Capital Inflows and Monetary Policy in Asia before the Financial Crisis

Sung Yeung Kwack

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Price USD 5

Capital Inflows and

Monetary Policy in Asia

before the Financial Crisis

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1999. 8

Executive Summary

Asia has received sizable capital inflows before the Asian crisis in 1997. Capital inflows are contributed in part by internal factors such as high economic growth, liberalizing the financial system and opening the capital market, and in part by external factors such as low rates of interest in industrial countries, especially the United States. Capital inflows supplied finance needed for a high rate of investment, imports and economic growth. At the same time, capital inflows distorted relative good prices, fed bubbles into real asset markets and inflationary pressure into the economy.

Substantial capital inflows can give rise to microeconomic and macroeconomic policy issues. Especially, capital inflow surges increase the difficulty in managing monetary policy of an open economy under a fixed exchange rate system and with unrestricted trade flows and capital flows. The higher the degree of capital mobility, the more difficult the maintenance of a fixed exchange rate and the control of the money stock.

The main purpose of this study is to empirically explore how the monetary authority in Asia did cope with the surge of capital inflows in the period 1985–1996. It statistically examines the extent to which the massive capital inflows influenced the conduct of monetary policy and the effects of the policy of sterilization and intervention in the foreign exchange market. It provides empirical evidence for what a group of seven selected countries across Asia have done. The seven countries in the group are Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, and Taiwan (R.O.C.). The regression is estimated

using a panel of 84 observations for the seven countries during 1985–1996.

A capital inflow generates monetary expansion and pressure for exchange rate adjustment. It poses an important policy question as to how to deal with capital inflows. It is uncertain whether capital inflows last long or not. Asian countries regarded capital inflows as a transitional phenomenon. As a result, Asian countries decided it was desirable to minimize the impact of capital inflows on the economy.

Asian countries heavily utilized the policy categories of measures to minimize the impact of capital inflows on the money supply and exchange rate. The monetary authority conducted contraction of the domestic source in the monetary base of the central bank, primarily directed to offset the effect on the money supply of an increase in the net foreign assets of the central bank resulting from capital inflows. At the same time, the monetary authority intervened in the foreign exchange market, primarily designed to absorb pressures on exchange rates that are accompanied by capital inflows and to prevent nominal exchange rate appreciation.

The statistical results indicate that the degree of sterilization of the monetary authority is very high and that the sterilization is undertaken to control the money supply rather than to control the monetary base. Furthermore, the effect of the intervention in the foreign exchange market is estimated to be small. The main statistical finding implies that the monetary authority took the policy of a high degree of sterilization with small effect of intervention on exchange rate. The policy leads for a capital inflow to yield negligible effects on the exchange rate and small positive effects on the money supply and the price level. Consequently, the monetary authority succeeded in keeping exchange rates at desired levels and in limiting increases in monetary growth, despite a surge of capital inflows.

The majority of industrial countries allow their exchange rates to float and unrestricted capital flows. Under the world conditions, the monetary authority in Asian countries could have accepted the view that capital flows are of a permanent nature and that sterilized intervention policies are effective over a short period. If the monetary authority accepted the view, it would have floated the exchange rate. The study concludes that Asian countries could have avoided the financial crisis.

Dr. Sung Yeung Kwack earned Ph.D. in Economics from the University of California at Berkeley (1968). He was research associate at the Brookings Institution (1968–1971) and worked at OASIA, U.S. Department of Treasury as Deputy Director (1971–1973). He was at the Board of Governors of the Federal Reserve System (1973–1978) and Center for Pacific Basin Studies, Wharton EFA as Director and Senior Economist (1978–1981). He has been Professor of Economics in Howard University (1981–present). Contact: Howard University, Washington, DC 20059; (Tel) 301–299–7678; (Fax) 301–299–0650; (E–Mail) skwack@fac.howard.edu.

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Capital Inflows and Monetary Policy in Asia before the Financial Crisis

Sung Y. Kwack*

I. Introduction

The financial crisis in Asia occurred in 1997. Before the crisis began, Asia's economic performance—high growth, low inflation and high saving—was envied. Books such as *Asian Miracle*, published by the World Bank in 1993, dramatically illustrated how Asia came to achieve such phenomenal growth.

The year of 1997 marked a turning point that has determined the future development of Asian economies. East Asian countries entered the financial crisis in 1997. The Thailand baht was devalued on July 2, 1997, followed by the Philippine peso, the Malaysian ringgit, and the Indonesian ruphia. The Korean won was floated on December 16, 1997. The value of the currencies of Indonesia, Korea, Malaysia, Philippines, and Thailand fell 52–101 percent against the U.S. dollar between the end of 1996 and the end of 1997. The Singapore dollar and the Taiwan NT$ depreciated by 20 and 18 percent, respectively.

Many studies in recent years have suggested that the main factors causing a financial crisis in Asia are appreciation in real exchange

rates, large current account deficits, large short term external debts, high leverages of corporations and weaknesses in the balance sheet of financial institutions.[1]

The financial crisis that has been in progress in Asia follows massive capital inflows into Asia particulary in the early 1990s, just as the crisis in Mexico and other countries in Latin America occurred after the surge of capital inflows in Latin America countries. Hence, it is helpful in understanding the Asian crisis if we know how Asian countries dealt with the surge of capital inflows in the period from late 1980s to the middle of 1990.

Asia has received sizable capital inflows before the Asian crisis in 1997. Capital inflows are contributed in part by internal factors such as high economic growth, liberalizing the financial system and opening the capital market, and in part by external factors such as low rates of interest in industrial countries, especially the United States.[2]

Capital inflows supplied finance needed for a high rate of investment, imports and economic growth. At the same time, capital inflows distorted relative good prices, fed bubbles into real asset markets and inflationary pressure into the economy.

