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IS INTERNATIONAL MONETARY POLICY COORDINATION FEASIBLE FOR THE ASEAN-5 + 3 COUNTRIES?

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ABSTRACT

We examine the feasibility of international monetary policy coordination among the ASEAN-5 + 3 countries using the two-production-factor Dynamic Stochastic General Equilibrium (DGSE) models. It explores three types of interaction regimes among these countries: (1) No Coordination; (2) Bilateral Coordination; and (3) Multilateral Coordination. We find 18 feasible Bilateral Coordination schemes and four feasible Multilateral Coordination schemes for the ASEAN-5 + 3 countries. The best among these schemes is the Multilateral Coordination scheme that involves all the ASEAN-5 + 3 countries. Therefore, we suggest that the ASEAN-5 + 3 countries should adopt this scheme if coordinating monetary policies.

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I. INTRODUCTION

Economic integration is progressing rapidly in the Asia Pacific region, particularly in East Asia and Southeast Asia. Based on the Asian Development Bank's (ADB) Asia-Pacific Regional Cooperation and Integration Index (ARCII), Southeast Asia (ASEAN) had the highest average score of integration among the sub-regions in the Asia Pacific during 2006–2017, followed by East Asia (ADB, 2019). In the light of the economic integration in Asia and the Pacific, it is crucial to discuss the importance of international policy coordination in the region. International policy coordination facilitates economic integration by creating macroeconomic stability, as suggested by Sutherland (2004), Branson and Healy (2005), Truman (2011), and Rillo (2018).

There are various international monetary policy coordination models developed by different researchers, but these models share the same spirit: policy action in one country creates externalities (or spillovers) on the other countries. The key insight from these models is that coordination of policies among countries that considers these externalities may lead to higher welfare for all these countries.

Previous studies have found that externalities can be harmful or beneficial for other countries. For example, Corsetti and Pesenti (2001) find that monetary policy expansions can have a beggar-thyself impact, while fiscal policy expansions are generally beggar-thy-neighbor in the long run. Sumando (2017) find that the announcement of unconventional monetary policy measures by the US, EU, Japan, and the UK created spillovers on the exchange rates of 15 Emerging Markets (EMs) during 2008 and 2012. Carlberg (2005) suggests that international monetary policy cooperation (coordination) is superior to international monetary policy competition because participating countries internalize negative externalities in their policymaking.

Many previous studies on international policy coordination have used the United States (US) and the European Union (EU) or the Euro Area (EA) in two-country models, including studies by Coenen (2008) and Liu and Pappa (2008). The US and EU (or EA) economies have similar sizes and characteristics, which allow researchers to impose symmetric assumptions on model parameters. However, the symmetric assumption is not suitable for the Asia Pacific countries because they have different sizes and have diverse economic characteristics. There are rather few studies on international policy coordination in the Asia-Pacific or the ASEAN countries, such as Branson and Healy (2005), Gupta (2012), Tan (2014), Majuca and Pagaduan (2015), and Sugandi (2018). These studies find that international policy coordination is somewhat feasible for the ASEAN and/or the Asia-Pacific countries under particular circumstances.

One area in international policy coordination studies is the study of international monetary policy coordination. International monetary policy coordination can be seen as a collective effort to provide an impure public good, which is macroeconomic stability as collective welfare that the participating countries can enjoy. The benefit of policy coordination is the improvement of welfare for the participating countries. Meanwhile, the cost of policy coordination is the loss of flexibility for the central bank of the participating country to conduct monetary policy in the presence of an economic shock. If the benefit of coordination for a country exceeds its cost, then the coordination can potentially improve the

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respective country's welfare. However, the feasibility of such coordination also depends on the cost-benefit considerations of the partner(s).

Being aware of the scant literature on international monetary policy coordination among the Asia-Pacific countries, we are motivated to conduct a study on this topic to enrich the existing literature. Our study also provides policy recommendations for policymakers pertaining to international monetary policy coordination and regional economic integration in the Asia-Pacific.

We examine the feasibility of international monetary policy coordination among the ASEAN-5 + 3 countries, which comprises the ASEAN-5 (Indonesia, Malaysia, Singapore, Thailand, the Philippines) and the CJK (China, Japan, and Korea). We select the ASEAN-5 + 3 countries because they show rapid economic integration and actively promote economic coordination. These countries have established the Chiang Mai Initiative and the ASEAN+3 Macroeconomic Research Office, and the Asian Bond Market Initiative. We do not include Brunei, Cambodia, Myanmar, Laos, and Vietnam due to a lack of publicly available data needed.

We investigate the hypothesis that international monetary policy coordination can improve the welfare of the participating ASEAN-5 + 3 countries. If the welfare of each participating country when they coordinate policies is higher than when they do not coordinate, then we cannot reject the hypothesis that international monetary policy coordination improves the welfare of the participating ASEAN-5 + 3 countries. If the welfare of each participant of the policy coordination is the same or lower than when they do not coordinate policies, then we reject the hypothesis that international monetary policy coordination improves the welfare of the participating ASEAN-5 + 3 countries.

There are two research questions that we seek to answer: (i) whether international monetary policy coordination can improve the welfare of the ASEAN-5 + 3 countries; and (ii) the best feasible scheme of coordination if international monetary policy coordination can improve the welfare of the participating ASEAN-5 + 3 countries. We consider a coordination scheme to be "feasible" when all the participating countries have higher welfare than when they do not coordinate policies. If the welfare of at least one participating country does not improve, then a coordination scheme is not feasible.

Our study differs from previous studies on international policy coordination in the ASEAN or ASEAN + CJK in at least one of these items: (1) the use of the Dynamic Stochastic General Equilibrium (DSGE) models (rather than conventional econometric models) that enables us to examine macroeconomic shock impacts on different economic agents and their responses; (2) the use of the multi-country rather than two-country DSGE models (as used in Liu and Pappa (2008) and Sugandi (2018)); (3) the use of the two-production-factor DSGE models that introduce capital as another production factor besides labor (rather than the labor-only production factor models as in Liu and Pappa (2008) and Sugandi (2018)); and (4) the use of the game theory framework identify feasible policy coordination schemes for the ASEAN-5 + 3 countries.

In all, we contribute to the literature by constructing empirical models that are suitable to ASEAN-5 + 3 countries, which will contribute to the literature on international policy coordination in the ASEAN and the Asia-Pacific countries. Previous studies on international monetary policy coordination are mostly

theoretical, while many empirical works on this topic focus on the EU (or the EA) and the US. We provide policy recommendations for policymakers should they decide to join international monetary policy coordination. Specifically, if they opt to coordinate policies, we recommend feasible policy coordination schemes from which they can choose.

We find that international monetary policy coordination is feasible for the ASEAN-5 + 3 countries under several bilateral and multilateral coordination schemes. Our findings suggest that the ASEAN-5 + 3 countries should pursue a multilateral coordination scheme that involves all of these countries, as it produces the highest welfare for each of the participants.

We re-estimate our models using different prior distributions, prior means, and prior standard deviations to check the robustness of the estimation results by following the procedures introduced by Beidas-Strom and Poghosyan (2011). The re-estimation results show that the parameter estimates in our models are robust. Our counterfactual simulations show the optimum welfare values calculated using the ***optimum*** interest rate gaps (i.e., the difference between the optimum policy rates and their long-term trend) in our models are different, but not way-off, from the welfare values using the ***actual*** interest rate gaps (i.e., the difference between the actual policy rates and their long-term trend).

The paper proceeds in the following direction. Section II elaborates the methodology of this study, including the specifications of the models, steps to solve the models and determine the feasible policy coordination schemes, and variables, parameters, and data sources. Section III discusses the results from parameters estimation, robustness tests of the parameter estimates, welfare values and feasible coordination schemes, and counterfactual analysis. Section IV concludes.

II. METHODOLOGY

A. Model Specifications

This section covers the home country, with the foreign nations mirroring the structure of the Home country. Throughout this paper, the subscript "t" refers to the time index, "n" denotes the Foreign Country index, "i" refers to the index for firms in the non-traded sector, and "j" means the index for firms in the traded sector.

The model assumes the existence of eleven countries representing the world—the home country and ten foreign nations—and similar economic agents live in each economy. The eleven countries are: (1) Indonesia; (2) Malaysia; (3) Singapore; (4) Thailand; (5) the Philippines; (6) the EU; (7) the US; (8) China; (9) Japan; (10) Korea; and (11) Australia. When we analyze policy interactions among the ASEAN-5 countries, we treat the remaining six countries as the external environment. Likewise, when we analyze the CJK, the ASEAN-5 + China, ASEAN-5 + Japan, ASEAN-5 + Korea, or ASEAN-5 + 3, we treat other countries outside the respective cluster as the external environment.

Externalities transmit across countries through trade and financial channels. The traded goods in the eleven countries are from domestic production and imports. The study assumes that these countries produce and consume non-traded goods domestically. Bond markets are connected across countries, and there is international risk-sharing among these countries.

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We assume three types of policy interactions among countries:

(i) No Coordination (NC) or the Nash regime

The government and central bank in the home country make policies without coordinating with other countries. The central bank seeks to optimize the home country's welfare by minimizing the output gaps (the difference between the actual output of an economy and its potential output) and inflation rates in the traded and non-traded sectors while considering policies and outputs in other countries as given.

(ii) Bilateral Coordination (BC) regime

There is a hypothetical supranational planner that seeks to optimize welfare in two participating countries in bilateral coordination by setting fiscal and monetary policies in both countries while considering the policies and outputs in the remaining nine countries as given. The supranational planner sets fiscal policies in each of the two countries independently. The planner sets the monetary policies in the two countries interdependently: it determines the interest rate policy in each country by considering the output gaps and inflation rates in the traded and non-traded sectors of both countries.

(iii) Multilateral Coordination (MC) regime

The supranational planner seeks to optimize the welfare of the participating countries in multilateral coordination by setting fiscal and monetary policies in these countries while considering the policies and outputs in the non-participating countries as given. The planner sets the fiscal policies in each of the participating countries independently, while it sets the monetary policies in these countries interdependently.

We assume the existence of four economic agents in each country: 1) households; 2) firms; 3) the government or supranational planner exercising fiscal policy; and 4) the central bank or supranational planner exercising monetary policy. In Appendix, Section A displays the equations for each agent's optimization problems.

A1. Households

There is a continuum of identical, infinitely lived households. The representative household in each country has an endowment of one unit of time and derives utility from consuming a basket of final goods (C_t) and a holding real balance of cash $\left(\frac{M_t}{P_t}\right)$ given price level P_t and subjective discount factor β. The household directly purchases a portion of C_t (i.e., $(\check{C}_t)$), and the government provides the rest as public goods (G_t). $\check{C}_t$ comprises non-traded goods $\left(\check{C}_{Nt}\right)$ and traded goods $(\check{C}_{Tt})$. $\check{C}_{Tt}$comprises domestically produced traded goods $(\check{C}_{Ht})$ and imported traded goods from foreign countries $\left(\sum_{n=1}^{10} \check{C}_{Fnt}\right)$.

The price index of non-traded goods $(\bar{P}_{Nt})$ and the price index of traded goods $(\bar{P}_{Tt})$ determine the price level (P_t). $\bar{P}_{Tt}$ is determined by the price index of domestically-produced traded goods $(\bar{P}_{Ht})$ and the price index of imported traded goods from Foreign Country-n in the domestic currency $(e_{nt}\bar{P}^*_{Fnt})$. The study defines e_{nt} as the value of domestic currency per foreign currency-n.

The representative household's assets at time t are in the form of capital investment (K_t-(1-δ) K_{t-1}), domestic government bonds (B_t), foreign government bonds ($\sum_{n=1}^{10} e_{nt}\, B_{nt}^{*}$), and cash money ($M_t$). These types of assets will pay capital lease rate (R_t^{kap}), domestic government bonds interest rate (R_t), and bond interest rate from Foreign Country-n (R_{nt}^{*}), of their respected principals at time t+1. The household's income at time t is in the form of wages (W_t), transfers from the government (TR_t), income from leasing capital at time t-1 $\left(R_{t-1}^{kap}\, K_{t-1}\right)$, interest payments from purchased domestic government bonds at time t-1 ($(1+R_{t-1})\, B_{t-1}$), and interest payment from purchased foreign government bonds at time t-1 ($\sum_{n=1}^{10}(1 + R_{nt-1}^{*})\, e_{nt-1}\, B_{nt-1}^{*}$). In the household's budget constraint, carried over cash money from the previous period (M_{t-1}) plus income at time t should equal to consumption and assets holding at time t.

At time t, the household supplies labor (L_t) to earn wages. It deducts a portion of the wages to pay income tax (t_{Lt}). By providing labor, the household loses part of its utility; we measure this marginal loss as the marginal disutility of labor (Ψ). It pays consumption tax (t_{Ct}) when purchasing goods. To simplify the model, we assume that the income tax rates are the same across time and economic sectors, likewise for consumption tax rates.

The representative household in each economy faces three optimization problems:

(i) Utility maximization subject to budget constraints to obtain the optimum real wage equation and the Euler equation.
(ii) Cost minimization of non-traded and traded goods consumption to obtain demand functions for non-traded and traded goods.
(iii) Cost minimization of domestically produced and imported traded goods consumption to obtain demand functions for domestically-produced and imported traded goods.

A2. Firms

There are two sectors in the economy: the non-traded sector and the traded sector. For each sector, we differentiate between firms producing intermediate goods (Y_{Nt} (i) and Y_{Tt} (j), where i and j are the index of firms in the non-traded and the traded sector, respectively) and firms producing final goods (Y_{Nt} and Y_{Tt}). Home-produced traded intermediate goods (Y_{Tt} (j)) comprise those sold in the domestic market (Y_{Ht} (j)) and those sold to foreign countries ($\sum_{n=1}^{10} Y_{Hnt}^{*}(j)$).

We assume that all firms use labor and capital as production factors and that the composition of labor and capital in the production technology function is different in the traded and non-traded sectors. It considers capital as a final good used to conduct the production process, and thus it is different from intermediate goods (which undergo processing to produce final goods). It assumes that capital is freely mobile across countries.

- **Firms Producing Intermediate Goods**

In each sector, there is a continuum of firms producing differentiated intermediate goods indexed in the interval [0,1]. Each firm uses Constant Return to Scale (CRS) technology to produce intermediate goods using labor and capital. We assume that firms producing intermediate goods are price takers in the input market but monopolistic competitors in the product market.

Following Calvo's price setting, firms seek to adjust their selling price every period, but only some of them can do so. The probability of firms being able to adjust their price at time t is $1-\gamma_N$ for firms in the non-traded sector and $1-\gamma_T$ for firms in the traded sector. In other words, the probability of keeping the price unchanged at time t is γ_N for firms in the non-traded sector and γ_T for firms in the traded sector. By the law of large numbers, a fraction $1-\gamma_N$ of firms in the non-traded sector can adjust their prices, while γ_N cannot. Likewise, a fraction $1-\gamma_T$ of firms in the traded sector can adjust their prices, while γ_T cannot. The government provides subsidies to firms in the non-traded sector (τ_N) and the traded sector (τ_N) to reduce the steady-state price markup distortions.

The representative firms producing **non-traded** intermediate goods face the following optimization problems:

(i) Cost minimization to derive the optimum unit cost in the non-traded sector V_{NIt} (which is the Lagrange multiplier obtained from optimization).
(ii) Profit maximization to derive the optimum pricing rules for non-traded intermediate goods.

The representative firms producing **traded** intermediate goods face the following optimization problems:

(i) Cost minimization to derive the optimum unit cost in the traded sector V_{TIt} (which is the Lagrange multiplier obtained from optimization).
(ii) Profit maximization to derive the optimum pricing rules for traded intermediate goods. (Prices of intermediate goods to be sold in foreign countries are assumed to be benchmarked to domestic prices before they are converted to foreign market prices using the respective country's exchange rates).

