What does exchange rate targeting tell us about the transition toward a Monetary Union?

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Abstract

We build a two open-region DSGE model calibrated on the ASEAN, which contains the phenomenon of original sin. We compare the effects of symmetric (supply and demand) shocks in the ASEAN economies, when they maintain existing independent regimes of exchange rate targeting, against the effects of the same shocks when the countries would join a Monetary Union. The welfare and sensitivity analysis have been conducted to strengthen our results. We find that, facing the rise of the symmetry in underlying shocks among the countries, the presence of foreign currency debt exhibits an important role of the shocks origin in the monetary regime choice. Additionally, we find that targeting the nominal effective exchange rate, independently, can lead to the stability of bilateral exchange rates within the region, which is similar to a kind of intra-regional fixity of exchange rates. We conclude on the feasibility of *de facto* currency area.

Keywords: ASEAN, Monetary Union, DSGE, *De facto* intra-regional exchange rate stability.

JEL Classification: E52, F33, F34, F41

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1. Introduction

The recent global financial crisis of 2007-2009 and the fears generated by the sovereign debt crisis in some European countries have fueled the debates among economists and policy makers about the future directions of monetary and exchange rate arrangements in the South-East Asian region. In particular, the sovereign debt crisis of euro area rouses the question of whether the Monetary Union is ultimately the best exchange rate regime or not for all participating countries, because some of them encounter the difficulties of adjustments with regard to current account deficits (absence of the exchange rate instrument).

The idea of a currency area has already been considered in South-East Asia and the literature on this issue has focused on the conformity or not of this region with optimum currency area (henceforth OCA) criteria (symmetry of shocks across countries, factor mobility, wage flexibility, trade and financial integration). The arguments outlined in many studies in favor of the formation of a (partial) Monetary Union in this region are based on the finding that the number of OCA criteria that are met by some of the countries has increased (see Eichengreen and Bayoumi (1999), Lee and Azali (2012), Lee and Koh (2012)). In particular, Eichengreen and Bayoumi (1999)'s study revealed that the value of their developed optimum currency index for ASEAN (Association of South-East Asian Nations)[1] is not very different from what it was in Europe prior to the Maastricht treaty. Lee and Koh (2012) finds an increased symmetry of shocks among ASEAN countries after the Asian Financial Crisis which shows that the regional policy coordinating effort after the crisis has put the region on the right track if currency area is a desired goal.

However, one of the main features of the ASEAN countries is not addressed in these studies. The countries of this region have the particularity of being heavily indebted in foreign currency (original sin phenomenon). This must be taken into account in the choice of exchange rate regime.
So, is the criterion of the symmetry of shocks (as the main of OCA criteria) in the context of debt denominated in foreign currency robust? Especially when one know that the regional currency agreement provides stable intra-regional exchange rates and maintains the flexibility of the exchange rates against that of non-members.
This paper proposes therefore a comparative analysis of the Monetary Union with the current regime of the NEER (Nominal Effective Exchange Rate) targeting, defended by some Asian countries after the 1997 crisis, when taking take into account the indebtedness in foreign currency.

Furthermore, an agreement called the Chiang Mai Initiative has been concluded in May 2000 to provide a network of bilateral currency swap arrangements among the members of ASEAN, China, Japan and South Korea. This agreement is a kind of explicit monetary cooperation, with the aim of arriving at greater stability of intra-regional exchange rates. As indicated by *de facto* classification of exchange rate arrangements developed by the IMF (2008), the authorities of the major ASEAN countries currently manage their exchange rates by targeting the nominal effective exchange rates (around a band or not). The nominal effective exchange rate thus serves as the nominal anchor or intermediate target of monetary policy.

In reality, it has been observed that the NEER targeting has enabled the stabilization of bilateral exchange rates in the region. As shown by Ma and McCauley (2011), the intra-regional exchange rate

[1]ASEAN members are: Brunei, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

stability could be improved if each country manages its exchange rate against its own trade-weighted basket. This stability arose because of similarity of countries trade-weighted baskets (see for currency weights in the baskets of some South-East Asian currencies, Girardin (2011)).

Consequently, we have a regime that is *de facto* similar to a fixed exchange rate inside the region. Is it worth it to go further? Anyway, it is possible that explicit cooperation could be built ultimately upon this implicit (or *de facto*) cooperation.

Then, how the stability of regional bilateral exchange rates (which is one of the preconditions for a currency area) can be obtained through the similar national policies of managing currencies against their own respective baskets?

This article focuses on two new directions of research on the prospects for monetary integration in South-East Asia. The first one involves knowing whether or not it is relevant for the five founding members of ASEAN (Thailand, Indonesia, Malaysia, Singapore and Philippines)[2] to form a Monetary Union rather than to maintain the status quo of managing nominal effective exchange rate in presence of foreign currency denominated debt and symmetric shocks. The second one theoretically evaluates if targeting the NEER can cause *de facto* stability or not of bilateral exchange rates. It analyzes how the implicit cooperation of exchange rate policies would lead to a (*de facto*) currency area. Rajan (2012) finds that the coefficients of the nominal effective exchange rate in targeting rules differ among countries that practice this policy. This asymmetry in the exchange rate policies is not necessarily incompatible with "*de facto*" stability of bilateral exchange rates generated by effective exchange rates management. It then will be examined how the asymmetry in the monetary authorities' preferences for stabilizing the NEER could impact their implicit goals. We will conduct the welfare analysis to strengthen our results.

The contribution of this paper is to propose a suitable DSGE model to answer these questions. To our knowledge, this subject has not been addressed before in the DSGE literature. Our model is a two open-region DSGE model and takes into account nominal and real rigidities, incomplete pass-through of exchange rate, financial frictions, financial accelerator and the indebtedness phenomenon in foreign currency. Most existing literature on two-country DSGE models concern the euro area and are often in the context of closed economy contrary to our model (see for example Badarau and Levieuge (2011), Gali and Monacelli (2008), Smets and Wouters (2003), Vogel et al. (2012)). Furthermore, working with open economy and putting all aforementioned characteristics together in a one two-country model is a novelty.

The remainder of the article is organized as follows: Section 2 lays out the multi-country general-equilibrium model. Section 3 presents the calibration of the model and the simulation results. Section 4 concludes.

[2] The choice of these five countries is motivated by the fact that they bring together 88% of ASEAN GDP in 2010 according to the Asian Development Bank database (ADB).

2. A two open-region DSGE model

The model consists of two symmetric regions of equal size, respectively a part of ASEAN region, denoted as home country (H) and the rest of the region (RoR) that represents foreign country. They are open to the rest of the world (RoW) which is fully exogenous.

The model contains price stickiness, monopolistic competition in final goods market, capital adjustment costs, incomplete pass-through of exchange rate via law of one price deviation and financial frictions.

Each region is populated by households, government and three types of producers: entrepreneurs, capital producers, and retailers (domestic and imported goods retailers). There are the monetary authorities that set the nominal risk-free interest rates for the two countries, but in the case of forming a currency area there is a unified monetary policy that sets the unique nominal interest rate for both countries. Capital producers build new capital and sell it to the entrepreneurs. Entrepreneurs produce wholesale goods and sell them to domestic goods retailers. Domestic and imported goods retailers set nominal prices of final goods *à la* Calvo (1983). The government finances its expenditures in purchases of aggregate public goods via lump-sum taxes.

2.1. Households

Each economy $i \in \{\mathrm{H}, \mathrm{RoR}\}$ is populated by a continuum of unit mass households with infinite life. The representative household of country i maximizes the following expected discounted sum of utilities:

$$E_t \sum_{t=0}^{\infty} \beta^t \left(\frac{(C_t^i)^{1-\sigma}}{1-\sigma} - \frac{(N_t^i)^{1+\eta}}{1+\eta} \right) \tag{1}$$

where C_t^i is aggregate consumption and N_t^i denotes the number of hours worked. E_t is the conditional expectation operator. The parameters $0 < \beta < 1$,$\sigma > 0$ and $\eta > 0$ are, respectively, the subjective discount factor, the inverse intertemporal elasticity of substitution and the inverse of the Frisch elasticity of labour supply.

The household faces the following period-by-period budget constraint:

$$P_t^i C_t^i + R_{t-1}^i B_{t-1}^i + R_{w,t-1} \Psi_{d,t-1}^i \left(d_{t-1}^i, Z_{t-1}^i\right) S_{2,t}^i D_{h,t-1}^i = W_t^i N_t^i + B_t^i + S_{2,t}^i D_{h,t}^i + \Lambda_t^i - \tau_t^i \tag{2}$$

where P_t^i is the consumer price index (CPI), W_t^i the nominal wage, B_t^i the nominal stock of domestic-currency debt and $D_{h,t}^i$ the nominal debt that is denominated in the rest of the world currency. R_t and $R_{w,t}$ are the domestic and the RoW gross nominal interest rate, respectively. $S_{2,t}^i$ is the bilateral nominal exchange rate between country $i \in \{\mathrm{H}, \mathrm{RoR}\}$ and the RoW (expressed in terms of units of domestic currency per unit of RoW currency)[3] , τ_t^i denotes lump-sum taxes paid to the government and

[3] We define the bilateral nominal exchange rate within the region by $S_{1,t}^i$ such that, $S_{1,t}^H$ is the bilateral nominal exchange rate between H and RoR, and $S_{1,t}^{RoR} = 1/S_{1,t}^H$ is the bilateral nominal exchange rate between RoR and H. In this case, the bilateral nominal exchange rate between the RoR and the RoW can be expressed as a function of $S_{1,t}^H$ and the bilateral nominal exchange rate between H and RoW , $(S_{2,t}^H)$, as : $S_{2,t}^{RoR} = S_{2,t}^H / S_{1,t}^H$. Notice that the formation of currency union implies that $S_{1,t}^H = S_{1,t}^{RoR} = 1$.

