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ABSTRACT

In this paper we have constructed a theoretical model in which Asian firms maximize their profit, competing with Japanese and US firms in their markets. The duopoly model is used to determine export prices and volumes in response to the exchange rate fluctuations vis-à-vis the Japanese yen and the US dollar. Then, the optimal basket weight to minimize the fluctuation of the growth rate of trade balance is derived. These are the novel features of our model.

The export price equation and export volume equation are estimated for several Asian countries for the sample period of 1981 to 1996. Results are generally reasonable. The optimal currency weights for the yen and the US dollars are derived and compared with actual weights that had been adopted before the currency crisis of 1997. For all the countries in the sample, it is shown that the optimal weight of the yen is significantly higher than the actual weight.

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1. Introduction

The currency crises in Asia in 1997 highlighted the danger of the fixed exchange rate system. Four ASEAN currencies (the Thai baht, the Malaysian ringgit, the Indonesian rupiah, and the Philippines peso) all depreciated by 30 to 40 percent in the three months following the baht depreciation of July 2. Thailand asked International Monetary Fund (IMF) for a balance of payments support package in August. The IMF support ($4 billion) was complemented by Japan ($4 billion) and other Asian nations together with the World Bank and Asian Development Bank (ADB). In November, Indonesia asked the IMF, the World Bank, and the ADB to advise them on economic reform together with a support for a potential balance of payment gap. The Indonesian package by IMF, World Bank, and ADB was also complemented by a secondary line of support by Japan, the U.S. and Asian countries. In late November Korea, after its currency depreciated sharply, asked for the IMF support. Also in November, the sharp decline in Hong Kong stock market, which was caused by defending the fixed exchange rate based on the currency board, caused a worldwide turmoil. The crisis spread to Korea in November, and the IMF package was hastily put together in the first week of December. The crises in these countries got deepened in December 1997 to January 1998, as the value of the Indonesian rupiah depreciated to a level one-sixth of the pre-crisis level, and other ASEAN countries and the Korean won depreciated to the level half of the pre-crisis level.

One of the common factors among these crisis countries was the choice of a de facto peg. Thailand has adopted a basket system, in which the value of the Thai baht is determined as a weighted average of major currencies. However, it was well known that the U.S. dollar had an overwhelming weight in the basket since 1985. Indonesia had adopted a slide system with a narrow band, where the slide was adjusted for the inflation rate difference between Indonesia and the United States. The Korean won had also maintained a stable value against the U.S. dollar. The Hong Kong dollar has been backed by a currency board arrangement, and nominally pegged to the U.S. dollar at HK$7.7-7.8 per US$, since 1984. Hence, most of these currencies have appreciated in the "real" exchange rate sense, vis-à-vis the U.S. dollar.

Moreover, these Asian countries in financial turmoil have substantial trade relationships with Japan. As the Japanese yen depreciated against the U.S. dollar from April 1995 to the summer of 1997, and the real "effective" exchange rates of these countries appreciated. Due to the appreciation, export competitiveness was lost. Thus exports from these countries declined and current account deficits increased in 1996-1997. In the practical level, this story makes sense. However, in theory, this needs some examinations.

To simplify, consider a case that the nominal exchange rates of (non-Japan) Asian countries are pegged to the U.S. dollar, while Asian products compete with Japanese products in the U.S. and Japanese markets. If the yen depreciates against the U.S. dollar, demands for Asian goods will decline. However, if Asian countries would like to avoid the loss of competitiveness, the export prices (in baht for example) can be cut instead of the exchange rate depreciation. Therefore, we need a framework in which prices are determined endogenously and adjusted imperfectly to the changes in the exchange rate.

It is easy to see that if Asian goods are perfect substitutes to Japanese and U.S.

goods in a one-good, two-country economy, then export prices will change inversely to the exchange rate changes. This can be called as a case of perfect pass-through. The exchange rate regime, whether they are pegged to the dollar or freely floated, is irrelevant when prices are perfectly flexible with perfect competition for exported goods. However, if they compete with the Japanese goods in an oligopolistic market, then the exchange rate fluctuation will not be perfectly offset by the changes in export prices.

Moreover, Asian countries import from Japan parts of the products that are exported to Japan and the United States. The Japanese yen appreciation, therefore, has two different effects, increasing costs of semifinished goods and increasing competitiveness of exports.

In the early 1980s, a number of papers, including Bhandari (1985), Flanders and Helpman (1979), Flanders and Tishler (1981), Lipschitz and Sundararajan (1980), and Turnovsky (1982), studied the optimal currency basket. Based on some open macroeconomic model including export and import functions, these papers explored how variances of balance of payments or some other measures can be minimized when there are shocks to exchange rates of trading partners. Bhandari (1985) and Turnovsky (1982) consider the question in a general equilibrium macromodel with capital mobility. However, a macroeconomic structure, such as consumption and export functions, is given without micro-foundation in these papers. The optimality is usually defined by minimizing variances of balance of payments, or real income.

Our paper is quite different from those papers in three respects. First, our model has micro-foundation, namely the oligopolistic exporter maximizes its profits. Competition with exporters of other countries is modeled. Thus, the export price is endogenously determined in response to the exchange rates. Price "stickiness" in our model is a result of optimizing behavior. Second, imports of parts (semifinished goods) are explicitly modeled. This reflects the cost aspects of the currency changes. Last, optimality in our model is to minimize the fluctuations, in terms of changes in the trade balances, which is equivalent to profits in our model. This criterion has is slightly different from criteria adopted in other papers in the literature.

The rest of the paper will be organized as follows. Section 2 will present a theoretical oligopolistic-competition model where prices are determined endogenously. Section 3 will use the above model to explore effects of the dollar peg on a trade balance of the ASEAN economy. Section 4 will derive an optimal peg weight to stabilize fluctuations in the trade balance. Section 5 summarizes the theoretical prediction of impacts of exchange rate changes on export volumes and export prices. Section 6 describes stylized facts on the movement of the exchange rates and trade flows. Theoretical predictions are tested in regressions in Section 7. Optimal peg weights are also calculated in the section. Section 8 concludes the paper.

2. The Models

An ASEAN country is modeled as a one-sector economy where a representative firm assembles parts imported from Japan and the United States into manufactured products[1]. We assume that volumes of parts that the ASEAN firm imports from Japan and the United States are constant shares, ω_m and $1-\omega_m$ respectively, of the total volumes. The firm is assumed to export its products to the Japanese and U.S. markets. The model is similar to the pricing to market model of Marston(1990)[2].

We set up two competitive situations: the first situation is that each of the Japanese and U.S. markets is modeled as a duopoly one where the ASEAN firm competes against the Japanese firm (Model A). The second situation is that each of the Japanese and U.S. markets is modeled as a duopoly one where the ASEAN firm competes against each local firm in the markets (Model B). That is, it competes against the Japanese firm in the Japanese market and, on one hand, against the U.S. firm in the U.S. market. The ASEAN, Japanese, and U.S. firms have an identical cost functions. We assume that each of the Japanese and U.S. firms assembles its products with its domestic parts only. Each firm maximizes its profits in terms of its own home currency.

2-1. Model A

Profits of the ASEAN firm in terms of the home currency π is calculated as:

(1) $$\pi = E^{A/¥}P_J^{¥}f(q_J)+E^{A/\$}P_{US}^{\$}g(q_{US})-E^{A/¥}P_m^{¥}\omega_m Q-E^{A/\$}P_m^{\$}(1-\omega_m)Q-C(Q)$$

where $P_J^{¥}$ denotes a price of the ASEAN firm's products in the Japanese market in terms of the yen; $P_{US}^{\$}$ a price of the ASEAN firm's products in the U.S. market in

[1] Ohno(1989) examined pass-through effects of exchange rates on export pricing behavior in manufacturing after taking account of prices of raw materials.

terms of the dollar; P_m^Y a price of parts imported from Japan in terms of the yen; $P_m^{\$}$ a price of parts imported from the U.S. in terms of the dollar; Q output of the ASEAN products ($Q = f(q_J) + g(q_{US})$); $f(\bullet)$ a demand function for the ASEAN products in the Japanese market ($f' < 0$); $g(\bullet)$ a demand function for the ASEAN firm's products in the U.S. market ($g' < 0$); $C(\bullet)$ a cost function of the ASEAN firm($C' > 0,\ C'' \geq 0$); $q_J \equiv P_J^Y / P_J^{Y*}$ a relative price of the ASEAN products relative to the Japanese products in the Japanese market; $q_{US} \equiv P_{US}^{\$} / P_{US}^{\$*}$ a relative price of the ASEAN products relative to the Japanese products in the U.S. market; P_J^{Y*} a price of the Japanese products in the Japanese market in terms of the yen; $P_{US}^{\$*}$ a price of the Japanese products in the U.S. market in terms of the dollar; $E^{A/Y}$ an exchange rate of the yen in terms of the ASEAN currency; $E^{A/\$}$ an exchange rate of the dollar in terms of the ASEAN currency.

From equation (1), profit-maximizing prices of the ASEAN firm in the Japanese and U. S. markets, respectively, are derived as follows:

$$\text{(2a)} \qquad P_J^Y = \mu_J \left(\omega_m P_m^Y + (1-\omega_m) \frac{E^{A/\$}}{E^{A/Y}} P_m^{\$} + \frac{\overline{C'}}{E^{A/Y}} \right)$$

$$\text{(2b)} \qquad P_{US}^{\$} = \mu_{US} \left(\omega_m \frac{E^{A/Y}}{E^{A/\$}} P_m^Y + (1-\omega_m) P_m^{\$} + \frac{\overline{C'}}{E^{A/\$}} \right)$$

where $\mu_J \equiv \dfrac{\varepsilon_J(q_J)}{\varepsilon_J(q_J) - 1}$ denotes markups of the ASEAN products in the Japanese

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[2] Krugman(1987) and Knetter(1989, 1993) analyzed the pricing to market questions.

market; $\varepsilon_J \equiv -\dfrac{f'(q_J)q_J}{f(q_J)}$ a price elasticity of demand for the ASEAN products in the Japanese market; $\mu_{US} \equiv \dfrac{\varepsilon_{US}(q_{US})}{\varepsilon_{US}(q_{US})-1}$ markups of the ASEAN products in the U.S. market; $\varepsilon_{US}(q_{US}) \equiv -\dfrac{g'(q_{US})q_{US}}{g(q_{US})}$ a price elasticity of demand for the ASEAN products in the U.S. market. We assume that $\dfrac{d\varepsilon_J}{dq_J} > 0$, $\dfrac{d\mu_J}{dq_J} > 0$, $\dfrac{d\varepsilon_{US}}{dq_{US}} > 0$, and $\dfrac{d\mu_{US}}{dq_{US}} > 0$. For simplicity, we also assume that the marginal production costs are constant ($C'(Q) = \overline{C'}$).

We convert equations (2a) and (2b) into a logarithm form:

$$\text{(2a')} \qquad \log P_J^Y = -\eta_J(\log P_J^Y - \log P_J^{Y*}) + \log\left(\omega_m P_m^Y + (1-\omega_m)\frac{E^{A/\$}}{E^{A/Y}} P_m^\$ + \frac{\overline{C'}}{E^{A/Y}}\right)$$

$$\text{(2b')} \qquad \log P_{US}^\$ = -\eta_{US}(\log P_{US}^\$ - \log P_{US}^{\$*}) + \log\left(\omega_m \frac{E^{A/Y}}{E^{A/\$}} P_m^Y + (1-\omega_m) P_m^\$ + \frac{\overline{C'}}{E^{A/\$}}\right)$$

where $\eta_J \equiv -\dfrac{\mu_J' q_J}{\mu_J} > 0$ denotes a price elasticity of the markups of the ASEAN products in the Japanese market; $\eta_{US} \equiv -\dfrac{\mu_{US}' q_{US}}{\mu_{US}} > 0$ a price elasticity of the markups of the ASEAN products in the U.S. market.

We derive reaction functions of the ASEAN firm in the Japanese and U.S. markets given the prices of the products made in Japan, respectively.

$$\text{(3a)} \qquad \log P_J^Y = \frac{\eta_J}{1+\eta_J}\log P_J^{Y*} + \frac{1}{1+\eta_J}\log\left(\omega_m P_m^Y + (1-\omega_m)\frac{E^{A/\$}}{E^{A/Y}} P_m^\$ + \frac{\overline{C'}}{E^{A/Y}}\right)$$

(3b) $$\log P_{US}^{\$} = \frac{\eta_{US}}{1+\eta_{US}} \log P_{US}^{\$*} + \frac{1}{1+\eta_{US}} \log\left(\omega_m \frac{E^{A/Y}}{E^{A/\$}} P_m^Y + (1-\omega_m) P_m^{\$} + \frac{\overline{C'}}{E^{A/\$}} \right)$$

Profits of the Japanese firm in terms of the yen π^* are calculated as follows:

(4) $$\pi^* = P_J^{Y*} f^*(1/q_J) + \frac{E^{A/\$} P_{US}^{\$*} g^*(1/q_{US})}{E^{A/Y}} - P_m^Y Q^* - C(Q^*)$$

where $Q^* = f^*(1/q_J) + g^*(1/q_{US})$, $f^*(1/q_J)$ denotes a demand function for the Japanese products in the Japanese markets ($f^{*'} < 0$), $g^*(1/q_{US})$ a demand function for the Japanese products in the U.S. markets ($g^{*'} < 0$).

Profit-maximizing prices of the Japanese firm in the Japanese and U.S. markets are, respectively, derived as follows:

(5a) $$P_J^{Y*} = \mu_J^* (P_m^Y + \overline{C'}$$

(5b) $$P_{US}^{\$*} = \mu_{US}^* \left(\frac{E^{A/Y}}{E^{A/\$}} P_m^Y + \frac{E^{A/Y}}{E^{A/\$}} \overline{C'} \right)$$

where $\mu_J^* \equiv \frac{\varepsilon_J^*(1/q_J)}{\varepsilon_J^*(1/q_J) - 1}$ denotes markups of the Japanese products in the Japanese market; $\varepsilon_J^* \equiv -\frac{f^{*'}(1/q_J)}{f^*(1/q_J) q_J}$ a price elasticity of demand for the Japanese products in the Japanese market; $\mu_{US}^* \equiv \frac{\varepsilon_{US}^*(1/q_{US})}{\varepsilon_{US}^*(1/q_{US}) - 1}$ markups of the Japanese products in the U.S. market; $\varepsilon_{US}^* \equiv -\frac{f^{*'}(1/q_{US})}{f^*(1/q_{US}) q_{US}}$ a price elasticity of demand for the Japanese products in the U.S. market. We assume that $\frac{d\varepsilon_J^*}{d(1/q_J)} > 0$, $\frac{d\mu_J^*}{d(1/q_J)} > 0$, $\frac{d\varepsilon_{US}^*}{d(1/q_{US})} > 0$, and $\dfrac{d\mu_{US}^{*}}{d(1/q_{US})} > 0$.

We derive reaction functions of the Japanese firm given the prices of the ASEAN products in the Japanese and U.S. market, respectively.

$$\text{(6a)} \qquad \log P_J^{Y^*} = \frac{\eta_J^*}{1+\eta_J^*} \log P_J^Y + \frac{1}{1+\eta_J^*} \log \{P_m^Y + \overline{C'}$$

$$\text{(6b)} \qquad \log P_{US}^{\$^*} = \frac{\eta_{US}^*}{1+\eta_{US}^*} \log P_{US}^{\$} + \frac{1}{1+\eta_{US}^*} \log \left\{ \frac{E^{A/Y}}{E^{A/\$}} \left(P_m^Y + \overline{C'} \right) \right\}$$

where $\eta_J^* \equiv -\dfrac{\mu^{*'}}{\mu^* q_J} > 0$ denotes a price elasticity of markups of the Japanese products in the Japanese market; $\eta_{US}^* \equiv -\dfrac{\mu_{US}^{*'}}{\mu_{US}^* q_{US}} > 0$ a price elasticity of markups of the Japanese products in the U.S. market.