- **Firms Producing Final Goods**

We assume that the production of final goods in the non-traded sector (Y_{Nt}) entirely uses domestically produced non-traded intermediate goods. It assumes that the home-produced traded final goods (Y_{Tt}) comprise those using domestically produced intermediate goods (Y_{Ht}) and those using imported intermediate goods from Foreign Country-n (Y_{Fnt}). There is some degree of substitutability between similar domestically produced and imported traded intermediate goods.

We assume the existence of an infinite number of identical firms in each sector that bundles intermediate goods to produce final goods according to the Constant Elasticity of Substitution (CES) aggregation technology.

The representative firm producing **non-traded** final goods faces the following optimization problems:

(1) Cost minimization to derive the optimum labor unit cost in the non-traded sector V_{NCt} (which is the Lagrange multiplier obtained from optimization).
(2) Profit maximization to obtain the home demand function for non-traded final goods.

The representative firm producing **traded** final goods faces the following optimization problems:

(1) Cost minimization to derive the optimum labor unit cost in the traded sector V_{TCt} (which is the Lagrange multiplier obtained from optimization).
(2) Profit maximization to obtain the home demand function for traded final goods.

A3. Government or Supranational Planner Exercising Fiscal Policy

We assume that the government or a supranational planner has a long-term horizon (i.e., focusing on the steady state) in making fiscal policy rather than responding to short-term shocks. The government (supranational planner) seeks to find optimum labor allocations in the steady state that help households to maximize their utility. Besides pursuing this long-term objective, at every point of time t, the government (supranational planner) purchases public goods for households (G_t), transfers cash to households (TR_t), pays bond interests to households ($(1+R_{t-1})\ B_{t-1}$), and provides subsidies for firms producing non-traded intermediate goods (τ_N) and traded goods (τ_T). When purchasing goods, the government (supranational planner) pays consumption tax.

To generate revenues for its expenditures, the government (supranational planner) collects consumption tax (t_C) and labor income tax (t_L) as well as issuing government bonds (B_t). The revenues that the supranational planner generates in a country can only be expensed in the respective country and cannot be used in another country.

At time t, G_t comprises government (supranational planner) spending on non-traded goods (G_{Nt}) and traded goods (G_{Tt}), where G_{Tt} consists of government (supranational planner) spending on domestically-produced traded goods (G_{Ht}) and imported traded goods from foreign countries ($\sum_{n=1}^{10} G_{Fnt}$).

The government (supranational planner) faces three optimization problems:

(i) Utility maximization (prepared for households) in the steady state to obtain the optimum labor allocation in the non-traded and traded sectors.
(ii) Cost minimization of government (supranational planner) spending on non-traded and traded goods to obtain the government (supranational planner) demand functions for non-traded and traded goods at time t.
(iii) Cost minimization of domestically produced and imported traded goods consumption to obtain the government (supranational planner) demand functions for domestically produced and imported traded goods at time t.

A4. Central Bank or Supranational Planner Exercising Monetary Policy

We assume that the central bank (supranational planner in exercising monetary policy) focuses on managing short-term shocks in the economy rather than pursuing long-term objectives. The central bank (supranational planner) seeks to optimize welfare by minimizing a social objective function subject to the private sector's (i.e., households' and firms') optimizing conditions.

The objective function includes a loss function that contains variables of output gaps in the non-traded and traded sectors ($\tilde{y}_{Nt}$ and $\tilde{y}_{Tt}$) and inflation in the two sectors (π_{Nt} and π_{Ht}) as well as parameters that measure the elasticity of substitution between differentiated products in the two sectors (θ_N and θ_T) and the responsiveness of pricing decisions to variations in the real marginal cost gaps of the two sectors (κ_N and κ_T). Nominal interest rate gap ($\hat{r}_t$), which is the gap between the short-term nominal interest rate and its natural rate, serves as a control variable in the model.

Under the NC regime, the central bank optimizes the welfare of the home economy. Under the BC or the MC regime, the supranational planner seeks to

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optimize the welfare contribution of each participating country based on their relative economic size as part of collective welfare. The collective welfare here is bilateral or regional macroeconomic stability, which is an impure public good that has non-rivalry and partially excludable characteristics.

The market-clearing conditions in the model are: (1) non-traded goods market-clearing condition; (2) traded goods market-clearing condition; (3) labor market-clearing condition; (4) capital-market-clearing condition; (5) international bonds market-clearing condition; (6) international risk-sharing condition; and (7) uncovered interest parity.

B. Steps to Solve the Model and Determination of Feasible Policy Coordination

There are five steps to solve the models and calculate the welfare values in our study, which are applicable for the NC, the BC, and the MC schemes:

B1. Optimization by Economic Agents

In this step, households maximize their utilities. Firms seek to find optimum output, optimum output price, and optimum factor unit cost. The government or supranational planner helps households to maximize their utilities via the provision of public goods and cash transfers, and through optimum labor allocation in the non-traded and traded sectors.

B2. Aggregation of Optimum Solutions and Market-clearing Conditions

Nominal aggregate supply and demand in the non-traded and traded sectors, real aggregate demand in the non-traded and traded sectors, aggregate domestic demand for final goods, and aggregate demand for production factors are derived using optimum solutions from step 1. Market-clearing conditions for the goods market, the labor market, the bonds market, and the capital market, as well as the international risk sharing condition that involve the terms of trade between the Home and Foreign economies, are all set in this step.

B3. Derivation of the Flexible Price (Natural Rate) Equilibrium

Using log-linearized aggregations of optimum solutions and market-clearing conditions in step 2, the natural rate equilibrium system is derived. The system comprises: (a) natural rate of non-traded output; (b) natural rate of traded output; (c) natural rate terms of trade between the Home economy and Foreign Countries; (d) natural rate of aggregate domestic demand; (e) real interest rate in the flexible-price equilibrium; (f) the relative price of non-traded goods in terms of traded goods.

B4. Derivation of Sticky-price Equilibrium

Using log-linearized aggregations of optimum solutions market-clearing conditions in step 2 and gaps of variables from their natural rate equilibrium values in step

3, we derive the sticky price equilibrium that comprises: (a) Phillips curve for the non-traded sector; (b) Phillips curve for the traded sector; (c) relations between changes in output in the non-traded and traded sectors; and (d) relations between output, inflation, and nominal interest rate.

B5. Welfare Optimization by the Central Bank or Supranational Planner

The central bank or the social planner optimizes the welfare objective function subject to households' and private sector's optimizing conditions (which are the equations in the sticky-price equilibrium). The monetary welfare optimization cannot be manually calculated as the objective function is stated in a linear quadratic form. Therefore, we use the linear-quadratic approximation solution technique as suggested by Diaz-Giménez (2004).

After having the welfare values, the next step is to use the Game Theory framework to create welfare pay-off matrixes for interaction between or among countries under different interaction regimes. An international monetary policy coordination scheme is deemed as feasible when all countries in the coordination have higher welfare compared to when they follow the NC regime. If there is at least one country whose welfare is not better-off when joining a policy coordination scheme, then the scheme is not feasible.

C. System of Equations for the Estimation

Following steps 1 to 5 to solve the models as explained in the previous sub-section, we derive the following system of log-linearized equations to solve the model and estimate the parameters.

- **For the NC regime**

$$\hat{a}_{Nt} = \text{ɒ}_1\ \hat{a}_{Nt-1} + \text{ɒ}_2\ \hat{a}_{Tt-1} + \varepsilon_{Nt} \quad (1)$$

$$\hat{a}_{Tt} = \varrho_1\ \hat{a}_{Nt-1} + \varrho_2\ \hat{a}_{Tt-1} + \varepsilon_{Tt} \quad (2)$$

$$\tilde{y}^*_{T1t} = \text{ɔ}^*_{T1}\ \tilde{y}^*_{T1t-1} + \varepsilon^*_{T1t}$$

…

$$\tilde{y}^*_{T10t} = \text{ɔ}^*_{T10}\ \tilde{y}^*_{T10t-1} + \varepsilon^*_{T10t} \quad (3)$$

$$\tilde{y}_{Nt} = \frac{1}{\kappa_N}\ E_t[\pi_{Nt} - \beta\ \pi_{Nt+1}] \quad (4)$$

$$\tilde{y}_{Tt} = \frac{1}{\kappa_T}\ E_t\ [\pi_{Ht} - \beta\ \pi_{Ht+1}] \quad (5)$$

$$\pi_{Nt} = -\frac{(1+\kappa_N)}{(1+\kappa_N+\beta\ \theta_N)}\left(\tilde{y}_{Nt} - \hat{r}_{t-1} + \alpha\ (\hat{a}_{Nt} - \hat{a}_{Nt-1}) - \alpha\ (\hat{a}_{Tt} - \hat{a}_{Tt-1})\right) - \frac{1}{(1+\kappa_N+\beta\ \theta_N)}\tilde{y}_{Nt-2} \quad (6)$$

$$\pi_{Ht} = -\frac{(1+\kappa_T)}{(1+\kappa_T+\beta\ \theta_T)}\left(\tilde{y}_{Tt} - \hat{r}_{t-1} - (1-\alpha)\ (\hat{a}_{Nt} - \hat{a}_{Nt-1}) + (1-\alpha)\ (\hat{a}_{Tt} - \hat{a}_{Tt-1})\right) - \frac{1}{(1+\kappa_T+\beta\ \theta_T)}\tilde{y}_{Tt-2} \quad (7)$$

$$\hat{r}_t = \frac{1}{[(1-\varphi_N)(1-\alpha)+(1-\varphi_T)\,\alpha\omega_0]}\{(1-\alpha)\,E_t(\tilde{y}_{Nt+1}+\pi_{Nt+1}+\alpha\,(\hat{a}_{Nt+1}-\hat{a}_{Nt})-\alpha\,(\hat{a}_{Tt+1}-\hat{a}_{Tt}))+\alpha\omega_0\,E_t(\tilde{y}_{Tt+1}+\pi_{Ht+1}-(1-\alpha)(\hat{a}_{Nt+1}-\hat{a}_{Nt})+(1-\alpha)(\hat{a}_{Tt+1}-\hat{a}_{Tt}))\} \quad (8)$$

- **For the BC and MC regimes**

$$\hat{a}_{Nt} = \text{ь}_1\,\hat{a}_{Nt-1} + \text{ь}_2\,\hat{a}_{Tt-1} + \varepsilon_{Nt} \quad (9)$$

$$\hat{a}_{Tt} = \varrho_1\,\hat{a}_{Nt-1} + \varrho_2\,\hat{a}_{Tt-1} + \varepsilon_{Tt} \quad (10)$$

…

$$\hat{a}^*_{N(k-1)t} = \text{ь}^*_{(k-1)\cdot 1}\,\hat{a}^*_{N(k-1)t-1} + \cdots + \text{ь}^*_{(k-1)\cdot(k-1)}\,\hat{a}^*_{T(k-1)t-1} + \varepsilon^*_{N(k-1)t} \quad (11)$$

$$\hat{a}^*_{T(k-1)t} = \varrho^*_{(k-1)\cdot 1}\,\hat{a}^*_{N*k-1)t-1} + \cdots + \varrho^*_{(k-1)\cdot(k-1)}\,\hat{a}^*_{T(k-1)t-1} + \varepsilon^*_{T(k-1)t} \quad (12)$$

$$\tilde{y}^*_{Tkt} = \text{ב}^*_{Tk}\,\tilde{y}^*_{Tkt-1} + \varepsilon^*_{Tkt}$$

$$\tilde{y}^*_{T(k+1)t} = \text{ב}^*_{T(k+1)}\,\tilde{y}^*_{T(k+1)t-1} + \varepsilon^*_{T(k+1)t}$$

…

$$\tilde{y}^*_{T10t} = \text{ב}^*_{T10}\,\tilde{y}^*_{T10t-1} + \varepsilon^*_{T10t} \quad (13)$$

$$\tilde{y}_{Nt} = \frac{1}{\kappa_N}\,E_t[\pi_{Nt} - \beta^{\blacklozenge}\pi_{Nt+1}] \quad (14)$$

$$\tilde{y}_{Tt} = \frac{1}{\kappa_T}\,E_t[\pi_{Ht} - \beta^{\blacklozenge}\pi_{Ht+1}] \quad (15)$$

$$\pi_{Nt} = -\frac{(1+\kappa_N)}{(1+\kappa_N+\beta^{\blacklozenge}\theta_N)}(\tilde{y}_{Nt} - \hat{r}_{t-1} + \alpha\,(\hat{a}_{Nt}-\hat{a}_{Nt-1}) - \alpha\,(\hat{a}_{Tt} - \hat{a}_{Tt-1})) - \frac{1}{(1+\kappa_N+\beta^{\blacklozenge}\theta_N)}\tilde{y}_{Nt-2} \quad (16)$$

$$\pi_{Ht} = -\frac{(1+\kappa_T)}{(1+\kappa_T+\beta^{\blacklozenge}\theta_T)}(\tilde{y}_{Tt} - \hat{r}_{t-1} - (1-\alpha)\,(\hat{a}_{Nt}-\hat{a}_{Nt-1}) + (1-\alpha)\,(\hat{a}_{Tt} - \hat{a}_{Tt-1})) - \frac{1}{(1+\kappa_T+\beta^{\blacklozenge}\theta_T)}\tilde{y}_{Tt-2} \quad (17)$$

$$\hat{r}_t = \frac{1}{[(1-\varphi_N)(1-\alpha)+(1-\varphi_T)\,\alpha\omega_0]}\{(1-\alpha)E_t\,(\tilde{y}_{Nt+1}+\pi_{Nt+1}+\alpha\,(\hat{a}_{Nt+1}-\hat{a}_{Nt})-\alpha\,(\hat{a}_{Tt+1}-\hat{a}_{Tt}))+\alpha\omega_0\,E_t(\tilde{y}_{Tt+1}+\pi_{Ht+1}-(1-\alpha)(\hat{a}_{Nt+1}-\hat{a}_{Nt})+(1-\alpha)(\hat{a}_{Tt+1}-\hat{a}_{Tt}))\} \quad (18)$$

…

$$\tilde{y}^*_{N(k-1)t} = \frac{1}{\kappa^*_{N(k-1)}}\,E_t\left[\pi^*_{N(k-1)t} - \beta^{\blacklozenge}\pi^*_{N(k-1)t+1}\right] \quad (19)$$

$$\tilde{y}^*_{T(k-1)t} = \frac{1}{\kappa^*_{T(k-1)}}\,E_t\left[\pi^*_{H(k-1)t} - \beta^{\blacklozenge}\pi^*_{H(k-1)t+1}\right] \quad (20)$$

$$\pi^*_{N(k-1)t} = -\frac{\left(1+\kappa^*_{N(k-1)}\right)}{\left(1+\kappa^*_{N(k-1)}+\beta^{\blacklozenge}\theta^*_{N(k-1)}\right)}\left(\tilde{y}^*_{N(k-1)t} - \hat{r}^*_{(k-1)t-1} + \alpha^*_{(k-1)}\left(\hat{a}^*_{N(k-1)t} - \hat{a}^*_{N(k-1)t-1}\right) - \alpha^*_{(k-1)}\left(\hat{a}^*_{T(k-1)t} - \hat{a}^*_{T(k-1)t-1}\right)\right) - \frac{1}{\left(1+\kappa^*_{N(k-1)}+\beta^{\blacklozenge}\theta^*_{N(k-1)}\right)} \quad (21)$$

$$\pi^*_{H(k-1)t} = -\frac{\left(1+\kappa^*_{T(k-1)}\right)}{\left(1+\kappa^*_{T(k-1)}+\beta^{\blacklozenge}\theta^*_{T(-1)k}\right)}\left(\tilde{y}^*_{T(k-1)t} - \hat{r}^*_{(k-1)t-1} - \left(1-\alpha^*_{(k-1)}\right)\left(\hat{a}^*_{N(k-1)t} - \hat{a}^*_{N(k-1)t-1}\right) + \left(1-\alpha^*_{(k-1)}\right)\left(\hat{a}^*_{T(k-1)t} - \hat{a}^*_{T(k-1)t-1}\right)\right) - \frac{1}{\left(1+\kappa^*_{T(k-1)}+\beta^{\blacklozenge}\theta^*_{T(k-1)}\right)}\tilde{y}^*_{T(k-1)t-2} \quad (22)$$

$$\hat{r}^*_{(k-1)t} = \frac{1}{\left[\left(1-\varphi^*_{N(k-1)}\right)\left(1-\alpha^*_{(k-1)}\right)+\left(1-\varphi^*_{T(k-1)}\right)\alpha^*_{(k-1)}\omega^*_{(k-1)}\right]}\left\{\left(1-\alpha^*_{(k-1)}\right) E_t\begin{pmatrix}\tilde{y}^*_{N(k-1)t+1}+\pi^*_{N(k-1)t+1}\\ +\alpha^*_{(k-1)}\left(\hat{a}^*_{N(k-1)t+1}-\hat{a}^*_{N(k-1)t}\right)\\ -\alpha^*_{(k-1)}\left(\hat{a}^*_{T(k-1)t+1}-\hat{a}^*_{T(k-1)t}\right)\end{pmatrix} + \alpha^*_{(k-1)}\omega^*_{(k-1)} E_t\begin{pmatrix}\tilde{y}^*_{T(k-1)t+1}+\pi^*_{T(k-1)t+1}\\ -\left(1-\alpha^*_{(k-1)}\right)\left(\hat{a}^*_{N(k-1)t+1}-\hat{a}^*_{N(k-1)t}\right)\\ +\left(1-\alpha^*_{(k-1)}\right)\left(\hat{a}^*_{T(k-1)t+1}-\hat{a}^*_{T(k-1)t}\right)\end{pmatrix}\right\} \quad (23)$$

where

k = number of participating countries (comprises the home economy and k-1 foreign countries)

