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Is international monetary policy coordination feasible for the ASEAN-5 + 3 countries?

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ADB Working Paper Series

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

Eric Alexander Sugandi

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Abstract

This study examines the feasibility of international monetary policy coordination among the ASEAN-5 + 3 countries using the two-production-factor dynamic stochastic general equilibrium (DGSE) model. It explores three types of interaction regimes among these countries: “no coordination,” “bilateral coordination,” and “multilateral coordination.”

This study defines the benefit of international monetary policy coordination as the improvement of welfare (in terms of macroeconomic stability) for the participating countries. The cost of policy coordination is the loss of flexibility for the central banks of the participating countries to conduct monetary policy in the presence of shocks. A coordination scheme is feasible when the benefit of such coordination exceeds the cost for each of the participating countries.

This study finds 18 feasible bilateral coordination schemes (out of 28 schemes) and 4 feasible multilateral coordination schemes (out of 6 schemes) for the ASEAN-5 + 3 countries, of which the ASEAN-5 + 3 multilateral monetary policy coordination is the best feasible scheme. The outcomes of multilateral policy coordination tend to be better than those of bilateral policy coordination.

The relative size of the participating countries is a dominant factor that determines the feasibility of policy coordination. Nonetheless, it is possible to have feasible coordination when there are big differences in size among the participating countries, provided that there are other factor(s) with a significant influence on welfare in these countries, such as strong trade and direct investment linkages.

Keywords: international monetary policy coordination, open economy macroeconomics

JEL Classification: F41, F42

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1. INTRODUCTION

Economic integration is progressing rapidly in the Asia and the Pacific region, particularly in East Asia and Southeast Asia. Based on the Asian Development Bank's (ADB) Asia-Pacific Regional Cooperation and Integration Index (ARCI), Southeast Asia (ASEAN) had the highest average score of integration among the sub-regions in Asia and the Pacific during the period 2006–2017, followed by East Asia (ADB 2019). In the light of the economic integration in Asia and the Pacific, it is important to discuss the role of international policy coordination in the region as it facilitates integration by creating macroeconomic stability.

Researchers, including Corsetti and Pesenti (2001), Obstfeld and Rogoff (2002), Sutherland (2004), Berger and Wagner (2006), Liu and Pappa (2008), and Coenen et al. (2008), have constructed various theoretical models of international policy coordination. These models share the same idea: as policy action in one country creates externalities in other countries, international policy coordination aims to improve participating countries' welfare by internalizing these externalities through coordinated efforts.

There is rather scant literature on international policy coordination in Asia and the Pacific. Among this research are the studies by Branson and Healy (2005), Truman (2011), Gupta (2012), Majuca (2013), Majuca and Pagaduan (2015), Tan (2016), and Sugandi (2016, 2018). Most previous studies on international policy coordination have used the United States and the European Union (or the euro area) in two-country models, because these economies have similar sizes and characteristics, hence allowing researchers to impose symmetrical assumptions on model parameters. Symmetrical assumptions for parameters in models for the countries in Asia and the Pacific are not suitable since these countries are different sizes and have diverse economic characteristics.

This paper is based on a study that examines the feasibility of international monetary policy coordination among the ASEAN-5 + 3 countries, that is, the ASEAN-5 (Indonesia, Malaysia, Singapore, Thailand, the Philippines) and the CJK (the People's Republic of China [PRC], Japan, and the Republic of Korea). This study seeks to contribute to the literature on international policy coordination by constructing a dynamic stochastic general equilibrium (DSGE) model suitable for the ASEAN-5 + 3 countries as well as providing policy recommendations for policy makers in these countries.

It is possible to see international monetary policy coordination in the ASEAN-5 + 3 countries as a collective effort to provide an impure public good, which is the collective welfare that the participating countries can enjoy. This study defines welfare as macroeconomic stability. 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 a shock. When the benefits of coordination for a country exceed its costs, then the coordination has the "potential" to improve the respective country's welfare. However, the feasibility of such coordination also depends on the cost-benefit considerations of the "potential" partner(s). The study considers a coordination scheme to be "feasible" when all the countries in the coordination have higher welfare than when they do not coordinate policies.

This study uses the Liu and Pappa (2008) model for theoretical reference, as it is a simple but comprehensive stochastic model that incorporates both fiscal and monetary policies. It also refers to the bilateral coordination DSGE model that Sugandi (2016, 2018) developed, which modified Liu and Pappa's model by adding taxes and government spending, and adjusts the model to suit the ASEAN-5 countries. There are three main features that distinguish the model in this study from the Liu–Pappa (L-P) and Sugandi models: (1) it is a two-production-factor model, in which labor and capital are the production factors (labor is the only production factor in the L-P and Sugandi models); (2) it introduces the role of money; and (3) it introduces the one-shot game theory framework to determine the feasibility of policy coordination.

This paper proceeds in the following direction. Section 2 elaborates the model that the study uses. Section 3 describes the variables, parameters, and data in the study. Section 4 analyzes the results from the study. Section 5 concludes.

2. THE MODEL

2.1 Basic Settings

This section only discusses the home economy side, as the foreign countries mirror the structure of the home economy. 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 countries—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 European Union; (7) the United States; (8) the PRC; (9) Japan; (10) the Republic of Korea; and (11) Australia. When this study analyzes policy interactions among the ASEAN-5 countries, it treats the remaining six countries as the external environment. Likewise, when this study analyzes the CJK, the ASEAN-5 + PRC, ASEAN-5 + Japan, ASEAN-5 + the Republic of Korea, or ASEAN-5 + 3, it treats 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 countries produce and consume non-traded goods domestically. Bond markets are connected across countries, and there is international risk sharing among these countries.

This paper assumes three types of policy interactions among countries:

(i) No coordination (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 regime

There is a hypothetical supranational planner that seeks to optimize welfare in two participating countries in a 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 regime

The supranational planner seeks to optimize the welfare of the participating countries in a 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.

2.2 Economic Agents

This study assumes the existence of four economic agents in each economy: (i) households; (ii) firms; (iii) the government or supranational planner exercising fiscal policy; and (iv) the central bank or supranational planner exercising monetary policy.

2.2.1 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 holding real balance of cash ($\frac{M_t}{P_t}$) 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 (G_t). \check{C}_t comprises non-traded goods (\check{C}_{Nt}) and traded goods (\check{C}_{Tt}). \check{C}_{Tt} comprises domestically produced traded goods (\check{C}_{Ht}) and imported traded goods from foreign countries ($\sum_{n=1}^{10} \check{C}_{Fnt}$).

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 ($ent \bar{P}_{Fnt}^*$). The study defines ent as the value of domestic currency per foreign currency- n .

$$\check{C}_t = \alpha^{-\alpha} (1 - \alpha)^{-(1-\alpha)} \check{C}_{Tt}^\alpha \check{C}_{Nt}^{1-\alpha} \quad (1)$$

$$\check{C}_{Tt} = \omega_0^{-\omega_0} \check{C}_{Ht}^{\omega_0} \prod_{n=1}^{10} \omega_n^{-\omega_n} \check{C}_{Fnt}^{\omega_n} \quad (2)$$

$$P_t = \bar{P}_{Tt}^\alpha \bar{P}_{Nt}^{1-\alpha} \quad (3)$$

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

where

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

ω_0 = the share of domestically produced traded goods in the total traded goods in the home economy

ω_n = the share of imported traded goods from foreign country- n to the total imported traded goods

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

The representative household's assets in period t are in the form of capital investment ($K_t - (1 - \delta) K_{t-1}$), 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 in period $t+1$. The household's income in period t is in the form of wages (W_t), transfers from the government (TR_t), income from leasing capital in period $t-1$ ($R_{t-1}^{kap} K_{t-1}$), principal and interest payments from purchased domestic government bonds in period $t-1$ ($(1 + R_{t-1}) B_{t-1}$), and principal and interest payment from purchased foreign government bonds in period $t-1$ ($\sum_{n=1}^{10} (1 + R_{nt-1}^*) e_{nt-1} B_{nt-1}^*$). In the household's budget constraint, carried over cash money from the previous period (M_{t-1}) plus income in period t should equal to consumption and assets holding in period t .