Substantial capital inflows can give rise to microeconomic and

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1) Among many articles and books covering the Asian crisis, see Chang and Velasco (1998), Corsetti et al. (1998), International Monetary Fund (1998), Krugman (1998), Kwack (1998a, 1998b), Letiche (1998), Moreno et al. (1998), and Radelet and Sachs (1998).

2) For interesting discussion, see Frankel (1994). For empirical studies on the causes of a surge of capital inflows in Latin America, see Calvo, Leiderman and Reinhart (1993) and for general discussions and country information of capital inflows in Asia see Hong Kong Monetary Authority (1994), and Khan and Reinhart (1995).

macroeconomic policy issues. Especially, capital inflow surges increase the difficulty in managing monetary policy of an open economy. In an open economy under a fixed exchange rate system and with unrestricted trade flows and capital flows, tight monetary policy raises domestic interest rates which generates capital inflows by raising foreign demand for domestic assets or by decreasing the demand for foreign liabilities by residents. Induced additional capital inflows increase the money supply and thus make the implementation of tight monetary policy difficult. The higher the degree of capital mobility, the more difficult the maintenance of a fixed exchange rate and the control of the money stock.[3]

As compared with many studies being undertaken to cover issues raised in connection with the surge of capital inflows into Latin America, a small number of studies were reported on the causes of a surge of capital inflows into Asia and policy responses to the surge.[4] These studies are of a qualitative and descriptive nature. They do not quantitatively examine the causes of capital inflows and the consequence of policy implemented in response to the surge of capital inflows. Hence, their discussions on the causes of capital inflows and the consequence of policy are subject to empirical tests and verifications.

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3) This is a moderate statement of the proposition shown by the monetary approach of the balance of payments: central bank in a small open economy under a fixed exchange system has no ability to manage the nominal money supply. See text books on open economy macroeconomics, Mundell (1963), and Glick and Moreno (1994)

4) Examples of studies are Bercuson and Koening (1993), International Monetary Fund (1995), Koening (1996), Khan and Reinhart (1995), Reisen (1993), and Schadler and Kohn (1993).

The main purpose of this paper is to empirically explore how the monetary authority in Asia did cope with the surge of capital inflows in the period 1985–1996. It statistically examines the extent to which the massive capital inflows influenced the conduct of monetary policy and the effects of the policy of sterilization and intervention in the foreign exchange market.

Statistical examinations would shed some light on the issues of whether monetary policy has been effective.

The paper does not undertake the detailed analysis of individual country action, but it provides empirical evidence for what a group of seven selected countries across Asia have done.

The seven countries in the group are Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, and Taiwan (R.O.C). The regression is estimated using a panel of 84 observations for the seven countries during 1985–1996.

The rest of the paper is organized as follows. Section II describes capital flows to developing countries. Section III highlights monetary policy implemented by the monetary authority in response to a surge of capital inflows and discusses the effects of monetary policy.

Section IV uses a model of the monetary sector of an open economy to analytically discuss the effects of monetary policy instruments in coping with capital inflows. Section V runs regression equations, which provide estimates of parameters in the model. By making use of the estimated parameter values, we calculate the extent to which the monetary policy of sterilization and intervention in the foreign exchange market had an effect on the economy. Section VI concludes with a summary of the empirical findings and remarks on the implications of monetary policy for coping with capital inflows.

Ⅱ. Capital Inflows to Developing Countries

In the early 1990s, net capital inflows to developing countries as a group increased very rapidly.

Net capital inflows on an average annual basis expanded from $ 9 billion during period 1983–89 to $105 billion during the period 1990–94 (see Table 1). There were significant changes in the composition of net capital flows. The sharp expansion in portfolio capital flows occurred, a rise from an annual average of $7 billion during the period 1983–89 to $44 billion during the period 1990–94.

Net capital inflows to Asia significantly increased from an annual average of $17 billion in the period 1983–89 to $52.2 billion in the period 1990–94. Both net direct investment and portfolio investment rose. About 60 percent of net direct investment to developing countries

⟨Table 1⟩ Capital Flows to Developing Countries

(In Billions of U.S. Dollars)

	1983–89 Ave.	1990	1991	1992	1993	1994
DEVELOPING COUNTRIES						
Total Net Capital Inflows	8.8	39.8	92.9	111.6	154.7	125.2
Financial Capital	19.8	25.7	51.3	77.2	141.1	118
Net Foreign Direct Investment	13.3	19.5	28.8	38	52.8	56.3
Net Portfolio Investment	6.5	6.2	22.5	39.1	88.3	61.7
Other	-11	14.2	41.7	34.5	13.6	7.2
ASIA						
Total Net Capital Inflows	16.7	25.6	50.7	39.2	72	73.4
Financial Capital	6.6	9.4	18	27.3	59.5	65
Net Foreign Direct Investment	5.2	9.8	14.9	19.9	35.6	36.9
Net Portfolio Investment	1.4	-0.4	3.1	7.4	23.9	28.1
Other	10.1	16.2	32.7	11.9	12.5	8.4

Source: International Monetary Fund, *International Capital Markets–Developments, Prospects, and Policy Issues*, August 1995, p. 3.

went to Asia during the period 1990–94, a rise from about 40 percent during the period 1983–89. Asia received about 30 percent of portfolio investment to developing countries during the period 1990–94, a rise form about 21 percent during the period 1983–89. A surge in capital flows to Asia in the early 1990s reflects the outstanding economic performance and policy measures taken to speed up the process of financial liberalization and market opening to the rest of the world.

