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Impact of International Financial Shocks on Small Open Economies: The Case of Four ASEAN Countries

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Arief Ramayandi

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The author accepts responsibility for any errors in the paper.

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Abstract

A more integrated global financial system has implications on the economic volatility of small open economies. This paper simulates the impact of a short-term shock originating from the global financial system on small open economies in the Association of Southeast Asian Nations (ASEAN). The simulation is conducted by means of empirically estimated small open economy dynamic stochastic general equilibrium models for Indonesia, Malaysia, the Philippines, and Thailand. The analysis highlights similarities and differences of the impact of a pure international financial shock on aggregate domestic price inflation and on output gap for each of the four ASEAN countries. It suggests that the impact of such shock on the sampled economies tends to be relatively small but long-lasting, hence placing challenges on the task of managing economic volatility in these economies.

I. Introduction

The recent global financial crisis started in the United States (US), the epicenter of the crisis, where toxic assets out of subprime mortgages were produced. Financial institutions in the Euro area, the United Kingdom, and Switzerland had large exposures to these toxic assets. At the same time, peripheral European countries had overborrowed from foreign countries. Consequently, as the crisis exploded, the financial sector in these countries collapsed, and countries with foreign overborrowing problems suffered a currency crisis. However, Asian countries (including the region's emerging economies) did not seem to experience the same suffering.

The above raises questions related to the implications of a shock originating from the global financial system on emerging economies. The purpose of this paper is to conduct a preliminary examination of the effects of an adverse shock in the global financial system on the macroeconomic condition in emerging Asia. In particular, the paper limits its examination to four emerging economies in the Association of Southeast Asian Nations (ASEAN), namely, Indonesia, Malaysia, the Philippines, and Thailand. To do this, the paper simulates the impact of an adverse short-term international shock that is purely financial in nature, using a simple structural dynamic stochastic general equilibrium model for a small and open economy, which is specifically characterized to represent each of the countries under consideration.

The employed structural dynamic stochastic general equilibrium model is built on the one derived in Gali and Monacelli (2005). It is a version of a small open economy model that features imperfect competition and nominal price rigidities. In addition, the model considers an incomplete pass-through effect, as suggested by Monacelli (2005), and staggered price setting in the domestic import goods market. The model extends the consumers' behavior side by considering external habit formation in consumers' utility.¹ These modifications are undertaken to capture richer dynamics in the model in order to make a closer representation of actual data.² Lastly, as in most of the literature discussing the New Keynesian small open economy models, the model used also treats the foreign sector as approximately closed since the domestic economy is not considered to be large enough to affect the foreign sector.

Given the parsimony structure of the employed model, the international financial system is crudely represented by an international interest rate equation that belongs to its system.

¹ A similar approach can also be seen in Fuhrer (2000), Christiano et al. (2005), Smets and Wouters (2003), etc.

² See Woodford (2003, chapter 5) for discussions on the issue.

The shock in the global financial system is measured as an unexpected innovation in the stochastic component of this equation. This choice of representing the international financial shock is justified by the two incidents of international financial crises that took place in the first decade of this century: the burst of the technology bubble in the early 2000s, and the first phase of the global financial crisis in the late 2000s. In both cases, aggressive policy easing took place in the leading industrial economies, sending their real interest rates to fall to a very low level. The rest of the paper is organized as follows. Section II describes the basic structure of the simple small open economy model used to characterize the economies under consideration. Section III simulates the impact of a negative external financial shock to the economies, with and without discretionary counter effects in domestic monetary policy, and provides interpretations to the results. Section IV concludes.

II. A Simple Small Open Economy Model

A. Households

The economy is assumed to be inhabited by a continuum of representative households (HH) that seek to maximize:

$$E_t \sum_{T=t}^{\infty} \beta^{T-t} \Upsilon_T [U(C_{T-t} - H_{T-t}) - V(N_{T-t})] \quad (1)$$

subject to an intertemporal budget constraint, which will be described later in this section. In the above equation, E_t denotes the expectation operator taken at time t ; β represents the discount factor; and Υ_T denotes the random HH preference shock, which is assumed to be strictly positive and with log values normally distributed with mean 0.

N_t denotes hours of labor and $V(N_t)$ represents the HH disutility out of working, and is defined as follows:

$$V(N_t) = \frac{N_t^{1+\varphi}}{1+\varphi} \quad (2)$$

where φ is the inverse elasticity of labor supply.

$U(\cdot)$ represents HH utility out of consumption that is assumed to take the form of:

$$U(C_t - H_t) = \frac{(C_t - H_t)^{1-\sigma}}{1-\sigma} \quad (3)$$

where σ is the inverse elasticity of intertemporal substitution. C_t is the time t composite consumption index of the representative HH that contains both bundles of domestic and imported goods ($C_{D,t}$ and $C_{F,t}$, respectively) defined by:

$$C_t = \left[(1-\alpha)^{\frac{1}{\eta}} C_{D,t}^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \quad (4)$$

$H_t = hC_{t-1}$ represents an external habit formation of the representative HH that is assumed to be taken exogenously at each time t .³ Notice that under this specification, α measures the degree of openness of the economy and η is the elasticity of substitution between the two categories of goods.

The aggregate domestic and import consumptions are given by the following constant elasticity of substitution aggregators of the quantities consumed in each type of good:

$$C_{D,t} = \left(\int_{i=0}^1 C_{D,t}(i)^{\frac{\varepsilon-1}{\varepsilon}} \partial i \right)^{\frac{\varepsilon}{\varepsilon-1}} \quad \text{and} \quad C_{F,t} = \left(\int_{i=0}^1 C_{F,t}(i)^{\frac{\varepsilon-1}{\varepsilon}} \partial i \right)^{\frac{\varepsilon}{\varepsilon-1}} \quad (5)$$

where ε is the elasticity of substitution among goods within each bundle category.

The maximization of equation (1) is subject to a sequence of an intertemporal budget constraint:

$$\int_{i=0}^1 [P_{D,t}(i)C_{D,t}(i) + P_{F,t}(i)C_{F,t}(i)] \partial i + E_t(\xi_{t,t+1} D_{t+1}) \leq W_t N_t + D_t + \tau_t \quad (6)$$

where P denotes the price of each good; D_{t+1} is the time $t + 1$ nominal pay-off of the portfolio held at the end of period t ; W_t is the nominal wage; τ denotes lump sum taxes or transfers; and $\xi_{t,t+1}$ denotes the stochastic discount factor for nominal pay-off ($E_t(\xi_{t,t+1}) = R_t^{-1}$, where R is the gross return). Throughout the model, the representative HH are assumed to have access to a complete set of contingent claims traded internationally. Further, the model specifies monetary policy in terms of an interest rate rule rather than a money rule. Therefore money is not explicitly introduced in the model and can be considered as only playing the role of a unit of account.

Under this specification, HH optimal allocation of expenditures within each category of goods yields demand functions:

$$C_{D,t}(i) = \left(\frac{P_{D,t}(i)}{P_{D,t}} \right)^{-\varepsilon} C_{D,t} \quad \text{and} \quad C_{F,t}(i) = \left(\frac{P_{F,t}(i)}{P_{F,t}} \right)^{-\varepsilon} C_{F,t}; \forall i \in [0, 1] \quad (7)$$

Equation (7) implies the price indices for domestic and imported goods as follows: $P_{D,t} = \left(\int_{i=0}^1 P_{D,t}(i)^{1-\varepsilon} \partial i \right)^{\frac{1}{1-\varepsilon}}$ and $P_{F,t} = \left(\int_{i=0}^1 P_{F,t}(i)^{1-\varepsilon} \partial i \right)^{\frac{1}{1-\varepsilon}}$. The optimal allocation between domestic and imported goods yields the aggregated demand function for each category of goods as follows:

³ This treatment follows the treatment used in Smets and Wouters (2003), Justiniano and Preston (2004), and Lindé et al. (2004), among others.

$$C_{D,t} = (1-\alpha) \left(\frac{P_{D,t}}{P_t} \right)^{-\eta} C_t \text{ and } C_{F,t} = \alpha \left(\frac{P_{F,t}}{P_t} \right)^{-\eta} C_t \quad (8)$$

The above equation implies $P_t = \left[(1-\alpha)P_{D,t}^{1-\eta} + \alpha P_{F,t}^{1-\eta} \right]^{\frac{1}{1-\eta}}$, where P_t is the consumer price index (CPI) at each period t .