From equations (3a) and (6a), we derive equilibrium prices of the ASEAN products and the Japanese products in the Japanese market, respectively:

$$\text{(7a)} \qquad \log P_J^Y = \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*} \log \left(\omega_m P_m^Y + (1-\omega_m) \frac{E^{A/\$}}{E^{A/Y}} P_m^{\$} + \frac{\overline{C'}}{E^{A/Y}} \right) + \frac{\eta_J}{1+\eta_J+\eta_J^*} \log (P_m^Y + \overline{C'}$$

$$\text{(7b)} \qquad \log P_J^{Y^*} = \frac{\eta_J^*}{1+\eta_J+\eta_J^*} \log \left(\omega_m P_m^Y + (1-\omega_m) \frac{E^{A/\$}}{E^{A/Y}} P_m^{\$} + \frac{\overline{C'}}{E^{A/Y}} \right) + \frac{1+\eta_J}{1+\eta_J+\eta_J^*} \log (P_m^Y + \overline{C'}$$

From equations (3b) and (6b), we derive equilibrium prices of the ASEAN products and the Japanese products in the U.S. market, respectively:

$$\text{(8a)} \qquad \log P_{US}^{\$} = \log \frac{E^{A/Y}}{E^{A/\$}} + \frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*} \log \left(\omega_m P_m^Y + (1-\omega_m) \frac{E^{A/\$}}{E^{A/Y}} P_m^{\$} + \frac{\overline{C'}}{E^{A/Y}} \right) + \frac{\eta_{US}}{1+\eta_{US}+\eta_{US}^*} \log \left(P_m^Y + \overline{C'} \right)$$

(8b)
$$\log P_{US}^{\$*} = \log \frac{E^{A/\yen}}{E^{A/\$}} + \frac{\eta_{US}^{*}}{1+\eta_{US}+\eta_{US}^{*}} \log\left(\omega_m P_m^{\yen} + (1-\omega_m)\frac{E^{A/\$}}{E^{A/\yen}} P_m^{\$} + \frac{\overline{C'}}{E^{A/\yen}} \right) + \frac{1+\eta_{US}}{1+\eta_{US}+\eta_{US}^{*}} \log\left(P_m^{\yen} + \overline{C'}\right)$$

From equations (7) and (8), we obtain equilibrium relative prices of the ASEAN products relative to the Japanese products in the Japanese and the U.S. markets, respectively:

(9a)
$$\log q_J = \log P_J^{\yen} - \log P_J^{\yen *} = \frac{1}{1+\eta_J+\eta_J^{*}} \left\{ \log\left(\omega_m P_m^{\yen} + (1-\omega_m)\frac{E^{A/\$}}{E^{A/\yen}} P_m^{\$} + \frac{\overline{C'}}{E^{A/\yen}} \right) - \log\left(P_m^{\yen} + \overline{C'}\right) \right\}$$

(9b)
$$\log q_{US} = \log P_{US}^{\$} - \log P_{US}^{\$*} = \frac{1}{1+\eta_{US}+\eta_{US}^{*}} \left\{ \log\left(\omega_m P_m^{\yen} + (1-\omega_m)\frac{E^{A/\$}}{E^{A/\yen}} P_m^{\$} + \frac{\overline{C'}}{E^{A/\yen}} \right) - \log\left(P_m^{\yen} + \overline{C'}\right) \right\}$$

Equations (9) show that the relative prices q_J and q_{US} depend on both the exchange rate of the yen relative to the ASEAN currency $E^{A/\yen}$ and the exchange rate of the dollar relative to the ASEAN currency $E^{A/\$}$. The exchange rate of the yen $E^{A/\yen}$ has effects on the relative prices via both the marginal cost of parts imported from the U.S. and the marginal production cost while the exchange rate of the dollar $E^{A/\$}$ has effects on the relative prices via the marginal cost of parts imported from the U.S.

A depreciation of the ASEAN currency against the yen has a negative effect on both the equilibrium relative prices of the ASEAN products relative to the Japanese products in the Japanese and the U.S. markets. On one hand, a depreciation of the ASEAN currency against the dollar has a positive effect on both the equilibrium relative prices.

We specify demand functions for the ASEAN products in the Japanese and the U.S. market from equation (9a) and (9b) as the price elasticities of demand in the Japanese and U.S. markets are ε_J and ε_{US}, respectively.

$$\text{(10a)} \qquad \log f = \frac{-\varepsilon_J}{1+\eta_J+\eta_J^*}\left\{\log\left(\omega_m P_m^{Y} + (1-\omega_m)\frac{E^{A/\$}}{E^{A/Y}}P_m^{\$} + \frac{\overline{C'}}{E^{A/Y}}\right) - \log\left(P_m^{Y} + \overline{C'}\right)\right\}$$

$$\text{(10b)} \qquad \log g = \frac{-\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}\left\{\log\left(\omega_m P_m^{Y} + (1-\omega_m)\frac{E^{A/\$}}{E^{A/Y}}P_m^{\$} + \frac{\overline{C'}}{E^{A/Y}}\right) - \log\left(P_m^{\$} + \overline{C'}\right)\right\}$$

Equations (10) shows that the demands for the ASEAN products in the Japanese market depend on both exchange rates of $E^{A/Y}$ and $E^{A/\$}$. Similarly for the U.S. market. The exchange rate of the yen $E^{A/Y}$ has effects on the demands via both the marginal cost of parts imported from the U.S. and the marginal production cost while the exchange rate of the dollar $E^{A/\$}$ has effects on the demands via the marginal cost of parts imported from the U.S.

A depreciation of the ASEAN currency against the yen has a positive effect on both the demands for the ASEAN products in the Japanese and the U.S. markets. Thus, the depreciation increases export volume of the ASEAN. On one hand, a depreciation of the ASEAN currency against the dollar has a negative effect on both the demands for the ASEAN products and export volume.

2-2. Model B

In Model B, the ASEAN firm compete against the Japanese firm in the

Japanese market and, on one hand, against the U.S. firm in the U.S. market. We suppose that the Japanese firm supplies its products only in the Japanese market while the U.S. firm supplies its products only in the U.S. market.

We formalize the same profit equation of the ASEAN firm as in Model A. However, $q_{US} \equiv P^{\$}_{US} / P^{\$\,*}_{US}$ represents a relative price of the ASEAN products relative to the U.S. products in the U.S. and $P^{\$\,*}_{US}$ represents a price of the U.S. products in the U.S. market in terms of the dollar in Model B. Thus, as in Model A, the reaction functions (3a) and (3b) of ASEAN firm in the Japanese and U.S. markets are derived.

Profits of the Japanese firm in terms of the yen π^*_J is formalized as follows:

(11) $$\pi^*_J = P^{Y\,*}_J f^*(1/q_J) - P^Y_m f^*(1/q_J) - C(f^*(1/q_J))$$

where $f^*(1/q_J)$ denotes a demand function for the Japanese products in the Japanese markets ($f^{*\prime} < 0$).

Profit-maximizing prices of the Japanese firm in the Japanese market is derived as follows:

(12) $$P^{Y\,*}_J = \mu^*_J \left(P^Y_m + \overline{C}'\right.$$

where $\mu^*_J \equiv \dfrac{\varepsilon^*_J(1/q_J)}{\varepsilon^*_J(1/q_J) - 1}$ denotes markups of the Japanese products in the Japanese market; $\varepsilon^*_J \equiv -\dfrac{f^{*\prime}(1/q_J)}{f^*(1/q_J)q_J}$ a price elasticity of demand for the Japanese products in the Japanese market. We assume that $\dfrac{d\varepsilon^*_J}{d(1/q_J)} > 0$ and $\dfrac{d\mu^*_J}{d(1/q_J)} > 0$.

We derive a reaction function of the Japanese firm given the prices of the

ASEAN products in the Japanese market.

(13) $$\log P_J^{Y*} = \frac{\eta_J^*}{1+\eta_J^*}\log P_J^Y + \frac{1}{1+\eta_J^*}\log\{P_m^Y + \overline{C'}$$

where $\eta_J^* \equiv -\frac{\mu_J^{*'}}{\mu_J^* q_J} > 0$ denotes a price elasticity of markups of the Japanese products in the Japanese market.

Profits of the U.S. firm in terms of the dollar π_{US}^* is formalized as follows:

(14) $$\pi_{US}^* = P_{US}^{\$*} g^*(1/q_{US}) - P_m^{\$} g^*(1/q_{US}) - C(g^*(1/q_{US}))$$

where $g^*(1/q_{US})$ denotes a demand function for the U.S. products in the U.S. markets ($g^{*'} < 0$).

Profit-maximizing prices of the U.S. firm in the U.S. market is derived as follows:

(15) $$P_{US}^{\$*} = \mu_{US}^*(P_m^{\$} + \overline{C'}$$

where, $\mu_{US}^* \equiv \frac{\varepsilon_{US}^*(1/q_{US})}{\varepsilon_{US}^*(1/q_{US}) - 1}$ denotes markups of the U.S. products in the U.S. market; $\varepsilon_{US}^* \equiv -\frac{f^{*'}(1/q_{US})}{f^*(1/q_{US})q_{US}}$ a price elasticity of demand for the U.S. products in the U.S. market. We assume that $\frac{d\varepsilon_{US}^*}{d(1/q_{US})} > 0$ and $\frac{d\mu_{US}^*}{d(1/q_{US})} > 0$.

We derive a reaction function of the U.S. firm given the prices of the ASEAN products in the U.S. market.

(16) $$\log P_{US}^{\$*} = \frac{\eta_{US}^*}{1+\eta_{US}^*}\log P_{US}^{\$} + \frac{1}{1+\eta_{US}^*}\log(P_m^{\$} + \overline{C'}$$

$\eta^*_{US} \equiv -\frac{\mu^{*\prime}_{US}}{\mu^*_{US} q_{US}} > 0$ denotes a price elasticity of markups of the U.S. products in the U.S. market.

From equations (3a) and (13), we derive equilibrium prices of the ASEAN products and Japanese products in the Japanese market, respectively:

(17a) $$\log P^Y_J = \frac{1+\eta^*_J}{1+\eta_J+\eta^*_J}\log\left(\omega_m P^Y_m + (1-\omega_m)\frac{E^{A/\$}}{E^{A/Y}}P^\$_m + \frac{\overline{C'}}{E^{A/Y}}\right) + \frac{\eta_J}{1+\eta_J+\eta^*_J}\log\left(P^Y_m + \overline{C'}\right)$$

(17b) $$\log P^{Y*}_J = \frac{\eta^*_J}{1+\eta_J+\eta^*_J}\log\left(\omega_m P^Y_m + (1-\omega_m)\frac{E^{A/\$}}{E^{A/Y}}P^\$_m + \frac{\overline{C'}}{E^{A/Y}}\right) + \frac{1+\eta_J}{1+\eta_J+\eta^*_J}\log\left(P^Y_m + \overline{C'}\right)$$

From equations (3b) and (16), we derive equilibrium prices of the ASEAN products and U.S. products in the U.S. market, respectively:

(18a) $$\log P^\$_{US} = \frac{1+\eta^*_{US}}{1+\eta_{US}+\eta^*_{US}}\log\left(\omega_m \frac{E^{A/Y}}{E^{A/\$}}P^Y_m + (1-\omega_m)P^\$_m + \frac{\overline{C'}}{E^{A/\$}}\right) + \frac{\eta_{US}}{1+\eta_{US}+\eta^*_{US}}\log\left(P^\$_m + \overline{C'}\right)$$

(18b) $$\log P^{\$*}_{US} = \frac{\eta^*_{US}}{1+\eta_{US}+\eta^*_{US}}\log\left(\omega_m \frac{E^{A/Y}}{E^{A/\$}}P^Y_m + (1-\omega_m)P^\$_m + \frac{\overline{C'}}{E^{A/\$}}\right) + \frac{1+\eta_{US}}{1+\eta_{US}+\eta^*_{US}}\log\left(P^\$_m + \overline{C'}\right)$$

From equations (17) and (18), we obtain an equilibrium relative price of the ASEAN products relative to the Japanese products in the Japanese markets and an equilibrium relative price relative to the U.S. products in the U.S. markets, respectively:

(19a) $$\begin{aligned}\log q_J &= \log P^Y_J - \log P^{Y*}_J \\ &= \frac{1}{1+\eta_J+\eta^*_J}\left\{\log\left(\omega_m P^Y_m + (1-\omega_m)\frac{E^{A/\$}}{E^{A/Y}}P^\$_m + \frac{\overline{C'}}{E^{A/Y}}\right) - \log\left(P^Y_m + \overline{C'}\right)\right\}\end{aligned}$$

$$\log q_{US} = \log P_{US}^{\$} - \log P_{US}^{\$\,*}$$

(19b)
$$= \frac{1}{1+\eta_{US}+\eta_{US}^{*}}\left\{\log\left(\omega_m \frac{E^{A/Y}}{E^{A/\$}} P_m^{Y} + (1-\omega_m)P_m^{\$} + \frac{\overline{C'}}{E^{A/\$}}\right) - \log\left(P_m^{\$} + \overline{C'}\right)\right\}$$

Equations (19) show that the relative prices q_J and q_{US} depend on both the exchange rate of the yen relative to the ASEAN currency $E^{A/Y}$ and the exchange rate of the dollar relative to the ASEAN currency $E^{A/\$}$. The exchange rate of the yen $E^{A/Y}$ has negative effects on the relative prices in the Japanese market via both the marginal cost of parts imported from the U.S. and the marginal production cost while it has positive effects on the relative prices in the U.S. market via the marginal cost of parts imported from Japan. On one hand, the exchange rate of the dollar $E^{A/\$}$ has positive effects on the relative prices in the Japanese market via the marginal cost of parts imported from the U.S. while it has negative effects on the relative prices in the U.S. market via both the marginal cost of parts imported from Japan and the marginal production cost.

A depreciation of the ASEAN currency against the yen has a negative effect on the equilibrium relative prices of the ASEAN products relative to the Japanese products in the Japanese market while it has a positive effect on the equilibrium relative prices in the U.S. markets. On one hand, a depreciation of the ASEAN currency against the dollar has a positive effect on the equilibrium relative price in the Japanese market while it has a negative effect on the equilibrium relative price in the U.S. market.

We specify demand functions for the ASEAN products in the Japanese and the

U.S. market from equation (19a) and (19b) as the price elasticities of demand in the Japanese and U.S. markets are ε_J and ε_{US}, respectively.

$$(20a) \qquad \log f = \frac{-\varepsilon_J}{1+\eta_J+\eta_J^*}\left\{\log\left(\omega_m P_m^Y + (1-\omega_m)\frac{E^{A/\$}}{E^{A/Y}}P_m^{\$} + \frac{\overline{C'}}{E^{A/Y}}\right) - \log\left(P_m^Y + \overline{C'}\right)\right\}$$

$$(20b) \qquad \log g = \frac{-\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}\left\{\log\left(\omega_m \frac{E^{A/Y}}{E^{A/\$}}P_m^Y + (1-\omega_m)P_m^{\$} + \frac{\overline{C'}}{E^{A/\$}}\right) - \log\left(P_m^{\$} + \overline{C'}\right)\right\}$$

Equations (20) shows that both the exchange rates of $E^{A/Y}$ and $E^{A/\$}$ have asymmetric effects on the demands for the ASEAN products in the Japanese and U.S. markets. As a result, the exchange rates have ambiguous effects on export volume of the ASEAN, which is a sum of both the demands $f+g$.

However, it is clearer how at least the exchange rate of the dollar affects the export volume of the ASEAN by supposing an extreme case where the ASEAN firm imported parts from Japan only, that is, $\omega_m = 1$. Demand functions for the ASEAN products in the Japanese and the U.S. market in the case of $\omega_m = 1$ are as following:

$$(20a') \qquad \log f = \frac{-\varepsilon_J}{1+\eta_J+\eta_J^*}\left\{\log\left(P_m^Y + \frac{\overline{C'}}{E^{A/Y}}\right) - \log\left(P_m^Y + \overline{C'}\right)\right\}$$

$$(20b') \qquad \log g = \frac{-\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}\left\{\log\left(\frac{E^{A/Y}}{E^{A/\$}}P_m^Y + \frac{\overline{C'}}{E^{A/\$}}\right) - \log\left(P_m^{\$} + \overline{C'}\right)\right\}$$

Equations (20a') and (20b') show that the exchange rate of the ASEAN currency against the dollar has unambiguous effects on export volume of the ASEAN $f+g$ while the exchange rate of the ASEAN currency against the yen has still ambiguous effects on export volume. If the share of parts imported from Japan is higher, it is more likely that the exchange rate against the dollar has unambiguous positive effects on the export volume while the exchange rate against the yen has ambiguous effects.

3. Effects of the Dollar peg on fluctuations in a trade balance

In this section, we explore effects of the dollar peg on a trade balance of the ASEAN economy.

A trade balance of the ASEAN economy is equal to a total export value or total sales of the ASEAN firm less than a total import value or total costs of imported parts in the our model. Therefore, we represent the trade balance in terms of the home currency T:

$$
\begin{aligned}
T &= E^{A/Y} P_J^Y f(q_J) + E^{A/\$} P_{US}^{\$} g(q_{US}) - \omega_m E^{A/Y} P_m^Y Q - (1-\omega_m) E^{A/\$} P_m^{\$} Q \\
&= \left[\left\{ \omega_x E^{A/Y} P_J^Y + (1-\omega_x) E^{A/\$} P_{US}^{\$} \right\} - \left\{ \omega_m E^{A/Y} P_m^Y + (1-\omega_m) E^{A/\$} P_m^{\$} \right\} \right] Q \\
&= (P_x^A - P_m^A) Q
\end{aligned}
\tag{21}
$$

where $\omega_x = f/Q$ denotes a share of products exported to Japan in the total export volumes; $P_x^A \equiv \omega_x E^{A/Y} P_J^Y + (1-\omega_x) E^{A/\$} P_{US}^{\$}$ a volume-weighted average export price in terms of the home currency; $P_m^A \equiv \omega_m E^{A/Y} P_m^Y + (1-\omega_m) E^{A/\$} P_m^{\$}$ a volume-weighted average import price in terms of the home currency. Equation (21) shows that the trade balance is proportional to a volume-weighted average export price less than a volume-weighted average import price because an total export volumes are equal to an total import volumes in our model.

