Deepening Interdependence in the Asia-Pacific Region: An Empirical Study Using a Macro-Econometric Model♦

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ABSTRACT

The development of an international division of labor across the Asia-Pacific basin was not only foundation for achieving the "East Asian Miracle," but also proved during the "Asian Currency Crisis" to be a possible trigger for an international chain reaction of economic bankruptcy. The purpose of this paper is to construct a macro-econometric model for the Asia-Pacific area, including Japan, the United States, Indonesia, Singapore, Thailand, the Philippines, Malaysia, South Korea, Hong Kong, and China. The model captures international specialization among regional neighbors in a simple way and enables us to quantify how their deepening interdependence affects economic activities in the area. Our main findings are as follows: (i) A Japanese recession may cause recession in East Asia and thereby rebound on Japanese exports. (ii) The depreciation of the Japanese yen favors its exports, but has a "beggar-thy-neighbor" effect on the East Asian economies. (iii) Foreign-demand shocks affect Japanese exports differently, depending on whether the shocks come from, say, the US or Asia. Moreover, the model includes policy rules (interest rate policy, exchange rate policy, and capital controls) to reflect the differing monetary policies observed in individual countries. These make it possible to simulate a change in a country's adopted policy rule and to quantify the effects of such a change, both on other countries and on itself. Using this model structure, we investigate which currency regime is most favorable for the East Asian economies. Our simulation results imply that (iv) it may be more desirable than the current policy regime or the US dollar peg that all the East Asian economies adopt the currency basket policy in order to preserve economic stability against turbulence arising inside or outside the East Asian economies.

I. INTRODUCTION

East Asia experienced high economic growth for a decade from the mid-1980s, an experience which has been called the "East Asian miracle" (Chart 1).[1] The growth rates in these countries, however, slowed down after the Asian Currency Crisis in 1997. The IT depression since 2001 caused growth rates to deteriorate further, and this was exacerbated by the terrorist attacks in the US (September 11, 2001).

Although the magnitude of shocks partly explains the sharpness of recent drops in the growth rates in East Asian countries, it is more important to recognize how the economic structure of the Asia-Pacific region has itself played an integral role in reinforcing such shocks. A remarkable fact about economic developments in the 1980s' Asian economies is that total exports and imports grew faster than total production (Chart 2). More importantly, intra-regional trade in East Asian grew more rapidly than total trade. In fact, the share of intra-regional increased from 20 percent in 1980 to 36 percent in 2000 in East Asia (excluding Japan, Chart 3).[2]

The rapid expansion of intra-regional trade in East Asia reflects the speed at which international specialization has developed within this area. The East Asian economies have developed an international production network, in which they trade parts and intermediate goods back and forth, eventually exporting final goods to huge markets such as the US and Japan. This international dispersion of the production process is one of the main forces driving the expansion of intra-regional trade in the East Asian economies.[3]

The development of international specialization is a "double-edged sword" for small economies like those in East Asia. By devoting their limited resources to narrow fields, they have been able to enhance the international competitiveness of the East Asian economies as a whole. The "East Asian Miracle" was achieved as the result of this mutually complementary growth among the East Asian economies, which grew as

[1] In this paper, we use "East Asia" to refer the NIES (South Korea, Hong Kong, and Singapore), the ASEAN (Thailand, the Philippines, Indonesia, and Malaysia), and China.

[2] The share of intra-East Asian trade, including Japan, out of total trade volume in the area increased from 33 percent in 1980 to 46 percent in 2000.

[3] See Isogai, et al. (2002) for details on recent intra-East Asian trade developments.

if they were a single entity. Yet, this deepening of interdependence also worked as a mechanism for transmitting negative shocks experienced in one country all over the area. Moreover, economic turmoil was made worse, because this East Asian international specialization developed spontaneously: The institutions to govern it have yet to become fully evolved.

The relationship between Japan and East Asia has become closer in recent years. In fact, Japan's export share to East Asia increased from 22 percent in 1980 to 32 percent in 2000 (Chart 4), while Japan's import share from East Asia reached 35 percent in 2000, increasing from 21 percent in 1980 (Chart 5). In terms of its trade with Japan, East Asia has made itself as important as the US, with which Japan's trading volume has, since the World War II, been the largest of all its trading partners.[4] Therefore, understanding trade interdependence within East Asia is of great importance for Japan, since it supplies parts and capital equipment to the East Asian economies and imports consumption goods from them.

For instance, we need to get an overall view of the complex and multi-dimensional chain reaction and repercussion that takes place between Japan and East Asia when analyzing, say, the effects of a deterioration in the US economy. In the first instance, a recession in the US economy reduces Japanese exports to the US. However, it also squeezes Japanese exports to East Asia due to the reduction in East Asia's exports to the US. Furthermore, the export contraction causes a deterioration in the Japanese economy, with the knock-on effect of reducing US and East Asian exports to Japan. Moreover, entrepreneurs may reduce current production, expecting stagnant exports in future.

The purpose of this paper is to construct a multi-country macro-econometric model that incorporates this East Asian international specialization and thus to quantify the effects of the area's deepening interdependence on economic activities in the Asia-Pacific region, including Japan and the US. The model introduced in this paper can be developed in two complementary ways. First, we build an "Asian Trade Model," which focuses on trading relationships in East Asia and takes individual domestic economies as given. Second, we construct an "Asian Economy Model," in which

[4] The US share of Japan's total imports increased from 17 percent in 1980 to 19 percent in 2000, while its share of Japan's total exports rose from 24 percent in 1980 to 30 percent in 2000. Nonetheless, the magnitudes of these share increases are smaller than those of the East Asian countries.

these domestic economies interact via trade volume and exchange rate behavior. We can employ the latter model to discuss the business cycles that emerge in East Asia, as shifts in production and income across individual countries take place and interact with one another.

The remainder of this paper is organized as follows. In Section II, we build the "Asian Trade Model," in which import functions link ten countries -- eight East Asian countries, Japan, and the US.[5] In Section III, we construct the "Asian Economy Model" by adding individual domestic economies to the "Asian Trade Model." Section IV discusses the quantitative properties and differences between the two models via a variety of simulations. In Section V, as an application of the model, we analyze how the choice of policy rules in East Asia affects the real economy of each country. Section VI concludes our discussion. Appendix A is a brief description of the monetary and exchange rate policies in these Asian countries. In Appendix B, we focus on the Chinese economy, which has enhanced its presence in the international economy in the 1990s and discuss the economic outcomes of its accession to the World Trade Organization (WTO) on December 2001. It should be noted that our model leaves aside the questions of why and how past currency crises occurred.

II. ASIAN TRADE MODEL

(1) Why the Asian Trade Model?

East Asia's deepening interdependence has had both good and bad aspects. It contributed to the "East Asian Miracle" during the decade since the mid-1980s, but it has also facilitated the transmission of shocks that hits one country all over the region. High economic growth in East Asia was a consequence of positive shocks that were amplified within the system of international specialization developed there. On the contrary, the "Asian Currency Crisis," which originated in Thailand in July 1997, provided ample illustration of how this deepening interdependence could easily strengthen negative shocks that hits one economy and draw the whole region into a recession spiral.

[5] The countries that are not treated explicitly in this paper constitute the "rest of the world" in our model.

In recent years, the Japanese economy has become more and more intimate with the East Asian economies. The larger the trading volume Japan has with the East Asian economies, the stronger the need for a macro-econometric model that emphasizes trading relationships between Japan and the East Asian countries. In particular, the Asian Currency Crisis in 1997 and the worldwide IT depression since 2000 were conspicuous enough to force recognition that a quantification of East Asia's deepening interdependence had become overdue. The purpose of this paper is therefore to construct a multi-country macro-econometric model that describes these global links through international trade and the international division of labor and to provide a quantitative exploration of the economic implications of deepening interdependence among Japan, the US and East Asia.[6]

The "Asian Trade Model" explained below focuses on trading relationships and takes as given individual domestic economies and exchange rates. The model allows us to investigate the pure effects of international division of labor and the resulting trade structure between the object countries. In reality, each domestic economy influences and is in turn influenced by others through its trade volume and exchange rate behavior. In the subsequent section, we introduce the "Asian Economy Model" and analyze the effects of this interaction between domestic economies.

(2) Structure of the Asian Trade Model

The building blocks of the "Asian Trade Model" are aggregate import functions for individual countries. Import growth rates are defined as follows:

$$\Delta \ln M_i(t) = \Sigma_{k=0}^{3} \alpha_{i,k} \Delta \ln X_i(t+k) + \Sigma_{k=0}^{3} \beta_{i,k} \Delta \ln D_i(t-k) + \Sigma_{k=0}^{3} \gamma_{i,k} \Delta \ln RE_i(t-k), \qquad (2\text{-}1)$$

where M_i denotes country i's aggregate imports, X_i its aggregate exports, D_i its domestic demand, RE_i its real effective exchange rate, and Δ the first-difference operator. Aggregates of imports, exports, and domestic demand are all real values and denominated in local currencies.

Eq. (2-1) is an orthodox aggregate import function in that aggregate imports depend on domestic demand and the real effective exchange rate. One characteristic of

[6] The model covers ten economies: Japan, the US, Indonesia, Singapore, Thailand, the Philippines, Malaysia, South Korea, Hong Kong, and China. We also have the "rest of the world" in the model.

Eq. (2-1) worth thinking is the fact that imports also depend on current and future exports.[7] A large portion of East Asia's imports consists of parts and capital or intermediate goods, which are processed into high value-added intermediate or final goods and ultimately exported back out of the country. As a result, in a system where the international division of labor is so well developed, imports and exports are highly correlated. Another point that should be noted about Eq. (2-1) is that current imports are determined by future exports, reflecting that it takes time for imported intermediate goods to be exported after being processed.

For simplicity, we fix import shares for each country. That is, we assume that other countries' respective shares of an individual country's imports are constant.[8] In this case, growth rates of bilateral imports are equal to those of aggregate imports.

$$\Delta \ln M_{ji}(t) = \Delta \ln M_j(t), \tag{2-2}$$

where M_{ji} denotes country j's imports from country i. The assumption of fixed import shares allows practitioners to save the time that it would take to estimate too many bilateral import functions. Moreover, the assumption is roughly supported by data in the short run. When a trade structure transforms rapidly, however, the assumption of fixed import shares appears unrealistic. In particular, confronted with the very repid increase in China's share of Japan's imports since the 1990s, it is evident that we should take the model as only a rough approximation of reality.

Aggregate export functions are derived from the aggregate import functions. Denote country i's aggregate exports by X_i and country i's exports to country j by X_{ij}. Then one country's aggregate exports are given by $X_i(t) = \Sigma_j X_{ij}(t)$. Log-linearizing this relationship gives us

$$\Delta \ln X_i(t) = \Sigma_j \theta_{ij} \Delta \ln X_{ij}(t), \tag{2-3}$$

In Eq. (2-3), θ_{ij} is the share of country i's exports that go to country j ($\theta_{ij} = X_{ij} / X_i$), which is constant under the assumption of fixed import shares. Notice

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[7] Bayoumi (1996) used a VECM to analyze intra-Asia regional trade. His model includes export volume in the import functions and thus shares similar properties with our model. A difference is that our model uses lead variables for exports and we build a structural model. By using lead variables for exports, we incorporate the forward-looking factors into the model.

[8] This is a difference between our model and that of Kamada, et al. (1998). Their model is based on bilateral import functions.

that country i's exports to country j are equal to country j's imports from country i. Using Eq. (2-2), we finally obtain growth rates of aggregate exports as follows:

$$\Delta \ln X_i(t) = \Sigma_j \theta_{ij} \Delta \ln M_j(t), \qquad (2\text{-}4)$$

which tells us that each country's export growth rate is an average of the growth rates of other countries' imports weighted by their export shares.

Now suppose that Japan's imports increase. Other countries' exports increase, which in turn raises their imports, as the aggregate import function predicts. This leads to an increase in Japan's exports, which feeds through into further Japan's demand for imports. Thanks to this multiplier effect, the Asian Trade Model is well-adapted to capture interdependent trading relationships within East Asia.

(3) Estimation of the Asian Trade Model

We estimate aggregate import functions, based on actual data. As Goldstein and Khan (1985) mention, there are many difficulties involved in estimating import functions. In particular, researchers often encounter problems with the sign of the estimated parameter on the real effective exchange rate. This has been known to suggest that a country's imports will increase when its currency depreciates. This is counterintuitive when we think about imports of final goods. The depreciation of the importing country's currency raises the prices of imported goods relative to those of domestic goods and should thus reduce import demand.

This problem of sign reversal on the real effective exchange rate is not necessarily ridiculous, when we consider that the demand for imports is in part derived from exports. Suppose the Japanese yen depreciates. The prices of Japanese export goods decline relative to foreign equivalents; thus demand for them increases. As a result, new demand is created for imports of intermediate goods. If the increase in imports of intermediate goods were to exceed the decrease in final goods coming from the depreciation of the yen, Japanese net imports would increase.

As pointed out before, the import functions, Eq. (2-1), include export volumes as explanatory variables. The first term on the right hand side of Eq. (2-1) is interpreted as a derived demand for import goods springing from future exports. If we follow the above argument and include this term in the import function, then it absorbs any increase in imports caused by currency depreciation; thus the estimated parameter on the real effective exchange rate takes the expected sign; and the intuition that currency

depreciation reduces import volumes is restored.

Chart 6 presents the estimation results of aggregate import functions for ten countries. The sample period spans the 1990s (quarterly bases). The fit of the equations is also good, with coefficients of determination beyond 40 percent in most cases. These high figures show empirically the potential of Eq. (2-2) as a general form for import functions. We should also note that, for all countries other than the Philippines and Singapore, the parameter on the real effective exchange rate takes the theoretically expected sign (the real effective exchange rate depreciates when the figure drops).

III. ASIAN ECONOMY MODEL

(1) Why the Asian Economy Model?

The Asian Trade Model developed in Section II focuses on the international division of labor and interdependence among the East Asian economies. For this reason, we treat domestic demand and the real effective exchange rates as exogenous. In reality, however, a change in foreign demand affects domestic production, foreign investment, exchange rates, and eventually economic policy. Therefore, in order to understand more precisely how the countries in the Asia-Pacific region respond to various economic shocks, we need to extend the Asian Trade Model into a model in which domestic demand and real exchange rates are determined endogenously. It is for this purpose that we introduce the Asian Economy Model in this section.

(2) Structure of the Asian Economy Model

The Asian Economy Model may be outlined as follows. We use the import and export functions developed in Section II. We also introduce functions to endogenously determine real exchange rates, which are treated as exogenous in the Asian Trade Model. Each country's domestic demand, which is also exogenous in the Asian Trade Model, is determined by its income and interest rates. Inflation rates depend on the output gap and the nominal effective exchange rates in a Phillips curve framework. Finally, we include policy reaction functions that describe individual countries' interest rate and exchange rate policies. All in all, we have a macro-econometric model that consists of about 170 equations.

A. Trade Sector

We start with the trade sector. We use the import and export functions as shown in Section II. Note, however, that we treat domestic demand and real effective exchange rates as endogenous below, while they were exogenous variables in Section II. The real effective exchange rates are defined in terms of wholesale prices (or producer prices) so as to emphasize imports of production materials (consumer prices are used for China, where production-side price indices are unavailable). That is,

$$\Delta RE_i(t) = \{\Delta \ln WPI_i(t) - \Delta \ln E_i(t)\} - \Sigma_j \delta_{ij}\{\Delta \ln WPI_j(t) - \Delta \ln E_j(t)\}, \qquad (3\text{-}1)$$

where WPI_i denotes country i's wholesale price index, E_i its nominal exchange rate against the US dollar (denominated in its local currency), and δ_{ij} the share of country i's imports that come from country j.[9]

Next, we define the ratio of the current account balance to potential output, which is a key element in the domestic demand functions, as described below. Denote potential output by PY. Then, by definition, the ratio of the current account balance to potential output is given by $RC \equiv (X - M)/PY$. Log-linearizing this, we obtain the following relationship.

$$\Delta RC_i(t) = \lambda_{1i}\Delta \ln X_i(t) - \lambda_{2i}\Delta \ln M_i(t) - \lambda_{3i}\Delta \ln PY, \qquad (3\text{-}2)$$

where $\lambda_{1i} = X_i / PY_i$, $\lambda_{2i} = M_i / PY_i$, and $\lambda_{3i} = (X_i - M_i)/PY_i$, which are all fixed. Notice that we standardize the current account balance by potential output rather than by actual output. This is because a country's foreign deficit should be evaluated against its ability to repay.

B. Production Sector

We make domestic demand as simple as possible. Basically, the determinants of domestic demand are past income and the real long-term interest rate.[10]

$$\Delta \ln D_i(t) = \Sigma_{k=0}^{3} \rho_{ik} \Delta \ln Y_i(t-k) - \sigma_i \Delta RL_i(t) + \tau_i RC_i(t-1), \qquad (3\text{-}3)$$

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[9] The real effective exchange rates are necessary to estimate import functions, Eq. (2-1). We use the real exchange rates defined by Eq. (3-1). In the estimation, we treat δ_{ij} as time-variant. In the model simulation, we fix δ_{ij} at the recent average.

[10] For Japan, we divide domestic demand into private demand and public demand and treat the latter as exogenous.

where RL_i is country i's real long-term interest rate, defined later. Note that the domestic demand function includes the ratio of the current account balance to potential output as an explanatory variable. This is to model the situation in which a country's current account deteriorates and foreign investors pull out their operating capital or refrain from making new investment, thereby hindering that country's production activity. This effect is expected to be serious, especially for many East Asian countries, although it is less of an issue in Japan (see Goldstein, et al. [2000]).

By definition, GDP is equal to the sum of domestic demand and foreign demand, that is, $Y \equiv D + X - M$. Log-linearizing this relationship around the benchmark-year level gives

$$\Delta \ln Y_i(t) = \mu_{1i} \Delta \ln D_i(t) + \mu_{2i} \Delta \ln X_i(t) - \mu_{3i} \Delta \ln M_i(t), \tag{3-4}$$

where $\mu_{1i} = D_i / Y_i$, $\mu_{2i} = X_i / Y_i$, and $\mu_{3i} = M_i / Y_i$, which are all fixed.

We assume that potential output follows the trend of actual output. Explicitly, potential growth is given by a one-year moving average of actual growth rates:

$$\Delta \ln PY_i(t) = \Delta \ln Y_i(t-4, t-1), \tag{3-5}$$

where $A(t-h, t-k)$ is the operator for calculating the moving average of variable A from period $t-h$ to $t-k$. When potential output is considered to move more slowly, the length of the moving average should be longer.

The output gap is defined as

$$GAP_i(t) = \ln Y_i(t) - \ln PY_i(t). \tag{3-6}$$

Note that Eq. (3-5) alone leaves the level of potential output undetermined. Thus the level of the output gap is also undetermined in Eq. (3-6). In this paper, we calculate the level of potential output so that the output gap is averaged to zero over the course of the sample period for parameter estimation.

