the net effect of an oil price shock appears to produce symmetric output and price responses.

Out of all the ASEAN-5 economies, Malaysia and Singapore appear to be the only ones that should be positively affected by an oil price increase. In the other economies, it is expected that they would be adversely affected. However, symmetry in output is still observed across all five economies. This can likely be attributed to the financial and labour linkages among the ASEAN-5 economies. Malaysia and Singapore are a focal point of remittances and portfolio investments in the region so these linkages facilitate migrant remittances and portfolio diversification which shares the wealth with the economies that are negatively affected by the same shock. This essentially encourages symmetry in their net output responses even if the initial output effect is asymmetric.

Other factors that influence Indonesia and Philippines include the strength of their domestic consumption which will be discussed in the next section.

Table 9: Bilateral Migrant Remittance Matrix for 2012 ($US million)

Sender \ Receiver	China	Indonesia	Malaysia	Philippines	Singapore	Thailand	TOTAL
China	0	-	-	-	-	-	-
Indonesia	432	0	0	0	-	0	445
Malaysia	772	3,786	0	1,247	-	365	7,252
Philippines	245	13	0	0	-	1	610
Singapore	3,929	401	927	0	0	0	6,717
Thailand	2,115	4	3	13	-	0	2,862
United States	13,071	321	47	10,604	-	1,140	123,273
TOTAL	60,246	7,207	1,272	24,453	-	4,124	528,769

- indicates that data is not available

Data retrieved from World Bank Migration database

5.3 Domestic Demand and Migrant Remittances

Osorio & Unsal (2013) find that domestic factors contribute relatively more to inflation dynamics in economies such as Indonesia where the domestic demand is large. Relative to the other ASEAN-5 economies, the size of domestic consumption as a share of output in Indonesia and to some extent Philippines as well is substantial and is expected to grow according to IMF (2012) and ADB (2013). The Asian Development Outlook in 2013 notes that according to the latest statistics, private consumption contributed almost half of total output growth in Indonesia (ADB, 2013). The GFEVDs support this; domestic factors were the main drivers of both price and output variation in Indonesia and Philippines while external (intra-ASEAN and global) factors explained these variations for Malaysia, Singapore and Thailand.

The GIRFs observed for Indonesia also support this explanation. All shocks explored have the ability to increase income in these economies through raising the level of exports with the regional production network (US and China's output shock), higher revenues with higher oil prices (oil price shock) or greater returns to financial holdings (US interest rate and monetary policy shock). Therefore, as a node in the production network, and as a net exporter of oil (for the larger portion of the data span), it can be expected that there might be an income effect in Indonesia. As an economy with a large domestic demand base, this effect could in turn increase consumption substantially too. Across all four shocks explored, Indonesia's imports increase by more than exports hinting at this effect. Strengthening it further is the fact that although the response in imports dominate, output still consistently increases in all these scenarios, even if the change is not significant according to the 95% bootstrapped confidence intervals.

Given the results in the GFEVDs, this characteristic might be a concern because if these economies are driven by differing factors *i.e.* domestic versus external factors, then they are likely to experience asymmetries in their responses. However, the GIRFs indicate that although there is some variation in their imports and exports responses, output still responds symmetrically to common shocks. There may be a labour market linkage that could potentially shed light on this result. As one of the largest migrant remittance receivers in the East Asian region if not globally according to Migration & Remittances Factbook (2011), domestic consumption in Indonesia and Philippines is likely being sustained through the labour linkages that facilitate remittances between countries. Table 9 summarises the migrant remittances among these economies for 2012. These statistics show that Malaysia is an important source of migrant remittances for both Indonesia and Philippines; Malaysia accounted for 53% of Indonesia's remittances received and while slightly less important, Malaysia was still the 4th most important source of migrant remittances to the Philippines and the 2nd most important source of migrant remittances to Thailand. In 2012, it accounted for 12% and 9% of remittances received in Philippines and Thailand, respectively. To add to the strength of this channel as a transmission channel, Singapore is the main source of remittances bound for Malaysia. This linkage is particularly strong; Singapore provides 73% of the remittances received in Malaysia.

While it can be said that domestic consumption explains the pattern of responses particularly observed in Indonesia, the migrant remittances through labour linkages present between each of these economies and the rest of the ASEAN-5 group has contributed to the degree of symmetry

observed in their output responses to a common shock. Therefore, these labour linkages do play a role in enabling symmetry mainly because it is able to mitigate asymmetries that arise in their responses to a common shock. While the same can be said for portfolio holdings across countries, Migration & Remittances Factbook (2011) finds that remittances are largely used for consumption and therefore, the labour linkages may be relatively more important a driver behind this economic feature.

6 Conclusion

This paper has analysed whether the ASEAN-5 economies respond symmetrically to a common shock, taking into account the spillovers that arise from trade and financial linkages present among them. This is done in order to determine if policy coordination is feasible since the act of policy coordination is made easier whenever shocks occur. In addition to this, the cost of policy coordination namely in having to cede national interests for regional ones is less stifling under such an agreement. The effects of four global shocks were explored: shocks to US monetary policy, US output, China's output and oil prices.

Output responses to these common shocks were symmetric. This result is underpinned by market linkages that exist among the ASEAN-5 economies. Trade, financial and labour linkages are likely present as intra-industry trade flows, portfolio investments and migrant remittances, respectively. More generally, the three economic characteristics of a regional production network, oil reliance and domestic consumption helped to explain the responses in their domestic variables. These results provide evidence in favour of feasibly coordinating exchange rate and monetary policies in the ASEAN-5 economies.

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