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TRADE PATTERNS AND EXCHANGE RATE REGIMES: TESTING THE ASIAN CURRENCY BASKET USING AN INTERNATIONAL INPUT-OUTPUT SYSTEM

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This paper aims at analyzing exchange rates and trade patterns of Indonesia, Malaysia, the Philippines, Thailand, China, Korea, Singapore, and Taiwan in relation to Japan and the United States, with reference to the Asian currency crises in 1997. In order to analyze these issues, we constructed an international input-output model linked with macroeconometric models of the ten countries/regions. Analyses on the Asian exchange rates with a currency basket peg framework show that the Asian exchange rate policy was the de-facto dollar peg policy. As for trade patterns in relation to the yen-dollar rate; when a country/region's industrial structure is similar to that of Japan's and the yen is weak, the appropriate change of the yen's weight proves to hold its competitiveness. By contrast, the weak yen shows a decrease of its imports, regarding complementary structure. In either case, however, effects are limited.

I. INTRODUCTION

The contemporary world economy is based on the interdependence between various countries/regions. In July of 1997, the adoption of a free floating exchange rate policy in Thailand triggered off the Asian currency crises. To this effect, the currency crises in Asia spread over Russia and Brazil.

There are numerous studies on the causes and policy considerations of the Asian currency crises. In this paper, we will focus on the Asian exchange rate policies which set forth the main causes of the Asian currency crises. As explained in Sections II and IV, the Asian countries/regions' governments had employed the de-facto U.S. dollar peg policy. Though the de-facto U.S. dollar peg system had three benefits; control of imported inflation, provision of smooth access to the U.S. market, and the attraction of foreign investments, it was inflexibility against the external

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environments which also lead to the moral hazard problem of the Asian financial institutions. Hence, a basket peg policy is one of the alternate exchange rate policies for the Asian countries/regions.

In this paper, we seek into how the Asian currencies are determined in relation to the movements of major currencies using the U.S. dollar, the Japanese yen, and the Deutsche mark as prime examples. Following, we analyze how trade patterns are affected when the Asian governments increase the weight of the Japanese yen in their currency baskets.[1]

To analyze these issues, we have constructed an international input-output model that is linked with macroeconometric models applying an international input-output table compiled by the Institute of Developing Economies (IDE). The IDE has been compiling international input-output tables for long periods and has had an important role in this field, worldwide. At present the IDE provides not only over twenty two-country/region-linked international input-output tables, but also international input-output tables of eight countries/regions (the international input-output table for ASEAN countries of 1975) (IDE 1982) and of ten countries/regions (the Asian international input-output tables of 1985 and 1990) (IDE 1993, 1998). Among these tables, the Asian international input-output table of 1990 composes the basis of our model. The table covers the following ten countries/regions: Indonesia (IDN), Malaysia (MLS), the Philippines (PHL), Thailand (THA), China (CHN), the Republic of Korea (KOR), Singapore (SGP), Taiwan (TWN), Japan (JPN), and the United States (USA),[2] and has seventy-eight industrial sectors for each country/region.

The model consists of macroeconometric models and an international input-output model. Regarding macroeconometric models, the demand-oriented Klein's (1983) skeleton model and the supply-oriented UNCTAD model are employed for developed as well as developing countries/regions, respectively.[3] In addition, we integrated the Filatov-Klein exchange rate model with macroeconometric models.[4] Based on these results, we estimated the weights of the U.S. dollar, the Japanese yen, and the Deutsche mark in the determinations of the Asian currencies. We interlinked macroeconometric models with an international input-output model and

1 As for simulation analyses on the Asian currency devaluations by large-scale models, there are few experiments. Fair (1999) uses a multicountry macroeconometric model to evaluate the effects of devaluations of Thai, Malaysian, Philippine, and Korean currencies. Noland et al. (1998) examine the economic impact of the productivity shocks and exchange rate devaluations using computable general equilibrium models. Shishido and Nakajima (1999) analyze impacts of the Asian currency devaluation and Japanese policy packages with an econometric multisector model in the context of multicountry.

2 Hereafter, we categorize the Asian economies as the ASEAN (Indonesia, Malaysia, the Philippines, and Thailand) and the Asian NIEs (Korea, Singapore, and Taiwan).

3 Regarding the UNCTAD model, see Ball (1973).

4 Details on the Filatov-Klein exchange rate model are provided in Section III.

simulated the trade patterns among the ten countries/regions. Further explanations on the model are provided in Kosaka (1994).

This paper is structured as follows: Section II summarizes the literature on the Asian currency crises. Section III explains the model structure. Section IV presents simulation results. Finally, Section V shows the conclusions.

II. CONTROVERSIES ON THE ASIAN CURRENCY CRISES

The Asian currency crises emerged by the abandonment of the closely fixed exchange rate policy in Thailand. Most studies on the Asian currency crises point out that the direct cause of the crises was derived from rapid international capital outflow. Table I shows movements on net capital inflow, foreign reserves, and the exchange rate of Thailand. Until 1996, the Thai exchange rate fluctuated at 25 baht to the U.S. dollar. Though the Thai government officially announced that it had adopted the multiple-currency basket peg policy with major trading partners' currencies, Dornbusch and Park (1999) note that roughly 80 per cent of the total weight was assigned to the U.S. dollar.[5] There was a net inflow of foreign capital into Thailand and foreign reserves increased until 1996. This indicates that the Thai government had maintained its closely fixed rate by interventions in the foreign exchange market (Kohsaka 2000, p. 29). However, there was an outflow of foreign capital in 1997. Due to the tremendous amount of capital outflow from Thailand, the Thai government could not afford to maintain the baht and altered its exchange rate policy to the free floating policy. This triggered the Asian currency crises.

Next, we examine causes of the rapid foreign capital outflow. The causes are shown based on two kinds of currency crisis models (the first-generation model and the second-generation model).[6] In the first-generation model, deterioration of macroeconomic fundamentals cause the collapse of the fixed exchange rate.[7] Monetizing the government debt increases the money supply, which in turn decreases the currency value due to inflation. This inconsistency between macroeconomic and exchange rate policies leads to speculative attacks. Although a government tries to maintain the fixed exchange rate, it abandons the fixed exchange rate regime when its foreign reserves are exhausted. As Table I shows, the fiscal balances of the Asian economies were either a surplus or a slight deficit.[8] Thus, fiscal balances were not a cause of the Asian currency crises. However, Corsetti, Pesenti, and Roubini (1998), Feldstein (1998), and Goldstein (1998) focus on the current account deficits and

[5] See also Section IV.
[6] Krugman (1998) argues that currency crisis models do not fit the Asian currency crises, that main causes of the crises are the bursting of asset bubbles and moral hazard problems in the financial sector.
[7] See Krugman (1979) and Flood and Garber (1984).
[8] See also Corsetti, Pesenti, and Roubini (1998) and Krugman (1998).

TABLE I

KEY MACROECONOMIC INDICATORS OF FIVE ASIAN ECONOMIES

	Exchange Rate (Local Currency per U.S.$)	International Reserves (U.S.$ Million)	Net Capital Inflow (U.S.$ Million)	Current Account (% of GDP)	Merchandise Export Growth (%)	Government Fiscal Balance (% of GDP)
Indonesia						
1993	2,087.100	11,262.700	5,632.000	−1.333	11.369	0.612
1994	2,160.750	12,132.700	3,839.000	−1.578	13.755	0.937
1995	2,248.610	13,708.200	10,259.000	−3.182	22.774	2.219
1996	2,342.300	18,251.100	10,847.000	−3.370	10.168	1.160
1997	2,909.380	16,586.900	−603.000	−2.266	39.332	−0.671
Malaysia						
1993	2.570	27,249.200	10,804.570	−4.464	17.020	0.206
1994	2.620	25,422.900	1,287.980	−6.059	25.447	2.255
1995	2.500	23,774.400	7,642.540	−9.713	20.357	0.837
1996	2.520	27,009.400	9,476.760	−4.431	8.129	0.715
1997	2.810	20,788.200	2,197.500	−5.917	12.309	2.351
Philippines						
1993	27.120	4,675.690	NA	−5.547	23.096	−1.485
1994	26.420	6,017.470	NA	−4.604	15.472	1.070
1995	25.710	6,372.440	NA	−2.671	25.923	0.581
1996	26.220	10,029.700	11,277.000	−4.772	20.081	0.288
1997	29.470	7,266.260	6,498.000	−5.284	38.028	0.064
Thailand						
1993	25.320	24,472.900	10,500.010	−5.042	13.033	1.740
1994	25.150	29,332.200	12,167.030	−5.651	21.379	2.813
1995	24.920	35,982.000	21,908.570	−8.249	23.521	3.296
1996	25.340	37,731.200	19,486.050	−8.075	−0.219	0.939
1997	31.360	26,179.500	−12,055.780	−2.013	28.869	−0.320
Korea						
1993	802.670	20,228.200	3,304.100	0.286	10.769	0.614
1994	803.450	25,639.300	10,845.100	−0.961	15.796	0.304
1995	771.270	32,677.700	17,394.500	−1.739	25.984	0.274
1996	804.450	34,037.100	23,841.600	−4.422	8.768	0.103
1997	951.290	20,367.900	−9,106.300	−1.714	26.125	−1.268

Source: IMF (2000).
Note: NA = not available.

shortages of foreign reserves. In Thailand, the ratio of the current account deficits to the nominal GDP had been approximately −8 per cent in 1995 and 1996 with an extremely high export slowdown.[9] Furthermore, foreign reserves were insufficient because the short-term debts per foreign reserves had been roughly 1 or

[9] See Table I.

over 1.[10] This deterioration in macroeconomic fundamentals made investors withdraw their capital from Thailand. On the other hand, the second-generation model does not depend on macroeconomic fundamentals but does for market expectations.[11] A government would adjust its currency to realize the market expectation changes; however, a government would not devalue its currency under certain circumstances that are based on market expectations and a government's policy objective function. Hence, this model has multiple equilibria. Furman and Stiglitz (1998) and Radelet and Sachs (1998) consider that market expectations were shifted by investors' panic leaving the Asian currency crises consistent with the second-generation model.[12]

Based on Table I, it is difficult to consider that market expectation shifts were not dependent on the Thai macroeconomic imbalances because they were actually deteriorated.[13] Hence, we can interpret that macroeconomic imbalances were the cause of the massive amount of international capital outflow from Thailand which led to the collapse of the Thai exchange rate policy.