Table 2 is a summary of the balance of payments of seven individual East Asian countries. Singapore and Taiwan kept their current account at a surplus during the period 1985–89 period and in each year during the period 1990–96. The other five Asian countries experienced deficits in their current account. Thailand's current account deficit as a percent of GDP is the highest, above five percent during the period 1990–96. The current account deficit in Korea is somewhat lower as compared to the deficits in Indonesia, Malaysia, Philippines, and Thailand for the same period. The deficits in the current account for Thailand and other deficit countries are substantial during the period 1995–96, above 3 percent of GDP.

The ASEAN countries have been the recipients of financial capital since the early 1990s.

In recent years, Taiwan exported capital abroad, and Singapore received capital in the form of direct investment. Net financial capital inflows to the other five Asian countries are very substantial during the period 1990–96, as compared with those during the period 1985–89. Net direct investments to ASEAN countries was large and rose in recent years to about 5 percent of GDP. This increase resulted from their market opening and low labor costs. Korea made a substantial amount of direct investment abroad, partly reflecting the location of plants of Korea's firms in the areas of low wage costs. Net portfolio

〈Table 2〉 Balance of Payments

(in Percent of GDP)

	1985–89	1990	1991	1992	1993	1994	1995	1996
INDONESIA								
Current Account	−2.54	−2.82	−3.65	−2.17	−1.33	−1.58	−3.47	−3.37
Financial Account	3.51	4.23	4.89	4.79	3.56	2.17	5.14	4.77
Direct Investment	0.52	1.03	1.27	1.39	1.04	0.85	1.85	2.46
Portfolio Investment	3.00	3.21	3.61	3.40	2.52	1.32	3.29	2.31
Error & Omissions	−0.87	0.70	0.08	−1.00	−1.86	−0.15	−0.89	0.58
Balance of Payments	0.11	2.12	1.31	1.62	0.38	0.44	0.78	1.98
KOREA								
Current Account	4.28	−0.69	−2.82	−1.28	0.31	−1.01	−1.81	−4.76
Financial Account	−2.35	1.13	2.28	2.26	0.96	2.79	3.77	4.96
Direct Investment	−0.11	−0.11	−0.11	−0.16	−0.23	−0.45	−0.38	−0.43
Portfolio Investment	−2.24	1.24	2.39	2.42	1.19	3.24	4.16	5.39
Error & Omissions	−0.12	−0.79	0.26	0.36	−0.22	−0.45	−0.32	0.22
Balance of Payments	1.67	−0.48	−0.39	1.21	0.90	1.21	1.54	0.29
MALAYSIA								
Current Account	2.41	−2.03	−8.89	−3.72	−4.66	−6.23	−8.43	−5.20
Financial Account	0.63	4.16	11.95	15.00	16.83	1.78	8.50	9.29
Direct Investment	2.36	5.45	8.50	8.89	7.80	5.99	4.73	3.23
Portfolio Investment	−1.73	−1.28	3.45	6.11	9.03	−4.21	3.77	6.06
Error & Omissions	−0.03	2.53	−0.32	0.14	5.65	0.21	−1.97	−1.59
Balance of Payments	2.90	4.56	2.63	11.35	17.68	−4.36	−2.02	2.50
PHILIPINES								
Current Account	−0.54	−6.08	−2.28	−1.89	−5.55	−4.60	−2.67	−4.30
Financial Account	1.44	4.64	6.44	6.06	6.01	7.99	7.16	8.35
Direct Investment	1.04	1.20	1.20	0.43	1.59	2.01	1.46	2.15
Portfolio Investment	0.40	3.45	5.25	5.63	4.42	5.98	5.71	6.20
Error & Omissions	0.87	1.34	−0.30	−0.98	0.16	0.24	−2.82	0.00
Balance of Payments	1.77	−0.10	3.86	3.19	0.62	3.63	1.67	4.06
SINGAPORE								
Current Account	3.59	8.33	11.29	11.38	7.57	17.21	16.97	15.18
Financial Account	2.34	10.54	5.38	3.61	−1.86	−16.09	−2.86	0.55
Direct Investment	9.23	9.46	10.01	1.79	4.57	6.51	4.94	4.93
Portfolio Investment	−6.44	1.09	−4.63	1.82	−6.43	−22.60	−7.80	−4.37
Error & Omissions	0.33	−4.31	−6.96	−2.63	7.39	5.66	−3.96	−7.73
Balance of Payments	6.26	14.50	9.63	12.28	12.99	6.67	10.07	7.86

⟨Table 2⟩ Continued

(in Percent of GDP)

	1985–89	1990	1991	1992	1993	1994	1995	1996
THAILAND								
Current Account	−2.05	−8.50	−7.67	−5.66	−5.09	−5.65	−8.09	−7.98
Financial Account	4.22	10.62	11.91	8.51	8.40	8.50	13.08	10.58
Direct Investment	1.11	2.69	1.87	1.77	1.26	0.61	0.71	0.76
Portfolio Investment	3.12	7.93	10.04	6.74	7.15	7.89	12.37	9.82
Error & Omissions	0.82	1.66	0.44	−0.13	−0.18	0.06	−0.71	−1.43
Balance of Payments	2.99	3.78	4.68	2.72	3.13	2.91	4.27	1.18
TAIWAN								
Current Account	14.01	6.82	6.95	4.03	3.16	2.70	2.10	4.02
Financial Account	−0.62	−9.46	−1.24	−3.26	−2.09	−0.58	−3.15	−3.22
Direct Investment	−1.07	−2.45	−0.44	−0.51	−0.76	−0.52	−0.55	−0.72
Portfolio Investment	0.45	−7.01	−0.81	−2.74	−1.33	−0.05	−2.60	−2.50
Error & Omissions	0.10	0.29	−0.07	0.06	−0.23	−0.06	−0.22	−0.15
Balance of Payments	13.48	−2.45	5.39	0.64	0.69	1.92	−1.51	−0.40

investments showed an upward trend. A rising trend is very apparent to Korea, Philippines and Thailand.