Λ_t^i the real profit from the monopolistic sector. Finally, $\Psi_{d,t}^i$ represents a risk premium that is a function of the economy's real aggregate level of net-foreign asset position in percentage of steady-state output, as follows:

$$\Psi_{d,t}^i(d_t^i, Z_t^i) = exp\left(-\psi_d^i\left(\frac{S_{2,t}^i D_t^i}{YP_t^i}\right) + Z_t^i\right) \tag{3}$$

where $d_t^i \equiv \frac{S_{2,t}^i D_t^i}{YP_t^i}$ is the real aggregate net-foreign asset position in percentage of steady-state output; $D_t^i \equiv D_{h,t}^i + D_{E,t}^i$ represents the total debt of each country[4]; $\psi_d^i > 0$ is a measure of the elasticity of the risk premium with respect to net-foreign asset (NFA) position. The variable Z_t^i is an exogenous shock on risk premium defined by
$\log(Z_t^i) = \rho_z \log(Z_{t-1}^i) + e_{z,t}$ with $e_{z,t} \sim i.i.d\ (0, \sigma_{e_z}^2)$. The term $\Psi_{d,t}^i(d_t^i, Z_t^i)$ is assumed to be strictly decreasing in d_t^i and satisfies $\Psi_d^i(0,0) = 1$. It captures imperfect integration in the international financial markets and ensures a well-defined steady-state in the model (Schmitt-Grohé and Uribe, 2003)[5].

The representative household chooses the paths for $\{C_t^i, N_t^i, B_t^i, D_t^i\}_0^\infty$ in order to maximize (1) subject to the budget constraint in (2). The following optimality conditions hold:

$$\frac{(N_t^i)^\eta}{(C_t^i)^{-\sigma}} = \frac{W_t^i}{P_t^i} \equiv w_t^i \tag{4}$$

$$(C_t^i)^{-\sigma} = \beta R_t^i E_t\left((C_{t+1}^i)^{-\sigma}\frac{P_t^i}{P_{t+1}^i}\right) \tag{5}$$

$$(C_t^i)^{-\sigma} = \beta R_{w,t}\Psi_{d,t}^i(d_t^i, Z_t^i)E_t\left((C_{t+1}^i)^{-\sigma}\frac{P_t^i}{P_{t+1}^i}\frac{S_{2,t+1}^i}{S_{2,t}^i}\right) \tag{6}$$

The final good, X_t^i, is allocated to consumption, C_t^i, investment, I_t^i and public spending, G_t^i. It is an aggregate function of goods produced in the domestic country, $X_{i,t}^i$, in the country k , $X_{k,t}^i$, and in the RoW, $X_{w,t}^i$:

$$X_t^i = \left[(1 - a_1^i - a_2^i)^{\frac{1}{\theta}}(X_{i,t}^i)^{\frac{\theta-1}{\theta}} + (a_1^i)^{\frac{1}{\theta}}(X_{k,t}^i)^{\frac{\theta-1}{\theta}} + (a_2^i)^{\frac{1}{\theta}}(X_{w,t}^i)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \tag{7}$$

for $X = \{C, I, G\};\ i, k \in \{\text{H}, \text{RoR}\}$ and $i \neq k$.

The parameters $\theta > 1$, a_1^i, and a_2^i are, respectively, the elasticity of substitution between the three types of goods, the share of imported goods from the country k and the share of imported goods from the RoW. We suppose that these shares are identical reciprocally between each country $i \in \{\text{H}, \text{RoR}\}$ of

[4] $D_{E,t}^i$ is the entrepreneurs borrowing defined in subsection 2.3.1.

[5] We assume the perfect integration in regional financial markets, i.e. there isn't a risk premium between the two countries of the region. Thus, the uncovered interest rate parity (UIP) is holds inside the region but it isn't holds between the economy $i \in \{\text{H}, \text{RoR}\}$ of the region and the rest of the world.

the region and the RoW. Therefore, the fraction $\left(1-a_1^i-a_2^i\right)$ is the degree of home bias in consumption, investment and public goods.

The price index (CPI) associated to (7) is given by:

$$P_t^i = \left[\left(1-a_1^i-a_2^i\right)\left(P_{i,t}^i\right)^{1-\theta} + a_1^i\left(P_{k,t}^i\right)^{1-\theta} + a_2^i\left(P_{w,t}^i\right)^{1-\theta}\right]^{\frac{1}{1-\theta}} \quad (8)$$

where $P_{i,t}^i$, $P_{k,t}^i$ and $P_{w,t}^i$ are, respectively, the domestic price of domestic goods, the domestic price of imported goods from the country k and the domestic price of imported goods from the RoW.

Define $X_{i,t}^i \equiv \left(\int_0^1 X_{i,t}^i(j)^{\frac{\chi-1}{\chi}} d_j\right)^{\frac{\chi}{\chi-1}}$, $X_{k,t}^i \equiv \left(\int_0^1 X_{k,t}^i(j)^{\frac{\chi-1}{\chi}} d_j\right)^{\frac{\chi}{\chi-1}}$ and

$X_{w,t}^i \equiv \left(\int_0^1 X_{w,t}^i(j)^{\frac{\chi-1}{\chi}} d_j\right)^{\frac{\chi}{\chi-1}}$ as the composite aggregates of differentiated varieties produced domestically, inside and outside the region, respectively, with χ being the elasticity of substitution between varieties originating in the same country; $X_{i,t}^i(j)$, $X_{k,t}^i(j)$ and $X_{w,t}^i(j)$ being a typical variety j of domestic goods, imported goods from the country k and imported goods from RoW, respectively. The corresponding prices are deduced easily and are given by, respectively:

$$P_{i,t}^i = \left(\int_0^1 P_{i,t}^i(j)^{1-\chi} d_j\right)^{\frac{1}{1-\chi}}, \quad P_{k,t}^i = \left(\int_0^1 P_{k,t}^i(j)^{1-\chi} d_j\right)^{\frac{1}{1-\chi}}, \quad P_{w,t}^i = \left(\int_0^1 P_{w,t}^i(j)^{1-\chi} d_j\right)^{\frac{1}{1-\chi}},$$

where $P_{i,t}^i(j)$ (respectively $P_{k,t}^i(j)$ and $P_{w,t}^i(j)$) is the price of a typical variety j produced in the domestic country (respectively imported prices from the country k and the RoW).

The optimal domestic demands for domestic, country k and RoW goods, are derived from expenditure minimization[6]:

$$X_{i,t}^i = \left(1-a_1^i-a_2^i\right)\left(\frac{P_{i,t}^i}{P_t^i}\right)^{-\theta} X_t^i \quad (9)$$

$$X_{k,t}^i = a_1^i\left(\frac{P_{k,t}^i}{P_t^i}\right)^{-\theta} X_t^i \quad (10)$$

$$X_{w,t}^i = a_2^i\left(\frac{P_{w,t}^i}{P_t^i}\right)^{-\theta} X_t^i \quad (11)$$

$\forall\, i,k \in \{\mathrm{H},\mathrm{RoR}\}$ and $i \neq k$.

2.2. Open-economy relations

This section outlines the key relations that describe the terms of trade, the real exchange rates and the law of one price deviations. For each economy $i,k \in \{\mathrm{H},\mathrm{RoR}\}$ and $i \neq k$, We define the bilateral terms of trade as:

[6] The optimization program is $min_{C_{i,t}^i,\, C_{k,t}^i,\, C_{w,t}^i, C_t^i} P_{i,t}^i C_{i,t}^i + P_{k,t}^i C_{k,t}^i + P_{w,t}^i C_{w,t}^i = P_t^i C_t^i$ subject to the following constraint:

$C_t^i = \left[(1-a_1-a_2)^{\frac{1}{\theta}}\left(C_{i,t}^i\right)^{\frac{\theta-1}{\theta}} + (a_1)^{\frac{1}{\theta}}\left(C_{k,t}^i\right)^{\frac{\theta-1}{\theta}} + (a_2)^{\frac{1}{\theta}}\left(C_{w,t}^i\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$.

$$TOT^i_{k,t} = \frac{P^i_{k,t}}{P^i_{i,t}} \text{ and } TOT^i_{w,t} = \frac{P^i_{w,t}}{P^i_{i,t}} \tag{12}$$

From (8), the terms of trade can be related to the CPI-DPI[7] ratio as follows:

$$\frac{P^i_t}{P^i_{i,t}} = \left[\left(1 - a^i_1 - a^i_2\right) + a^i_1\left(TOT^i_{k,t}\right)^{1-\theta} + a^i_2\left(TOT^i_{w,t}\right)^{1-\theta}\right]^{\frac{1}{1-\theta}} \tag{13}$$

Assume that the law of one price (LOP) holds for the export sector, but there is incomplete pass-through in the import sector. This assumption is motivated by the existence of monopolistic domestic importers in the region that practice local currency pricing (Devereux and Engel, 2001). This behaviour can make the price of the foreign goods in the domestic market temporarily deviate from the producer price level in the country of origin. The wedge between these two prices is called the law of one price gap (LOPG) and is given by, bilaterally:

$$LOPG^i_{k,t} = \frac{S^i_{1,t}P^k_{k,t}}{P^i_{k,t}} \text{ and } LOPG^i_{w,t} = \frac{S^i_{2,t}P^w_{w,t}}{P^i_{w,t}} \tag{14}$$

where $P^k_{k,t}$ and $P^w_{w,t}$ are domestic prices in country k of the region and in the RoW.