In order to obtain policy implications, we look into the cause of current account deficits and foreign reserve shortages. The de-facto dollar peg policy should be considered as the cause. The de-facto dollar peg policy was a rational policy for Thailand in order to control imported inflations, have smooth access to the U.S. market and introduce foreign investment. Yet the Thai baht became overvalued due to the weak yen from 1995 (Corsetti, Pesenti, and Roubini 1998, pp. 19–23; Goldstein 1998, pp. 14–15). Therefore Thailand lost its competitiveness which created a slowdown in the export growth of Thai merchandise.[14] Because of low exchange rate risks due to the de-facto dollar peg policy and an insufficient financial supervision system, Thai financial institutions borrowed tremendous amounts of foreign capital generating moral hazard problems. Most foreign capital was used to invest in real estate or unproductive matters. These investments would not contribute to future production or exports, thus we could not expect export recovery in the process of current account deterioration.[15]

The collapse of the Thai exchange rate regime quickly spread to other Asian economies. Fukuchi and Tokunaga (1999) developed a monthly econometric model for Indonesia and analyzed causes of exchange rate changes. They show that 66, 18.4, and 15.6 per cent of rupiah changes are explained by the bandwagon effect,

10 See Corsetti, Pesenti, and Roubini (1998), Goldstein (1998), and Radelet and Sachs (1998).
11 See Obstfeld (1994, 1996).
12 Radelet and Sachs (1998) consider that those macroeconomic imbalances were not so serious as to cause the Asian currency crises.
13 Krugman (1996) points out that if we take into account the deterioration of macroeconomic fundamentals in the new model, the possibility of a unique equilibrium becomes higher.
14 See Table I.
15 As for moral hazard problems, financial deregulations and unproductive investments in Asia, see Corsetti, Pesenti, and Roubini (1998) and Goldstein (1998).

the purchasing power parity (PPP) factor, and the net capital inflow, respectively. Ito (1999) also confirms that there were contagion effects among Thailand, Indonesia, Malaysia, the Philippines, and Korea by using weekly data of their currencies. As for an explanation to their exchange rate collapses, a contagion framework would be appropriate: however, Table I shows current account deficits and a sudden fall of merchandise export growth in 1996 regarding Indonesia, Malaysia, the Philippines, and Korea as they do for Thailand. Though the direct cause of their exchange rate collapses is the contagion effects, the contagion is based on the deterioration of their macroeconomic fundamentals.[16]

These interpretations on the Asian currency crises indicate that the Asian economies should adopt a more flexible exchange rate regime. Though the most flexible regime is the free floating policy, it is not appropriate for the Asian economies because they are highly trade dependent small economies. Hence, a basket peg policy would be more appropriate than that of the free floating policy.[17]

III. THE STRUCTURE OF THE MODEL

A. *Macroeconometric Models*

1. *Theoretical framework*

There are several differences in the economic structures between developed and developing countries/regions. Of course, we can apply the same model to both, yet it is not an accurate approach in analyzing their economies. To acquire a more precise output for each country/region's differences, we have constructed two kinds of macroeconometric models.[18] As for the developed countries/regions (the Asian NIEs, Japan, and the United States), we adopted the Klein's skeleton model as the benchmark model. This model is a demand-oriented system, where the gross domestic expenditure determines the GDP. Regarding the developing countries/regions (the ASEAN and China), we modified the UNCTAD's supply-oriented macroeconometric model.[19] In most cases, developing economies are labor surplus-capital shortage economies. Hence, it is important to model them with the focus on production. The Appendixes A and B show the structure of the skeleton and the UNCTAD models.

Neither the skeleton nor the UNCTAD model has an exchange rate function;

[16] Deterioration of macroeconomic fundamentals is one of the hypotheses on causes of contagion (see Ito 1999).

[17] Hamada (1998) analyzes the exchange rate policy of a small country whose initial exchange rate policy is the fixed one by applying the framework of the three-country (two large countries and one small country) monetary policy games. His analysis shows that the free floating policy or the currency basket policy is better than the fixed exchange rate, and that the currency basket policy is more appropriate than the free floating policy under the strong wage demand pressure.

[18] A flow chart of the model is provided in Figure 1.

[19] See Ball (1973).

thus we applied the Filatov-Klein exchange rate model.[20] This model is written as:

$$\ln e_t = \alpha_{00} + \alpha_{01}\ln(P_t / P_{US,t}) + \alpha_{02}(r_t - r_{US,t}) + \alpha_{03}(BAL_t / P_t Z_t), \tag{1}$$

where e_t is the exchange rate, P_t is the general price level of the home country/region, $P_{US,\,t}$ is the general price level of the United States, r_t is the nominal interest rate of the home country/region, $r_{US,\,t}$ is the nominal U.S. interest rate, BAL_t is the current account, Z_t is the real GDP, and the t subscript denotes the time period of the observation. The Filatov-Klein model explains the exchange rate by relative prices between the home country and the United States, the interest rate differences, and the nominal current account per nominal GDP. The exchange rate is basically determined by the PPP. Its short-term fluctuation depends on the interest rate differences and the current account. As shown in Section II, capital transactions are one of the key causes of the Asian currency crises. Though the Filatov-Klein model does not have capital accounts as one of the explanatory variables, we consider that capital accounts are simplified as the interest rate differences.

Regarding policy instruments, the Klein's skeleton model has the money supply and the real government spending, whereas the UNCTAD model has only the money supply. In Japan and the United States, monetary authorities control the short-term interest rates instead of the money supply. Thus, we adopt the short-term interest rates as monetary policy instruments and explain the money supply as:

$$\ln MS_t = \alpha_{10} + \alpha_{11}\ln Z_t + \alpha_{12} r_t, \tag{2}$$

where MS_t is the money supply. We also explain the short-term interest rates by estimating monetary policy reaction functions. The prototype model of the monetary policy reaction function can be written as:

$$r_t = \alpha_{20} + \alpha_{21} GR4\_P_t + \alpha_{22} GR4\_MS_t + \alpha_{23} r_{t-1}, \tag{3}$$

where $GR4\_P_t$ is the four-period percentage change of the price deflator and $GR4\_MS_t$ is the four-period percentage change of the money supply. As for the other Asian countries/regions, we consider that monetary policy instruments are the money supply and estimate the monetary policy reaction function as:

$$GR\_MS_t = \alpha_{30} + \alpha_{31} GR\_P_t + \alpha_{32} e_t + \alpha_{33}(BAL_t / P_t Z_t), \tag{4}$$

where GR_MS_t is the one-period percentage change of the money supply and GR_P_t is the one-period percentage change of the price deflator. In contrast, we divide government spending of Japan and the United States into government consumption and public investment. Though we treat government consumption as one of the exogenous variables, public investment of Japan and the United States are explained by the following base model:

[20] See De Grauwe and Peeters (1983).

TABLE II

SELECTED FEATURES OF MACROECONOMETRIC MODELS

Country/Region	Type	Time Frame	Endogenous Variables	Exogenous Variables
Indonesia	Supply-oriented	Annual	52	25
Malaysia	Supply-oriented	Annual	48	24
Philippines	Supply-oriented	Annual	51	45
Thailand	Supply-oriented	Annual	55	21
China	Supply-oriented	Annual	36	31
Korea	Demand-oriented	Annual	44	24
Singapore	Demand-oriented	Annual	36	18
Taiwan	Demand-oriented	Annual	41	22
Japan	Demand-oriented	Quarterly	77	44
United States	Demand-oriented	Quarterly	65	24

$$GR4\_IG_t = \alpha_{40} + \alpha_{41} GR4\_Z_t + \alpha_{42} GR4\_IG_{t-1}, \tag{5}$$

where $GR4\_IG_t$ is the four-period percentage change of real public investment and $GR4\_Z_t$ is the four-period percentage change of the real GDP. Other Asian government spendings are exogenous variables as is government consumption of Japan and the United States.

2. *Estimation results*

Structural equations of the ten countries/regions are estimated by time-series data. Table II shows several features of our macroeconometric models. We applied the Klein's skeleton model to the Asian NIEs, Japan, and the United States, and the UNCTAD model to the ASEAN and China. Macroeconometric models of Japan and the United States are quarterly models, yet those of the other countries/regions are annual. Each model is a medium-sized model that has over thirty-six endogenous and over eighteen exogenous variables.

Table III provides exchange rate function results that are most important in this analysis.[21]

Indonesia. The Indonesian rupiah is explained by the Japanese yen (1987–), the PPP, the ratio of current accounts to the nominal GDP, and dummy variables. Statistics show that this function is well estimated, however, the Japanese yen is statistically significant at the 10 per cent level.

Malaysia. The Malaysian ringgit depends on the Japanese yen (1985–), the Deutsche mark (1986–), the relative export deflators, the nominal current account per nominal GDP, and dummy variables. We can find that most statistics provide sufficient results.

[21] For the estimation of exchange rate functions, we use the Japanese yen and the Deutsche mark as explanatory variables in order to introduce currency baskets.