Singapore and Taiwan experienced a surplus in the current account. Singapore added a substantial portion of the current account surplus to its foreign exchange reserve assets. In the 1990s, Taiwan used the current account surplus to invest abroad, instead of greatly augmenting its foreign exchange reserve assets. The other five countries experienced a deficit in the current account and a surplus in the financial account. A large portion of the financial account surplus financed the current account deficit. The remaining small amount of the financial account surplus was invested in reserve assets. On the average during the period 1985–89, the balance of payments was positive. Except for 1990 and 1991 in Korea, 1994 and 1995 in Malaysia, 1990 in Philippines, and 1990 and 1996 in Taiwan, all the seven countries showed the balance of payments surplus during the period 1990–96. This together

with a surplus in the balance of payments during the period 1985–89 raised the foreign source of the monetary base.

Ⅲ. Monetary Policy Responses to Capital Inflows

The exchange rate system of the selected Asian countries was a fixed exchange system or highly managed system, even though a limited variability in exchange rate movements was allowed. A capital inflow generates monetary expansion and pressure for exchange rate adjustment. It poses an important policy question as to how to deal with capital inflows. It is uncertain whether capital inflows last long or not. Asian countries regarded capital inflows as a transitional phenomenon. As a result, Asian countries decided it was desirable to minimize the impact of capital inflows on the economy.

Asian countries utilized four policy categories of measures to minimize the impact of capital inflows. The first policy category is to control capital inflows. The second category is to encourage capital outflows and to increase imports of goods and services. The third category is to reduce the impact on the money supply and exchange rage. The fourth is to implement tight fiscal policy. Asian countries utilized the combination of policy instruments in the four categories. Table 3 presents a summary of the major policy instruments used in some of Asian countries. Since Asian countries heavily used the third policy category of measures, our discussion will be largely confined to the third policy category.[5]

The main objective of monetary policy in these countries was twofold: to maintain the target of money supply and the fixed (desired)

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5) Detailed descriptions and discussions on policy instruments are found in IMF (1995) and Reinhart and Reinhart (1993).

⟨**Table 3**⟩ **Policy Mix in Response to Capital Inflows**

	Sterilized Intervention	Reserve Requirement	Control on Capital Inflows	Relax of Capital Outflows	Exchange Rate Variability	Fiscal Restraint
INDONESIA	YES		YES	NO	YES	NO
KOREA	YES	YES	NO	YES	YES	NO
MALAYSIA	YES	YES	YES	YES	YES	YES
PHILIPPINES	YES	YES	NO	YES	YES	NO
THAILAND	YES		YES	YES	NO	YES

Source: IMF, *International Capital Markets–Developments, Prospects, and Policy Issues*(August 1995), pp.80–90.
Reinhart, C. M. and V. R. Reinhart (1998), pp. 93–127.

level of exchange rates. The monetary authority conducted contraction of the domestic source in the monetary base of the central bank, a risen in reserve requirements on bank deposits, and other measures. These instruments were primarily directed to offset the effect on the money supply of an increase in the net foreign assets of the central bank resulting from capital inflows. At the same time, the monetary authority intervened in the foreign exchange market. The intervention in foreign exchange markets is primarily designed to absorb pressures on exchange rates that are accompanied by capital inflows and to prevent nominal exchange rate appreciation. Hence, the policy of sterilization with foreign exchange market intervention was very often utilized in Asia. Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand and Taiwan heavily utilized sterilization (see Box I.3, I.5 in International Monetary Fund (1995, pp. 81–83)).

Reserve requirements ratios were raised by Malaysia and Philippines to lower the money supply multiplier and reduce the money supply. (see Box I.4 in International Monetary Fund (1995, p. 83)). Some

countries such as Malaysia in 1989–96, Indonesia in 1995, and Philippines in 1994 adjusted reserve requirements ratios to discourage short–term borrowing from abroad.

Some countries like Korea encouraged capital outflows in the form of direct investment, so that net capital inflows would be reduced.

A. Sterilization

Table 4 summarizes the movement in money supply and monetary base. The money supply (measured by M_2) and the monetary base grew at a positive rate. The growth rate in the money supply fluctuated in a narrower range than the growth rate in the monetary base.

Furthermore, the rate of change in the money supply multiplier fluctuated to a great extent. This phenomenon is a result of a frequent change in reserve requirement ratios and a significant change in the share of time deposits in the money supply.

When the ratio (share) of a change in the net domestic assets to a change in the monetary base moves in the opposite direction of the ratio of a change in the net foreign assets, it indicates the operation of sterilization.[6] Data show that the sign on the ratio of a change in the net domestic assets differ from the sign on the ratio of a change in the net foreign assets. In the case of Singapore and Thailand, the

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6) This operation represents a reaction of the monetary authority and is an operation of sterilization in a broad sense. Sterilization differs from negative response of capital flows to a change in the domestic source of the monetary base. The degree of response of capital flows which offsets a change in the domestic source, called as offsetting coefficient, indicates the effectiveness of monetary policy and the degree of capital mobility. See Herring and Marston (1997) and Argy and Kouri (1974).