In period t , the household supplies labor (L_t) to earn wages. It deducts a portion of the wages to pay income tax (t_L). By providing labor, the household loses part of its utility; the study measures this marginal loss as the marginal disutility of labor (Ψ). It pays consumption tax (t_C) when purchasing goods. To simplify the model, this study assumes 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.

$$\begin{aligned} \check{C}_t, L_t, B_t, B_{nt}^*, K_t, M_t \quad \max \quad U_t &= E_t \sum_{t=0}^{\infty} \beta^t \left[\ln C_t - \Psi L_t + v \ln \left(\frac{M_t}{P_t} \right) \right] \\ &\equiv E_t \sum_{t=0}^{\infty} \beta^t \left[\ln(\check{C}_t + G_t) - \Psi L_t + v \ln \left(\frac{M_t}{P_t} \right) \right] \end{aligned}$$

subject to

$$\begin{aligned} (1 + t_C) P_t C_t + [K_t - (1 - \delta) K_{t-1}] + B_t + \sum_{n=1}^{10} e_{nt} B_{nt}^* + M_t \\ = (1 - t_L) W_t L_t + TR_t + R_{t-1}^{kap} K_{t-1} + (1 + R_{t-1}) B_{t-1} + \\ \sum_{n=1}^{10} (1 + R_{nt-1}^*) e_{nt-1} B_{nt-1}^* + M_{t-1} \end{aligned} \quad (5)$$

where v is the income elasticity of money demand.

- (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

$$\check{C}_t = \alpha^{-\alpha} (1 - \alpha)^{-(1-\alpha)} \check{C}_{Tt}^{\alpha} \check{C}_{Nt}^{1-\alpha} \quad (6)$$

- (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

$$\check{C}_{Tt} = \omega_0^{-\omega_0} \check{C}_{Ht}^{\omega_0} \prod_{n=1}^{10} \omega_n^{-\omega_n} \check{C}_{Fnt}^{\omega_n} \quad (7)$$

2.2.2 Firms

There are two sectors in the economy: the non-traded sector and the traded sector. For each sector, this study differentiates 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 ($\sum_{n=1}^{10} Y_{Hnt}^*(j)$).

The study assumes that all firms use labor and capital and that the composition of labor and capital in the production technology 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.

2.2.2.1 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. The study assumes that firms producing intermediate goods are price takers in the input market but monopolistic competitors in the product market.

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

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

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

where L_{NIt} and K_{NIt} are labor and capital for non-traded intermediate good production; L_{TIt} and K_{TIt} are labor and capital for traded intermediate good production; A_{Nt} and A_{Tt} are shocks in the non-traded and traded sectors, respectively.

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

$$\hat{a}_{Nt} = \mathfrak{b}_1 \hat{a}_{Nt-1} + \mathfrak{b}_2 \hat{a}_{Tt-1} + \varepsilon_{Nt}; \quad \varepsilon_{Nt} \sim i. i. d. (0, \sigma_{Nt}^2) \quad (10)$$

$$\hat{a}_{Tt} = \mathfrak{q}_1 \hat{a}_{Nt-1} + \mathfrak{q}_2 \hat{a}_{Tt-1} + \varepsilon_{Tt}; \quad \varepsilon_{Tt} \sim i. i. d. (0, \sigma_{Tt}^2) \quad (11)$$

where

$\mathfrak{b}_1, \mathfrak{b}_2, \mathfrak{q}_1, \mathfrak{q}_2$ are shock parameters; ε_{Nt} and ε_{Tt} are error terms for non-traded and traded sector, respectively.

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 in period 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 in period 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_T) 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).

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

subject to

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

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

$$\max_{P_{Nt}(i)} E_t \sum_{s=t}^{\infty} \gamma_N^{s-t} [P_{Nt}(i) (1 + \tau_N) - V_{NIt}] Y_{Nt}^d(i) \quad (13)$$

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

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

$$\min_{L_{TIt}, K_{TIt}} W_t L_{TIt}(j) + R_t^{kap} K_{TIt}(j)$$

subject to

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

- (iv) 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).

$$\max_{P_{Ht}(j)} E_t \sum_{s=t}^{\infty} \gamma_T^{s-t} [P_{Ht}(j)(1 + \tau_T) - V_{TIt}] Y_{Tt}^d(j) \quad (15)$$

2.2.2.2 Firms Producing Final Goods

The study assumes 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.

This paper assumes the existence of an infinite number of identical firms in each sector that bundles intermediate goods with final goods according to the constant elasticity of substitution (CES) aggregation technology.

The formulation of the aggregation of final goods in the non-traded and traded sectors is as follows:

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

$$Y_{Tt} = Y_{Ht} + \sum_{n=1}^{10} Y_{Fnt} \quad (17)$$

where

$$Y_{Ht} = \left[\int_0^1 Y_{Ht}(j)^{(\theta_T-1)/\theta_T} dj \right]^{\theta_T/(\theta_T-1)} \quad (17a)$$

$$Y_{Fnt} = \left[\int_0^1 Y_{Fnt}(j)^{(\theta_T-1)/\theta_T} dj \right]^{\theta_T/(\theta_T-1)} \quad (17b)$$

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

$$A_{Nt} L_{Nct}^{\varphi_N} K_{Nct}^{1-\varphi_N} = Y_{Nt} \quad (18)$$

where L_{Nct} and K_{Nct} are labor and capital for non-traded final good production.

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

(Prices of final goods to be sold in foreign countries are assumed to be benchmarked to domestic prices before being converted to foreign market prices using the respective country's exchange rates.)

$$\max_{P_{Nt}(i)} \bar{P}_{Nt} \left[\int_0^1 Y_{Nt}(i)^{\frac{(\theta_N-1)}{\theta_N}} di \right]^{\frac{\theta_N}{(\theta_N-1)}} - \int_0^1 P_{Nt}(i) Y_{Nt}(i) di - V_{Nct} \quad (19)$$

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).

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

subject to

$$A_{Tt} L_{Tct}^{\varphi_T} K_{Tct}^{1-\varphi_T} = Y_{Tt} \quad (20)$$

where L_{Tct} and K_{Tct} are labor and capital for traded final good production.

- (2) Profit maximization to obtain the home demand function for traded final goods. (Prices of final goods to be sold in foreign countries are assumed to be benchmarked to domestic prices before being converted to foreign market prices using the respective country's exchange rates.)

$$\max_{P_{Ht}(j)} \bar{P}_{Ht} \left[\int_0^1 Y_{Tt}(j)^{(\theta_T-1)/\theta_T} dj \right]^{\theta_T/(\theta_T-1)} - \int_0^1 P_{Tt}(j) Y_{Ht}(j) dj - V_{Tct} \quad (21)$$

2.2.3 Government or Supranational Planner Exercising Fiscal Policy

The study assumes 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 time period the government (supranational planner) purchases goods for households (G_t), transfers cash to households (TR_t), pays bond principal and 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.

In period 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 following equations describe the relations among G_t , G_{Nt} , G_{Tt} , G_{Ht} , and G_{Ft} :

$$G_t = \alpha^{-\alpha} (1 - \alpha)^{-(1-\alpha)} G_{Tt}^\alpha G_{Nt}^{1-\alpha} \quad (22)$$

$$G_{Tt} = \omega_0^{-\omega_0} G_{Ht}^{\omega_0} \prod_{n=1}^{10} \omega_n^{-\omega_n} G_{Fnt}^{\omega_n} \quad (23)$$

The formulation of the government's (supranational planner's) fiscal balance at time t is:

$$\int_0^1 ((1 + t_c) G_t + TR_t + (1 + R_{t-1}) B_{t-1}) dx + \int_0^1 \tau_N P_{Nt}(i) Y_{Nt}(i) di + \int_0^1 \tau_T P_{Ht}(j) Y_{Tt}(j) dj = \int_0^1 (t_c (\check{C}_t + G_t) + t_L W_t L_t + B_t) dx \quad (24)$$

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

$$\begin{aligned}
C &= \alpha^{-\alpha} (1 - \alpha)^{-(1-\alpha)} Y_N^{1-\alpha} (Y_T^{\omega_0} \prod_{n=1}^{10} (Y_{Tn}^* \omega_n))^\alpha \\
&\equiv \alpha^{-\alpha} (1 - \alpha)^{-(1-\alpha)} (L_N^{\varphi_N} K_N^{1-\varphi_N})^{1-\alpha} (Y_T^{\omega_0} \prod_{n=1}^{10} (Y_{Tn}^* \omega_n))^\alpha \\
L &= L_N + L_T \tag{25}
\end{aligned}$$

- (ii) Cost minimization of government spending on non-traded and traded goods to obtain the government's (supranational planner's) demand functions for non-traded and traded goods at time t.