Given the above optimality conditions in equations (7) and (8), the representative HH intertemporal budget constraint can be rewritten as:

$$P_t C_t + E_t(\xi_{t,t+1} D_{t+1}) \leq W_t N_t + D_t + \tau_t \quad (9)$$

It follows that the representative HH problem now is to maximize equation (1) subject to equation (9). The resulting first order necessary conditions (FONCs) can be rearranged as follows:

$$\frac{N_t^\varphi}{(C_t - hC_{t-1})^{-\sigma}} = \frac{W_t}{P_t} \quad (10)$$

and,

$$\beta R_t E_t \left[\frac{Y_{t+1}}{Y_t} \left(\frac{C_{t+1} - hC_t}{C_t - hC_{t-1}} \right)^{-\sigma} \frac{P_t}{P_{t+1}} \right] = 1 \quad (11)$$

where equation (10) represents the standard intratemporal optimality conditions for HH labor-leisure choice, and equation (11) denotes the stochastic Euler equation.

B. Domestic Inflation, Real Exchange Rate, and Terms of Trade

Domestic inflation is characterized by the domestic CPI inflation, which in its log-linearization around its steady state takes the form of:

$$\rho_t = (1-\alpha)\rho_{D,t} + \alpha\rho_{F,t} \quad (12)$$

where lowercase subscripts denote the log difference of a variable from its steady state value. Given that the log value of domestic terms of trade is defined as $s_t = \rho_{F,t} - \rho_{D,t}$,⁴ equation (12) can also be written as $\rho_t = \rho_{D,t} + \alpha s_t$. It follows that the domestic inflation ($\pi_t = \rho_t - \rho_{t-1}$) can be written as follows:

$$\begin{aligned} \pi_t &= (1-\alpha)\pi_{D,t} + \alpha\pi_{F,t} \\ &= \pi_{D,t} + \alpha\Delta s_t \end{aligned} \quad (13)$$

⁴ The term "domestic" here is included to accommodate the assumed incompleteness in the pass-through effect in the economy. In this case, $\rho_{F,t} \neq e_t + p_t^*$, where e denotes the nominal exchange rate and p^* denotes international prices (Monacelli 2005).

The above equation shows that the more open the economy is, the bigger the impact of changes in the domestic terms of trade on domestic CPI inflation.

The real exchange rate (Q_t) is defined as a ratio between the international prices in terms of domestic currency and the domestic prices $\left(\frac{s_t P_t^*}{P_t}\right)$. It follows that the log deviation from the steady-state value of Q_t can be written as $q_t = e_t + p_t^* - p_t$, where e denotes the nominal exchange rate and p^* denotes the international prices. In an environment where an incomplete pass-through effect is possible, $e_t + p_t^*$ does not necessarily have to be equal to $p_{F,t}$, i.e., $e_t + p_t^* - p_{F,t} = \psi_t$. The term ψ in the last expression denotes the deviation from the law of one price, in which domestic import price deviates from the domestic value of the international price. Under this setup, q_t can be rewritten as:

$$q_t = (1 - \alpha)s_t + \psi_t \quad (14)$$

The above relationship is derived by substituting equation (12) into the real exchange rate identity. It follows that there are two sources of deviation from aggregate purchasing power parity in this framework, namely, the heterogeneity of the consumption basket between the small open economy and the rest of the world, and the deviation from the law of one price.

C. International Risk Sharing and Uncovered Interest Parity

Under the assumption of a complete international financial market and perfect capital mobility, the expected nominal return from risk-free assets must equal the expected domestic currency return from foreign assets. This assumed existence of a complete contingent claims market has implications for international consumption risk sharing. In equilibrium, movements in the ratio of domestic to foreign marginal utility in consumption must imply a proportional movement in the real exchange rate. Following the arguments in Chari et al. (2002) and Galí and Monacelli (2005), the complete markets assumption and the HH Euler equations in both domestic and foreign economies imply:

$$(C_t - hC_{t-1}) = K(C_t^* - hC_{t-1}^*)Q_t^{\frac{1}{\sigma}} \quad (15)$$

or, in its log linear approximation form:

$$c_t - hc_{t-1} = y_t^* - hy_{t-1}^* + \frac{(1-h)}{\sigma} q_t + v_t^q \quad (16)$$

where v_t^q can be interpreted as a shock to the risk premium, and the foreign sector output, $y_t^* = c_t^*$.⁵ Note also that the relationship contains both the contemporaneous relationship as well as the effect from including external habit formation in the HH preference structure.

⁵ The last relationship uses the fact that the foreign sector is approximately closed in structure so that in equilibrium $y_t^* = c_t^*$.

The above assumption also helps to recover the uncovered interest parity condition that relates domestic and foreign interest rates. By combining the efficiency conditions for optimal portfolio holdings of both the domestic and foreign sectors, equation (15) can be rewritten as:

$$\frac{\varepsilon_{t+1}}{\varepsilon_t} = \frac{(1+i_t)}{(1+i_t^*)} \quad (17)$$

or, in its log-linear approximation form:

$$i_t - i_t^* = E_t(\Delta e_{t+1}) \quad (18)$$

D. Domestic Firms and Optimal Price Setting

1. Domestic Firm Technology

There is a continuum of identical monopolistically competitive firms in the economy indexed by $i \in [0,1]$. Each firm produces differentiated outputs (Y) with a representative production function as follows:

$$Y_t(i) = B_t N_t(i) \quad (19)$$

where $b_t = \ln(B_t)$ is the productivity shock that is assumed to follow an AR(1) process $b_t = \rho_b b_{t-1} + v_t^b$, where $v_t^b \sim (0, \sigma_{v^b}^2)$. Letting $Y_t \equiv \left[\int_{i=0}^1 Y_t(i)^{\frac{\varepsilon-1}{\varepsilon}} \partial i \right]^{\frac{\varepsilon}{\varepsilon-1}}$ to represent the aggregate output, then integrating the labor employed in each firm will produce: $\int_{i=0}^1 N_t(i) = N_t = \frac{Y_t}{B_t}$.

The real total costs (TC) faced by firms are $TC_t = \frac{w_t}{P_{D,t}} N_t = \frac{w_t Y_t}{P_{D,t} B_t}$ after substituting N_t by equation (19). Therefore, the marginal cost is $MC_t = \frac{w_t}{P_{D,t} B_t}$. Then, the log-linear approximation of the marginal costs can be written as:

$$\begin{aligned} mc_t &= w_t - p_{D,t} - b_t \\ &= w_t - \left[(1-\alpha) p_{D,t} + \alpha p_{F,t} \right] + \alpha (p_{F,t} - p_{D,t}) - b_t \\ &= w_t - p_t + \frac{\alpha}{1-\alpha} (q_t - \psi_t) - b_t \end{aligned} \quad (20)$$

The third line in the above equation is obtained using equation (12), the definition for the domestic terms of trade (s), and equation (14).

Recall that the log-linear approximation of equation (10) states that $w_t - p_t = \varphi n_t + \frac{\sigma}{1-h} (c_t - h c_{t-1})$. Therefore, by employing the log-linear version of equation (19) to substitute for n_t , equation (20) can also be expressed as:

$$mc_t = \varphi y_t + \frac{\sigma}{1-h} (c_t - h c_{t-1}) + \frac{\alpha}{1-\alpha} (q_t - \psi_t) - (1+\varphi) b_t \quad (21)$$

2. Optimal Price Setting Mechanism

Both domestic producers and importers are assumed to set prices in a staggered fashion following Calvo (1983). Hence, within any period t , there is a fraction $(1 - \theta_j)$ of firms that reset their price optimally ($j = D, F$), while the remainder $0 \leq \theta_j \leq 1$ does not. The fraction of firms that does not reset prices is assumed to adjust its price by indexing it to the last period domestic CPI inflation as follows:

$$p_{j,t}(i) = p_{j,t-1}(i) + \delta\pi_{t-1} \quad (22)$$

where $\delta \in [0, 1]$ represents the degree of price indexation to the previous period's inflation rate. Since each firm has the opportunity to reset its price optimally in some period t , every firm faces the same decision problem, hence setting a common optimal price $P_{j,t}^{new}(i) = P_{j,t}^{new}$. The aggregate price index in sector j evolves according to the following equation:

$$P_{j,t} = \left\{ (1 - \theta_j) P_{j,t}^{new(1-\varepsilon)} + \theta_j \left[P_{j,t-1} \left(\frac{P_{t-1}}{P_{t-2}} \right)^\delta \right]^{1-\varepsilon} \right\}^{\frac{1}{1-\varepsilon}} \quad (23)$$