Similarly, we define the bilateral real exchange rates as follows:

$$RER^i_{k,t} = \frac{S^i_{1,t}P^k_t}{P^i_t} \text{ and } RER^i_{w,t} = \frac{S^i_{2,t}P^w_t}{P^i_t} \tag{15}$$

Finally, one can express the effective terms of trade, the effective law of one price gap and the real effective exchange rate, for each country $i \in \{\text{H}, \text{RoR}\}$ as[8]:

$$TOT^i_t = \left(TOT^i_{k,t}\right)^{a^i_1}\left(TOT^i_{w,t}\right)^{a^i_2} \tag{16}$$

$$LOPG^i_t = \left(LOPG^i_{k,t}\right)^{a^i_1}\left(\ LOPG^i_{w,t}\right)^{a^i_2} \tag{17}$$

$$RER^i_t = \left(RER^i_{k,t}\right)^{a^i_1}\left(RER^i_{w,t}\right)^{a^i_2} \tag{18}$$

Suppose that if the two regions $\{\text{H}, \text{RoR}\}$ decide to form a monetary union, they will have the same size in it and the real effective exchange rate for the union is therefore:

$$RER^u_t = (RER^H_t)^{\frac{1}{2}}(RER^{RoR}_t)^{\frac{1}{2}} = \left(RER^H_{w,t}\right)^{\frac{a^i_2}{2}}\left(RER^{RoR}_{w,t}\right)^{\frac{a^i_2}{2}} \tag{19}$$

which can be written also in terms of union's nominal exchange rate (S_t):

$$RER^u_t = \frac{S_t P^w_t}{P^u_t} \tag{20}$$

where P^u_t and P^w_t are CPI of the Monetary Union (the average of both national CPIs) and the rest of the world.

[7] DPI: Domestic Price Index.

[8] The nominal effective exchange rate (NEER) for each country is $S^i_t = \left(S^i_{1,t}\right)^{a^i_1}\left(S^i_{2,t}\right)^{a^i_2}$.

2.3. Production sector

2.3.1. Entrepreneurs

The presence of entrepreneurs introduces the financial accelerator mechanism into the model. As in Bernanke et *al.* (1999), entrepreneurs manage a continuum of firms $j \in [0,1]$ that produces, by using K_t^i units of capital and N_t^i units of labour, wholesale (intermediate) goods in a perfectly competitive market according to the following technology:

$$Y_t^i(j) = A_t^i K_t^i(j)^{\alpha} N_t^i(j)^{1-\alpha} \tag{21}$$

where A_t^i is a technological shock that is common to all firms and follows a stationary first-order autoregressive process : $\log(A_t^i) = \rho_A \log(A_{t-1}^i) + e_{A,t}$, with $e_{A,t} \sim i.i.d(0, \sigma_{e_A}^2)$; $\alpha \in [0,1]$ is the share of capital in the production technology.

The representative firm maximizes its profit by choosing K_t^i and N_t^i subject to the production function (21). The first-order conditions for this optimization problem are:

$$w_t^i = (1-\alpha) mc_t^i \frac{Y_t^i}{N_t^i} \frac{P_{i,t}^i}{P_t^i} \tag{22}$$

$$mpc_t^i = \alpha\, mc_t^i \frac{Y_t^i}{K_t^i} \frac{P_{i,t}^i}{P_t^i} \tag{23}$$

where mc_t^i is the Lagrangian multiplier associated with the production function (21) and denotes the real marginal cost; w_t^i is the real wage; and mpc_t^i is the real marginal productivity of capital.

Entrepreneurs are risk neutral and borrow from outside the region to finance a share of capital used in the production process. This indebtedness in the rest of the world currency characterizes the original sin phenomenon. As in Bernanke *et al.* (1999), to ensure that they never accumulate enough funds to fully self-finance their own activities entirely, assume that they have a finite expected horizon. In each period t, entrepreneurs face a constant probability $(1-\nu)$ of leaving the economy. We follow Christensen and Dib (2008) in allowing newly entering entrepreneurs to inherit a fraction of the net worth of those firms which exit from the business. This assumption is made in order to ensure that new entrepreneurs start out with a positive net worth.[9]

At the end of each period, entrepreneurs purchase capital, K_{t+1}^i, that will be used in the next period at the real price q_t^i. Thus, the total funding needed by an entrepreneur to purchase capital is $q_t^i K_{t+1}^i$. The capital acquisition is financed partly by their net worth, NW_{t+1}^i, and by borrowing,

$D_{E,t+1}^i = q_t^i K_{t+1}^i - NW_{t+1}^i$, from the RoW .

As demonstrated in Bernanke et *al.* (1999), the optimal financial contract between borrower and lender implies an external finance premium (the difference between the cost of external and internal finance), $\Psi_{\mathrm{E},t}^i(\cdot)$, that depends on the entrepreneur's leverage ratio (capital to net worth ratio).

[9] In contrast, Bernanke *et al.* (1999) ensure this by assuming that entrepreneurs also work. This difference does not affect the results.

In optimum, the entrepreneur's demand for capital satisfies the equality between expected real return on capital and the expected marginal financing cost (gross premium for external finance plus the gross real interest rate on the borrowing)[10]:

$$E_t\left(R^i_{K,t+1}\right) = E_t\left[R_{w,t}\Psi^i_{d,t}\left(d^i_t, Z^i_t\right)\Psi^i_{\mathrm{E},t+1}(\cdot)\frac{S^i_{2,t+1}}{S^i_{2,t}}\frac{P^i_t}{P^i_{t+1}}\right] \tag{24}$$

where $\Psi^i_{\mathrm{E},t+1}(\cdot)$ is the function that describes how the external finance premium depends on the financial position of the firm (specific risk premium) and is given by: $\Psi^i_{\mathrm{E},t+1}(\cdot) = \left(\frac{NW^i_{t+1}}{q^i_t K^i_{t+1}}\right)^{-\gamma}$ with $\left(\Psi^i_{\mathrm{E},t+1}(\cdot)\right)' < 0$, $\Psi^i_{\mathrm{E}}(1) = 1$ and γ is the elasticity of the external finance premium with respect to firm's leverage ratio. Thus, the external finance premium is an equilibrium inverse function of the aggregate financial position in the economy, expressed by the leverage ratio. Equation (24) provides the basis for the financial accelerator. If entrepreneur's net worth goes up, the external finance premium falls, the cost of borrowing falls and firms get cheaper access to credit.

The capital demand must satisfy the following differentiation between the ex post marginal return on capital, $E_t\left(R^i_{K,t+1}\right)$, and the marginal productivity of capital at $t+1$, mpc^i_t, which is the rental rate of capital:

$$E_t\left(R^i_{K,t+1}\right) = E_t\left[\frac{mpc^i_{t+1} + (1-\delta)q^i_{t+1}}{q^i_t}\right] \tag{25}$$

where δ is the capital depreciation rate and $(1-\delta)q^i_{t+1}$ is the value of one unit of capital used in $t+1$.

Aggregate entrepreneurial net worth accumulation of the economy depends on profits earned in previous periods plus the bequest, Ω^i_t, that newly entering entrepreneurs receive from entrepreneurs who leave the economy, and evolves according to:

$$NW^i_{t+1} = \nu\left[R^i_{K,t}q^i_{t-1}K^i_t - R_{w,t}\Psi^i_{d,t}\left(d^i_t, Z^i_t\right)\frac{S^i_{2,t+1}}{S^i_{2,t}}\frac{P^i_t}{P^i_{t+1}}\left(\frac{NW^i_t}{q^i_{t-1}K^i_t}\right)^{-\gamma}\left(q^i_{t-1}K^i_t - NW^i_t\right)\right] + (1-\nu)\Omega^i_t \tag{26}$$

2.3.2. Capital producers

Competitive capital producers use a linear technology to produce new capital K^i_{t+1} from final investment goods I^i_t and existing capital stock leasing from entrepreneurs without costs. When producing capital, they are subject to quadratic capital adjustment costs specified as

$$\frac{\psi_I}{2}\left(\frac{I^i_t}{K^i_t} - \delta\right)^2 K^i_t.$$

where $\psi_I > 0$ is the parameter that measures the adjustment costs elasticity.

The aggregate capital stock used by producers in each economy i evolves as follow:

[10] For details, see Bernanke *et al*. (1999).

$$K_{t+1}^i = \left[\frac{I_t^i}{K_t^i} - \frac{\psi_I}{2}\left(\frac{I_t^i}{K_t^i} - \delta\right)^2\right] K_t^i + (1-\delta)K_t^i \tag{27}$$

Capital producers face an optimization problem which consists, in real terms, in choosing the level of investment that maximizes their profits:

$$\max_{I_t^i} \left\{ q_t^i I_t^i - I_t^i - \frac{\psi_I}{2}\left(\frac{I_t^i}{K_t^i} - \delta\right)^2 K_t^i \right\} \tag{28}$$

The following equilibrium condition holds:

$$q_t^i - \psi_I\left(\frac{I_t^i}{K_t^i} - \delta\right) = 1 \tag{29}$$

which is the standard Tobin's Q equation that links the price of capital to the marginal adjustment costs.