C. Price Sector

In this paper, the entire structure of prices is based on wholesale prices (WPI). For country i, the inflation rate in wholesale prices is determined by the Phillips curve:

$$\begin{aligned} \Delta \ln WPI_i(t) = \theta_i &+ \zeta_i \Delta WPI_i(t-1) + \eta_i GAP_i(t-1) \\ &- \kappa_i \{\Delta \ln RE_i(t) - \Delta \ln WPI_i(t)\}. \end{aligned} \tag{3-7}$$

The current inflation rate depends primarily on past inflation rates and the output gap. A secondary effect on the inflation rate comes from import prices; thus we include the depreciation rate of the nominal effective exchange rate ($\Delta \ln RE_i - \Delta \ln WPI_i$) as an explanatory variable for the inflation rate.

Changes in wholesale prices are transmitted into the consumer price index (CPI) gradually over time. Explicitly, we let the inflation rate of consumer prices be a one-year moving average of the inflation rates of wholesale prices.

$$\Delta \ln CPI_i(t) = \Delta \ln WPI_i(t-3,t) . \qquad (3\text{-}8)$$

The length of the moving average should reflect the speed at which cost changes in upstream industries are passed into price changes in downstream industries. Therefore, we can adopt different lengths of moving average across different countries.

D. Financial Sector

The exchange rate and interest rates in a country are closely linked with those in other countries, though controlled partly by its local monetary authority. In particular, in a country allowing free capital movements, the open market parity condition means that there are strong international links between interest rates and exchange rates. As a result, such a country cannot determine its interest rates and exchange rate in isolation.

Since monetary policy varies across countries, modeling the determination of interest rates and exchange rates is a cumbersome task. We therefore classify the ten countries into four groups according to their adopted monetary policy rules: (a) Policy-making in Japan and the US may be reasonably described by the *Taylor rule*. (b) Malaysia, Hong Kong, and China can be considered to have adopted a *dollar-peg exchange rate* policy. (c) Singapore makes use of a *currency basket system*. (d) Indonesia, Thailand, the Philippines, and South Korea have adopted, or are about to adopt, *inflation targets*. A point to notice is that we avoid excessive generalization of the diverse monetary policies observed in the East Asian economies and take the greatest care to keep the individual characteristics of each country's real policy-making process. Below, we first describe the Japanese monetary policy and then proceed to show what modifications are required to model other countries' monetary policies.

<Japan's Financial Sector>

Since capital movements are free in Japan, the exchange rate should satisfy the

uncovered exchange rate parity condition. Denote country i's nominal short-term interest rate by I_i and the benchmark US rate by I_{us}. Let $RISK_i$ be country i's risk premium relative to the US's. Then, uncovered exchange rate parity is satisfied when

$$I_i(t) = I_{us}(t) + \Delta \ln E_i(t+1) + RISK_i(t). \tag{3-9}$$

The short-term interest rate is determined by the well-known Taylor rule, according to which the monetary authority (in country i) controls the nominal short-term interest rate, paying attention to the inflation rate (the percent change in consumer prices) and the output gap:

$$I_i(t) = C_i(t) + \pi_i\{\Delta \ln CPI_i(t) - \Delta \ln CPI_i^*\} + \chi_i\{GAP_i(t) - GAP_i^*\}, \tag{3-10}$$

where $\Delta \ln CPI_i^*$ denotes the steady-state rate of consumer price inflation and GAP_i^* the output-gap-based NAIRU (*N*on-*A*ccelerating *I*nflation *R*ate of *U*nemployment). C_i summarizes all factors other than the inflation rate and the output gap. Explicitly, it is the sum of the steady-state real interest rate, the steady-state inflation rate, and the deviation of the risk premium from its steady-state value:

$$C_i(t) = RS_i^* + \Delta \ln CPI_i^* + \upsilon_i\{RISK_i(t) - RISK_i^*\}, \tag{3-11}$$

where RS_i^* is the real short-term interest rate in the steady state.[11]

The last term is the deviation of the risk premium from its steady-state value. Basically, we consider $\upsilon_i = 1$ in this paper. This implies that the nominal short-term interest rate rises in the face of an increase in the risk premium for Japan. Together with Eq. (3-9), this means that the nominal exchange rate of the yen vis-à-vis the US dollar is independent of the risk premium. This relationship holds, when Japan's credit risk is properly evaluated in its domestic financial market and there is no difference in the degree of risk aversion between Japan and the US. Suppose that Japanese investors undervalue Japan's credit risk relative to their US counterparts. This implies that $\upsilon_i < 1$. In such a case, the yen would depreciate against the US dollar. This is because the yen would have to appreciate in the future to compensate for the smaller

[11] Eq. (3-11) has to hold even in the steady-state. This implies that the following equation has to hold:

$$RISK_i^* = (RS_i^* + \Delta \ln CPI_i^*) - (RS_{us}^* + \Delta \ln CPI_{us}^*).$$

That is, the risk premium in the steady-state is equal to the difference in the steady-state real interest rate between Japan and the US.

increase in its nominal short-term interest rate. Whether or not this is an interesting possibility, there are no simple models to describe the behavior of risk premium, and we therefore treat it as exogenous in this paper.

The real short-term interest rate is obtained from the Fisher equation:

$$RS_i(t) = I_i(t) - \Delta \ln CPI_i(t+1). \tag{3-12}$$

We use the term structure model of interest rates and define the real long-term interest rate as a 2-quarter forward moving average of the real short-term interest rate:

$$RL_i(t) = RS_i(t, t+1). \tag{3-13}$$

Various assumptions are admissible for the length of the moving average and the weights.

<Other Countries' Financial Sectors>

The US financial sector is almost the same as Japan's. Differences are that in the US case, it is not necessary to specify an uncovered exchange rate parity condition and that the US risk premium is zero by definition. Determination of the US real long-term interest rate is carried out as for Japan.

The East Asian countries adopt various exchange rate policies. For instance, Malaysia and China adopt a fixed exchange rate policy (the US dollar peg); Hong Kong has a currency board; and Singapore pegs its exchange rate to a currency basket (Chart 7). In addition, the extent to which capital controls remain in place differs across countries. Since the mid-1980s, many of the East Asian countries have deregulated their capital control policies rapidly, although Malaysia and China maintain strict capital controls even today. In this paper, we try to balance two objectives: adequate reflection of this diverse reality against the need to keep our model of monetary policy and capital controls as simple as possible.

Consider first the US dollar peg adopted by Malaysia and China and also Hong Kong's currency board. For Malaysia, the US dollar peg means that the ringgit is fixed against the US dollar and thus can be expressed as follows:

$$\Delta \ln E_i(t) = 0. \tag{3-14}$$

We can describe Malaysia's exchange rate policy by replacing Eq. (3-10) with Eq. (3-14). The same relationship may be applied to the exchange rate policies of China and

Hong Kong. Note that we assume away the uncovered exchange rate parity condition for Malaysia and China, since they maintain relatively strict capital controls in comparison to other East Asian countries. Instead, we assume that Malaysia's nominal interest rate is determined along with the inflation rate of consumer prices, while China's is treated as exogenous.

We construct Singapore's currency basket by averaging the depreciation rates of other countries' currencies, using their import shares as currency weights.[12] To obtain Singapore's currency basket policy, we equate the depreciation rate of the currency basket to that of the Singapore dollar:

$$\Delta \ln E_i(t) = \Sigma_j \delta_{ij} \Delta \ln E_j(t) . \qquad (3\text{-}15)$$

We can describe Singapore's monetary policy by replacing Eq. (3-10) with Eq. (3-15).

Some of the East Asian countries have adopted, or are about to adopt, an inflation targeting policy (South Korea in 1998, Thailand in 2000, the Philippines in 2002, and Indonesia in the near future). Since the history of inflation targeting policy is rather short in these countries, we have only limited knowledge of the mechanism with which they commit themselves to this policy. For this reason, we should be satisfied, for the time being, with estimating the following equation.

$$I_i(t) = \xi_i + \phi_i \Delta \ln CPI_i(t) + \varphi_i \Delta \ln E_i(t) . \qquad (3\text{-}16)$$

That is, monetary authorities monitor not only inflation rates of consumer prices, but also depreciation rates of their currencies, since the latter are a possible cause of future inflation.[13]

(3) Estimation of the Asian Economy Model

We estimated import functions in the previous section. There remain domestic demand functions, Phillips curves, and policy reaction functions for several countries to be estimated. We admit that it is desirable to employ an estimation technique with

[12] Singapore has been using a currency basket since 1981, but the weight of each currency in the basket has not been announced. In this paper, we substitute import shares for these weights for simplicity. Alternatively, we could use estimation results from Frankel and Wei (1994), Seki (1995), and Fukuda and Ji (2001).

[13] If the Phillips curve does not include output gap as an explanatory variable, inflation targeting and exchange rate targeting are almost the same.

which we can avoid simultaneous equation bias, e.g., the full information maximum likelihood estimator and the three step least square estimator. However, there are many equations to be estimated in the current model. For this reason, we estimate the individual equations separately by OLS. The estimation results are shown in Charts 8 to10.

To begin with, we estimated domestic demand functions (Chart 8). The samples are quarterly data. Most of them span the 1990s, though only short samples are available for some countries. Looking at our OLS estimates, we see that the fit of the domestic demand function is unsatisfactory for most countries, with coefficients of determination around 0.3; the exception is South Korea, whose coefficient of determination is close to 0.7. The fit is extremely poor for Singapore, the Philippines, and China. Thus, we treat these countries' domestic demands as exogenous in the analysis below. The low coefficients of determination may imply that the current treatment of domestic demand is too simple to adequately reflect reality. Thus, improvements will be required in future.

Let us examine the significance of the ratio of the current account balance to potential output in the domestic demand function. This ratio is not statistically significant in the domestic demand functions for Japan and the US, whereas it is statistically significant in Thailand, Malaysia, and Hong Kong. Significance of this raio implies that the trade deficit causes outflows of foreign capital, which in turn discourage both investment and production activities.

Next, we estimate Phillips curves (Chart 9). The fit of the model is good for most countries, with the exception of the Philippines and the US. The significance of individual explanatory variables varies from country to country. For Singapore and the ASEAN countries, the effects of the output gap on prices are insignificant, whereas those of the nominal effective exchange rate are significant. Thus, the Phillips-curve relationship does not hold well in these countries. In the other countries, however, the output gap is a significant variable in explaining price movements, implying that the Phillips-curve relationship holds.

Finally, we consider the estimation of policy reaction functions (Chart 10). We estimate the Taylor rule in Eq. (3-10) for Japan and the US.[14] As for South Korea, Indonesia, Thailand, and the Philippines, which have adopted, or are about to adopt, inflation targeting policies, we estimate Eq. (3-16), considering that a change in the

[14] See Kamada and Muto (2000).

exchange rate has more significant effects on the inflation rate than that in the output gap does.[15] According to the estimation results, these policy rules suit the data rather well. Note, however, that the results are based on a limited sample period (the period following the Asian Currency Crisis). Thus, we should be careful when using these results below.

IV. SIMULATION ANALYSIS

In this section, we analyze the quantitative properties of the two estimated models (the Asian Trade Model and the Asian Economy Model) by hitting them with external shocks. We investigate the following four external shocks: (i) The growth rate of Japan's domestic demand decreases by 1 percent; (ii) the yen depreciates 10 percents against the US dollar; (iii) the growth rate of US domestic demand decreases by 1 percent; (iv) the growth rate of East Asia's domestic demand decreases by 1 percent (excluding Japan). Key simulation results are also summarized in the Annex (attached on the end of this paper, following the charts).

(i) A 1 percent decline in the growth rate of Japan's domestic demand (Chart 11)

First, we simulate the situation where the growth rate of Japan's domestic demand decreases by 1 percent per annum (a -0.25 percent decline every quarter for four quarters <periods 1 to 4>). The effects on the Japanese economy are shown in Chart 11-1, which plots each variable's percentage deviation from its baseline. The effects on exports are the most remarkable. The distinctive properties of our two models -- the Asian Trade Model and the Asian Economy Model -- can be seen most clearly in the contrast between them here. In the Asian Trade Model (thin line), Japan's exports decline in the following mechanism: The decrease in domestic demand causes a decline in imports, i.e., in foreign countries' exports. This results in a decrease in foreign countries' imports from Japan, i.e., a decrease in Japan's exports.

In contrast, in the Asian Economy Model (bold line), Japan's exports first rise temporarily and decline after a while. The initial increase in exports comes from the depreciation of the yen caused by the recession. At the same time, however, foreign

[15] Only a few years have passed since South Korea, Indonesia, Thailand, and the Philippines first adopted inflation targets. Due to data availability, we estimate policy reaction functions since 1998, immediately following the Asian Currency Crisis.

domestic demand shrinks. This shrinkage reduces demand for goods exported from Japan. As time goes by, the negative effects from the latter outweigh the positive effects from the former, that is, the yen's depreciation. Eventually, Japan's exports in the Asian Economy Model fall short of their level in the Asian Trade Model.

The increase in prices is also worth remarking. The depreciation of the yen pushes up Japan's price level temporarily. After a while, however, prices are put under downward pressure generated by the negative output gap due to the recession, as the Phillips curve predicts.

Faced with the worsening of the output gap and the deflation, the monetary authority must lower the nominal short-term interest rate in accordance with the Taylor rule. Since the late 1990s, however, the short-term interest rate has already reached zero percent in Japan. Thus the monetary authority no longer has the option to lower the interest rate. In this case, the economic slump and the resulting deflation are likely to be severer than shown in the simulation here.

Next, we turn to the effects of the Japanese recession on the Thai economy (Chart 11-2). The Thai baht depreciates against the US dollar. This is a consequence of market investors foreseeing that the monetary authority will lower the interest rate when prices begin to decline in future. What is more important, however, is that the real effective exchange rate will not decline, since many of the other countries' currencies depreciate as well. Consequently, Thai exports and real GDP continue deteriorating. In addition, the decline in foreign demand leads to a decrease in the ratio of the current account balance to potential output, which impacts negatively on domestic demand (Eq. 3-3).

(ii) A 10 percent depreciation of the Japanese yen against the US dollar (Chart 12)

Next, we simulate the situation in which the Japanese yen depreciates against the US dollar by 10 percent. A bit of a trick is necessary to generate this situation. Exploiting the model's forward-looking property, we supply a shock that devalues the yen in the remote future so that the yen depreciates by exactly 10 percent in the current period.

Chart 12-1 depicts the effects of the depreciation of the yen on the Japanese economy. A point worth noting is that the effects on exports in the Asian Economy Model are smaller than those in the Asian Trade Model. In the Asian Trade Model (thin line), exports rise above their baseline value. This is almost trivial, since the yen

depreciates. Of more importance is that exports expand only temporarily in the Asian Economy Model (bold line). This happens in accordance with the following mechanism. The depreciation of the yen causes foreign countries' exchange rates to appreciate. This induces a decrease in exports, an increase in imports, and thus a reduction of income in foreign countries, which in turn results in a decline in domestic demand. Foreign countries then reduce imports and thus exert downward pressure on Japanese exports.[16]

The above simulation results show that the weak yen has a "beggar-thy-neighbor" effect on other Asian economies. Initially, the Japanese monetary authority raises the interest rate to suppress the price hike caused by the depreciation of the yen. This dampens the increase in the domestic demand, thereby restraining the rise in real GDP. Thereafter, as inflation weakens, the interest rate returns to its initial level, removing the downward pressure on domestic demand. Supported also by increases in exports, real GDP begins eventually to expand. In the East Asian countries, on the other hand, real GDP declines along with the decrease in foreign demand caused by the appreciation of real effective exchange rates. For confirmation, see the simulation results for Thailand (Chart 12-2). Of particular importance is that the decrease in the ratio of the current account balance to potential output reinforces the above effects by suppressing domestic demand as well and spirals down real GDP.

(iii) A 1 percent decline in the growth rate of US domestic demand (Chart 13)

Next, we simulate the situation where the growth rate of US domestic demand declines by 1 percent per annum (a -0.25 percent decline every quarter for four quarters <periods 1 to 4>). A point worth remarking is the effect on Japanese exports, shown in Chart 13-1. In the Asian Trade Model, Japanese exports fall below their baseline by -1 percent. Since the US is Japan's biggest export market, it is quite natural that a recession in the US economy has a direct impact on the Japanese economy. Nonetheless, the magnitude of the impact is quite large, when we consider that the US share of Japan's total exports is at most 30 percent. The following indirect effect is important in explaining this: The recession in the US induces a reduction in Asia's exports to US markets; this in turn reduces Japan's exports to Asia.

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[16] Note that we do not take into account the possible effect that the yen depreciation shifts demand overseas to Japan. Such an effect is missed both in the Asian Trade Model and in the Asian Economy Model. Thus, the effects on Japanese exports shown in chart 12-1 may be subject to underestimation.

Furthermore, a decline in US domestic demand has long-lasting dampening effects on world business. The main reason is that a diminishing US market for other countries' exports causes world income to spiral down. At the same time, some countries, such as Thailand, experience exchange rate appreciation. This squeezes their net exports and thus income still further (Chart 13-2). These two effects work synergistically to cause the world economy to shrink. As a result, Japanese exports fall below its baseline by about -3.5 percent.

(iv) A 1 percent decline in the growth rates of domestic demand across all of the East Asian economies (excluding Japan) (Chart 14)

Finally, we simulate the case where the growth rates of domestic demand decrease across all of the ASEAN economies, the NIES economies, and China by 1 percent per annum (a -0.25 percent decline every quarter for four quarters <periods 1 to 4>). As shown in Chart 14-1, in the Asian Trade Model, the decrease in Japanese exports is one fifth of that observed for the decline in US domestic demand simulated above. The magnitude of the impact seems quite reasonable, considering that East Asia share of Japan's total exports is around 30 percent.

This result has an important implication, when combined with the results obtained in the earlier simulation of a decrease in US domestic demand. Both the US and the East Asian countries have 30 percent shares of total Japanese exports. Nevertheless, the magnitude of the impact on the Japanese economy differs dramatically, depending on where the shock comes from. This difference reflects the respective roles that the two economic areas play in the world economy: the US as the "world's largest consumer" and the East Asian economies as the "world factory." A decrease in domestic demand in the East Asian economies, which are not final destinations of consumption goods, has a relatively small impact on Japan, and indeed on the global economy. For instance, in the simulation of a decline in US domestic demand, a decline in Thailand's real GDP is -4.5 percent 2 years after the shock. In comparison, when we simulate a decrease in the East Asian economies' domestic demand, the corresponding decline in Thailand's real GDP is -2 percent after 1 year, and only -1.5 percent after 2 years.