For a firm producing domestically, the price setting problem when it wants to reoptimize its price in some period t would be to maximize its expected present discounted value of profits with respect to $P_{D,t}^{new}$ if it was unable to reoptimize in the future:

$$\max_{P_{D,t}^{new}} \sum_{T=t}^{\infty} (\beta\theta_D)^{T-t} E_t \left\{ \xi_{t,T} \left[Y_T(i) \left(P_{D,t}^{new} \left(\frac{P_{T-1}}{P_{t-1}} \right)^\delta - P_{D,T} MC_T \right) \right] \right\} \quad (24)$$

subject to the sequence of demand constraints:

$$Y_T(i) = \left[\frac{P_{D,t}^{new}}{P_{D,T}} \left(\frac{P_{T-1}}{P_{t-1}} \right)^\delta \right]^{-\varepsilon} Y_T \pi \quad (25)$$

The corresponding FONC of the above problem could be written as:

$$\begin{aligned} & \sum_{T=t}^{\infty} (\beta\theta_D)^{T-t} E_t \left\{ \xi_{t,T} Y_T \left[P_{D,t}^{new} \left(\frac{P_{D,t}^{new}}{P_{D,T}} \right)^{-\varepsilon} \left(\frac{P_{T-1}}{P_{t-1}} \right)^{\delta(1-\varepsilon)} \right] \right\} \\ & = \sum_{T=t}^{\infty} (\beta\theta_D)^{T-t} E_t \left\{ \xi_{t,T} Y_T \left[\frac{\varepsilon}{\varepsilon - 1} \left(\frac{P_{D,t}^{new}}{P_{D,T}} \right)^{-\varepsilon} \left(\frac{P_{T-1}}{P_{t-1}} \right)^{-\delta\varepsilon} P_{D,T} MC_T \right] \right\} \end{aligned} \quad (26)$$

By taking the condition that in the steady state $\xi_{t,t} = \xi = 1$; $P_D^{new} = P_D$ and $MC = \frac{\varepsilon-1}{\varepsilon}$,⁶ the first order log-linear approximation of the above equation can be written as:

$$p_{D,t}^{new} = (1 - \beta\theta_D) \sum_{T=t}^{\infty} (\beta\theta_D)^{T-t} E_t \left[p_{D,T} + mc_T - \delta (p_{T-1} - p_{t-1}) \right]$$

or,

$$p_{D,t}^{new} = (1 - \beta\theta_D) (p_{D,t} + mc_t) + \beta\theta_D \left[E_t (p_{D,t+1}^{new}) - \delta\pi_t \right] \quad (27)$$

Substituting equation (27) into the log-linearized approximation of the Calvo pricing equation for domestic producing firms:

$$p_{D,t} = (1 - \theta_D) p_{D,t}^{new} + \theta_D (p_{D,t-1} + \delta\pi_{t-1}) \quad (28)$$

we can work out the equation that governs the development of the domestic price inflation:

$$\pi_{D,t} = \frac{1}{1 + \beta\delta} \left[\beta E_t (\pi_{D,t+1}) + \delta\pi_{t-1} + \frac{(1 - \theta_D)(1 - \beta\theta_D)}{\theta_D} mc_t \right] \quad (29)$$

Similarly, the optimal price setting problem for the domestic importing firms could be solved to derive the import price inflation as follows:

$$\pi_{F,t} = \frac{1}{1 + \beta\delta} \left[\beta E_t (\pi_{F,t+1}) + \delta\pi_{t-1} + \frac{(1 - \theta_F)(1 - \beta\theta_F)}{\theta_F} \psi_t \right] \quad (30)$$

where ψ_t is the marginal cost faced by the firms in this category. The last two equations above show that, for both domestic and imported goods, inflation is governed by expected future inflation, the last period CPI inflation (due to price indexation), and their respective marginal costs—which in the case of importing firms is simply the difference between the domestic imported price and the world price.

As discussed earlier, domestic CPI inflation is a weighted sum of inflation for both domestic and imported goods. Therefore, by substituting equations (29) and (30) in to equation (13), the domestic CPI inflation can be expressed as the following:

$$\begin{aligned} \pi_t = (1 - \alpha) & \left[\beta E_t (\pi_{D,t+1}) + \frac{(1 - \theta_D)(1 - \beta\theta_D)}{\theta_D} mc_t - \beta\delta\pi_t + \delta\pi_{t-1} \right] \\ & + \alpha \left[\beta E_t (\pi_{F,t+1}) + \frac{(1 - \theta_F)(1 - \beta\theta_F)}{\theta_F} \psi_t - \beta\delta\pi_t + \delta\pi_{t-1} \right] \end{aligned}$$

or,

⁶ Variables without time subscript denote their steady-state values.

$$\pi_t = \frac{1}{1 + \beta\delta} \left[\beta E_t(\pi_{t+1}) + \delta\pi_{t-1} + (1 - \alpha)\Gamma_D mc_t + \alpha\Gamma_F \psi_t \right] \quad (31)$$

where $\Gamma_D = \frac{(1-\theta_D)(1-\beta\theta_D)}{\theta_D}$ and $\Gamma_F = \frac{(1-\theta_F)(1-\beta\theta_F)}{\theta_F}$.

3. Market Clearing Condition

In equilibrium, domestic output is being cleared out by both domestic consumption and export of domestic goods consumed by the foreign sector ($C_{D,t}^*$), i.e.,

$$Y_t = C_{D,t} + C_{D,t}^* \quad (32)$$

Using both domestic and foreign demand for domestic goods described in equation (8), the above can be rewritten as:

$$Y_t = (1 - \alpha) \left(\frac{P_{D,t}}{P_t} \right)^{-\eta} C_t + \alpha^* \left(\frac{P_{D,t}}{\varepsilon_t P_t^*} \right)^{-\eta} Y_t^* \quad (33)$$

or, in its log-linear approximation

$$y_t = (1 - \alpha) c_{D,t} + \alpha c_{D,t}^* \quad (34)$$

where, $c_{D,t} = -\eta(p_{D,t} - p_t) + c_t$ and $c_{D,t}^* = -\eta(p_{D,t} - e_t - p_t^*) + c_t^*$.

By applying equation (12), the log-linear approximation of both the definition for domestic terms of trade (s) and real exchange rate (q), as well as equation (14), equation (34) can also be written as:

$$y_t = (1 - \alpha) c_t + \alpha y_t^* + \frac{(2 - \alpha)\alpha\eta}{1 - \alpha} q_t - \frac{\alpha\eta}{1 - \alpha} \psi_t \quad (35)$$

where the demand for domestic output is affected positively by domestic consumption, foreign income, and real exchange rate; and is negatively related to the deviations from the law of one price.

4. The Monetary Sector

The monetary sector in this economy is represented by a policy function, which specifies the monetary policy regime for the economy. Conditional on the evolution of the world economy and other exogenous disturbances, the monetary policy rule will also act as a closure for the model in general. In particular, the policy rule is specified to follow a Taylor type rule:

$$i_t = (1 - \rho_i)(\kappa_1 E_t \pi_{t+n} + \kappa_2 y_t) + \rho_i i_{t-1} + v_t^i \quad (36)$$

where v_t^i is added to represent a possible unexpected innovation in monetary policy. Notice also that the Taylor-type specification above includes a lagged endogenous term. This is done to capture the possible degree of persistence in the interest rate movement to avoid loss of credibility from impulsive large changes in the interest rate.

5. Specifying the Foreign Sector

As the primary objective of the model is to analyze how a small open economy works, and since the foreign economy is treated as exogenous to the domestic economy, there is some flexibility in specifying the data generating process for the foreign variables. For the sake of convenience, rather than using a structural model, a stylized model for the rest of the world is employed to specify the determination of foreign variables. The path of those variables is assumed to be determined by an unrestricted vector auto regression. The reduced form of the foreign sector data generating process is as follows:

$$\mathbf{x}_t^* = \mathbf{A}(L)\mathbf{x}_{t-1}^* + \mathbf{v}_t^* \quad (37)$$

where $\mathbf{x}_t^* = [y_t^* \ (i_t^* - E_t \pi_{t+1}^*)]'$, $\mathbf{A}(L)$ is a matrix of coefficients with an appropriate dimension and \mathbf{v}_t^* is a vector of error with the usual properties.

III. Simulating the Model

A. Log-Linear Approximation of the Model

The equation for consumption is given by log-linearizing equation (11) around its nonstochastic steady-state value.

$$c_t = \frac{1}{1+h} E_t c_{t+1} + \frac{h}{1+h} c_{t-1} - \frac{(1-h)}{(1+h)\sigma} (i_t - E_t \pi_{t+1}) + v_t^c \quad (38)$$

where v_t^c is a random preference shock with mean zero and variance $\sigma_{v^c}^2$. The real interest rate elasticity of consumption is negatively affected by both the intertemporal elasticity of substitution (σ) and the external habit persistence parameter (h). That is, given σ a higher degree of habit persistence (h) in this case will tend to lower the impact of real interest rate on consumption.