⟨Table 4⟩ **Money Stock, Monetary Base, and shares of
a Change in Net Domestic Assets**

(in Percent)

	1985–89 ave.	1990	1991	1992	1993	1994	1995	1996
INDONESIA								
M₂ Money Stock	26.87	44.60	17.46	19.76	20.23	19.98	27.16	27.18
Money Supply Multiplier	12.09	24.32	13.73	−8.68	10.98	−4.16	7.93	−6.38
Monetary Base	14.31	16.32	3.28	31.14	8.34	25.19	17.82	35.85
Share of Net Domestic Assets	−4.12	−274.46	−1482.39	−261.68	99.44	−4.57	129.34	61.81
Share of Net Foreign Assets	104.12	374.46	1582.39	361.68	0.56	104.57	−29.34	38.19
KOREA								
M₂ Money Stock	18.89	17.17	21.89	14.94	16.58	18.68	15.59	15.83
Money Supply Multiplier	−4.02	8.75	3.14	3.61	−8.54	8.67	−0.58	31.96
Monetary Base	25.74	7.74	18.18	10.94	27.46	9.20	16.27	−12.22
Share of Net Domestic Assets	−76.49	56.44	104.80	−66.50	40.07	−97.51	−9.00	175.58
Share of Net Foreign Assets	176.49	43.56	−4.80	166.50	59.93	197.51	109.00	−75.58
MALAYSIA								
M₂ Money Stock	8.68	10.63	16.88	29.15	26.64	12.71	19.97	25.35
Money Supply Multiplier	−1.47	−9.87	2.10	6.01	13.43	−17.25	−3.76	−7.28
Monetary Base	10.57	22.74	14.47	21.83	11.65	36.20	24.66	35.19
Share of Net Domestic Assets	−319.17	−59.76	−30.52	−269.64	−891.83	180.90	146.38	63.00
Share of Net Foreign Assets	419.17	159.76	130.52	369.64	991.83	−80.90	−46.38	37.00
PHILIPINES								
M₂ Money Stock	15.91	22.54	17.31	13.62	27.07	24.42	24.16	23.23
Money Supply Multiplier	−5.30	4.13	−2.32	0.52	6.91	18.39	5.97	7.61
Monetary Base	23.06	17.68	20.09	13.03	18.86	5.09	17.16	14.52
Share of Net Domestic Assets	214.39	290.35	−217.13	−243.83	−123.19	−277.15	18.05	−249.67
Share of Net Foreign Assets	−114.39	−190.35	317.13	343.83	223.19	377.15	81.95	349.67
SINGAPORE								
M₂ Money Stock	13.91	19.98	12.45	8.90	8.45	14.43	8.50	9.79
Money Supply Multiplier	4.24	11.95	1.63	−1.56	0.04	7.76	−0.82	2.85
Monetary Base	9.24	7.17	10.64	10.62	8.41	6.19	9.39	6.74
Share of Net Domestic Assets	−468.12	−1239.73	−519.22	−668.67	−961.42	−703.85	−731.92	−806.35
Share of Net Foreign Assets	568.12	1339.73	619.22	768.67	1061.42	803.85	831.92	906.35
THAILAND								
M₂ Money Stock	17.68	26.68	19.83	15.58	18.38	12.85	17.01	12.57
Money Supply Multiplier	2.75	6.82	5.79	−1.94	1.93	−1.45	−4.53	−0.82
Monetary Base	14.56	18.59	13.27	17.86	16.14	14.52	22.56	13.50
Share of Net Domestic Assets	−138.29	−236.26	−323.75	−96.64	−174.79	−162.72	−129.47	−8.30
Share of Net Foreign Assets	238.28	336.26	423.75	196.64	274.79	262.72	229.47	108.30
TAIWAN								
M₂ Money Stock	21.75	10.45	15.79	19.06	15.39	15.07	9.41	9.12
Money Supply Multiplier	−2.95	9.66	−0.81	6.81	8.22	4.56	11.86	8.12
Monetary Base	25.83	0.72	16.74	11.47	6.63	10.05	−2.18	0.93
Share of Net Domestic Assets	−208.97	−503.80	14.69	120.59	−44.13	−28.39	201.36	386.93
Share of Net Foreign Assets	308.97	603.80	85.31	−20.59	144.13	128.39	−101.36	−286.93

ratios of the change in the net domestic assets has a negative sign over the entire period. Whereas the ratios of the change in the net foreign assets has a positive sign over the entire period. Thus, a high degree of sterilization operation seems to have occurred in these countries and hence have decreased the money supply effect of capital inflows.[7]

Sterilization substitutes foreign exchange reserve assets with low rates of interest for domestic assets with high rates of interest rates. Thus, when sterilization is undertaken, it creates a financing burden, what is referred to in the literature as the cost of sterilization or quasi-fiscal cost of sterilization. The cost of sterilization depends on the scale of the operations by the monetary authority and the size of interest rate differentials, as well as the instruments used.[8]

The longer the sterilization operation continue, the cost will be higher. The high cost makes it difficult for sterilization policy to last over a long period.

In Latin America cases, the cost is estimated to be high. For example, Calvo, Leiderman, and Reinhart (1993) estimated quasi-fiscal costs in Columbia in 1991 of 0.5 percent of GDP.

Annual cost in Chile during 1990–93 and in Mexico during 1990–93 is estimated to be about 0.5 percent of GDP and 0.25 percent of GDP,

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7) Analytically, if interest rates are determined in money (bond) market, sterilization raises domestic interest rates by decreasing the money supply or by inducing to hold the increased supply of non-money liabilities of central bank. In Korea during 1985–1990, a positive interest rate effect of sterilization is reported in Kwack (1994); short-term interest rates increased in Korea.

8) According to Calvo (1991), sterilization could bring about credibility problems. In this case, the cost of sterilization is excessively high.

respectively. (see Velasco and Cabezas (1998, pp. 142–143)). In the case of Korea, Kwack (1994) estimated that interest payments on the Monetary Stabilization Bonds, which amounted to 3.5 percent of M_2 in 1989, implying that the cost of sterilization is high. Kletzer and Spiegel (1996) argued that the costs of sterilization in the Pacific Basin countries are not large. The quasi–fiscal costs in 1987 and 1992 are estimated to be 0.12 and 0.22 percent of GDP for Indonesia, the cost in 1988 is estimated to be 0.28 percent of GDP for Korea.