$\hat{a}_{Nt}$ = log-linearized shock in the non-traded sector of the home economy at time t

$\hat{a}^*_{N(k-1)t}$ = log-linearized shock in the non-traded sector of foreign Country k-1 at time t

$\hat{a}_{Tt}$ = log-linearized shock in the traded sector of the home economy at time t

$\hat{a}^*_{T(k-1)t}$ = log-linearized shock in the traded sector of foreign Country k-1 at time t

$\mathfrak{b}_1$ = parameter for shock in the non-traded sector that comes from the non-traded sector in the home economy

$\mathfrak{b}_2$ = parameter for shock in the non-traded sector that comes from the traded sector (cross-sector shock) in the home economy

$\mathfrak{g}_1$ = parameter for shock in the traded sector that comes from the non-traded sector (cross-sector shock) in the home economy

ϱ_2 = parameter for shock in the traded sector that comes from the traded sector in the home economy

$\flat^*_{(k\text{-}1)\cdot 1}$ = parameter for shock in the non-traded sector that comes from the non-traded sector in foreign country *k*-1

$\flat^*_{(k\text{-}1)\cdot 2}$ = parameter for shock in the non-traded sector that comes from the traded sector (cross-sector shock) in foreign country *k*-1

$\varrho^*_{(k\text{-}1)\cdot 1}$ = parameter for shock in the traded sector that comes from the non-traded sector (cross-sector shock) in foreign country *k*-1

$\varrho^*_{(k\text{-}1)\cdot 2}$ = parameter for shock in the traded sector that comes from the traded sector in foreign country *k*-1

ε_{Nt} = error term for shock in the non-traded sector of the home economy

ε_{Nt} = error term for shock in the traded sector of the home economy

$\varepsilon^*_{N(k\text{-}1)t}$ = error term for shock in the non-traded sector of foreign country *k*-1

$\varepsilon^*_{T(k\text{-}1)t}$ = error term for shock in the traded sector of foreign country *k*-1

$\tilde{y}^*_{Tkt}$ = output gap in the traded sector of foreign country k at time *t*

$\tilde{y}^*_{T(k+1)t}$ = output gap in the traded sector of foreign country *k*+1 at time *t*

$\tilde{y}^*_{T10t}$ = output gap in the traded sector of Foreign Country-10 at time *t*

$\beth^*_{T1}$ = autoregression parameter of $\tilde{y}^*_{T1t}$ (when $\tilde{y}^*_{T1t}$ is assumed as exogenous in the case of BC regime)

$\beth^*_{T(k+1)}$ = autoregression parameter of $\tilde{y}^*_{T(k+1)t}$

$\beth^*_{T10}$ = autoregression parameter of $\tilde{y}^*_{T10t}$

$\tilde{y}_{Nt}$ = output gap in the non-traded sector of the home economy at time *t*

$\tilde{y}_T$ = output gap in the traded sector of the home economy at time *t*

π_{Nt} = inflation in the non-traded sector of the home economy at time *t*

π_{Ht} = inflation in the traded sector of the home economy at time *t*

$\hat{r}_t$ = nominal interest rate gap in the home economy at time *t*

$\tilde{y}^*_{N(k\text{-}1)t}$ = output gap in the non-traded sector of foreign country *k*-1 at time *t*

$\tilde{y}^*_{T(k\text{-}1)t}$ = output gap in the traded sector of foreign country *k*-1 at time *t*

$\pi^*_{N(k\text{-}1)t}$ = inflation in the non-traded sector of foreign country *k*-1 at time *t*

$\pi^*_{H(k\text{-}1)t}$ = inflation in the traded sector of foreign country *k*-1 at time *t*

$\hat{r}^*_{(k\text{-}1)t}$ = nominal interest rate gap in foreign country *k*-1 at time *t*

β = discount factor in the NC regime

$\beta^{\blacklozenge}$ = joint discount factor in the BC or MC regime

α = share of traded goods values to total values of goods in the home economy

ω_0 = share of domestically-produced traded goods values to total values of traded goods in the Home economy

ω_n = share of imported traded goods values from foreign country-*n* to total values of traded goods in the Home economy

θ_N = elasticity of substitution between differentiated products in the non-traded sector of the home economy

θ_T = elasticity of substitution between differentiated products in the traded sector

κ_N = responsiveness of pricing decisions to variations in the real marginal cost gaps of the non-traded sector of the home economy

κ_T = responsiveness of pricing decisions to variations in the real marginal cost gaps of the traded sector of the home economy

$\alpha^*_{(k\text{-}1)}$ = share of traded goods values to total values of goods in foreign country *k*-1

$\omega^*_{(k\text{-}1)}$ = share of domestically-produced traded goods values to total values of traded goods in foreign country *k*-1

$\theta^*_{N(k\text{-}1)}$ = elasticity of substitution between differentiated products in the non-traded sector of foreign country *k*-1

θ^*_{T1} = elasticity of substitution between differentiated products in the traded sector of the foreign country-1

κ^*_{N1} = responsiveness of pricing decisions to variations in the real marginal cost gaps of the non-traded sector of foreign country-1

κ^*_{T1} = responsiveness of pricing decisions to variations in the real marginal cost gaps of the traded sector of foreign country-1

D. Variables, Parameters, and Data

The study employs quarterly frequency, spanning from Q3-2003 to Q2-2018. We define the non-traded sector as a sector that comprises service activities (e.g., public services, wholesale and retail trade, transport and communication, and business and financial services). The traded sector encompasses goods-producing activities (e.g., agriculture, manufacturing, mining, and quarrying). Table 1 summarizes the variables, the data, and the data sources.

We obtain the output gap data from the constant-price Gross Domestic Product (GDP) data after the rebasing, seasonal adjustment, one-sided Hodrick–Prescott (HP) filtering, and calculation processes. The quarter-on-quarter inflation data are derived from the Consumer Price Index (CPI) data after the rebasing, seasonal adjustment, and calculation processes. The nominal interest rate gap data come from the yield of 10-year government bond data after the HP filtering and calculation processes. The data processing and estimation in our study mostly follow the methods that Adjemian *et al*. (2011) and Pfeifer (2018) suggested for the DSGE model using the Dynare software.

GDP and CPI data with different base years are rebased (rescaled) to obtain a long and consistent time series. We then cleanse the time series data from the seasonal and cyclical components to allow us focusing on the long-term trends. Seasonal adjustment removes the seasonal components from the time series data, while the HP filter extracts the trend component of a time series from short-term fluctuations associated with the business cycle.

The calculated parameter values are directly calculated using the available data; the calibrated parameters are parameters whose values are obtained through trial and error to make the variables in the model converge to their steady-state values; and the estimated parameters are parameters whose values are obtained by solving the model. There are also some parameters whose values are derived from the estimated parameters.

The calculated parameters for the home economy are: (i) the relative size of the home economy to the world of 11 countries (ρ); (ii) the discount factor in the home economy (β); (iii) the share of traded goods to the total goods in the home economy (α); (iv) the share of domestically-produced traded goods to the total traded goods in the home economy (ω_0); (v) the share of imported traded goods from Foreign Country-*n* to the total imported traded goods (ω_n); (vi) the marginal

disutility of labor (Ψ); (vii) the labor input share in the non-traded sector (φ_N); and (viii) the labor input share in the traded sector (φ_T). We calculate the long-run interest rate to obtain the discount factor by following Ramayandi (2008). The income elasticity of money demand (v) parameter is set to 1 to simplify the model. The shock parameters $\mathfrak{b}_1$, $\mathfrak{b}_2$, ϱ_1, ϱ_2 are the calibrated parameters, which are obtained through trial and error. Table 2 displays the values of the calculated and calibrated parameters, while Tables 3 and 4 show the joint discount factors in the BC and MC models, respectively. In Appendix, Section B displays the formulas for the calculated variables.

The estimated parameters are: (a) the responsiveness off pricing decision by firms to variations in the real marginal cost gap in the non-traded sector (κ_N); (b) the responsiveness of pricing decision by firms to variations in the real marginal cost gap in the traded sector (κ_T); (c) the elasticity of substitution between differentiated products in the non-traded sector (θ_N); and (d) the elasticity of substitution between differentiated products in the traded sector (θ_T).

The parameters that we derive from the estimated parameters are: (1) the probability of intermediate goods producers adjusting their prices in the non-traded sector (γ_N); (2) the probability of intermediate goods producers adjusting their prices in the traded sector (γ_T); (3) the steady-state price markup in the non-traded sector (μ_N); and (4) the steady-state price markup in the traded sector (μ_T).

Table 1.
Variables, Calibrated Parameters, Data, and Data Source

This table lists all variables and parameters in the models, along with their data and data source.

Variable or Parameter	Data	Source
Non-traded sector output gap	Constant price GDP of the ASEAN-5+3 countries, broken down by economic sector	CEIC
Traded sector output gap	Constant price GDP of the ASEAN-5+3 countries, broken down by economic sector	CEIC
Non-traded sector inflation	CPI of the ASEAN-5+3 countries, broken down by economic sector	CEIC
Traded sector inflation	CPI of the ASEAN-5+3 countries, broken down by economic sector.	CEIC
Interest rate gap	Yield of the 10-Year government bonds for the ASEAN-5+3 countries.	Bloomberg
Exchange rate	Exchange rate of the ASEAN-5+3 currencies per US Dollar.	Bloomberg
Relative economic size	Nominal GDP of the ASEAN-5+3 countries.	IMF World Economic Outlook
Share of non-traded sector	Constant price GDP of the ASEAN-5+3 countries, broken down by sector.	CEIC
Share of traded sector	Constant price GDP of the ASEAN-5+3 countries, broken down by economic sector.	CEIC
Share of domestically produced traded goods	Constant price GDP of the ASEAN-5+3 countries, broken down by expenditure components.	CEIC

Table 1.
Variables, Calibrated Parameters, Data, and Data Source (Continued)

Variable or Parameter	Data	Source
Share of imported traded goods by country	Imports values of the ASEAN-5+3 countries, broken down by country. Nominal GDP, broken down by component of expenditures.	IMF Directory of Trade Statistics CEIC
Capital gap	Gross fixed capital formation from constant price GDP, broken down by component of expenditures.	CEIC
Labor input share in the economy	Labor input share in the economy of the ASEAN-5+3 countries, or labor income component of constant price GDP, broken down by income flows to factor owners.	Penn World Table (University of Groningen) CEIC
Labor supply	Average weekly working hours per worker.	ILO and country statistics offices

Table 2.
Calculated and Calibrated Parameter Values for the ASEAN-5 + 3 Countries

This table displays the values of calculated parameters (whose values are directly calculated using available data) and the calibrated parameters (whose values are obtained through trial and error to make the models converge). The calculated parameters here are ρ, β, α, ω, φ_N, and φ_T. The calibrated parameters are $\mathfrak{b}_1$, $\mathfrak{b}_2$, ϱ_1, and ϱ_2. Source: Author's calculation.

Country	ρ	β	α	ω	φ_N	φ_T	$\mathfrak{b}_1$	$\mathfrak{b}_2$	ϱ_1	ϱ_2
Indonesia	0.014	0.978	0.467	0.678	0.507	0.499	0.700	0.010	0.010	0.700
Malaysia	0.005	0.990	0.449	0.392	0.304	0.617	0.700	0.010	0.010	0.700
Singapore	0.005	0.994	0.191	0.100	0.569	0.677	0.700	0.010	0.010	0.700
Thailand	0.007	0.991	0.393	0.363	0.592	0.622	0.700	0.010	0.010	0.700
The Philippines	0.004	0.984	0.354	0.405	0.658	0.547	0.700	0.010	0.010	0.700
China	0.129	0.991	0.482	0.710	0.361	0.504	0.700	0.010	0.010	0.700
Japan	0.109	0.998	0.210	0.573	0.535	0.366	0.700	0.010	0.010	0.700
Korea	0.024	0.990	0.328	0.390	0.358	0.589	0.700	0.010	0.010	0.700

Table 3.
Joint Discount Factor ($\beta^{\blacksquare}$) Values among the ASEAN-5 + 3 Countries in BC Schemes

This table displays the values of joint discount factors for each of the ASEAN-5 + 3 countries in BC schemes. The joint discount factor is calculated as a weighted average of the discount rates of the two participating countries. The weight is based on the relative size of a country's economy to the total economic size of these two countries, where the economic size is measured by the nominal GDP. Source: Author's calculation.

$\beta^{\blacksquare}$	Indonesia	Malaysia	Singapore	Thailand	The Philippines	China	Japan	Korea
Indonesia	–	0.981	0.982	0.982	0.979	0.990	0.996	0.986
Malaysia	0.981	–	0.992	0.991	0.987	0.991	0.998	0.990
Singapore	0.982	0.992	–	0.992	0.989	0.991	0.998	0.991
Thailand	0.982	0.991	0.992	–	0.988	0.991	0.998	0.990
The Philippines	0.979	0.987	0.989	0.987	–	0.991	0.997	0.989
China	0.990	0.991	0.991	0.991	0.991	–	0.994	0.991
Japan	0.996	0.998	0.998	0.998	0.997	0.994	–	0.997
Korea	0.986	0.990	0.991	0.990	0.989	0.991	0.997	–

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Table 4.
Joint Discount Factor ($\beta^{\blacklozenge}$) Values among the ASEAN-5 + 3 Countries in MC Schemes

This table displays the values of joint discount factors for each of the ASEAN-5 + 3 countries in MC schemes. The joint discount factor is calculated as a weighted average of the discount rates of the participating countries. The weight is based on the relative size of a country's economy to the total economic size of the participating countries, where the economic size is measured by the nominal GDP. Source: Author's calculation.

	ASEAN-5	ASEAN-5 + China	ASEAN-5 + Japan	ASEAN-5 + Korea	CJK	ASEAN-5 + 3
$\beta^{\blacklozenge}$	0.985	0.990	0.995	0.987	0.994	0.993

III. RESULTS AND ANALYSIS

A. Parameter Estimation Results

In Appendix, Section C displays the parameter estimation results under the NC, BC, and MC regimes. The results show that, for all the ASEAN-5 + 3 countries and in all types of interaction regimes, intermediate goods producers' pricing decision responsiveness in the traded sector (κ_T) is higher than the responsiveness of intermediate goods producers in the non-traded sector (κ_N). This is because the market for traded intermediate goods is more competitive than the market for non-traded intermediate goods. International trade makes the traded intermediate goods market competitive, as final goods producers have options to buy products from more sellers (intermediate goods producers) while intermediate goods producers have options to sell to more buyers (final goods producers). On the contrary, the demand for non-traded intermediate goods comes entirely from domestic final goods producers (based on assumption in the models). Thus, intermediate goods producers in the traded sector are more flexible in changing prices to cope with economic shocks than intermediate goods producers in the non-traded sector are.