$$\begin{aligned}
&\min_{G_{Tt}, G_{Nt}} (1 + t_C) \bar{P}_{Tt} G_{Tt} + (1 + t_C) \bar{P}_{Nt} G_{Nt} \\
&\text{subject to} \\
G_t &= \alpha^{-\alpha} (1 - \alpha)^{-(1-\alpha)} G_{Tt}^\alpha G_{Nt}^{1-\alpha} \tag{26}
\end{aligned}$$

- (iii) Cost minimization of domestically produced and imported traded goods consumption to obtain the government's (supranational planner's) demand functions for domestically produced and imported traded goods at time t.

$$\begin{aligned}
&\min_{G_{Ht}, G_{Fnt}} (1 + t_C) \bar{P}_{Ht} G_{Ht} + (1 + t_C) \sum_{n=1}^{10} e_{nt} \bar{P}_{Fnt}^* G_{Fnt} \\
&\text{subject to} \\
G_{Tt} &= \omega_0^{-\omega_0} G_{Ht}^{\omega_0} \prod_{n=1}^{10} \omega_n^{-\omega_n} G_{Fnt}^{\omega_n} \tag{27}
\end{aligned}$$

2.2.4. Central Bank or Supranational Planner Exercising Monetary Policy

The study assumes 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}_N and \tilde{y}_T) and inflation in the two sectors (π_N and π_H) 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). The nominal interest rate gap (\hat{r}), 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 “no coordination” regime, the central bank optimizes the welfare of the home economy. Under the “bilateral coordination” or the “multilateral coordination” regime, the supranational planner seeks to optimize the “welfare contribution” of each participating country based on their relative economic size as part of “collective welfare.” The definition of collective welfare here is bilateral or regional macroeconomic stability, which is an impure public good that has non-rivalry and partially excludable characteristics.

The formulation of the objective function for the central bank or supranational planner is in linear quadratic form. This study uses the linear quadratic solution technique that Diaz-Gimenez (2004) developed. The welfare optimization problem for the central bank under the “no coordination” regime is as follows:

$$\begin{aligned} \mathbb{W}^{NC} &= \min_{\pi_{Nt}, \tilde{y}_{Nt}, \pi_{Ht}, \tilde{y}_{Tt}} -\frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t \{LOSS_t + TIP + O(\|\xi\|^3)\} \\ &\equiv \min_{\pi_{Nt}, \tilde{y}_{Nt}, \pi_{Ht}, \tilde{y}_{Tt}} -\frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \begin{aligned} &\frac{(1-\alpha)}{(1-\varphi_N)} \left[\tilde{y}_{Nt}^2 + (1-\varphi_N) \frac{\theta_N}{\kappa_N} \pi_{Nt}^2 \right] + \frac{\alpha\omega_0}{(1-\varphi_T)} \left[\tilde{y}_{Tt}^2 + (1-\varphi_T) \frac{\theta_T}{\kappa_T} \pi_{Ht}^2 \right] \\ &+ (1+\nu) \alpha \sum_{n=1}^{10} \omega_n \tilde{y}_{Tnt}^* + \nu (1-\alpha) \tilde{y}_{Nt} + \nu \alpha \omega_0 \tilde{y}_{Tt} \\ &+ TIP + O(\|\xi\|^3) \end{aligned} \right\} \end{aligned}$$

subject to

$$\begin{aligned} \pi_{Nt} &= \beta E_t \pi_{Nt+1} + \kappa_N \tilde{y}_{Nt} \\ \pi_{Ht} &= \beta E_t \pi_{Ht+1} + \kappa_T \tilde{y}_{Tt} \\ \Delta \tilde{y}_{Nt} + \pi_{Nt} + \Delta \hat{a}_{Nt} &= \Delta \tilde{y}_{Tt} + \pi_{Ht} + \Delta \hat{a}_{Tt} \\ (1-\alpha) \tilde{y}_{Nt} + \alpha \tilde{y}_{Tt} &= E_t [(1-\alpha) \tilde{y}_{Nt+1} + \alpha \tilde{y}_{Tt+1}] - \\ &\{\hat{r}_t - E_t [(1-\alpha) \pi_{Nt+1} + \alpha \pi_{Ht+1}]\} \end{aligned} \quad (28)$$

where

TIP = terms independent of policy and shocks

$O(\|\xi\|^3)$ = terms that are of third or higher order in an appropriate bound on the amplitude of the shocks

The formulation of the welfare optimization problem for the supranational planner under the “bilateral coordination” regime is:

$$\begin{aligned} \mathbb{W}^{BC} &= \min_{\pi_{Nt}, \tilde{y}_{Nt}, \pi_{Ht}, \tilde{y}_{Tt}, \pi_{N1t}^*, \tilde{y}_{N1t}^*, \pi_{H1t}^*, \tilde{y}_{T1t}^*} - \\ &\frac{1}{2} E_0 \sum_{t=0}^{\infty} \left\{ \begin{aligned} &\frac{(\rho_0 + \rho_1)}{\rho_0} \left(\beta^{\blacksquare t} LOSS_t + TIP + O(\|\xi^3\|) \right) \\ &+ \frac{(\rho_0 + \rho_1)}{\rho_1} \left(\beta^{\blacksquare t} LOSS_{1t}^* + TIP_{1t}^* + O_1(\|\xi_1^3\|) \right) \end{aligned} \right\} \end{aligned}$$

subject to

$$\begin{aligned} \pi_{Nt} &= \beta^{\blacksquare} E_t \pi_{Nt+1} + \kappa_N \tilde{y}_{Nt} \\ \pi_{Ht} &= \beta^{\blacksquare} E_t \pi_{Ht+1} + \kappa_T \tilde{y}_{Tt} \\ \Delta \tilde{y}_{Nt} + \pi_{Nt} + \Delta \hat{a}_{Nt} &= \Delta \tilde{y}_{Tt} + \pi_{Ht} + \Delta \hat{a}_{Tt} \\ (1-\alpha) \tilde{y}_{Nt} + \alpha \tilde{y}_{Tt} &= E_t [(1-\alpha) \tilde{y}_{Nt+1} + \alpha \tilde{y}_{Tt+1}] - \{\hat{r}_t - E_t [(1-\alpha) \pi_{Nt+1} + \\ &\alpha \pi_{Ht+1}]\} \\ \pi_{N1t}^* &= \beta^{\blacksquare} E_t \pi_{N1t+1}^* + \kappa_{N1}^* \tilde{y}_{N1t}^* \\ \pi_{H1t}^* &= \beta^{\blacksquare} E_t \pi_{H1t+1}^* + \kappa_{T1}^* \tilde{y}_{T1t}^* \\ \Delta \tilde{y}_{N1t}^* + \pi_{N1t}^* + \Delta \hat{a}_{N1t}^* &= \Delta \tilde{y}_{T1t}^* + \pi_{H1t}^* + \Delta \hat{a}_{T1t}^* \\ (1-\alpha_1^*) \tilde{y}_{N1t}^* + \alpha \tilde{y}_{T1t}^* &= E_t [(1-\alpha_1^*) \tilde{y}_{N1t+1}^* + \alpha_1^* \tilde{y}_{T1t+1}^*] - \\ \{\hat{r}_{1t}^* - E_t [(1-\alpha_1^*) \pi_{N1t+1}^* + \alpha_1^* \pi_{H1t+1}^*]\} \end{aligned} \quad (29)$$

where

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

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

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

$$LOSS_{1t}^* = \frac{(1-\alpha_1^*)}{(1-\varphi_{N1}^*)} \left[\tilde{y}_{N1t}^{*2} + \frac{\theta_{N1}^*}{\kappa_{N1}^*} \pi_{N1t}^{*2} \right] + \frac{\alpha_1^* \omega_{1.1}^*}{(1-\varphi_{T1}^*)} \left[\tilde{y}_{T1t}^{*2} + \frac{\theta_{T1}^*}{\kappa_{T1}^*} \pi_{H1t}^{*2} \right]$$

$$+ (1+v_1^*) [\alpha_1^* \omega_{1.0}^* \tilde{y}_{Tt} + \alpha_1^* \sum_{n=2}^{10} \omega_{1.n}^* \tilde{y}_{Tnt}^*] + v_1^* (1-\alpha_1^*) \tilde{y}_{N1t}^* + v_1^* \alpha_1^* \omega_{1.1}^* \tilde{y}_{T1t}^*$$