TABLE III

ESTIMATION RESULTS OF EXCHANGE RATE FUNCTION

A. Indonesia, 1983–97 (OLS)

Explanatory Variables	Coefficient	t-statistic	p-value
Constant	2,221.012	16.515	0.0000
$D87LATER$ (= 1 for 1987–, otherwise 0) $\cdot e_{jpn}$	1.515	1.777	0.1093
ln($PEX93IDN/PEX92USA$)	1,528.812	10.381	0.0000
$BALIDN_{-4}/GDPIDN_{-4}$	−4,345.824	−2.666	0.0258
$D89\_90$ (= 1 for 1989–90, otherwise 0)	−311.929	−2.781	0.0214
$D91\_96$ (= 1 for 1991–96, otherwise 0)	−199.835	−2.308	0.0464
Adj. R^2	0.955		
S.E.	116.248		
D.W.	2.992		

Note: *PEX93IDN* = export deflator of Indonesia (1993 = 100), *PEX92USA* = export deflator of the United States (1992 = 100), *BALIDN* = nominal current account of Indonesia, and *GDPIDN* = nominal GDP of Indonesia.

B. Malaysia, 1978–97 (OLS)

Explanatory Variables	Coefficient	t-statistic	p-value
Constant	1.929	16.232	0.0000
$D85LATER$ (= 1 for 1985–, otherwise 0) $\cdot e_{jpn}$	0.001	4.057	0.0016
$D86LATER$ (= 1 for 1986–, otherwise 0) $\cdot e_{ger}$	0.140	5.832	0.0001
ln($PEX78MLS/PEX92USA$)	0.782	3.016	0.0107
$BALMLS/GDPMLS$	−0.554	−1.931	0.0775
$D82\_84$ (= 1 for 1982–84, otherwise 0)	0.099	1.856	0.0881
$D88\_91$ (= 1 for 1988–91, otherwise 0)	0.114	2.921	0.0128
$D95\_96$ (= 1 for 1995–96, otherwise 0)	−0.117	−2.287	0.0412
Adj. R^2	0.897		
S.E.	0.059		
D.W.	1.643		

Note: *PEX78MLS* = export deflator of Malaysia (1978 = 100), *PEX92USA* = export deflator of the United States (1992 = 100), *BALMLS* = nominal current account of Malaysia, and *GDPMLS* = nominal GDP of Malaysia.

C. The Philippines, 1979–97 (OLS)

Explanatory Variables	Coefficient	t-statistic	p-value
Constant	17.647	47.432	0.0000
$D86LATER$ (= 1 for 1986–, otherwise 0) $\cdot e_{jpn}$	0.009	1.969	0.0706
ln($PEX85PHL/PEX92USA$)	11.608	23.056	0.0000
$D79$ (= 1 for 1979, otherwise 0)	−2.589	−3.098	0.0085
$D90\_91$ (= 1 for 1990–91, otherwise 0)	2.452	3.999	0.0015
$D93$ (= 1 for 1993, otherwise 0)	1.652	2.032	0.0631
Adj. R^2	0.993		
S.E.	0.768		
D.W.	1.788		

Note: *PEX85PHL* = export deflator of the Philippines (1985 = 100) and *PEX92USA* = export deflator of the United States (1992 = 100).

TABLE III (Continued)

D. Thailand, 1980–97 (OLS)

Explanatory Variables	Coefficient	t-statistic	p-value
Constant	22.740	83.039	0.0000
$D85LATER$ (= 1 for 1985–, otherwise 0) $\cdot e_{jpn}$	0.012	6.119	0.0001
ln($PEX88THA$ / $PEX92USA$)	18.405	14.057	0.0000
$RGBTHA_{-1} - RGBUSA_{-1}$	–0.318	–4.150	0.0016
$D82\_85$ (= 1 for 1982–85, otherwise 0)	2.487	7.638	0.0000
$D86\_87$ (= 1 for 1986–87, otherwise 0)	1.823	4.780	0.0006
$D95\_96$ (= 1 for 1995–96, otherwise 0)	–1.891	–5.174	0.0003
Adj. R^2	0.965		
S.E.	0.430		
D.W.	2.861		

Note: $PEX88THA$ = export deflator of Thailand (1988 = 100), $PEX92USA$ = export deflator of the United States (1992 = 100), $RGBTHA$ = government bond yield of Thailand, and $RGBUSA$ = government bond yield of the United States.

E. China, 1980–97 (nonlinear least squares)

Explanatory Variables	Coefficient	t-statistic	p-value
Constant	8.228	22.279	0.0000
$D85LATER$ (= 1 for 1985–, otherwise 0) $\cdot e_{jpn}$	0.004	2.112	0.0584
ln($PGDP95CHN$ / $PGDP92USA$)	3.328	1.970	0.0745
$D80\_87$ (= 1 for 1980–87, otherwise 0)	–3.496	–3.169	0.0089
$D88\_89$ (= 1 for 1988–89, otherwise 0)	–3.175	–3.703	0.0035
$D90\_93$ (= 1 for 1990–93, otherwise 0)	–1.973	–2.911	0.0142
AR (1)	0.297	2.196	0.0504
Adj. R^2	0.975		
S.E.	0.393		
D.W.	1.780		

Note: $PGDP95CHN$ = GDP deflator of China (1995 = 100) and $PGDP92USA$ = GDP deflator of the United States (1992 = 100).

F. Korea, 1980–97 (nonlinear least squares)

Explanatory Variables	Coefficient	t-statistic	p-value
Constant	792.308	19.445	0.0000
e_{jpn}	0.913	4.619	0.0006
ln($PEX95KOR$/$PEX92USA$)	1911.794	7.307	0.0000
$RSKOR - RSUSA$	–7.938	–1.851	0.0886
$BALKOR_{-1}$ / $GDPKOR_{-1}$	–493.547	–2.714	0.0188
AR (1)	0.339	4.425	0.0008
Adj. R^2	0.935		
S.E.	20.984		
D.W.	1.914		

Note: $PEX95KOR$ = export deflator of Korea (1995 = 100), $PEX92USA$ = export deflator of the United States (1992 = 100), $RSKOR$ = deposit rate of Korea, $RSUSA$ = deposit rate of the United States, $BALKOR$ = nominal current account of Korea, and $GDPKOR$ = nominal GDP of Korea.

TABLE III (Continued)

G. Singapore, 1979–97 (OLS)

Explanatory Variables	Coefficient	*t*-statistic	*p*-value
Constant	1.698	28.607	0.0000
*D*86*LATER* (= 1 for 1986–, otherwise 0) $\cdot e_{jpn}$	0.002	4.638	0.0005
RSSGP – *RSUSA*	–0.045	–3.626	0.0031
$BALSGP_{-1}$ / $GDPSGP_{-1}$	–3.341	–11.599	0.0000
*D*83_85 (= 1 for 1983–85, otherwise 0)	0.210	4.178	0.0011
*D*94 (= 1 for 1994, otherwise 0)	–0.145	–2.143	0.0516
Adj. R^2	0.953		
S.E.	0.063		
D.W.	2.008		

Note: *RSSGP* = deposit rate of Singapore, *RSUSA* = deposit rate of the United States, *BALSGP* = nominal current account of Singapore, and *GDPSGP* = nominal GDP of Singapore.

H. Taiwan, 1982–97 (OLS)

Explanatory Variables	Coefficient	*t*-statistic	*p*-value
Constant	21.726	20.390	0.0000
e_{jpn}	0.036	4.074	0.0015
ln(*PEX*91*TWN* / *PEX*92*USA*)	39.565	9.948	0.0000
$RSTWN_{-3}$ – $RSUSA_{-3}$	–0.314	–2.558	0.0251
Adj. R^2	0.981		
S.E.	0.810		
D.W.	2.031		

Note: *PEX*91*TWN* = export deflator of Taiwan (1991 = 100), *PEX*92*USA* = export deflator of the United States (1992 = 100), *RSTWN* = deposit rate of Taiwan, and *RSUSA* = deposit rate of the United States.

I. Japan, 1985:Q2–2000:Q2 (OLS)

Explanatory Variables	Coefficient	*t*-statistic	*p*-value
Constant	5.064	363.795	0.0000
ln(*PEX*90*JPN* / *PEX*92*USA*)	1.821	48.998	0.0000
*D*973*LATER* (= 1 for 1997:Q3–, otherwise 0) $\cdot$ ln(*PEX*90*JPN* / *PEX*92*USA*)	–0.599	–13.191	0.0000
$RGBJPN_{-1}$ – $RGBUSA_{-1}$	–0.010	–3.582	0.0007
$BALJPN_{-1}$ / $GDPJPN_{-1}$	–0.048	–10.488	0.0000
*D*871_911 (=1 for 1987:Q1–1991:Q1, otherwise 0)	–0.104	–11.881	0.0000
MA (4)	–0.339	–2.465	0.0169
Adj. R^2	0.980		
S.E.	0.029		
D.W.	1.259		

Note: *PEX*90*JPN* = export deflator of Japan (1990 = 100), *PEX*92*USA* = export deflator of the United States (1992 = 100), *RGBJPN* = government bond yield of Japan, *RGBUSA* = government bond yield of the United States, *BALJPN* = nominal current account of Japan, and *GDPJPN* = nominal GDP of Japan.

General notations: e_{jpn} = exchange rate of Japan, e_{ger} = exchange rate of Germany, *AR* (1) = first order autoregressive process, *MA* (4) = fourth order moving average process, Adj. R^2 = adjusted *R*-squared, *S.E.* = standard error of regression, and *D.W.* = Durbin-Watson statistic.

TABLE IV

ROOT MEAN SQUARE PERCENTAGE ERROR OF LINKAGE VARIABLES

	W	*e*	*CP*	*I*	Simulation Period
Indonesia	5.604	6.733	3.424	10.397	1987–97
Malaysia	2.987	2.133	5.444	5.440	1990–97
Philippines	6.616	3.498	0.642	3.003	1986–97
Thailand	4.393	1.794	3.637	11.959	1986–97
China	10.566	9.283	3.925	6.918	1983–96
Korea	7.797	7.301	4.569	9.366	1981–97
Singapore	2.152	3.684	2.964	4.299	1988–97
Taiwan	3.068	3.086	2.119	6.940	1982–97
Japan	0.967	6.752	1.368	2.561	1990:Q1–1997:Q4
United States	1.367	—	0.609	2.391	1988:Q1–1997:Q4

Note: W = wages, e = exchange rate, CP = real private consumption, I = real gross fixed capital formation, Q1 = first quarter, and Q4 = fourth quarter.