When $\psi_I = 0$ (no adjustment costs), the capital price, q_t^i is constant and equal to 1. This shows that capital adjustment costs imply necessarily the capital price (q_t^i) variation and therefore contribute to the volatility of entrepreneurial net worth.

2.3.3. Retailers: price and inflation dynamics

The existence of retailers provides the source of nominal stickiness in the economy. Retailers take wholesale goods as inputs, repackage these costlessly, and sell them in a monopolistically competitive market. There are domestic goods retailers and imported goods retailers. Following Calvo (1983), we assume that retailers set nominal prices on a staggered basis: at each period, a fraction $\left(1-\phi^i\right)$ of retailers are randomly selected to set new prices while the remaining fraction ϕ^i of retailers keep their prices unchanged. For simplicity, these fractions are assumed to be equals within the two groups of retailers.

All home goods retailers purchase the wholesale goods from entrepreneurs at a price equal to the entrepreneurs' nominal marginal cost. Each retailer j of them setting price at t will choose the optimal price, $\widetilde{P}_{i,t}^i$, that maximizes the expected profits for s periods, so that:

$$\max_{\widetilde{P}_{i,t}^i(j)} E_t\left\{\sum_{s=0}^{\infty}\left(\beta\phi^i\right)^s \frac{\lambda_{t+s}^i}{\lambda_t^i}\left[Y_{i,t+s}^i(j)\left(\widetilde{P}_{i,t}^i(j) - P_{i,t+s}^i mc_{t+s}^i\right)\right]\right\} \tag{30}$$

subject to the demand function,

$Y_{i,t+s}^i(j) = \left(\frac{\widetilde{P}_{i,t+s}^i(j)}{P_{i,t+s}^i}\right)^{-\chi} Y_{i,t+s}^i$, where $\frac{\lambda_{t+s}^i}{\lambda_t^i}$ is the households' marginal utilities ratio between $t+s$ and t.

The first-order condition for this problem yields,

$$\widetilde{P}_{i,t}^i(j) = \frac{\chi}{\chi-1}\frac{E_t\left\{\sum_{s=0}^{\infty}\left(\beta\phi^i\right)^s \lambda_{t+s}^i Y_{i,t+s}^i(j) P_{i,t+s}^i mc_{t+s}^i\right\}}{E_t\left\{\sum_{s=0}^{\infty}(\beta\phi^i)^s \lambda_{t+s}^i Y_{i,t+s}^i(j)\right\}} \tag{31}$$

Aggregating across all retailers, the price index for domestically produced goods is given by,

$$P_{i,t}^{i} = \left[\left(1-\phi^{i}\right)\left(\widetilde{P}_{i,t}^{i}\right)^{1-\chi} + \phi^{i}\left(P_{i,t-1}^{i}\right)^{1-\chi}\right]^{\frac{1}{1-\chi}} \quad (32)$$

Combining log-linearized versions of equations (31) and (32) yields an expression of the inflation rate for domestically produced goods, defined by the following New Keynesian Phillips curve:

$$\hat{\pi}_{i,t}^{i} = \beta E_t \hat{\pi}_{i,t+1}^{i} + \frac{\left(1-\phi^{i}\right)\left(1-\beta\phi^{i}\right)}{\phi^{i}} \widehat{mc}_t^{i} \quad (33)$$

where mc_t^i is the real marginal cost, $\pi_{i,t}^{i} = (\frac{P_{i,t}^{i}}{P_{i,t-1}^{i}})$ is domestic inflation and variables with hats are log deviations from their steady-state values.

Similarly, imported goods retailers purchase the products from foreign producers at the wholesale price, $P_{G,t}^{i}$. At the wholesale level, the law of one price holds. Thus, $P_{G,t}^{i} = S_{1,t}^{i} P_{k,t}^{k}$ and $P_{G,t}^{i} = S_{2,t}^{i} P_{w,t}^{w}$ are the wholesale prices (nominal marginal costs) for goods coming from the country k and the RoW, respectively. But at the retail level, we assume that the law of one price does not hold (such as $P_{k,t}^{i} \neq S_{1,t}^{i} P_{k,t}^{k}$ and $P_{w,t}^{i} \neq S_{2,t}^{i} P_{w,t}^{w}$). There is, thus, incomplete exchange rate pass-through in the model. Similar to the home good retailers, imported goods retailers set prices according to a Calvo-style price setting equation. Their optimization problems are identical except for real marginal costs. The latter are, respectively, $(\frac{S_{1,t}^{i} P_{k,t}^{k}}{P_{k,t}^{i}}) \equiv LOPG_{k,t}^{i}$ and $(\frac{S_{2,t}^{i} P_{w,t}^{w}}{P_{w,t}^{i}}) \equiv LOPG_{w,t}^{i}$ for imported goods from the country k and the RoW. The inflation rates for imported goods then satisfy these following New Keynesian Phillips curves:

$$\hat{\pi}_{k,t}^{i} = \beta E_t \hat{\pi}_{k,t+1}^{i} + \frac{\left(1-\phi^{i}\right)\left(1-\beta\phi^{i}\right)}{\phi^{i}} \widehat{lopg}_{k,t}^{i} \quad (34)$$

$$\hat{\pi}_{w,t}^{i} = \beta E_t \hat{\pi}_{w,t+1}^{i} + \frac{\left(1-\phi^{i}\right)\left(1-\beta\phi^{i}\right)}{\phi^{i}} \widehat{lopg}_{w,t}^{i} \quad (35)$$

where $\pi_{k,t}^{i}$ and $\pi_{w,t}^{i}$ are imported inflation prices from the country k and the RoW.

Finally, from equation (8), CPI inflation, $\hat{\pi}_t^i$, is a composite of domestic, country k and world goods prices inflation, such that:

$$\hat{\pi}_t^{i} = \left(1-a_1^{i}-a_2^{i}\right)\hat{\pi}_{i,t}^{i} + a_1^{i}\hat{\pi}_{k,t}^{i} + a_2^{i}\hat{\pi}_{w,t}^{i} \quad (36)$$

2.4. Monetary Policy Regimes

Independent managed float policies

Empirically, it is well known that most of the monetary authorities within ASEAN area target the stability of exchange rates in their monetary rule. We follow Monacelli (2004) which shows that a positive coefficient on exchange rate variation in policy rule can be used to model a managed float exchange rate. Each country $i \in \{\mathrm{H}, \mathrm{RoR}\}$ has its monetary autonomy and the monetary authority practices the managed exchange rate regime according to the following augmented Taylor-type rule:

$$\log\left(\frac{R_t^{i}}{R^{i}}\right) = \beta_0^{i} \log\left(\frac{R_{t-1}^{i}}{R^{i}}\right) + \left(1-\beta_0^{i}\right) E_t\left[\beta_1^{i}\log\left(\frac{\pi_{t+1}^{i}}{\pi^{i}}\right) + \beta_2^{i}\log\left(\frac{Y_t^{i}}{Y^{i}}\right) + \beta_3^{i}\log\left(\frac{\Delta S_{t+1}^{i}}{\Delta S^{i}}\right)\right] + e_{r,t} \quad (37)$$

avec $e_{r,t} \sim i.i.d.\left(0, \sigma_{e_r}^2\right)$.

R^i, π^i , Y^i and ΔS^i are the steady-state values of R_t^i, π_t^i, Y_t^i and ΔS_t^i ; β_1^i, β_2^i et β_3^i are the coefficients that measure central bank responses to expected inflation, output deviations and expected NEER variations (ΔS_t^i). $0 < \beta_0^i < 1$ is the interest rate smoothing parameter.

Monetary Union

We assume that if countries decide to form a Monetary Union, they would opt for a floating exchange rate. Therefore, the common central bank sets the nominal interest rate according to the following Taylor-type interest rate rule:

$$\log\left(\frac{R_t}{R}\right) = \beta_0 \log\left(\frac{R_{t-1}}{R}\right) + (1-\beta_0)\, E_t\left[\beta_1 \log\left(\frac{\pi_{t+1}^{um}}{\pi^{um}}\right) + \beta_2 \log\left(\frac{Y_t^{um}}{Y^{um}}\right)\right] + e_{r,t} \tag{38}$$

with $e_{r,t} \sim i.i.d.\left(0, \sigma_{e_r}^2\right)$.

R, π^{um} and Y^{um} are the steady-state values of R_t, π_t^{um} and Y_t^{um}, that are, respectively, the nominal interest rate, the inflation rate and output of the union. The variables π_t^{um} and Y_t^{um} are the average values of inflation and output of the two equal-size countries:

$$\pi_t^{um} = \frac{1}{2}\left(\pi_t^h + \pi_t^f\right) \text{ and } Y_t^{um} = \frac{1}{2}\left(Y_t^h + Y_t^f\right) \tag{39}$$

$\beta_1 > 1$ and $\beta_2 < 1$ are coefficients that measure central bank responses to expected inflation and output deviations. The parameter $0 < \beta_0 < 1$ captures the degree of interest rate smoothing.