B. Foreign Exchange Market Intervention

Foreign exchange reserve assets in the countries increased during the period 1990–96, as shown in Table 2. Besides Malaysia, the balance of payments of Asian countries were in a surplus. The balance of payments accounts for the transactions of international reserve assets by the monetary authority in exchange for domestic currency assets. The purchase of international reserve assets in foreign exchange markets makes the currency's external nominal value stronger than it would be if no purchase took place. Generally, increasing net capital inflows tend to induce an appreciation in the nominal exchange rate.

As shown in Table 5, the nominal exchange rate of a currency (as measured by unit of home currency per unit of U.S. dollar) for Korea and Philippines depreciated over the period 1990–96 (exchange rate appreciation in 1995 for Korea, and appreciation in 1992, 1994 and 1995 for Philippines). Nominal exchange rates for Indonesia, Malaysia, Singapore, Thailand, and Taiwan appreciated over the period 1990–96 (exchange rate depreciation in 1996 for Thailand and Taiwan)

On the whole during the period 1990–96, real exchange rates against the U.S. dollars appreciated for the seven countries. Real exchange

⟨Table 5⟩ Growth, Inflation, and Exchange Rates

(in Percent)

	1985–89ave.	1990	1991	1992	1993	1994	1995	1996
INDONESIA								
Economic Growth	5.3	7.24	6.95	6.46	6.50	7.54	8.22	7.98
Inflation (CPI)	6.86	7.81	9.41	7.53	12.54	9.67	8.95	6.64
Nominal Exchange Rate Depreciation against $	11.89	4.11	5.83	4.08	2.82	3.53	4.07	4.15
Real Exchange Rate Depreciation against $	8.41	1.76	0.79	-0.24	-5.91	-3.21	-1.79	0.52
Real Exchange Rate Depreciation against yen	19.77	-5.17	7.37	4.73	5.37	3.42	3.71	-15.42
Real Effective exchange Rate Depreciation against $ & Y	13.63	-1.77	4.03	2.22	-0.43	0.05	0.92	-7.79
KOREA								
Economic Growth	9.46	9.51	9.13	5.07	5.75	8.58	8.94	7.13
Inflation (CPI)	4.22	8.58	9.30	6.24	4.80	6.27	4.47	4.96
Nominal Exchange Rate Depreciation against $	-3.34	5.41	3.62	6.45	2.82	0.10	-4.00	4.30
Real Exchange Rate Depreciation against $	-3.82	2.30	-1.22	3.28	1.03	-3.42	-5.52	2.27
Real Exchange Rate Depreciation against yen	5.99	-4.67	5.23	8.41	13.15	3.19	-0.23	-13.94
Real Effective exchange Rate Depreciation against $ & Y	0.67	-1.25	1.95	5.81	6.92	-0.17	-2.91	-6.18
MALAYSIA								
Economic Growth	4.71	9.74	8.42	7.80	8.35	9.24	9.62	8.20
Inflation (CPI)	1.35	2.62	4.36	4.77	3.54	3.72	5.30	3.52
Nominal Exchange Rate Depreciation against $	2.98	-0.15	1.67	-7.37	1.05	1.95	-4.57	0.46
Real Exchange Rate Depreciation against $	5.27	2.54	1.52	-8.87	0.50	0.78	-6.82	-0.13
Real Exchange Rate Depreciation against yen	15.71	-4.45	8.14	-4.34	12.56	7.68	-1.60	-15.96
Real Effective exchange Rate Depreciation against $ & Y	10.05	-1.02	4.78	-6.63	6.36	4.17	-4.24	-8.39
PHILIPINES								
Economic Growth	2.68	2.97	-0.51	0.34	2.12	4.42	4.74	5.67
Inflation (CPI)	9.72	14.14	18.71	8.92	7.59	9.06	8.09	8.43
Nominal Exchange Rate Depreciation against $	5.5	11.84	13.03	-7.16	6.30	-2.59	-2.66	1.93
Real Exchange Rate Depreciation against $	-0.05	3.25	-0.78	-12.14	1.75	-8.42	-7.40	-3.25
Real Exchange Rate Depreciation against yen	10.93	-3.78	5.69	-7.77	13.95	-2.15	-2.22	-18.59
Real Effective exchange Rate Depreciation against $ & Y	4.99	-0.33	2.40	-9.99	7.68	-5.33	-4.85	-11.25
SINGAPORE								
Economic Growth	6.33	8.98	7.27	6.29	10.44	10.05	8.75	7.32
Inflation (CPI)	0.7	3.46	3.43	2.26	2.29	3.10	1.72	1.36
Nominal Exchange Rate Depreciation against $	-1.74	-7.06	-4.69	-5.71	-0.81	-5.47	-7.21	-0.52
Real Exchange Rate Depreciation against $	1.11	-5.34	-3.98	-4.96	-0.14	-5.99	-6.20	1.01
Real Exchange Rate Depreciation against yen	11.28	-11.79	2.29	-0.23	11.84	0.45	-0.95	-15.00
Real Effective exchange Rate Depreciation against $ & Y	5.77	-8.62	-0.89	-2.63	5.68	-2.82	-3.61	-7.34
THAILAND								
Economic Growth	9.04	11.62	8.41	7.77	8.27	8.85	8.68	6.70
Inflation (CPI)	3.19	5.98	5.70	4.07	3.38	5.09	5.77	5.85
Nominal Exchange Rate Depreciation against $	1.96	-0.45	-0.27	-0.46	-0.32	-0.67	-0.93	1.71
Real Exchange Rate Depreciation against $	2.34	-1.02	-1.68	-1.41	-0.70	-3.08	-3.70	-1.12
Real Exchange Rate Depreciation against yen	11.99	-7.76	4.73	3.49	11.21	3.55	1.69	-16.79
Real Effective exchange Rate Depreciation against $ & Y	6.76	-4.45	1.47	1.01	5.09	0.18	-1.04	-9.29
TAIWAN								
Economic Growth	9.08	5.39	7.55	6.76	6.32	6.53	6.01	5.61
Inflation (CPI)	1.33	4.17	3.60	4.54	2.86	4.13	3.71	3.08
Nominal Exchange Rate Depreciation against $	-6.35	1.82	-0.26	-6.19	4.89	0.23	0.15	3.66
Real Exchange Rate Depreciation against $	-5.53	3.00	0.32	-7.50	5.01	-1.31	-0.70	3.50
Real Exchange Rate Depreciation against yen	3.85	-4.02	6.86	-2.90	17.61	5.45	4.36	-12.91
Real Effective exchange Rate Depreciation against $ & Y	-1.23	-0.57	3.54	-5.23	11.13	2.01	2.04	-5.06