TIP = terms independent of policy and shocks for the home economy

$O(\|\xi\|^3)$ = terms that are of third or higher order in an appropriate bound on the amplitude of the shocks for the home economy

TIP_{1t}^* = terms independent of policy and shocks for the foreign country

$O_1^*(\|\xi_1^{*3}\|)$ = terms that are of third or higher order in an appropriate bound on the amplitude of the shocks for the foreign country

The welfare optimization problem for the supranational planner under the “multilateral coordination” regime is:

$$\mathbb{W}^{MC} = \min_{\pi_{Nt}, \tilde{y}_{Nt}, \pi_{Ht}, \tilde{y}_{Tt}, \pi_{N1t}^*, \tilde{y}_{N1t}^*, \pi_{H1t}^*, \tilde{y}_{T1t}^* \dots \pi_{Nkt}^*, \tilde{y}_{Nkt}^*, \pi_{Hkt}^*, \tilde{y}_{Tkt}^*}$$

$$-\frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^{\diamond t} \left\{ \begin{aligned} & \frac{(\rho_0 + \rho_1 + \dots + \rho_k)}{\rho_0} (LOSS_t + TIP + O(\|\xi^3\|)) \\ & + \frac{(\rho_0 + \rho_1 + \dots + \rho_k)}{\rho_1} (LOSS_{1t}^* + TIP_{1t}^* + O_1^*(\|\xi_1^{*3}\|)) \\ & + \dots \\ & + \frac{(\rho_0 + \rho_1 + \dots + \rho_k)}{\rho_k} (LOSS_{kt}^* + TIP_{kt}^* + O_k^*(\|\xi_k^{*3}\|)) \end{aligned} \right\}$$

subject to

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

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

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

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

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

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

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

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

...

$$\begin{aligned}
\pi_{Nkt}^* &= \beta^\diamond E_t \pi_{Nkt+1}^* + \kappa_{Nk}^* \tilde{y}_{Nkt}^* \\
\pi_{Hkt}^* &= \beta^\diamond E_t \pi_{Hkt+1}^* + \kappa_{Tk}^* \tilde{y}_{kt}^* \\
\Delta \tilde{y}_{Nkt}^* + \pi_{Nkt}^* + \Delta \hat{a}_{Nkt}^* &= \Delta \tilde{y}_{Tkt}^* + \pi_{Hkt}^* + \Delta \hat{a}_{Tkt}^* \\
(1 - \alpha_k^*) \tilde{y}_{Nkt}^* + \alpha_k^* \tilde{y}_{Tkt}^* &= E_t [(1 - \alpha_k^*) \tilde{y}_{Nkt+1}^* + \alpha_k^* \tilde{y}_{Tkt+1}^*] - \\
\{\hat{r}_{kt}^* - E_t [(1 - \alpha_k^*) \pi_{Nkt+1}^* + \alpha_k^* \pi_{Hkt+1}^*]\} &
\end{aligned} \tag{30}$$

where

k = number of participating countries - 1

$$\beta^\diamond = \frac{\rho_0 \beta + \rho_1 \beta_1^* + \dots + \rho_k \beta_k^*}{(\rho_0 + \rho_1 + \dots + \rho_k)}$$

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

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

$$LOSS_{1t}^* = \frac{(1-\alpha_1^*)}{(1-\varphi_{N1}^*)} \left[\tilde{y}_{N1t}^{*2} + \frac{\theta_{N1}^*}{\kappa_{N1}^*} \pi_{N1t}^{*2} \right] + \frac{\alpha_1^* \omega_{1.1}^*}{(1-\varphi_{T1}^*)} \left[\tilde{y}_{T1t}^{*2} + \frac{\theta_{T1}^*}{\kappa_{T1}^*} \pi_{H1t}^{*2} \right]$$

$$+ (1+v_1^*) [\alpha_1^* \omega_{1.0}^* \tilde{y}_{Tt} + \alpha_1^* \sum_{n=2}^{10} \omega_{1.n}^* \tilde{y}_{Tnt}^*] + v_1^* (1-\alpha_1^*) \tilde{y}_{N1t}^* + v_1^* \alpha_1^* \omega_{1.1}^* \tilde{y}_{T1t}^*$$

...

$$LOSS_{kt}^* = \frac{(1-\alpha_k^*)}{(1-\varphi_{Nk}^*)} \left[\tilde{y}_{Nkt}^{*2} + \frac{\theta_{Nk}^*}{\kappa_{Nk}^*} \pi_{Nkt}^{*2} \right] + \frac{\alpha_k^* \omega_{k.k}^*}{(1-\varphi_{Tk}^*)} \left[\tilde{y}_{Tkt}^{*2} + \frac{\theta_{Tk}^*}{\kappa_{Tk}^*} \pi_{Hkt}^{*2} \right]$$

$$+ (1+v_k^*) [\alpha_k^* \omega_{k.0}^* \tilde{y}_{Tt} + \alpha_k^* \omega_{k.1}^* \tilde{y}_{T1t}^* + \dots + \alpha_k^* \sum_{n=k-1}^{10} \omega_{k.n}^* \tilde{y}_{Tnt}^*]$$

$$+ v_k^* (1-\alpha_k^*) \tilde{y}_{Nkt}^* + v_k^* \alpha_k^* \omega_{k.k}^* \tilde{y}_{Tkt}^*$$

TIP = terms independent of policy and shocks for the home economy

$O(\|\xi\|^3)$ = terms that are of third or higher order in an appropriate bound on the amplitude of the shocks for the home economy

TIP_{1t}^* = terms independent of policy and shocks for foreign country-1

$O_1^*(\|\xi_1^*\|^3)$ = terms that are of third or higher order in an appropriate bound on the amplitude of the shocks for foreign country-1

TIP_{kt}^* = terms independent of policy and shocks for foreign country-k

$O_k^*(\|\xi_k^*\|^3)$ = terms that are of third or higher order in an appropriate bound on the amplitude of the shocks for foreign country-k

2.3 Aggregations of Optimum Solutions, Market Clearing Conditions, and Equilibria

2.3.1 Aggregations of Optimum Solutions

Solving the optimization problems for households, firms, and the government (supranational planner) can obtain the following aggregations of the optimum solutions for the home economy (the aggregate solutions for foreign economies are analogous to those of the home economy):

- Terms of trade of the home economy with respect to foreign country- n in period t (S_{nt})

$$S_{nt} = \frac{Y_{Tt}}{Y_{Tn}^*} \quad (31)$$

- Real aggregate demand for goods in the non-traded sector in period t (Y_{Nt})

$$Y_{Nt} = (1 - \alpha) (C_t + K_t) Q_{Nt}^{-\alpha} \quad (32)$$

- Real aggregate demand for goods in the traded sector in period t (Y_{Tt})

$$Y_{Tt} = \alpha (C_t + K_t) Q_{Nt}^{1-\alpha} \prod_{n=1}^{10} S_{nt}^{\omega_n} \quad (33)$$

- Aggregate domestic demand in period t (C_t^A)

$$C_t^A \equiv (C_t + K_t) = \alpha^{-\alpha} (1 - \alpha)^{\alpha-1} Y_{Nt}^{1-\alpha} (Y_T^{\omega_0} \prod_{n=1}^{10} (Y_{Tn}^* \omega_n))^{\alpha} \quad (34)$$

Aggregate demand for labor in the non-traded sector in period t (L_{Nt})

$$K_{Nt} L_{Nt} = \frac{1}{A_{Nt}} \int_0^1 Y_{Nt}(i) di = \frac{\hat{\Delta}_{Nt}}{A_{Nt}} Y_{Nt} \quad (35)$$

where $\hat{\Delta}_{Nt} = \int_0^1 \left(\frac{P_{Nt}(i)}{\bar{P}_N} \right)^{-\theta_N} di$ measures price dispersion within the non-traded sector

- Aggregate demand for labor in the traded sector in period t (L_{Tt})

$$K_{Tt} L_{Tt} = \frac{1}{A_{Tt}} \int_0^1 (Y_{Ht}(j) + Y_{Ht}^*(j)) dj = \frac{\hat{\Delta}_{Ht}}{A_{Tt}} Y_{Tt} \quad (36)$$

where $\hat{\Delta}_{Ht} = \int_0^1 \left(\frac{P_{Ht}(j)}{\bar{P}_H} \right)^{-\theta_H} dj$ measures price dispersion within the traded sector

2.3.2 Market Clearing Conditions

The market clearing conditions are:

- (1) The non-traded goods market clearing condition for each country in period 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 ($n = 1, 2, \dots, 10$)

$$\bar{P}_{Nnt} Y_{Nnt} = (1 - \alpha_n^*) \bar{P}_{nt}^* (C_{nt}^* + K_{nt}^*) \quad (37)$$

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

$$\bar{P}_{Ht} Y_{Tt} + \sum_{i=0}^{10} \bar{P}_{Fnt}^* Y_{Tnt}^* = \alpha P_t (C_t + K_t) + \sum_{n=1}^{10} \{\alpha_n^* \bar{P}_{nt}^* (C_{nt}^* + K_{nt}^*)\} \quad (38)$$

(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 ($n = 1, 2, \dots, 10$)

$$L_{nt}^* = L_{Nnt}^* + L_{Tnt}^* \equiv L_{NInt}^* + L_{NCnt}^* + L_{TInt}^* + L_{TCnt}^* \quad (39)$$

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

$$K_{Ht} + \sum_{n=1}^{10} K_{Fnt} + \sum_{n=1}^{10} \left[K_{nt}^* + \sum_{\substack{i=0, \\ n \neq i}}^{10} K_{Fnt}^* \right] = K_{Nt} + K_{Tt} + \sum_{n=1}^{10} \left[K_{Nnt}^* + \sum_{\substack{i=0, \\ n \neq i}}^{10} K_{Tnt}^* \right] \quad (40)$$

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):

$$B_t + \sum_{n=1}^{10} e_{nt} B_{nt}^* = 0 \quad (41)$$

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

- 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 ($n = 1, 2, \dots, 10$)

$$Q_{nt}^* = \sum_{\substack{i=0, \\ n \neq i}}^{10} \left(\frac{\alpha_n^*}{\alpha_i} \frac{\omega_{n,n}^*}{(1-\omega_{n,i}^*)} \frac{C_{nt}^*}{C_{n,it}^*} \right) \quad (42)$$

(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 ($n = 1, 2, \dots, 10$)

$$\begin{aligned} R_{nt}^{* nat} - R_{it}^{* nat} &= E_t \hat{e}_{n,it+1}^{* nat} - \hat{e}_{n,it}^{* nat} + u_t \\ &\equiv E_t \hat{s}_{n,it+1}^{* nat} - \hat{s}_{n,it}^{* nat} + E_t \pi_{Fnt+1}^* + E_t \pi_{Fit+1}^* + u_t \end{aligned} \quad (43)$$

where u_t is a global exchange rate shock felt by all countries.

2.3.3 Natural Rate Equilibrium

The study derives the following natural rate equilibrium log-linearized equations for the home economy from the aggregated optimum solutions and the market clearing conditions (the equations for foreign economies are analogous to those of the home economy):

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

$$\hat{y}_{Nt}^{nat} = \varphi_N (\hat{k}_{Nt}^{nat} - \hat{l}_{Nt}^{nat}) + \hat{a}_{Nt} \quad (44)$$

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

$$\hat{y}_{Tt}^{nat} = \varphi_T (\hat{k}_{Tt}^{nat} - \hat{l}_{Tt}^{nat}) + \hat{a}_{Tt} \quad (45)$$

- Natural rate of the terms of trade of the home economy with foreign country- n (\hat{s}_{nt}^{nat})

$$\hat{s}_{nt}^{nat} = \varphi_T (\hat{k}_{Tt}^{nat} - \hat{l}_{Tt}^{nat}) - \varphi_{Tn}^* (\hat{k}_{Tnt}^{* nat} - \hat{l}_{Tnt}^{* nat}) + (\hat{a}_{Tt} - \hat{a}_{Tnt}^*) \quad (46)$$

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

$$\begin{aligned} \hat{c}_t^{A nat} &= (1 - \alpha) [\varphi_N (\hat{k}_{Nt}^{nat} - \hat{l}_{Nt}^{nat}) + \hat{a}_{Nt}] + \alpha [\varphi_T (\hat{k}_{Tt}^{nat} - \hat{l}_{Tt}^{nat}) + \hat{a}_{Tt}] - \\ &\alpha \sum_{n=1}^{10} \omega_n \hat{s}_t^{nat} \end{aligned} \quad (47)$$

- Real interest rate (\hat{r}_t^{nat}) in the flexible-price equilibrium

$$\hat{r}_t^{nat} = E_t \Delta \hat{c}_{t+1}^{nat} = 0 \quad (48)$$

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

$$\begin{aligned} \hat{q}_{Nt}^{nat} &\equiv \hat{p}_{Nt}^{nat} - \hat{p}_{Tt}^{nat} = \varphi_T (\hat{k}_{Tt}^{nat} - \hat{l}_{Tt}^{nat}) - \varphi_N (\hat{k}_{Nt}^{nat} - \hat{l}_{Nt}^{nat}) + \hat{a}_{Tt} - \hat{a}_{Nt} - \\ &\alpha \sum_{n=1}^{10} \omega_n \hat{s}_t^{nat} \end{aligned} \quad (49)$$

2.3.4 Sticky Price Equilibrium

The study derives the following sticky price equilibrium log-linearized equations for the home economy from the aggregated optimum solutions, the market clearing conditions, and the gaps of output gaps, inflation, and interest rate variables from their natural rate

equilibrium values (the equations for foreign economies are analogous to those of the home economy):

- Phillips curve in the non-traded sector

$$\pi_{Nt} = \beta E_t \pi_{Nt+1} + \kappa_N \tilde{y}_{Nt} \quad (50)$$

where

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

is a constant that measures the responsiveness of pricing decisions to the variations in the real marginal cost gap in the non-traded sector

- Phillips curve in the traded sector

$$\pi_{Ht} = \beta E_t \pi_{Ht+1} + \kappa_T \tilde{y}_{Tt} \quad (51)$$

where

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

is a constant that measures the responsiveness of pricing decisions to the variations in the real marginal cost gap in the traded sector

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

$$\Delta \tilde{y}_{Nt} + \Delta \hat{a}_{Nt} + \pi_{Nt} = \Delta \tilde{y}_{Tt} + \Delta \hat{a}_{Tt} + \pi_{Ht} \quad (52)$$

- Relationship between output, inflation, and nominal interest rate

$$(1-\alpha) \tilde{y}_{Nt} + \alpha \tilde{y}_{Tt} = E_t [(1-\alpha) \tilde{y}_{Nt+1} + \alpha \tilde{y}_{Tt+1}] - \{r_t - E_t [(1-\alpha) \pi_{Nt+1} + \alpha \pi_{Ht+1}]\} \quad (53)$$

3. VARIABLES, PARAMETERS, AND DATA

The models that this study develops use five main variables: (1) non-traded sector inflation; (2) traded sector inflation; (3) non-traded sector output gap; (4) traded sector output gap; and (5) nominal interest rate gap. The study defines 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), while the traded sector comprises goods-producing activities (e.g. agriculture, manufacturing, mining, and quarrying).

This study obtained 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. It obtained quarter-on-quarter inflation data 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 this study mostly follows 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 need rebasing (rescaling) to obtain a long and consistent time series. This study follows the GDP base year rescaling method that the World Bank uses. For example, it rebases Indonesia's GDP data using the 2000 base year to the 2010 base year by first creating an index dividing each year of the base year 2000 series by its 2010 value and then multiplying each year's index result by the corresponding 2010 value. This study uses the same rebasing method for the CPI. After rebasing, it is necessary to cleanse the time series data from the seasonal and cyclical components to allow the study to focus 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 parameters in this paper are parameters whose values are directly calculated using the available data, 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 estimated parameters are parameters whose values are obtained by solving the model. 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 in the total goods in the home economy (α); (iv) the share of domestically produced traded goods in 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). The study calculated the long-run interest rate to obtain the discount factor following Ramayandi (2008). The income elasticity of money demand (v) parameter is set to 1 to simplify the model. The shock parameters $b_1, b_2, \varrho_1, \varrho_2$ are the calibrated parameters. Appendix 1 displays the values of the calculated and calibrated parameters in the model.

The estimated parameters are: (a) the responsiveness of the pricing decision to variations in the real marginal cost gap in the non-traded sector (κ_N); (b) the responsiveness of the pricing decision 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 the study derived from the calibrated and 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).

4. RESULTS AND ANALYSIS

Appendix 2 presents the parameter estimation results. 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. 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 for similar products to substitute than traded intermediate goods are. Non-traded final goods producers require less specific intermediate goods for their production 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 in 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 derived parameter μ_T are higher than 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 in relation to 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. These findings imply that the economic structures of the interacting countries specifically determine the parameter values.