2.5.Government

In this model, we abstract from public debt and assume that the government finances its expenditures in purchases of aggregate public goods G_t^i through lump-sum taxes, such that:

$$P_t^i G_t^i = \tau_t^i \tag{40}$$

Public spending is fully exogenous and follows the autoregressive process:

$$\log\left(G_t^i\right) = \rho_g \log\left(G_{t-1}^i\right) + e_{g,t} \tag{41}$$

where $e_{g,t} \sim i.i.d.\left(0, \sigma_{e_g}^2\right)$.

2.6. General equilibrium conditions

In equilibrium, the factor markets, the final goods market and the balance of payments must clear in each country $i \in \{\text{H}, \text{RoR}\}$.

Equilibrium in factor markets requires:

$$N_t^i = \int_0^1 N_t^i(j)dj \text{ and } K_t^i = \int_0^1 K_t^i(j)dj \tag{42}$$

Let $Y_t^i \equiv \left(\int_0^1 Y_t^i(j)^{\frac{\chi-1}{\chi}} d_j\right)^{\frac{\chi}{\chi-1}}$ denote aggregate output. Thus, the goods market clearing condition satisfies:

$$Y_t^i = C_{i,t}^i + I_{i,t}^i + G_{i,t}^i + EX_t^i \tag{43}$$

where $EX_t^i = a_1^i \left(\frac{P_{i,t}^i}{S_{1,t}^i P_t^k}\right)^{-\theta} AB_t^k + a_2^i \left(\frac{P_{i,t}^i}{S_{2,t}^i P_t^w}\right)^{-\theta} AB_t^w$

The variable EX_t^i represents total exports and AB_t^i (with $\in \{k, w\}$) stands for absorption.

AB_t^i, AB_t^k and AB_t^w are, respectively, absorption in the economy i, the country k and the RoW such that,

$$AB_t^i = C_t^i + I_t^i + G_t^i \tag{44}$$

$$AB_t^k = C_t^k + I_t^k + G_t^k \tag{45}$$

and AB_t^w is an exogenous process.

Then the domestic economy's aggregate resource constraint can be rewritten as:

$$Y_t^i = \left(\frac{P_{i,t}^i}{P_t^i}\right)^{-\theta} \left[(1 - a_1^i - a_2^i) AB_t^i + a_1^i \left(\frac{1}{RER_{k,t}^i}\right)^{-\theta} AB_t^k + a_2^i \left(\frac{1}{RER_{w,t}^i}\right)^{-\theta} AB_t^w\right] \tag{46}$$

The evolution of net foreign assets at the aggregate level can be expressed for each country as:

$$S_{2,t}^i D_t^i = S_{2,t}^i R_{w,t-1} \Psi_{d,t-1}^i (d_{t-1}^i, Z_{t-1}^i) D_{t-1}^i + EX_t^i - (IM_{k,t}^i + IM_{w,t}^i) \tag{47}$$

where $IM_{k,t}^i$ and $IM_{w,t}^i$ are imports of country i originating from country k and from the RoW, respectively.

The expression of the evolution of total real NFA position in percentage of steady-state output is:

$$d_t^i = R_{w,t-1} \Psi_{d,t-1}^i \frac{1}{\pi_t^i} d_{t-1}^i + \frac{1}{Y}\left(\frac{P_{i,t}^i}{P_t^i} Y_t^i - C_t^i - I_t^i - G_t^i\right) \tag{48}$$

$\forall\, i, k \in \{\text{H}, \text{RoR}\}$ and $i \neq k$.

2.7. Rest of the world

We assume that the RoW is fully exogenous and its variables follow an autoregressive process such that:

$$\log(AB_t^w) = \rho_{ABw} \log(AB_{t-1}^w) + e_{ABw,t} \tag{49}$$

$$\log(R_{w,t}) = \rho_{Rw} \log(R_{w,t-1}) + e_{rw,t} \tag{50}$$

$$\log(\pi_{w,t}) = \rho_{\pi w} \log(\pi_{w,t-1}) + e_{\pi w,t} \tag{51}$$

where $\rho_x \in [0,1]$ with $x = ABw, Rw$ and πw are the coefficients of autoregressive process and $e_{x,t} \sim i.i.d(0, \sigma_{e_x}^2)$ are the associated exogenous shocks.

3. Calibration of the model and simulations results

We now derive a numerical solution for the model, by calibrating and then simulating. The model is log-linearized around the steady state[11] and the software Dynare is used to do the simulations.

3.1. Calibration of the model

The calibration of the model is summarized in Table 1 below. For each country $i \in \{\mathrm{H}, \mathrm{RoR}\}$, some parameters are taken from the literature on the Emerging Market Economies (EME) and others are calculated by the author using data from Asian Development Bank (ADB) databases.

Table 1: Parameter calibration

Description	Parameter	Value	References
Preferences			
Subjective discount factor	β	0.99	Literature on the EME
Inverse of the Frisch elasticity of labour supply	η	1	Christiano et al. (1997), Devereux et al. (2006)
Inverse intertemporal elasticity of substitution in consumption	σ	2	Backus et al. (1992)
Share of imported goods from the rest of the region	a_1^i	0.10	ADB database
Share of imported goods from the rest of the world	a_2^i	0.27	ADB database
Elasticity of substitution between domestic and imported goods	θ	1.4	Cook (2004)
Elasticity of the risk premium with respect to NFA position	ψ_d^i	0.0007	Schmitt-Grohé and Uribe (2003)
Technology			
Capital contribution to production function	α	0.35	Choi and Cook (2004)
Capital depreciation rate	δ	0.025	Cook (2004), Choi and Cook (2004)
Internal capital adjustment costs parameter	ψ_I	0.25	Bernanke et *al.* (1999)
Probability of not adjusting prices	ϕ^i	0.75	Gertler et al. (2007)
Steady-state mark-up	$\chi/(\chi-1)$	1.1	Literature on the EME
Financial frictions parameters			
Steady-state capital-net worth ratio	K^i/NW^i	3	Devereux et al. (2006)
Steady-state quarterly risk spread	$R_K^i - R^i$	0.02	Elekdag and Tchakarov (2007), Devereux et al. (2006)
Elasticity of the external finance premium with respect to firm's leverage ratio	γ	1	Literature on the EME
Entrepreneurs' probability of leaving the economy	$(1-\nu)$	0.0272	Bernanke et al. (1999)
Macroeconomic Ratios			
Consumption/GDP ratio	C^i/Y^i	0.57	ADB database
Public expenditures/GDP ratio	G^i/Y^i	0.11	ADB database
Monetary policy			
Smoothing coefficient in the monetary rule	β_0^i	0.5	Literature on the EME
Inflation stabilizing coefficient in the monetary rule	β_1^i	2	Gertler et al. (2007)
Output stabilizing coefficient in the monetary rule	β_2^i	0.8	Literature on the EME
NEER targeting coefficient in the monetary rule	β_3^i	0.7	Literature on the EME

[11] The linearized version of the model is available upon request.

Persistence parameter of interested shocks[12]		
Autocorrelation of technology shock	ρ_A	0.7
Autocorrelation of foreign demand shock	ρ_{ABw}	0.6

3.2. Status quo Versus Monetary Union in ASEAN-5

As indicated in the introduction, the status quo of the exchange rate policies in South-East Asia is characterized by the managing currencies against their own trade-weighted baskets. Indeed, ASEAN-5 countries (except Philippines) target the baskets of currencies based on their own rather than common, trade weights.

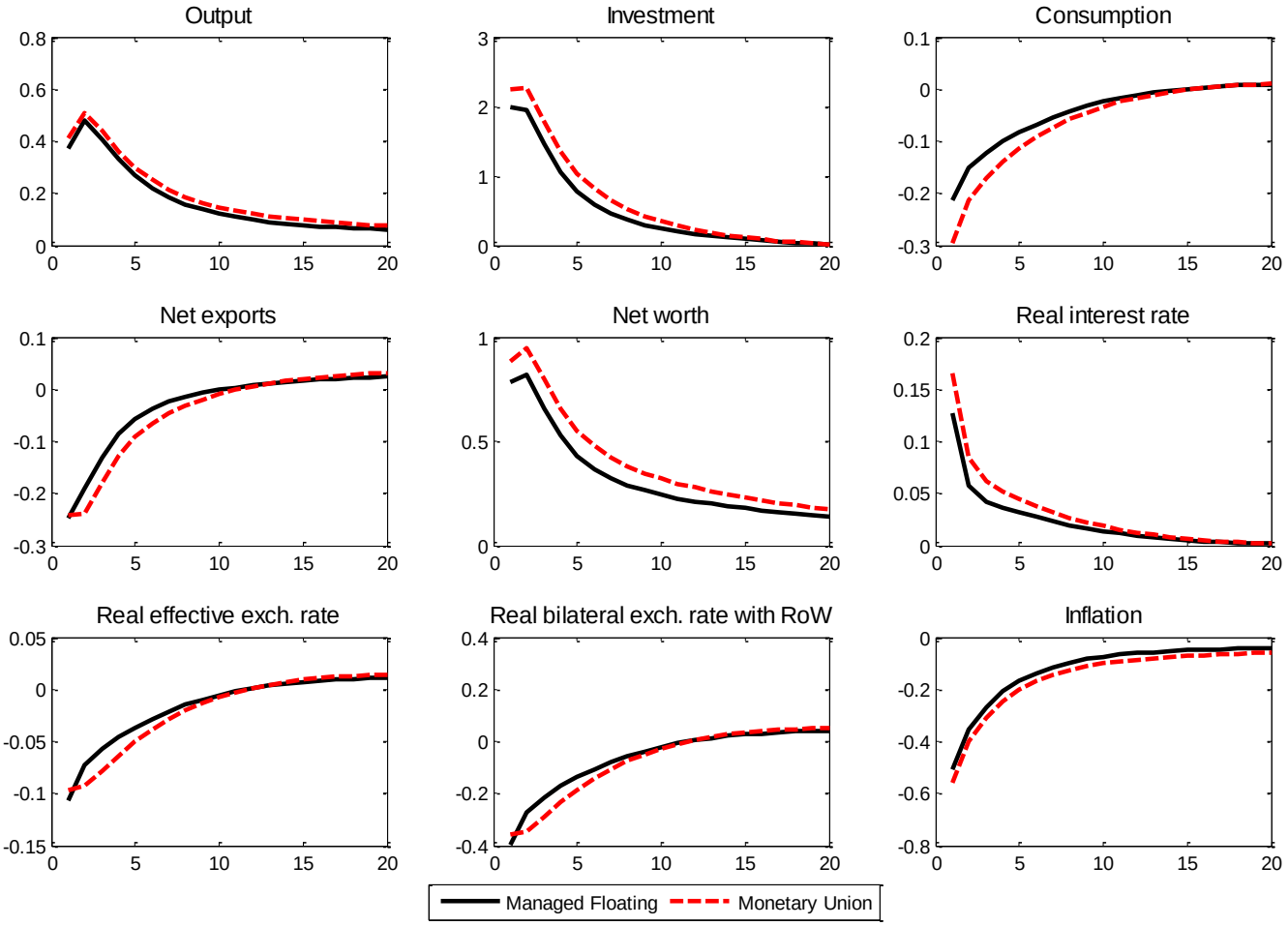
In this section, we focus on the following framework: under the assumption that Monetary Union has been settled in ASEAN-5, the question is whether participating countries are better off in this union if an economic shock occurs compared to the current status quo. First, we evaluate the dynamics of the model under symmetric (supply/demand) shocks (which is considered as one of the preconditions for forming a Monetary Union, theoretically) and next, we make the welfare comparison of both monetary policies.