V. POLICY ANALYSIS

In this section, we explore the following question: How does shifts of policy rules by some of the East Asian countries affect not only their own economies but also other countries' economies? In the previous section, we conducted various simulations to explore the model's properties under the policy rules being employed by these countries in 2002. As observed there, the international division of labor developed within the East Asia has created an environment where one country's policymaking has substantial effects on other countries. In this section, based on the Asian Economy Model, we provide one perspective on the following question: Which policy regime should be preferred for the East Asian economies?[17]

(1) Policy Regime

A combination of individual countries' "policy rules" is called a "policy regime" in this paper. Various policy regimes can be generated. It is unrealistic, however, to examine all the possible policy combinations for the ten countries. Here, in addition to the current regime described above, we focus on the following two policy regimes. The first regime is called the "US dollar peg regime" and describes a regime in which all the countries, except for Japan and the US, are assumed to employ a US dollar peg policy. This regime is broadly consistent with the situation before the Asian Currency Crisis (1997). As history has demonstrated, it was not only a key determinant of the "East Asian Miracle," but also proved to be instrumental in compounding the "Asian Currency Crisis." Remember that Malaysia, Hong Kong, and China currently employ a dollar peg policy. Therefore, there are five countries (Indonesia, Singapore, Thailand, South Korea, and the Philippines) that would be required to change their policy rules to conform to this new regime.

In the second regime, we assume that all the countries, except for Japan and the US, peg their currencies to their respective currency baskets. The East Asian countries are assumed to construct their own currency baskets with import shares as currency weights and to peg their currencies to these baskets (we assume the same scheme for Singapore). We call this the "currency basket regime." There are many advocates

[17] Our model does not discuss the generation mechanism of currency crisis and leaves open the following questions: Why and how did the past currency crises occur? Our model is designed to show the most plausible behavior of the East Asian economies before and after a currency crisis occurs.

for this regime. The purpose of this section is to show whether their opinions are supportable on the basis of our econometric model.

(2) Shock Simulation

The preferred choice of policy regime for the East Asian countries may differ, depending on the nature of the shock that hits their economies. We consider the following two specific shocks in this paper. In the first scenario, we assume that the growth rate of US domestic demand decreases by 1 percent per annum. In the second scenario, we assume that the Thai baht depreciates by 10 percent and that the growth rate of its domestic demand declines by 10 percent.

(i) A Shock from the US (Chart 15)

The first scenario assumes a 1 percent decline in the growth rate of US domestic demand (a -0.25 percent decline every quarter for four quarters). We showed in the previous section how seriously this type of shock affects the East Asian economies. In fact, the IT depression since 2000 and the terrorist attacks in 2001 have shown how economic turbulence in Asia can be amplified in a chain-reaction of real economic deterioration and financial contagion. In this section, we discuss the policy regime that is the most effective in ameliorating the impact of economic shocks on East Asian countries.

In the case of a US domestic demand shock, the influence of the choice of policy regime is felt most strongly in Thailand. Chart 15 shows the extent to which regime choice affects impulse responses in Thailand. Note the movements of the output gap.[18] Among the three policy regimes, the currency basket regime (broken line) minimizes the volatility of the output gap, which is half as large as in the current regime (bold line). The US dollar peg regime (thin line) amplifies economic turbulence further. Specifically, the distance from peak to trough in the US dollar peg regime is three times as large as in the currency basket regime. In consequence, it is the currency basket regime that minimizes the Thai business cycle against a US domestic demand shock.

[18] There is some question about the appropriate criteria to use in evaluating the preferred policy rule. For the countries that adopt the Taylor rule (i.e., Japan and the US), criteria are the volatility of their business cycles (the output gap or the volatility of GDP) and their inflation rates. There is no consensus, however, on whether the same criteria are applicable for East Asian countries.

Though not shown here, the currency basket regime is the best currency system for many of the East Asian countries. In some countries, although the currency basket regime is not the best, it is virtually harmless. South Korea, Malaysia, and Hong Kong can gain by switching to the currency basket regime. Remember that the ratio of the current account balance to potential output is one of the explanatory variables in the domestic demand function for Thailand, Malaysia, and Hong Kong. The reason that the currency basket regime stabilizes these economies is that it acts to stabilize both the real effective exchange rate and the current account balance, thereby preserving a positive investment environment for foreign capital.[19]

(ii) A Shock from Thailand (Chart 16)

Next, we assume that the Thai baht depreciates by 10 percent against the US dollar and the growth rate of its domestic demand decreases by 10 percent (a -2.5 percent decline every quarter for four quarters). This is an example of an internal shock, i.e., one that originates inside the East Asian region. The Asian Currency Crisis was initiated by a speculative attack on the Thai baht. Nevertheless, the secondary effects were very real and involved a sequential deterioration in real economic activity across the area. Our focus in the current scenario is not to investigate the transmission mechanism of financial shocks (i.e., financial contagion) but to analyze the behavior of the real side of economy that follows the financial shock.

It is interesting to look at the effects of the current shock on the Thai economy, that is, the source of the shock itself. Chart 16 depicts the different Thai impulse responses, depending on the choice of policy regime. The volatility of the output gap is larger in the current regime (bold line) than it is in the currency basket regime (broken line) or in the US dollar peg regime (thin line). The output gap in the currency basket regime is half as much as that in the current regime.

For Thailand, the US dollar peg regime has almost the same stabilization effect as the currency basket regime. Though not shown here, however, this stabilization effect is slightly larger for the currency basket regime than for the US dollar peg regime in

[19] The reasons that the volatility of South Korea's output gap shrinks under the currency basket regime are as follows. The speed with which the real effective exchange rate appreciates is slowest under the currency basket system; the concomitant price decline is moderate. As a result, South Korea's monetary authority does not need to cut its short-term so aggressively. In the domestic demand function of South Korea, the real interest rate is statistically significant. Therefore, not only the domestic demand but also the volatility of the output gap is reduced.

many countries, e.g., in Malaysia. When the US dollar peg regime is replaced with the currency basket regime, the real effective exchange rate depreciates rather than appreciates. This eases the decline in the ratio of the current account balance to potential output that occurs immediately after the shock. As a result, the volatility of the output gap is reduced.

(3) Summary

In this section, we simulate the two scenarios in which the East Asian countries switch from the current policy either to a US dollar peg policy or to a currency basket policy. With the output gap fluctuation as a criterion, we investigate the preferred policy regime for the East Asian countries. Our results suggest that the currency basket regime, which tames international capital flows effectively, is preferable from the viewpoint of economic stabilization. Especially, the currency basket regime has greater potential to achieve economic stability than the current policy regime.

In general, there may emerge conflicts of interests between countries in the choice of policy regime. Nonetheless, in the above case, conflicts among East Asian countries are small enough to agree to take the currency basket regime. It seems natural, however, to think that the preferred policy regime may be replaced when the economic structure changes. We should be aware that the estimations in our model are carried out, using a very specific sample (East Asia in the 1990s); thus it is necessary to keep track of the changing economic structure in applying the model to the highly variable Asian economies of the 21st century.

VI. CONCLUSION

In this paper, we try to understand the mechanism underlying the "rise and fall" of East Asia during the 1980s and 1990s through simulations using a macro-econometric model. We ascertain that the growth of the Asian economies was founded on the international division of labor and deep interdependence within the area. We also show that this deep interdependence contributed to East Asia's vulnerability. Furthermore, we point out how rapidly international capital flows might exacerbate the business cycle in the East Asian economies.

We conduct detailed simulations to see what implications these Asian economic characteristics have for the Japanese economy. A few decades ago, it was enough for

Japan to pay attention to the US economy. Recently, however, the Japanese economy has become involved in the East Asian international division of labor and thus affected by the business cycle in East Asia. In order to consider the effect of the US business cycle on the Japanese economy, it is not enough to look only at its primary effects on Japanese exports. We must also note that the US business cycle creates business cycles in East Asia and that these in turn affect Japanese exports.

As suggested in our model, exchange rates play an important role in the evolution of business cycles in the East Asian economies. Since the Asian Currency Crisis, much research has been devoted to the question of the optimal currency regime for the Asian region. This paper analyzes the same question from the viewpoint of an econometric model. The results favor the currency basket regime. Nonetheless, we should bear in mind that East Asia has experienced rapid structural changes recently and it is highly likely that the preferred currency system will change, as time passes.

APPENDIX A

BRIEF CHRONOLOGY OF CURRENCY SYSTEMS IN EAST ASIA

The high growth in East Asia from the mid-1980s through the early 1990s was praised as the "East Asian miracle." This growth was supported by massive capital inflows from Japan, the US, and Europe. Many East Asian countries adopted a *de facto* US dollar peg to promote capital inflows from abroad. At the same time, many monetary authorities in East Asia preferred to adopt independent monetary policies. It was in this economic environment that the depreciation of the Thai baht in 1997 triggered the Asian Currency Crisis. In order to survive in the international community, East Asian countries were urged not only to deal with the crisis that confronted them, but also to establish a new currency system after the crisis has passed.

A consensus has emerged among economists that there exists an "open-economy tri-lemma."[20] This tells us that the three policy goals, "independent monetary policy," "free capital mobility," and "exchange rate stability" cannot be achieved simultaneously. If a country desires to pursue an independent monetary policy to stabilize its domestic economy, then it has to give up either exchange rate stability or free capital movement. Similarly, if a country prefers to invite foreign capital by stabilizing its exchange rate and liberalizing its capital markets, then it has to abandon an independent monetary policy. The Asian Currency Crisis forced the monetary authorities in East Asia to acknowledge the risk of pursuing their economic goals in ignorance of the "open-economy tri-lemma."

In this appendix, we discuss how the East Asian countries have operated their financial markets over the two decades since the early 1980s. Due to limitations of space, we are unable to present a comprehensive history of the Asian financial system. Instead, we focus on the major historical events that are indispensable for understanding the arguments in this paper. We review the evolution of policy systems in the East Asian economies, taking special note of "exchange rate market operations," "monetary policy in pursuit of domestic economic stability," and "capital controls."

[20] Different names are given to the same notion: unholy trinity, impossible theorem, inconsistent trinity, and incompatible trinity.

(1) Indonesia

In 1978, Indonesia abandoned its fixed exchange rate system (the US dollar peg) and adopted a managed floating exchange rate system. The latter system was maintained until the Asian Currency Crisis in 1997. Capital and exchange transactions have been deregulated gradually over the past thirty years and have contributed to the high economic growth during the 1990s in Indonesia.

The outbreak of the Asian Currency Crisis in 1997 forced Indonesia to adopt an independent floating exchange rate system. When the depreciation of the Thai baht triggered the currency crises, the effects were transmitted all over East Asia and the Indonesian rupiah was also exposed to substantial downward pressure. At the beginning of the crisis, the monetary authority sought to preserve its managed float by widening the exchange rate target band. However, the authority was eventually forced to give up the target band.

Indonesia currently maintains an independent free floating exchange rate system. Nevertheless, the stability of the rupiah remains one of the main concerns of the monetary authority. Capital transactions are almost free in Indonesia, although, since 2001, there has been some "non-internationalization" of the rupiah (regulations on offshore transaction of the rupiah). Indonesia is gradually introducing an inflation targeting policy to replace the exchange rate as a nominal anchor.[21]

(2) Singapore

In 1973, when the Bretton Woods System collapsed, the Monetary Authority of Singapore (MAS) adopted a managed floating exchange rate system in line with other industrialized countries. In 1981, the MAS shifted to a currency basket system and has maintained this system to date.[22]

The "non-internationalization" of the Singapore dollar is at the heart of this country's capital control policy. The purpose of this policy is to protect the Singapore dollar from being sold speculatively by non-residents. There is some discussion that the non-internationalization policy blocked currency speculation and limited the damage

[21] The central bank had been a part of the government in Indonesia. In May 1999, the government amended the banking law and assured independence to the central bank.

[22] The MAS currency basket, composed of the currencies of the country's main trading partners, is managed so that it moves within a certain target band. So far, the MAS has kept secret both the currency composition of the basket and the target band.

of the Asian Currency Crisis on the Singapore dollar.

In Singapore, the currency basket system is one of the measures by which to achieve price stability. The MAS operates domestic monetary policy in accordance with this system. As for capital controls, the non-internationalization policy is gradually being liberalized to foster the domestic capital market. For instance, non-residents are now allowed to buy the Singapore dollar necessary to buy stocks and bonds denominated in Singapore dollars.

(3) Thailand

In 1984, Thailand adopted a currency basket system in place of its fixed exchange rate system (the US dollar peg). At first, the composition of the currency basket was determined on a trade-volume basis. As time passed, however, the weight of the US dollar became dominant in the currency basket. We can therefore consider Thailand to have been employing a *de facto* US dollar peg system, when the Asian Currency Crisis occurred. Though somewhat skewed in its make-up, the Thai currency basket system lasted 13 years until the 1997 crisis.

During the first half of the 1990s, Thailand eased regulations on inward investment. In particular, the Bangkok International Bank Facilities (BIBF; an offshore financial market established in 1993) allowed non-resident-to-resident transactions as well as non-resident-to-non-resident transactions. The BIBF played a significant role in raising the enormous funds necessary for the country's economic growth.

In the second half of 1996, Thai exports slowed, putting the brakes on GDP growth. Against this background, market investors began to suspect that the Thai baht might be overvalued. Finally, in May 1997, foreign speculators began a massive sell-off of the baht. In July, the monetary authority ran short of foreign currency reserves and could not protect the baht anymore. The currency basket system was abandoned eventually.

Faced with this situation, the Thai government started to regulate capital inflows to the BIBF. Furthermore, non-internationalization of the Thai baht (regulations on offshore transactions denominated in Thai baht) was introduced after the crisis. As for domestic monetary policy, Thailand adopted an inflation targeting policy in May 2000, which it hoped would provide a new nominal anchor to replace the currency basket system.

(4) The Philippines

From 1994 to 1998, the Philippines employed a *de facto* US dollar peg. Exchange control was implemented according to the "real demand principle" of exchange contracts. Actual exchange control, however, was not very complete due to the existence of the *forex corporations*.

The Philippine peso weakened in the midst of the Asian Currency Crisis. The monetary authority was forced to devaluate the peso in 1997. The impact of the crisis on the Philippine economy, however, was smaller than on other ASEAN economies. This was because the low ratings of private companies under the Marcos Administration have discouraged foreign funds from entering the country in the first place.

The Philippines has been under an independent floating exchange rate system since 1998. To provide a new nominal anchor, an inflation targeting policy has been in operation since 2002. After the crisis, the government strengthened regulations on the forex corporations.

(5) Malaysia

When the Asian Currency Crisis occurred in 1997, Malaysia was under a managed floating exchange rate system. Even after a substantial depreciation during the crisis, the Malaysian ringgit still found itself under strong downward pressure due to the unstable financial system -- a crash of equity prices and a rise in the non-performing-loan ratio.

Malaysia overcame the Asian Currency Crisis without assistance from the IMF. This was largely owing to restrictions on overseas borrowing that limited the amount of short-term debt, and also due to the country's adequate holdings of foreign exchange reserves. In 1998, new capital regulations (suspension of the offshore ringgit market and of overseas remission of equity-sales proceeds by non-residents) were introduced. At the same time, a fixed exchange rate system (the US dollar peg) was adopted.

As the Asian Currency Crisis receded, the government gradually removed the regulations governing overseas remission of equity-sales proceeds. To date, these regulations have been completely withdrawn. In contrast, the offshore ringgit market is still suspended. Thus, non-residents cannot carry out short-sales of the ringgit.

(6) South Korea

In 1980, South Korea adopted a currency basket system in place of its fixed exchange

rate system (the US dollar peg). In 1990, the country then adopted a managed floating exchange rate system and limited daily movements of the exchange rate. As for exchange controls, South Korea accepted its obligations under Article VIII of the IMF Article of Agreement in 1988 and removed all the restrictions on the won trading necessary for current account transactions. Of the restrictions on the capital account, the first to be liberalized was outward investment. This followed the emergence of the excess liquidity problem after South Korea became a current-account surplus country toward the end of the 1980s.

From 1995, however, a heating-up of South Korean domestic demand increased imports, while the combination of a strong won and a weakened yen reduced exports substantially. As a result, South Korea's current account fell into substantial deficit. A large portion of this deficit was financed with short-term loans from the country's local banks. From 1997, following the bankruptcy of some *chaebols* (South Korean conglomerates), non-performing loans piled up in the banking sector. When short-term foreign funds fled overseas, the Korean won experienced a dramatic depreciation. At the end of 1997, the South Korean monetary authority was forced to shift to an independent floating exchange rate system.

In 1997, South Korea called for IMF economic assistance and started a series of structural reforms: tightening of macroeconomic policy, reform of its financial and corporate sectors, liberalization of capital transactions (especially related to inward investment). South Korea adopted an inflation targeting policy in 1998 and placed "price stability" at the heart of its monetary policy.

(7) Hong Kong

In 1974, following the breakdown of the Bretton Woods System, Hong Kong abandoned its currency board system, in which the Hong Kong dollar was pegged to the British pound, and adopted a floating exchange rate system instead. In 1983, however, the Hong Kong monetary authority returned to the currency board system in response to the massive speculation triggered by the dispute over Hong Kong's reversion to China from the UK.

A currency board system differs from a fixed exchange rate system in that it requires bank notes to be fully backed by foreign reserves. This requirement is considered to enhance the stability of the exchange rate by reinforcing the credibility of the government commitment to exchange the currency for foreign reserves on demand. In 1998, during the Asian Currency Crisis, foreign speculators started what is known as

"double trading," i.e., selling short both in the Hong Kong dollar market and in the Hong Kong stock market. The Hong Kong Monetary Authority, however, tamed the stock market successfully through its aggressive market intervention.

Under the currency board system, Hong Kong is unable to control monetary aggregates freely. Therefore, it cannot ease monetary policy and expand the money supply to stimulate the domestic economy. The corollary of Hong Kong's desire to stabilize its exchange rate is that it gives up its independent monetary policy instead.

(8) China

China abolished its dual exchange rate system, whereby official and market rates coexisted, in 1994 and has only a single market exchange rate today. China employs a managed floating exchange rate system. Nonetheless, the Chinese yuan moves against the US dollar by only tiny amounts. Thus, we can consider this to be a *de facto* US dollar peg system.

China continues to impose strict exchange controls, even after it accepted in principle its obligations under Article VIII of the IMF Article of Agreement in 1996. The purpose of exchange control is to achieve exchange rate stability. In China, (i) currency trading necessary for current account transactions is free; but (ii) that necessary for capital transactions is strictly controlled. It is thanks to this strict regulation as well as its great current account surplus that China managed to keep the yuan stable in face with the Asian Currency Crisis, despite rumors of currency depreciation.

As described above, China pursues exchange rate stability, while controlling capital movements strictly. This leaves the Chinese government room for conducting monetary policy to manage the domestic economy.

The WTO accession in December 2001, however, is changing the environment surrounding the Chinese system of regulations. The main obligation incurred in the country's accession to the WTO was the removal of regulations on trade and direct investment, including reductions in import tariffs and removal of non-tariff barriers. Nonetheless, as the Chinese market opens up to the global economy, there will emerge considerable pressure for it to deregulate its capital controls. If China wishes to keep its monetary policy independent and to relax capital controls, it will have to allow the Chinese yuan to move more flexibly than it has to date.