Table 1 displays the parameter estimates and the values of derived parameters for the ASEAN-5 + 3 countries under the no coordination regime. Among the ASEAN-5 + 3 countries, the PRC has the highest κ_N , the lowest θ_N , the lowest γ_N , and the highest μ_N . These findings imply that intermediate goods producers in the PRC's non-traded sector are more responsive to economic shocks and more likely to change the prices of their outputs than their counterparts in other ASEAN-5 + 3 countries. As the elasticity of substitution between differentiated non-traded intermediate goods is relatively low, intermediate goods producers in the PRC's non-traded sector have a higher bargaining position than final goods producers compared with the bargaining of their counterparts in other ASEAN-5 + 3 countries. Compared with the government of other ASEAN-5 + 3 countries, the PRC government needs to provide more subsidies to minimize the price markup in the non-traded sector.

Under the no coordination regime, the values of the κ_T regime in general are the same for the ASEAN-5 + 3 countries, implying that international trade has created "common" price responsiveness behavior among intermediate goods producers when responding to economic shocks. The value of γ_T is generally the same across the ASEAN-5 + 3 countries, also indicating that international trade has created "common" pricing decision behavior among these countries.

Malaysia has the lowest value of θ_T among the ASEAN-5 + 3 countries, meaning that the elasticity of substitution between traded intermediate goods in Malaysia is lower than that in the other ASEAN-5 + 3 countries. It implies that intermediate goods producers in Malaysia have higher bargaining power against final goods producers than traded intermediate goods producers in the other ASEAN-5 + 3 countries have. In line with the finding on θ_T , this result shows that the Malaysian government needs to provide larger subsidies for traded intermediate goods producers (μ_T) than the governments of other ASEAN-5 + 3 countries need to provide. With a relatively stronger bargaining position against buyers than the bargaining positions of intermediate goods in other ASEAN-5 + 3 countries, traded intermediate goods producers in Malaysia can set a higher price markup.

Table 1: Parameter Estimates for the ASEAN+3 Countries under the “No Coordination” Regime

	κ_N	κ_T	θ_N	θ_T	γ_N	γ_T	μ_N	μ_T
Indonesia	8.758	34.999	11.295	10.405	9.395%	2.706%	1.097	1.106
Malaysia	8.703	34.999	11.374	10.003	9.434%	2.705%	1.096	1.111
Singapore	8.608	34.999	11.462	10.135	9.517%	2.705%	1.096	1.109
Thailand	8.660	34.999	11.398	10.233	9.472%	2.705%	1.096	1.108
Philippines	8.660	34.999	11.405	10.252	9.478%	2.706%	1.096	1.108
PRC	8.914	34.999	11.136	10.402	9.247%	2.705%	1.099	1.106
Japan	8.659	34.999	11.411	10.282	9.468%	2.705%	1.096	1.108
Republic of Korea	8.662	35.000	11.407	10.249	9.476%	2.706%	1.096	1.108

Source: Author's calculation.

Appendix 3 displays the welfare values for each of the ASEAN-5 + 3 countries under the three interaction regimes: “no coordination” (NC), “bilateral coordination” (BC), and “multilateral coordination” (MC). All the variables in the model for each of the ASEAN-5 + 3 economies in all the interaction regimes have zero values in the steady state. This implies that the model has a unique solution for each country and for each interaction regime and that all the variables in the model converge to their steady-state values.

Appendix 4 presents the best to the worst potential coordination partners under the BC and MC regimes for each of the ASEAN-5 + 3 countries. “Potential” here means that, while it may be beneficial for a country to enter a BC or an MC coordination scheme to improve its welfare, the feasibility of policy coordination depends on whether the scheme also benefits the counterpart country (countries). Within the ASEAN-5 + 3 group, Indonesia is the best BC potential partner for Singapore, the Philippines, and the Republic of Korea; the PRC is the best BC potential partner for Malaysia and Thailand; the Philippines is the best BC potential partner for Indonesia; and Thailand is the best potential BC partner for Japan. Within the (sub)group of the ASEAN-5, Indonesia is the best potential BC partner for all the other countries. Within the CJK (sub)group, the PRC is the best coordination BC partner for Japan and the Republic of Korea. Meanwhile, the ASEAN-5 + 3 scheme is the best potential MC scheme for all the ASEAN-5 + 3 countries. The ASEAN-5 is the worst MC potential scheme for all the ASEAN-5 countries, while the CJK is the worst potential scheme for all the CJK countries.

From the assessment of policy coordination feasibility using the game theory framework (Appendix 5), there are 18 BC and four MC feasible cases (Table 2). The great disparity in economic size remains the main issue that hinders monetary policy coordination among the ASEAN-5 + 3 countries in most cases (Table 3). With the weighted sum aggregation technology, countries with a larger share (here: larger economic size) must bear a greater cost in the provision of the impure public good (here: macroeconomic stability).

The two-production-factor DSGE model in this study provides more feasible cases of policy coordination among the ASEAN-5 + 3 than the one-production-factor model for the ASEAN-5 countries that Sugandi (2016, 2018) developed. The introduction of the PRC, Japan, and the Republic of Korea allows for more favorable burden sharing for Indonesia in the ASEAN-5 + PRC, ASEAN-5 + Japan, ASEAN-5 + the Republic of 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 cases. 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 adaptable 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.

Among the feasible BC cases, Singapore has the highest number of feasible cases. Singapore has relatively lower inflation and fewer 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, the PRC, Japan, and the Republic of Korea). For Indonesia (which is the best “potential” partner for other ASEAN-5 countries), the feasible schemes are BC with Singapore and the Philippines. Within the CJK group, the PRC–Japan and PRC–Republic of Korea schemes are feasible, while the Japan–Republic of Korea scheme is not feasible.

Table 2: Feasible Monetary Policy Coordination Schemes for the ASEAN-5 + 3 Countries

Policy Coordination Regime	Feasible Policy Coordination Cases
<i>Bilateral Coordination</i>	1) Indonesia–Singapore 2) Indonesia–Philippines 3) Malaysia–Singapore 4) Malaysia–Thailand 5) Malaysia–PRC 6) Malaysia–Japan 7) Malaysia–Republic of Korea 8) Singapore–Thailand 9) Singapore–Philippines 10) Singapore–PRC 11) Singapore–Japan 12) Singapore–Republic of Korea 13) Thailand–PRC 14) Thailand–Japan 15) Thailand–Republic of Korea 16) Philippines–PRC 17) PRC–Japan 18) PRC–Republic of Korea
<i>Multilateral Coordination</i>	1) ASEAN-5 + PRC 2) ASEAN-5 + Japan 3) ASEAN-5 + Republic of Korea 4) ASEAN-5 + 3

Source: Author’s calculation.

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

	EU	US	PRC	JPN	ROK	AUS	IDN	THA	MYS	SGP	PHL	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

Note: EU = European Union, US = United States, PRC = People’s Republic of China, JPN = Japan, ROK = Republic of Korea, AUS = Australia, IDN = Indonesia, THA = Thailand, MYS = Malaysia, SGP = Singapore, PHL = Philippines.

Source: Author’s calculation.

Almost all the MC cases are feasible in the two-production-factor model, except the ASEAN-5 MC and CJK schemes. The huge 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 costs for entering the ASEAN-5 MC scheme still exceed the benefits, although, for other ASEAN-5 countries, this MC scheme is beneficial.

Likewise, the costs for the PRC 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.

5. CONCLUSIONS

The main finding from this 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. This study shows that there are more feasible policy coordination schemes than Sugandi (2016, 2018) suggested. Of all the 22 feasible bilateral and multilateral coordination cases in this study, the ASEAN-5 + 3 multilateral monetary policy coordination is the best feasible policy option for all the ASEAN-5 + 3 countries. The outcomes of multilateral policy coordination tend to be better than those of bilateral coordination.

The relative size of the participating countries is a dominant factor that determines the feasibility of policy coordination. Having said that, it is possible to have feasible coordination when there are big differences in size among the participating countries, if there are other factor(s) with a significant influence on the welfare of these countries, such as strong trade and direct investment linkages.

The models in this study can be improved in future studies by, among others, the following options: (i) the introduction of restrictions on capital mobility across countries; (ii) the introduction of other production factors besides labor and capital (such as oil and land); (iii) the differentiation between physical and financial capital; (iv) the differentiation of economic agents (such as the differentiation of households based on their income group); and (v) the introduction of other monetary instruments available for central banks or supranational planners. Further study can also expand the scope of international policy coordination by including fiscal policy coordination, exchange rate coordination, and/or trade policy coordination.