Note that the trade balance is equivalent to nominal GDP in our model.

Therefore, we can say that we explore effects of the dollar peg on the nominal GDP in our model.

We derive a relationship between fluctuations in the trade balance and those in the exchange rates in each Model A and B(see appendix):

$$\hat{T} = \frac{1}{T}\Big[T_J \hat{E}^{A/Y} + T_{US}\hat{E}^{A/\$} +$$
$$(22) \qquad \left\{\frac{1+\eta_J^* - \varepsilon_J}{1+\eta_J+\eta_J^*} X_J + \frac{1+\eta_{US}^* - \varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*} X_{US}\right\}\Big[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}\Big] +$$
$$\left\{\frac{\varepsilon_J}{1+\eta_J+\eta_J^*}\omega_x + \frac{\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}(1-\omega_x)\right\} M\Big[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}\Big]\Big]$$

$$\hat{T} = \frac{1}{T}\Big[T_J \hat{E}^{A/Y} + T_{US}\hat{E}^{A/\$} +$$
$$\frac{1+\eta_J^* - \varepsilon_J}{1+\eta_J+\eta_J^*} X_J\Big[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}\Big] +$$
$$(23) \qquad \frac{1+\eta_{US}^* - \varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*} X_{US}\Big[-\{1-(1-\omega_m)B_1\}\hat{E}^{A/\$} + \{1-(1-\omega_m)B_1 - B_2\}\hat{E}^{A/Y}\Big] +$$
$$\frac{\varepsilon_J}{1+\eta_J+\eta_J^*}\omega_x M\Big[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}\Big]\Big] +$$
$$\frac{\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}(1-\omega_x) M\Big[-\{1-(1-\omega_m)B_1\}\hat{E}^{A/\$} + \{1-(1-\omega_m)B_1 - B_2\}\hat{E}^{A/Y}\Big]\Big]$$

where $T_J \equiv (\omega_x E^{A/Y} P_J^Y - \omega_m E^{A/Y} P_m^Y)Q$ denotes a trade balance with Japan; $T_{US} \equiv \{(1-\omega_x)E^{A/\$}P_{US}^{\$} - (1-\omega_m)E^{A/\$}P_m^{\$}\}Q$ a trade balance with the United States; $X_J \equiv \omega_x E^{A/Y} P_J^Y Q$ a value of exports to Japan; $X_{US} \equiv (1-\omega_x)E^{A/\$}P_{US}^{\$}Q$ a value of exports to the U.S.; $M \equiv P_m^A Q$ a total import value, $B_1 \equiv \left(\dfrac{E^{A/\$}P_m^{\$}}{E^{A/Y}}\right)\Big/ TC_A$; $(1-\omega_m)B_1$ a share of a marginal cost of parts imported from the U.S. in the total marginal costs;

$B_2 \equiv \left(\frac{\overline{C'}}{E^{A/Y}}\right) \Big/ TC_A$ a share of a marginal production cost in the total marginal costs;

$TC_A \equiv \omega_m P_m^Y + (1-\omega_m)\frac{E^{A/\$}P_m^{\$}}{E^{A/Y}} + \frac{\overline{C'}}{E^{A/Y}}$ the total marginal costs; $\hat{x}$ means a rate of change in a variable x.

For simplicity, the price elasticity of demand in the Japanese is assumed to be equal to that in the U.S. markets ($\varepsilon_J = \varepsilon_{US} = \varepsilon$). When the price elasticities of demand are equal to each other, the price elasticities of markups in both the markets are also equal to each other ($\eta_J = \eta_{US} = \eta$ and $\eta_J^* = \eta_{US}^* = \eta^*$). Therefore, we change equation (22) and (23) into the following equation:

(22')
$$\hat{T} = \frac{1}{T}\Bigg[\left\{T_J\hat{E}^{A/Y} + T_{US}\hat{E}^{A/\$}\right\} + \frac{1+\eta^*}{1+\eta+\eta^*}X\left\{(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}\right\} - \frac{\varepsilon}{1+\eta+\eta^*}T\left\{(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}\right\}\Bigg]$$

(23')
$$\hat{T} = \frac{1}{T}\Bigg[\left\{T_J\hat{E}^{A/Y} + T_{US}\hat{E}^{A/\$}\right\} + \frac{1+\eta^*}{1+\eta+\eta^*}X\left\{(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}\right\} - \frac{\varepsilon}{1+\eta+\eta^*}T\left\{(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}\right\} + \left\{\frac{1+\eta^*}{1+\eta+\eta^*}X_{US} + \frac{\varepsilon}{1+\eta+\eta^*}T_{US}\right\}(\hat{E}^{A/Y} - \hat{E}^{A/\$})\Bigg]$$

where $X \equiv P_x^A Q$: a total export value.

Equations (22') and (23') shows that the effects of the exchange rates on the trade balance have the following transmission channels.

The first channel is a direct effect of the exchange rates on the trade balance as shown in the first angle bracket in both the equations. The ASEAN country imports parts from Japan and the United States and exports products to the countries. Thus, the exchange rates have the direct effect via both the export values and the import values.

The second channel is an indirect effect of the exchange rates via the product prices as shown in the second angle bracket of the equations. The exchange rates have effects on the product prices as shown in equations (7), (8), (17), and (18). The product prices have effects on export values. Thus, this price channel is that the exchange rates have effects on the export volumes.

The third channel is an indirect effect of the exchange rate via the demands for the ASEAN products and in turn its outputs as shown in the third brace bracket of the equations. The exchange rates have effects on the product prices, which change the relative prices of the products in the Japanese and the U.S. markets as shown in equations (9) and (19). The changes in the relative prices have effects on the demands for the products in both the markets as shown in equations (10) and (20). The demands for the ASEAN products is equivalent to export volumes of the ASEAN economy. On one hand, changes in outputs have effects on import volumes because the ASEAN economy imports all of parts from the foreign countries in our model. Thus, this output channel is that the exchange rates have effects on both the export volumes and the import volumes. The fourth brace bracket of equation (23') is related to the second and third channels for the trade with the United States.

Now we consider the effect of exchange rate regime on a trade balance of an ASEAN country. The monetary authorities of the ASEAN country is assumed to peg its home currency to the dollar. The dollar peg is equivalent to a case of $\hat{E}^{A/\$} = 0$. Substituting $\hat{E}^{A/\$} = 0$ to equations (22') and (23'), we obtain the following equations:

$$(24) \qquad \hat{T} = \frac{1}{T}\left[T_J - \frac{1+\eta^*}{1+\eta+\eta^*} X\{(1-\omega_m)B_1 + B_2\} + \frac{\varepsilon}{1+\eta+\eta^*} T\{(1-\omega_m)B_1 + B_2\}\right]\hat{E}^{A/Y}$$

$$(25) \qquad \hat{T} = \frac{1}{T}\left[T_J - \frac{1+\eta^*}{1+\eta+\eta^*} X\{(1-\omega_m)B_1 + B_2\} + \frac{\varepsilon}{1+\eta+\eta^*} T\{(1-\omega_m)B_1 + B_2\} + \left\{\frac{1+\eta^*}{1+\eta+\eta^*} X_{US} + \frac{\varepsilon}{1+\eta+\eta^*} T_{US}\right\}\right]\hat{E}^{A/Y}$$

In the case of the dollar peg, changes in the exchange rate of the yen against the ASEAN currency have some effects on the trade balance in our model where the ASEAN firm imports parts for production from Japan and the United States and exports its products to Japan and the United States. The ASEAN products compete against the Japanese firm or the US firm. Changes in the exchange rate of the yen have effects on the trade balance through the above three transmission channels.

For example, a depreciation of the yen ($\hat{E}^{A/Y} < 0$) deteriorates the trade balance via the first direct channel if the ASEAN country has a trade balance surplus with Japan ($T_J > 0$) as shown in the first term in the square bracket of equations (24) and (25). On one hand, it improves the trade balance if the ASEAN country has a trade balance deficit with Japan ($T_J < 0$).

Next, a depreciation of the yen against the home currency increases the marginal costs of parts imported from the U.S. and domestic production of the ASEAN firm relative to those of the Japanese firm. The ASEAN firm is forced to increase its product prices in both the Japanese and the U.S. markets though it imperfectly pass-through the increase in the marginal costs into the product prices because it compete against the Japanese firm in both the markets as shown equations (7a), (8a), (17a), and (18a). As a result, the depreciation of the yen improves the trade balance via the price channel as shown in the second term of equations (24) and (25).

Third, a depreciation of the yen increases the relative prices of the ASEAN products relative to the Japanese products in both the Japanese and the U.S. markets as shown in equations (9) and (19). In turn, it reduces the demands for the ASEAN products in both the markets as shown in equations (10) and (20). The results in a contraction in outputs of the ASEAN firm, and decreases both the export volumes and the import volumes of parts. Therefore, a depreciation of the yen deteriorates the trade balance surplus ($T > 0$) or improves the trade balance deficit ($T < 0$) via the output channel as shown in the third term of equations (24) and (25).

4. The optimal weights

The monetary authorities are assumed to choose weights of the yen and the dollar in order to stabilize the fluctuations in the trade balance caused by changes in the exchange rates.[3] In particular, we adopt a criterion of minimizing the squared rate of change in the trade balances. The goal of the monetary authorities is

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[3] Flanders and Helpman(1979), Lipschitz and Sundararajan((1980), and Flanders and Tishler(1981) emphasized only real side of economy in modeling the basket peg issue. On one hand, Turnovsky(1982) and Bhandari(1985) used a general equilibrium macromodel which include capital mobility.

equivalent to stabilizing the nominal GDP in our model because the trade balance is equivalent to the nominal GDP. Pegging the home currency to a basket of the yen and the dollar implies that the monetary authorities try to keep the exchange rate of the currency basket in terms of the home currency unchanged. Therefore, changes in the exchange rate of the currency basket in terms of the home currency is zero:

(26) $$w\hat{E}^{A/\$} + (1-w)\hat{E}^{A/¥} = 0$$

where w is a weight of the dollar in pegging the home currency to the currency basket. If w turns out to be 1 (0, respectively), then this country is in the optimal currency area of the dollar (yen, respectively).[4]

Note that it is not necessary to take into account a correlation between the exchange rates vis-à-vis the yen and vis-à-vis the dollar, because the optimality is defined to minimize the weighted average (currency basket) of the changes in the exchange rates against the dollar and yen (that is, the left hand side of equation (26)). The correlation would have been relevant, if we were to adopt a criterion that minimizes variance of the currency basket (that is, the variance of the left hand side of equation (26)).

For the choice of criteria for "optimality," the literature does not have a standard. If the objective of the optimal basket is regarded as a multi-country replacement for the peg to a single currency, then stability of the real effective exchange rate is the criterion. This is a basic stance of Lipschitz and Sundrarajan (1980). It is implicit in this choice that if the exchange rate is stable (at around the

[4] The standard references of optimal currency area include Kenen (1969), Mundell

equilibrium), then the trade balance is stable. One can make it more explicit. The principal role of the exchange rate is to keep the balance of trade or current accounts, so a natural candidate is the trade balance stabilization. This line of thoughts is followed by Flanders and Helpman (1979) and Flanders and Tishler (1981). However, the exchange rate policy is only one part of overall economic policy that pursue price stabilization and income growth. The balance of payments cannot be a stand-alone objective. Turnovsky (1985) proposes the criterion of stabilizing domestic income, more general objective of economic policy. For domestic income stabilization, there are policy options other than the currency basket weights. Other policy options should be modeled if a general policy objective is introduced. Bhandari (1985), extending Turnovsky, considers four criteria (or their combination) at the same time, including the real effective exchange rate, in a similar model. It is not clear whether these four criteria can be weighted and combined in one loss function.

Our paper is different from the previous papers in the literature. Our model is based on the exporter's maximizing behavior, instead of ad hoc macro model. How prices respond to the exchange rate changes is solved in the model. This feature avoids a criticism that the optimal peg literature takes the prices as given. Our model makes it explicit how prices are set by the profit-maximizing firm. The optimality is to minimize the squared rate of change in the trade balance $\hat{T}^2$ subject to equation (26), where a rate of change in the trade balance $\hat{T}$ is shown in equation (22') or (23'). The criteria is equivalent to minimizing the variance of the growth rate, provided

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(1961), and McKinnon (1963).

that the mean growth rate is equal to zero.[5]

In Model A, we obtain optimal weights of pegging the home currency to the dollar w^*:

$$w^* = \frac{T_{US} + \frac{1+\eta^*}{1+\eta+\eta^*} X(1-\omega_m)B_1 - \frac{\varepsilon}{1+\eta+\eta^*} T(1-\omega_m)B_1}{T - \frac{1+\eta^*}{1+\eta+\eta^*} XB_2 + \frac{\varepsilon}{1+\eta+\eta^*} TB_2} \tag{27}$$

where both the denominators and the numerators are assumed to be different from zero. Especially, the optimal peg weights are indeterminate if the numerators are equal to zero.

In Model B, we obtain optimal weights of pegging the home currency to the dollar w^*:

$$w^* = \frac{T_{US} - \frac{1+\eta^*}{1+\eta+\eta^*} \{X_{US} - X(1-\omega_m)B_1\} + \frac{\varepsilon}{1+\eta+\eta^*} \{T_{US} - T(1-\omega_m)B_1}{T - \frac{1+\eta^*}{1+\eta+\eta^*} XB_2 + \frac{\varepsilon}{1+\eta+\eta^*} TB_2} \tag{28}$$

Equations (27) and (28) imply that both the optimal peg weights are related to three factors. The exchange rates made impacts on the trade balance of the ASEAN economy via the above-mentioned three channels: the direct channel, the price channel, and the output channel. Here, we find the three channels in the equations.

[5] In the literature, minimizing the variance of the level of trade balance is used, while minimizing the growth rate of the trade balance is our objective function. The difference is that in our case, when the level is deviated from the mean, staying at the new level (growth rate is zero) is not penalized in the objective function, while it is penalized in the objective function of the literature. We consider that a particular level cannot be determined as the long run optimum in our model, because the firm is

The first terms in both the denominators and the numerators are related with the direct channel. The second terms are related with the price channel. The third terms are related with the output channel.

We could focus on only a ratio of the trade balance with the United States or Japan to the total trade balances in determining the optimal peg weights if the price and the output channels were ineffective. However, the ASEAN firm sets the product prices in both the Japanese and the U.S. markets by adding the markups to the total marginal costs in terms of the relevant currencies. The exchange rates have effects on the total marginal costs in terms of the relevant currencies. The two components of the total marginal costs for the ASEAN firm—the marginal cost of parts imported from the U.S. and the production marginal cost—are different from those for the competing Japanese firm. These are expressed in $(1-\omega_m)B_1$ and B_2 in the equations.

Thus, the optimal peg weights are related with the price elasticities of demand and the cost compositions as well as the trade structures. This makes the difference in choosing an optimality criterion other than the real effective exchange rate, such as Lipschitz and Sundararajan (1980).

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maximizing profits, that is the trade balance in our model.