Movements in nominal interest rate are governed by the interest rate reaction function in equation (36). Domestic output is determined by the goods market clearing condition as seen in equation (35) and movements in real exchange rate are governed by the international consumption risk sharing mechanism as seen in equation (16).

Domestic CPI inflation, which is given by equation (31), depends on both expected future and past inflation, as well as the current marginal cost faced by both domestic producers (mc_t) and import retailers (ψ_t). mc is given by equation (21) and ψ is calculated based on the definition in equation (14). For the purpose of estimation, ψ is treated as exogenous and is assumed to follow an AR(1) process $\psi_t = \rho_\psi \psi_{t-1} + v_t^\psi$, where $v_t^\psi \sim (0, \sigma_{v^\psi}^2)$.

To complete the system, the external sector is represented by equation (37) as explained previously.

$$\begin{bmatrix} y_t^* \\ r_t^* \end{bmatrix} = \begin{bmatrix} \phi_1 & \phi_2 \\ \phi_3 & \phi_4 \end{bmatrix} \begin{bmatrix} y_{t-1}^* \\ r_{t-1}^* \end{bmatrix} + \begin{bmatrix} v_t^{y^*} \\ v_t^{r^*} + v_t^{y^*} \end{bmatrix} \quad (39)$$

B. Parameterization

The complete representation of the de-meaned system consists of 10 equations in 10 variables ($c, i, y, q, \pi, mc, \psi, b, y^*, r^*$) and is outlined in Appendix 1.⁷ The specific characterization of the model for Indonesia, Malaysia, the Philippines, and Thailand are done following the empirically estimated parameterization reported in Ramayandi (2008). The complete set of parameterization for each of the developing ASEAN economies is summarized in Tables 1 and 2.

The magnitudes of α in Table 1 suggest that, in terms of economic openness, Malaysia is the most open and Indonesia is the least open economy within the group of countries considered in this study. The degree of price indexation (δ) is relatively similar for Malaysia, the Philippines, and Thailand (around the value of 0.5 and 0.65), with the latter showing the tendency to be indexing more heavily relative to the other two. Indonesia stands out from the group with a value a little over 0.9, suggesting that the non reoptimizing firms are adjusting their price by indexing very heavily to the last period inflation. The degree of Calvo price stickiness for prices of domestic goods (θ_D) and imported goods (θ_F) indicates different average duration in the implicit price contracts across the group of countries.⁸ Both the domestic and imported goods price in Thailand tend to be more persistent than the rest of the group.

⁷ The de-meaning system implies that the long-term, steady-state value of the variables involved in the model turns to zero. This approach does not alter any of the qualitative features embedded in each country model since it simply shifted the mean of the variables involved in the system into zero without removing any of their dynamic characteristics.

⁸ The average duration of price contracts is calculated as $\frac{1}{1-\theta_j}$; $j = D, F$.

Table 1: System Parameters

Parameters	Indonesia	Malaysia	Philippines	Thailand
α	0.30	0.65	0.49	0.48
β	0.963	0.988	0.972	0.984
δ	0.92	0.49	0.49	0.65
σ	0.86	0.32	0.09	0.74
θ_D	0.92	0.82	0.76	0.94
θ_F	0.91	0.89	0.77	0.98
φ	1.99	1.99	1.00	1.49
η	0.003	0.39	0.08	0.43
h	0.77	0.55	0.97	0.81
ρ_ψ	0.99	0.99	0.88	0.85
ρ_b	0.61	0.81	0.89	0.60
ρ_i	0.52	0.69	0.55	0.70
κ_1	1.78	1.66	0.72	2.65
κ_2	1.04	0.19	1.60	0.00
σ_b	0.46	0.16	0.01	0.37
σ_c	0.03	0.05	0.02	0.05
σ_i	0.035	0.07	0.02	0.016
σ_ψ	0.08	0.06	0.10	0.07
σ_q	0.09	0.10	0.05	0.11

Sources: Ramayandi (2007 and 2008).

Table 2: Parameters for the Foreign Sector Block

Parameter	Estimate
ϕ_1	0.87
ϕ_2	-0.01
ϕ_3	0.07
ϕ_4	0.95
σ_{y^*}	0.005
σ_{r^*}	0.005

Source: Ramayandi (2008).

The inverse elasticity of labor supply, $(\varphi)^9$, suggests that a percentage change in nominal wage will tend to induce a less than proportional change in labor supply. The elasticity of substitution between home and imported goods (η) is found to be relatively small in all cases, suggesting a small degree of substitutability between home and imported consumption goods.¹⁰ Habit persistence (h) varies quite widely among the group. External habit formation over past consumption ranges from 0.55 (Malaysia) to 0.97 (Philippines). The point estimate of the inverse elasticity of intertemporal substitution (σ) also varies quite widely among the group. Smaller values of σ imply that households are less willing to accept deviations from a uniform pattern of consumption over time. Both the estimates of h and σ are informative to the interest elasticity of consumption in the model. For any given value of σ , higher values of h penalize the impact of the real rate of interest on consumption. Consumption appears to be more sensitive to real interest rate changes in Malaysia relative to the rest of the group; an observation that seems to be consistent with the different degrees of financial market development in these countries.

Movements of nominal interest rate in the model are assumed to be governed by the likely historical conduct of monetary policy in each country, approximated by the relevant policy reaction function. The magnitude of ρ_ψ and ρ_b suggest that the exogenous productivity and deviation from the law of one price shock in the model are persistent. The degree of persistence in ψ is very high, especially for the case of Indonesia and Malaysia. The degree of persistence in b tends to be relatively lower, where the lowest is commonly shared by Indonesia and Thailand (around 0.6). This observation is also accompanied by a relatively high standard deviation for the innovation in productivity shock (σ_b) for the two countries.

Table 2 provides the parameterization of the foreign sector, as well as the standard deviations for both the foreign output gap and real interest rate.

C. The Impact of an External Financial Shock

This section uses the previously discussed model and its parameterization to analyze the effect of a one-time shock in the external financial system to the aggregate economic stability of the four developing ASEAN countries. More specifically, the paper looks at the responses of aggregate domestic inflation and the output gap to an unexpected innovation in the external real interest rate. The impulse responses of these two key macroeconomic indicators reported in this section are produced based on the particular monetary policy reaction function as characterized in Table 1.¹¹

⁹ That turns out to be equal to 1 or higher in all cases.

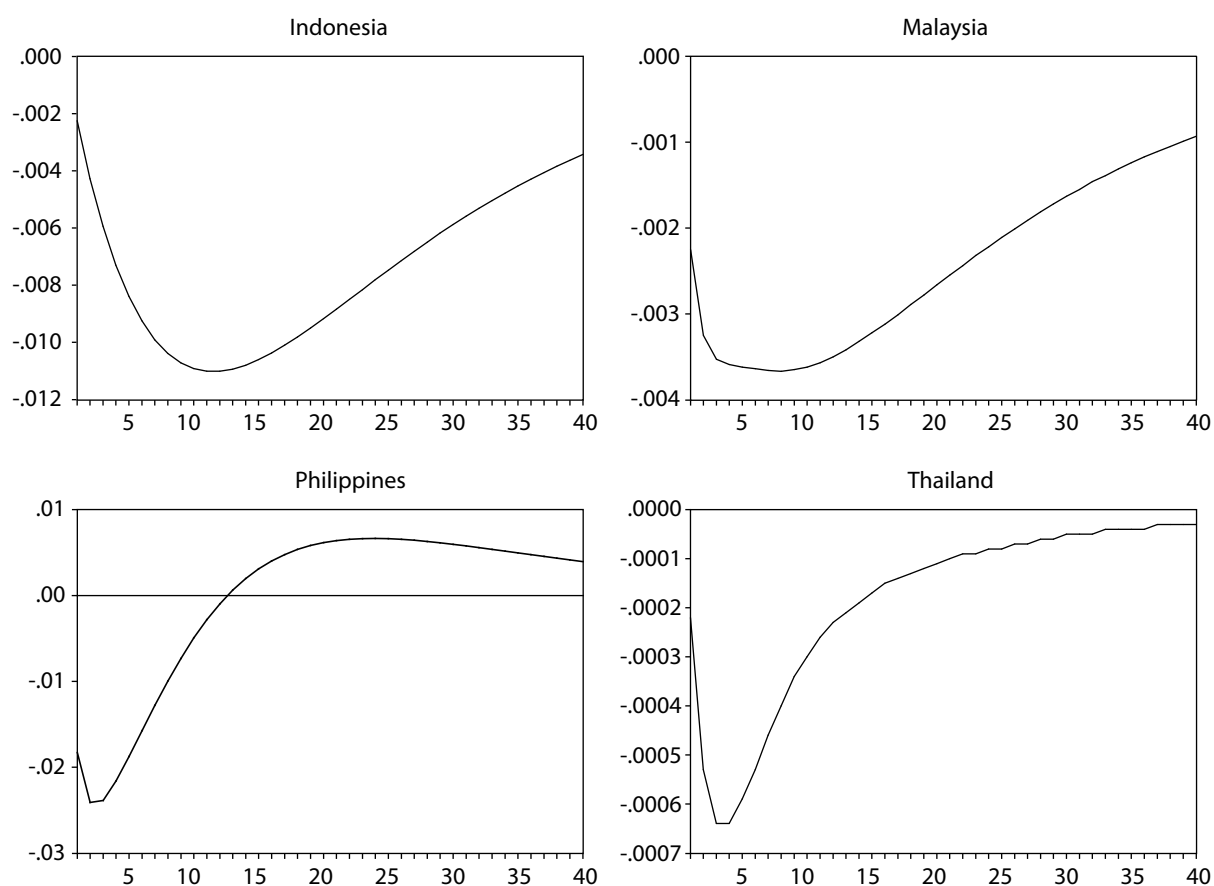
¹⁰ In interpreting this degree of substitutability between home and imported goods, it is useful to note that the domestically produced consumption goods also comprise the nontradables. Therefore, a low elasticity of substitution between the two categories of goods makes sense.