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APPENDIX 1: CALCULATED AND CALIBRATED PARAMETERS IN THE MODEL

Table 1-1: Calculated and Calibrated Parameter Values for the ASEAN-5 + 3 Countries

Country	ρ	β	α	ω	φ_N	φ_T	b_1	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
Philippines	0.004	0.984	0.354	0.405	0.658	0.547	0.700	0.010	0.010	0.700
PRC	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
Republic of Korea	0.024	0.990	0.328	0.390	0.358	0.589	0.700	0.010	0.010	0.700

Source: Author's calculation.

Table 1-2: Joint Discount Factor (β^\blacksquare) Values in Bilateral Monetary Policy Coordination among the ASEAN-5 + 3 Countries

β^\blacksquare	Indonesia	Malaysia	Singapore	Thailand	Philippines	PRC	Japan	Republic of 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
Philippines	0.979	0.987	0.989	0.987	–	0.991	0.997	0.989
PRC	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
Republic of Korea	0.986	0.990	0.991	0.990	0.989	0.991	0.997	–

Source: Author's calculation.

Table 1-3: Joint Discount Factor (β^\blacklozenge) Values in Multilateral Monetary Policy Coordination among the ASEAN-5 + 3 Countries

β^\blacklozenge	ASEAN-5	ASEAN-5 + PRC	ASEAN-5 + Japan	ASEAN-5 + Republic of Korea	CJK	ASEAN-5 + 3
β^\blacklozenge	0.985	0.990	0.995	0.987	0.994	0.993

Source: Author's calculation.

APPENDIX 2: PARAMETER ESTIMATES AND DERIVED PARAMETER VALUES

Table 2-1: 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 the PRC	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 the Republic of Korea	8.754	34.999	11.303	10.409	9.392%	2.706%	1.097	1.106
Multilateral Coordination								
in ASEAN-5	8.751	34.999	11.312	10.408	9.396%	2.706%	1.097	1.106
in ASEAN-5 + PRC	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 + Republic of 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 2-2: 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 the PRC	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 the Republic of 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 + PRC	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 + Republic of 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
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Table 2-3: 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 the PRC	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 the Republic of 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 + PRC	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 + Republic of 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 2-4: 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 the PRC	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 the Republic of 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 + PRC	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 + Republic of 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 2-5: 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 the PRC	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 the Republic of 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 + PRC	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 + Republic of 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 2-6: People's Republic of 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 the Republic of 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 + PRC	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 2-7: 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 the PRC	8.661	34.999	11.416	10.293	9.469 %	2.705 %	1.096	1.108
with the Republic of 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 2-8: Republic of Korea

	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 the PRC	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 + Republic of 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

Source: Author's calculation.

APPENDIX 3: WELFARE VALUES

- **No Coordination Cases**

	IDN	MYS	SGP	THA	PHL	PRC	JPN	ROK
Welfare	–	–	–	–	–	–	–	–
	0.08843	0.09488	0.09514	0.09505	0.09224	0.09454	0.09659	0.09337

- **Bilateral Coordination Cases**

	IDN	MYS	SGP	THA	PHL	PRC	JPN	ROK
IDN	–	–0.09059	–0.08815	–0.09078	–0.08771	–0.09061	–0.09365	–0.09001
MYS	–0.09059	–	–0.09332	–0.09382	–0.09244	–0.08663	–0.09271	–0.09331
SGP	–0.08815	–0.09332	–	–0.09327	–0.09198	–0.09163	–0.09432	–0.09258
THA	–0.09078	–0.09382	–0.09327	–	–0.09259	–0.08960	–0.09091	–0.09323
PHL	–0.08771	–0.09244	–0.09198	–0.09259	–	–0.08906	–0.09242	–0.09254
PRC	–0.09061	–0.08663	–0.09163	–0.08960	–0.08906	–	–0.09377	–0.09248
JPN	–0.09365	–0.09271	–0.09432	–0.09091	–0.09242	–0.09377	–	–0.09452
ROK	–0.09001	–0.09331	–0.09258	–0.09323	–0.09254	–0.09248	–0.09452	–

- **Multilateral Coordination Cases**

	CJK	ASEAN-5	ASEAN-5 + PRC	ASEAN-5 + JPN	ASEAN-5 + ROK	ASEAN-5 + 3
IDN	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
MYS	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
SGP	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
THA	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
PHL	–	–0.09209	0.01288	0.02596	–0.01405	0.81320
PRC	–0.11077	–	0.01288	–	–	0.81320
JPN	–0.11077	–	–	0.02596	–	0.81320
ROK	–0.11077	–	–	–	–0.01405	0.81320

Note: IDN = Indonesia, MYS = Malaysia, SGP = Singapore, THA = Thailand, PHL = Philippines, PRC = People's Republic of China, JPN = Japan, ROK = Republic of Korea.

Source: Author's calculation.

APPENDIX 4: BEST TO WORST “POTENTIAL” COORDINATION PARTNERS FOR THE ASEAN-5 + 3 COUNTRIES

Table 4-1: Best to Worst “Potential” Partners in Bilateral Policy Coordination

	1	2	3	4	5	6	7
Indonesia	Philippines	Singapore	ROK	Malaysia	PRC	Thailand	Japan
Malaysia	PRC	Indonesia	Philippines	Japan	ROK	Singapore	Thailand
Singapore	Indonesia	PRC	Philippines	ROK	Thailand	Malaysia	Japan
Thailand	PRC	Indonesia	Japan	Philippines	ROK	Singapore	Malaysia
Philippines	Indonesia	PRC	Singapore	Japan	Malaysia	ROK	Thailand
PRC	Malaysia	Philippines	Thailand	Indonesia	Singapore	ROK	Japan
Japan	Thailand	Philippines	Malaysia	Indonesia	PRC	Singapore	ROK
ROK	Indonesia	PRC	Philippines	Singapore	Thailand	Malaysia	Japan

(1) Within the ASEAN-5 Group

	1	2	3	4
Indonesia	Philippines	Singapore	Malaysia	Thailand
Malaysia	Indonesia	Philippines	Singapore	Thailand
Singapore	Indonesia	Philippines	Thailand	Malaysia
Thailand	Indonesia	Philippines	Singapore	Malaysia
Philippines	Indonesia	Singapore	Malaysia	Thailand

(2) Within the CJK Group

	1	2
PRC	ROK	Japan
Japan	PRC	ROK
ROK	PRC	Japan

**Table 4-2: Best to Worst “Potential” Schemes for the ASEAN-5 + 3 Countries’
Multilateral Policy Coordination**

	1	2	3	4	5
Indonesia	ASEAN-5 + 3	ASEAN-5 + Japan	ASEAN-5 + PRC	ASEAN-5 + ROK	ASEAN-5
Malaysia	ASEAN-5 + 3	ASEAN-5 + Japan	ASEAN-5 + PRC	ASEAN-5 + ROK	ASEAN-5
Singapore	ASEAN-5 + 3	ASEAN-5 + Japan	ASEAN-5 + PRC	ASEAN-5 + ROK	ASEAN-5
Thailand	ASEAN-5 + 3	ASEAN-5 + Japan	ASEAN-5 + PRC	ASEAN-5 + ROK	ASEAN-5
Philippines	ASEAN-5 + 3	ASEAN-5 + Japan	ASEAN-5 + PRC	ASEAN-5 + ROK	ASEAN-5
PRC	ASEAN-5 + 3	ASEAN-5 + PRC	CJK	–	–
Japan	ASEAN-5 + 3	ASEAN-5 + Japan	CJK	–	–
ROK	ASEAN-5 + 3	ASEAN-5 + ROK	CJK	–	–

PRC = People’s Republic of China, ROK = Republic of Korea.

Source: Author’s calculation.

APPENDIX 5: INTERACTION PAYOFFS

This appendix displays the interaction payoffs based on the assumption of a one-shot game with perfect information to investigate whether monetary policy coordination is feasible for the ASEAN-5 + 3 countries. When dealing with its potential partner(s), each country can opt to coordinate or not to coordinate its policy. A coordination scheme is feasible when it benefits ALL the participating countries. When a coordination scheme is feasible, the pay-off cell is marked in blue with a star.