5. Theoretical Prediction

5.1. Regression forms

In order to prepare for regression, we derive operational regressions from theoretical models in Section 2. Export prices in Model A can be expressed as a function of the exchange rate, say the Baht, against the US dollar and the Baht against the Japanese yen. (See Appendix for derivation.)

$$\hat{P}_x^A = \alpha_1 \hat{E}^{A/\$} + \alpha_2 \hat{E}^{A/Y}$$
$$= \left[\frac{1+\eta^*}{1+\eta+\eta^*}(1-\omega_m)B_1\right]\hat{E}^{A/\$} + \left[1-\frac{1+\eta^*}{1+\eta+\eta^*}\{(1-\omega_m)B_1 + B_2\}\right]\hat{E}^{A/Y}$$

$$\alpha_1 \equiv \frac{1+\eta^*}{1+\eta+\eta^*}(1-\omega_m)B_1 > 0$$

$$\alpha_2 = 1-\frac{1+\eta^*}{1+\eta+\eta^*}\{(1-\omega_m)B_1 + B_2\} = 1-\alpha_1-\frac{1+\eta^*}{1+\eta+\eta^*}B_2 > 0$$

Export price in Model B (from Appendix)

$$\hat{P}_x^A = \alpha_3 \hat{E}^{A/\$} + \alpha_4 \hat{E}^{A/Y}$$
$$= \left[\frac{1+\eta^*}{1+\eta+\eta^*}(1-\omega_m)B_1 + \frac{\eta}{1+\eta+\eta^*}(1-\omega_x)\right]\hat{E}^{A/\$} +$$
$$\left[1-\frac{1+\eta^*}{1+\eta+\eta^*}\{(1-\omega_m)B_1 + B_2\} - \frac{\eta}{1+\eta+\eta^*}(1-\omega_x)\right]\hat{E}^{A/Y}$$

$$\alpha_3 \equiv \frac{1+\eta^*}{1+\eta+\eta^*}(1-\omega_m)B_1 + \frac{\eta}{1+\eta+\eta^*}(1-\omega_x) > 0$$

$$\alpha_4 = 1-\frac{1+\eta^*}{1+\eta+\eta^*}\{(1-\omega_m)B_1 + B_2\} - \frac{\eta}{1+\eta+\eta^*}(1-\omega_x) = 1-\alpha_3-\frac{1+\eta^*}{1+\eta+\eta^*}B_2 > 0$$

Export volume in Model A (from Appendix)

$$\hat{Q} = \beta_1 \hat{E}^{A/\$} + \beta_2 \hat{E}^{A/Y}$$
$$= -\frac{\varepsilon}{1+\eta+\eta^*}(1-\omega_m)B_1\hat{E}^{A/\$} + \frac{\varepsilon}{1+\eta+\eta^*}\{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y}$$

$$\beta_1 \equiv -\frac{\varepsilon}{1+\eta+\eta^*}(1-\omega_m)B_1 < 0$$

$$\beta_2 \equiv \frac{\varepsilon}{1+\eta+\eta^*}\left\{(1-\omega_m)B_1 + B_2\right\} = -\beta_1 + \frac{\varepsilon}{1+\eta+\eta^*}B_2 > 0$$

Export volume in Model B (from Appendix)

$$\hat{Q} = \beta_3 \hat{E}^{A/\$} + \beta_4 \hat{E}^{A/¥}$$
$$= -\left[\frac{\varepsilon}{1+\eta+\eta^*}(1-\omega_m)B_1 - \frac{\varepsilon}{1+\eta+\eta^*}(1-\omega_x)\right]\hat{E}^{A/\$} +$$
$$\left[\frac{\varepsilon}{1+\eta+\eta^*}\left\{(1-\omega_m)B_1 + B_2\right\} - \frac{\varepsilon}{1+\eta+\eta^*}(1-\omega_x)\right]\hat{E}^{A/¥}$$

$$\beta_3 \equiv -\frac{\varepsilon}{1+\eta+\eta^*}(1-\omega_m)B_1 + \frac{\varepsilon}{1+\eta+\eta^*}(1-\omega_x)$$

$$\beta_4 \equiv \frac{\varepsilon}{1+\eta+\eta^*}\left\{(1-\omega_m)B_1 + B_2\right\} - \frac{\varepsilon}{1+\eta+\eta^*}(1-\omega_x) = -\beta_3 + \frac{\varepsilon}{1+\eta+\eta^*}B_2$$

the optimal dollar peg weight in Model A:

$$w^* = \frac{T_{US} + \frac{1+\eta^*}{1+\eta+\eta^*}X(1-\omega_m)B_1 - \frac{\varepsilon}{1+\eta+\eta^*}T(1-\omega_m)B_1}{T - \frac{1+\eta^*}{1+\eta+\eta^*}XB_2 + \frac{\varepsilon}{1+\eta+\eta^*}TB_2}$$

$$w^* = \frac{T_{US} + \alpha_1 X + \beta_1 T}{T + (\alpha_1 + \alpha_2 - 1)X + (\beta_1 + \beta_2)T}$$

the optimal dollar peg weight in Model B:

$$w^* = \frac{T_{US} - \frac{1+\eta^*}{1+\eta+\eta^*}\left\{X_{US} - X(1-\omega_m)B_1\right\} + \frac{\varepsilon}{1+\eta+\eta^*}\left\{T_{US} - T(1-\omega_m)B_1\right.}{T - \frac{1+\eta^*}{1+\eta+\eta^*}XB_2 + \frac{\varepsilon}{1+\eta+\eta^*}TB_2}$$

For simplicity, we assume that ω_x and ω_m are nearly equal to each other.

$$w^* = \frac{-M_{US} + \alpha_3 X + \beta_3 T}{T + (\alpha_3 + \alpha_4 - 1)X + (\beta_3 + \beta_4)T}$$

where M_{US}: a value of imports from the U.S.

5.2 Sign conditions

Major predictions of the exchange rate changes on the export volumes and prices based on the theoretical model developed in Section 2 can be summarized as follows. Based on Model A (the model where Asian exports compete with Japanese goods in Japan and in the United States), export volume will rise if the baht depreciate against the Japanese yen, but will decline if the baht depreciate against the US dollar. The reason that export volume will decline when the baht depreciate against the US dollar is the hike in costs of imported parts from the United States, while the costs for Japanese producers would not change as they use local parts. If the dollar peg is maintained, then the yen depreciation vis-à-vis the US dollar means the baht appreciation vis-à-vis the yen, while the baht-dollar exchange rate is stable, resulting in the decrease in export volume.

Based on Model B (the model where Asian exports compete in the US market against US-made goods and compete in Japanese markets against Japanese-made goods, the following theoretical prediction is obtained. A depreciation of the baht against the dollar has two effects. The costs of imported parts will rise, so this has a negative effect on export volume. On the other hand, local costs of Thai exporters will become less than the US producers. This will have positive effects on export volume. Similarly, a depreciation of the baht against the yen has two effects, higher imported parts costs and lower local costs. In the end, sign of the coefficients are not determined.

Consider a special case where parts are imported only from Japan (ω_m

= 1). In case of Model A, a baht depreciation against the dollar does not have any effect on export volume, while the baht depreciation against the yen will increase export volume; and in case of Model B, the baht depreciation against the dollar will increase export volume, while the effect of the baht depreciation against the yen still has an ambiguous sign on export volume.

The effects of the exchange rate changes on the export price of Thailand are more straightforward. Both in Model A and Model B, a baht depreciation against the dollar results in the hike of export prices. This reflects the increase in costs of the imported parts. However, the increase in the prices is less than the change in the exchange rate, due to competitive pressure in the destination market, thus an imperfect pass-through. The baht depreciation against the yen results in the price hike also results in the export price increase in Model A and Model B. The discussion is summarized in Table 1.

**** insert Table 1**

6. Stylized Facts and Regressions

6.1 De facto Dollar peg

Many East and Southeast Asian countries had adopted de facto dollar peg regimes until the currency crisis of 1997, some explicitly and others implicitly. Hong Kong has explicitly maintained the currency board, the nominal peg to the dollar. Thailand, before July 1997, adopted a currency basket system with undisclosed currency weights, but it was well-known in the market that the weight of the US dollar in the basket was more than 90 percent. Indonesia adopted the crawling pet against the US dollar, where the rupiah depreciated with a schedule with a narrow band. Malaysia adopted the managed float, but the movement of the ringgit was stable against the US dollar. The movement of the Singaporean dollar and the Korean Won was more flexible, compared to other currencies, responding some to the Japanese yen movement.

The actual weights, which may be quietly adjusted time to time, can be estimated from actual movements of the exchange rates. Frankel and Wei (1994) estimated the weights of the US dollar and the yen and other currencies in currency baskets of nine Asian currencies. Asian currencies (in terms of the Swiss Franc) are regressed on the US dollar (in terms of the Swiss Franc) and the Japanese yen (in terms of the Swiss Franc), for various sub-periods in 1972-92, with weekly data. They showed that the US dollar had an overwhelming weight in all currencies in all periods.

According to Frankel and Wei, the US dollar weight was typically about 95% for the Korean won, that is, if the US dollar depreciated by 1 % vis-à-vis the Swiss Franc, the Korean won depreciates 0.95% that week. Hong Kong dollar, Taiwan Dollar, Indonesia rupiah, Philippine peso, and Thai baht had a coefficient on the US dollar higher than 90 percent. For the movement of the Singaporean dollar, the weight of the US dollar was about 75%, significantly lower than the Korean won. Similarly, the Malaysian ringgit moves with the US dollar by 78%. In the case of the Chinese Yuan, the coefficient is 0.87. A major part of the Frankel and Wei study is summarized in Table 2.

** Insert Table 2

Frankel and Wei examined whether adding other currencies, DM, Australian dollar, and New Zealand dollar would change the results. For Singaporean dollar, when these currencies were added, the coefficients of the US dollar and the Japanese yen were reduced to 0.71 and 0.12, respectively; and the coefficient of DM is 0.14, and that of the NZ dollar 0.02, both being statistically significant. Similarly, for the Malaysian ringgit. (It is also possible that the Singaporean dollar was the genuine basket currency, and the Malaysian ringgit was pegged to the Singaporean dollar.) For other currencies, one cannot reject a hypothesis that coefficients of DM, the Austrarian dollar and the NZ dollar were statistically significantly different from zero.

From Frankel and Wei, we may conclude that only the Singaporean dollar and the Malaysian Ringgit had a genuine basket system. The former put to the US dollar a weight of 70 percent, and the Japanese yen and the German mark, splitting the rest. The weights were similar for Malaysian Ringgit. Other than these currencies, the Asian currencies were de facto pegged to the US dollar, its weight in the basket being about 90 percent or higher.

6.2. Trade Linkage to US and Japan

One of the reasons for the de facto dollar peg is that a large part of exports is destined to the United States, and the dollar denomination is convenient for avoiding fluctuation in export competitiveness. However, Japan is also a major trading partner for Asian countries. In fact, for most Asian economies, Japan and the United States are equally important as export destinations. Many Asian countries import parts and semi-finished goods from Japan. As the nominal or real exchange rate vis-à-vis the US dollar has been stabilized by the exchange rate policy, the real effective exchange rate vis-à-vis Japanese yen fluctuates widely as the Japanese yen fluctuate vis-à-vis the US dollar.

Table 3 shows exports and imports of NIES(except Taipei, China), ASEAN-4 (Thailand, Indonesia, Malaysia, and Philippines), and China, , by their destination or origin. Several features stand out. First, Japan is as important as the United States as trade partner for most Asian countries. The trade linkage to Japan is especially stronger for the ASEAN-4.

Second, Japan tends to be more important as an import origin than as an export destination. Except for Indonesia and India, the import share from Japan is higher than the export share. The export share of Japan is lower that the export share of US for all countries in the table, except for Indonesia and China. The import share of Japan is higher than that of US for all countries except for Korea (in 1996 only).

Third, the Asian developing countries collectively are also an important trading partner. For Hong Kong, Malaysia and Singapore, about a half of their exports go to Asian developing countries. For Thailand and the Philippines, the share of Asian developing countries have increased markedly from 1990 to 1996, reflecting that trade linkage is now stronger among the ASEAN-4.

*** Insert **Table 3**

6.3. Real Exchange Rates and Export Volume

In order to make observations on the relationship between the exchange rate movement and export performance, the real exchange rate of country A (say, Thailand) vis-à-vis the Japanese yen, say the baht/yen real exchange rate, or

95 are accompanied by a surge in export volume growth rates. Also, in many countries, the yen depreciation (or appreciation of an Asian currency vis-à-vis yen) of 1989-90 affected export volume adversely.

For Malaysia, the correlation between the RER(A/Y) and export volume was weak in the 1980s but became stronger in the 1990s, because its export structure became much more industrial (especially, electronics) in the 1990s. The Indonesian export movement does not seem be correlated with its RER. This is because oil and other mineral resources has a large share in the Indonesian trade structure, and their export performances, which may not be directly related to RER, have a large impact on the Indonesian export growth. It is more important to look at the non-oil-and-gas exports, in order to see the impact of the exchange rate.

** Insert Figures 1 to 7: Real Exchange Rates and Export Volume. (Korea, Taiwan, Singapore, Thailand, Malaysia, Philippines, Indonesia).

Therefore, it is reasonable to conclude that the exchange rate movement vis-à-vis Japan and its effects on the export industry is important, and this is a result of the policy that de facto fixed their exchange rate to the US dollar.

In each graph, the spike of RER(A/Y) in the second quarter of 1995 is very prominent. This reflects a sharp yen appreciation at the time, and the Asian currencies' de facto dollar peg. The yen had a trend to appreciate in the first half of the 1990s and climaxed at 80 yen/dollar in April 1995. The yen reversed its movement and depreciated to the 100 level in the following five months, and further depreciated to 120 level in the following two years. The yen appreciation in the first half of the 1990s helped exports from most of Asian countries. The subsequent yen depreciation significantly dampened exports from these countries, expecially from Thailand.

7. Regression Analysis

7.1 Pass-through equation

This section investigates quantitatively theoretical prediction of the model (Section 5), with some prior knowledge of general movements of exports from stylized facts (Section 6). First, the pass-through equation, the response of export price to the changes in the exchange rate, will be estimated. The innovative feature of our model is that there are two exchange rates in the model. The ASEAN firm is expected to respond to both the baht/yen exchange rate and the baht/dollar exchange rate. Consider the effects of the baht/yen exchange rate change and the baht/dollar exchange rate, in order. Second, the volume of exports will be regressed on the bilateral real exchange rates of the baht/yen and baht/dollar, and the real income growth of Japan and the United States. The coefficients of the exchange rates will capture the price elasticities of the demand for the ASEAN goods, and the coefficients of the income variables will capture the income elasticities of the ASEAN goods.

<u>Pass through equation:</u>

The change in the real export price in local currency is regressed on the changes in the real exchange rates against the dollar and the yen.

D(Real export price in local currency(t)) = $\gamma_0 + \gamma_1$ D(RER(A/D)(t)) + γ_2 D(RER(A/Y)(t)) + e(t)

where D(.) is the growth rate operator; export prices are divided by the respective CPI; coefficients γ_1 and γ_2 represents the pass-through coefficients, or sensitivities, of the real export price to the changes in the real exchange rate vis-à-vis the dollar and vis-à-vis the yen, respectively. When the export price trend is different from CPI, then it is captured in the constant term. For example, when the Balassa-Samuelson effect is present, that is productivity growth is significantly different nontradable and tradable sectors, the nontradable prices are likely to increase faster than the tradable prices. If the pass-through coefficient is unity, then the changes in the export price fully reflect the exchange rate changes, that is, one percent depreciation vis-à-vis the dollar will increase the export price in local currency by one percent so that the export price in the dollar remains the same (a full pass-through). However, this would put the exporters in the less competitive positions against the Japanese exporters in the Japanese market, and, in case of model A, in the US market as well.

Monthly data are collected either from IFS or national sources. The change was taken against the same month of the previous year. The autocorrelation in the error terms is dealt with by using the robust error method (RATS program). The sample period is from 1981-1996, except it is noted. **Table 4** summarizes the regression results. In general, the degree of export price adjustment varies from country to another.

Insert Table 4.

In Thailand, where the sample period starts in 1986 to avoid the exchange rate regime change of 1984, the sensitivity of the export prices to the dollar is small and insignificant, while the sensitivity with respect to the yen is about 0.14

and barely significant (at 10 percent).[1] The constant term is insignificant (no Balassa-Samuelson).

In Indonesia, where the sample period starts in 1988 to avoid the exchange rate regime in 1986, sensitivities with respect to the dollar and the yen are both statistically insignificant.

The Korean case presents an interesting picture. The Korean export prices respond to the dollar and the yen in a similar magnitude of sensitivity, 0.12 and 0.13, respectively, but only the yen is statistically significant. The constant term is also significant, with negative coefficient, suggesting that prices of the nontradables (containted in CPI) are increasing more than the export prices (tradables).

The Taiwan case is rather different from the above countries, in that the sensitivity of export prices with respect to the dollar movement is large, 0.49. About half of the dollar fluctuation is absorbed by the export price changes. The sensitivity with respect to the yen is small and insignificant.

Singapore presents a puzzling case, in that the sensitivity with respect to the dollar is negative, large, and significant. A small Balassa-Samuelson effect is detected.

In the case of the Philippines, the sensitivity with respect to the yen is large (0.41) and mildly significant (at 6%). A strong Balassa-Samuelson effect is detected. Note that the Balassa-Samuelson effect is a proposition on the relative magnitude of the two sectors. A large negative constant term is consistent with a case where nontradables are extremely unproductive and experienced high inflation, while tradables did not.

7.2 Volume Equation

---

[1] The magnitude of the coefficient and t-statistics are only slightly different whtn the sample period is extended back to 1981.