The Philippines.The Philippine peso is determined by the Japanese yen (1986–), the relative export deflators, and dummy variables. The Japanese yen is not statistically significant at the 5 per cent level, but is at the 10 per cent level. In exception to that, we can conclude that this function is well estimated.

Thailand. The Thai baht is explained by the Japanese yen (1985–), the PPP, the long-term interest rate difference, and dummy variables. In the Thai case, most statistics show sufficient results.

China. The Chinese yuan is explained by the Japanese yen (1985–), the relative GDP deflators, and dummy variables. Yet, the coefficient of the relative price is statistically significant at the 10 per cent level.

Korea. The Korean won is determined by the Japanese yen, the relative export deflators, the interest rate difference, and the current account. Though the coefficient of the interest rate difference is not statistically significant at the 5 per cent level, the Korean exchange rate function is well estimated.

Singapore. The Singapore dollar is explained by the Japanese yen (1986–), the interest rate difference, the current account against the nominal GDP, and dummy variables. Statistics show that this function is well estimated.

Taiwan. As for Taiwan; the Japanese yen, the relative export deflators, and the interest rate difference explain the exchange rate. The current account per nominal GDP does not affect the exchange rate. All statistics are acceptable.

Japan. The Japanese yen is explained by the relative export deflators, the long-term interest rate difference, and the current account per nominal GDP. Statistics show overall good results.

Table IV presents the root mean square percentage errors (RMSPEs) of linkage variables between macroeconometric models and our international input-output model (wages, exchange rate, private consumption, and gross fixed capital formation). Though we see insufficient RMSPEs to the Indonesian investment, the Thai investment and the Chinese wages, Table IV shows overall good results.

B. *International Input-Output Model*

Shown here is the precise structure of our international input-output model.[22] First, we define technical coefficients. In this model, we do not distinguish between domestic and imported goods for its definition. Hence, intermediate inputs of the ith commodity in the jth sector of the kth economy (X_{ij}^k) can be written as:

$$X_{ij}^k = a_{ij}^k X_j^k, \tag{6}$$

where a_{ij}^k is the technical coefficient of the ith commodity in the jth sector of the kth economy and X_j^k is control totals in the jth sector of the kth economy. Rearranging equation (6), we obtain technical coefficients as:

$$a_{ij}^k = \sum_h X_{ij(h)}^k \,/\, X_j^k, \tag{7}$$

where $X_{ij(h)}^k$ is intermediate inputs of the ith commodity imported from the hth economy in the jth sector of the kth economy. Next, we allocate a share of each economy in total intermediate inputs by applying the Hickman and Lau (1973) trade linkage model. The share is explained by the base year share and the relative export prices between the home country/region and competitors, as in the following equation:

$$X_{ij(h)}^k \,/\, X_{ij}^k = m_{ij(h)}^{k*}\{(1 + t_i^k)PX_{ij(h)}^k \,/\, [\sum_{q \neq h} m_{ij(q)}^{k*}(1 + t_i^k)PX_{ij(q)}^k]\}^{-s_{(ijk)}}, \tag{8}$$

where $m_{ij(h)}^{k*}$ is the base year share of the ith commodity imported from the hth economy in the jth sector of the kth economy, $PX_{ij(h)}^k$ is export prices of the ith commodity of the hth economy in the jth sector of the kth economy, t_i^k is the tariff rate of the ith commodity of the kth economy $\left(= \dfrac{\text{tariffs on the } i\text{th commodity of the } k\text{th economy}}{\text{imports of the } i\text{th commodity of the } k\text{th economy}}\right)$, $s_{(ijk)}$ is the elasticity of substitution of the ith commodity in the jth sector of the kth economy, and q denotes competitors.

Control totals are explained from the following balance equation:

$$\sum_i \sum_k X_{ij(h)}^k + F_{i(h)} = X_{i(h)}, \quad i = 1, 2, \ldots, M; \; h = 1, 2, \ldots, N, \tag{9}$$

where $F_{i(h)}$ is final demands in the ith sector of the hth economy and $X_{i(h)}$ is control totals in the ith sector of the hth economy. Regarding final demands, we divide them into those economies composing an international input-output table and the rest of the world. In our model, macroeconometric models explain final demands

[22] This international input-output model is based on Kosaka (1994). For another formulation of an international input-output model, see Torii and Akiyama (1989).

(except for that of the rest of the world), and then we allocate them to sectors by shares. Though shares are determined by the base year shares, they vary by relative prices and elasticities of substitution. Hence, final demands in this system can be written as:

$$\begin{aligned} F &= \sum_k F^k + F^o \\ &= \sum_k H^k g^k + F^o, \end{aligned} \tag{10}$$

where $H^k = (f_{ig}^k) = (\sum_{q \neq k} P_i^q / P_i^k)^{sf_{(igk)}} f_{ig}^{k*}$. In equation (10), F is final demands, F^k is final demands of the kth economy, F^o is final demands of the rest of the world, H^k is the converter matrix of the final demands of the kth economy $(= f_{ig}^k)$, g^k is final demands of the kth economy explained by its macroeconometric model, P_i^k is prices in the ith sector of the kth economy, P_i^q is prices in the ith sector of the qth economy, $sf_{(igk)}$ is elasticities of substitution of the final demands in the ith sector of the kth economy, and f_{ig}^{k*} is the base year shares of final demands in the ith sector of the kth economy.

To determine prices endogenously in an international input-output model, we first explain international freight and insurance, tariffs, and other costs. The international freight and insurance, tariffs, and other costs can be split into tariffs and other costs. From the definition of tariffs, we explain them as:

$$C_{j1}^k = \sum_{h \neq k} \sum_i t_i^k PX_{ij(h)}^k X_{ij(h)}^k, \tag{11}$$

where C_{j1}^k is tariffs on imports of the ith commodity in the jth sector of the kth economy. As for other costs, we assume that their base year ratio relative to control totals is fixed for the entire simulation periods. Thus, we formulate them as follows:

$$C_{j0}^k = c_{j0}^k X_j^k, \tag{12}$$

where C_{j0}^k is the international freight and insurance, and other costs in the jth sector of the kth economy (= total costs of the international freight and insurance, tariffs, and other costs minus tariffs), and c_{j0}^k is the base year ratio of the international freight and insurance, and other costs to control totals in the jth sector of the kth economy. Based on another balance equation of an international input-output table, we obtain the following cost structure equation:

$$P_j^k X_j^k = V_j^k + \sum_i \sum_h PX_{ij(h)}^k X_{ij(h)}^k + (C_{j1}^k + C_{j0}^k), \tag{13}$$

where P_j^k is prices in the jth sector of the kth economy and V_j^k is the value added in the jth sector of the kth economy. Dividing equation (13) by control totals in the jth sector of the kth economy, we obtain the price determination equation as follows:

$$\begin{aligned} P_j^k &= V_j^k / X_j^k + \sum_i \sum_h PX_{ij(h)}^k X_{ij(h)}^k / X_j^k + (C_{j1}^k + C_{j0}^k) / X_j^k \\ &= v_j^k + \sum_i \sum_h PX_{ij(h)}^k X_{ij(h)}^k / X_j^k + (C_{j1}^k / X_j^k + c_{j0}^k), \end{aligned} \tag{14}$$

where v_j^k is value added coefficients in the jth sector of the kth economy. Prices in the jth sector of the kth economy are set equal to unity. Then, we explain the value added. The value added can be divided by wages and other costs. The wage rate and employment consist of wages, thus, we can write wages as:

$$V_j^k = W_j^k + V_{j0}^k = w_j^k L_j^k + V_{j0}^k , \tag{15}$$

where W_j^k is wages in the jth sector of the kth economy, V_{j0}^k is the value added (except for wages) in the jth sector of the kth economy, w_j^k is the wage rate in the jth sector of the kth economy, and L_j^k is employment in the jth sector of the kth economy. The sectoral wage rate is explained by the wage rate determined in a macroeconometric model as follows:

$$w_j^k = f(w^k), \tag{16}$$

where w^k is the wage rate of the kth economy. We explain the sectoral employment by the Ozaki (1979) employment function as follows:

$$L_j^k = \alpha_j^k (X_j^k)^{\beta_j^k}, \quad \beta_j^k < 1, \tag{17}$$

where α_j^k is the employment rate in the jth sector of the kth economy and β_j^k is the elasticity of labor input in the jth sector of the kth economy. The elasticity of labor input reflects economies of scale. Dividing equation (15) by control totals in the jth sector of the kth economy yields value added coefficients as:

$$v_j^k = V_j^k / X_j^k = w_j^k L_j^k / X_j^k + V_{j0}^k / X_j^k = w_j^k L_j^k / X_j^k + v_{j0}^k, \tag{18}$$

where v_{j0}^k is the ratio of the value added (except for wages) to control totals in the jth sector of the kth economy. Finally, we explain export prices. In cases where an economy subsidies exports of the ith commodity, export prices of the ith commodity of the hth economy in the jth sector of the kth economy is formulated as:

$$PX_{ij(h)}^k = (1 - \tau_i^h) P_i^h, \tag{19}$$

where τ_i^h is the export subsidy of the ith commodity of the hth economy and P_i^h is prices in the ith sector of the hth economy. Where there are no export subsidies, the export prices can be written as:

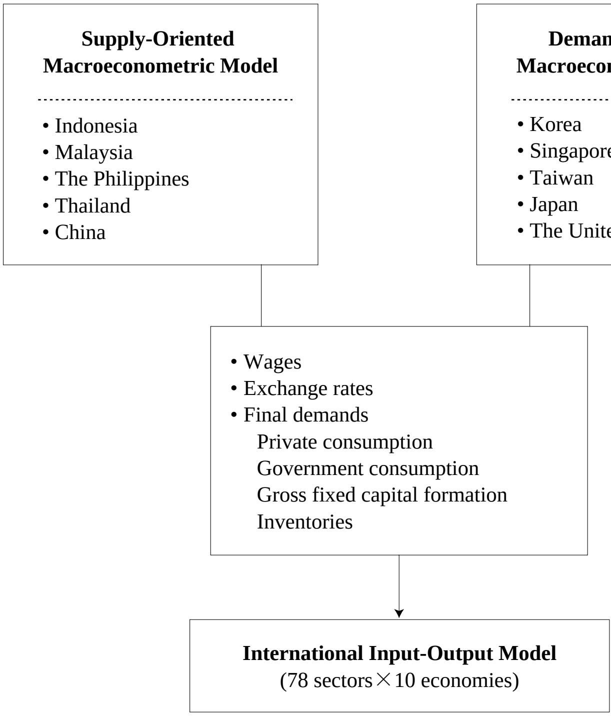
$$PX_{ij(h)}^k = P_i^h. \tag{20}$$

C. *Model Linkage*

In this subsection, we explain the overall picture of our model and the linkage between macroeconometric models and the international input-output model.