The parameter estimates show that the elasticity of substitution between differentiated products in the non-traded sector (θ_N) is higher than the elasticity in the traded sector (θ_T) for all the ASEAN-5 + 3 countries and in all types of interaction regimes. This finding shows that non-traded intermediate goods are easier to substitute with similar products than traded intermediate goods are. Non-traded final goods producers require less specific intermediate goods for their production process because these firms aim their production of final goods only at domestic consumers with less diverse preferences. On the contrary, final producers of traded goods need more specific intermediate goods, as they sell their products to domestic and foreign consumers with more diverse preferences. The finding also implies that, for all the ASEAN-5 + 3 countries, non-traded intermediate goods producers have a lower bargaining position against final goods producers compared with the bargaining position of intermediate goods producers in the traded sector.

The values of derived parameters γ_N and γ_T are both less than 10% for all the ASEAN-5 + 3 countries in all the interaction regimes, implying a high likelihood of intermediate goods producers in the non-traded and traded sectors changing their prices in the presence of economic shocks. γ_T is smaller than γ_N in all the ASEAN-5 + 3 countries and all the types of interaction regimes, implying that intermediate goods producers in the traded sector are more likely to change their prices than

intermediate goods producers in the non-traded sector. This finding is in line with the previous finding that intermediate goods producers in the traded sector are more responsive than intermediate goods producers in the non-traded sector. It is easier for intermediate goods producers in the traded sector to change their prices, as they have access to buyers in the domestic and foreign markets and thus have more bargaining power than buyers. Intermediate goods producers in the non-traded sector have a weaker bargaining position to change their prices as they can only sell to domestic buyers.

The values of the derived parameter μ_T are higher than those of μ_N for all the ASEAN-5 + 3 countries and in all the types of interaction regimes. This implies that the governments of the ASEAN-5 + 3 countries must provide bigger subsidies to reduce the price markup for intermediate goods producers in the traded sector than the subsidies for intermediate goods producers in the non-traded sector. Intermediate goods producers in the traded sector can set a higher price markup as they have a relatively stronger bargaining position *vis a vis* the buyers compared with intermediate goods producers in the non-traded sector.

The parameter estimates and the values of the derived parameters show that there is no clear direction of value changes when a country moves from one interaction regime to another. It implies that the unique economic structures of the interacting countries specifically determine the parameter values.

B. Robustness Tests of the Parameter Estimates

We follow Beidas-Strom and Poghosyan's (2011) criteria to check the robustness of parameter estimates in our models. The first criterion is to re-estimate the models using a different prior distribution (i.e., the truncated normal) and compare the results with the estimates in the base model (which uses the gamma prior distribution). The second criterion is to re-estimate the models using different means of the prior distribution (where we set the means 1% higher than the means in the base models) and compare the new estimates to the estimates from the base models. The third criterion is to re-estimate the models using different standard deviations of the prior distribution (where we set the standard deviations of the parameters 50% higher than those in the base models) and compare the new estimates with the estimates from the base models.

In Appendix, Section D displays the robustness tests results for parameter estimates in the ASEAN-5 +3 MC models. Robustness tests results for other policy interaction schemes are available upon request. There are no substantial differences between the new estimates and the estimates from the base models. The new estimates also show that the changes in the parameter estimates go in both directions, i.e., some of the new estimates are higher but others are lower than the estimates in the base models. These results confirm the robustness of the estimation results from the base models.

C. Assessment of Policy Coordination Feasibility

Tables 5, 6, and 7 display the welfare values for each of the ASEAN-5 + 3 countries under different policy regimes. From the assessment of policy coordination

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feasibility using the game theory framework, there are 18 BC and four MC feasible cases (Table 8). The disparities in economic size are the main issue that hinders monetary policy coordination among the ASEAN-5 + 3 countries in most schemes (Table 9). Countries with a larger share (i.e., larger economic size) must bear a greater cost in the provision of the public good (i.e., macroeconomic stability).

The two-production-factor model in our study provides more feasible schemes of policy coordination among the ASEAN-5 + 3 than the one-production-factor model for the ASEAN-5 countries that Sugandi (2018) developed. The introduction of China, Japan, and Korea allows for more favorable burden-sharing for Indonesia in the ASEAN-5 + China, ASEAN-5 + Japan, ASEAN-5 + Korea, and ASEAN + 3 MC schemes. Furthermore, the introduction of capital (through parameters φ_N and φ_T in the welfare equation system) allows the two-production-factor model to produce more feasible BC and MC schemes. From the economic point of view, by having capital as another production input besides labor, intermediate goods producers (in both the non-traded and the traded sector) become more flexible in terms of pricing decision responsiveness and more able to differentiate their products and prices. This leads to more competitive and efficient intermediate goods markets in the two-production-factor model than in the one-production-factor model.

Singapore has the highest number of feasible BC schemes. Singapore has relatively lower inflation and smaller output gaps than the other ASEAN-5 countries, hence allowing it to form BC with countries with low inflation and/or small output gaps (i.e., Malaysia, Thailand, China, Japan, and Korea). For Indonesia, the feasible schemes are BC with Singapore and the Philippines. Within the CJK Group, the China–Japan and China–Korea schemes are feasible, while the Japan–Korea scheme is not.

Table 5.
Welfare Values for the ASEAN-5 + Countries in the NC Schemes

This table displays the welfare values for each of the ASEAN-5 + 3 countries when exercising their monetary policies without coordinating each other.

	Indonesia	Malaysia	Singapore	Thailand	Philippines	China	Japan	Korea
Welfare	–0.08843	–0.09488	–0.09514	–0.09505	–0.09224	–0.09454	–0.09659	–0.09337

Table 6.
Welfare Values for the ASEAN-5 + 3 Countries in the BC Schemes

This table displays the welfare values for each of the ASEAN-5 + 3 countries when they bilaterally coordinate monetary policies.

	Indonesia	Malaysia	Singapore	Thailand	Philippines	China	Japan	Korea
Indonesia	–	–0.09059	–0.08815	–0.09078	–0.08771	–0.09061	–0.09365	–0.09001
Malaysia	–0.09059	–	–0.09332	–0.09382	–0.09244	–0.08663	–0.09271	–0.09331
Singapore	–0.08815	–0.09332	–	–0.09327	–0.09198	–0.09163	–0.09432	–0.09258
Thailand	–0.09078	–0.09382	–0.09327	–	–0.09259	–0.08960	–0.09091	–0.09323
Philippines	–0.08771	–0.09244	–0.09198	–0.09259	–	–0.08906	–0.09242	–0.09254
China	–0.09061	–0.08663	–0.09163	–0.08960	–0.08906	–	–0.09377	–0.09248
Japan	–0.09365	–0.09271	–0.09432	–0.09091	–0.09242	–0.09377	–	–0.09452
Korea	–0.09001	–0.09331	–0.09258	–0.09323	–0.09254	–0.09248	–0.09452	–

Table 7.
Welfare Values from the MC Schemes

This table displays the welfare values for each of the ASEAN-5 + 3 countries when they multilaterally coordinate monetary policies. There are six types of multilateral policy coordination schemes examined in our study. Source: Author's calculation.

	CJK	ASEAN-5	ASEAN-5 + China	ASEAN-5 + Japan	ASEAN-5 + Korea	ASEAN-5 + 3
Indonesia	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
Malaysia	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
Singapore	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
Thailand	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
Philippines	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
China	–0.11077	–	0.01288	–	–	0.81320
Japan	–0.11077	–	–	0.02596	–	0.81320
Korea	–0.11077	–	–	–	–0.01405	0.81320

Almost all the MC schemes are feasible in our study, except the ASEAN-5 MC and CJK schemes. The big difference in sizes that leads to unfavorable burden-sharing is the main reason for the unfeasibility of the ASEAN-5 and CJK schemes. For Indonesia, the cost for entering the ASEAN-5 MC scheme still exceeds the benefit, although, for other ASEAN-5 countries, this MC scheme is beneficial. Likewise, the costs for China and Japan to establish the CJK MC exceed the benefits. This finding explains why the CJK countries prefer to attach themselves to the extended ASEAN-5 policy coordination schemes.

Table 8.
Feasible Monetary Policy Coordination Schemes for the ASEAN-5 + 3 Countries

This table displays the feasible bilateral and multilateral monetary policy coordination schemes among the ASEAN-5 + 3 countries. A coordination scheme is feasible when all participating countries have higher welfare compared to when they follow the NC regime. Source: Author's calculation.

Policy Coordination Regime	Feasible Policy Coordination Schemes
Bilateral Coordination (BC)	1) Indonesia–Singapore
	2) Indonesia–Philippines
	3) Malaysia–Singapore
	4) Malaysia–Thailand
	5) Malaysia–China
	6) Malaysia–Japan
	7) Malaysia–Korea
	8) Singapore–Thailand
	9) Singapore–Philippines
	10) Singapore–China
	11) Singapore–Japan
	12) Singapore–Korea
	13) Thailand–China
	14) Thailand–Japan
	15) Thailand–Korea
	16) Philippines–China
	17) China–Japan
	18) China–Korea

Table 8.
Feasible Monetary Policy Coordination Schemes for the ASEAN-5 + 3 Countries (Continued)

Policy Coordination Regime	Feasible Policy Coordination Schemes
Multilateral Coordination (MC)	1) ASEAN-5 + China 2) ASEAN-5 + Japan 3) ASEAN-5 + Korea 4) ASEAN-5 + 3

Table 9.
Relative Economic Size (ρ) of the ASEAN-5 + 3 Countries in the Model (%)

This table display the relative economic size of each country in the world's economy represented by 11 countries. The total size of the world economy is the summation of the nominal GDP of these 11 countries. The relative size of each economy is calculated by dividing the nominal GDP of the respective country to the world's nominal GDP.

EU = European Union, US = United States, CN = China, JP = Japan, SK = Korea, AU = Australia, ID = Indonesia, TH = Thailand, MY = Malaysia, SG = Singapore, PH = the Philippines. Source: Author's calculation.

	EU	US	CN	JP	SK	AU	ID	TH	MY	SG	PH	TOTAL
ρ	35.52	32.67	12.89	10.87	2.36	2.32	1.35	0.65	0.50	0.46	0.41	100.00

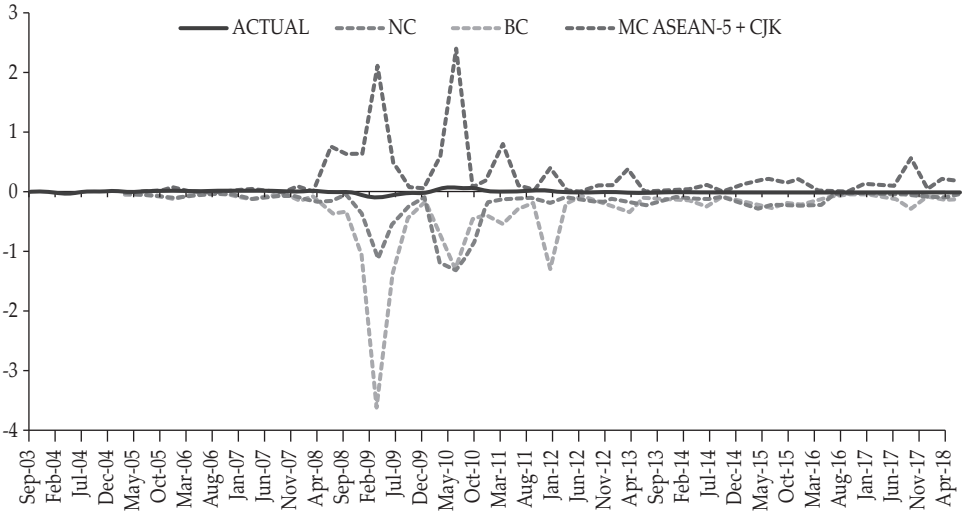
D. Counterfactual Analysis

We conduct counterfactual analysis by using data from Q3-2003 to Q2-2018 to compare the welfare produced by the optimum interest rate gaps under the NC, BC, and MC regimes to the actual welfare (i.e., welfare under the actual interest rate gaps). The counterfactual analysis here serves as a "sanity check" to examine whether the optimum welfare values produced by using the optimum interest rate gaps in the models are far different from the welfare values using the actual interest rate gaps. Figure 1 displays the comparisons between the weighted average of actual welfare values and the weighted average of computed optimum welfare values in the NC, BC, and MC schemes for the ASEAN-5 + 3 countries.

The figure shows that the optimum welfare values from the models are different, but not way off, from the welfare values calculated by using the actual interest rate gaps. The ASEAN-5 + CJK MC scheme always produces higher welfare than the actual welfare and welfare produced by the NC and BC schemes. The figure also suggests that while some of the BC schemes are feasible in the long-run (i.e., at the steady-state), they do not necessarily produce higher welfare than the actual welfare and the NC schemes in the short-run.

Figure 1.
Counterfactual Welfare Values

This figure displays the weighted average of actual welfare values and the weighted average of computed optimum welfare values in the NC, BC, and MC schemes for the ASEAN-5 + 3 countries. The weights are calculated by dividing the nominal GDP of each of the ASEAN-5 + 3 countries by the total nominal GDP of the ASEAN-5 +3 countries. Source: Author's calculation.



IV. CONCLUSIONS

The main finding from our study, that policy coordination is feasible for the ASEAN-5 + 3 countries, supports the conclusions from Branson and Healy (2005), Gupta (2012), and Tan (2016) that envisage promising prospects of international policy coordination in the ASEAN and/or East Asia. The value-added of our study compared to those previous studies is that our study identifies the feasible policy coordination schemes for the ASEAN-5 + 3 countries.

We find that there are more feasible policy coordination schemes than Sugandi (2018) had suggested. Of all the 22 feasible BC and MC schemes in this study, the ASEAN-5 + 3 MC scheme is the best feasible policy option for all the ASEAN-5 + 3 countries. Therefore, we suggest that the ASEAN-5 + 3 countries adopt the MC scheme that involves all these countries if coordinating monetary policies.

Our suggestion is in line with the multilateralism approach that the ASEAN + 3 countries have adopted. Multilateral policy coordination will help the ASEAN + 3 countries to promote regional macroeconomic stability and stabilize the regional economy in the presence of major shocks, such as those coming during the 2008 – 2009 Global Financial Crisis and the ongoing COVID-19 pandemic.

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APPENDIX

A. Equations in the Models

The following are the equations in the models used for this study. The definitions of the notations are displayed in the last part of this Appendix.