APPENDIX B

ECONOMIC CONSEQUENCES OF CHINA'S WTO ACCESSION

(1) China Now

China's recent economic achievements have been remarkable, and this country has enhanced its presence rapidly in the world economy. The country's growth rate in the 1990s reached 9.7 percent on average.[23] In world rankings of nominal GDP, China was 11th in 1990, but had climbed to 6th in 2000 (following the US, Japan, Germany, the UK, and France).[24] This high growth in China was primarily attributed to the government's export-oriented economic policy. Actually, China's exports almost quadrupled during the 1990s, and the country's share of world exports rose to about 4 percent in 2000.[25]

China was accepted as the 143rd WTO economy in the Ministerial Conference in Doha (capital of Qatar) on November 10, 2001. According to the WTO, China obtains an institutional guarantee to enjoy benefits, such as the "Most Favored Nation Treatment" and the "Equal National Treatment." However, China must also incur plenty of costs, through lowering import tariffs, lifting non-tariff barriers, and reducing or removing export subsidies.[26] Due to the strong international dependence within the Asian region, China's trade liberalization is significant not only for its own economy but also for the Asian economies as a whole. We investigate the economic consequences of China's accession to the WTO in this appendix. First, we summarize

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[23] China, *Statistical Yearbook* (2001).

[24] IMF, *World Economic Outlook (WED) Database* (October 2001).

[25] IMF, *Direction of Trade Statistics*.

[26] "Most Favored Nation Treatment (MFN)" is one of the WTO fundamental principles. It states that the trade treatment extended to the country that receives the most favorable terms of trade should be extended equally to all the other countries. "Equal National Treatment" is another WTO principle, which states that commodities imported from abroad should be dealt on the same terms as those made domestically. 65 percent of China's exports are directed to Japan, the US, and Hong Kong (returned by the UK to China in 1997). Japan and the US have had the MFN Treatment with China since the long before China acceded to the WTO. This means that the WTO MFN adds little in the way of economic benefits for China, except that its MFN status is ensured by the WTO.

the effects of China's accession to the WTO qualitatively. Then, we simulate a lowering of Chinese import tariffs, using the model developed in Section III.

(2) Effects of China's Accession to the WTO (Qualitative Analysis)

Here, we summarize the expected qualitative effects of China's accession to the WTO both on China itself and on other countries. First, we consider the economic gains and losses to China itself. China's gain is to enjoy WTO privileges, including the "Most Favored Nation Treatment" and the "Equal National Treatment." The WTO dispute settlement mechanism ensures China's international competitiveness. This mechanism removes trade barriers intended to block Chinese merchandise. As a result, China's export of labor-intensive commodities is likely to expand in future.

Meanwhile, the lowering of import tariffs, the removal of non-tariff trade barriers, and the reduction or elimination of export subsidies are all represent losses to China at least in the short run.[27,28] Since China's accession to the WTO, the Chinese industries that were protected by high import tariffs are being exposed to severe competition with commodities made in foreign countries or by foreign-affiliated companies. Inefficient enterprises are being urged to restructure or driven to bankruptcy. Consequently, high unemployment may prevail temporarily. These effects are expected to be felt especially strongly in industries that are not internationally competitive, such as IT-related sectors, car manufacturing, service sectors, and agriculture. Short term discomfort, however, will produce gains in the long-run by establishing a firm foundation from which the Chinese economy can progress in future.

We turn now to the effects on other East Asian countries. To be a member of the WTO, China is obliged to open up its market to other East Asian economies by lowering import tariffs and by removing non-tariff trade barriers. Thus an inevitable short run gain for the East Asian countries is the expansion of their exports to China. China, however, is viewed as the "factory for the world" in a wide variety of industries and not just in the old labor-intensive industries. With China's accession to the WTO, the East Asian economies must not only compete with China in international trade, but also maintain the foreign investment and technology transfer that have hitherto supported their development. Experience of many economic crises since the mid-

[27] China is a developing country and thus can apply for special tariff treatment.

[28] Furthermore, China promised to sign the Information Technology Agreement (ITA) and to remove tariffs on and non-tariff barriers for information technology goods.

1990s makes the East Asian countries particularly sensitive to Chinese economic development. Notice, however, that China's accession to the WTO will intensify international competition and force East Asian firms to pursue further improvements in production efficiency. All these will enhance East Asia's potential to develop in future.

The economic effects of China's accession to the WTO are summarized as follows. China's short-run gains include an increase in foreign direct investment and technological transfer from the industrialized countries as well as an enlarged market for Chinese commodities. China's short-run losses are the expansion of imports and reduction in real GDP caused by the lifting of import tariffs and the removal of non-tariff trade barriers. A short-run gain for other countries is the increase in their exports that results from the removal of China's trade barriers. A short-run loss for them is the increased competition with China for foreign capital. Taking a long-run perspective, however, China's accession to WTO will prompt productivity growth and enhance economic welfare in the Asian economies.

(3) Effects of China's Accession to the WTO (Quantitative Analysis)

There are numerous estimates of the expected economic effects of China's accession to the WTO. As may be guessed from the qualitative discussion above, however, most of these effects are hard to capture quantitatively. For this reason, measured effects vary across researchers.[29] To sidestep some of the problems, we adopt the following strategy. First, we calculate the negative effects of China's reduction in import tariffs.[30] Second, we observe whether a tiny positive shock can succeed in overcoming the negative effects of reductions in tariffs and increase Chinese real GDP. If only a small positive shock is enough, clearly its accession to the WTO benefits China.

The tariff reduction agreements in the Doha WTO Ministerial Conference are summarized as follows:

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[29] It is often pointed out that it is hard to simulate in an econometric model the effects of the removal of export subsidies and non-tariff trade barriers or the liberalization of the service sector.

[30] To prepare the accession to the WTO, China concluded bilateral agreements with 37 countries that wanted to make negotiations individually and promised to open its markets in agriculture, manufacturing, and the service sector.

(i) The tariff concession rates for all 7,151 items are gradually lowered from 17.5 percent (average in 1998) to 9.8 percent (putative average in 2010);
(ii) The tariff concession rates for 6,174 industrial items are gradually lowered from 16.6 percent (average in 1998) to 8.9 percent (putative average in 2010);
(iii) The tariff concession rates for 977 agricultural items are gradually lowered from 22.7 percent (average in 1998) to 15.0 percent (putative average in 2010).

When China lowers its tariffs according to this agreement, its import prices will fall. In addition, the fall in import prices will push domestic prices down. Below, we consider the following specific scenario: On the basis of China's import penetration rate (17 percent), China's quarter-to-quarter consumer price inflation rate is assumed to fall 0.11 percent annually (a 0.028 percent decline every quarter) over the period 1998/1Q-2010/4Q. The fall in import tariffs implies a decline in import prices for Chinese residents. This section captures this event as an appreciation of the real effective exchange rate. We employ the Asian Economy Model built in Section III in order to simulate China's accession to the WTO.

According to the simulation result (Chart B, bold lines), China's real imports rise about 0.1 percent above their baseline one year after starting tariff reductions. In the first year, the ratio of the current account balance to potential output falls slightly, since real exports do not increase by much. Real output declines by only 0.01 percent; potential output declines by an even smaller amount. Price deflation is also only 0.15 percent. After twelve years, when, tariff reductions complete, the increase in trade volume is not very large: Imports rise about 1.5 percent above their baseline, while exports around 0.2 percent. This tells us that the tariff reductions required for China are too small to have substantial negative effects on the country's economy.

China's accession to the WTO will stimulate foreign direct investment and will provide further impetus to its production. As a result, China will start to expand, led by its own domestic demand. The above result suggests that these positive effects will easily overwhelm the negative effects of tariff reductions. Chart B (thin lines) simulates the case where the growth rate of Chinese domestic demand rises 0.1 percent annually. The results show that the accession to the WTO is likely to benefit China on the whole.

Though not shown in the chart, in line with the increase in Chinese imports, both Japanese real exports and imports rise by 0.01 percent above their baselines one year after the tariff reductions start. Even after 12 years, the overall rise in Japanese exports

is only 0.2 percent and for imports it is only 0.1 percent. The yen appreciates against the US dollar, moving about 0.05 percent above its baseline at its peak. Overall, China's reduction in tariffs has only minimal influence on the Japanese economy. Among other East Asian countries, China's trade liberalization policy will benefit South Korea most, since the share of its total exports that go to China amounts to 12 percent.

The above analysis focuses on the effects of tariff reductions in measuring the effects of China's accession to the WTO. In doing so, we ignore the fact that tariff reduction rates differ across import items. A big defect is the exclusion from the analysis of the effects of lifting non-tariff trade barriers. Therefore, our result may underestimate the negative effects felt by China and other countries to some extent.

REFERENCES

Bayoumi, T., "International Trade and Real Exchange Rates," in *Exchange Rate Movements and Their Impact on Trade and Investment in the APEC Region*, International Monetary Fund, Washington, D.C., 1996.

Frankel, J. A., and Shang-Jin Wei, "Yen Bloc or Dollar Bloc: Exchange Rate Policies of the East Asian Economies," in T. Ito and A. O. Krueger (eds.), *Macroeconomic Linkage*, University of Chicago Press, Chicago, 1994, pp. 295-329.

Fukuda, S., and C. Ji, "Tsuka kiki go no higashi asia no tsuka seido (East Asia's Currency System after the Asian Currency Crisis)," *Monetary and Economic Studies*, Institute for Monetary and Economic Studies, Vol. 20, No. 4, Bank of Japan, 2001, pp. 205-250 (in Japanese).

Goldstein, M., and M. S. Khan, "Income and Price Effects in Foreign Trade," in R. W. Jones and P. B. Kenen (eds.), *Handbook of International Economics*, Vol. II, Elsevier Science Publishers B. V., Amsterdam, 1985.

Goldstein, M., G. L. Kaminsky, and C. M. Reinhart, *Assessing Financial Vulnerability*, Institute for International Economics, Washington, D. C., 2000.

Isogai, T., H. Morishita, and R. Rüfer, "Higashi Asia no boueki wo meguru bunseki -- hikaku yui kouzou no henka, ikinaigai boueki flow no sougo izon kankei (An Analysis of East Asian Trade -- structural changes in comparative advantage and interaction of intra- and inter-regional trade in East Asia)," *Bank of Japan International Department Working Paper Series*, No. 02-J-1, 2002 (in Japanese).

Kamada K. and I. Muto, "Forward-Looking Models and Monetary Policy in Japan," *Bank of Japan Research and Statistics Department Working Paper Series*, No. 00-7, 2000.

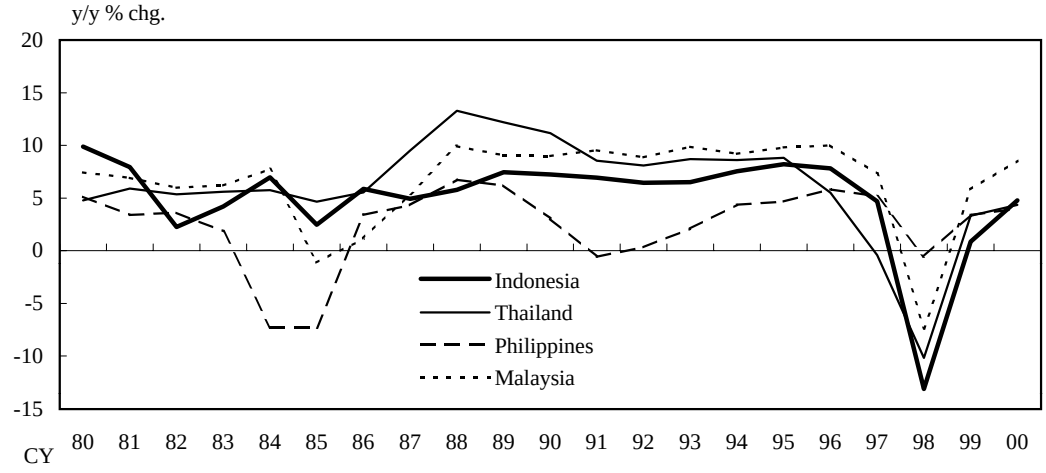
Kamada, K., Y. Oenoki, and K. Watanabe, "A Local Model of Asian Economies," *Bank of Japan Research and Statistics Department Working Paper Series*, No. 98-5, 1998.

Kwan, C.H., *En ken no keizai gaku* (Economics in the yen area), Nihon keizai shinbunsha, 1995 (in Japanese).

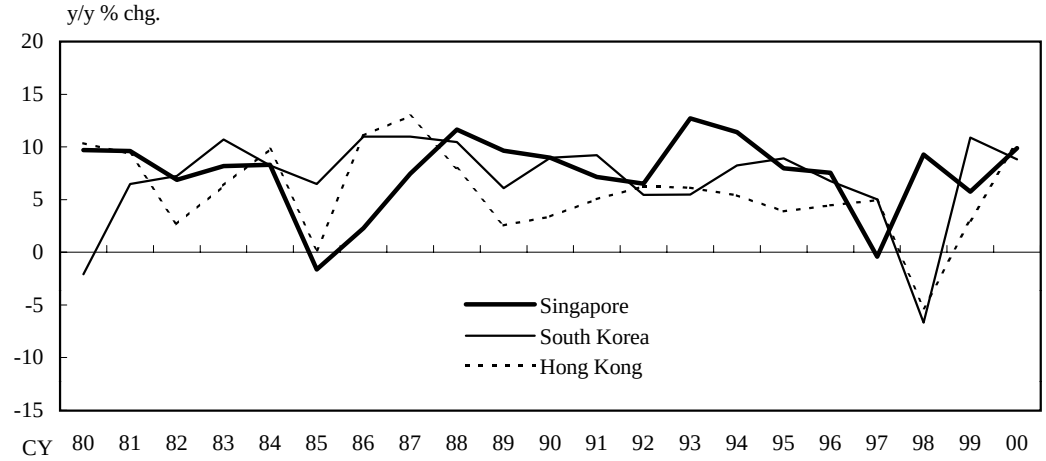
Chart 1

Real GDP Growth in the Asia-Pacific Region

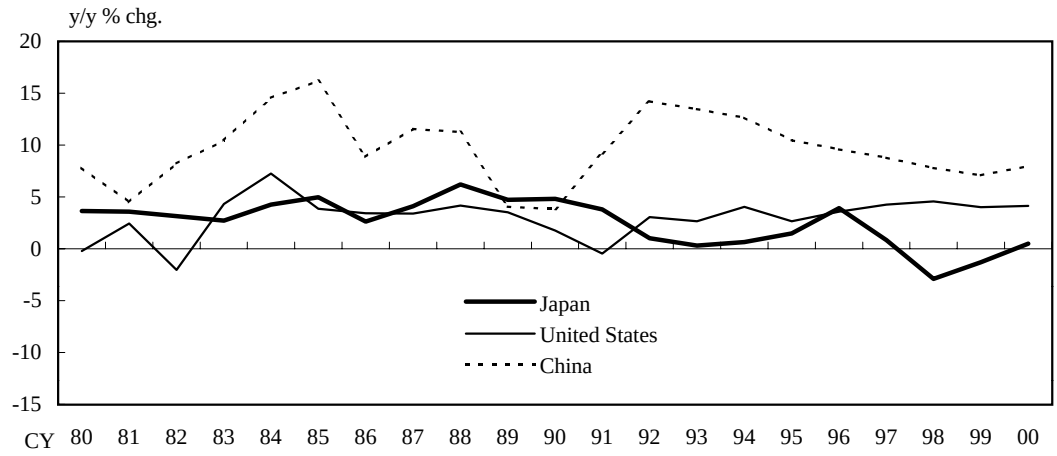
(1) ASEAN



(2) NIES



(3) Large countries

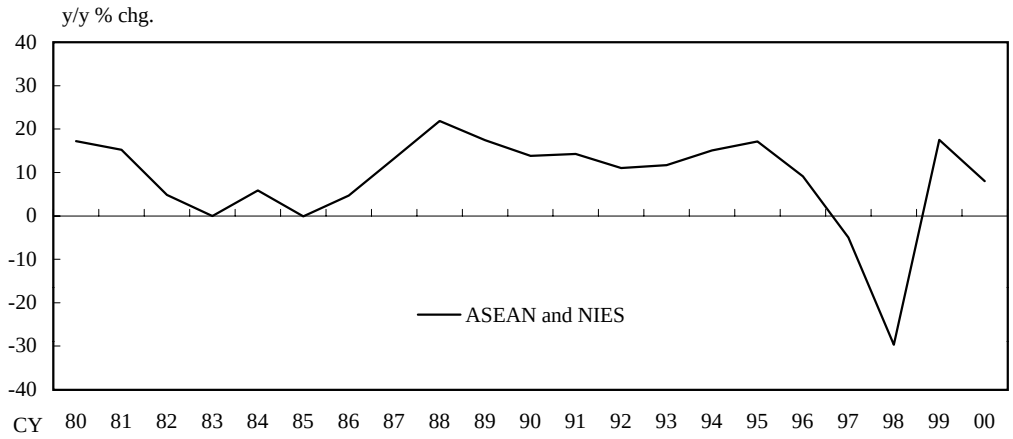


Source: International Monetary Fund, “International Financial Statistics.”