Figure 1 is the flow chart of the model. Wages, exchange rates, and final demand components (private consumption, government consumption, gross fixed capital formation, inventories) that are explained in each macroeconometric model feed

Fig. 1. Flow Chart of the Model



into the international input-output model. The currency unit of the international input-output model is the U.S. dollar. Hence, wages and final demand components in the home currency are converted into the U.S. dollar by using the exchange rate. After allocating them into each sector and each country/region, sectoral production and trade transactions are analyzed by the international input-output model. As shown in Figure 1, though macroeconometric models are linked to the international input-output model, this model does not have a feedback mechanism from the international input-output model to macroeconometric models.

Among the six transferred variables, government final consumption and inventories are exogenous variables in the macroeconometric models. National accounts data is not consistent with the Asian international input-output table. Hence, we adjust the national accounts data to the international input-output table by using converter coefficients. Converter coefficients are the base year ratio of final demand components in the international input-output table to those of national accounts. We assume that the converter coefficients are fixed for the simulation periods. Next, we allocate final demand components to sectors and countries/regions.

We define sector allocation coefficients and country/region allocation coefficients. The sector allocation coefficients are the shares of industrial sectors to the total of each final demand component. As with technical coefficients, we do not distinguish between domestic and imported goods in the definition. We also define country/region allocation coefficients. The country/region allocation coefficients are defined as the shares of each country/region against the total of sectoral final demand components. These shares can vary by the relative price changes as shown in equation (10). The relative prices between countries/regions are endogenously determined in the international input-output model. Final demand components that are transferred to the international input-output model become consistent with the international input-output table by multiplying converter coefficients. The consistent final demands are allocated to each sector and each country/region by using sector allocation coefficients and country/region allocation coefficients, respectively. As for exports to the rest of the world, we assume that they grow at 10 per cent from the base year international input-output table.

As explained in this section, our model does not have any feedback mechanism from the international input-output model to macroeconometric models. Though the Asian international input-output table of 1985 has been published, we use only the table of 1990 for this analysis. Hence, trade transactions, wages, and price levels between macroeconometric models and the international input-output model are not necessarily consistent.[23]

IV. SIMULATION ANALYSES ON THE ASIAN CURRENCY CRISES

A. *Formulation and Estimation of a Currency Basket*

1. *Theoretical and computational framework*

A currency basket peg policy is one of the exchange rate policies, which pegs the home currency to a basket of foreign currencies. Though there are several methods to formulate a currency basket, we adopt the arithmetic average method because we apply regression analyses to estimate the weights of composite currencies.[24]

A currency basket in the arithmetic average manner can be written as:

$$e_t = \sum_i x_i e_{it}, \tag{21}$$

where e_t is the home currency, x_i is the unit of the ith currency, and e_{it} is the ith currency. Dividing equation (21) by the home currency, we obtain the following equation:

$$1 = \sum_i (x_i e_{it} / e_t). \tag{22}$$

[23] By using the Asian international input-output tables of 1985 and 1990, we can construct the model with consistencies of transferred variables. This is to be one of our future research topics.

[24] For other formulations and implementations of a currency basket, see Takagi (1988).

At the base level, the right-hand side of equation (22) for the ith currency should equal its weight, thus we can write the weight of the ith currency as:

$$\rho_i = x_i e_i^* / e^*, \tag{23}$$

where ρ_i is the share of the ith currency, e^* is the base level of the home currency, and e_i^* is the base level of the ith currency. Rearranging equation (23) yields the unit of the ith currency as follows:

$$x_i = \rho_i e^* / e_i^*. \tag{24}$$

Substituting equation (24) into equation (21), a currency basket in the arithmetic average method can be rewritten as:

$$e_t = \sum_i [(\rho_i e^* / e_i^*) e_{it}]. \tag{25}$$

In the explanation on the theory of a currency basket peg policy, we naturally assume that currency shares in a currency basket are given. Since governments do not announce them publicly, they must be estimated. Frankel and Wei (1994) and Kwan (1995) test the possibility of the yen block by estimating currency shares in the Asian exchange rates. They consider that when movements of currencies are parallel, the weights of explanatory currencies are heavy. Takagi (1996) also analyzes the relations between the Asian currencies and the Japanese yen. Without applying changes of currencies as in the analyses of Frankel and Wei (1994) and Kwan (1995), we can explain currency shares as shown below:

The summation of currency shares should be equal to 100 per cent (or 1), thus we can write this assumption as:

$$\sum_i \rho_i = 1. \tag{26}$$

Since the U.S. dollar is the world key currency, we can rewrite equation (25) as:

$$e_t = \rho_1 e^* + \sum_{i=2} [\rho_i (e^* / e_i^*) e_{it}], \quad \rho_1 = 1 - \sum_{i=2} \rho_i, \tag{27}$$

where ρ_1 is the share of the U.S. dollar. As shown in Section III, our model already has the Filatov-Klein model to explain the exchange rate. Under a currency basket peg or the de-facto U.S. dollar peg policy, the constant term of the Filatov-Klein model can be interpreted as the level pegged to the currency basket. Hence, we replace the constant term of the Filatov-Klein model with a currency basket determination equation. Substituting equation (27) into equation (1), we obtain an exchange rate function with a currency basket as:[25]

$$\begin{aligned} e_t = {} & (1 - \sum_{i=2} \rho_i) e^* + \sum_{i=2} [\rho_i (e^* / e_i^*) e_{it}] + \alpha_{51} \ln(P_t / P_{US,\,t}) + \alpha_{52}(r_t - r_{US,t}) \\ & + \alpha_{53}(BAL_t / P_t Z_t). \end{aligned} \tag{28}$$

For the estimation of the Asian exchange rates by equation (28), we select the U.S.

[25] To estimate currency shares by regression analysis, the independent variable, e_t, is not in log form.

TABLE V

Shares of Currencies for the ASEAN and China

(%)

	Indonesia		Malaysia			Philippines		Thailand		China	
	USD	JPY	USD	JPY	DM	USD	JPY	USD	JPY	USD	JPY
1978	NA	NA	NA	NA	NA	NA	NA	NA	NA	100.000	0.000
1979	NA	NA	NA	NA	NA	NA	NA	NA	NA	100.000	0.000
1980	NA	NA	NA	NA	NA	NA	NA	NA	NA	100.000	0.000
1981	NA	NA	NA	NA	NA	NA	NA	NA	NA	100.000	0.000
1982	NA	NA	NA	NA	NA	NA	NA	NA	NA	100.000	0.000
1983	NA	NA	NA	NA	NA	NA	NA	NA	NA	100.000	0.000
1984	NA	NA	NA	NA	NA	NA	NA	NA	NA	100.000	0.000
1985	NA	NA	NA	NA	NA	NA	NA	95.026	4.974	100.000	0.000
1986	NA	NA	NA	NA	NA	90.652	9.348	94.958	5.042	100.000	0.000
1987	93.037	6.963	NA	NA	NA	90.652	9.348	94.958	5.042	100.000	0.000
1988	93.037	6.963	NA	NA	NA	90.652	9.348	88.942	11.058	100.000	0.000
1989	91.770	8.230	NA	NA	NA	90.652	9.348	88.942	11.058	100.000	0.000
1990	91.770	8.230	74.912	9.373	15.715	94.292	5.708	88.942	11.058	100.000	0.000
1991	92.964	7.036	74.912	9.373	15.715	94.292	5.708	88.942	11.058	100.000	0.000
1992	92.964	7.036	76.294	9.306	14.400	90.652	9.348	88.942	11.058	100.000	0.000
1993	92.964	7.036	76.294	9.306	14.400	93.771	6.229	88.942	11.058	100.000	0.000
1994	92.964	7.036	76.294	9.306	14.400	90.652	9.348	88.942	11.058	95.281	4.719
1995	92.964	7.036	72.819	10.767	16.414	90.652	9.348	88.085	11.915	95.281	4.719
1996	92.964	7.036	72.819	10.767	16.414	90.652	9.348	88.085	11.915	95.281	4.719
1997	93.037	6.963	76.294	9.306	14.400	90.652	9.348	88.942	11.058	95.281	4.719

Note: USD = U.S. dollar, JPY = Japanese yen, DM = Deutsch mark, and NA = not available.

dollar, the Japanese yen, and the Deutsche mark as composite currencies of the Asian currency basket because the United States, Japan, and Germany are large trading partners to the Asian economies. As in estimation results of exchange rate functions, dummy variables are added to explanatory variables. We interpret them as changes of levels pegged to the U.S. dollar.

2. *Estimation results*

The estimation results of currency weights for the ASEAN and China, and the Asian NIEs are provided in Tables V and VI, respectively.[26]

Indonesian rupiah. In Indonesia, the currency basket peg policy had been adopted since 1978. Our analysis shows that the Indonesian government composed its currency basket with the U.S. dollar and the Japanese yen. The weight of the Japanese yen has been statistically significant since 1987, and was estimated at approximately 7 per cent in 1987 and 1988. It increased to roughly 8.2 per cent between 1989 and 1990, however, it has decreased to approximately 7 per cent since 1991.