A.I. Economic Agents

A.I.I. Households

Relations among $\check{C}_t$, $\check{C}_{Tt}$, $\check{C}_{Nt}$, $\check{C}_{Ht}^{\omega}$, and $\check{C}_{Fnt}$ are described by the following equations:

$$\check{C}_t = \alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}\,\check{C}_{Tt}^{\alpha}\,\check{C}_{Nt}^{1-\alpha} \tag{A.1}$$

$$\check{C}_{Tt} = \omega_0^{-\omega_0}\,\check{C}_{Ht}^{\omega_0}\prod_{n=1}^{10}\omega_n^{-\omega_n}\,\check{C}_{Fnt}^{\omega_n} \tag{A.2}$$

$$P_t = \bar{P}_{Tt}^{\alpha}\,\bar{P}_{Nt}^{1-\alpha} \tag{A.3}$$

$$\bar{P}_{Tt} = \bar{P}_{Ht}^{\omega_0}\prod_{n=1}^{10}(e_{nt}\,\bar{P}_{Fnt}^{*})^{\omega_n} \tag{A.4}$$

where

$$\omega_0 + \sum_{n=1}^{10}\omega_n = 1$$

Representative household's optimization problems are:

(i) Utility maximization subject to budget constraints to obtain the optimum real wage equation and the Euler equation.

$$\max_{\check{C}_t,\,L_t,\,B_t,B_{nt}^{*},\,K_t,\,M_t} U_t = E_t\sum_{t=0}^{\infty}\beta^t\,[\ln C_t - \Psi L_t + v\ln(M_t/P_t)]$$

$$\equiv E_t\sum_{t=0}^{\infty}\beta^t\left[ln\left(\check{C}_t + G_t\right) - \Psi L_t + v\ln\left(\frac{M_t}{P_t}\right)\right]$$

subject to

$$(1+t_{Ct})\,P_t\,C_t + [K_t - (1-\delta)\,K_{t-1}] + B_t + \sum_{n=1}^{10}e_{nt}\,B_{nt}^{*} + M_t$$

$$= (1-t_{Lt})\,W_t\,L_t + TR_t + R_{t-1}^{kap}\,K_{t-1} + (1+R_{t-1})\,B_{t-1} + \tag{A.5}$$

(ii) Cost minimization of non-traded and traded goods consumption to obtain demand functions for non-traded and traded goods.

$$\min_{\check{C}_{Tt},\check{C}_{Nt}}(1+t_C)\,\bar{P}_{Tt}\,\check{C}_{Tt} + (1+t_C)\,\bar{P}_{Nt}\,\check{C}_{Nt}$$

subject to

$$\check{C}_t = \alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}\,\check{C}_{Tt}^{\alpha}\,\check{C}_{Nt}^{1-\alpha} \tag{A.6}$$

(iii) Cost minimization of domestically-produced and imported traded goods consumption to obtain demand functions for domestically-produced and imported traded goods.

$$\min_{\check{C}_{Ht},\check{C}_{Fnt}} (1+t_C)\ \bar{P}_{Ht}\ \check{C}_{Ht} + (1+t_C)\ \sum_{n=1}^{10} e_{nt}\ \bar{P}^*_{Fnt}\ \check{C}_{Fnt}$$

subject to

$$\check{C}_{Tt} = \omega_0^{-\omega_0}\ \check{C}_{Ht}^{\omega_0} \prod_{n=1}^{10} \omega_n^{-\omega_n}\ \check{C}_{Fnt}^{\omega_n} \tag{A.7}$$

A.II. Firms

A.II.I. Firms Producing Intermediate Goods

Production functions for firms producing intermediate goods in the non-traded and traded sectors are:

$$Y_{Nt}(i) = A_{Nt} L_{NIt}^{\varphi_N}\ K_{NIt}^{1-\varphi_N}; \qquad i \in [0,1] \tag{A.8}$$

$$Y_{Tt}(j) \equiv Y_{Ht}(j) + \sum_{n=1}^{10} Y^*_{Hnt}(j) = A_{Tt}\ L_{TIt}^{\varphi_T}\ K_{TIt}^{1-\varphi_T};\ \ j \in [0,1] \tag{A.9}$$

The log-linearized forms of productivity shocks in each sector are:

$$\hat{a}_{Nt} = \text{Þ}_1\ \hat{a}_{Nt-1} + \text{Þ}_2\ \hat{a}_{Tt-1} + \varepsilon_{Nt};\ \ \varepsilon_{Nt} \sim i.i.d.(0, \sigma^2_{Nt}) \tag{A.10}$$

$$\hat{a}_{Tt} = \varrho_1\ \hat{a}_{Nt-1} + \varrho_2\ \hat{a}_{Tt-1} + \varepsilon_{Tt};\ \ \varepsilon_{Tt} \sim i.i.d.(0, \sigma^2_{Tt}) \tag{A.11}$$

Optimization problems for the representative firm producing **non-traded** intermediate goods are:

(i) Cost minimization to derive the optimum unit cost in the non-traded sector V_{NIt} (which is the Lagrange multiplier obtained from optimization).

$$\min_{L_{NIt},K_{NIt}} W_t\ L_{NIt}(i) + R_t^{kap} K_{NIt}(i)$$

subject to

$$A_{Nt}\ L_{NIt}^{\varphi_N}(i)\ K_{NIt}^{1-\varphi_N}(i) = Y_{Nt}(i) \equiv \left(\frac{P_{Nt}(i)}{\bar{P}_{Nt}}\right)^{-\theta_N}\ Y_{Nt} \tag{A.12}$$

(ii) Profit maximization to derive the optimum pricing rules for non-traded intermediate goods.

$$\max_{P_{Nt}(i)} E_t \sum_{\gamma=t}^{\infty} \gamma_N^{\gamma-t} \left[P_{Nt}(i)\ (1+\tau_N) - V_{NI\gamma}\right] Y^d_{N\gamma}(i) \tag{A.13}$$

Optimization problems for the representative firm producing **traded** intermediate goods are:

(i) Cost minimization to derive the optimum unit cost in the traded sector V_{NIt} (which is the Lagrange multiplier obtained from optimization).

$$\min_{L_{NIt},K_{NIt}} W_t\, L_{NIt}(i) + R_t^{kap} K_{NIt}(i)$$

subject to

$$A_{Tt}\, L_{TIt}^{\varphi_T}(j)\, K_{TIt}^{1-\varphi_T}(j) = Y_{Tt}(j) \equiv \left(\frac{P_{Tt}(j)}{\bar{P}_{Tt}}\right)^{-\theta_T} Y_{Tt} \tag{A.14}$$

(ii) Profit maximization to derive the optimum pricing rules for traded intermediate goods. (Prices of intermediate goods to be sold in foreign countries are assumed to be benchmarked to domestic prices before they are converted to foreign market prices using the respective country's exchange rates).

$$\max_{P_{Ht(j)}} E_t \sum_{\gamma=t}^{\infty} \gamma_T{}^{\gamma-t} \left[P_{Ht}(j)(1+\tau_T) - V_{TI\gamma}\right] Y_{T\gamma}^{d}(j) \tag{A.15}$$

A.II.II. Firms Producing Final Goods

Aggregation of final goods in the non-traded and traded sectors are formulated as follows:

$$Y_{Nt} = \left[\int_0^1 Y_{Nt}(i)^{(\theta_N-1)/\theta_N}\, di\right]^{\theta_N/(\theta_N-1)} \tag{A.16}$$

$$Y_{Tt} = Y_{Ht} + \sum_{n=1}^{10} Y_{Fnt} \tag{A.17}$$

where

$$Y_{Ht} = \left[\int_0^1 Y_{Ht}(j)^{(\theta_T-1)/\theta_T}\, dj\right]^{\theta_T/(\theta_T-1)} \tag{A.18}$$

$$Y_{Fnt} = \left[\int_0^1 Y_{Fnt}(j)^{(\theta_T-1)/\theta_T}\, dj\right]^{\theta_T/(\theta_T-1)} \tag{A.19}$$

The representative firm producing **non-traded** final goods faces the following optimization problems:

(1) Cost minimization to derive the optimum labor unit cost in the non-traded sector V_{NCt} (which is the Lagrange multiplier obtained from optimization).

$$\min_{L_{NCt},K_{NCt}} W_t\, L_{NCt} + R_t^{kap} K_{NCt}$$

subject to

$$A_{Nt}\, L_{NCt}^{\varphi_N}\, K_{NCt}^{1-\varphi_N} = Y_{Nt} \tag{A.20}$$

(2) Profit maximization to obtain the home demand function for non-traded final goods.

$$\max_{P_{Nt}(i)} \bar{P}_{Nt} \left[\int_0^1 Y_{Nt}(i)^{\frac{(\theta_N-1)}{\theta_N}}\, di\right]^{\frac{\theta_N}{(\theta_N-1)}} - \int_0^1 P_{Nt}\,(i)\, Y_{Nt}(i)\, di - V_{NCt} \tag{A.21}$$

The representative firm producing **traded** final goods faces the following optimization problems:

(1) Cost minimization to derive the optimum labor unit cost in the traded sector V_{TCt} (which is the Lagrange multiplier obtained from optimization).

$$\min_{L_{TCt},\, K_{TCt}} W_t\, L_{Tt} + R_t^{kap} K_{TCt}$$

subject to

$$A_{Tt}\, L_{Tt}^{\varphi_T}\, K_{Tt}^{1-\varphi_T} = Y_{Tt} \tag{A.22}$$

(2) Profit maximization to obtain the home demand function for traded final goods.

$$\max_{P_{Ht}(j)} \bar{P}_{Ht} \left[\int_0^1 Y_{Tt}(j)^{(\theta_T-1)/\theta_T}\, dj\right]^{\theta_T/(\theta_T-1)} - \int_0^1 P_{Tt}(j)\, Y_{Ht}(j)\, dj - V_{TCt} \tag{A.23}$$

A.III. Government of Supranational Planner Exercising Fiscal Policy

Relations among G_t, G_{Nt}, G_{Tt}, G_{Ht}, and G_{Ft} are described by the following equations:

$$G_t = \alpha^{-\alpha}\,(1-\alpha)^{-(1-\alpha)}\, G_{Tt}^{\alpha}\, G_{Nt}^{1-\alpha} \tag{A.24}$$

$$G_{Tt} = \omega_0^{-\omega_0}\, G_{Ht}^{\omega_0} \prod_{n=1}^{10} \omega_n^{-\omega_n}\, G_{Fnt}^{\omega_n} \tag{A.25}$$

where

$$\omega_0 + \sum_{n=1}^{10} \omega_n = 1$$

The formulation of the government (supranational planner) fiscal balance at time t is:

$$\int_0^1 \left((1+t_C)\, G_t + TR_t + (1+R_{t-1})\, B_{t-1}\right) dx + \int_0^1 \tau_N\, P_{Nt}(i)\, Y_{Nt}\,(i)\; di + \int_0^1 \tau_T\, P_{Ht}(j)\, Y_{Tt}\,(j)\; dj = \int_0^1 \left(t_C\left(\check{C}_t + G_t\right) + t_L\, W_t\; L_t + B_t\right) dx \tag{A.26}$$

The government (supranational planner) faces three optimization problems:

(i) Utility maximization (prepared for households) in the steady state to obtain the optimum labor allocation in the non-traded and traded sectors.

$$\max_{L_N, L_T} U = \ln C - \Psi L + v \ln\left(\frac{M}{P}\right)$$

subject to

$$C = \alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)} Y_N^{1-\alpha} \left[\frac{Y_T^{\omega_0} \prod_{n=1}^{10}\left(Y_{Tn}^{*\,\omega_n}\right)}{\left(\omega_0 + \sum_{n=1}^{10}\omega_n\right)^{\omega_0} \prod_{n=1}^{10}\left(\left|\omega_{n0}^{*} + \sum_{k=1, n\neq k}^{10}\omega_{Fnk}^{*}\right|^{\omega_n}\right)}\right]^{\alpha}$$

$$\equiv \alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}\left(L_N^{\varphi_N} K_N^{1-\varphi_N}\right)^{1-\alpha}\left[\frac{\left(L_T^{\varphi_T} K_T^{1-\varphi_T}\right)^{1-\alpha} \prod_{n=1}^{10}\left(Y_{Tn}^{*\,\omega_n}\right)}{\left(\omega_0 + \sum_{n=1}^{10}\omega_n\right)^{\omega_0} \prod_{n=1}^{10}\left(\left|\omega_{n0}^{*} + \sum_{k=1, n\neq k}^{10}\omega_{Fnk}^{*}\right|^{\omega_n}\right)}\right]^{\alpha}$$

$$L = L_N + L_T \tag{A.27}$$

(ii) Cost minimization of government spending on non-traded and traded goods to obtain the government (supranational planner) demand functions for non-traded and traded goods at time *t*.

$$\min_{G_{Tt}, G_{Nt}} (1+t_C)\,\bar{P}_{Tt}\,G_{Tt} + (1+t_C)\,\bar{P}_{Nt}\,G_{Nt}$$

subject to

$$G_t = \alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)} G_{Tt}^{\alpha} G_{Nt}^{1-\alpha} \tag{A.28}$$

(iii) Cost minimization of domestically produced and imported traded goods consumption to obtain the government (supranational planner) demand functions for domestically produced and imported traded goods at time *t*.

$$\min_{G_{Ht}, G_{Fnt}} (1+t_C)\,\bar{P}_{Ht}\,G_{Ht} + (1+t_C)\sum_{n=1}^{10} e_{nt}\,\bar{P}_{Fnt}^{*}\,G_{Fnt}$$

subject to

$$G_{Tt} = \omega_0^{-\omega_0} G_{Ht}^{\omega_0} \prod_{n=1}^{10} \omega_n^{-\omega_n} G_{Fnt}^{\omega_n} \tag{A.29}$$

A.IV. Central Bank or Supranational Planner Exercising Monetary Policy

The welfare optimization problem for the central bank under the **NC** regime is as follows:

$$\mathbb{W}^{NC} = \min_{\pi_{Nt},\tilde{y}_{Nt,}\,\pi_{Ht},\tilde{y}_{Tt}} -\frac{1}{2}E_0\sum_{t=0}^{\infty}\beta^t\{LOSS_t + TIP + O(\|\xi\|^3)\}$$

$$\equiv \min_{\pi_{Nt},\tilde{y}_{Nt,}\,\pi_{Ht},\tilde{y}_{Tt}} -\frac{1}{2}E_0\sum_{t=0}^{\infty}\beta^t\left\{\frac{(1-\alpha)}{(1-\varphi_N)}\left[\tilde{y}_{Nt}^2+(1-\varphi_N)\frac{\theta_N}{\kappa_N}\pi_{Nt}^2\right]\right.$$

$$+\frac{\alpha\omega_0}{(1-\varphi_T)}\left[\tilde{y}_{Tt}^2+(1-\varphi_T)\frac{\theta_T}{\kappa_T}\pi_{Ht}^2\right]+(1+v)\,\alpha\sum_{n=1}^{10}\omega_n\,\tilde{y}_{Tnt}^*$$

$$\left.+\,v\,(1-\alpha)\,\tilde{y}_{Nt}+v\,\alpha\,\omega_0\,\tilde{y}_{Tt}+TIP+O(\|\xi\|^3)\right\}$$

subject to

$$\pi_{Nt} = \beta\,E_t\,\pi_{Nt+1}+\kappa_N\,\tilde{y}_{Nt}$$

$$\pi_{Ht} = \beta\,E_t\,\pi_{Ht+1}+\kappa_T\,\tilde{y}_{Tt}$$

$$\Delta\,\tilde{y}_{Nt}+\pi_{Nt}+\Delta\,\hat{a}_{Nt} = \Delta\,\tilde{y}_{Tt}+\pi_{Ht}+\Delta\,\hat{a}_{Tt}$$

$$(1-\alpha)\,\tilde{y}_{Nt}+\alpha\,\tilde{y}_{Tt} = E_t[(1-\alpha)\,\tilde{y}_{Nt+1}+\alpha\,\tilde{y}_{Tt+1}]-\{\hat{r}_t-E_t[(1-\alpha)\,\pi_{Nt+1}+\alpha\,\pi_{Ht+1}]\} \quad \text{(A.30)}$$

$$\mathbb{W}^{BC} = \min_{\pi_{Nt},\tilde{y}_{Nt,}\pi_{Ht},\tilde{y}_{Tt},\pi_{N1t}^*,\tilde{y}_{N1t}^*,\pi_{H1t}^*,y_{T1t}^*} -$$

$$\frac{1}{2}E_0\sum_{t=0}^{\infty}\left\{\begin{array}{l}\frac{(\rho_0+\rho_1)}{\rho_0}\left(\beta^{\blacksquare t}LOSS_t+TIP+O(\|\xi^3\|)\right)\\ +\frac{(\rho_0+\rho_1)}{\rho_1}\left(\beta^{\blacksquare t}\,LOSS_{1t}^*+TIP_{1t}^*+O_1^*\left(\left\|\xi_1^{*3}\right\|\right)\right)\end{array}\right\}$$