¹¹ The values of κ_1 , κ_2 , and ρ_i characterizing the monetary policy reaction function of the four developing ASEAN economies are adopted from Ramayandi (2007).

1. Impact on Aggregate Domestic Inflation and Output Gap

To put the analysis into the context of the past two international financial crises, this section simulates the impact of a one-time unexpected negative innovation in the international interest rate on domestic inflation and output gap in the four developing ASEAN economies. More specifically, Figures 1 and 2 look at an impact of a 1% decrease in external interest rate on the two key macroeconomic indicators of the four economies.

Figure 1: Impact of a Negative External Interest Rate Shock on Domestic Inflation



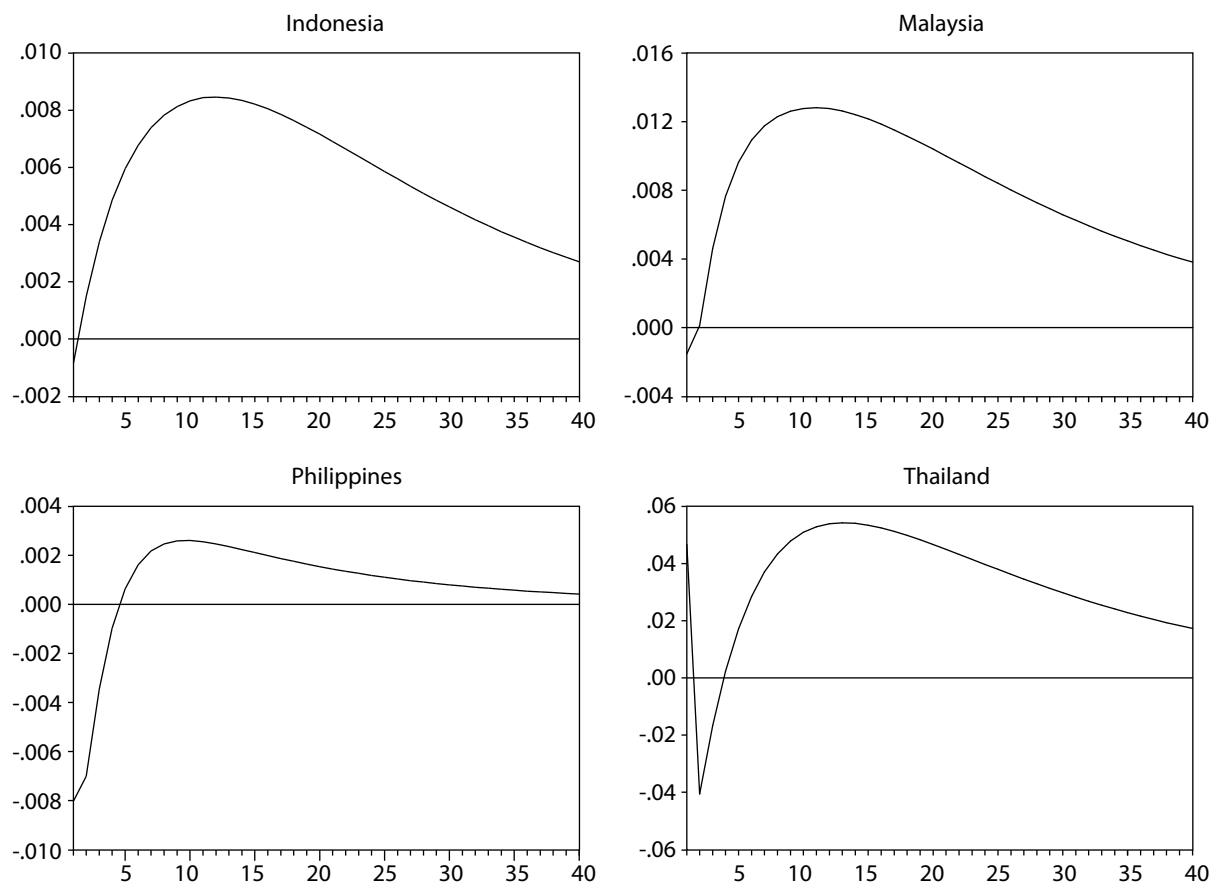
Source: Author's simulation.

The impact of a negative shock in the international interest rate to domestic inflation in the four ASEAN economies displays similar patterns (Figure 1). The magnitudes are generally small and culminated a few quarters after the shock. An exogenous 1% drop in international interest rate leads to lower inflation in all of the four economies, with a maximum fall of less than 5 basis points at their culmination. In terms of the maximum impact, Indonesia and the Philippines tend to be more susceptible than Malaysia and

Thailand (the least vulnerable within the group). In terms of the period of culmination before heading back to its steady state, the inflation impact in the Philippines and Thailand culminates faster than in Indonesia and Malaysia. The case of the Philippines, however, stands out of the group as inflation becomes positive in about the third year after the shock.

The impact on output gap also displays similar patterns (Figure 2). Its magnitudes are also generally small, but the impact peaked at a relatively longer time in all cases (about 2–3 years after the shock). Initially, output gap drops in response to a negative shock in the international financial system. Thailand tends to be more vulnerable than the rest of the group, with a much higher initial negative impact. As demand from overseas expanded due to cheaper funds in the international markets, however, the small economies gain international competitiveness, hence pushing up aggregate demand in their economies. As a result, output gap moves to positive territory and peaks before settling back to its steady state. The peak of the impact on output gap is found largest for the case of Thailand and smallest in the Philippines.

Figure 2: Impact of Negative External Interest Rate Shock on Output Gap



Source: Author's simulation.

Although the effects displayed in Figures 1 and 2 are generally similar, there are some differences in the particular patterns of how the two key macro indicators are responding to the shock. Relative to the group, the impact on inflation in Thailand tends to be shorter and smaller. The Philippines displayed the opposite extreme case, where the impact on inflation tends to be larger and switched signs in about 3 years after the shock. In terms of impact on output gap, the opposite is observed. Given the same magnitude of international interest rate shock, Thailand's output gap becomes the most volatile in the group, while the least is observed in the case of the Philippines.

Part of the explanation for these differences lies in the endogenous part of monetary policy. Based on the model's characterization, monetary policy in Thailand is focusing mainly on inflation and responding more vigorously to inflation compared to the rest of the group.¹² As a result, the impact of an international financial shock on inflation is more quickly absorbed by Thailand's reaction in its domestic monetary policy. However, the direct impact on output gap was mainly unchecked since no weights were placed on output gap development. The Philippines provides an opposing case; relative to the rest of the group, its monetary policy reacts more vigorously to developments in output gap and a lot less to inflation. Consequently, the impact on output gap is relatively more benign than the rest of the group, at the cost of more volatile inflation.