Malaysian ringgit. The Malaysian government adopted the managed floating sys-

[26] Though we can treat the base level of exchange rates as exogenous, they are estimated in this analysis. As for details on computational procedures, see the Appendix C.

TABLE VI

SHARES OF CURRENCIES FOR THE ASIAN NIEs

(%)

	Korea		Singapore		Taiwan	
	USD	JPY	USD	JPY	USD	JPY
1978	NA	NA	NA	NA	NA	NA
1979	NA	NA	NA	NA	NA	NA
1980	88.153	11.847	NA	NA	NA	NA
1981	88.153	11.847	NA	NA	NA	NA
1982	88.153	11.847	NA	NA	80.776	19.224
1983	88.153	11.847	NA	NA	80.776	19.224
1984	88.153	11.847	NA	NA	80.776	19.224
1985	88.153	11.847	NA	NA	80.776	19.224
1986	88.153	11.847	88.119	11.881	80.776	19.224
1987	88.153	11.847	88.119	11.881	80.776	19.224
1988	88.153	11.847	88.119	11.881	80.776	19.224
1989	88.153	11.847	88.119	11.881	80.776	19.224
1990	88.153	11.847	88.119	11.881	80.776	19.224
1991	88.153	11.847	88.119	11.881	80.776	19.224
1992	88.153	11.847	88.119	11.881	80.776	19.224
1993	88.153	11.847	88.119	11.881	80.776	19.224
1994	88.153	11.847	86.938	13.062	80.776	19.224
1995	88.153	11.847	88.119	11.881	80.776	19.224
1996	88.153	11.847	88.119	11.881	80.776	19.224
1997	88.153	11.847	88.119	11.881	80.776	19.224

Note: USD = U.S. dollar, JPY = Japanese yen, and NA = not available.

tem and monitored the value of the Malaysian ringgit against the currency basket composed by major trading partners' currencies. The Malaysian ringgit has been pegged to the U.S. dollar since 1998. Our analysis shows that the U.S. dollar, the Deutsche mark, and the Japanese yen received the weights of approximately 75 per cent, 15.7 per cent, and 9.3 per cent, respectively.

The Philippine peso. The Philippine exchange rate system has been under the free floating policy. Our estimated weights of the U.S. dollar and the Japanese yen are roughly 90 per cent and 10 per cent, respectively.

Thai baht. The Thai baht had been pegged to a currency basket from 1978 to 1996. It was composed by the U.S. dollar and the Japanese yen (1985–) with the weights of approximately 95 and 5 per cent (1985–87) and 89 and 11 per cent (1988–97), respectively. The Thai baht seems to have been assigned higher weight to the Japanese yen since 1988.

Chinese yuan. The Chinese government had adopted the dual currency system until 1993. In 1994, it reformed the system and adopted the market rate as the official rate. It is said that the earlier official rate was overvalued. Hence, this reform was the de-facto devaluation of the Chinese yuan.

Based on our analysis, the Chinese government seems to have conducted its exchange rate policy with attention to the U.S. dollar and the Japanese yen. Until 1993, the coefficient for the Japanese yen was not statistically significant, thus the Chinese yuan seemed to be pegged to the U.S. dollar. Though the Japanese yen's share has been statistically significant since 1994, its share is estimated at roughly 5 per cent with the remaining 95 per cent assigned to the U.S. dollar.

Korean won. The Korean won had been pegged to the currency basket between 1980 and 1996. As a result of our estimation, we find that the U.S. dollar and the Japanese yen composed the Korean currency basket with weights of approximately 88 per cent and 12 per cent, respectively.

Singapore dollar. The managed floating system has been adopted as the exchange rate policy in Singapore. The Singaporean government checks the volatility of the Singapore dollar against a currency basket composed by major trading partner currencies like Malaysia. According to our analysis, the U.S. dollar and the Japanese yen (1986–) compose the Singaporean currency basket. The weights are estimated at roughly 88 per cent for the U.S. dollar and 12 per cent for the Japanese yen.

New Taiwan dollar. The Taiwanese government had adopted the managed floating system between 1982 and 1988 and has adopted the free floating one since 1989. The new Taiwan dollar shows the weights of the U.S. dollar at approximately 80 per cent and the Japanese yen at roughly 20 per cent. The 20 per cent weight of the Japanese yen is the highest among the Asian countries/regions.

As a result of this estimation, the weights of the Japanese yen in the ASEAN and China ranged between roughly 5 and 12 per cent. We found that the weight of the Japanese yen in Thailand was relatively high among the ASEAN economies and China. We also found that the weights ranging between 12 and 20 per cent were assigned to the Japanese yen in the Asian NIEs. The range of the weights assigned to the Japanese yen in the currency baskets of Asian economies was roughly between 5 and 20 per cent. Hence, we can conclude that the Asian currencies were nearly pegged to the U.S. dollar.

B. *Simulation Analyses*

Industrial structures of the Asian countries/regions differ from one another. Generally, the industrial structures of the Asian NIEs are similar to those of the United States and Japan who compete with Japan in the world market. The ASEAN and China would not compete with Japan in the world market due to the differences in industrial and trade structures.[27] Therefore, the effects of the yen-dollar rate's move-

[27] Kwan (1998) analyzes the similarities of trade structures of the ten countries/regions and Hong Kong by computing the matrix of bilateral correlation coefficients. He concludes that trade structures of Indonesia, Malaysia, the Philippines, Thailand, and China are complementary to that of Japan. Those of Hong Kong, Korea, Singapore, Taiwan, and the United States are competitive to that of Japan.

ments differ between the Asian NIEs, and the ASEAN and China. We analyze the Asian trade patterns with reference to the weak yen from 1995. We have prepared two scenarios for simulation analyses. Both scenarios are simulated from 1990 to 1997. We note that E+0*x* and E–0*x* in Tables VII–X mean 10^{x} and 10^{-x}, respectively.

1. *Simulation on exchange rate policies: The Asian NIEs case*

The weak yen from 1995 led to the lower pricing of Japanese products. Respectively, the competitors' (e.g., the Asian NIEs) export competitiveness was lowered, causing an expected decrease in their exports to other countries. Here, we analyzed the case of Korea. In order to maintain its competitiveness, Korea would have supposedly altered the weight of the yen. We have subtracted 10 per cent from the figures between 1995 and 1996 and added 10 per cent to the figure in 1997 to examine the changes in Korean and Japanese shares in other countries/regions' imports.[28]

Table VII shows selected sectors' import share changes from the baseline scenario. As an example, Malaysia is chosen as the other country/region. For intermediate demands, we find large changes in the leather and leather products, metal products, and other manufacturing products industries. According to our results, Korean shares would have an approximate increase ranging between 0.00002 and 0.002 points. In contrast, Japanese shares would show a decrease ranging between –0.0004 and –0.000004 points. Average share changes range from roughly 0.00000003 to 0.00002 points for Korea and from roughly –0.00001 to –0.00000007 points for Japan. In regards to final demands, there would be considerable changes in the metal products, specialized industrial machinery and shipbuilding sectors. Results show that Korean shares would increase between roughly 0.0000006 and 0.0003 points. In contrast, Japan's shares would show a rough decrease between –0.0006 and –0.0000003 points. Average share changes range from roughly 0.00000002 to 0.000001 points for Korea and from roughly –0.000001 to –0.00000002 points for Japan. By changing the weight of yen in the Korean currency basket, shares of Korea would increase and those of Japan would decrease. Yet, all changes are quite minimal in absolute values. These results indicate that

[28] In our currency basket framework, the base levels of currencies play important roles to determine currency weights in the currency basket of the home country/region. In the case of Korea, we analyzed that the Korean currency basket had been formed by the U.S. dollar and the Japanese yen. Should the Japanese yen be stronger than its base level in the Korean currency basket, then Korea would decrease the weight of the Japanese yen to weaken the Korean won. As shown in the Appendix C, the base level of the Japanese yen in the Korean currency basket is 116.65 yen per U.S. dollar. According to the International Monetary Fund (2000), the Japanese yen per U.S. dollar between 1995 and 1997 was 94.06 yen, 108.78 yen, and 120.99 yen, respectively. This indicates that the Japanese yen was stronger than its base level of the Korean currency basket in 1995 and 1996, and weaker in 1997. Therefore, we subtracted the weight of the Japanese yen in the Korean currency basket for 1995 and 1996, and added the weight for 1997.

TABLE VII

SELECTED SECTORS' IMPORT SHARE CHANGES FROM THE BASELINE: IMPORTS OF MALAYSIA FROM KOREA AND JAPAN

Sector No.	1995	1996	1997
A. Intermediate demands			
Korea			
33	2.037E–03	7.671E–04	3.092E–05
52	1.351E–03	1.053E–03	2.160E–05
67	1.375E–03	5.419E–05	2.347E–05
Average	2.215E–05	2.150E–05	3.302E–08
Japan			
33	–1.600E–04	–6.099E–05	–3.941E–06
52	–3.366E–04	–3.785E–04	–4.790E–06
67	–2.324E–04	–4.153E–04	–3.631E–06
Average	–5.445E–06	–1.145E–05	–7.223E–08
B. Final demands			
Korea			
52	7.138E–05	5.566E–05	1.141E–06
54	3.544E–05	4.670E–06	5.829E–07
63	3.328E–04	1.830E–04	5.185E–06
Average	1.470E–06	1.343E–06	2.194E–08
Japan			
52	–1.778E–05	–1.985E–05	–2.536E–07
54	–2.458E–05	–9.480E–06	–4.631E–07
63	–5.839E–04	–2.599E–04	–8.850E–06
Average	–1.177E–06	–9.816E–07	–1.639E–08

Note: Sector numbers 33, 52, 54, 63, and 67 denote leather and leather products, metal products, specialized industrial machinery, shipbuilding, and other manufacturing products, respectively. As for final demands, inventories are not included. Figures between 1990 and 1994 are 0.

changing the yen's weight under the movement of the weak yen would prevent the Asian countries/regions from losing their competitiveness, however small the effects may be.