subject to

$$\pi_{Nt} = \beta^{\blacksquare}E_t\,\pi_{Nt+1}+\kappa_N\,\tilde{y}_{Nt}$$

$$\pi_{Ht} = \beta^{\blacksquare}E_t\,\pi_{Ht+1}+\kappa_T\,\tilde{y}_{Tt}$$

$$\Delta\,\tilde{y}_{Nt}+\pi_{Nt}+\Delta\,\hat{a}_{Nt} = \Delta\,\tilde{y}_{Tt}+\pi_{Ht}+\Delta\,\hat{a}_{Tt}$$

$$(1-\alpha)\,\tilde{y}_{Nt}+\alpha\,\tilde{y}_{Tt} = E_t[(1-\alpha)\,\tilde{y}_{Nt+1}+\alpha\,\tilde{y}_{Tt+1}]-\{\hat{r}_t-E_t[(1-\alpha)\,\pi_{Nt+1}+\alpha\,\pi_{Ht+1}]\}$$

$$\pi_{N1t}^* = \beta^{\blacksquare}E_t\,\pi_{N1t+1}^*+\kappa_{N1}^*\tilde{y}_{N1t}^*$$

$$\pi_{H1t}^* = \beta^{\blacksquare}E_t\,\pi_{H1t+1}^*+\kappa_{T1}^*\tilde{y}_{T1t}^*$$

$$\Delta\,\tilde{y}_{N1t}^*+\pi_{N1t}^*+\Delta\hat{a}_{N1t}^* = \Delta\,\tilde{y}_{T1t}^*+\pi_{H1t}^*+\Delta\hat{a}_{T1t}^*$$

$$(1-\alpha_1^*)\tilde{y}_{N1t}^*+\alpha\tilde{y}_{T1t}^* = E_t\,[(1-\alpha_1^*)\tilde{y}_{N1t+1}^*+\alpha_1^*\tilde{y}_{T1t+1}^*]-\{\hat{r}_{1t}^*-E_t[(1-\alpha_1^*)\pi_{N1t+1}^*+\alpha_1^*\pi_{H1t+1}^*]\} \quad \text{(A.31)}$$

where

$$\beta^{\blacksquare} = \frac{\rho_0\,\beta + \rho_1\,\beta_1^*}{(\rho_0+\rho_1)}$$

$$LOSS_t = \frac{(1-\alpha)}{(1-\varphi_N)}\left[\tilde{y}_{Nt}^2 + \frac{\theta_N}{\kappa_N}\,\pi_{Nt}^2\right] + \frac{\alpha\omega_0}{(1-\varphi_T)}\left[\tilde{y}_{Tt}^2 + \frac{\theta_T}{\kappa_T}\pi_{Ht}^2\right]$$
$$+ (1+v)\,[\alpha\omega_1\,\tilde{y}_{T1t}^* + \alpha\sum_{n=2}^{10}\omega_n\,\tilde{y}_{Tnt}^*] + v\,(1-\alpha)\,\tilde{y}_{Nt} + v\,\alpha\omega_0\,\tilde{y}_{Tt}$$

$$LOSS_{1t}^* = \frac{(1-\alpha_1^*)}{(1-\varphi_{N1}^*)}\left[\tilde{y}_{N1t}^{*\,2} + \frac{\theta_{N1}^*}{\kappa_{N1}^*}\,\pi_{N1t}^{*\,2}\right] + \frac{\alpha_1^*\,\omega_{1\cdot1}^*}{(1-\varphi_{T1}^*)}\left[\tilde{y}_{T1t}^{*\,2} + \frac{\theta_{T1}^*}{\kappa_{T1}^*}\,\pi_{H1t}^{*\,2}\right]$$
$$+ (1+v_1^*)\,[\alpha_1^*\,\omega_{1\cdot0}^*\,\tilde{y}_{Tt} + \alpha_1^*\,\sum_{n=2}^{10}\omega_{1\cdot n}^*\,\tilde{y}_{Tnt}^*] + v_1^*\,(1-\alpha_1^*)\,\tilde{y}_{N1t}^* +$$
$$v_1^*\,\alpha_1^*\omega_{1\cdot1}^*\,\tilde{y}_{T1t}^*$$

The welfare optimization problem for the supranational planner under the **BC** or **MC** regime is:

$$\mathbb{W}^{MC} = \min_{\pi_{Nt},\tilde{y}_{Nt},\pi_{Ht},\tilde{y}_{Tt},\pi_{N1t}^*,\tilde{y}_{N1t}^*,\pi_{H1t}^*,y_{T1t}^* \ldots \pi_{Nkt}^*,\tilde{y}_{Nkt}^*,\pi_{Hkt}^*,y_{Tkt}^*}$$
$$-\frac{1}{2}\,E_0\sum_{t=0}^{\infty}\beta^{\blacklozenge\,t}\left\{\begin{array}{c}\frac{(\rho_0+\rho_1+\ldots+\rho_k)}{\rho_0}\left(LOSS_t + TIP + O(\|\xi^3\|)\right)\\ +\frac{(\rho_0+\rho_1+\ldots+\rho_k)}{\rho_1}\left(\,LOSS_{1t}^* + TIP_{1t}^* + O_1^*\left(\|\xi_1^{*3}\|\right)\right)\\ +\ \ldots\\ +\frac{(\rho_0+\rho_1+\ldots+\rho_k)}{\rho_k}\left(LOSS_{kt}^* + TIP_{kt}^* + O_k^*\left(\|\xi_k^{*3}\|\right)\right)\end{array}\right\}$$

subject to

$$\pi_{Nt} = \beta^{\blacklozenge}E_t\,\pi_{Nt+1} + \kappa_N\,\tilde{y}_{Nt}$$

$$\pi_{Ht} = \beta^{\blacklozenge}E_t\,\pi_{Ht+1} + \kappa_T\,\tilde{y}_{Tt}$$

$$\Delta\,\tilde{y}_{Nt} + \pi_{Nt} + \Delta\,\hat{a}_{Nt} = \Delta\,\tilde{y}_{Tt} + \pi_{Ht} + \Delta\,\hat{a}_{Tt}$$

$$(1-\alpha)\,\tilde{y}_{Nt} + \alpha\,\tilde{y}_{Tt} = E_t[(1-\alpha)\,\tilde{y}_{Nt+1} + \alpha\,\tilde{y}_{Tt+1}] - \{\hat{r}_t - E_t[(1-\alpha)\,\pi_{Nt+1} + \alpha\,\pi_{Ht+1}]\}$$

$$\pi_{N1t}^* = \beta^{\blacklozenge}E_t\,\pi_{N1t+1}^* + \kappa_{N1}^*\tilde{y}_{N1t}^*$$

$$\pi_{H1t}^* = \beta^{\blacklozenge}E_t\,\pi_{H1t+1}^* + \kappa_{T1}^*\tilde{y}_{T1t}^*$$

$$\Delta\,\tilde{y}_{N1t}^* + \pi_{N1t}^* + \Delta\hat{a}_{N1t}^* = \Delta\,\tilde{y}_{T1t}^* + \pi_{H1t}^* + \Delta\hat{a}_{T1t}^*$$

$$(1-\alpha_1^*)\tilde{y}_{N1t}^* + \alpha_1^*\,\tilde{y}_{T1t}^* = E_t\,[(1-\alpha_1^*)\tilde{y}_{N1t+1}^* + \alpha_1^*\tilde{y}_{T1t+1}^*] -$$
$$\{\hat{r}_{1t}^* - E_t[(1-\alpha_1^*)\pi_{N1t+1}^* + \alpha_1^*\pi_{H1t+1}^*]\}$$

…

$$\pi_{Nkt}^* = \beta^{\blacklozenge}E_t\,\pi_{Nkt+1}^* + \kappa_{Nk}^*\tilde{y}_{Nkt}^*$$

$$\pi^*_{Hkt} = \beta^{\blacklozenge} E_t \pi^*_{Hkt+1} + \kappa^*_{Tk} \tilde{y}^*_{kt}$$

$$\Delta \tilde{y}^*_{Nkt} + \pi^*_{Nkt} + \Delta \hat{a}^*_{Nkt} = \Delta \tilde{y}^*_{Tkt} + \pi^*_{Hkt} + \Delta \hat{a}^*_{Tkt}$$

$$(1-\alpha^*_k)\tilde{y}^*_{Nkt} + \alpha^*_k \tilde{y}^*_{Tkt} = E_t\left[(1-\alpha^*_k)\tilde{y}^*_{Nkt+1} + \alpha^*_k \tilde{y}^*_{Tkt+1}\right] -$$

$$\{\hat{r}^*_{kt} - E_t[(1-\alpha^*_k)\pi^*_{Nkt+1} + \alpha^*_k \pi^*_{Hkt+1}]\} \quad \text{(A.32)}$$

where

k = number of participating countries – 1
(k=2 in the case of BC regime)

$$\beta^{\blacklozenge} = \frac{\rho_0\,\beta + \rho_1\,\beta^*_1 + \cdots + \rho_k\,\beta^*_k}{(\rho_0 + \rho_1 + \cdots + \rho_k)}$$

$$LOSS_t = \frac{(1-\alpha)}{(1-\varphi_N)}\left[\tilde{y}^2_{Nt} + \frac{\theta_N}{\kappa_N}\pi^2_{Nt}\right] + \frac{\alpha\omega_0}{(1-\varphi_T)}\left[\tilde{y}^2_{Tt} + \frac{\theta_T}{\kappa_T}\pi^2_{Ht}\right]$$

$$+ (1+v)\left[\alpha\omega_1\,\tilde{y}^*_{T1t} + \alpha\sum_{n=2}^{10}\omega_n\,\tilde{y}^*_{Tnt}\right] + v\,(1-\alpha)\,\tilde{y}_{Nt} + v\,\alpha\omega_0\,\tilde{y}_{Tt}$$

$$\cdots$$

$$LOSS^*_{kt} = \frac{(1-\alpha^*_k)}{(1-\varphi^*_{Nk})}\left[\tilde{y}^{*\,2}_{Nkt} + \frac{\theta^*_{Nk}}{\kappa^*_{Nk}}\pi^{*\,2}_{Nkt}\right] + \frac{\alpha^*_k\,\omega^*_{k\cdot k}}{(1-\varphi^*_{Tk})}\left[\tilde{y}^{*\,2}_{Tkt} + \frac{\theta^*_{Tk}}{\kappa^*_{Tk}}\pi^{*\,2}_{Hkt}\right]$$

$$+(1+v^*_k)\left[\alpha^*_k\,\omega^*_{k\cdot 0}\,\tilde{y}_{Tt} + \alpha^*_k\,\omega^*_{k\cdot 1}\,\tilde{y}^*_{T1t} + \cdots + \alpha^*_k\sum_{n=k-1}^{10}\omega^*_{k\cdot n}\,\tilde{y}^*_{Tnt}\right]$$

$$+v^*_k\,(1-\alpha^*_k)\,\tilde{y}^*_{Nkt} + v^*_k\,\alpha^*_k\omega^*_{k\cdot k}\,\tilde{y}^*_{Tkt}$$

A.V. Market-clearing Conditions

The market-clearing conditions are:

(1) The non-traded goods market-clearing condition for each country at time t, where each country's aggregate supply of non-traded goods equals the respective country's aggregate demand for non-traded goods:

- For the home economy

$$\bar{P}_{Nt} Y_{Nt} = (1-\alpha)\,\bar{P}_t\,(C_t + K_t)$$

- For each of the foreign countries (n = 1, 2, …, 10)

$$\bar{P}_{Nnt} Y_{Nnt} = (1-\alpha^*_n)\,\bar{P}^*_{nt}\,(C^*_{nt} + K^*_{nt}) \quad \text{(A.33)}$$

(2) The traded goods market-clearing condition at time t, where the global aggregate supply of traded goods equals the global aggregate demand for traded goods:

$$\bar{P}_{Ht}\,Y_{Tt} + \sum_{i=0}^{10}\bar{P}^*_{Fnt}\,Y^*_{Tnt} = \alpha\left[\omega_0 + \sum_{n=1}^{10}\omega_{Hn}\right]P_t\,(C_t + K_t)$$

$$+ \sum_{n=1}^{10}\left\{\alpha^*_n\left[\omega^*_{n\cdot n} + \sum_{\substack{i=0\\ n\neq i}}^{10}\omega^*_{Fn\cdot i,}\right]\bar{P}^*_{nt}(C^*_{nt} + K^*_{nt})\right\} \quad \text{(A.34)}$$

(3) The labor market-clearing condition for each economy at time *t*, where the labor supply equals the market demand from the non-traded and traded sectors:

- For the home economy

$$L_t = L_{Nt} + L_{Tt} \equiv L_{NIt} + L_{NCt} + L_{TIt} + L_{TCt}$$

- For each of the foreign countries (n = 1, 2, …, 10)

$$L^*_{nt} = L^*_{Nnt} + L^*_{Tnt} \equiv L^*_{NInt} + L^*_{NCnt} + L^*_{TInt} + L^*_{TCnt} \quad \text{(A.35)}$$

(4) The capital market-clearing condition, where the global supply of capital goods equals the global demand for capital goods:

$$K_{Ht} + \sum_{n=1}^{10} K_{Fnt} + \sum_{n=1}^{10}\left[K^*_{nt} + \sum_{\substack{i=0,\\ n\neq i}}^{10} K^*_{Fnt}\right] = K_{Nt} + K_{Tt} + \sum_{n=1}^{10}\left[K^*_{Nnt} + \sum_{\substack{i=0,\\ n\neq i}}^{10} K^*_{Tnt}\right] \quad \text{(A.36)}$$

with

$$K_{Nt} = K_{NIt} + K_{Nct}$$
$$K_{Tt} = K_{TIt} + K_{Tct}$$
$$K^*_{Nnt} = K^*_{NInt} + K^*_{NCnt}$$
$$K^*_{Tnt} = K^*_{TInt} + K^*_{TCnt}$$

(5) The international bond market-clearing condition, where there is no excess supply or excess demand of bonds in the world economy (households in the other countries will absorb an excess supply of bonds in one country, while buying bonds from other countries can meet the excess demand for bonds in one country):

$$B_t + \sum_{n=1}^{10} e_{nt}\, B^*_{nt} = 0 \quad \text{(A.37)}$$

(6) The international risk-sharing condition, where the consumption in all economies in the world determines the real effective exchange rate of each economy (Q_t):

- For the home economy

$$Q_t = \sum_{n=1}^{10}\left(\frac{\alpha}{\alpha_n}\,\frac{\omega_0}{(1-\omega^*_n)}\,\frac{C_t}{C^*_{nt}}\right)$$

- For each of the foreign countries (n = 1, 2, …, 10)

$$Q^*_{nt} = \sum_{\substack{i=0,\\ n\neq i}}^{10}\left(\frac{\alpha^*_n}{\alpha_i}\,\frac{\omega^*_{n\cdot n}}{(1-\omega^*_{n\cdot i})}\,\frac{C^*_{nt}}{C^*_{n\cdot it}}\right) \quad \text{(A.38)}$$

(7) Uncovered interest parity:

- For the home economy

$$R_t^{nat} - R_{nt}^{*\,nat} = E_t\hat{e}_{nt+1}^{nat} - \hat{e}_{nt}^{nat} + u_t \equiv E_t\hat{s}_{nt+1}^{nat} - \hat{s}_{nt}^{nat} + E_t\pi_{Ht+1} + E_t\pi_{Hnt+1}^{*} + u_t$$

- For each of the foreign countries (i, n = 1, 2, …, 10 ; i ≠n)

$$R_{nt}^{*\,nat} - R_{it}^{*\,nat} = E_t\hat{e}_{n\cdot it+1}^{*\,nat} - \hat{e}_{n\cdot it}^{*\,nat} + u_t \equiv E_t\hat{s}_{n\cdot it+1}^{*\,nat} - \hat{s}_{n\cdot it}^{*\,nat} + E_t\,\pi_{Fnt+1}^{*} + E_t\,\pi_{Fit+1}^{*} + u_t \quad \text{(A.39)}$$

A.VI. Natural Rate Equilibrium

The following are the natural rate equilibrium log-linearized equations for the home economy (the equations for foreign economies are analogous to those of the home economy). Notations in small letter with cap denotes the gap between the log-linearized value of a variable with its log-linearized long-term trend value.