The relatively small effects of the international financial shock on inflation and output gap in the four ASEAN economies is somewhat in line with the stylized facts observed in the recent international financial crises. The Bank of International Settlements characterizes the recent global financial crisis into four periods (Filarado et al. 2009): Phase 1 (third quarter [Q] of 2007 to 2008Q3), where aggressive policy easing and liquidity support was done in the international markets coupled with high commodity prices; phase 2 (2008Q4), where the bankruptcy of Lehman Brothers was followed by a freezing up in global finance; phase 3 (2009Q1), where a synchronized recession in the G3 took place; and phase 4 (2009Q2), where G3 real activity is still weak coupled by a financial market rally. During both the tech-bubble crisis and phase 1 of the recent global financial crisis, international interest rates significantly dropped, yet no serious signs of an obvious distortion in inflation or output gap were observed in any of the four developing ASEAN considered in this study. A drop in the two key macroeconomic indicators in these countries were only observed during phases 2 and 3 of the crisis, when the second-round impact of the global financial crisis kicked in through huge falls in export demand due to recession in the four ASEAN economies' traditional markets.

Simulations in this section are, however, by no means intended to replicate the actual dynamic responses to both international financial crises for the four ASEAN economies since it involves identifying various exogenous shocks hitting these economies together at the same time, and with multiple periods. The section is only simulating the effect of short-run shocks in the international financial market, with a one-time drop in international

¹² This can be seen by comparing the values of κ_1 and κ_2 in Table 1.

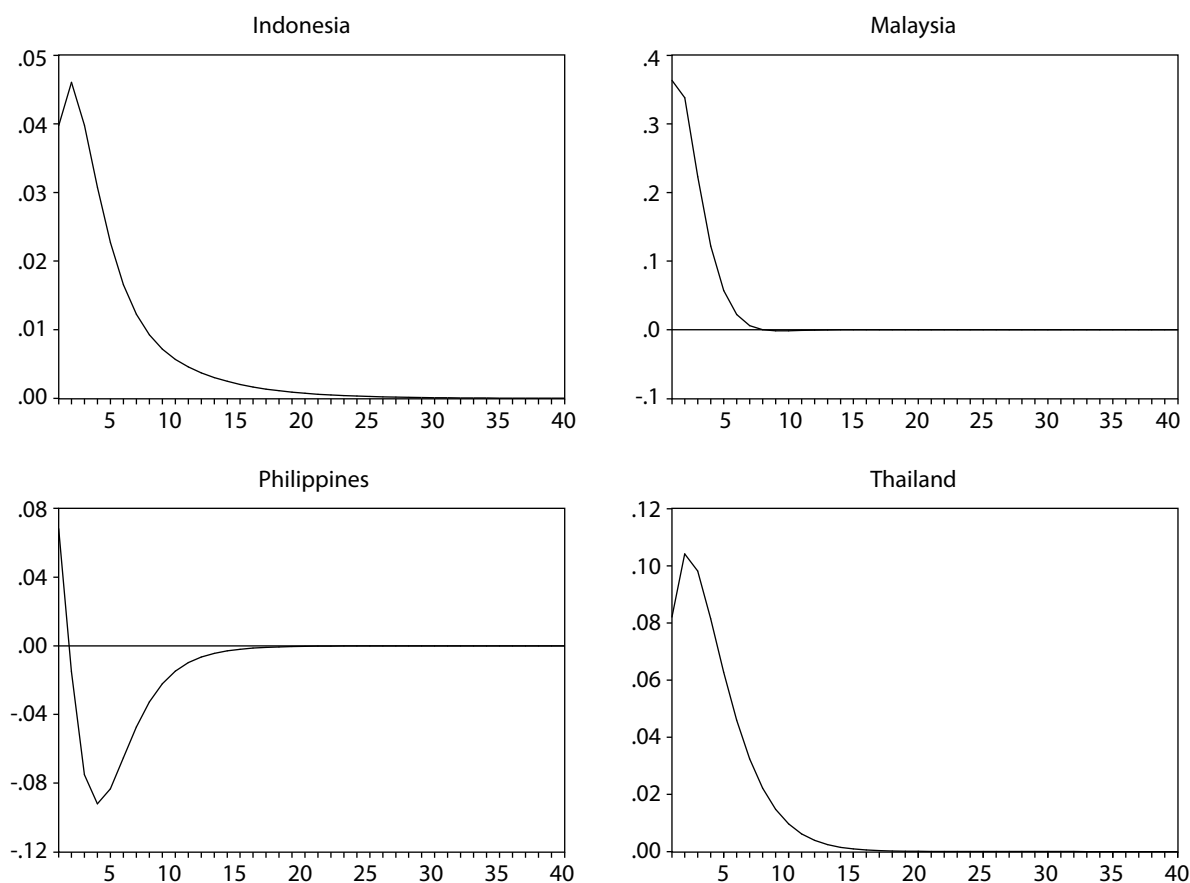
interest rate, to gauge what the likely impact on the four ASEAN economies would be. Interestingly, the fact that inflation in the four ASEAN countries did not seem to be affected by phase 1 of the crisis seems to be consistent with the findings of relatively very small effects of an international interest rate shock to inflation in Indonesia, Malaysia, the Philippines, and Thailand. Further, Figure 2 suggests that the negative shocks in the international interest rate during phase 1 of the crisis may have contributed to the yawning positive output gap in these countries.

Despite the small impact, another observation that may have more serious implications on the four ASEAN economies is that the impact of an international financial shock on these economies tends to be long-lasting. This observation suggests that a shock in international financial markets would entail a long-lasting impact on economic volatility in the economies considered in this paper. The countries may ignore the implication if the size of the international financial shock is negligible. However, as what is commonly anticipated following a financial crisis, the countries may consequently have to live in a more volatile environment in the global financial system. As a result, the magnitude of any potential future financial shock becomes greater. The greater the size of the shock coming from the international financial system, the more serious the consequences for maintaining economic stability for the four ASEAN countries.

2. Countering an External Financial Shock with Monetary Policy

Monetary policy is often used as means to deal with short-run disturbances hitting an economy. This section looks at the consequences of countering the effects of a short-run international financial shock by exogenously shifting domestic monetary policy in the context of the four ASEAN economies considered in this study. Figures 3 and 4 illustrate the responses in domestic inflation and output gap given a percentage point exogenous negative innovation to domestic interest rate.

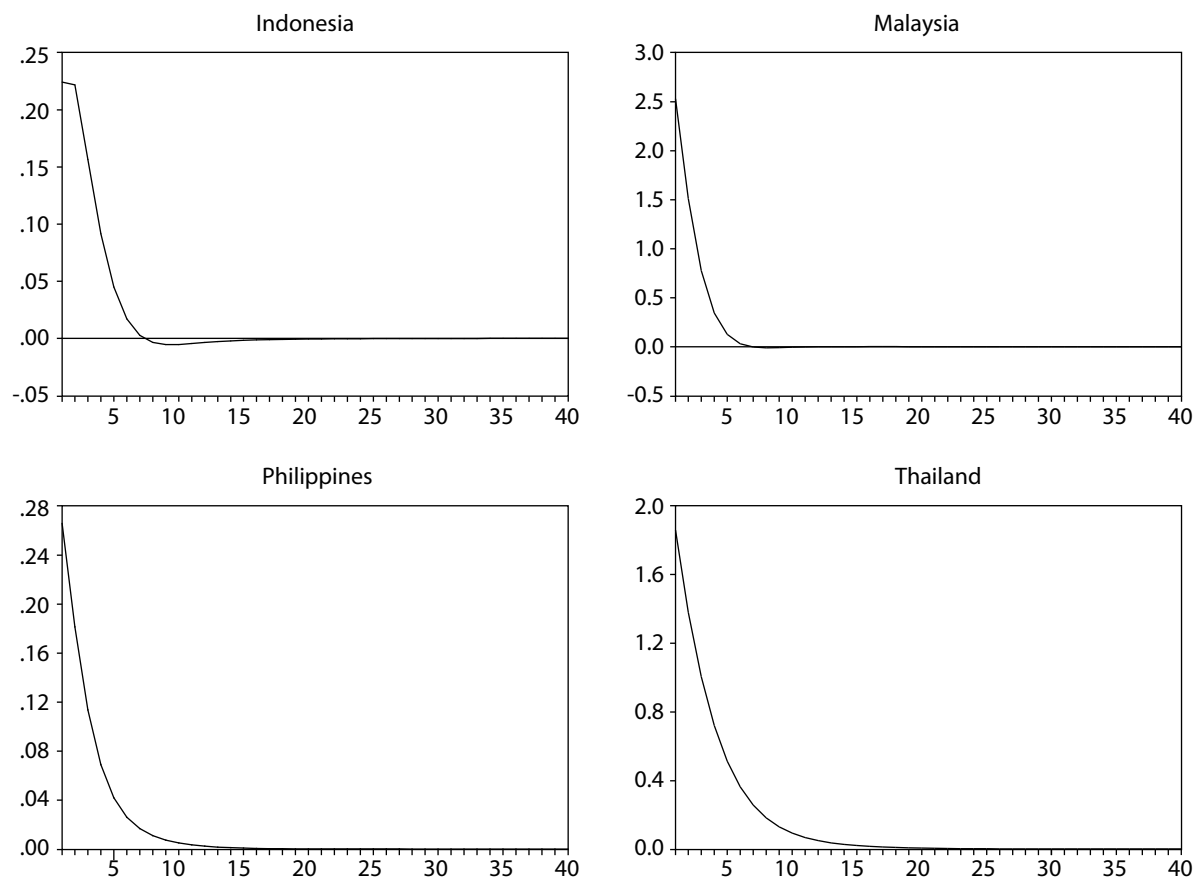
Impacts of this one-time exogenous monetary policy shock tend to be relatively short-lived. The impact of a loosening in monetary policy to both inflation and output gap tends to die away after about 2 years before being completely gone within around 3–4 quarters later. A reduction in the domestic interest rate when monetary policy is loosened immediately increases consumption and depreciates the real exchange rate, forcing an increase in marginal costs, hence pushing inflation and the output gap up. As the effect of a one-time loosening in monetary policy disappears, the economy moves back to its steady-state position.