We also provide the selected sectors' output changes from the baseline scenario. Based on the results in Table VIII, there are great decreases (approximately between U.S.$ –1,365 million and U.S.$ –0.2 million) in the Korean paddy, other milled grain and flour, and sugar sectors. As for Japan, negative output changes range from roughly U.S.$ –48 million to U.S.$ –0.1 million in the agricultural machinery and equipment, heavy electric machinery, and engines and turbines sectors. Percentage changes of the highest three sectors in Korea and Japan vary between –6.41 and –0.06 per cent, and between –0.08 and –0.0005 per cent, respectively. By modifying equations (8) and (10), we decomposed the changes in outputs between simulation scenarios and the baseline into six parts: changes in home countries/regions' export prices, those in competitors' export prices, those in home coun-

TABLE VIII

SELECTED SECTORS' OUTPUT CHANGES FROM THE BASELINE: CASES OF KOREA AND JAPAN

Sector No.	Deviation from the Baseline (U.S.$ 1,000)			% Deviation from the Baseline		
	1995	1996	1997	1995	1996	1997
Korea						
1	−3.801E+05	−1.365E+06	−4.068E+03	−2.424E+00	−6.409E+00	−2.379E−01
21	−3.135E+04	−1.081E+05	−3.456E+02	−2.250E+00	−5.881E+00	−1.167E−01
22	−1.991E+04	−7.352E+04	−2.109E+02	−1.886E+00	−5.332E+00	−6.225E−02
Japan						
53	−3.507E+03	−7.597E+03	−4.871E+01	−3.749E−02	−8.193E−02	−6.063E−04
56	−3.016E+04	−4.864E+04	−4.476E+02	−4.085E−02	−6.582E−02	−6.739E−04
57	−6.947E+03	−1.179E+04	−1.011E+02	−3.460E−02	−5.689E−02	−5.425E−04

Note: Sector numbers 1, 21, 22, 53, 56, and 57 denote paddy, other milled grain and flour, sugar, agricultural machinery and equipment, heavy electric machinery, and engines and turbines, respectively. Figures between 1990 and 1994 are 0.

tries/regions' prices, those of competitors' prices, those in exchange rates, and those in final demands in home currencies. For both Korea and Japan, exchange rate differences showed roughly 95 per cent of output changes in 1995. As for 1996 and 1997, not only differences in exchange rates but also those in final demands in home currencies showed changes in outputs. Although we did not alter the exchange rate function of Japan, its output changes are accounted for by exchange rate and final demands (in home currencies) differences. This is due to changes in Korean demands for Japanese products derived by weight alterations in the Korean currency basket.

2. *Simulation on exchange rate policies: The ASEAN and China case*

Regarding the ASEAN and China, the weak yen would be one of the factors to improve their current accounts. As Kwan (1998) shows, their industrial structures are complementary to that of Japan. This implies that they would not compete with Japan in the foreign market whereas they would import many goods from Japan. Prices of Japanese products in the U.S. dollar would decrease by the weak yen, therefore, we could expect a decrease in imports of the ASEAN and China from Japan. This contrast indicates that the strong yen would increase imports of the ASEAN and China from Japan. We have created a strong yen movement from 1995 by subtracting 0.02 for 1995, 0.15 for 1996, and 0.3 for 1997 from the constant term of the Japanese exchange rate function. In this scenario, the yen would appreciate roughly 4 per cent in 1995, 24 per cent in 1996, and 36 per cent in 1997 from the baseline. Next, we selected Thailand as an example to evaluate the differences in Thai imports from Japan. This simulation result is shown in Table IX. There are

TABLE IX

SELECTED SECTORS' IMPORT CHANGES FROM THE BASELINE: IMPORTS OF THAILAND FROM JAPAN

Sector No.	Deviation from the Baseline (U.S.$ 1,000)			% Deviation from the Baseline		
	1995	1996	1997	1995	1996	1997
23	1.102E+03	8.137E+03	1.284E+04	1.290E+00	9.450E+00	1.443E+01
35	5.892E+01	4.519E+02	6.651E+02	4.338E–01	3.147E+00	4.962E+00
51	7.012E+02	5.298E+03	7.569E+03	3.824E–01	2.796E+00	4.799E+00
Total	2.436E+04	1.853E+05	2.356E+05	1.766E–01	1.294E+00	2.224E+00

Note: Sector numbers 23, 35, and 51 denote fish products, wooden furniture, and nonferrous metal, respectively. Figures between 1990 and 1994 are 0.

great changes in the fish products, wooden furniture and nonferrous metal sectors. Thai imports from Japan would increase between roughly U.S.$59,000 and U.S.$1 million. Percentage changes in Table IX range from 0.38 to 14.43 per cent for the three sectors. In total, differences and percentage changes range from roughly U.S.$24 million to U.S.$235 million and from approximately 0.18 to 2.22 per cent, respectively. These results suggest that though the weak Japanese yen would decrease Thai imports from Japan, the effects would be limited compared to changes of the Japanese yen.

Table X shows the selected sectors' output changes in Thailand and Japan. The Thai output increase ranges from roughly U.S.$0.5 million to U.S.$624 million in the natural rubber, tin ore and fish products sectors. That of Japan is from approximately U.S.$1,463 million to U.S.$25,110 million in the paddy, milled rice, and cement and cement products sectors. Percentage changes of Thailand and Japan range from roughly 0.5 to 29 per cent and from approximately 3.8 to 56 per cent, respectively. According to our decomposition analysis, differences in exchange rates showed over 90 per cent of output changes in Thailand and Japan.[29]

V. CONCLUSIONS

In this study, we constructed an international input-output model (seventy-eight sectors multiplied by ten economies) linked with macroeconometric models of Indonesia, Malaysia, the Philippines, Thailand, China, Korea, Singapore, Taiwan, Japan, and the United States. Using this system, we estimated currency shares in the Asian currency baskets formed by the arithmetic average method, and tested the effects of the Asian currency basket policies on trade patterns. These findings can be summarized as follows:

[29] In our model, the exchange rate of Japan is one of the explanatory variables in the exchange rate function of Thailand. Therefore, the fluctuation of the Japanese yen affects that of the Thai baht.

TABLE X

SELECTED SECTORS' OUTPUT CHANGES FROM THE BASELINE: CASES OF THAILAND AND JAPAN

Sector No.	Deviation from the Baseline (U.S.$ 1,000)			% Deviation from the Baseline		
	1995	1996	1997	1995	1996	1997
Thailand						
3	1.862E+04	1.378E+05	2.240E+05	9.865E–01	8.232E+00	1.367E+01
15	5.010E+02	3.698E+03	4.417E+03	4.645E–01	3.845E+00	2.850E+01
23	5.299E+04	3.923E+05	6.245E+05	1.453E+00	1.072E+01	1.625E+01
Japan						
1	1.463E+06	1.079E+07	1.710E+07	3.752E+00	3.083E+01	5.589E+01
20	1.656E+06	1.222E+07	1.937E+07	3.763E+00	3.094E+01	5.613E+01
47	2.042E+06	1.655E+07	2.511E+07	3.769E+00	3.132E+01	5.528E+01

Note: Sector numbers 1, 3, 15, 20, 23, and 47 denote paddy, natural rubber, tin ore, milled rice, fish products, and cement and cement products, respectively. Figures between 1990 and 1994 are 0.

1. The weight of the Japanese yen was low in the Asian currency baskets. It ranged roughly between 5 and 20 per cent. Thus, the Asian exchange rate policies were the de-facto dollar peg policy.
2. In accordance with the movement of the Japanese yen, the appropriate change in the weight of the yen would help the Asian countries/regions whose industrial structures are similar to that of Japan's (e.g., the Asian NIEs) to maintain their competitiveness.
3. As for a country/region whose industrial structure is complementary to Japan (e.g., ASEAN and China), the weak yen would decrease their imports.

Our model could analyze Asian exchange rate policies and their effects on sectoral trade patterns, however, improvements are necessary in some aspects. First, a balance of payments block and a contagion mechanism should be added to macroeconometric models to precisely analyze the Asian exchange rates. Second, feedback mechanisms must be modeled from the international input-output model to macroeconometric models. Next, there should be a consistency in wages, trade, and prices between macroeconometric models and the international input-output model. Following, in order to analyze the possibility of future currency crises, comparative analyses on structural changes before and after the Asian currency crises will be needed. Finally, currency crises influences on firm level balances should be modeled, which could not be analyzed due to data unavailability.

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APPENDIX A

THE SKELETON MODEL

A.1. *List of Variables*

Endogenous variables

- C_t : Real private final consumption.
- D_t : Real depreciation.
- EX_t : Real exports.
- I_t : Real gross fixed capital formation.
- IM_t : Real imports.
- K_t : Real capital stock.
- L_t : Employment.
- LF_t : Labor force.
- P_t : General price level.
- r_t : Nominal interest rate.
- T_{1t} : Nominal indirect taxes.
- T_{2t} : Nominal personal taxes.
- T_{3t} : Nominal corporate taxes.
- T_{rt} : Nominal transfer payments.
- Y_t : Nominal disposable income.
- w_t : Wage rate.
- Z_t : Real GNP.[a]
- π_t : Nominal corporate profits.

Exogenous variables

- G_t : Real government spending.
- MS_t : Nominal money supply.
- N_t : Population.
- PM_t : Import prices.
- PW_t : World trade prices.
- WT_t : Real volume of the world trade.

A.2. *Identities*

Real GNP

$$C_t + I_t + G_t + EX_t - IM_t = Z_t. \tag{A1}$$

Nominal GNP

$$P_tZ_t - T_{1t} - P_tD_t = Y_t + T_{2t} + T_{3t} - T_{rt}. \tag{A2}$$

[a] Though the original skeleton model uses the real GNP, we use the real GDP in this paper.