Source: Nominal exchange rate is the number of home currency per U.S. dollar. Real exchange rate refers to the ratio of nominal exchange rate times an equal weighted average of U. S. and Japaness CPI prices in U.S. dollar divided by CPI price index.

rates against the Japanese yen is affected by the nominal exchange rate change in the Japanese yen against the U.S. dollar. The yen appreciated every year from 1991 to 1995, with the largest appreciation of 13 percent in 1993, and depreciated 16 percent in 1996. The variations in real exchange rates against the yen were similar, in the direction to the variations in the nominal exchange rate of the yen. Real exchange rates of Indonesia, Korea, Malaysia, Singapore, Thailand and Taiwan depreciated against the yen from 1991 to 1995 and they appreciated in 1996. The real exchange rate of Philippines appreciated against the yen on the average.

Real effective exchange rates are defined as an equal–weighted average of real exchange rates against the U.S. dollar and the Japanese yen. Real effective rates of Asian countries appreciated in 1996, mostly reflecting a large depreciation of the yen in 1996. During the period 1990–95, a small depreciation in real effective rates happened for Indonesia, Korea, Malaysia, Thailand, and Taiwan. A small apprecia-tion occurred for the currency of the Philippines and Singapore.

During the period 1990–96, nominal exchange rates did not greatly appreciate on the average for the seven countries. Real exchange rates against the U.S. dollar appreciated. and real effective exchange rates made a small appreciation. On the basis of the development of exchange rate changes discussed above, it is hard to ascertain the effects on exchange rates of foreign exchange market interventions, Judging from the movement of exchange rates against the U.S. dollar, which is the currency under intervention, however, it seems that foreign exchange market intervention would not bring significant effects on nominal exchange rates.

IV. A Model of Monetary Sector

On the basis of the observations made in Section III, it appears that the monetary authority in Asia achieved the objective of monetary policy in face of substantial capital inflows during the period 1990–96. Statistical examination will be taken to evaluate the consequence of monetary policy in the next section. In this section, we systematically analyze the subject, using a model of the monetary sector.

We introduce a model of the monetary sector covering money demand, money supply and foreign exchange intervention. The model is simple, but provides an appropriate framework for analyzing the effects of sterilization policy with intervention in foreign exchange markets, which is the most important instrument of monetary policy used by Asian countries.

The demand for real money balance is positively related to aggregate income and negatively related to domestic interest rate.[9]

$$(1) \quad m-p \ = \ a \ +\varphi \, y-\mu \, i \qquad \varphi \ \rangle \ 0, \ \mu \ \rangle \ 0$$

Where m, p and y are the nominal money stock (M), the price level (P), and the aggregate output measured in logarithms, respectively. i is the domestic interest rate.

The money supply is linked to the monetary base (MB) through the money supply multiplier (Q). The monetary base of the central bank consists of net domestic assets (DA) and net foreign assets (FA).

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9) The money demand specification is a well-known specification and was used by Tseng and Corker (1991) in estimating money demand equations for Asian countries.

Hence, the money supply is determined by:

(2) $M = Q \cdot MB = Q \cdot (DA + FA)$

The rate of change in the money supply can be approximated by

(3) $\Delta m = \Delta q + \Delta d + \Delta f$

where $\Delta m = \Delta M / Md_{-1}$, and $\Delta q = \Delta Q / Q_{-1}$, $\Delta d = \Delta DA / MB_{-1} = (DA/MB)(\Delta DA / DA_{-1})$, and $\Delta f = \Delta FA / MB_{-1} = (FA/MB)(\Delta FA / FA_{-1})$

It is assumed that the monetary authority desires the nominal exchange rate to follow the relative prices of home goods. In the presence of capital inflow surges and balance of payments surplus, the monetary authority concludes that exchange rate adjustment is necessary. It intervenes in the foreign exchange market to support an exchange rate appreciation. The intervention operation is generally consistent with a policy of leaning with the wind.[10] Glick and Moreno (1994) note that a number of East Asian countries allow their exchange rates to adjust. Taiwan, Korea, Singapore, and Malaysia allowed some appreciation. Hence, it is assumed that the nominal exchange rate is adjusted positively to inflation at home and negatively on inflation abroad and the rate of foreign exchange reserve accumulation.

The intervention function is written by

(4) $\Delta e = \Delta p - \Delta pf - \beta \Delta f$ $\qquad$ $\beta > 0$

Where e is the nominal exchange rate (E) in logarithms, and pf is foreign prices in logarithms.

β is a parameter which characterizes foreign exchange market

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10) For discussion on foreign exchange market intervention, see Quirk (1977), Dominguez and Frankel (1993), Watanabe (1994) and Weymark (1998).

intervention of the monetary authority.

Equality of money demand and supply determines the price level. To solve for the rate of inflation, we differentiate equations (1) and (3) with respect to time. The resulting differentiated equations are solved for the rate of inflation as follows:

(5) $\Delta p = \Delta q + \Delta d + \Delta f + \mu \Delta i - \Delta y$

Equation (5) states that inflation represents an excess of the growth in money supply over the rate of growth in money demand. If output and the interest rates are assumed to be constant, namely $\Delta y = 0$ and Δi, the rate of inflation is the same as the rate of growth in the money supply.