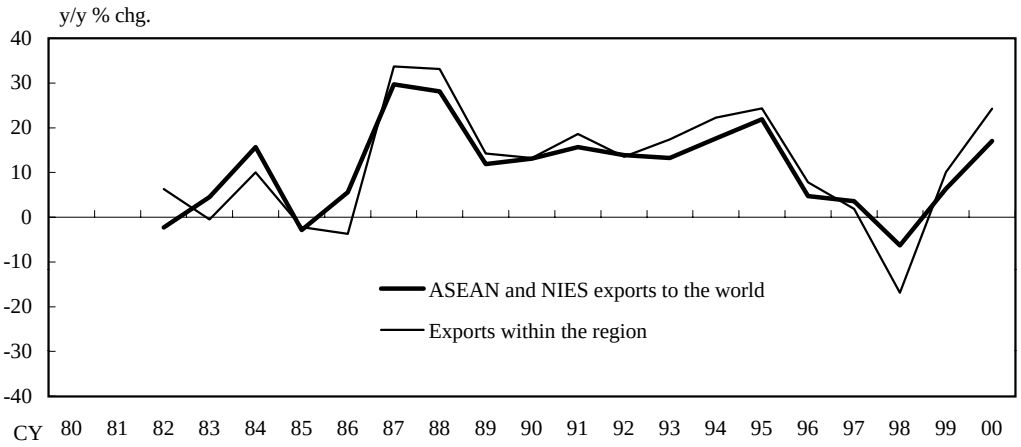
Chart 2

Output and Trade in the Asia-Pacific Region

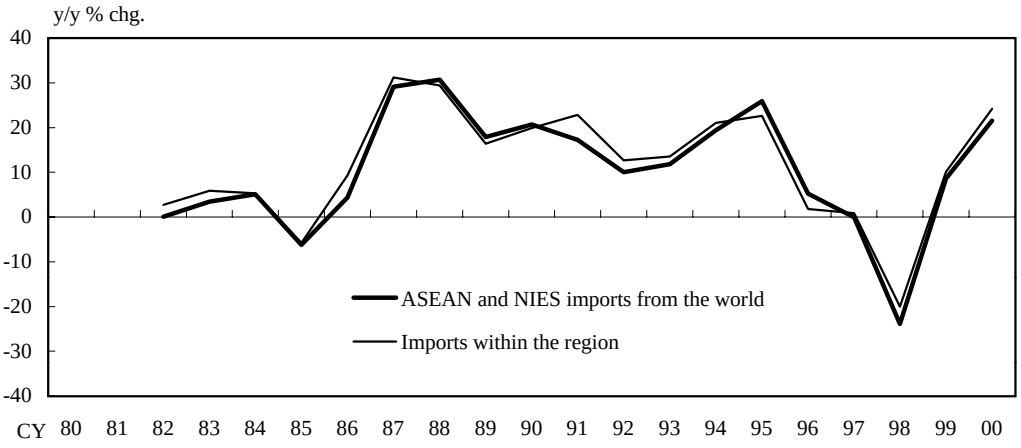
(1) Nominal GDP



(2) Exports



(3) Imports

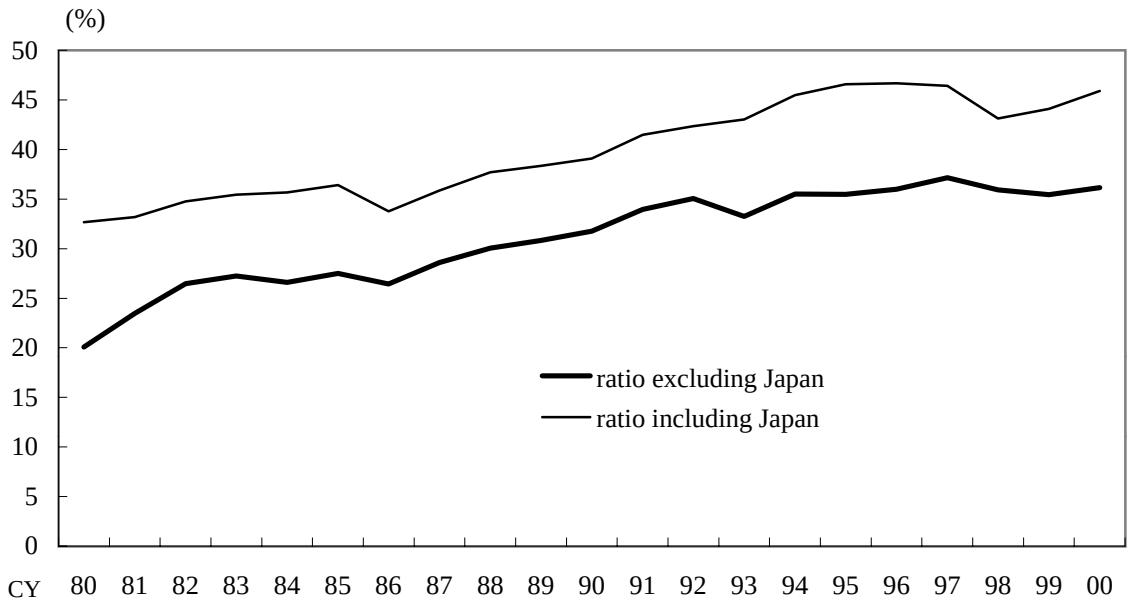


Note: "Nominal GDP," "Exports," and "Imports" are year-to-year percent changes of aggregated nominal GDP, exports, and imports denominated in dollars, respectively.

Sources: International Monetary Fund, "International Financial Statistics," "Direction of Trade Statistics."

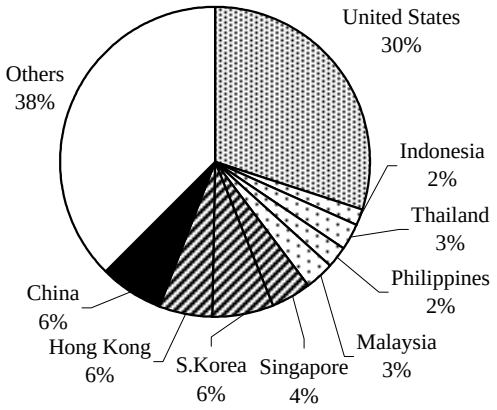
Chart 3

Intra-regional Trade Ratio in East Asia

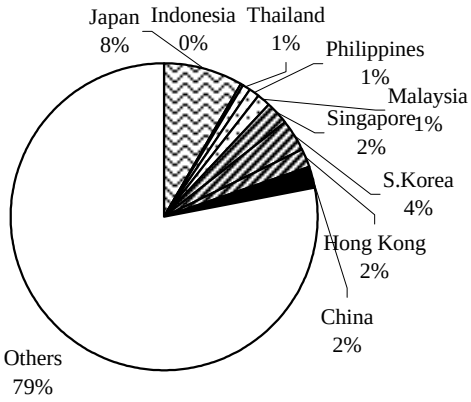


Export shares (1)

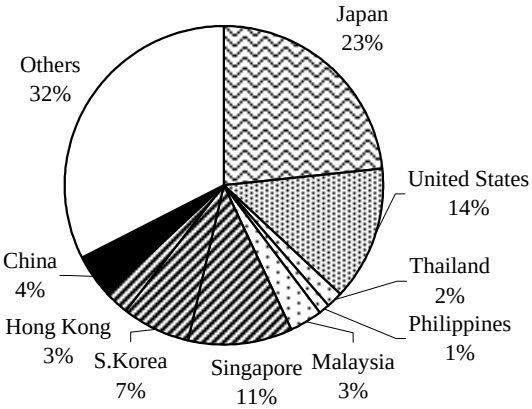
1. Exports from Japan



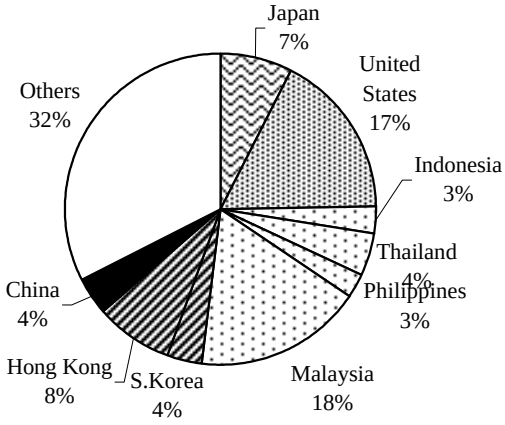
2. Exports from the United States



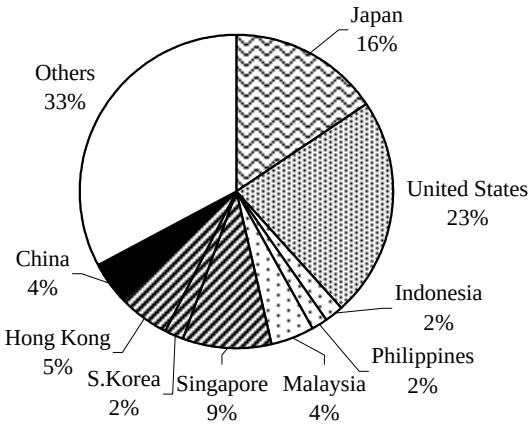
3. Exports from Indonesia



4. Exports from Singapore



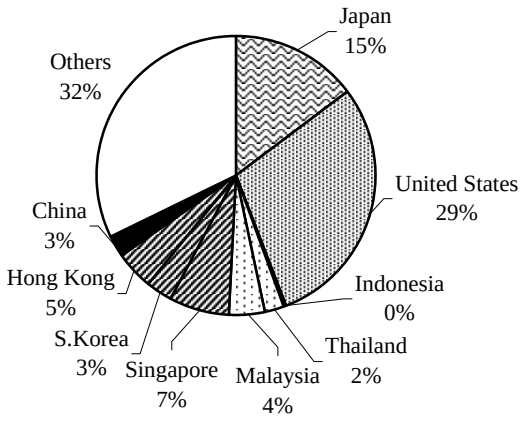
5. Exports from Thailand



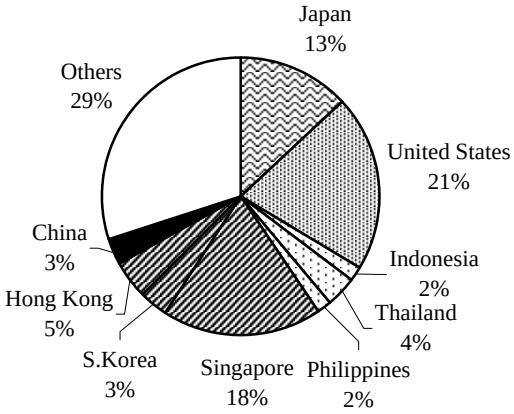
Note: Figures are average values of quarterly data in 2000.
Source: International Monetary Fund, “International Financial Statistics,” “Direction of Trade Statistics.”

Export shares (2)

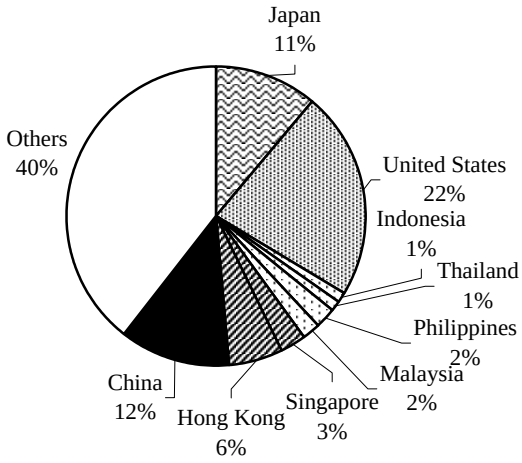
6. Exports from the Philippines



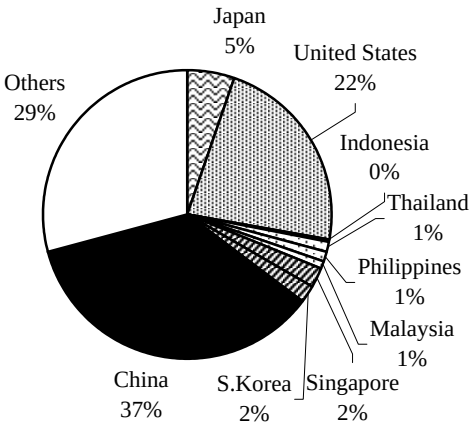
7. Exports from Malaysia



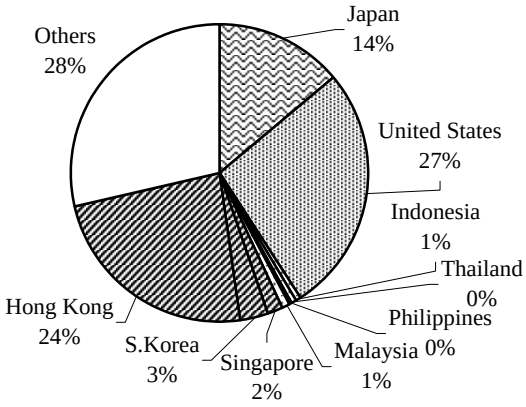
8. Exports from South Korea



9. Exports from Hong Kong



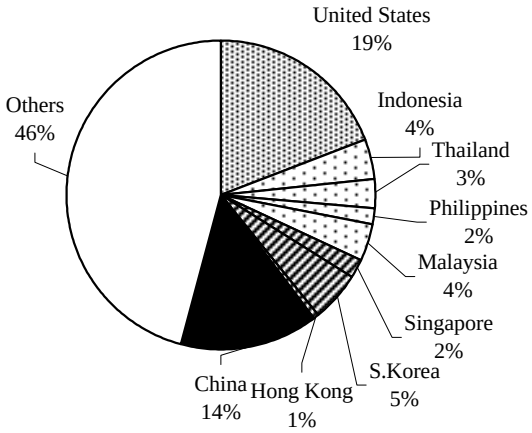
10. Exports from China



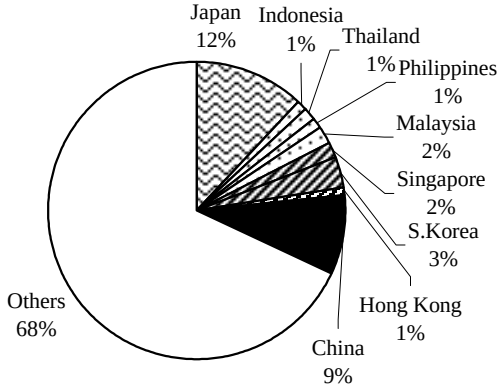
Note: Figures are average values of quarterly data in 2000.
Source: International Monetary Fund, “International Financial Statistics,” “Direction of Trade Statistics.”

Import shares (1)

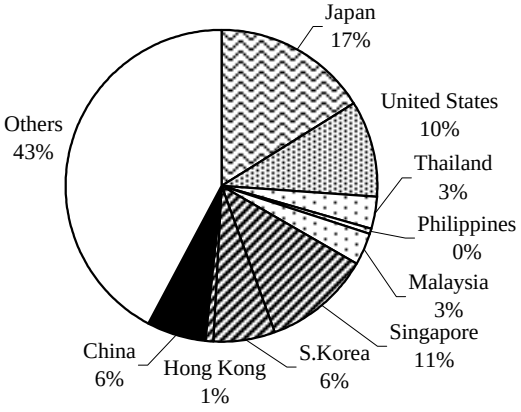
1. Imports to Japan



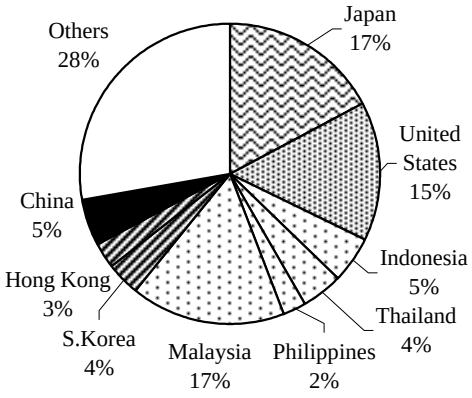
2. Imports to the United States



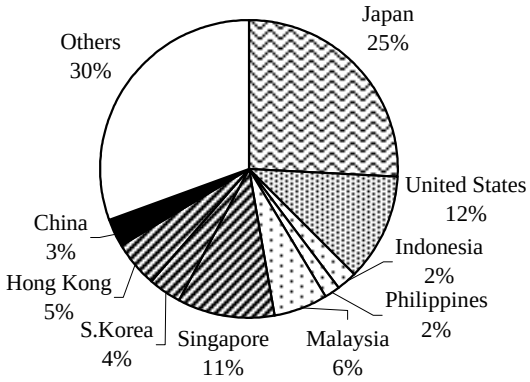
3. Imports to Indonesia



4. Imports to Singapore



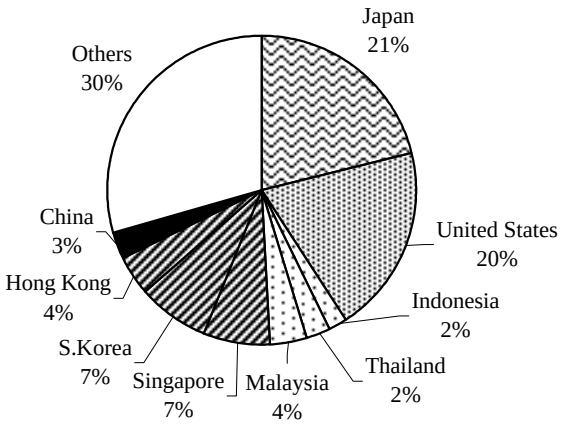
5. Imports to Thailand



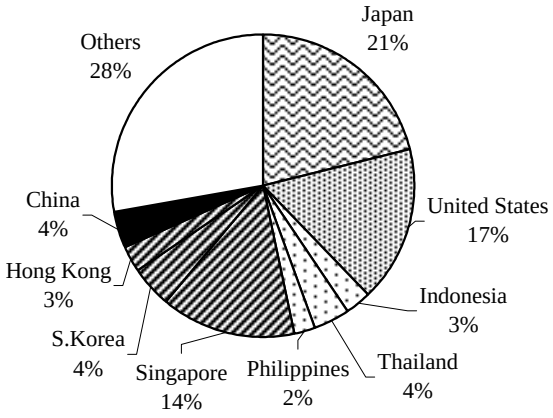
Note: Figures are average values of quarterly data in 2000.
Source: International Monetary Fund, “International Financial Statistics,” “Direction of Trade Statistics.”

Import shares (2)

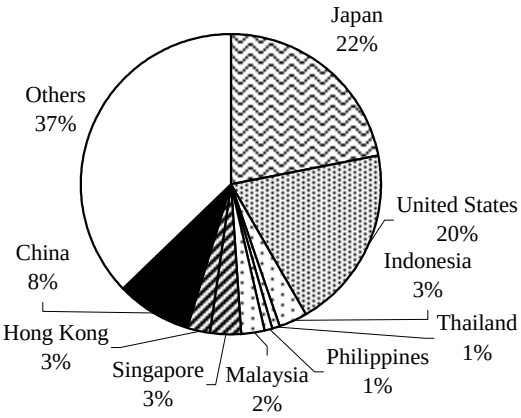
6. Imports to the Philippines



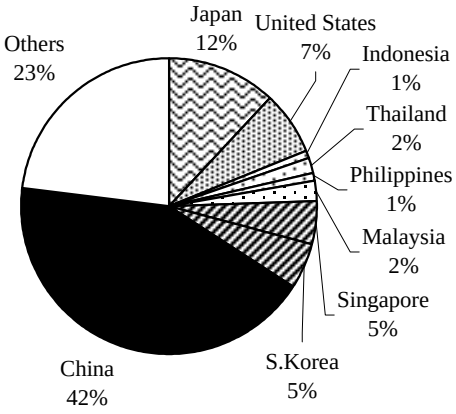
7. Imports to Malaysia



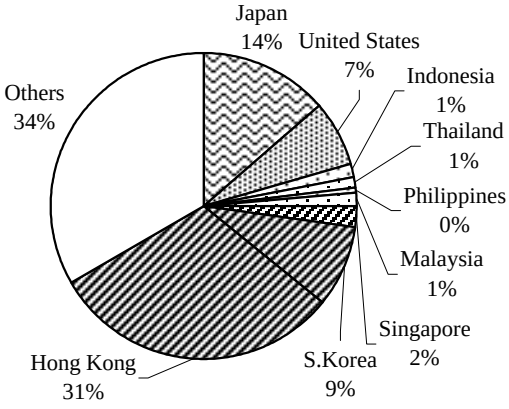
8. Imports to South Korea



9. Imports to Hong Kong



10. Imports to China



Note: Figures are average values of quarterly data in 2000.
Source: International Monetary Fund, “International Financial Statistics,” “Direction of Trade Statistics.”