National income

$$w_t L_t + \pi_t = Y_t + T_{2t} + T_{3t} - T_{rt}. \tag{A3}$$

Capital stock

$$K_t = K_{t-1} + I_t - D_t. \tag{A4}$$

A.3. *Behavioral and Technological Equations*

Consumption

$$C_t = a_{00} + a_{01}(Y_t / P_t) + a_{02} C_{t-1}. \tag{A5}$$

Investment

$$I_t = a_{10} + a_{11} Z_t + a_{12} r_t + a_{13} K_{t-1}. \tag{A6}$$

Exports

$$EX_t = a_{20} + a_{21} WT_t + a_{22}(PW_t / P_t) + a_{23} EX_{t-1}. \tag{A7}$$

Imports

$$IM_t = a_{30} + a_{31} Z_t + a_{32}(P_t / PM_t) + a_{33} IM_{t-1}. \tag{A8}$$

Employment

$$\ln L_t = a_{40} + a_{41} \ln Z_t + a_{42} \ln K_{t-1} + a_{43} \ln L_{t-1}. \tag{A9}$$

General price level

$$P_t = a_{50} + a_{51}(w_t L_t / Z_t) + a_{52} PM_t. \tag{A10}$$

Wage rate

$$\Delta \ln w_t = a_{60} + a_{61}[LF_t / (LF_t - L_t)] + a_{62} \Delta \ln P_t. \tag{A11}$$

Labor force

$$LF_t / N_t = a_{70} + a_{71}[(LF_t - L_t) / LF_t] + a_{72}(w_t / P_t). \tag{A12}$$

Velocity of circulation of money

$$\ln(P_t Z_t / MS_t) = a_{80} + a_{81} r_t + a_{82} \Delta \ln P_t. \tag{A13}$$

Depreciation

$$D_t = a_{90} K_{t-1}. \tag{A14}$$

A.4. *Institutional Equations*

Indirect taxes

$$T_{1t} = a_{100} + a_{101}(P_t Z_t). \tag{A15}$$

Personal taxes

$$T_{2t} = a_{110} + a_{111} Y_t. \tag{A16}$$

Corporate taxes

$$T_{3t} = a_{120} + a_{121} \pi_t. \tag{A17}$$

Transfer payments

$$T_{rt} = a_{130} + a_{131}(LF_t - L_t) + a_{132} w_t. \tag{A18}$$

APPENDIX B

THE UNCTAD MODEL

B.1. *List of Variables*[b]

Endogenous variables

- C_t : Real private consumption.
- $D_{f,t}$: Nominal external indebtedness.
- EX_t : Real exports.
- I_t : Real investment.
- IM_t : Real imports.
- J_t : Inventories.
- K_t : Real capital stock.
- PE_t : Export prices.
- $PE_{d,t}$: Export prices in the home currency.
- P_t : General price level in the home currency.
- $P_{a,t}$: Agricultural prices in the home currency.
- $P_{na,t}$: Nonagricultural prices in the home currency.
- R_t : International reserves.
- $Z_{a,t}$: Agricultural production.
- $Z_{d,t}$: Real GDP.
- $Z_{f,t}$: Real net factor payments abroad.
- $Z^*_{f,t}$: Nominal net factor payments abroad.
- $Z_{n,t}$: Real GNP.
- $Z_{na,t}$: Nonagricultural production.
- $Z^P_{na,t}$: Nonagricultural production potential.

Exogenous variables

- E_t : Exchange rate (the U.S. dollar per home currency).
- F_t : Net capital inflow.
- MS_t : Money supply.
- N_t : Population.
- PM_t : Import prices.
- PW_t : World export price index.
- t : Time.
- TW_t : World export volume index.

[b] All variables are in U.S. dollars except for those noted.

B.2. *Identities*

Real GDP

$$Z_{d,t} = Z_{a,t} + Z_{na,t}. \tag{A19}$$

Real GNP

$$Z_{n,t} = Z_{d,t} - Z_{f,t}. \tag{A20}$$

Inventories

$$J_t = Z_{d,t} + IM_t - C_t - I_t - EX_t. \tag{A21}$$

Capital stock

$$K_t = \sum I_{t-i}. \tag{A22}$$

Nominal external indebtedness

$$D_{f,t} = \sum[(PM_t IM_t) - (PE_t EX_t) + Z^{*}_{f,t}]. \tag{A23}$$

International reserves

$$R_t = R_{t-1} + F_t + (PE_t EX_t) - (PM_t IM_t) - Z^{*}_{f,t}. \tag{A24}$$

Export prices

$$PE_t = PE_{d,t} E_t. \tag{A25}$$

Real net factor payments abroad

$$Z_{f,t} = (Z^{*}_{f,t} / PM_t). \tag{A26}$$

B.3. *Behavioral Equations*

Agricultural production

$$Z_{a,t} = a_{140} + a_{141} t. \tag{A27}$$

Consumption

$$C_t / N_t = a_{150} + a_{151}(Z_{n,t} / N_t) + a_{152}(C_{t-1} / N_{t-1}). \tag{A28}$$

Investment

$$I_t = a_{160} + a_{161} Z_{d,t} + a_{162} Z_{d,t-1}. \tag{A29}$$

Exports

$$EX_t = a_{170} + a_{171} TW_t + a_{172}(PE_t / PW_t). \tag{A30}$$

Imports

$$IM_t = a_{180} + a_{181} Z_{d,t} + a_{182}(R_{t-1} / PM_{t-1}) + a_{183}(PM_t / P_t E_t). \tag{A31}$$

Nonagricultural production potential

$$Z^{P}_{na,t} = a_{190} + a_{191} K_{t-1}. \tag{A32}$$

Nonagricultural production—Type I

$$Z_{na,t} / Z^{P}_{na,t} = a_{200} + a_{201} IM_t + a_{202} Z_{a,t}. \tag{A33}$$

Nonagricultural production—Type II

$$Z_{na,t} = a_{200} + a_{201} C_t + a_{202} I_t + a_{203} EX_t. \tag*{(A33)$'$}$$

Agricultural prices

$$P_{a,t} = a_{210} + a_{211}Z_{a,t} + a_{212}Z_{a,t-1} + a_{213}Z_{na,t}. \tag{A34}$$

Nonagricultural prices—Type I

$$P_{na,t} = a_{220} + a_{221}(Z_{na,t} / Z^{P}_{na,t}) + a_{222}(MS_t / Z_{d,t}) + a_{223}P_{a,t} + a_{224}PM_t. \tag{A35}$$

Nonagricultural prices—Type II

$$P_{na,t} = a_{220} + a_{221}Z_{na,t} + a_{222}Z_{na,t-1} + a_{223}(MS_t / Z_{d,t}). \tag{A35$'$}$$

General price level

$$P_t = a_{230} + a_{231}P_{a,t} + a_{232}P_{na,t}. \tag{A36}$$

Export prices in the home currency

$$PE_{d,t} = a_{240} + a_{241}P_t + a_{242}EX_t + a_{243}PE_{d,t-1}. \tag{A37}$$

Nominal net factor payments abroad

$$Z^{*}_{f,t} = a_{250} + a_{251}D_{f,t-1} + a_{252}(PE_tEX_t). \tag{A38}$$

APPENDIX C

THE COMPUTATION OF CURRENCY SHARES: THE CASE OF KOREA

In a currency basket system, shares of currencies, and the base level of exchange rates are unknown parameters. We estimate both instead of using them exogenously. We explain the estimation method using Korea as an example. Since 1980, the Korean government had conducted its exchange rate policy under the basket peg system, up to 1996. Due to the Asian currency crises, Korea withdrew the basket peg policy adopting the free floating system. The estimation results of Table VI show that the Korean won was pegged to a currency basket composed of the U.S. dollar and the Japanese yen. In this case, the first and second terms of the right-hand side should be the value of the Korean currency basket. We can write them as follows:

$$(1 - \rho_{jpn})e^{*}_{kor} = \text{the coefficient of the intercept} = 792.308, \tag{A39}$$

$$\rho_{jpn}(e^{*}_{kor} / e^{*}_{jpn}) = \text{the coefficient of the Japanese yen} = 0.913, \tag{A40}$$

where ρ_{jpn} is the weight assigned to the Japanese yen in the currency basket of Korea, and e^{*}_{kor} and e^{*}_{jpn} are the base levels of the Korean won and the Japanese yen per U.S. dollar, respectively. Substituting equation (A39) into equation (A40) yields:

$$e^{*}_{kor} - 0.913 \cdot e^{*}_{jpn} = 792.308. \tag{A41}$$

We compute equation (A41) with data on exchange rates of both the won and yen. The results are provided in Appendix Table I. The coefficient of the intercept, which is 792.308, lies in 1996 and 1997. Using data from 1996 and 1997, we calculate weights to obtain the intercept as the weighted average. They are 0.3576 and 0.6424,

APPENDIX TABLE I

COMPUTED VALUE OF EQUATION (A41)

	$e_{kor} - 0.913 \cdot e_{jpn}$		$e_{kor} - 0.913 \cdot e_{jpn}$
1980	400.417	1989	545.457
1981	479.677	1990	575.460
1982	503.671	1991	610.476
1983	558.904	1992	664.996
1984	589.125	1993	701.115
1985	652.179	1994	710.135
1986	727.642	1995	685.393
1987	690.514	1996	705.136
1988	614.472	1997	840.824

Note: e_{kor} = exchange rate of Korea and e_{jpn} = exchange rate of Japan.

respectively. We then compute the base level of exchange rates for the Korean won and Japanese yen with these weights. The computed values are 898.787 Korean won and 116.65 Japanese yen. By substituting computed results into equation (A39) or (A40), we obtain the share of the Japanese yen in the Korean currency basket at roughly 11.8 per cent.