Table 5-1: Bilateral Coordination vs. No Coordination Payoffs

		Malaysia	
		No Coordination	Coordination
Indonesia	No Coordination	(-0.08843; -0.09488)	(-0.08843; -0.09059)
	Coordination	(-0.09059; -0.09488)	(-0.09059; -0.09059)
Indonesia–Singapore			
		Singapore	
		No Coordination	Coordination
Indonesia	No Coordination	(-0.08843; -0.09514)	(-0.08843; -0.08815)
	Coordination	(-0.08815; -0.09514)	(-0.08815; -0.08815)*
Indonesia–Thailand			
		Thailand	
		No Coordination	Coordination
Indonesia	No Coordination	(-0.08843; -0.09505)	(-0.08843; -0.09078)
	Coordination	(-0.09078; -0.09505)	(-0.09078; -0.09078)
Indonesia–Philippines			
		Philippines	
		No Coordination	Coordination
Indonesia	No Coordination	(-0.08843; -0.09224)	(-0.08843; -0.08771)
	Coordination	(-0.08771; -0.09224)	(-0.08771; -0.08771)*
Indonesia–PRC			
		PRC	
		No Coordination	Coordination
Indonesia	No Coordination	(-0.08843; -0.09454)	(-0.08843; -0.09061)
	Coordination	(-0.09061; -0.09454)	(-0.09061; -0.09061)
Indonesia–Japan			
		Japan	
		No Coordination	Coordination
Indonesia	No Coordination	(-0.08843; -0.09659)	(-0.08843; -0.09365)
	Coordination	(-0.09365; -0.09659)	(-0.09365; -0.09365)

- Indonesia–Republic of Korea

		Republic of Korea	
		No Coordination	Coordination
Indonesia	No Coordination	(−0.08843; −0.09337)	(−0.08843; −0.09001)
	Coordination	(−0.09001; −0.09337)	(−0.09001; −0.09001)

- Malaysia–Singapore

		Singapore	
		No Coordination	Coordination
Malaysia	No Coordination	(−0.09488; −0.09514)	(−0.09488; −0.09332)
	Coordination	(−0.09332; −0.09514)	(−0.09332; −0.09332)*

- Malaysia–Thailand

		Thailand	
		No Coordination	Coordination
Malaysia	No Coordination	(−0.09488; −0.09505)	(−0.09488; −0.09382)
	Coordination	(−0.09382; −0.09505)	(−0.09382; −0.09382)*

- Malaysia–Philippines

		Philippines	
		No Coordination	Coordination
Malaysia	No Coordination	(−0.09488; −0.09224)	(−0.09488; −0.09244)
	Coordination	(−0.09244; −0.09224)	(−0.09244; −0.09244)

- Malaysia–PRC

		PRC	
		No Coordination	Coordination
Malaysia	No Coordination	(−0.09488; −0.09454)	(−0.09488; −0.08663)
	Coordination	(−0.08663; −0.09454)	(−0.08663; −0.08663)*

- Malaysia–Japan

		Japan	
		No Coordination	Coordination
Malaysia	No Coordination	(−0.09488; −0.09659)	(−0.09488; −0.09271)
	Coordination	(−0.09271; −0.09659)	(−0.09271; −0.09271)*

- Malaysia–Republic of Korea

		Republic of Korea	
		No Coordination	Coordination
Malaysia	No Coordination	(−0.09488; −0.09337)	(−0.09488; −0.09331)
	Coordination	(−0.09331; −0.09337)	(−0.09331; −0.09331)*

- Singapore–Thailand

		Thailand	
		No Coordination	Coordination
Singapore	No Coordination	(−0.09514; −0.09505)	(−0.09514; −0.09327)
	Coordination	(−0.09327; −0.09505)	(−0.09327; −0.09327)*

- **Singapore–Philippines**

		Philippines	
		No Coordination	Coordination
Singapore	No Coordination	(-0.09514; -0.09224)	(-0.09514; -0.09198)
	Coordination	(-0.09198; -0.09224)	(-0.09198; -0.09198)*

- **Singapore–PRC**

		PRC	
		No Coordination	Coordination
Singapore	No Coordination	(-0.09514; -0.09454)	(-0.09514; -0.09163)
	Coordination	(-0.09163; -0.09454)	(-0.09163; -0.09163)*

- **Singapore–Japan**

		Japan	
		No Coordination	Coordination
Singapore	No Coordination	(-0.09514; -0.09659)	(-0.09514; -0.09432)
	Coordination	(-0.09432; -0.09659)	(-0.09432; -0.09432)*

- **Singapore–Republic of Korea**

		Republic of Korea	
		No Coordination	Coordination
Singapore	No Coordination	(-0.09514; -0.09337)	(-0.09514; -0.09258)
	Coordination	(-0.09258; -0.09337)	(-0.09258; -0.09258)*

- **Thailand–Philippines**

		Philippines	
		No Coordination	Coordination
Thailand	No Coordination	(-0.09505; -0.09224)	(-0.09505; -0.09259)
	Coordination	(-0.09259; -0.09224)	(-0.09259; -0.09259)

- **Thailand–PRC**

		PRC	
		No Coordination	Coordination
Thailand	No Coordination	(-0.09505; -0.09454)	(-0.09505; -0.08960)
	Coordination	(-0.08960; -0.09454)	(-0.08960; -0.08960)*

- **Thailand–Japan**

		Japan	
		No Coordination	Coordination
Thailand	No Coordination	(-0.09505; -0.09659)	(-0.09505; -0.09091)
	Coordination	(-0.09091; -0.09659)	(-0.09091; -0.09091)*

- **Thailand–Republic of Korea**

		Republic of Korea	
		No Coordination	Coordination
Thailand	No Coordination	(-0.09505; -0.09337)	(-0.09505; -0.09323)
	Coordination	(-0.09323; -0.09337)	(-0.09323; -0.09323)*

- **Philippines–PRC**

		PRC	
		No Coordination	Coordination
Philippines	No Coordination	(-0.09224; -0.09454)	(-0.09224; -0.08906)
	Coordination	(-0.08906; -0.09454)	(-0.08906; -0.08906)*

- **Philippines–Japan**

		Japan	
		No Coordination	Coordination
Philippines	No Coordination	(-0.09224; -0.09659)	(-0.09224; -0.09242)
	Coordination	(-0.09242; -0.09659)	(-0.09242; -0.09242)

- **Philippines–Republic of Korea**

		Republic of Korea	
		No Coordination	Coordination
Philippines	No Coordination	(-0.09224; -0.09337)	(-0.09224; -0.09254)
	Coordination	(-0.09254; -0.09337)	(-0.09254; -0.09254)

- **PRC–Japan**

		Japan	
		No Coordination	Coordination
PRC	No Coordination	(-0.09454; -0.09659)	(-0.09454; -0.09377)
	Coordination	(-0.09377; -0.09659)	(-0.09377; -0.09377)*

- **PRC–Republic of Korea**

		Republic of Korea	
		No Coordination	Coordination
PRC	No Coordination	(-0.09454; -0.09337)	(-0.09454; -0.09248)
	Coordination	(-0.09248; -0.09337)	(-0.09248; -0.09248)*

- **Japan–Republic of Korea**

		Republic of Korea	
		No Coordination	Coordination
Japan	No Coordination	(-0.09659; -0.09337)	(-0.09659; -0.09452)
	Coordination	(-0.09452; -0.09337)	(-0.09452; -0.09452)

Source: Author's calculation.

Table 5-2: Multilateral Coordination vs. No Coordination Payoffs

	No Coordination	ASEAN-5	ASEAN-5 + PRC*	ASEAN-5 + Japan*	ASEAN-5 + ROK*	CJK	ASEAN-5 + CJK*
Indonesia	-0.08843	-0.09209	0.01288	0.02596	-0.01405	-	0.81320
Malaysia	-0.09488	-0.09209	0.01288	0.02596	-0.01405	-	0.81320
Singapore	-0.09514	-0.09209	0.01288	0.02596	-0.01405	-	0.81320
Thailand	-0.09505	-0.09209	0.01288	0.02596	-0.01405	-	0.81320
Philippines	-0.09224	-0.09209	0.01288	0.02596	-0.01405	-	0.81320
PRC	-0.09454	-	0.01288	-	-	-	0.81320
						0.11077	
Japan	-0.09659	-	-	0.02596	-	-	0.81320
						0.11077	
ROK	-0.09337	-	-	-	-0.01405	-	0.81320
						0.11077	

PRC = People's Republic of China, ROK = Republic of Korea.

Source: Author's calculation.