3.2.1. Supply shock

Figure 1 displays the dynamics of the main variables of a country in response to a one-standard deviation positive productivity shock, under the two monetary regimes (Monetary Union and Managed Float).

[12] I only present in the table the parameters of shocks that are considered by this paper.

Figure 1: Effects of a positive productivity shock on any country



A persistent growth in factor productivity would lead to augment in equilibrium investment and output. The hump-shaped pattern of output is generated by the real and nominal rigidities in the model. This shock induces a decrease in marginal cost and inflation. Under both regimes, the central bank revises downwardly the nominal interest rates for stabilizing the expected inflation. But this decline is less than the fall in inflation, leading to higher real interest rates. As a result, decline in consumption and the appreciation of the current real effective exchange rate (REER) and bilateral real exchange rate (with RoW) are observed. The REER appreciation reduces net exports. The appreciation of the bilateral real exchange rate increases the net worth (because the current value of the foreign currency denominated debt decreases) and that is favorable to investment. Moreover, the share of investment purchased abroad is cheaper in domestic currency, which boosts investment more. These effects of increasing investment are adding to its initial rise due to the growth in productivity.

The reactions of the monetary authorities introduce a difference between the two monetary regimes. Indeed, the Monetary Union's central bank does not react to changes in the NEER, because we assume that if countries decide to form a Monetary Union, they would opt for a floating exchange rate. After the productivity shock, the appreciation pressure of the exchange rate leads the central bank to lower the nominal interest rate in managed float, while this latter remains unchanged in Monetary Union under such pressure (an initial drop in interest rates being caused by the decrease in inflation). Inflation

falls (and, consequently, the real interest rate rises) more under currency union than under managed float regime. This relative increase in real interest rate under the Monetary Union leads to the largest decline in consumption, the more appreciation of REER/bilateral real exchange rate, and a greater increase in net worth, investment and output. Finally, the impulse responses of different variables show that shock effects are more cushioned under currency union regime than that under the managed float regime facing a domestic supply shock.

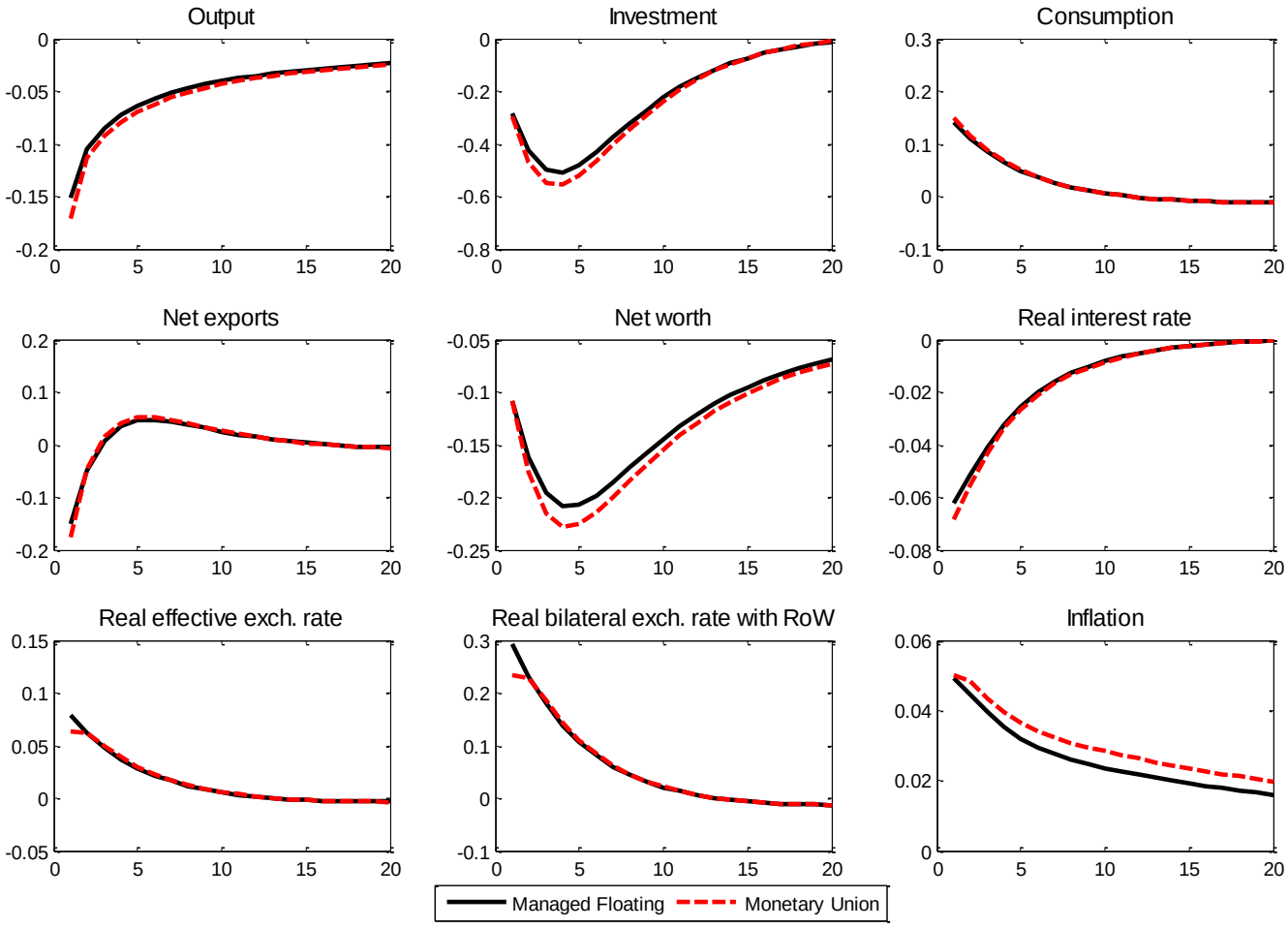
3.2.2. Demand shock

In the context of foreign currency denominated debt, the analysis of external shocks is very informational. Due to the South-East Asia's openness, the foreign demand shock is chosen.

Under the two monetary regimes (Monetary Union and Managed Float), the dynamics of the country variables in response to a one-standard deviation fall in current exports are depicted in Figure 2. The shock induces the adverse effects on both investment and output. The entrepreneurial demand for borrowing declines and this leads to lower the real interest rate. In addition, to cope with contractionary effects of the shock, monetary authorities decrease the nominal interest rate (given the unchanged expected inflation). Consequently, the current inflation rate increases, the real interest rate goes down and leads to the rise of consumption. By UIP, there is a depreciation of the bilateral real exchange rate (with RoW) and the REER depreciation. The real depreciation with respect to RoW increases the cost of investment purchased abroad and decrease the net worth of entrepreneurs (since the debt value increases in local currency). Both developments increase the risk premium, which is unfavorable to investment.

Comparing the managed exchange rate regime and the Monetary Union, notice that the first regime provides more stability than the latter. Indeed, given the contraction in foreign demand and the low level of the expected inflation, the central bank must lower less its nominal interest rate under managed exchange rate regime because of the current and expected depreciation pressure. Therefore, the current inflation goes up more under Monetary Union than under managed float. As results, under the latter regime the decrease in real interest rate is limited and, the bilateral and effective real exchange rates are more depreciated. Finally, net exports and output decrease more under Monetary Union. This shows that Monetary Union is less desirable than the managed exchange rate regime facing a foreign demand shock.