The export volume is regressed on the real exchange rate changes against the US dollar and the Japanese yen, and real GDP growth rates of the United States and Japan. The latter terms represent export demand increase due to income increases in the United States and Japan.

$$D(\text{Export volume }(t)) = \omega_1 D(RER(A/D)(t)) + \omega_2 D(RER(A/Y)(t)) + \omega_3 D\ (USGDP(t)) + \omega_4 D(JAGDP(t)) + e(t)$$

where D(.) is the growth rate operator, RER(.) is the real exchange rate using CPI, and USGDP and JAGDP denote real GDP of theUnited States and Japan, respectively. Data are quarterly, due to the availability of GDP data. All variables are measured as the change over the preceding year (4 quarters). The autocorrelation in the error terms are dealt with the robust error method (RATS Program).

Table 5 summarizes the results of this regression. There is no general observation. In all countries but Taiwan, the export volume has an increasing trend (a positive constant in the above regression with export volume increase on the left-hand-side variable).

Insert Table 5 about here

For Thai export volume, the baht/yen rate is the only significant (at 10%) variable. The elasticity of the export volume with respect to the yen movement is estimated as 0.34. Recall that the Thai graph in stylized facts section gave a general impression that the yen movement and the export volume are correlated. This regression confirmed that observation. Although insignificant, the coefficient of the dollar movement is positive, suggesting that, for Thailand, Model B (Thai products compete with the US products in the US) is more consistent than Model A (Thai products compete with Japanese products in the

US).

For Indonesian exports, the coefficient of the rupiah/dollar is negitive, suggesting that Model A is applicable, but neither the rupiah/yen or therupiah/dollar exchange rate is statistically significant. The Japanese growth is mildly significant. This may reflect the fact that Japan is a number one destination of Indonesia.

Korean exports are explained by the won/yen real exchange rate (significantce at 10%) and US economic growth (significance at 1%). This result is consistent with theoretical predictions. The Korean exports are found to be negatively affected by the won/US dollar and Japanese growth rates, but the coefficients are statistically insignificant. Recalling the theoretical prediction (Table 1), this may mean that the Korean exports face a situation similar to Model A (competing with Japanese exports in both Japanese and US markets, while importing parts from Japan).

Unlike Korea and Singapore, Taiwan exports are most significantly affected by the NTdollar/yen rate. The yen depreciation of ten percent will decrease the export volume by 3.5 percent. Other factors are insignificant.

Singaporean export volumes are explained by the SINdollar/USdollar exchange rate, with negative coefficient, and the US growth. The Singporean case, being consistent with Model A, indicates that Singaporean exports have an industrial structure and technological levels similar to Japanese exports and that they are competing in the United States.

Philippines exports are shown to be very sensitive with both exchange rates. The peso/dollar rate has a negative coefficient, suggesting that Model A is more applicable to the Philippines case. On the contrary, the export volumes from the Philippines increase with the yen devaluation. However, a puzzling features is that the Philippine export volume declines when the US economic growth rate increases.

In sum, export volume regressions present a reasonable result, with only a few puzzling coefficients. For Thailand, Model B applies, and for other countries, Model A seems to apply, but t-statistics of the exchange rate vis-à-vis the US dollar are low, except for Singapore and the Philippines, so that the result may not be reliable.

7.3 Optimal Currency Weight

At the end of theory section, a formula for the optimal currency basket weight was proposed, equation (27) for Model A and equation (28) for Model B. Now with regression results in the preceding subsections, and bilateral trade balance shown in Table 3, we can calculate the optimal weights. Table 6 shows the optimal weights for each country, for Model A (with a constant term in price equation (A-1), and without a constant term (A-2)) and Model B (with a constant term in price equation (B-1), and without a constant term (B-2)).

In general, estimates fall between 0 and 1, except three sub-cases of Taiwan and one sub-case of the Philippines. According to our estimates, in all countries, the yen weight should be much higher than the actual weight estimated by Frankel and Wei, cited in Table 2. Unfortunately, estimates are sensitive to the choice of model (A-1, A-2, B-1, or B-2) for each country. Estimates naturally vary across countries. As we interpreted results of volume regressions, we may tentatively choose Model B for Thailand, and Model A for all other cases. For Thailand, the optimal yen weight is estimated anywhere between 39% (model B-1) and 65% (model B-2). For Indonesia, the yen optimal weight is between 52% (model A-1) and 60% (model A-2). For Korea, both A-1 and A-2 models indicate that the optimal yen weight is 89%. Taiwan shows a puzzling case in which the optimal yen weight is more than 100 %. We suspect that coefficients in either price and volume equations are somehow wrongly estimated for the Taiwan case, and we do not take the Taiwan result seriously. The optimal weight of the yen for the Singaporean dollar is between 77 % (Model A-1) and 88% (Model A-2). The case of Model A-1 for the Philippines is puzzling in that the weight of the yen exceeds 100%. Again, we do not take this case seriously. However, in the case of A-2, the optimal yen weight is calculated as 72%.

In sum, the optimal weight of the yen is highest in Korea and Singapore. Since these countries are often thought to have industrial structure and associated technological levels similar to Japan, their exports directly compete with Japanese products in Japan and the United States. Therefore, the results of the high optimal yen weights in the two countries look reasonable.

Of course, we are aware that many of the coefficients in the price and volume equations which are used in calculating the optimal weights have low t-statistics. Robustness of our results with respect to theoretical model specification, variables in the regressions are not as ideal as we desire. However, the result shows an important avenue for further research on the optimal currency weight in Asia.

8. Conclusion

In this paper, we have constructed a theoretical model in which the Asian firm maximize its profit, competing with the Japanese and the US firms in their markets. The duopoly model is used to determine export prices and volumes in response to the exchange rate fluctuations vis-à-vis the Japanese yen and the US dollar. Then, the optimal basket weight, that would minimize the fluctuation of the growth rate of trade balance, was derived. These are the novel feature of our model.

The export price equation and export volume equation are estimated for several Asian countries for the sample period from 1981 to 1996. Results are generally reasonable. The optimal currency weights for the yen and the US dollar are derived and compared with actual weights that had been adopted before the currency crisis of 1997. For all countries in the sample, it is shown that the optimal weight of the yen is significantly higher than the actual weight.

It would be interesting to extend our model so that multiple Asian countries are included. In such a model, Asian exporters compete with other (non-Japan) Asian exporters, as well as to Japanese and US producers, in the world market. The cross exchange rates (e.g., the baht/rupiah rate) would become relevant in such a model, and the optimal currency basket include those cross rates. Then, we can investigate issues such as competitive devaluation, contagion of a currency crisis, a benchmark basket, and the optimal weights of the benchmark basket. However, these topics are left for future research.

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RER(A/Y), is calculated using the baht/yen nominal exchange rate, or (A/Y), and CPI of country A (say, Thailand), CPIA, and CPI of Japan, or CPIJ. Therefore, RER(A/Y) = (A/Y)*(CPIJ)/(CPIA). The real exchange rate vis-à-vis the US dollar, RER(A/D), is similarly defined, RER(A/D) = (A/D)*(CPIU)/(CPIA), where CPIU is the CPI of the United States.

In Figures 1-7, the real exchange rates, RER(A/Y) and RER(A/D) are plotted against the export volume, in bars, for each of NIEs (except Hong Kong) and four ASEAN countries, with the quarterly frequency, from 1981:1 to 1997:2. The levels of the real exchange rates are measured with normalization of the last observation equals one. The export volume is measured as the changes over the preceding four quarters.

In general, the real exchange rate vis-à-vis the US dollar, RER(A/D), is stable, reflecting the dollar peg policy. However, it is also evident that occasional devaluation (vis-à-vis the US dollar) took place, such as the Thailand in 1984, and Indonesia in 1983 and 1986. The degree of stability varies from country to country. As the RER-US movement is not volatile, its correlation with export volume is not apparent. The trend real appreciation of their currencies vis-à-vis the US dollar mainly reflects the inflation differential. The real exchange rate vis-à-vis the US dollar, RER(A/D), for Thailand and Indonesia has been remarkably stable since the mid-1980s.

The real exchange rate vis-à-vis the yen, RER(A/Y), fluctuates as the yen/dollar rate fluctuation. In some countries, strong correlation between RER(A/Y) and export volume is observed. In all countries, the yen appreciation (or depreciation of an Asian currency vis-à-vis yen) episodes of 1985-87 and 1992-

Appendix

(a)Model A

We use equations (7a) and (8a) to derive rates of changes in the prices of the ASEAN products in the Japanese and U.S. markets in Model A, respectively.

$$
\begin{aligned}
\hat{P}_J^Y &= \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}\left\{\frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^\$}{E^{A/Y}}}{TC_A}(\hat{E}^{A/\$}-\hat{E}^{A/Y})-\frac{\dfrac{\overline{C'}}{E^{A/Y}}}{TC_A}\hat{E}^{A/Y}\right\} \\
&= \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}\left\{(1-\omega_m)B_1(\hat{E}^{A/\$}-\hat{E}^{A/Y})-B_2\hat{E}^{A/Y}\right\} \\
&= \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}(1-\omega_m)B_1\hat{E}^{A/\$}-\frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}\{(1-\omega_m)B_1+B_2\}\hat{E}^{A/Y}
\end{aligned}
\tag{A1}
$$

$$
\begin{aligned}
\hat{P}_{US}^\$ &= \hat{E}^{A/Y}-\hat{E}^{A/\$}+\frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}\left\{\frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^\$}{E^{A/Y}}}{TC_A}(\hat{E}^{A/\$}-\hat{E}^{A/Y})-\frac{\dfrac{\overline{C'}}{E^{A/Y}}}{TC_A}\hat{E}^{A/Y}\right\} \\
&= \hat{E}^{A/Y}-\hat{E}^{A/\$}+\frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}\left\{(1-\omega_m)B_1(\hat{E}^{A/\$}-\hat{E}^{A/Y})-B_2\hat{E}^{A/Y}\right\} \\
&= \left\{\frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}(1-\omega_m)B_1-1\right\}\hat{E}^{A/\$}+\left\{1-\frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}\{(1-\omega_m)B_1+B_2\}\right\}\hat{E}^{A/Y}
\end{aligned}
\tag{A2}
$$

$$
\begin{aligned}
\hat{P}_x^A &= \frac{X_J}{X}\left(\hat{P}_J^Y+\hat{E}^{A/Y}\right)+\frac{X_{US}}{X}\left(\hat{P}_{US}^\$+\hat{E}^{A/\$}\right) \\
&= \left[\frac{1+\eta^*}{1+\eta+\eta^*}(1-\omega_m)B_1\right]\hat{E}^{A/\$}+\left[1-\frac{1+\eta^*}{1+\eta+\eta^*}\{(1-\omega_m)B_1+B_2\}\right]\hat{E}^{A/Y}
\end{aligned}
\tag{A3}
$$

We use equations (10a) and (10b) to derive rates of changes in the outputs exported to the Japanese and U.S. markets, respectively:

$$
\hat{f} = \frac{-\varepsilon_J}{1+\eta_J+\eta_J^*}\left\{\frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^\$}{E^{A/Y}}}{TC_A}\hat{E}^{A/\$}-\frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^\$}{E^{A/Y}}+\dfrac{\overline{C'}}{E^{A/Y}}}{TC_A}\hat{E}^{A/Y}\right\}
\tag{A4}
$$

$$
= \frac{-\varepsilon_J}{1+\eta_J+\eta_J^*}\left[(1-\omega_m)B_1\hat{E}^{A/\$}-\{(1-\omega_m)B_1+B_2\}\hat{E}^{A/Y}\right]
$$

$$
(A5)\qquad \hat{g} = \frac{-\varepsilon_{US}}{1+\eta_{US}+\eta^{*}_{US}} \left\{ \frac{(1-\omega_m)\dfrac{E^{A/\$}P^{Y}_{m}}{E^{A/Y}}}{TC_A}\hat{E}^{A/\$} - \frac{(1-\omega_m)\dfrac{E^{A/\$}P^{Y}_{m}}{E^{A/Y}} + \dfrac{\overline{C'}}{E^{A/Y}}}{TC_A}\hat{E}^{A/Y} \right\}
$$

$$
= \frac{-\varepsilon_{US}}{1+\eta_{US}+\eta^{*}_{US}} \left[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y} \right]
$$

From equations (A3) and (A4), we derive a rate of changes in the total outputs of the ASEAN firm:

$$
\hat{Q}_A = \omega_x \hat{f} + (1-\omega_x)\hat{g}
$$

$$
(A6)\qquad = \frac{-\varepsilon_J}{1+\eta_J+\eta^{*}_J}\omega_x \left[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y} \right] + \frac{-\varepsilon_{US}}{1+\eta_{US}+\eta^{*}_{US}}(1-\omega_x)\left[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y} \right]
$$

$$
= -\left\{ \frac{\varepsilon_J}{1+\eta_J+\eta^{*}_J}\omega_x + \frac{\varepsilon_{US}}{1+\eta_{US}+\eta^{*}_{US}}(1-\omega_x) \right\}\left[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1 + B_2\}\hat{E}^{A/Y} \right]
$$

From equation (21), we obtain a rate of changes in the trade balance of the ASEAN economy:

$$
\hat{T} = \left\{ \frac{E^{A/Y}P^{Y}_{J}f}{T} - \frac{E^{A/Y}P^{Y}_{m}\omega_m Q_A}{T} \right\}\hat{E}^{A/Y} + \left\{ \frac{E^{A/\$}P^{\$}_{US}g}{T} - \frac{E^{A/\$}P^{\$}_{m}(1-\omega_m)Q_A}{T} \right\}\hat{E}^{A/\$} +
$$

$$
\frac{E^{A/Y}P^{Y}_{J}f}{T}(\hat{P}^{Y}_{J} + \hat{f}) + \frac{E^{A/\$}P^{\$}_{US}g}{T}(\hat{P}^{\$}_{US} + \hat{g}) - \frac{E^{A/Y}P^{Y}_{m}\omega_m Q_A + E^{A/\$}P^{\$}_{m}(1-\omega_m)Q_A}{T}\hat{Q}_A
$$

$$
\hat{T} = \left\{ \frac{f}{Q_A}\frac{E^{A/Y}P^{Y}_{J}Q_A}{T} - \frac{E^{A/Y}P^{Y}_{m}\omega_m Q_A}{T} \right\}\hat{E}^{A/Y} + \left\{ \frac{g}{Q_A}\frac{E^{A/\$}P^{\$}_{US}Q_A}{T} - \frac{E^{A/\$}P^{\$}_{m}(1-\omega_m)Q_A}{T} \right\}\hat{E}^{A/\$} +
$$

$$
\frac{f}{Q_A}\frac{E^{A/Y}P^{Y}_{J}Q_A}{T}(\hat{P}^{Y}_{J} + \hat{f}) + \frac{g}{Q_A}\frac{E^{A/\$}P^{\$}_{US}Q_A}{T}(\hat{P}^{\$}_{US} + \hat{g}) - \frac{E^{A/Y}P^{Y}_{m}\omega_m Q_A + E^{A/\$}P^{\$}_{m}(1-\omega_m)Q_A}{T}\hat{Q}_A
$$

$$
(A7)\qquad \hat{T} = \frac{Q_A}{T}\Big[\{\omega_x E^{A/Y}P^{Y}_{J} - \omega_m E^{A/Y}P^{Y}_{m}\}\hat{E}^{A/Y} + \{(1-\omega_x)E^{A/\$}P^{\$}_{US} - (1-\omega_m)E^{A/\$}P^{\$}_{m}\}\hat{E}^{A/\$} + \omega_x E^{A/Y}P^{Y}_{J}(\hat{P}^{Y}_{J} + \hat{f}) + (1-\omega_x)E^{A/\$}P^{\$}_{US}(\hat{P}^{\$}_{US} + \hat{g}) - \{\omega_m E^{A/Y}P^{Y}_{m} + (1-\omega_m)E^{A/\$}P^{\$}_{m}\}\hat{Q}_A \Big]
$$

Substituting equations (A1)-(A5) into equation (A6), we obtain equation (22).