- Natural rate of non-traded output ($\hat{y}_{Nt}^{nat}$)

$$\hat{y}_{Nt}^{nat} = \varphi_N\left(\hat{k}_{Nt}^{nat} - \hat{l}_{Nt}^{nat}\right) + \hat{a}_{Nt} \quad \text{(A.40)}$$

- Natural rate of traded output ($\hat{y}_{Tt}^{nat}$)

$$\hat{y}_{Tt}^{nat} = \varphi_T\left(\hat{k}_{Tt}^{nat} - \hat{l}_{Tt}^{nat}\right) + \hat{a}_{Tt} \quad \text{(A.41)}$$

- Natural rate of the terms of trade of the home economy with Foreign Country-*n* ($\hat{s}_{nt}^{nat}$)

$$\hat{s}_{nt}^{nat} = \varphi_T\left(\hat{k}_{Tt}^{nat} - \hat{l}_{Tt}^{nat}\right) - \varphi_{Tn}^{*}\left(\hat{k}_{Tnt}^{*\,nat} - \hat{l}_{Tnt}^{*\,nat}\right) + (\hat{a}_{Tt} - \hat{a}_{Tnt}^{*}) \quad \text{(A.42)}$$

- Natural rate of the aggregate domestic demand ($\hat{c}_{Nt}^{nat}$)

$$\hat{c}_t^{A\,nat} = (1-\alpha)\left[\varphi_N\left(\hat{k}_{Nt}^{nat} - \hat{l}_{Nt}^{nat}\right) + \hat{a}_{Nt}\right] + \alpha\left[\varphi_T\left(\hat{k}_{Tt}^{nat} - \hat{l}_{Tt}^{nat}\right) + \hat{a}_{Tt}\right] - \alpha\sum_{n=1}^{10}\omega_n\,\hat{s}_t^{nat} \quad \text{(A.43)}$$

- Real interest rate ($\widehat{rr}_t^{nat}$) in the flexible-price equilibrium

$$\widehat{rr}_t^{nat} = E_t\,\Delta\,\hat{c}_{t+1}^{nat} = 0 \quad \text{(A.44)}$$

- Relative price of non-traded goods in terms of traded goods ($\hat{q}_{Nt}^{nat}$)

$$\hat{q}_{Nt}^{nat} \equiv \hat{p}_{Nt}^{nat} - \hat{p}_{Tt}^{nat} = \varphi_T\left(\hat{k}_{Tt}^{nat} - \hat{l}_{Tt}^{nat}\right) - \varphi_N\left(\hat{k}_{Nt}^{nat} - \hat{l}_{Nt}^{nat}\right) + \hat{a}_{Tt} - \hat{a}_{Nt} - \alpha\sum_{n=1}^{10}\omega_n\,\hat{s}_t^{nat} \quad \text{(A.45)}$$

A.VII. Sticky Price Equilibrium

The following are the sticky price equilibrium log-linearized equations for the home economy (the equations for foreign economies are analogous to those of the home economy):

- Phillips curve in the non-traded sector

$$\pi_{Nt} = \beta E_t \pi_{Nt+1} + \kappa_N \tilde{y}_{Nt} \quad \text{(A.46)}$$

where

$$\kappa_N = \frac{(1-\beta\gamma_N)(1-\gamma_N)}{\gamma_N}$$

- Phillips curve in the traded sector

$$\pi_{Ht} = \beta E_t \pi_{Ht+1} + \kappa_T \tilde{y}_{Tt} \quad \text{(A.47)}$$

where

$$\kappa_T = \frac{(1-\beta\gamma_T)(1-\gamma_T)}{\gamma_T}$$

- Relationship between changes in output in the non-traded and traded sectors

$$\Delta \tilde{y}_{Nt} + \Delta \hat{a}_{Nt} + \pi_{Nt} = \Delta \tilde{y}_{Tt} + \Delta \hat{a}_{Tt} + \pi_{Ht} \quad \text{(A.48)}$$

- Relationship between output, inflation, and nominal interest rate

$$(1-\alpha)\tilde{y}_{Nt} + \alpha \tilde{y}_{Tt} = E_t[(1-\alpha)\tilde{y}_{Nt+1} + \alpha \tilde{y}_{Tt+1}] - \{r_t - E_t[(1-\alpha)\pi_{Nt+1} + \alpha \pi_{Ht+1}]\} \quad \text{(A.49)}$$

Table A.1.
Notations in the Models and Their Definitions

This table displays the notations used in the models and their definitions.

Notation	Definition	Notation	Definition
t	time index; t = 0, 1, ...	$\bar{P}_{Tt}$	Price index of traded goods at time t
α	share of traded goods values to total values of goods in the economy	$\bar{P}_{Ht}$	Price index of domestically produced traded goods at time t
ω_0	Share of domestically produced traded goods values to total values of traded goods in the Home economy	e_{nt}	Exchange rate of domestic currency per currency of Foreign Country-n at time t
ω_n	Share of imported traded goods values from Foreign Country-n to total values of traded goods in the home economy	$Y_{Nt}(i)$	Non-traded intermediate good i produced in the home economy at time t (seen from the supply side)
U_t	Household's utility at time t	$Y_{Tt}(j)$	Traded intermediate goods j produced in the Home economy at time t
E_t	Expectation operator for time t	$Y_{Ht}(j)$	Traded intermediate goods sold in the home economy at time t
β	Subjective discount factor	$Y^*_{Hnt}(j)$	Traded intermediate goods exported to the Foreign Country-n at time t
C_t	Household's final goods consumption at time t	A_{Nt}	Productivity shock in the non-traded sector at time t

Table A.1.
Notations in the Models and Their Definitions (Continued)

Notation	Definition	Notation	Definition
$\check{C}_t$	Self-purchased household's final good consumption at time *t*	A_{Tt}	Productivity shocks in the traded sector at time *t*
G_t	Household's consumption of government-provided final goods at time *t*	$L_{Nlt}(i)$	Labor input for the representative firm producing non-traded good *i* at time *t*
Ψ	Marginal disutility of labor	$L_{Tlt}(j)$	Labor input for the representative firm producing traded good *j* at time *t*
L_t	Labor supply (in ratio of working hours to total hours per week) at time *t*	$K_{Nlt}(i)$	Capital input for the representative firm producing non-traded good *i* at time *t*
v	Income elasticity of money demand	$K_{Tlt}(j)$	Capital input for the representative firm producing traded good *j* at time *t*
$\frac{M_t}{P_t}$	Real money demand at time *t*	φ_N	Labor input elasticity in the non-traded sector
t_L	Income tax	φ_T	Labor input elasticity in the traded sector
t_C	Consumption tax	$\hat{a}_{Nt}$	Log-linearized productivity shock in the non-traded sector at time *t*
P_t	Aggregate price level at time *t*	$\hat{a}_{Tt}$	Log-linearized productivity shock in the traded sector at time *t*
K_t	Capital (in nominal term) at time *t*	$\mathfrak{b}_1$	Shock parameter for $\hat{a}_{Nt-1}$ in $\hat{a}_{Nt}$ equation
δ	Capital rate of depreciation	$\mathfrak{b}_2$	Shock parameter for $\hat{a}_{Tt-1}$ in $\hat{a}_{Nt}$ equation
R_t^{kap}	Rent rate of capital	ϱ_1	Shock parameter for $\hat{a}_{Nt-1}$ in $\hat{a}_{Tt}$ equation
B_t	Nominal amount of government bonds held by household at time *t*	ϱ_2	Shock parameter for $\hat{a}_{Tt-1}$ in $\hat{a}_{Tt}$ equation
R_t	Nominal interest rate of bond at time *t*	ε_{Nt}	Error terms for non-traded sector at time *t*
W_t	Nominal wage at time *t*	ε_{Tt}	Error terms for the traded sector at time *t*
TR_t	Transfers from the government at time *t*	θ_N	Elasticity of substitution between differentiated products in non-traded sector
$\check{C}_{Nt}$	Self-purchased household's consumption of non-traded goods at time *t*	$P_{Nt}(i)$	Price of non-traded good *i* set by intermediate-good-producing firm at time *t*
$\check{C}_{Tt}$	Self-purchased household's consumption of traded goods at time *t* at time	$Y_{N\mathfrak{y}}(i)$	Demand for Home-produced non-traded intermediate good *i* at time ϟ (all sold in the Home economy)
$\check{C}_{Ht}$	Self-purchased household's consumption of domestically produced traded goods at time *t*	γ_N	Probability of intermediate-good-producing firms in the non-traded sector to keep price unchanged
$\check{C}_{Fnt}$	Self-purchased household's consumption of imported traded goods from Foreign Country-*n* at time *t*	τ_N	Government subsidy for firms producing non-traded intermediate goods

Table A.1.
Notations in the Models and Their Definitions (Continued)

Notation	Definition	Notation	Definition
$\bar{P}_{Nt}$	Price index of non-traded goods at time t	$V_{N\digamma}$	Unit cost of the representative firm in the non-traded sector at time ϝ (which is identical across firms)
θ_T	Elasticity of substitution between differentiated products in the traded sector	Y_T	Traded sector output (final goods) in the Home at the steady state
$P_{Tt}(j)$	Price of traded good j set by intermediate-good-producing firm at time t	Y^*_{Tn}	Traded sector output in Foreign Country-n at the steady-state; n = 1, 2, …, 10
$Y_{H\digamma}(j)$	Total demand for Home-produced traded intermediate good j at time ϝ	E_0	Expectation operator for time t = 0
$Y_{Hd\digamma}(j)$	Demand for Home-produced traded intermediate good j sold in the home economy at time ϝ	ω^*_{n0}	Share of domestically produced traded goods to total values of traded goods in Foreign Country- n; n = 1, 2, …, 10
$Y^*_{Hn\digamma}(j)$	Demand for Home-produced intermediate good j at time ϝ exported to the Foreign Country-n; n = 1, 2, …, 10	ω^*_{Fnk}	Share of imported traded goods by Foreign Country-n from Foreign Country-k to its total values of traded goods
τ_T	Government subsidy for firms producing intermediate traded goods	R_t^{nat}	Home economy's natural real interest rate at time t
$V_{T\digamma}$	Unit cost of the representative firm in the traded sector at time ϝ (which is identical across firms)	$R_{nt}^{*\,nat}$	Foreign Country-n's natural real interest rate at time t
Y_{Nt}	Aggregate demand for non-traded final goods at time t	W^{NC}	Country's welfare under the NC regime
Y_{Tt}	Aggregate demand for traded final goods in the home economy at time t	W^{BC}	Participating country's welfare under the BC regime
Y_{Hdt}	Demand for Home-produced traded final goods sold in the home economy at time t	W^{BC}	Participating country's welfare under the MC regime
Y_{Fnt}	Demand for imported traded final goods from Foreign Country-n sold in the home economy at time t; n = 1, 2, …, 10	$LOSS_t$	Loss function of the central bank (supranational planner) at time t
$Y_{Hdt}(j)$	Demand for Home-produced traded intermediate good j sold in the home economy at time t	TIP	Terms independent of policy and shocks
$Y_{Fnt}(j)$	Demand for imported traded intermediate good j from Foreign Country-n sold in the home economy at time t; n = 1, 2, …, 10	$O(\|\|\xi\|\|^3)$	Terms that are of third or higher order in an appropriate bound on the amplitude of the shocks
L_{NCt}	Labor input for representative firm producing non-traded final goods at time t	κ_N	Responsiveness of pricing decisions to variations in the real marginal cost gaps of the non-traded sector
K_{NC}	Capital input for the representative firm producing final non-traded good at time t	κ_T	Responsiveness of pricing decisions to variations in the real marginal cost gaps of the traded sector

Table A.1.
Notations in the Models and Their Definitions (Continued)

Notation	Definition	Notation	Definition
V_{Nt}	Unit cost of the representative firm in the non-traded sector at time *t* (which is identical across firms)	$\tilde{y}_{Nt}$	Output gap in the non-traded sector of the home economy at time *t*
L_{Tt}	Labor input for representative firm producing traded final goods at time *t*	$\tilde{y}_{Tt}$	Output gap in the traded sector of the home economy at time *t*
K_{Tt}	Capital input for the representative firm producing traded final goods at time *t*	π_{Nt}	Inflation in the non-traded sector of the home economy at time *t*
V_{Tt}	Unit cost of final-good-producing firm in the traded sector at time *t* (which is identical across firms)	π_{Ht}	Inflation in the traded sector of the home economy at time *t*
G_{Nt}	Government spending to provide non-traded final goods for households at time *t*	$\hat{r}_t$	Nominal interest rate gap in the home economy at time *t*
G_{Tt}	Government spending to provide traded final goods for households at time *t*	$\omega^*_{k\text{-}0}$	Share of domestically produced traded goods values to total values of traded goods in the Foreign Country-*k*
G_{Ht}	Government spending on domestically produced final goods for households at *t*	$\omega^*_{k\text{-}n}$	Share of imported traded goods from other Foreign Country-*n* to total values of traded goods in Foreign Country-*k*
G_{Fnt}	Government spending to import traded final goods from Foreign Country-*n* for households at time *t*; *n*= 1, 2, …, 10	*	All variables with * denotes variables for Foreign Countries

B. Formulas for the Calculated Parameters

- Relative economic size to the world of 11 economies

$$\rho_0 = average\left(\frac{nominal\ GDP\ of\ the\ Home\ economy}{to\ nominal\ GDP\ of\ the\ 11\ economies}\right) \text{ from Q3-2003 to Q2-2018} \quad (A.50)$$

- Parameter β

$$\beta = (1+\bar{\imath})^{-0.25} \quad (A.51)$$

where
$\bar{\imath}$ = long-run interest rate, approximated by the average yield of 10-year government bond from Q3-2003 to Q2-2018

- Parameter α

$$\alpha = average\left(\frac{nominal\ GDP\ of\ tradable\ sector}{total\ nominal\ GDP}\right) \text{ from Q3-2003 to Q2-2018} \quad (A.52)$$

- Parameter ω_0 for each country

$$\omega_0 = average\left(\frac{nominal\ GDP\ of\ traded\ sector}{nominal\ GDP\ of\ traded\ sector + nominal\ GDP\ of\ imports}\right)$$

from Q3-2003 to Q2-2018 (A.53)

- Parameter ω_n for imported goods from Foreign Country-n

$$\omega_n = average\left(\frac{imports\ values\ from\ Country-n}{total\ import\ values}\right) \text{ from Q3-2003 to Q2-2018} \quad \text{(A.54)}$$

- Parameter v

$$v = 1 \quad \text{(A.55)}$$

- Parameter Ψ

$$\Psi = \frac{(1-\varphi_N)(1-\alpha)+(1-\varphi_T)\,\alpha\omega_0}{L} \quad \text{(A.56)}$$

where

$$L = \frac{combined\ working\ hours\ per\ week\ in\ the\ nontradable\ and\ tradable\ sectors}{total\ hours\ per\ week}$$

The joint parameter β in the BC and MC regimes is calculated as a weighted average of the β values of the participating countries in the monetary policy coordination. The weights are the relative size of each economy to the total size of economies of the participating countries.

$$\beta_{BCOOP} = \frac{\rho_0}{(\rho_0+\rho_0)}\beta_0 + \frac{\rho_1}{(\rho_0+\rho_0)}\beta_1 \quad \text{(A.56)}$$

$$\beta_{BCOOP} = \frac{1}{\sum_{n=0}^{k-1}\rho_n}\sum \rho_n\ \beta_n \quad \text{(A.57)}$$

where k = the number of participating countries

C. Parameter Estimates and Derived Parameter Values

Table A.2.
Indonesia's Parameter Estimates and Derived Parameter Values

This table displays the values of estimated parameters and derived parameters for Indonesia.