Figure 3: Impact of Exogenous Easing in Monetary Policy on Domestic Inflation

Source: Author's simulation.

The case of inflation in the Philippines deserves particular mention since inflation falls quite considerably before heading back to its stationary value. The drop in inflation in this case is mainly driven by the underlying characteristics of the monetary policy reaction function of the Philippines. A coefficient $\kappa_1 < 1$ in the case of the Philippines suggests that its monetary policy tends to accommodate inflation.¹³ A drop in expected inflation after an initial one-time (unexpected) decrease in the interest rate is not matched by at least a one-to-one response in monetary policy. As a result, the real rate of interest tends to increase rather than decrease, dampening consumption and having an appreciating effect on the real exchange rate. The latter depresses marginal costs, hence (together with a decrease in consumption) pulling inflation down.

¹³ See, for example, Clarida et al. (2000) and Walsh (2003) for a more detailed discussion about the stabilizing nature of monetary policy.

Figure 4: Impact of Exogenous Easing in Monetary Policy on Output Gap

Source: Author's simulation.

Figure 3 suggests that a 1% discretionary decrease in domestic interest rate will provide a more than needed effect to counter the short-term deflationary effect from a negative international financial shock of the same magnitude. However, given the short-lived character of the monetary policy impact, this neutralizing effect fades out fairly quickly and leaves behind the medium- to longer-term effect of the external financial shock unchecked. Appendix 2.1 provides a set of charts for each of the ASEAN countries. In the Philippines, the effect only lasts for a quarter. In Indonesia and Malaysia, the effect of domestic monetary policy counter expires after 2 years. In Thailand, the effect lasts much longer before it ceases in about the fifth year after the shocks. This more effective monetary policy counter on controlling inflation in Thailand is mainly driven by the fact that the impact of the international financial shock in this case is smaller and is culminating faster than in the rest of the group. In the cases of Malaysia and the Philippines, the effect of an external financial disturbance worsens around the end of the monetary policy countereffect.

For the case of output gap reactions, the monetary policy counter move in general aggravates output gap volatility. A small exception is seen in the case of Indonesia and Malaysia, where the counter move does seem to soften the external shock impact on output gap for some few early quarters (see Appendix 2.2).

The above discussion suggests that a one-time discretionary shock to domestic monetary policy may not be a proper tool for countering the impact of a short-run shock in the international financial system. When the international shock is solely financial in nature, monetary policy may take care of the short-run inflation effects, but aggravates the short-run impact on the output gap at the same time. The cure may have worsened the illness in this case. A discretionary monetary policy reaction may be the only a sensible option when the global financial shock is accompanied by a global recession that pushes the domestic output gap down at the same time. In this case, the cure will have the desired short-run impact on managing the domestic volatility effects of the global shocks on both domestic inflation and the output gap.

Another issue worth further consideration is the unmatched duration of the effects from the two different shocks. The effect of domestic monetary policy shock is short-lived, while that of external shocks is long-lasting. While a discretionary response in monetary policy may work on containing short-run volatility implications of international shocks, domestic policy makers will be left with a lingering problem of managing volatility in the medium to longer term once the effect of the discretionary policy dies away. Due to the long-lasting characteristic of the effects of external shocks on inflation and output gap, this is true even for the case of only short-run external disturbances. In this regard, efforts to manage domestic economic volatility implications of even a one-time or a large enough shock in the international financial system would entail not just a simple short-run policy response in the four ASEAN countries, but more complicated structural adjustments in their overall economy if they are to manage economic volatility better in the medium- to long-term future.

IV. Concluding Observations

This paper has taken a very simple measure to describe the effects of an adverse short-term international financial shock on four small open emerging economies in the ASEAN. Nevertheless, the analysis provides a coherent story about the implications of such a shock to the ASEAN economies under consideration. In addition, the micro-founded structure of the model provides a detailed explanation on the mechanism of how an international financial shock affects the countries' domestic macroeconomic condition. This feature is particularly useful for drawing relevant policy implications in dealing with the external shock.

Several key messages emerge from the analysis. Although the effect of a short-term international financial shock on the four ASEAN economies is relatively small, it can potentially disturb the quest for managing domestic macroeconomic stability in these countries. The long-lasting effect of such a shock complicates the challenge for appropriately dealing with its impact. A large enough short-term international financial shock entails not only a short-run implication on domestic economic stability. It also has medium- to longer-term impacts that last far beyond the normal duration of any short-term demand management policy (e.g., monetary policy), which are commonly called upon to counter any adverse implication from such an external shock.

Calling for discretionary moves in monetary policy to deal with the immediate effects of an adverse international shock that is only financial in nature may not be a productive option. In fact, the move may even make the problem worse by aggravating volatilities in the development of domestic output gap. A discretionary monetary policy response would only be effective when the global financial shock is accompanied by a global recession that pushes domestic output gap down at the same time. In this case, the move will have the desired short-run impact when managing domestic volatility effects emanating from the global shocks.

To deal with the longer-term impact of an international financial shock, authorities in the four ASEAN countries under consideration will need to go for policies that have longer-term structural adjustment implications on their economy. To this end, supporting the current efforts to restructure the global financial system in order to reduce future risks of more volatility in the system is definitely in the interest of each of the four ASEAN countries. In addition, given the similarities in the pattern of the international financial shock's impact, the rationale for enhancing policy coordination and cooperation among the countries to better deal with such disturbances is called for.

The simplistic feature of the model used in the analysis of this paper limits the possibility of assessing the implications of global financial shocks on more specific sectors in the domestic economy. However, the sensible results coming out from such a simple model provide promising prospects for expanding the model further in order to study more detailed implications of such external shocks on the economies under consideration. Introducing more specific domestic financial and government sector blocks is a possible avenue for extending this analysis further. Better characterization of the external sector is another useful possible future expansion.

Appendix 1: Summary of the Complete System

1. CPI Inflation

$$\pi_t = \frac{1}{1+\beta\delta} \left[\beta E_t(\pi_{t+1}) + \delta\pi_{t-1} + (1-\alpha)\Gamma_D m c_t + \alpha\Gamma_F \psi_t \right]$$

2. Marginal cost equation

$$m c_t = \varphi y_t + \frac{\sigma}{1-h}(c_t - h c_{t-1}) + \frac{\alpha}{1-\alpha}(q_t - \psi_t) - (1+\varphi)b_t$$

3. Euler equation for consumption

$$(c_t - h c_{t-1}) = E_t(c_{t+1} - h c_t) - \frac{(1-h)}{\sigma}(i_t - E_t \pi_{t+1}) + v_t^c$$

4. Goods market clearing condition

$$y_t = (1-\alpha)c_t + \alpha y_t^* + \frac{\alpha(2-\alpha)\eta}{(1-\alpha)} q_t - \frac{\alpha\eta}{(1-\alpha)} \psi_t$$

5. Interest reaction function

$$i_t = (1-\rho_i)(\kappa_1 E_t \pi_{t+n} + \kappa_2 y_t) + \rho_i i_{t-1} + v_t^i$$