Chart 6

Estimation Results for Import Functions

Dependent variable $\Delta \ln M_t$	Japan	United States	Indonesia	Singapore	Thailand	Philippines	Malaysia	South Korea	Hong Kong	China
$\Delta \ln X_t$	-	-	0.380 (1.909)	0.739 (16.921)	0.563 (2.169)	0.365 (3.406)	0.412 (3.178)	0.597 (5.241)	0.994 (12.527)	-
$\Delta \ln X_{t+1}$	0.345 (4.517)	-	-	-	0.247 (1.134)	0.363 (3.376)	-	0.270 (2.328)	-	-
$\Delta \ln X_{t+2}$	-	0.200 (1.361)	-	-	-	-	-	-	-	0.280 (2.297)
$\Delta \ln D_t$	-	-	0.814 (2.666)	0.409 (15.504)	-	0.979 (3.591)	0.110 (1.087)	0.624 (2.024)	-	0.306 (1.692)
$\Delta \ln D_{t-1}$	0.483 (1.906)	1.907 (5.472)	-	-	-	-	0.439 (4.960)	-	0.137 (1.237)	-
$\Delta \ln D_{t-2}$	-	-	-	-	0.623 (2.201)	-	-	-	-	-
$\Delta \ln RE_t$	-	-	0.187 (1.343)	-	0.299 (1.142)	-	-	0.355 (1.829)	-	-
$\Delta \ln RE_{t-1}$	0.101 (1.772)	-	-	-	0.505 (1.976)	-	0.198 (1.197)	0.337 (2.134)	0.089 (1.149)	-
$\Delta \ln RE_{t-2}$	-	0.252 (0.971)	-	-	-	-	-	-	-	0.224 (1.493)
Dummy	94/2-96/1 0.027 (4.325)		2000/1 0.288 (3.914)			98/1 -0.229 (-4.044)				2000/1 0.257 (4.823)
Sample period	90/3-01/2	92/2-01/1	93/2-01/2	90/2-01/3	93/4-01/1	90/1-01/1	91/3-01/2	90/3-01/2	90/3-00/3	94/2-00/3
R^2	0.512	0.320	0.581	0.882	0.392	0.383	0.510	0.650	0.821	0.524
DW	2.140	2.510	2.513	1.681	2.589	1.778	2.733	2.427	2.709	2.016

Note: t-values in parentheses.

Chart 7

Monetary and Exchange Rate Policies Both Before and After Asian Currency Crisis

	Before Asian Currency Crisis	After Asian Currency Crisis
Japan (yen)	Taylor Rule / Independent Floating (since February 1973)	
United States (dollar)	Taylor Rule / Independent Floating	
Indonesia (rupiah)	Managed Floating (since 1978)	Inflation Targeting (since January 2000) / Independent Floating (since August 1997)
Singapore (Singapore dollar)	Managed Floating <Currency Basket> (since 1981)	
Thailand (baht)	Managed Floating <Currency Basket> (since November 1984)	Inflation Tageting (since May 2000) / Managed Floating (since July 1997)
The Philippines (peso)	Independent Floating <*de facto* Peg against the U.S. dollar> (since December 1994)	Inflation Tageting (since 2002) / Independent Floating (since March 1998)
Malaysia (ringgit)	Managed Floating (since 1973)	Fixed Peg Arrangements (since September 1998)
South Korea (won)	Managed Floating (since March 1990)	Inflation Targeting (since September 1998) / Independent Floating (since December 1997)
Hong Kong (Hong Kong dollar)	Currency Board Arrangements (since October 1983)	
China (yuan)	Managed Floating <*de facto* Peg against the U.S. dollar> (since 1994)	

Source: International Monetary Fund, “Annual Report 2001.”

Estimation Results for Domestic Demand Functions

Dependent variable $\Delta \ln D_t$	Japan	United States	Indonesia	Singapore	Thailand	Philippines	Malaysia	South Korea	Hong Kong	China
$\Delta \ln Y_{t-1}$	0.209 (1.861)	0.573 (4.208)	0.694 (3.998)	-	0.977 (3.037)	-	0.984 (2.169)	0.852 (5.941)	0.724 (2.932)	-
$\Delta \ln Y_{t-2}$	0.278 (2.616)	0.446 (3.265)	-	-	-	-	-	-	0.348 (1.375)	-
$\Delta \ln Y_{t-3}$	0.409 (3.792)	-	-	-	-	-	-	-	-	-
ΔRL_t	-0.376 (-1.131)	-0.262 (-1.118)	-	-	-	-	-	-0.563 (-3.107)	-	-
RC_{t-1}	-	-	-	-	0.060 (1.197)	-	0.082 (0.945)	-	0.082 (1.384)	-
Dummy	97/2 -0.033 (-3.323)	90/4 -0.014 (-2.579)					98/1,2 -0.139 (-3.028)	98/1 -0.166 (-8.027)		
Sample period	86/2-01/1	90/4-01/1	93/3-01/3	-	94/1-01/3	-	92/2-01/2	90/1-01/1	90/1-01/3	-
R^2	0.317	0.361	0.604	-	0.240	-	0.402	0.699	0.258	-
DW	1.881	2.367	1.699	-	1.510	-	2.476	1.851	2.150	-

Notes: 1. t-values in parentheses.
2. The fit was poor for the Philippines, Singapore, and China. We treat these countries' domestic demands as exogenous.

Chart 9

Estimation Results for Phillips Curves

Dependent variable $\Delta \ln WPI_t$	Japan	United States	Indonesia	Singapore	Thailand	Philippines	Malaysia	South Korea	Hong Kong	China
Constant	-0.005 (-5.070)	0.002 (1.080)	0.007 (1.670)	-	0.003 (1.181)	0.012 (3.099)	0.006 (13.113)	-	-	-
$\Delta \ln WPI_{t-1}$	-	0.479 (3.074)	0.243 (4.274)	-	0.350 (3.408)	-	-	0.398 (5.435)	0.795 (10.010)	0.508 (4.509)
GAP_{t-1}	0.258 (3.642)	0.379 (1.867)	-	-	-	-	-	0.065 (1.462)	0.079 (1.490)	0.002 (2.474)
$\Delta \ln RE_t - \Delta \ln WPI_t$	-0.111 (-8.074)	-	-0.417 (-15.211)	-0.391 (-1.757)	-0.236 (-6.441)	-0.088 (-1.105)	-0.023 (-2.082)	-0.225 (-10.729)	-0.068 (-1.198)	-
Dummy				93/1,2 0.077 (6.273)			94/1, 98/1,2 0.012 (7.629)			
Sample period	92/2-01/1	92/2-01/3	90/2-01/3	91/4-01/3	90/2-01/3	90/2-01/3	92/4-01/2	90/2-01/3	90/3-01/3	94/2-00/3
R^2	0.737	0.259	0.866	0.521	0.549	0.027	0.689	0.715	0.615	0.783
DW	1.492	1.929	1.916	1.729	2.351	1.837	1.021	2.583	2.716	2.466

Note: t-values in parentheses.

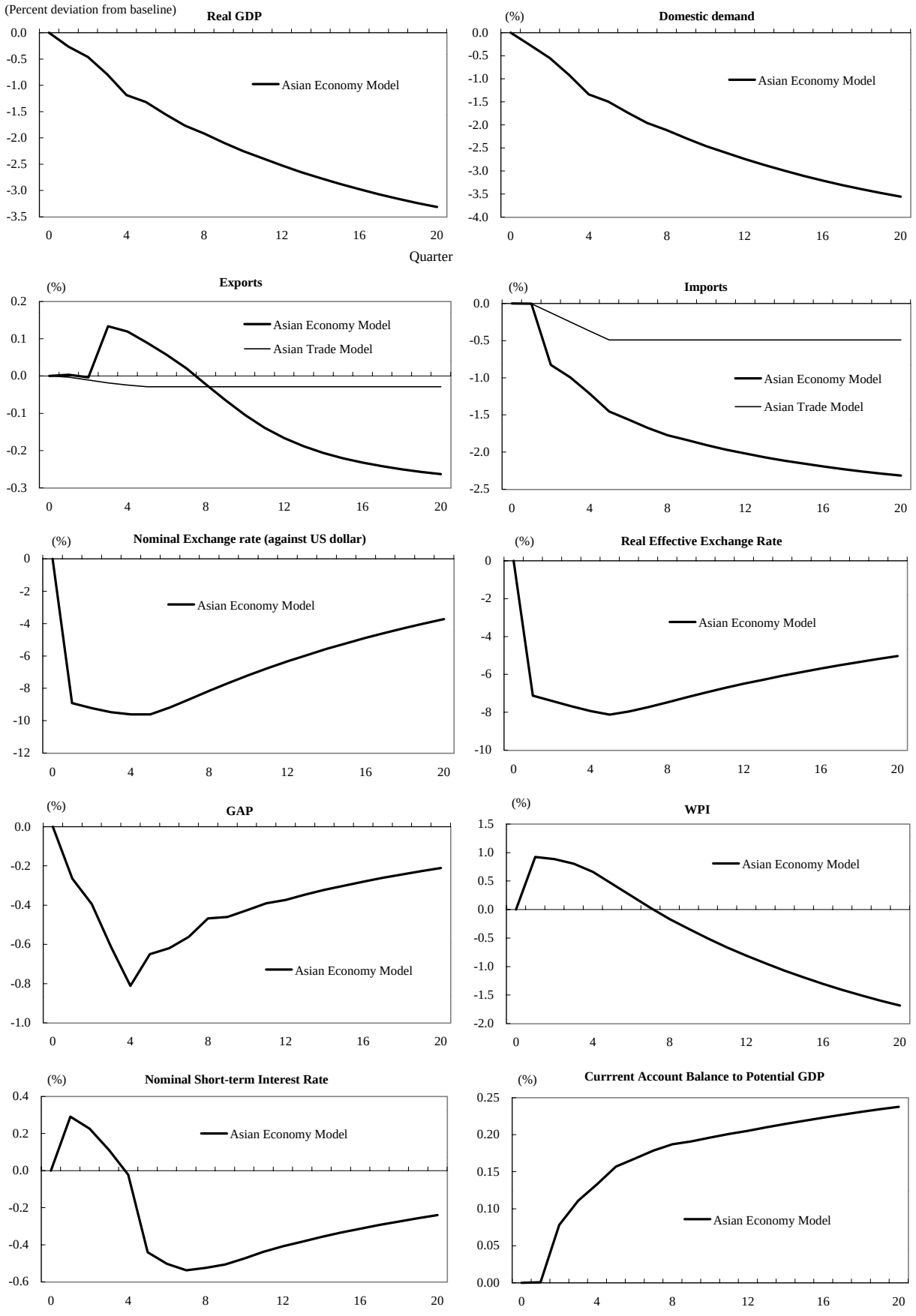
Chart 10

Estimation Results for Policy Rules

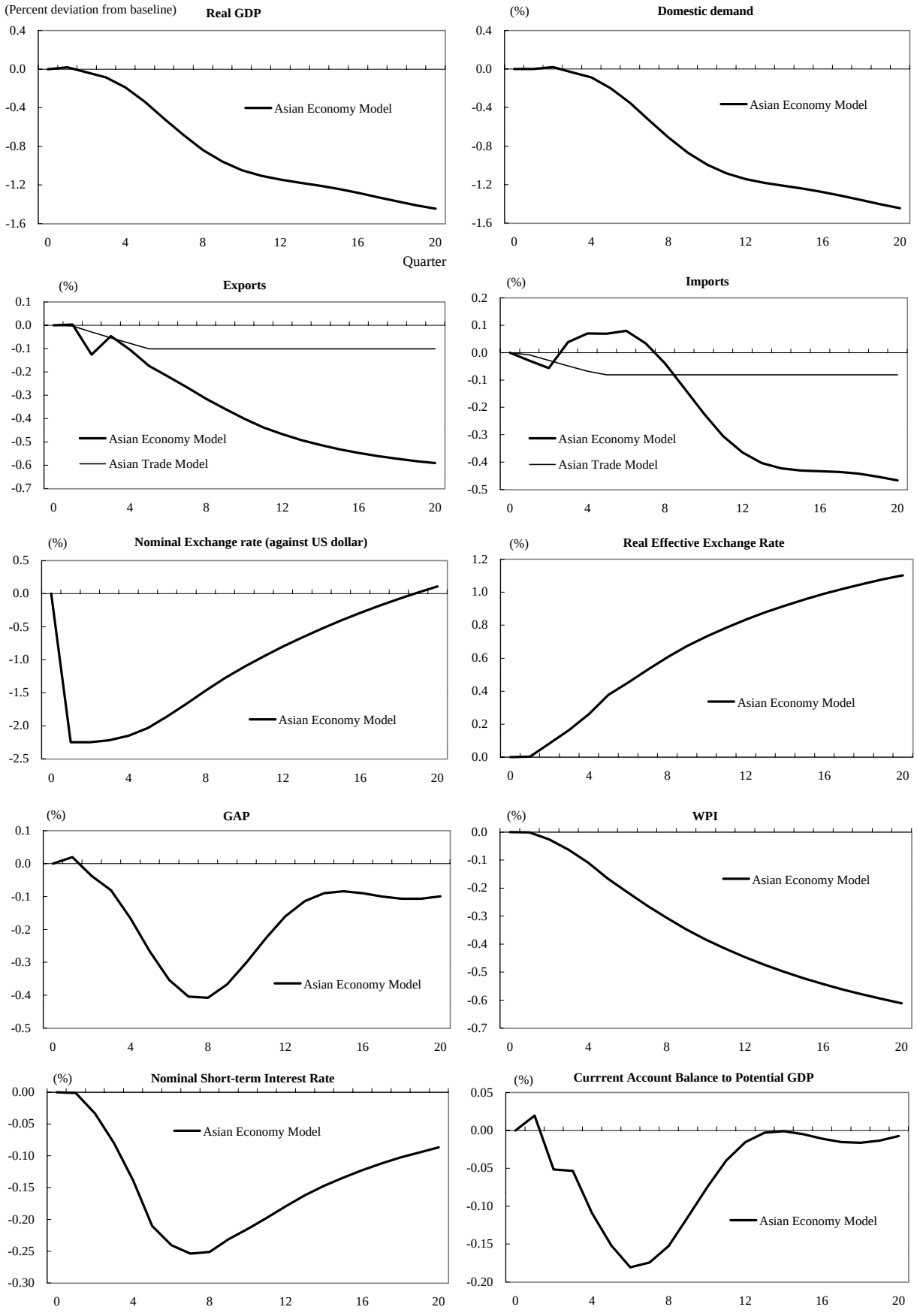
Dependent variable I_t	Japan	United States	Indonesia	Singapore	Thailand	Philippines	Malaysia	South Korea	Hong Kong	China
Constant	0.046 (9.078)	0.046 (22.794)	-0.008 (-0.098)	-	0.002 (0.136)	0.083 (5.748)	0.025 (3.370)	0.029 (1.846)	-	-
$\Delta \ln CPI_t$	1.689 (5.031)	1.084 (2.589)	4.259 (3.797)	-	5.095 (3.872)	1.038 (1.253)	2.936 (3.789)	4.785 (3.712)	-	-
GAP_t	0.372 (2.086)	0.305 (1.168)	-	-	-	-	-	-	-	-
$\Delta \ln E_t$	-	-	0.272 (1.618)	-	-	0.256 (2.233)	-	0.203 (2.088)	-	-
Sample period	82/2-95/4	92/1-01/3	98/1-01/3	-	98/1-01/3	98/1-01/3	98/1-01/2	98/1-01/3	-	-
R^2	0.382	0.158	0.573	-	0.536	0.292	0.545	0.628	-	-
DW	0.132	0.185	0.659	-	0.536	0.930	0.976	0.988	-	-

Notes: 1. t-values in parentheses.
2. Nominal short-term interest rate in China is taken as exogenous.

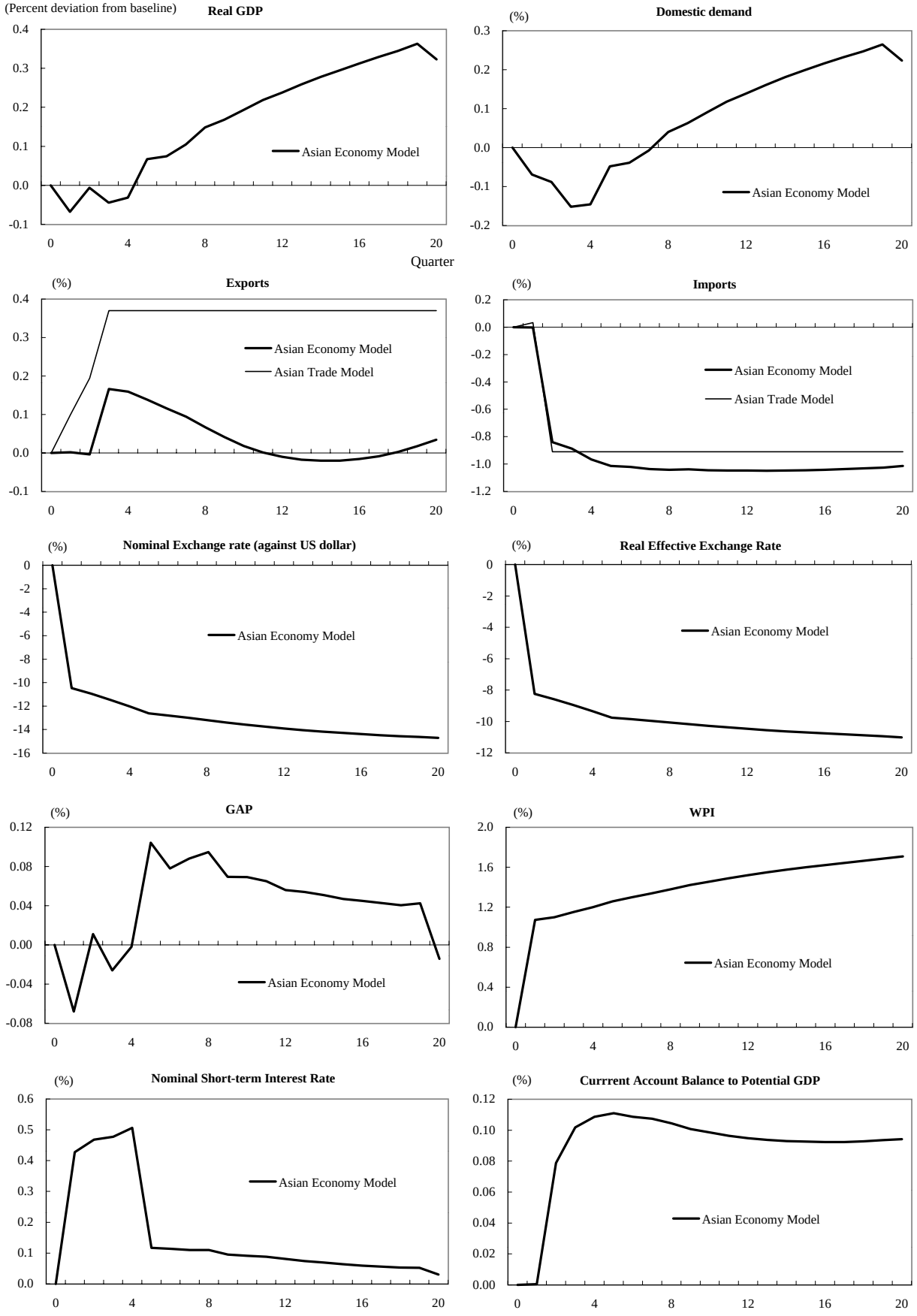
Impulse Response: (i) A 1 percent decline in the growth rate of Japan's domestic demand <Effects on Japan>