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
No Coordination	8.758	34.999	11.295	10.405	9.395%	2.706%	1.097	1.106
Bilateral Coordination								
with Malaysia	8.749	34.999	11.307	10.411	9.401%	2.706%	1.097	1.106
with Singapore	8.745	34.999	11.306	10.413	9.403%	2.706%	1.097	1.106
with Thailand	8.747	34.999	11.309	10.414	9.401%	2.706%	1.097	1.106
with the Philippines	8.749	34.999	11.304	10.411	9.402%	2.706%	1.097	1.106
with China	8.746	34.999	11.296	10.407	9.396%	2.705%	1.097	1.106
with Japan	8.747	34.999	11.306	10.405	9.390%	2.705%	1.097	1.106
with Korea	8.754	34.999	11.303	10.409	9.392%	2.706%	1.097	1.106

Table A.2.
Indonesia's Parameter Estimates and Derived Parameter Values (Continued)

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
Multilateral Coordination								
in ASEAN-5	8.751	34.999	11.312	10.408	9.396%	2.706%	1.097	1.106
in ASEAN-5 + China	8.746	34.999	11.309	10.397	9.396%	2.705%	1.097	1.106
in ASEAN-5 + Japan	8.760	34.999	11.314	10.413	9.380%	2.705%	1.097	1.106
in ASEAN-5 + Korea	8.767	35.000	11.286	10.397	9.379%	2.706%	1.097	1.106
in ASEAN-5 + 3	8.755	35.000	11.296	10.409	9.385%	2.705%	1.097	1.106

Table A.3.
Malaysia's Parameter Estimates and Derived Parameter Values

This table displays the values of estimated parameters and derived parameters for Malaysia.

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
No Coordination	8.703	34.999	11.374	10.003	9.434%	2.705%	1.096	1.111
Bilateral Coordination								
with Indonesia	8.703	34.999	11.376	10.013	9.442%	2.706%	1.096	1.111
with Singapore	8.702	35.000	11.378	10.012	9.434%	2.705%	1.096	1.111
with Thailand	8.696	34.999	11.375	10.012	9.440%	2.705%	1.096	1.111
with the Philippines	8.703	34.999	11.374	10.011	9.436%	2.706%	1.096	1.111
with China	8.695	34.998	11.375	10.011	9.440%	2.705%	1.096	1.111
with Japan	8.692	34.999	11.362	10.012	9.438%	2.705%	1.097	1.111
with Korea	8.693	35.000	11.371	10.013	9.443%	2.705%	1.096	1.111
Multilateral Coordination								
in ASEAN-5	8.708	34.998	11.391	10.012	9.433%	2.706%	1.096	1.111
in ASEAN-5 + China	8.707	34.998	11.358	10.014	9.431%	2.706%	1.097	1.111
in ASEAN-5 + Japan	8.709	34.998	11.364	10.011	9.425%	2.705%	1.096	1.111
in ASEAN-5 + Korea	8.694	34.997	11.380	10.013	9.445%	2.706%	1.096	1.111
in ASEAN-5 + 3	8.683	34.998	11.387	10.010	9.450%	2.705%	1.096	1.111

Table A.4.
Singapore's Parameter Estimates and Derived Parameter Values

This table displays the values of estimated parameters and derived parameters for Singapore.

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
No Coordination	8.608	34.999	11.462	10.135	9.517%	2.705%	1.096	1.109
Bilateral Coordination								
with Indonesia	8.611	34.999	11.458	10.132	9.524%	2.706%	1.096	1.110
with Malaysia	8.623	35.000	11.461	10.142	9.505%	2.705%	1.096	1.109
with Thailand	8.605	34.999	11.456	10.136	9.522%	2.705%	1.096	1.109
with the Philippines	8.611	34.999	11.462	10.137	9.519%	2.706%	1.096	1.109
with China	8.606	35.000	11.459	10.123	9.522%	2.705%	1.096	1.110
with Japan	8.608	35.000	11.457	10.139	9.514%	2.705%	1.096	1.109
with Korea	8.611	35.000	11.459	10.140	9.517%	2.705%	1.096	1.109
Multilateral Coordination								
in ASEAN-5	8.610	35.000	11.460	10.126	9.523%	2.706%	1.096	1.110
in ASEAN-5 + China	8.601	34.998	11.453	10.127	9.527%	2.706%	1.096	1.110
in ASEAN-5 + Japan	8.605	34.998	11.468	10.136	9.519%	2.705%	1.096	1.109
in ASEAN-5 + Korea	8.599	34.999	11.468	10.111	9.531%	2.706%	1.096	1.110
in ASEAN-5 + 3	8.607	34.999	11.470	10.132	9.519%	2.705%	1.096	1.110

Table A.5.
Thailand's Parameter Estimates and Derived Parameter Values

This table displays the values of estimated parameters and derived parameters for Thailand.

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
No Coordination	8.660	34.999	11.398	10.233	9.472%	2.705%	1.096	1.108
Bilateral Coordination								
with Indonesia	8.663	34.999	11.394	10.247	9.476%	2.706%	1.096	1.108
with Malaysia	8.677	34.999	11.399	10.243	9.458%	2.705%	1.096	1.108
with Singapore	8.667	35.000	11.396	10.010	9.465%	2.705%	1.096	1.111
with the Philippines	8.656	35.000	11.406	10.235	9.479%	2.706%	1.096	1.108
with China	8.660	35.000	11.394	10.242	9.472%	2.705%	1.096	1.108
with Japan	8.661	34.999	11.408	10.246	9.466%	2.705%	1.096	1.108
with Korea	8.660	35.000	11.400	10.245	9.473%	2.705%	1.096	1.108
Multilateral Coordination								
in ASEAN-5	8.656	34.998	11.391	10.241	9.481%	2.706%	1.096	1.108
in ASEAN-5 + China	8.664	34.998	11.398	10.236	9.470%	2.706%	1.096	1.108
in ASEAN-5 + Japan	8.650	34.999	11.402	10.248	9.478%	2.705%	1.096	1.108
in ASEAN-5 + Korea	8.666	34.999	11.400	10.245	9.470%	2.706%	1.096	1.108
in ASEAN-5 + 3	8.652	35.000	11.382	10.242	9.478%	2.705%	1.096	1.108

Table A.6.
The Philippines's Parameter Estimates and Derived Parameter Values

This table displays the values of estimated parameters and derived parameters for the Philippines.

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
No Coordination	8.660	34.999	11.405	10.252	9.478%	2.706%	1.096	1.108
Bilateral Coordination								
with Indonesia	8.656	34.999	11.412	10.248	9.485%	2.706%	1.096	1.108
with Malaysia	8.654	34.999	11.409	10.257	9.481%	2.706%	1.096	1.108
with Singapore	8.652	34.999	11.409	10.248	9.481%	2.705%	1.096	1.108
with Thailand	8.653	35.000	11.398	10.259	9.482%	2.706%	1.096	1.108
with China	8.653	34.999	11.406	10.255	9.479%	2.705%	1.096	1.108
with Japan	8.648	35.000	11.399	10.248	9.478%	2.705%	1.096	1.108
with Korea	8.647	34.996	11.400	10.245	9.486%	2.706%	1.096	1.108
Multilateral Coordination								
in ASEAN-5	8.653	34.998	11.399	10.239	9.484%	2.706%	1.096	1.108
in ASEAN-5 + China	8.666	34.999	11.405	10.262	9.468%	2.705%	1.096	1.108
in ASEAN-5 + Japan	8.659	35.001	11.412	10.250	9.470%	2.705%	1.096	1.108
in ASEAN-5 + Korea	8.666	34.999	11.403	10.256	9.470%	2.706%	1.096	1.108
in ASEAN-5 + 3	8.651	35.001	11.400	10.243	9.479%	2.705%	1.096	1.108

Table A.7.
China's Parameter Estimates and Derived Parameter Values

This table displays the values of estimated parameters and derived parameters for China.

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
No Coordination	8.914	34.999	11.136	10.402	9.247%	2.705%	1.099	1.106
Bilateral Coordination								
with Indonesia	8.917	35.000	11.133	10.402	9.246%	2.705%	1.099	1.106
with Malaysia	8.916	34.999	11.141	10.405	9.246%	2.705%	1.099	1.106
with Singapore	8.914	34.999	11.142	10.402	9.248%	2.705%	1.099	1.106
with Thailand	8.915	34.999	11.139	10.409	9.247%	2.705%	1.099	1.106
with the Philippines	8.916	34.999	11.127	10.403	9.246%	2.705%	1.099	1.106
with Japan	8.913	34.999	11.135	10.401	9.246%	2.705%	1.099	1.106
with Korea	8.916	34.999	11.135	10.412	9.246%	2.705%	1.099	1.106
Multilateral Coordination								
in CJK	8.916	34.999	11.129	10.393	9.244%	2.705%	1.099	1.106
in ASEAN-5 + China	8.899	34.998	11.141	10.396	9.261%	2.706%	1.099	1.106
in ASEAN-5 + 3	8.920	34.998	11.144	10.407	9.241%	2.705%	1.099	1.106

Table A.8.
Japan's Parameter Estimates and Derived Parameter Values

This table displays the values of estimated parameters and derived parameters for Japan.

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
No Coordination	8.659	34.999	11.411	10.282	9.468%	2.705%	1.096	1.108
Bilateral Coordination								
with Indonesia	8.658	34.999	11.421	10.280	9.470%	2.705%	1.096	1.108
with Malaysia	8.656	35.000	11.417	10.289	9.471%	2.705%	1.096	1.108
with Singapore	8.656	34.999	11.415	10.282	9.470%	2.705%	1.096	1.108
with Thailand	8.652	34.999	11.419	10.291	9.474%	2.705%	1.096	1.108
with the Philippines	8.659	35.000	11.415	10.289	9.468%	2.705%	1.096	1.108
with China	8.661	34.999	11.416	10.293	9.469%	2.705%	1.096	1.108
with Korea	8.653	35.001	11.410	10.286	9.474%	2.705%	1.096	1.108
Multilateral Coordination								
in CJK	8.649	34.999	11.404	10.285	9.480%	2.705%	1.096	1.108
in ASEAN-5 + Japan	8.645	34.998	11.410	10.267	9.483%	2.705%	1.096	1.108
in ASEAN-5 + 3	8.661	34.998	11.411	10.292	9.470%	2.705%	1.096	1.108

Table A.9.
Korea's Parameter Estimates and Derived Parameter Values

This table displays the values of estimated parameters and derived parameters for Korea. Source: Author's calculation.

	Parameter Estimates				Derived Parameter Values			
	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
No Coordination	8.662	35.000	11.407	10.249	9.476%	2.706%	1.096	1.108
Bilateral Coordination								
with Indonesia	8.677	34.999	11.416	10.251	9.462%	2.706%	1.096	1.108
with Malaysia	8.669	34.999	11.411	10.251	9.465%	2.705%	1.096	1.108
with Singapore	8.667	35.000	11.409	10.249	9.467%	2.705%	1.096	1.108
with Thailand	8.675	34.999	11.407	10.245	9.459%	2.705%	1.096	1.108
with the Philippines	8.682	34.997	11.418	10.247	9.454%	2.706%	1.096	1.108
with China	8.666	34.999	11.407	10.243	9.467%	2.705%	1.096	1.108
with Japan	8.671	34.999	11.417	10.247	9.457%	2.705%	1.096	1.108
Multilateral Coordination								
in CJK	8.670	34.999	11.405	10.245	9.461%	2.705%	1.096	1.108
in ASEAN-5 + Korea	8.679	34.998	11.416	10.226	9.459%	2.706%	1.096	1.108
in ASEAN-5 + 3	8.663	35.002	11.414	10.258	9.468%	2.705%	1.096	1.108

D. Robustness Tests of Parameter Estimates in the Asean-5 + 3 Multilateral Coordination (MC) Model

Table A.10.
Parameter Estimates Using Different Prior Distributions

This table compares the parameter estimates in the ASEAN-5 + 3 MC model using different prior distributions, i.e., the gamma and the truncated normal distributions.

	Parameter Estimates Using Gamma Prior Distribution (Base Model)				Parameter Estimates Using Truncated Normal Prior Distribution			
	κ_N	κ_T	θ_N	θ_T	κ_N	κ_T	θ_N	θ_T
Indonesia	8.7551	34.9997	11.2958	10.4090	8.5263	34.9996	11.1524	10.3864
Malaysia	8.6825	34.9984	11.3871	10.0099	8.4759	35.0015	11.2310	10.0075
Singapore	8.6066	34.9990	11.4702	10.1321	8.3187	34.9985	11.2864	10.1231
Thailand	8.6521	34.9995	11.3820	10.2416	8.4085	34.9983	11.2390	10.2201
Philippines	8.6513	35.0009	11.3995	10.2430	8.4086	34.9999	11.2490	10.2448
China	8.9204	34.9984	11.1444	10.4071	8.7595	34.9995	11.0362	10.3715
Japan	8.6612	34.9977	11.4107	10.2923	8.3989	34.9986	11.2620	10.2706
Korea	8.6630	35.0017	11.4143	10.2582	8.4114	35.0002	11.2527	10.2371

Table A.11.
Parameter Estimates in the Base Model Versus Estimates Using 1% Higher Prior Mean Than the Base

This table compares the parameter estimates in the ASEAN-5 + 3 MC model using different means of the prior distribution, i.e., the means in the base model and the means in the alternative model that are 1% higher than the prior mean in the base model.

	Parameter Estimates in the Base Model				Parameter Estimates in the Re-estimated Model			
	κ_N	κ_T	θ_N	θ_T	κ_N	κ_T	θ_N	θ_T
Indonesia	8.7551	34.9997	11.2958	10.4090	8.6516	35.3509	11.3904	10.5194
Malaysia	8.6825	34.9984	11.3871	10.0099	8.5674	35.3500	11.4562	10.1124
Singapore	8.6066	34.9990	11.4702	10.1321	8.4953	35.3490	11.5556	10.2251
Thailand	8.6521	34.9995	11.3820	10.2416	8.0805	35.3473	11.4712	10.3378
Philippines	8.6513	35.0009	11.3995	10.2430	8.5439	35.3512	11.4742	10.3315
China	8.9204	34.9984	11.1444	10.4071	8.8150	35.3493	11.2335	10.5044
Japan	8.6612	34.9977	11.4107	10.2923	8.5622	35.3482	11.5103	10.3689
Korea	8.6630	35.0017	11.4143	10.2582	8.6630	35.3486	11.5098	10.3284

Table A.12.
Parameter Estimates in the Base Model Versus Estimates using 50% Higher Standard Deviation than the Base

This table compares the parameter estimates in the ASEAN-5 + 3 MC model using different standard deviations of the prior distribution, i.e., the standard deviations in the base model and the standard deviations in the alternative model that are 50% higher than the standard deviations in the base model.

	Parameter Estimates in the Base Model				Parameter Estimates in the Re-estimated Model			
	κ_N	κ_T	θ_N	θ_T	κ_N	κ_T	θ_N	θ_T
Indonesia	8.7551	34.9997	11.2958	10.4090	8.5069	34.8733	11.1648	10.3986
Malaysia	8.6825	34.9984	11.3871	10.0099	8.4775	34.9112	11.2275	10.2713
Singapore	8.6066	34.9990	11.4702	10.1321	8.3355	34.9579	11.3095	10.1350
Thailand	8.6521	34.9995	11.3820	10.2416	8.4008	34.9243	11.2337	10.2389
Philippines	8.6513	35.0009	11.3995	10.2430	8.3933	34.9104	11.2526	10.2341
China	8.9204	34.9984	11.1444	10.4071	8.7543	34.8780	11.0252	10.3804
Japan	8.6612	34.9977	11.4107	10.2923	8.3815	34.9073	11.2619	10.2827
Korea	8.6630	35.0017	11.4143	10.2582	8.4238	34.9261	11.2625	10.2438