Figure 2: Effects of a negative foreign demand shock on any country



3.2.3. Welfare comparison

To obtain robusted ranking among monetary policy arrangements, welfare cost comparison is relevant. Following Lucas (1987), we use a measure of the welfare costs in terms of business cycles given by the fraction of steady state consumption that households would be willing to give up in order to negate the effect of the shocks, i.e. to be indifferent between a constant sequence of consumption and working hours and the stochastic sequences of the same variables under the monetary regime considered.
Formally:

$$U\big((1+u)C,N\big) = E\big(U(C_t,N_t)\big) \tag{52}$$

A second-order Taylor approximation of the unconditional expectation of utility function around steady state yields:

$$E\big(U(C_t,N_t)\big) = U(C,N) + C^{1-\sigma}E\big(\hat{C}_t\big) - \frac{1}{2}\sigma C^{1-\sigma}var\big(\hat{C}_t\big) - N^{1+\eta}E\big(\widehat{N}_t\big) - \frac{1}{2}\eta N^{1+\eta}var\big(\widehat{N}_t\big) \tag{53}$$

The welfare metric has then two components: the part that measures the effect of the shocks on the variances of the variables (u^{var}) and the part that captures the effect of uncertainty on the means of these variables (u^{m}), such as:

$$U\big((1+u^{m})C,N\big) \;=\; U(C,N) + C^{1-\sigma}E\big(\hat{C}_t\big) - N^{1+\eta}E\big(\widehat{N}_t\big) \tag{54}$$

$$U\left((1+u^{var})C,N\right) \;=\; U(C,N)-\frac{1}{2}\sigma C^{1-\sigma}var\left(\hat{C}_t\right)-\frac{1}{2}\eta N^{1+\eta}var\left(\widehat{N}_t\right) \tag{55}$$

From (54-55), u^m and u^{var} can be found, respectively:

$$u^m=\left[1+(1-\sigma)E\left(\hat{C}_t\right)-\frac{(1-\sigma)N^{1+\eta}}{C^{1-\sigma}}E\left(\widehat{N}_t\right)\right]^{\frac{1}{1-\sigma}}-1 \tag{56}$$

$$u^{var}=\left[1-\frac{1}{2}\sigma(1-\sigma)var\left(\hat{C}_t\right)-\frac{1}{2}\eta\frac{(1-\sigma)N^{1+\eta}}{C^{1-\sigma}}var\left(\widehat{N}_t\right)\right]^{\frac{1}{1-\sigma}}-1 \tag{57}$$

The total welfare costs values reported in Table 2 is obtained by addition of u^m and u^{var}.

Table 2 shows that the welfare costs analysis confirms the previous results provided by impulse responses functions. Indeed, the Monetary Union is a better regime in terms of the welfare stability facing a domestic supply shock (as productivity shock) whereas managed float is desirable in the presence of external shocks such as foreign demand shock.

Table 2: Welfare costs (Percentage units of steady-state consumption) across different monetary regimes and under different symmetric Shocks

Types of shocks	Monetary Union	Managed Float
Productivity shock	0.26	0.27
Foreign demand shock	0.09	0.08

3.3. Asymmetry in exchange rate policies and *de facto* monetary cooperation

Managing the NEER is *de facto* exchange rate policy of the major countries of ASEAN. In a sensitivity analysis framework, the asymmetry is introduced in the targeting degree (coefficient) of NEER.

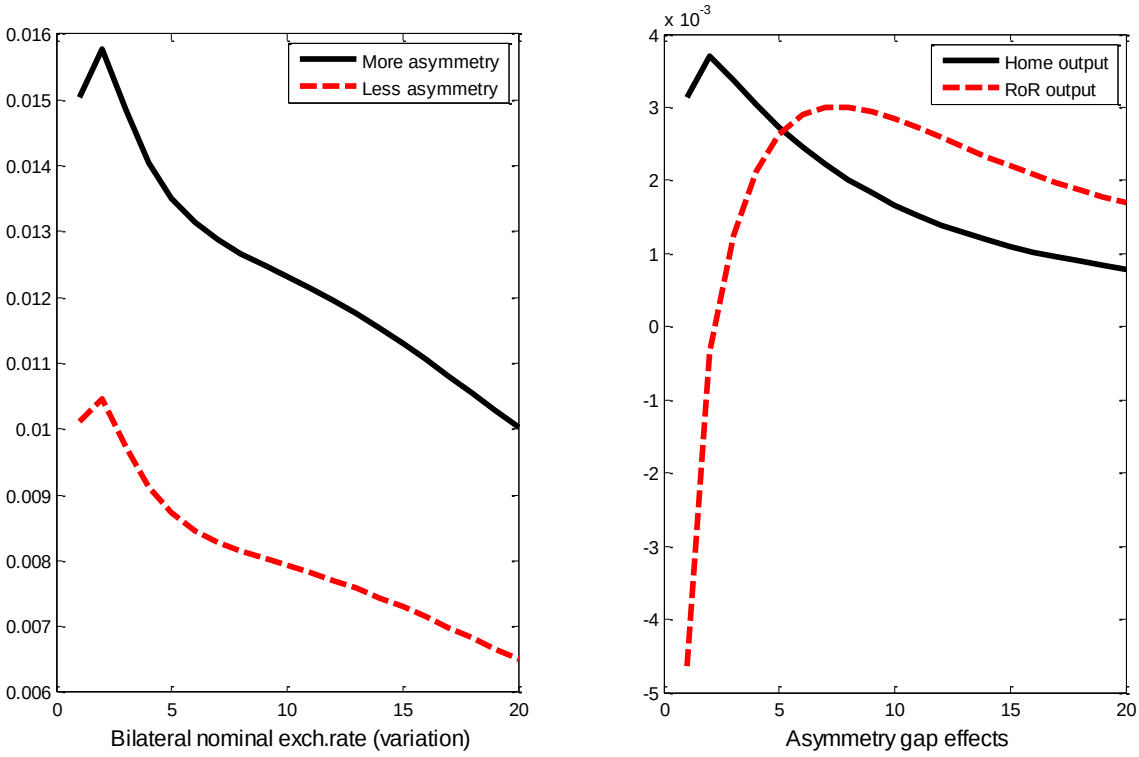
There are countries that have more "fear of floating" (high β_3^i) than others (low β_3^i). β_3^i is then the preference parameter for exchange rate stabilization. In two countries model setting, the countries of the region are gathered into two groups: one group (home country) for which the parameter associated to the NEER target is high and the second (RoR) for which this parameter is low. The gap between these two parameters measures the degree of asymmetry in the NEER targeting.

Considering more (less, respectively) asymmetry between the two countries in the exchange rate targeting, we calibrate $\beta_3^{\mathrm{H}}=0.7$ and $\beta_3^{\mathrm{RoR}}=0.001$ ($\beta_3^{\mathrm{H}}=0.7$ and $\beta_3^{\mathrm{RoR}}=0.2$, respectively).

Figure 3-a shows the effect of a symmetric and positive productivity shock on the home (and RoR) output and on the bilateral nominal exchange rate between the two countries. The domestic bilateral exchange rate depreciates because the nominal interest rate of RoR drops more than that of the domestic country (via the UIP with perfect capital mobility between the two countries). Indeed, the domestic central bank reacts less than that of the RoR to the expected appreciation of NEER further to a productivity shock, because of the relative high level of the output caused by the more stabilized NEER in the home country. The figure shows that less asymmetry in the NEER targeting causes less depreciation in the bilateral nominal exchange rate, therefore this latter stabilizes in accordance to the intuition at first.

The gap between the effects of more and less asymmetry on the home /RoR output is plotted on the right side of the figure 3-a. Let's define an asymmetry gap effect, which could be the difference between the effects under regime of more asymmetry and the effects under less asymmetry. The finding is that more asymmetry is favorable to the home country, i.e. the positive gap between the output levels under both degrees of the asymmetry (asymmetry gap effect), because of its high degree of the NEER stabilization (and therefore its high degree of favorable stabilization regarding bilateral nominal exchange rate). The asymmetry gap effect on the RoR output is negative directly after the shock before becoming positive. This means that less asymmetry is favorable to the RoR output in the short term, but this effect tends to be reversed in the long term because the output returns more quickly to the steady state due to the evolution of the bilateral nominal exchange rate (in particular, the speed of return to equilibrium).

Figure 3-a: Effect of positive productivity shock on the home/RoR output and bilateral nominal exchange rate under different degrees of asymmetry



One can observe in Figure 3-b that when the asymmetry in the NEER management is reduced by 28.43% in terms of variation, the volatility of bilateral nominal exchange rate between the home country and the RoR decreases by 33.10% (after a productivity shock)[13].

[13] The volatility is measured after the simulation of 10000 periods.