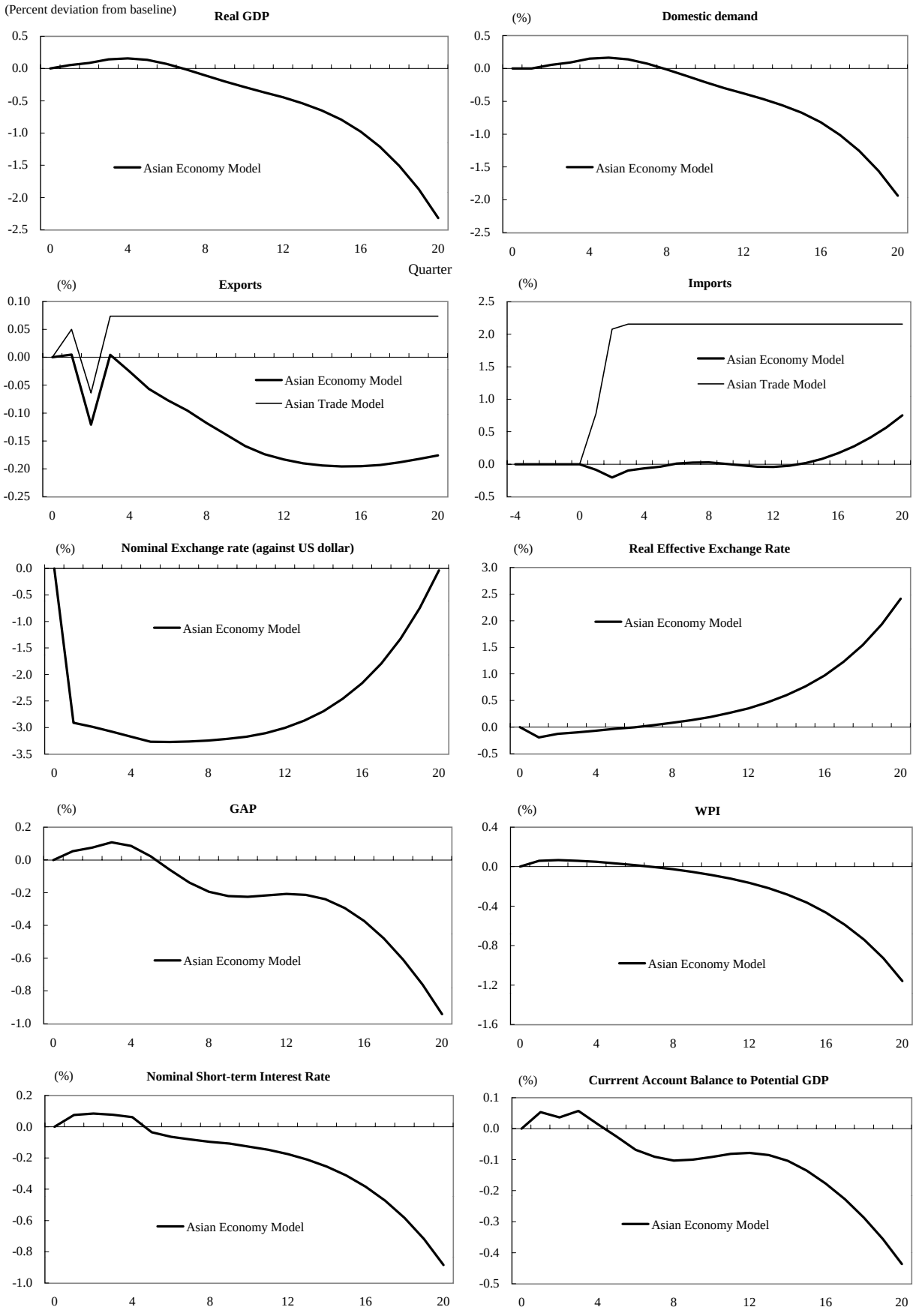
Impulse Response: (i) A 1 percent decline in the growth rate of Japan's domestic demand <Effects on Thailand>



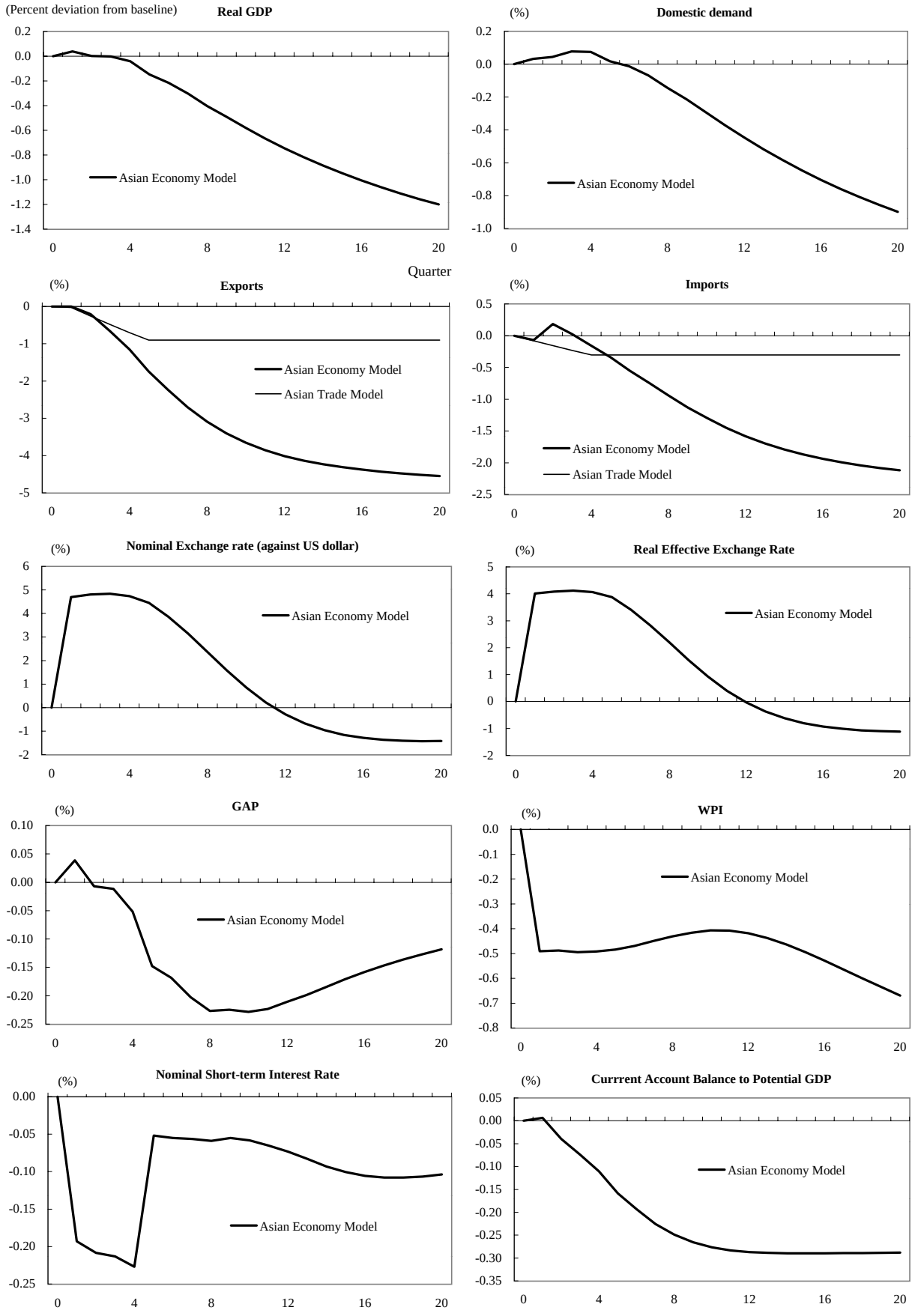
Impulse Response: (ii) A 10 percent depreciation of the Japanese yen against the US dollar <Effects on Japan>



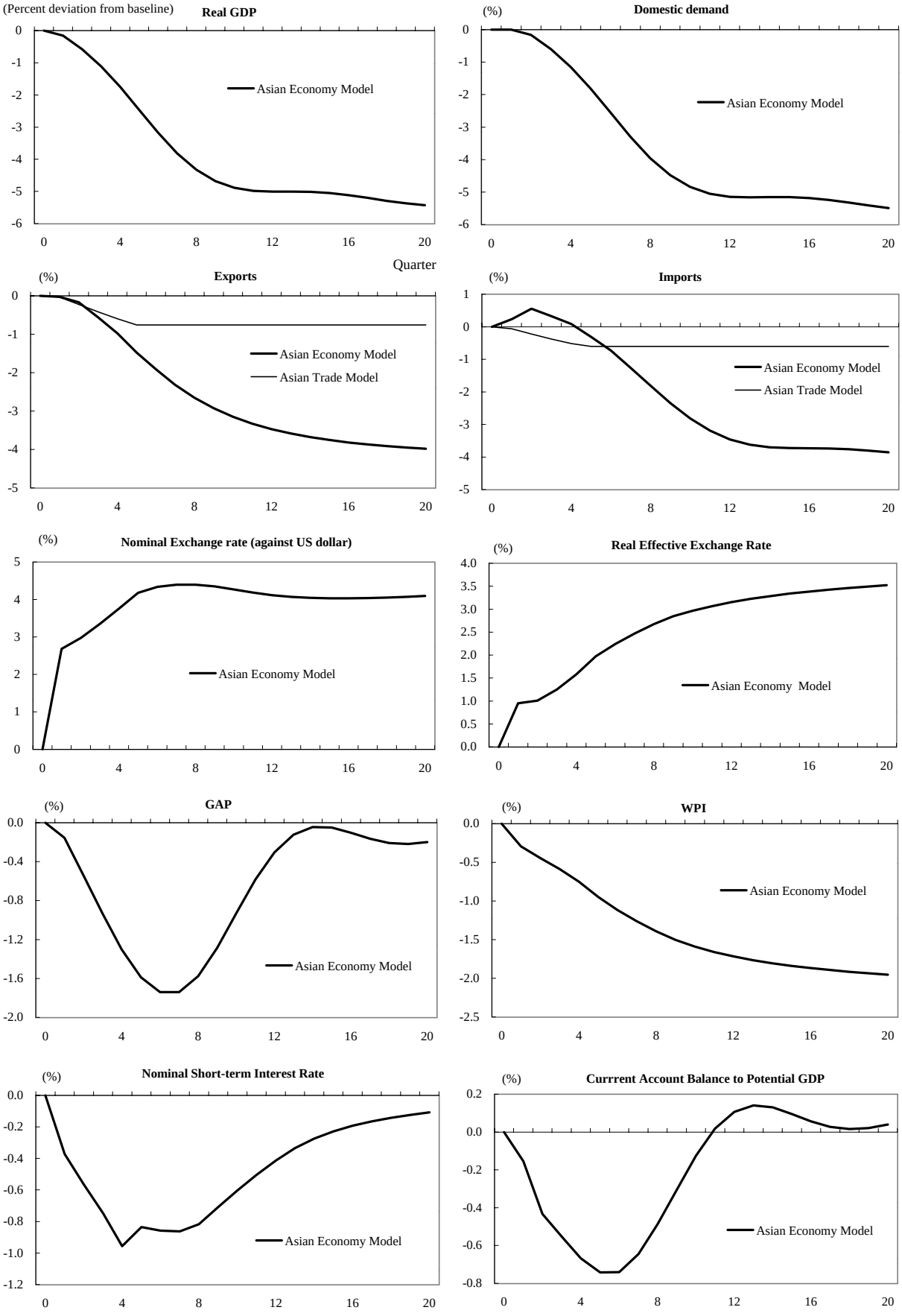
Impulse Response: (ii) A 10 percent depreciation of the Japanese yen against the US dollar <Effects on Thailand>



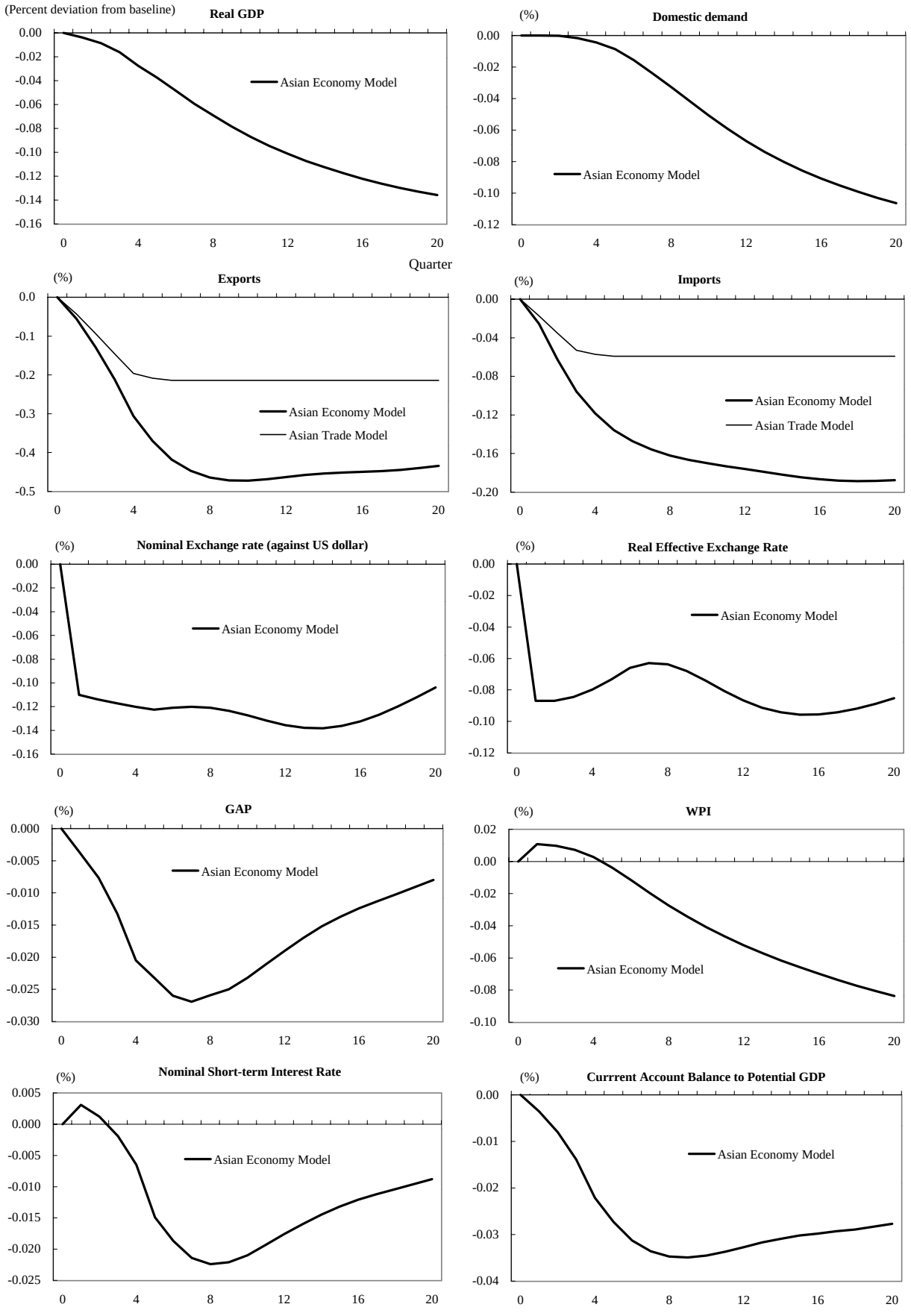
Impulse Response: (iii) A 1 percent decline in the growth rate of US domestic demand <Effects on Japan>



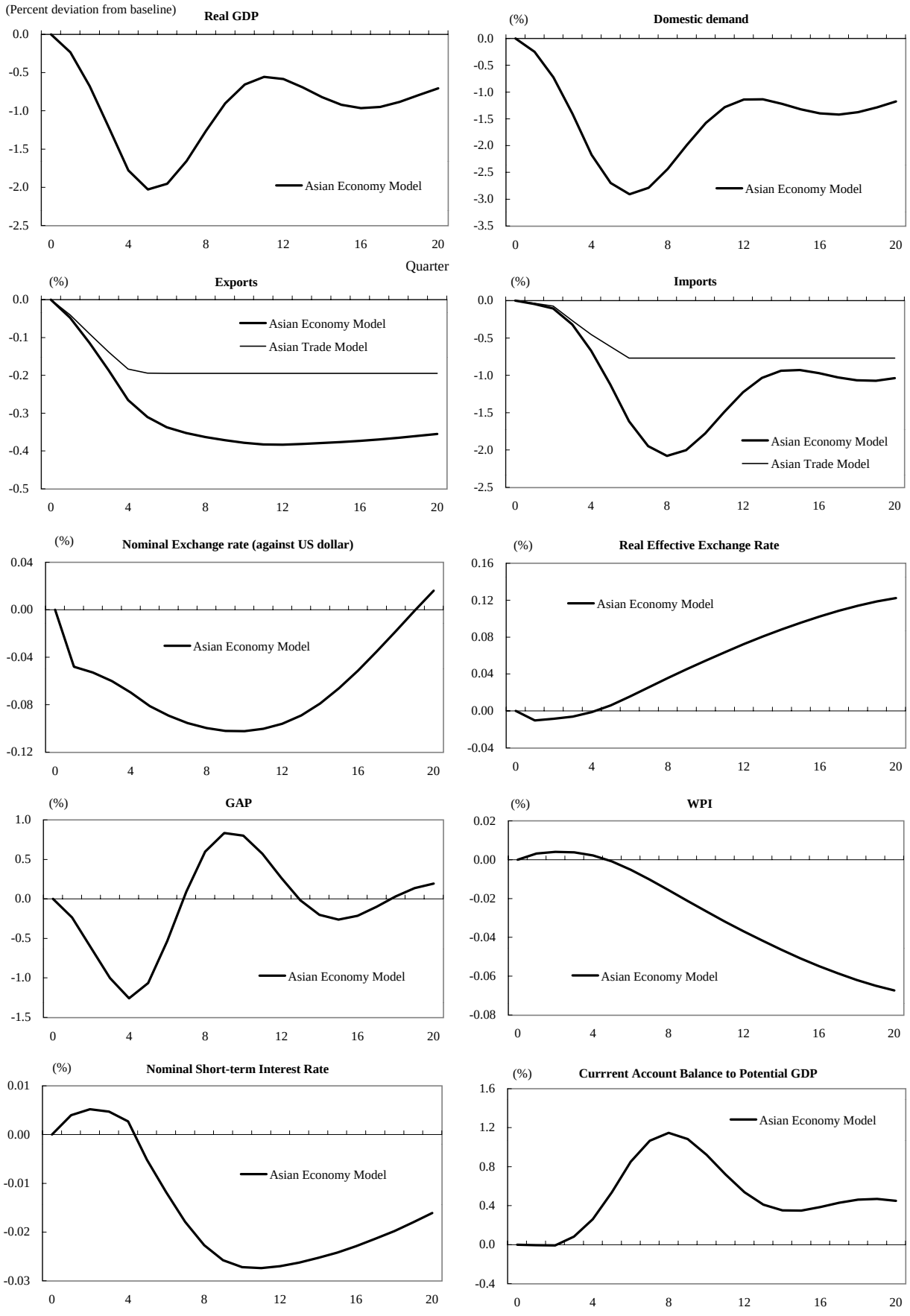
Impulse Response: (iii) A 1 percent decline in the growth rate of US domestic demand <Effects on Thailand>