(b)Model B

We use equations (17a) and (18a) to derive rates of changes in the prices of the ASEAN products in the Japanese and U.S. markets in Model B, respectively.

$$\begin{aligned}
\hat{P}_J^Y &= \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}\left\{\frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^\$}{E^{A/Y}}}{TC_A}(\hat{E}^{A/\$}-\hat{E}^{A/Y}) - \frac{\dfrac{\overline{C'}}{E^{A/Y}}}{TC_A}\hat{E}^{A/Y}\right\} \\
&= \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}\left\{1-\omega_m)B_1(\hat{E}^{A/\$}-\hat{E}^{A/Y}) - B_2\hat{E}^{A/Y}\right\} \qquad \text{(A1)} \\
&= \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}\left[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1+B_2\}\hat{E}^{A/Y}\right] \\
&= \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}(1-\omega_m)B_1\hat{E}^{A/\$} - \frac{1+\eta_J^*}{1+\eta_J+\eta_J^*}\{(1-\omega_m)B_1+B_2\}\hat{E}^{A/Y}
\end{aligned}$$

$$\begin{aligned}
\hat{P}_{US}^\$ &= \frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}\left\{\hat{E}^{A/Y}-\hat{E}^{A/\$} + \frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^\$}{E^{A/Y}}}{TC_A}(\hat{E}^{A/\$}-\hat{E}^{A/Y}) - \frac{\dfrac{\overline{C'}}{E^{A/Y}}}{TC_A}\hat{E}^{A/Y}\right\} \\
&= \frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}\left\{\hat{E}^{A/Y}-\hat{E}^{A/\$}+(1-\omega_m)B_1(\hat{E}^{A/\$}-\hat{E}^{A/Y}) - B_2\hat{E}^{A/Y}\right\} \qquad \text{(A2')} \\
&= \frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}\left[-\{1-(1-\omega_m)B_1\}\hat{E}^{A/\$} + \{1-(1-\omega_m)B_1-B_2\}\hat{E}^{A/Y}\right] \\
&= -\frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}\{1-(1-\omega_m)B_1\}\hat{E}^{A/\$} + \frac{1+\eta_{US}^*}{1+\eta_{US}+\eta_{US}^*}\{1-(1-\omega_m)B_1-B_2\}\hat{E}^{A/Y}
\end{aligned}$$

$$\begin{aligned}
\hat{P}_x^A &= \frac{X_J}{X}\left(\hat{P}_J^Y+\hat{E}^{A/Y}\right) + \frac{X_{US}}{X}\left(\hat{P}_{US}^\$+\hat{E}^{A/\$}\right) \\
&= \left[\frac{1+\eta^*}{1+\eta+\eta^*}(1-\omega_m)B_1 + \frac{\eta}{1+\eta+\eta^*}\frac{X_{US}}{X}\right]\hat{E}^{A/\$} + \qquad \text{(A3')} \\
&\quad \left[1-\frac{1+\eta^*}{1+\eta+\eta^*}\{(1-\omega_m)B_1+B_2\} - \frac{\eta}{1+\eta+\eta^*}\frac{X_{US}}{X}\right]\hat{E}^{A/Y}
\end{aligned}$$

We use equations (20a) and (20b) to derive rates of changes in the outputs exported to the Japanese and U.S. markets, respectively:

(A4)

$$\hat{f} = \frac{-\varepsilon_J}{1+\eta_J+\eta_J^*}\left\{\frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^{\$}}{E^{A/Y}}}{TC_A}\hat{E}^{A/\$} - \frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^{\$}}{E^{A/Y}}+\dfrac{\overline{C'}}{E^{A/Y}}}{TC_A}\hat{E}^{A/Y}\right\}$$

$$= \frac{-\varepsilon_J}{1+\eta_J+\eta_J^*}\left[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1+B_2\}\hat{E}^{A/Y}\right]$$

(A5')

$$\hat{g} = \frac{-\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}\left\{\left(\frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^{Y}}{E^{A/Y}}}{TC_A}-1\right)\hat{E}^{A/\$} + \left(1-\frac{(1-\omega_m)\dfrac{E^{A/\$}P_m^{Y}}{E^{A/Y}}+\dfrac{\overline{C'}}{E^{A/Y}}}{TC_A}\right)\hat{E}^{A/Y}\right\}$$

$$= \frac{-\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}\left[-\{1-(1-\omega_m)B_1\}\hat{E}^{A/\$} + \{1-(1-\omega_m)B_1-B_2\}\hat{E}^{A/Y}\right]$$

From equations (A3) and (A4'), we derive a rate of changes in the total outputs of the ASEAN firm:

(A6')

$$\hat{Q}_A = \omega_x\hat{f} + (1-\omega_x)\hat{g}$$

$$= \frac{-\varepsilon_J}{1+\eta_J+\eta_J^*}\omega_x\left[(1-\omega_m)B_1\hat{E}^{A/\$} - \{(1-\omega_m)B_1+B_2\}\hat{E}^{A/Y}\right] +$$

$$\frac{-\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}(1-\omega_x)\left[-\{1-(1-\omega_m)B_1\}\hat{E}^{A/\$} + \{1-(1-\omega_m)B_1-B_2\}\hat{E}^{A/Y}\right]$$

$$= \left[\frac{\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}(1-\omega_x) - \left\{\frac{\varepsilon_J}{1+\eta_J+\eta_J^*}\omega_x + \frac{\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}(1-\omega_x)\right\}(1-\omega_m)B_1\right]\hat{E}^{A/\$} +$$

$$\left[\frac{-\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}(1-\omega_x) + \left\{\frac{\varepsilon_J}{1+\eta_J+\eta_J^*}\omega_x + \frac{\varepsilon_{US}}{1+\eta_{US}+\eta_{US}^*}(1-\omega_x)\right\}\{(1-\omega_m)B_1+B_2\}\right]\hat{E}^{A/Y}$$

Substituting equations (A1), (A2'), (A3), (A4'), and (A5') into equation (A6), we obtain equation (22').

Table 1 Theoretical prediction of sign conditions

Effects on Export volume	Model A		Model B	
From	**General**	**Special (ω_m=0)**	**General**	**Special (ω_m=0)**
Baht/dollar hike (depreciation of Baht against dollar)	$\beta_1 < 0$	$\beta_1 = 0$	β_3 ?	$\beta_3 > 0$
Baht/yen hike (depreciation of Baht against yen)	$\beta_2 > 0$	$\beta_2 > 0$	β_4 ?	β_4 ?

Effects on Export prices	Model A		Model B	
From	**General**	**Special (ω_m=0)**	**General**	**Special (ω_m=0)**
Baht/dollar hike (depreciation of Baht against dollar)	$\alpha_1 > 0$	$\alpha_1 = 0$	$\alpha_3 > 0$	$\alpha_3 > 0$
Baht/yen hike (depreciation of Baht against yen)	$\alpha_2 > 0$	$\alpha_2 > 0$	$\alpha_4 > 0$	$\alpha_4 > 0$

Table 2: The exchange rate basket

Sample period, 1979-1992				
LHS	Constant	Dollar	Yen	R2 / D.W.
Korean Won	-0.0007* (0.0003)	0.96** (0.02)	-0.1 (0.03)	0.82 1.94
Singaporean Dollar	0.0003** (0.0002)	0.75** (0.01)	0.13** (0.02)	0.86 2.28
Hong Kong Dollar	-0.0007* (0.0003)	0.92** (0.02)	-0.00 (0.03)	0.76 2.04
Taiwan Dollar	0.0005* (0.0002)	0.96** (0.02)	0.05* (0.02)	0.88 2.07
Malaysian Ringgit	-0.0003 (0.0003)	0.78** (0.02)	0.07** (0.02)	0.79 2.19
Indonesian Rupia	-0.0018* (0.0007)	0.95** (0.05)	0.16* (0.07)	0.44 2.04
Philippine Peso	-0.0018** (0.0006)	1.07** (0.04)	-0.01 (0.06)	0.54 2.06
Thai Baht	-0.0004 (0.0003)	0.91** (0.02)	0.05** (0.03)	0.75 2.24
Chinese Yuan	-0.0018 (0.0005)	0.87** 0.04	-0.04 (0.05)	0.54 2.05

Notes: Standard errors in parentheses. **Statistically significant at the 99 percent level; * statistically significant at the 95 percent level; # statistically significant at the 90 percent level; and ## statistically significant at the 85 percent level.

Source: Frankel and Wei (1994).

Table 3 NIES Gross Exports and Imports, by country and region

Hong Kong Exports and Imports (US$mil, and %)

Exports To	1990	1991	1992	1993	1994	1995	1996
World	82,160	98,577	119,512	135,248	151,395	173,754	180,745
US	24.1%	22.7%	23.1%	23.0%	21.9%	21.8%	21.2%
Japan	5.7%	5.4%	5.2%	5.1%	5.6%	6.1%	6.5%
Asia	40.7%	41.9%	43.5%	45.0%	45.6%	46.5%	47.2%
Imports from							
World	82,474	100,255	123,430	138,658	161,777	192,777	198,560
US	8.1%	7.6%	7.4%	7.4%	7.1%	7.7%	7.9%
Japan	16.1%	16.4%	17.4%	16.6%	15.6%	14.8%	13.6%
Asia	59.6%	61.1%	60.0%	60.5%	61.5%	61.3%	62.0%

Korea Exports and Imports (US$mil, and %)

Exports to	1990	1991	1992	1993	1994	1995	1996
World	65,016	71,870	76,632	82,236	96,013	125,058	129,835
US	29.9%	25.9%	23.6%	22.1%	21.4%	19.3%	16.8%
Japan	19.4%	17.2%	15.1%	14.1%	14.1%	13.7%	12.3%
Asia	17.6%	22.6%	28.0%	31.9%	32.2%	35.2%	38.0%
Imports from							
World	69,844	81,525	81,775	83,800	102,348	135,119	150,212
US	24.3%	23.2%	22.4%	21.4%	21.1%	22.5%	22.2%
Japan	26.6%	25.9%	23.8%	23.9%	24.8%	24.1%	20.9%
Asia	11.2%	15.9%	17.0%	16.7%	15.9%	16.0%	16.7%

Singapore, Exports and Imports (US$mil and %)

Exports to	1990	1991	1992	1993	1994	1995	1996
World	52,752	59,025	63,484	74,012	96,826	118,268	125,024
US	21.3%	19.8%	21.1%	20.4%	18.7%	18.2%	18.4%
Japan	8.8%	8.7%	7.6%	7.5%	7.0%	7.8%	8.2%
Asia	42.8%	44.1%	43.3%	46.3%	50.4%	51.4%	51.3%
Imports from							
World	60,889	66,293	72,179	85,234	102,670	124,507	131,338
US	16.1%	15.8%	16.4%	16.4%	15.2%	15.0%	16.4%
Japan	20.1%	21.3%	21.1%	21.9%	21.9%	21.1%	18.2%
Asia	32.3%	34.2%	34.3%	36.2%	37.4%	38.1%	37.3%

Source: International Monetary Fund, Direction of Trade Statistics, Year book, 1997.

ASEAN Exports and Imports, by country and region

Thailand Exports and Imports (US$mil, and %)

Exports to	1990	1991	1992	1993	1994	1995	1996
Exports Total	23,070	28,428	32,472	36,775	45,130	56,459	55,789
US	22.7%	21.3%	22.5%	21.8%	21.1%	17.9%	18.0%
Japan	17.2%	18.1%	17.5%	17.1%	17.1%	16.8%	16.8%
Asia	22.1%	22.8%	24.0%	28.8%	34.8%	36.0%	36.8%
Imports Total	33,379	37,591	40,686	45,922	54,459	70,776	73,484
US	10.8%	10.6%	11.7%	11.7%	11.8%	12.0%	12.6%
Japan	30.4%	29.4%	29.3%	30.4%	30.2%	30.6%	27.8%
Asia	28.0%	30.0%	28.8%	26.8%	28.9%	26.6%	28.2%

Indonesia, Exports and Imports, (US$mil., and %)

Exports to	1990	1991	1992	1993	1994	1995	1996
Exports Total	25,675	29,142	33,967	36,823	40,054	45,417	49,814
US	13.1%	12.0%	13.0%	14.2%	15.4%	14.3%	16.0%
Japan	42.5%	36.9%	31.7%	30.3%	28.6%	27.2%	27.8%
Asia	25.1%	29.2%	31.1%	30.6%	28.0%	31.2%	25.4%
Imports Total	21,837	25,869	27,280	28,328	31,985	40,629	42,292
US	11.5%	13.1%	14.0%	11.5%	10.7%	11.3%	10.3%
Japan	25.0%	24.5%	22.0%	22.1%	25.8%	24.3%	23.6%
Asia	24.8%	26.0%	26.2%	27.2%	26.0%	27.0%	27.7%

Malaysia, Exports and Imports (US$mil., and %)

	1990	1991	1992	1993	1994	1995	1996
Exports Total	29,416	34,349	40,713	47,122	58,756	74,037	78,246
US	15.9%	16.9%	18.7%	20.3%	21.2%	20.7%	18.2%
Japan	15.3%	15.9%	13.3%	13.0%	11.9%	12.4%	13.4%
Asia	44.6%	44.4%	44.6%	43.9%	44.2%	43.6%	46.8%
Imports Total	29,258	36,648	39,926	45,657	59,581	77,751	78,422
US	16.9%	15.4%	15.9%	16.9%	16.6%	16.3%	15.5%
Japan	24.1%	26.1%	26.0%	27.5%	26.7%	27.2%	24.5%
Asia	32.0%	33.8%	35.4%	34.3%	32.6%	31.8%	34.6%

Philippines, Exports and Imports (US$mil., and %)

	1990	1991	1992	1993	1994	1995	1996
Exports Total	8,068	8,767	9,752	11,089	13,304	17,502	20,417
US	38.5%	35.9%	39.4%	39.2%	38.9%	35.5%	34.1%
Japan	20.1%	20.2%	17.9%	16.3%	15.2%	15.7%	18.0%
Asia	18.1%	18.8%	16.8%	21.0%	22.9%	25.6%	25.9%
Imports Total	13,041	12,786	15,449	18,754	22,546	28,337	34,122
US	19.5%	20.4%	17.0%	18.8%	18.5%	18.4%	18.3%
Japan	18.4%	19.7%	20.0%	21.4%	24.2%	22.2%	20.3%
Asia	28.2%	30.1%	26.8%	27.5%	30.2%	29.4%	27.8%

Source: International Monetary Fund, Direction of Trade Statistics Yearbook, 1997.

Table 4: Pass-through equations

$$D(\text{Export Price in l.c.}(t)) = \gamma_0 + \gamma_1 D((A/D)(t)) + \gamma_2 D((A/Y)(t)) + e(t)$$

where D(*) is the difference over the same month of year t-1. The "Robusterrors" option (RATS) is used to correct for autocorrelation in error terms.

Thailand
Period: 1986:01-1996:05
Data source of Export Price: IFS

With Constant

	Coef.	T-value	Signif.
Constant	-0.01	-0.53	0.598
Dollar Ex.	0.03	0.06	0.954
Yen Ex.	0.14	1.68	0.092

R-bar-sq. : 0.086

Without Constant

	Coef.	t-value	Signif
Dollar Ex.	0.28	0.76	0.447
Yen Ex.	0.14	1.62	0.106

R-bar-sq. : 0.080

Indonesia
Period: 1988:1-1996:12
Data source of Export Price: Biropusat Statiskik

With Constant

	Coef.	T-value	Signif.
constant	-0.02	-1.38	0.167
Dollar Ex.	-0.62	-1.28	0.200
Yen Ex.	0.08	1.21	0.228

R-bar-sq. : 0.145

Without Constant

	Coef.	T-value	Signif.
Dollar Ex.	-0.48	-0.99	0.323
Yen Ex.	0.09	0.91	0.362

R-bar-sq. : 0.038

Korea
Period: 1981:1-1996:12
Data source of Export Price: Bank of Korea

With Constant

	Coef.	T-value	Signif.
constant	-0.03	-4.47	0.000
Dollar Ex.	0.12	1.35	0.176
Yen Ex.	0.13	5.93	0.000

R-bar-sq. : 0.386

Without Constant

	Coef.	T-value	Signif.
Dollar Ex.	0.16	2.20	0.028
Yen Ex.	0.10	2.03	0.042

R-bar-sq. : -0.184

Taiwan

Period: 1985:12-1988:12, 1990:9-1996:12

Data source of Export Price: The Central Bank of China

With Constant

	Coef.	T-value	Signif.
constant	0.02	1.13	0.257
Dollar Ex.	0.49	3.40	0.001
Yen Ex.	-0.06	-1.18	0.239

R-bar-sq. : 0.314

Without Constant

	Coef.	T-value	Signif.
Dollar Ex.	0.39	2.86	0.004
Yen Ex.	-0.02	-0.48	0.630

R-bar-sq. : 0.258

Singapore

Period: 1981:1-1996:12

Data source of Export Price: IFS

With Constant

	Coef.	T-value	Signif.
Constant	-0.03	-3.57	0.000
Dollar Ex.	-0.82	-5.38	0.000
Yen Ex.	-0.07	-0.93	0.350

R-bar-sq. : 0.318

Without Constant

	Coef.	T-value	Signif.
Dollar Ex.	-0.68	-3.68	0.000
Yen Ex.	-0.09	-0.89	0.375

R-bar-sq. : 0.111

Philippines

Period: 1981:1-1991:12

Data source of Export Price: IFS

With Constant

	Coef.	T-value	Signif.
constant	-0.16	-3.96	0.000
Dollar Ex.	-0.20	-0.51	0.608
Yen Ex.	0.41	1.89	0.059

R-bar-sq. : 0.142

Without Constant

	Coef.	T-value	Signif.
Dollar Ex.	-0.67	-1.19	0.233
Yen Ex.	0.34	0.91	0.364

R-bar-sq. : -0.715

Table 5. Export Volume

D(Export volume (t)) = ω_1 **D(RER(A/D)(t))** + ω_2 **D(RER(A/Y)(t))** + ω_3 **D (USGDP(t))** + ω_4 **D(JAGDP(t)) + e(t)**

where D(*) is the difference over the four quarters. The "Robusterrors" option (RATS) is used to correct for autocorrelation in error terms.