Figure 3-b: Bilateral nominal exchange rate volatility after the productivity shock (in percentage)

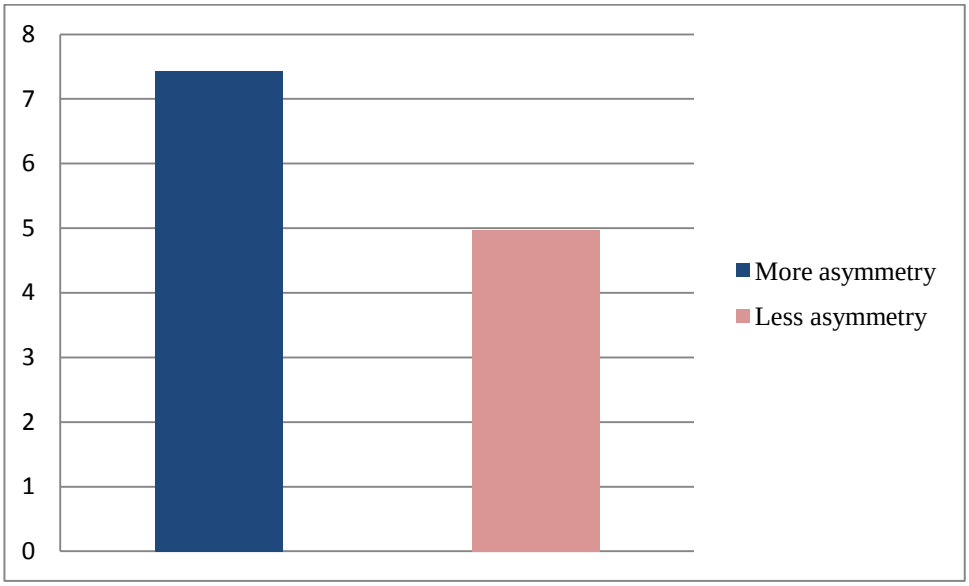


Figure 4-a displays the effect of a symmetric and negative foreign demand shock on the home/RoR output and on the bilateral nominal exchange rate between the two countries. The NEER depreciation due to this shock leads the monetary authorities of both countries to raise nominal interest rates, but the magnitude is less important in the RoR than in the domestic country. This allows, through UIP, the bilateral nominal appreciation between the two countries. As before, the more the gap between the targeting coefficients is high, the more the appreciation of the bilateral nominal exchange rate is important. The gap between the output levels under both degrees of the asymmetry (asymmetry gap effect) is plotted on the right side of the figure 4-a. It is interpreted similarly to the case of productivity shock.

According to Figure 4-b a 28.43% fall in asymmetry leads to a reduction of 32.98% in the volatility of the bilateral nominal exchange rate (after a shock to foreign demand).

Figure 4-a: Effect of negative foreign demand shock on the home/RoR output and bilateral nominal exchange rate under different degrees of asymmetry

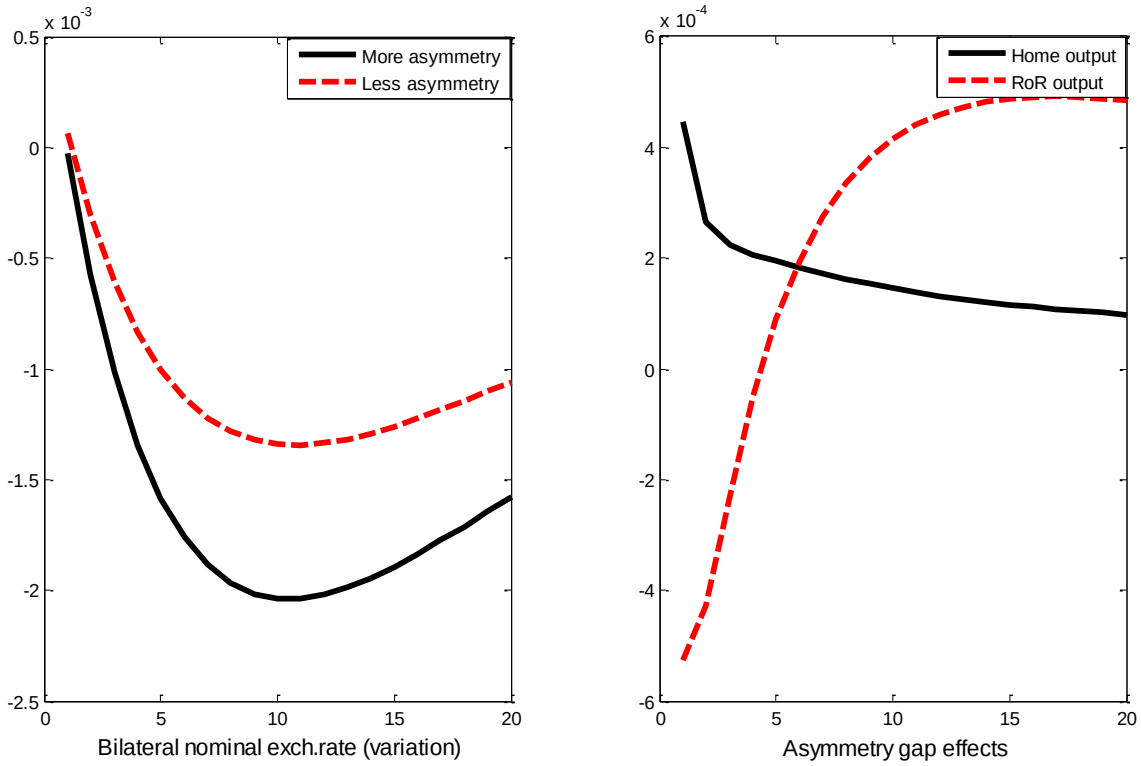
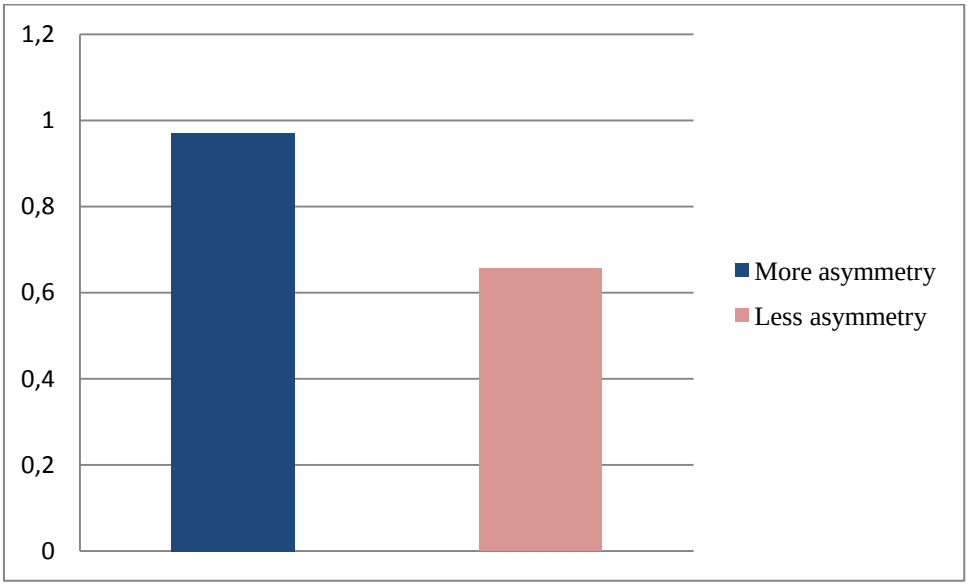


Figure 4-b: Bilateral nominal exchange rate volatility after the foreign demand shock (in percentage)



Notice that the degree of asymmetry in the NEER management influences the output of countries and the bilateral nominal exchange rate between the two countries. The less there is the gap between authorities' preferences with respect to the NEER targeting, the more the bilateral nominal exchange rate between the two countries is stabilized. The less there is asymmetry in the degree of the NEER

targeting, the more the home country, that has a high degree of NEER targeting, loses in terms of the asymmetry benefit on its output; while, the more the RoR output obtains a favorable effect in the short run and unfavorable effect in the long run (due to the rapid reestablishment of the equilibrium in the case of less asymmetry).

Table 3 states the welfare losses for the home country after the productivity and foreign demand shocks. The results confirm what has been said previously: the reduction of asymmetry in exchange rate policies implies a decrease in the welfare losses after the shocks. This is also true for the RoR whose results are not presented here.

Table 3: Welfare costs (Percentage units of steady-state consumption) after different symmetric Shocks and under different degrees of the asymmetry

Types of shocks	More Asymmetry	Less Asymmetry
Productivity shock	0.28	0.27
Foreign demand shock	0.082	0.081

Finally, when the preferences in terms of the countries' NEER stabilization in the region are close, one can expect a *de facto* stability of their reciprocal bilateral nominal exchange rates. This de facto consistency of bilateral exchange rates is a kind of unconcerted monetary cooperation that could eventually lead to the formation of a (*de facto* or *de jure*) currency area.

4. Conclusion

The traditional theory of the optimal currency area argues in favor of for the symmetry of the shocks and exchange rate stability as some of the preconditions for forming a Monetary Union. This article shows that, facing the rise of the symmetry in underlying shocks among the ASEAN economies, the presence of foreign currency debt exhibits an important role of the shocks origin in the monetary regime choice (domestic-external shocks trade-off). The economic policy implication is that, if an external symmetric shock occurs in a region, the adoption of an alternative exchange rate arrangement such as the managed float, could be more beneficial than a Monetary Union, because of the foreign currency denominated debt.

It is also shown in this article that intra-regional exchange rate stability can arise if currencies are separately managed against their own similar trade-weighted baskets. This *de facto* monetary cooperation (or fixity of bilateral exchange rates) could lead to the explicit cooperation and hence to the formation of *de facto* currency area.

Finally, in their desire to form a Monetary Union, the ASEAN economies must not only strengthen their national policies' similarities of managing the nominal effective exchange rate but also reduce the foreign currency denomination of their debts. These results could be generalized to others regions.

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