6. International consumption risk sharing condition

$$\frac{(1-h)}{\sigma} q_t = (c_t - h c_{t-1}) - (y_t^* - h y_{t-1}^*) + v_t^q$$

7. Domestic aggregate productivity

$$b_t = \rho_b b_{t-1} + v_t^b$$

8. Deviation of the law of one price

$$\psi_t = \rho_\psi \psi_{t-1} + v_t^\psi$$

9. External block

$$y_t^* = \phi_1 y_{t-1}^* + \phi_2 (i_{t-1}^* - E_t \pi_t^*) + v_t^{y^*}$$

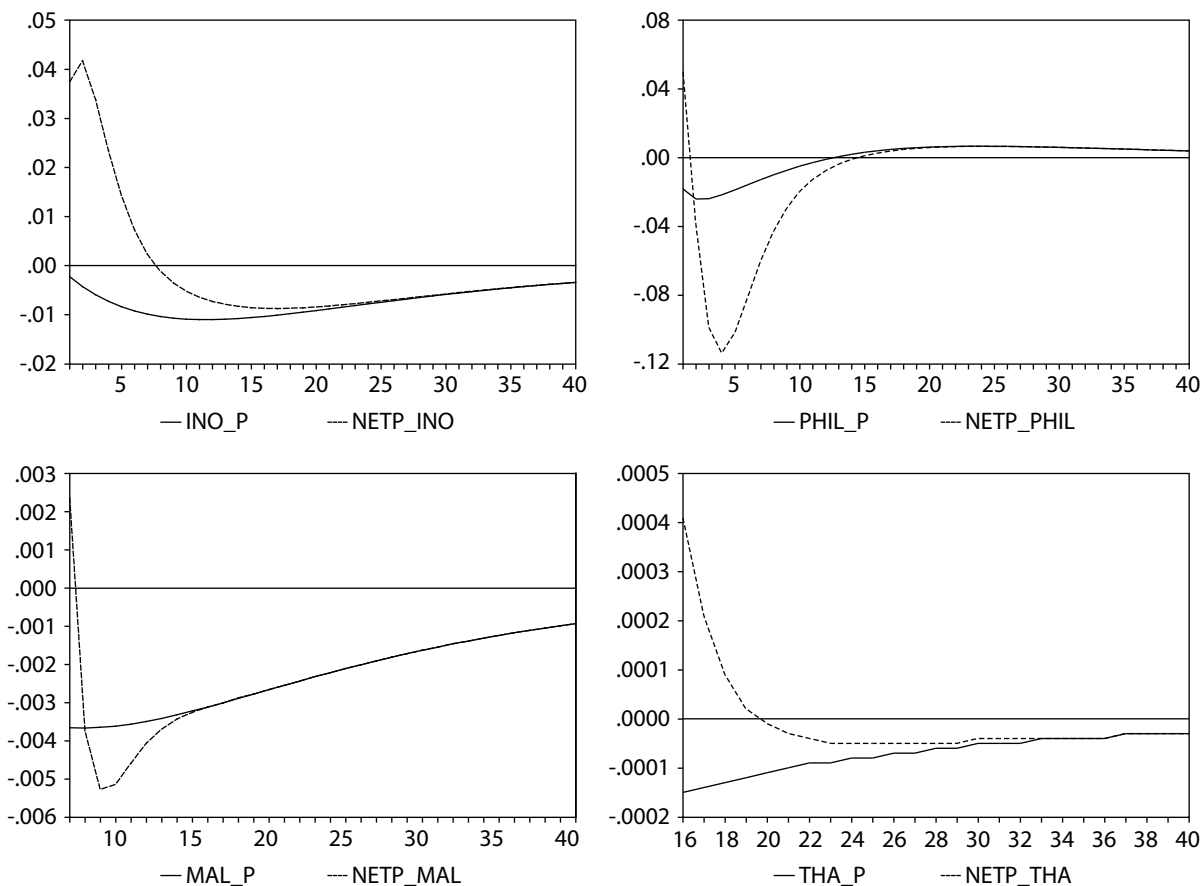
$$(i_t^* - E_t \pi_{t+1}^*) = \phi_3 y_{t-1}^* + \phi_4 (i_{t-1}^* - E_t \pi_t^*) + (v_t^i + v_t^{y^*})$$

Appendix 2: Net Impacts

Notations:

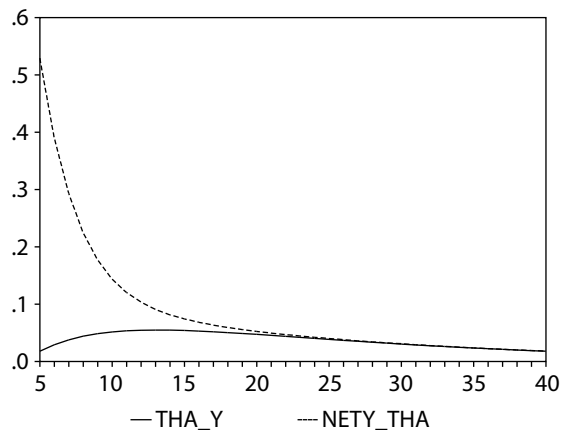
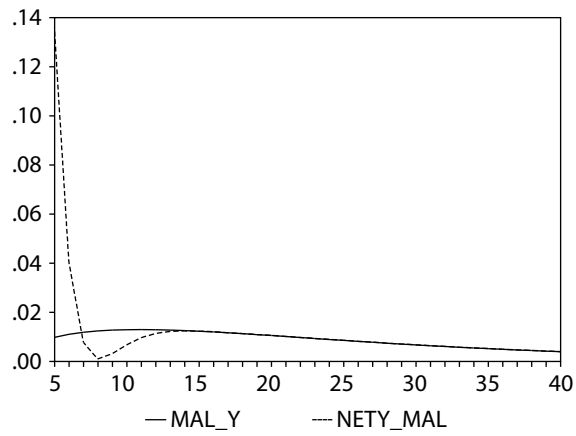
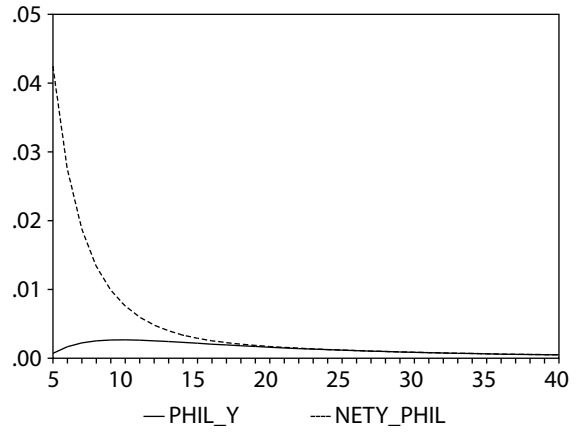
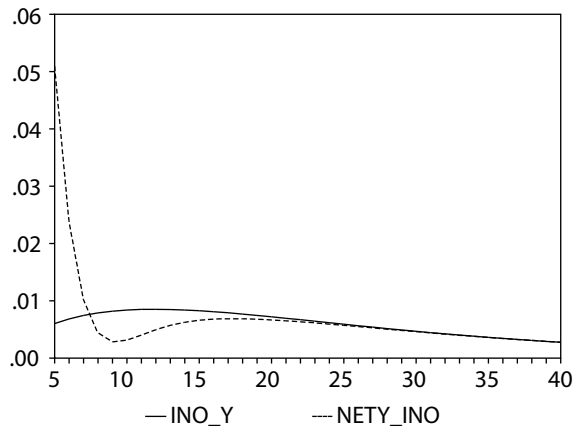
- X_P = Country X inflation dynamic responses to an external interest rate shock
- X_Y = Country X output gap dynamic responses to an external interest rate shock
- NETP_X = Net effect of country X's inflation dynamic responses to an external interest rate shock with a discretionary response in domestic monetary policy
- NETY_X = Net effect of country X's inflation dynamic responses to an external interest rate shock with a discretionary response in domestic monetary policy
- X = Country of study: Indonesia (INO), Malaysia (MAL), Philippines (PHIL), Thailand (THA)

2.1 On Inflation



Source: Author's simulation.

2.2 On Output Gap



Source: Author's simulation.

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About the Paper

Arief Ramayandi simulates the impact of a short-term shock originating from the global financial system on small open economies in the Association of Southeast Asian Nations (ASEAN). The simulation uses empirically estimated general equilibrium models for Indonesia, Malaysia, the Philippines, and Thailand. The study finds that the impact of a pure international financial shock on aggregate domestic price inflation and on output gap for each of the four ASEAN countries tends to be relatively small but long-lasting, placing challenges in the medium- to long-term management of economic volatility.

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