Thailand
Period: 1986:Q1-1996:Q4
Data source of Export Volume : IFS

	Coef.	T-value	Signif.
constant	0.14	3.17	0.002
Dollar Ex.	2.42	1.45	0.148
Yen Ex.	0.34	1.87	0.061
US-RGDP	0.43	0.36	0.718
JP-RGDP	0.91	1.29	0.195

R-bar-sq. : 0.126

Indonesia
Period: 1988:Q1-1996:Q4
Data source of Export Volume : IFS

	Coef.	T-value	Signif.
constant	0.19	4.38	0.000
Dollar Ex.	-0.08	-0.06	0.950
Yen Ex.	0.10	0.48	0.632
US-RGDP	-2.76	-1.64	0.100
JP-RGDP	-1.68	-1.80	0.071

R-bar-sq. : -0.048

Korea
Period: 1981:Q1-1996:Q4
Data source of Export Volume : IFS

	Coef.	T-value	Signif.
constant	0.10	2.96	0.003
Dollar Ex.	-0.03	-0.10	0.921
Yen Ex.	0.17	1.72	0.085
US-RGDP	1.13	3.41	0.001
JP-RGDP	-0.22	-0.29	0.773

R-bar-sq. : 0.114

Taiwan

Period: 1985:Q1-1996:Q4
Data source of Export Volume : IFS

	Coef.	T-value	Signif.
constant	0.01	0.15	0.880
Dollar Ex.	-0.25	-1.14	0.253
Yen Ex.	0.35	4.64	0.000
US-RGDP	1.27	1.19	0.233
JP-RGDP	1.00	1.32	0.188

R-bar-sq. : 0.304

Singapore

Period: 1981:Q1-1996:Q4
Data source of Export Volume : IFS

	Coef.	T-value	Signif.
constant	0.08	1.99	0.047
Dollar Ex.	-0.89	-2.62	0.009
Yen Ex.	0.16	1.54	0.124
US-RGDP	1.47	3.22	0.001
JP-RGDP	0.17	0.14	0.885

R-bar-sq. : 0.209

Philippines

Period: 1981:Q1-1996:Q4
Data source of Export Volume : IFS

	Coef.	T-value	Signif.
constant	0.13	3.53	0.000
Dollar Ex.	-0.67	-2.83	0.005
Yen Ex.	0.27	3.26	0.001
US-RGDP	-1.00	-1.81	0.071
JP-RGDP	-0.97	-1.17	0.242

R-bar-sq. : 0.253

Table 6. Optimal Weight

	Actual weight *		Optimal weight							
			Model A-1		Model A-2		Model B-1		Model B-2	
	US$(%)	Yen (%)	US$(%)	Yen (%)	US$(%)	Yen (%)	US$(%)	Yen (%)	US$(%)	Yen (%)
Thai Baht	91	5	42.9	57.1	4.3	95.7	61.3	38.7	35.3	64.7
Indonesian Rupia	95	16	40.5	59.5	47.7	52.3	71.2	28.8	77.9	22.1
Korean Won	96	-10	10.5	89.5	10.9	89.1	47.4	52.6	45.7	54.3
Taiwan Dollar	96	5	-92.7	192.7	-73.7	173.7	-5.3	105.3	7.3	92.7
Singaporean Dollar	75	13	22.6	77.4	12.4	87.6	57.4	42.6	51.0	49.0
Philippine Peso	107	-1	-2.9	102.9	27.6	72.4	67.3	32.7	72.8	27.2

Notes:

Model A-1 uses the coefficients estimated in the case of price equations (model A) with constant in Table 4 and the coefficients estimated in the volume equations in Table 5.

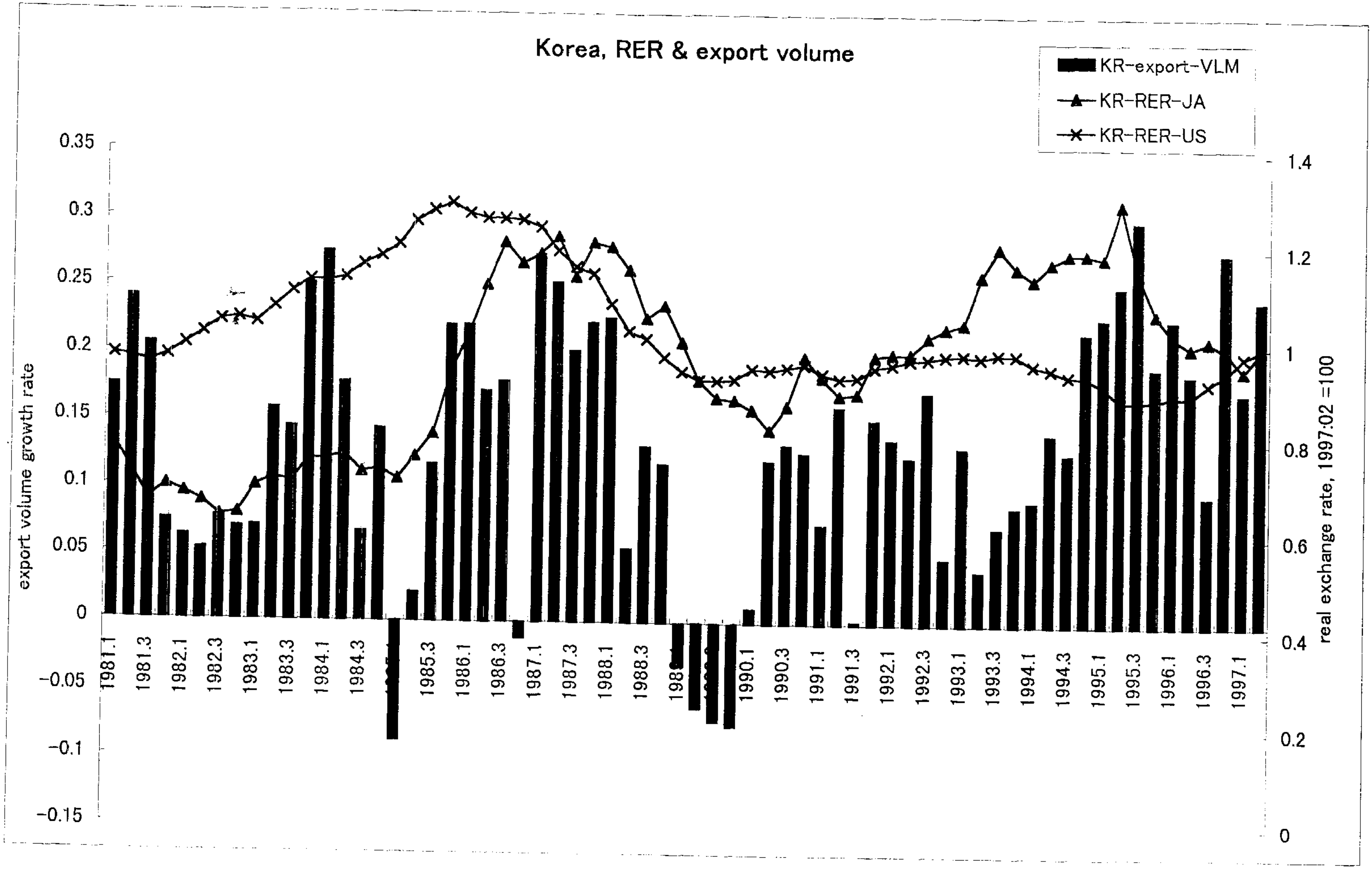
Model A-2 uses those in price equations (model A) without constant in Table 4 and those in the volume equations in Table 5.

Model B-1 uses those in the price equations (model B) with constant in Table 4 and those in the volume equations in Table 5.

Model B-2 uses those in the price equations (model B) without constant in Table 4 and those in thevolume equations in Table 5.

In calculating the export to and import from the world in equations (27) and (28), only the sum of those with Japan and the U.S. only are used.

For Actual Weight, see Table 2.



Korea, RER & export volume
KR-export-VLM
KR-RER-JA
KR-RER-US
export volume growth rate
real exchange rate, 1997:02 =100
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1981.1
1981.3
1982.1
1982.3
1983.1
1983.3
1984.1
1984.3
1985.3
1986.1
1986.3
1987.1
1987.3
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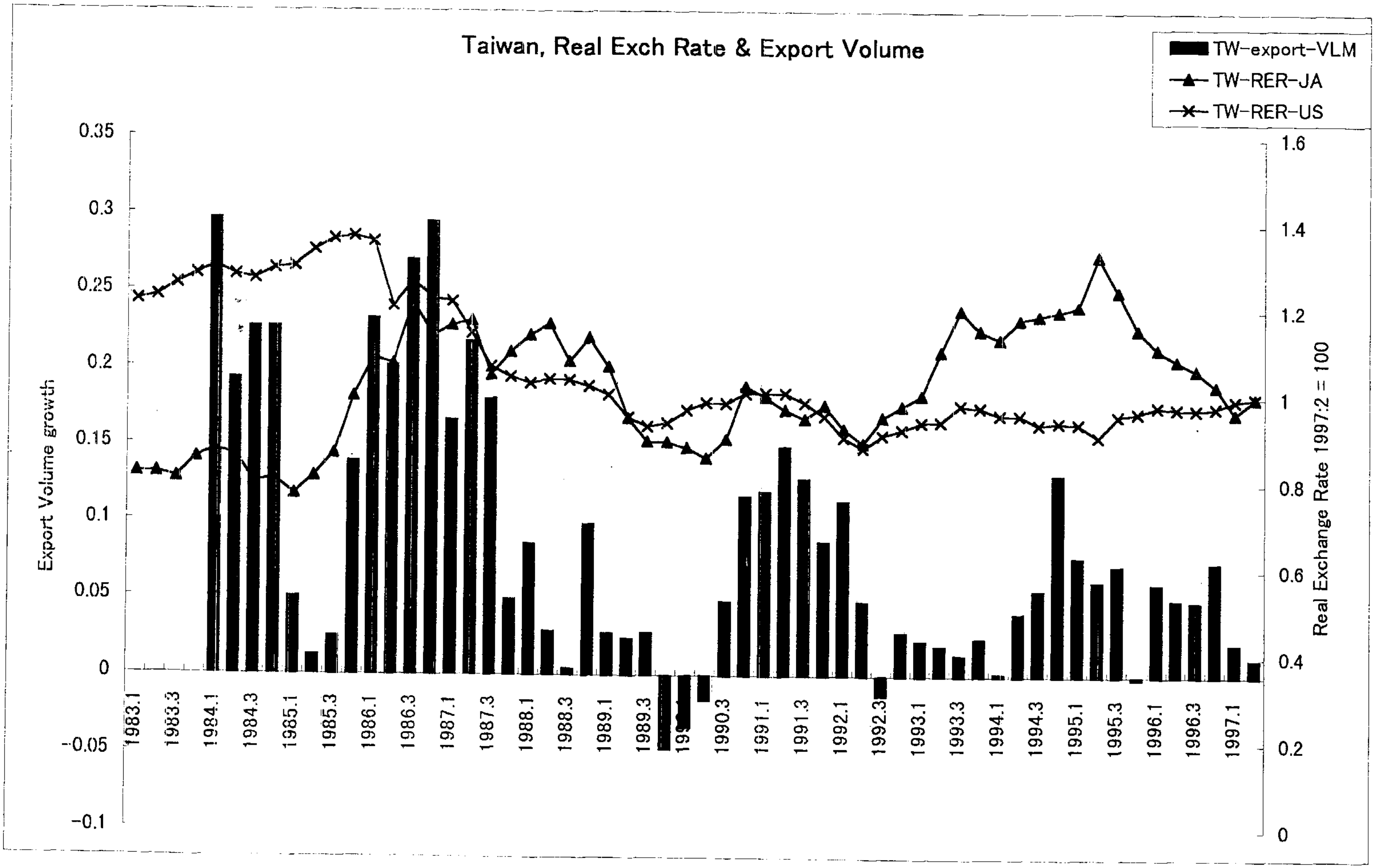
1996.1
1996.3
1997.1


Taiwan, Real Exch Rate & Export Volume
TW-export-VLM
TW-RER-JA
TW-RER-US
Export Volume growth
Real Exchange Rate 1997:2 = 100
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1983.1
1983.3
1984.1
1984.3
1985.1
1985.3
1986.1
1986.3
1987.1
1987.3
1988.1
1988.3
1989.1
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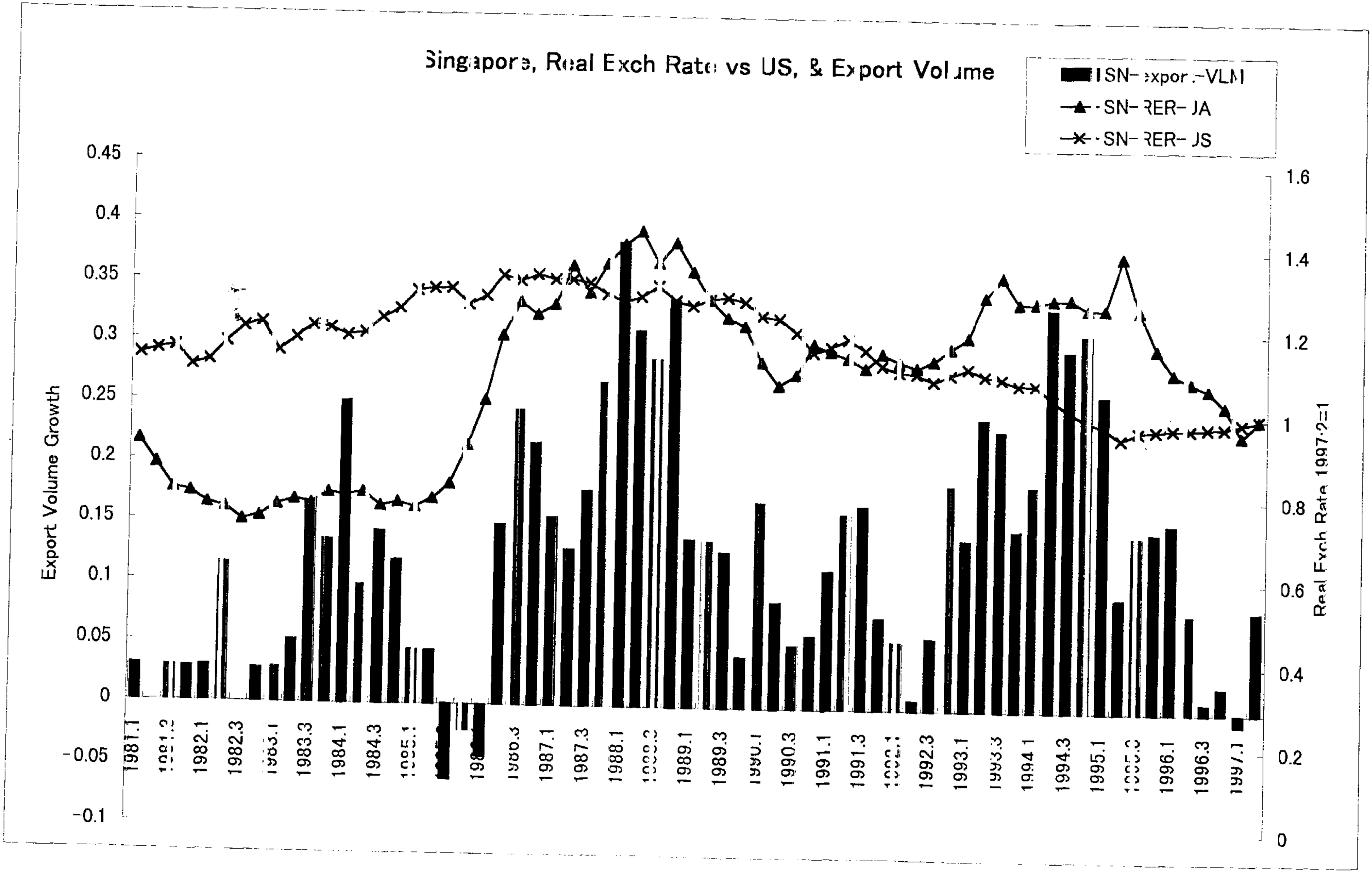
1996.1
1996.3
1997.1