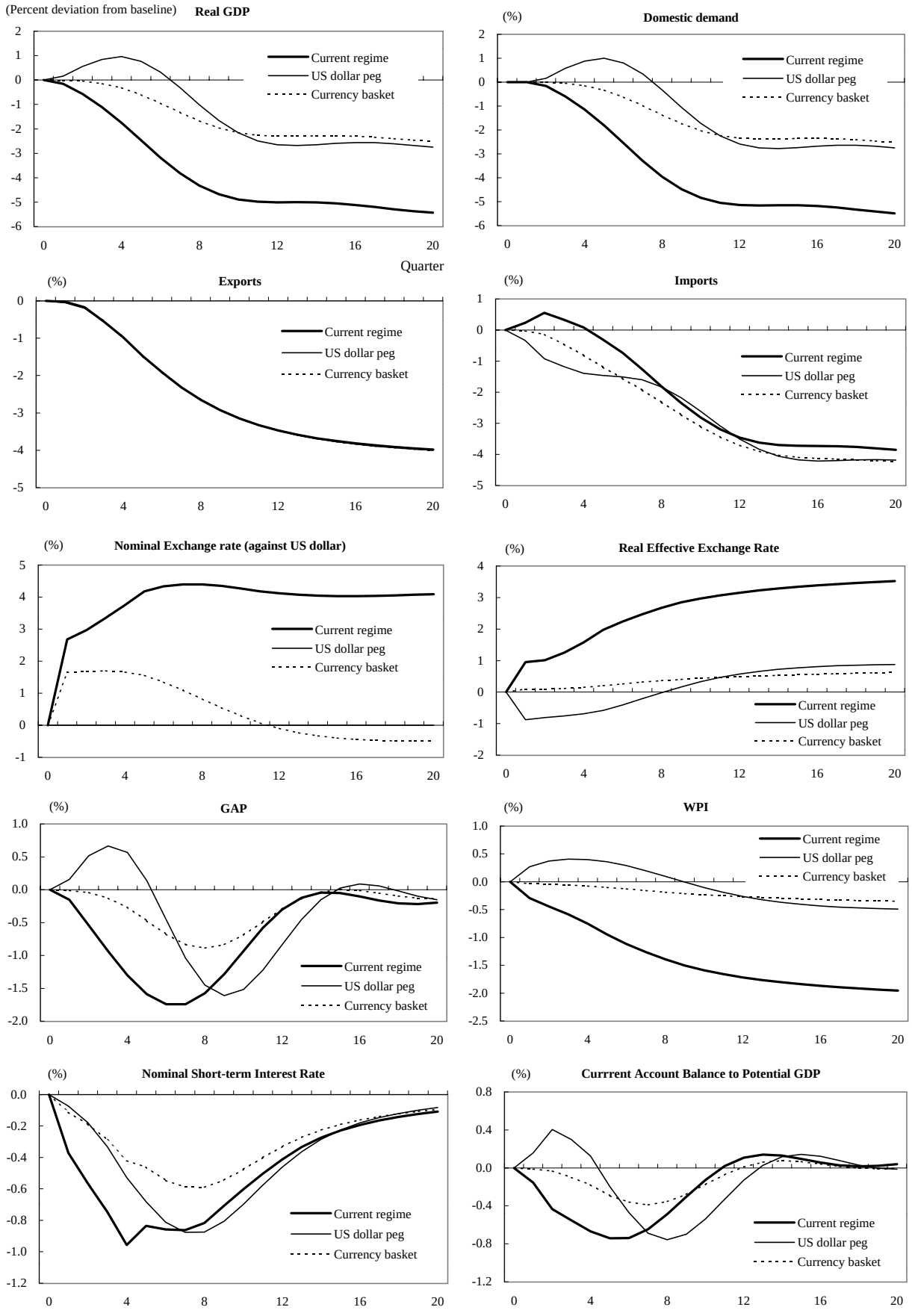
Impulse Response: (iv) A 1 percent decline in the growth rate of East Asia's domestic demand <Effects on Japan>



Impulse Response: (iv) A 1 percent decline in the growth rate of East Asia's domestic demand <Effects on Thailand>

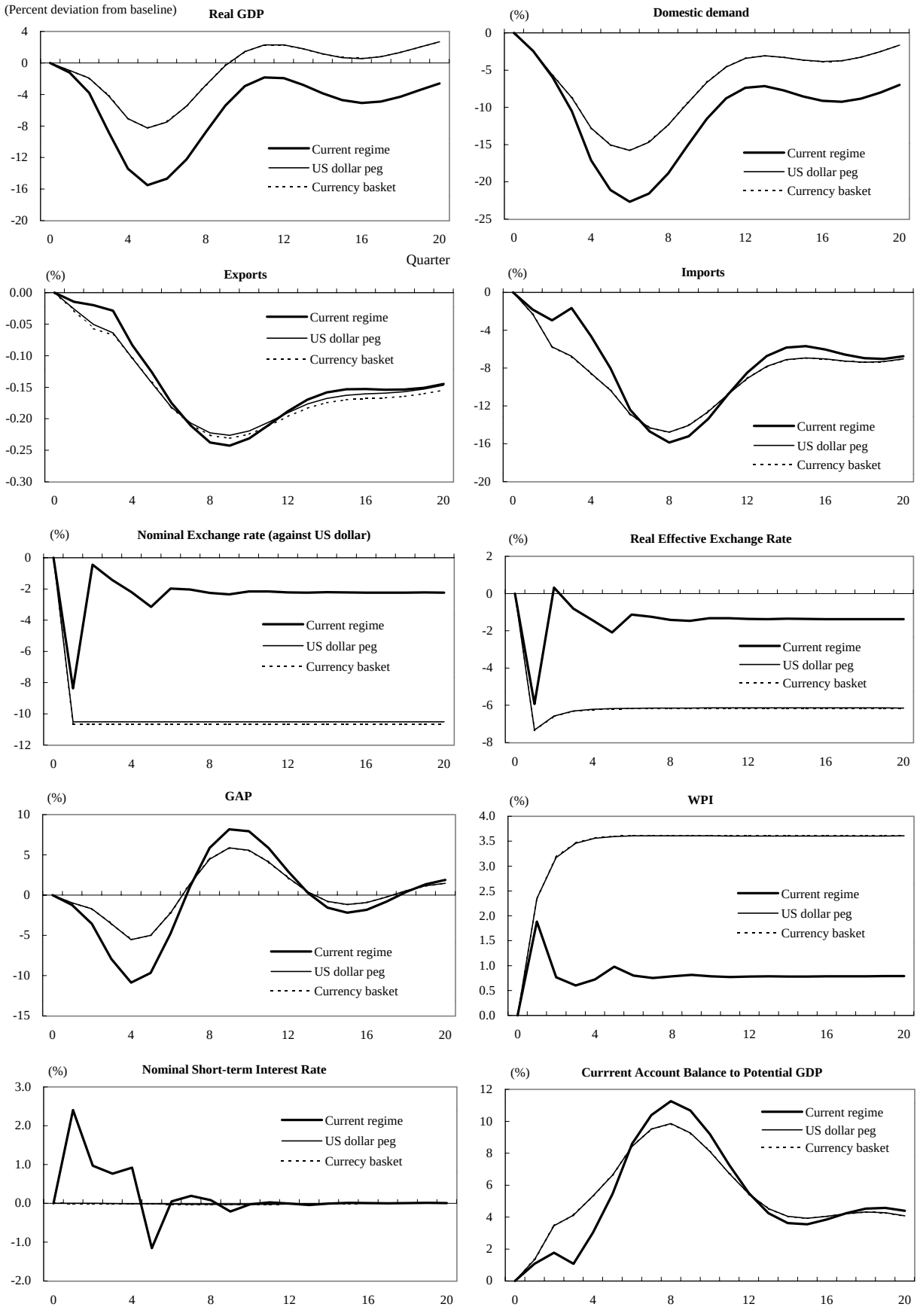


Policy Regime Analysis: (i) A 1 percent decline in the growth rate of US domestic demand <Effects on Thailand>

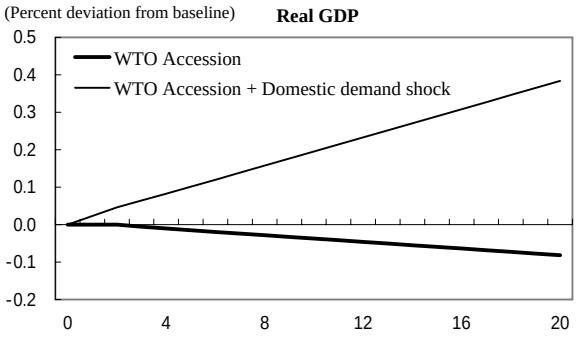


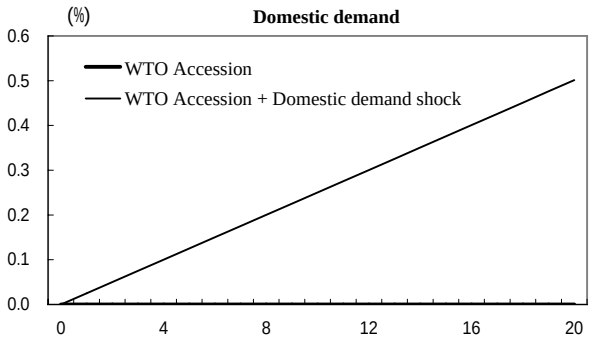
Policy Regime Analysis: (ii) A 10 percent decline in the growth rate of Thai domestic demand plus a 10 percent depreciation of the Thai baht against the US dollar

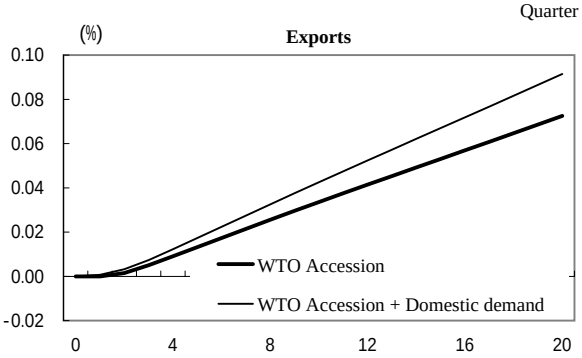
<Effects on Thailand>

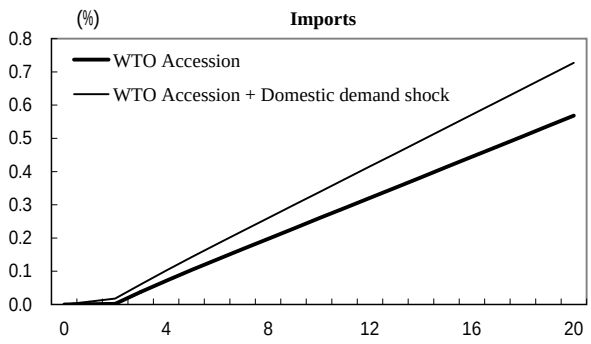


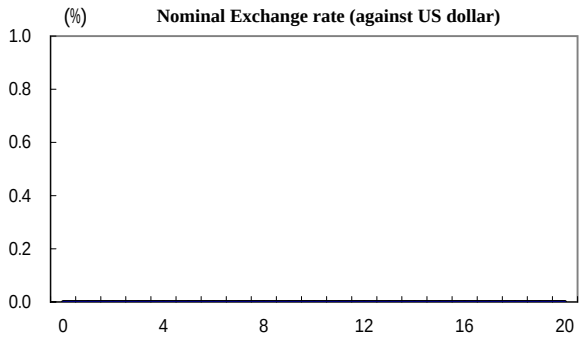
Effects of China's WTO Accession on Chinese Economy

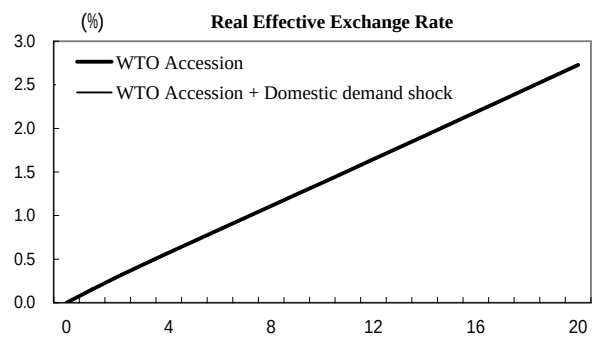


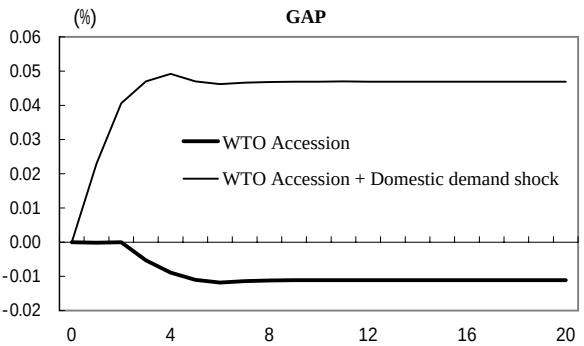


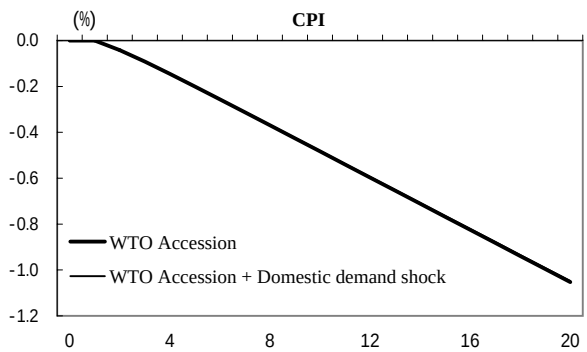


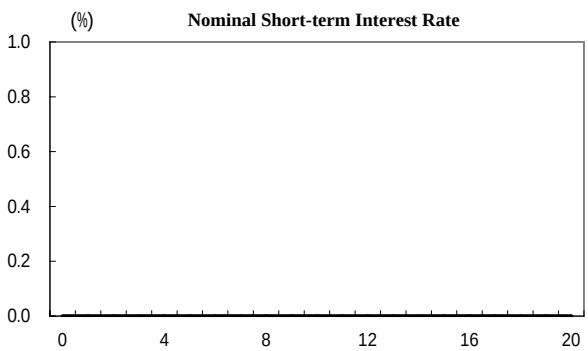


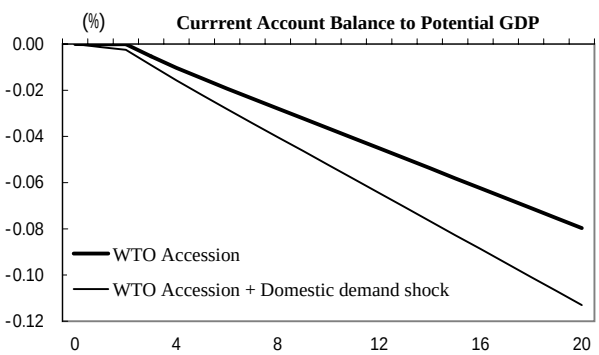












Responses of Real GDP and Exports to Four Types of Shock

(i) A 1 percent decline in the growth rate of Japanese domestic demand

	Real GDP		Exports	
	First year	Second year	First year	Second year
Japan	-1.18	-1.92	0.12	-0.02
United States	-0.08	-0.17	-0.08	-0.20
Indonesia	-0.10	-0.22	-0.22	-0.44
Singapore	0.00	-0.07	-0.01	-0.18
Thailand	-0.19	-0.84	-0.10	-0.32
Philippines	0.00	-0.05	-0.08	-0.30
Malaysia	-0.87	-0.88	-0.08	-0.28
South Korea	-0.02	-0.11	-0.04	-0.22
Hong Kong	-0.32	-0.52	0.12	-0.01
China	-0.08	-0.12	-0.11	-0.33

(ii) A 10 percent depreciation of the yen against the US dollar

	Real GDP		Exports	
	First year	Second year	First year	Second year
Japan	-0.03	0.15	0.16	0.07
United States	-0.09	-0.18	-0.04	-0.08
Indonesia	-0.06	-0.10	-0.13	-0.20
Singapore	0.00	0.00	0.05	-0.02
Thailand	0.16	-0.11	-0.03	-0.12
Philippines	0.00	-0.02	-0.01	-0.11
Malaysia	-0.95	-0.89	-0.02	-0.10
South Korea	-0.01	-0.03	0.04	-0.05
Hong Kong	-0.38	-0.64	0.20	0.14
China	-0.09	-0.12	-0.03	-0.13

(iii) A 1 percent decline in the growth rate of US domestic demand

	Real GDP		Exports	
	First year	Second year	First year	Second year
Japan	-0.04	-0.40	-1.15	-3.09
United States	-1.49	-2.49	-0.51	-1.44
Indonesia	-0.31	-1.06	-0.72	-2.13
Singapore	-0.34	-0.98	-0.88	-2.55
Thailand	-1.75	-4.32	-0.98	-2.65
Philippines	-0.11	-0.54	-1.09	-3.02
Malaysia	-0.49	-2.77	-0.92	-2.57
South Korea	-0.14	-0.98	-1.00	-2.59
Hong Kong	0.14	-0.12	-1.05	-2.51
China	-0.06	-0.34	-0.97	-2.64

(iv) A 1 percent decline in the growth rate of East Asian domestic dema excluding Japan

	Real GDP		Exports	
	First year	Second year	First year	Second year
Japan	-0.03	-0.07	-0.31	-0.46
United States	-0.03	-0.07	-0.18	-0.27
Indonesia	-1.11	-1.45	-0.32	-0.45
Singapore	-0.55	-0.62	-0.39	-0.56
Thailand	-1.78	-1.27	-0.27	-0.36
Philippines	-0.49	-0.53	-0.24	-0.38
Malaysia	-0.84	-0.69	-0.32	-0.48
South Korea	-1.11	-1.16	-0.21	-0.31
Hong Kong	-1.63	-2.45	-0.24	-0.30
China	-0.96	-0.99	-0.25	-0.41

Note: Figures are percent deviations from baseline.