Singapore, Real Exch Rate vs US, & Export Volume
SN-export-VLM
SN-RER-JA
SN-RER-US
Export Volume Growth
Real Exch Rate 1997:2=1
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1981.1
1982.1
1982.3
1983.3
1984.1
1984.3
1987.1
1987.3
1988.1
1989.1
1989.3
1990.3
1991.1
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1993.1
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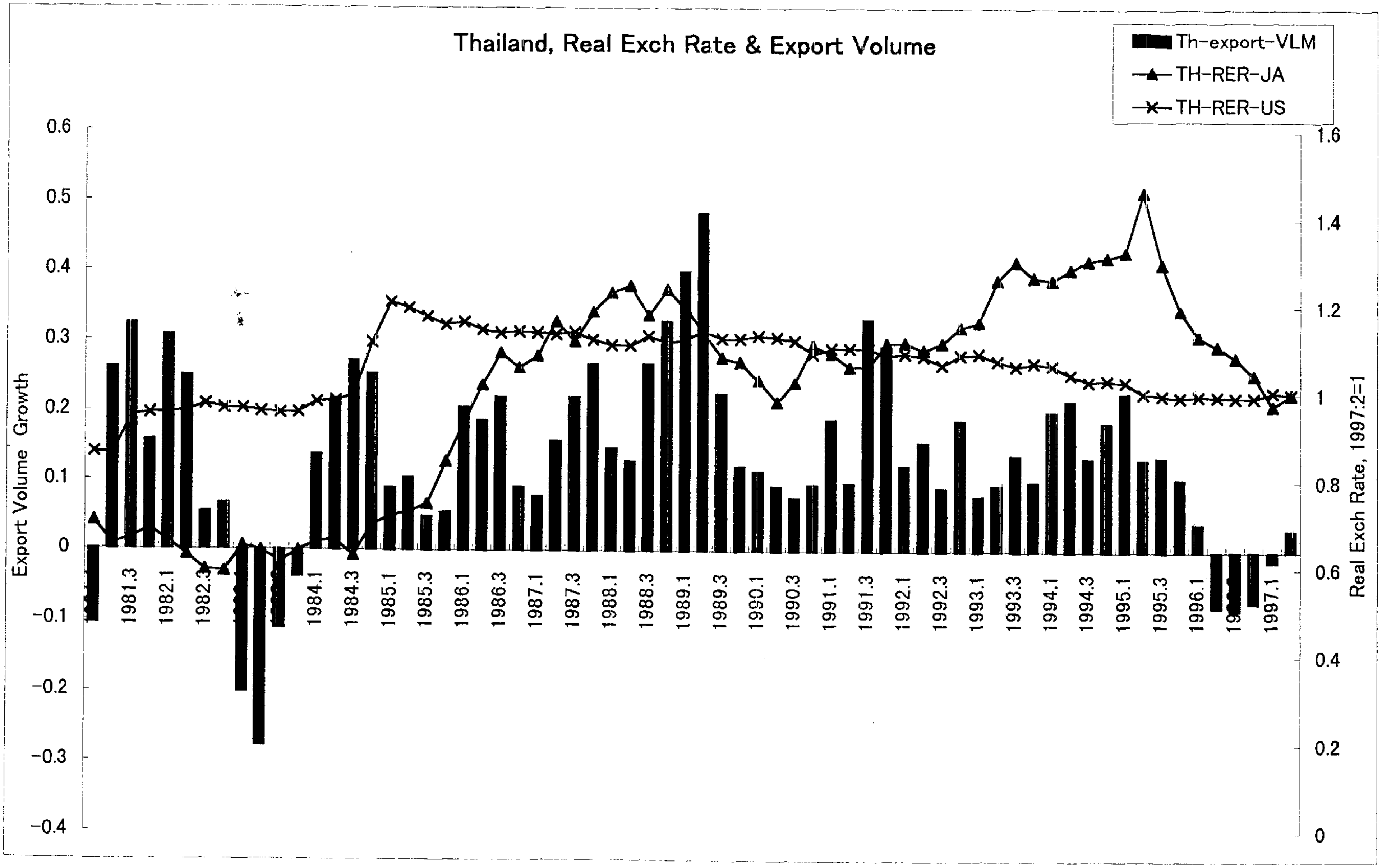
1994.3
1995.1
1996.1
1996.3



Thailand, Real Exch Rate & Export Volume
Th-export-VLM
TH-RER-JA
TH-RER-US
Export Volume Growth
Real Exch Rate, 1997:2=1
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1981.3
1982.1
1984.1
1984.3
1985.1
1985.3
1986.1
1986.3
1987.1
1987.3
1988.1
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1989.1
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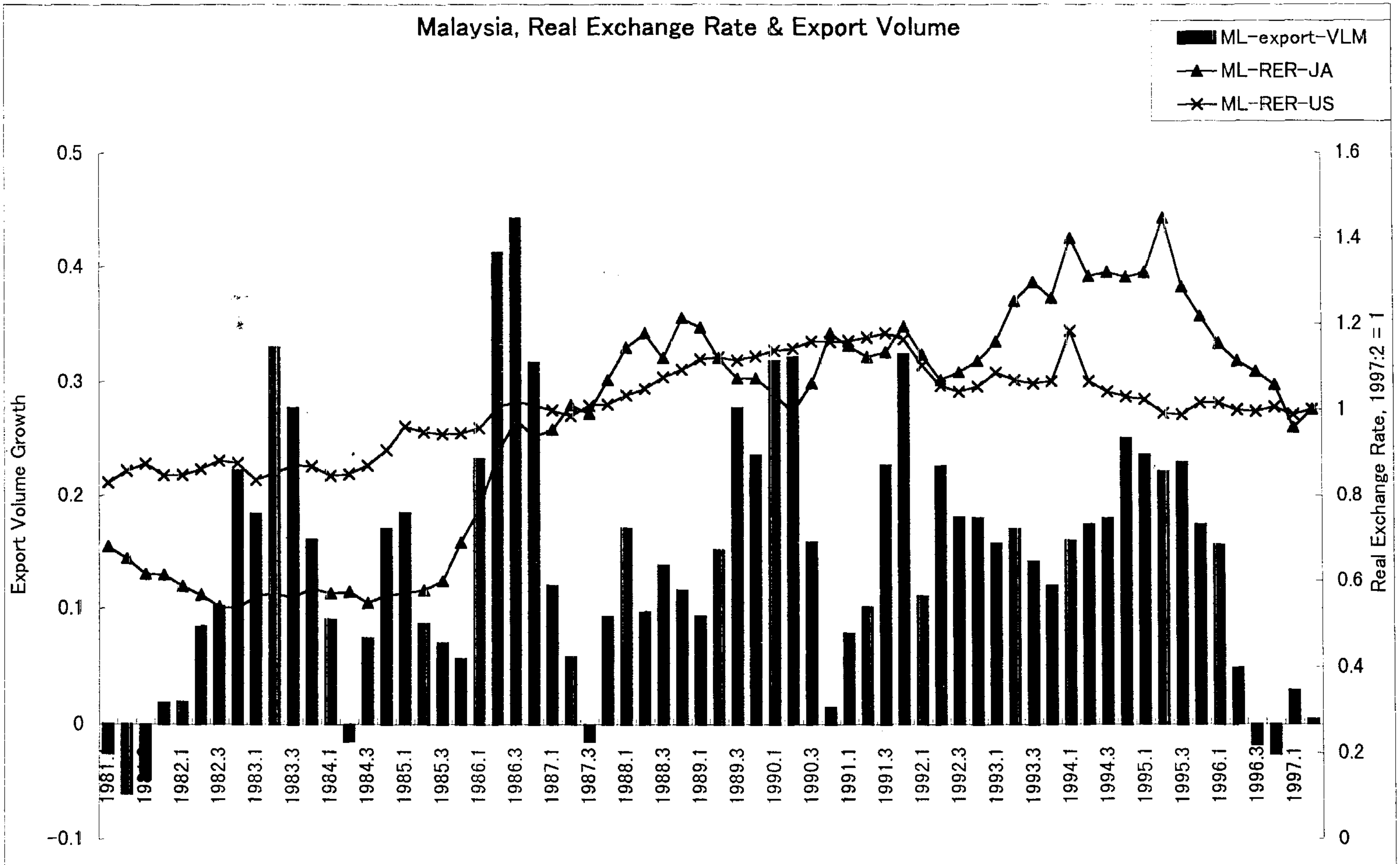
1995.1
1995.3
1996.1
1997.1


Malaysia, Real Exchange Rate & Export Volume
ML-export-VLM
ML-RER-JA
ML-RER-US
Export Volume Growth
Real Exchange Rate, 1997:2 = 1
0.5
0.4
0.3
0.2
0.1
0
-0.1
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1982.1
1982.3
1983.1
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1984.1
1984.3
1985.1
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1986.1
1986.3
1987.1
1987.3
1988.1
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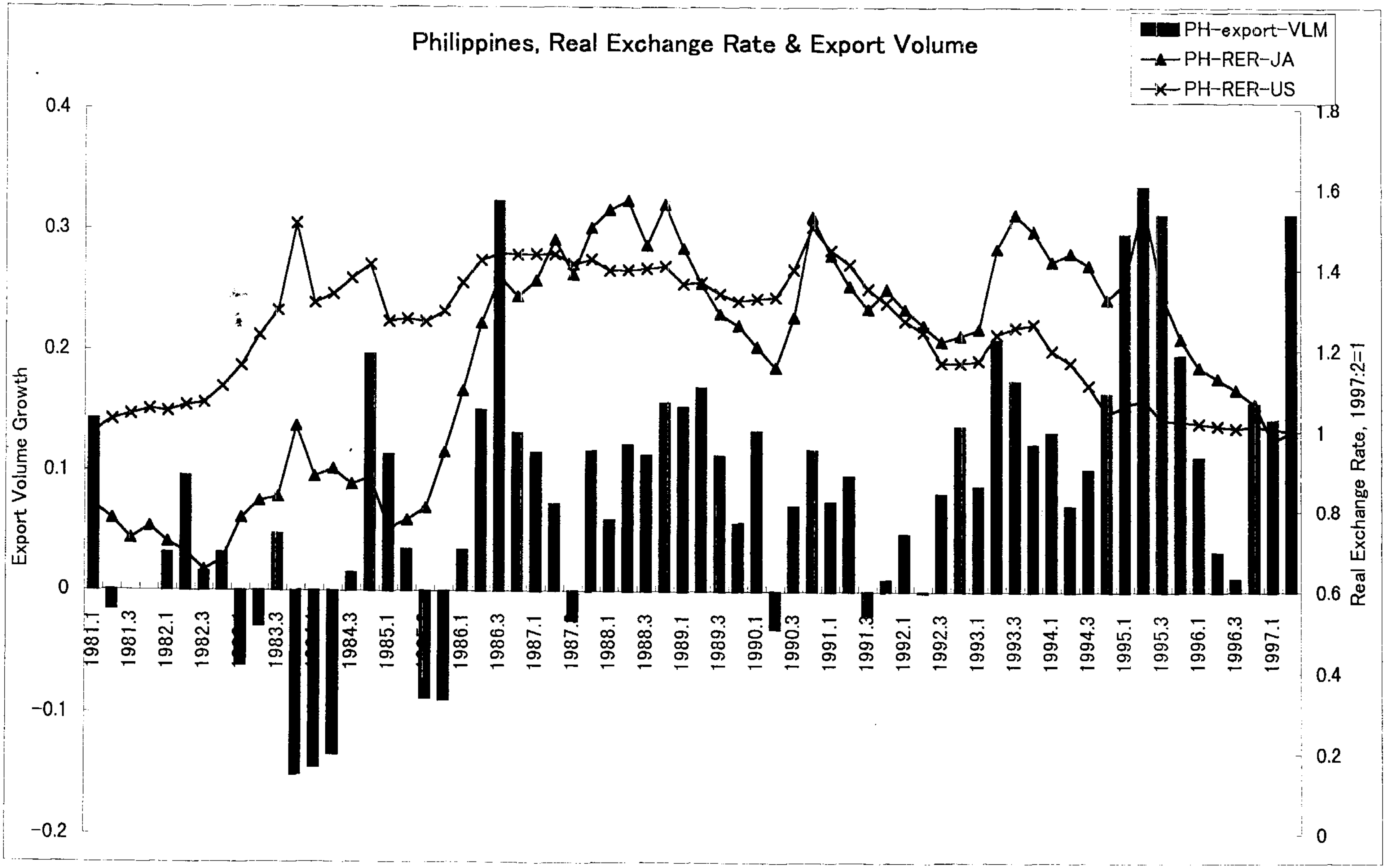
1996.1
1996.3
1997.1



Philippines, Real Exchange Rate & Export Volume
PH-export-VLM
PH-RER-JA
PH-RER-US
Export Volume Growth
Real Exchange Rate, 1997:2=1
0.4
0.3
0.2
0.1
0
-0.1
-0.2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1981.1
1981.3
1982.1
1982.3
1983.3
1984.3
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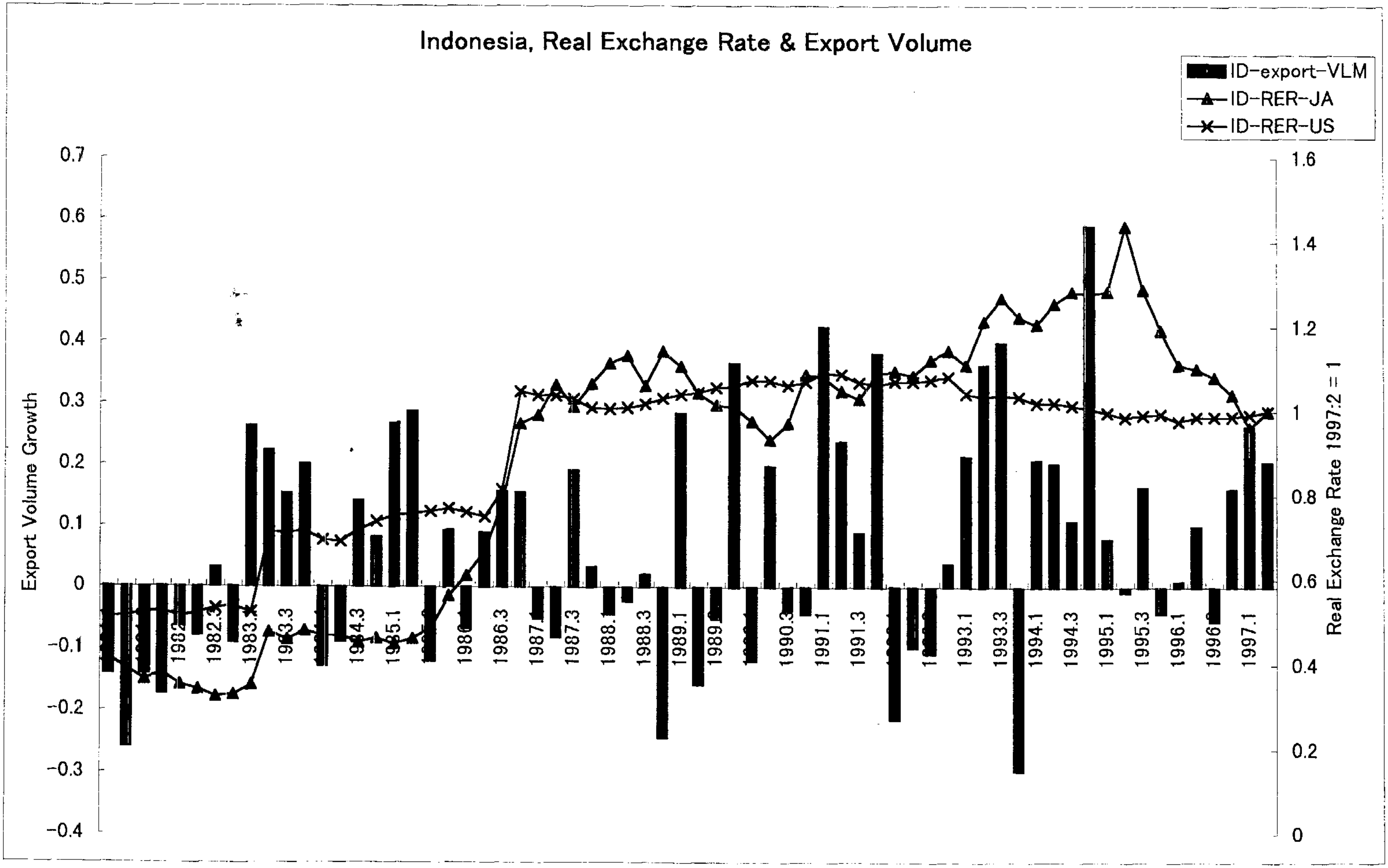
1996.1
1996.3
1997.1



Indonesia, Real Exchange Rate & Export Volume
ID-export-VLM
ID-RER-JA
ID-RER-US
Export Volume Growth
Real Exchange Rate 1997:2 = 1
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1982.3
1983.3
1984.3
1985.1
1986.3
1987.3
1988.3
1989.1
1991.1
1991.3
1993.1
1993.3
1994.1
1994.3
1995.1
1995.3
1996.1
1997.1