The fact that money demand and supply conditions determine the rate of inflation implies that the interest rates are determined primarily by the non-monetary sectors in the economy. It is quite reasonable to assume that interest rates in Asia are determined exogenously by the monetary authority. Using the fact that Asian countries have begun to open their capital markets to foreigners in recent years, we could assume that domestic interest rates are determined by foreign interest rates, exchange rate expectation and risk premium. The implied assumption of a high mobility of capital across countries seems to be too strong.[11] Consequently, we do not use the assumption of a high capital mobility in the model.

Substitution of Δp in (4) by equation (5) yields the equation to

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11) Frankel and Chinn (1993) conclude that barriers keep Pacific Basin countries' interest rates largely independent. Kwack (1996) provides evidence for declining gaps in the interest rates between the United States and Korea. Montiel (1994) shows that the degree of capital mobility in Asia is neither high nor low.

determine the exchange rate change:

(6) $\Delta e = \Delta q + \Delta d + (1-\beta)\Delta f - \Delta pf + \mu \Delta i - \varphi \Delta y$

Equation (6) implies that it is necessary for the monetary authority to accommodate money demand so as to maintain the nominal exchange rate at the fixed level.

If the monetary authority desires the money supply to keep at a fixed level, the monetary authority performs open market operation in such a way that a rise in the net foreign assets is exactly offset by a decrease in the net domestic assets and the money supply multiplier. This is the case of complete sterilization in a broad sense (complete sterilization in a narrow sense is achieved when a rise in the net foreign assets is exactly offset by a decrease in the net domestic assets; in this case, the monetary base remains constant). We explicitly introduce the sterilization operation of the central bank in the framework as follows.[12]

(7) $\Delta d = -\gamma(\Delta f + \Delta q)$ $\qquad 0 \leq r \leq 1$

In (7), $\gamma = 0$ and $\gamma = 1$ indicate no sterilization and complete sterilization, respectively.

The substitution of Δd in equations (3), (5) and (6) by equation (7) yields a system of three reduced form equations (8)–(11):

(8) $\Delta p = (1-\gamma)(\Delta q + \Delta f)$

(9) $\Delta p = (1-\gamma)(\Delta q + \Delta f) + \mu \Delta i - \varphi \Delta u$

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12) For empirical estimation of sterilization equations, see Herring and Marston (1977), Cumby and Obstfelt (1981), Kwack (1994). For in-depth studies, see Kletzer and Spiegel (1996).

(10) $\Delta e = (1-\gamma-\beta)\Delta f+(1-\gamma)\Delta q-\Delta pf+\mu\Delta i-\varphi\Delta y$

From the system of equations (8)–(10) and known parameter values, the effects on the money supply, the rate of inflation and the rate of change in the nominal exchange rate of a change in an exogenous variables can be analyzed. Consider three interesting cases: (a) no sterilization, $\gamma=0$, and no exchange market intervention, $\beta=0$, (b) complete sterilization, $\gamma=1$, and no exchange market intervention, $\beta=0$, and (c) complete sterilization, $\gamma=1$, and exchange market intervention, $\beta>0$. All other things being equal, the case (a) produces that an additional capital inflow causes the price to rise and the exchange rate to depreciate. This is a result of an induced rise in the money supply. The case (b) generates no price changes and no exchange rate changes. In the case (c) there are no price change and an exchange rate appreciation.

V. Estimated Equations and Capital Inflow Effects

An exogenous rise in capital inflows influences all the endogenous macro-economy variables.

Thus, the effects on an endogenous variable include its direct and indirect induced effects. In order to analyze its effects in a great detail, a well-structured model of an economy is necessary.

Our statistical analysis in this paper is limited, however, to the estimation of the direct effect on the rate of inflation and exchange rate. The central information needed for the estimation are the sterilization coefficient, and foreign exchange market intervention coefficient, Y, and foreign exchange market intervention coefficient, β.

We selected the following seven countries that received substantial capital inflows from abroad: Indonesia, Korea, Malaysia, the Philippines, Singapore, Thailand, and Taiwan. The exchange rate systems of these countries are close to a pegged or managed floating system.

For the seven countries as a group, regression equations are estimated using panel data across countries and the time period from 1985 to 1996. Almost all the data except Taiwan's data were obtained from IMF's *International Financial Statistics*. The data on Taiwan economy are from Taiwan's *Financial Statistics, the Balance of Payments, and Taiwan Statistical Data Book.*

A. Sterilization

Much empirical research has been done on the sterilization subject, notably by Herring and Marston (1977) and Kwack (1994) . The

following sterilization equations are specified on the basis of equation
(7) and the results of past research:

(11) $\Delta d = \gamma_1 + \gamma_2 \Delta f$

(12) $\Delta d = \gamma_1 + \gamma_2 \Delta f + \gamma_{31} \Delta q$

(13) $\Delta DA = \gamma_1 + \gamma_{22} \Delta FA + \gamma_{32} \Delta Q$

Δd, Δq, and Δf are expressed in percent, The money stock used
in calculating the money supply multipliers is the money stock in M_2.
Table 6 presents the coefficient estimates of equation (10)–(12) for

〈Table 6〉 Sterilization and Money Demand

Equation	R^2/SEE/DW

(11e) Δd = 16.6 − 0.95 Δf − 0.2 DK + 0.4 DM
    (5.4)   (30.8)   (0.0)   (0.1)
 	
+1.5 DP − 10.5 DR − 2.6 DR − 3.6 DW
    (0.3)   (2.3)   (0.6)   (0.8)
	0.94/10.4/1.81

(12e) Δd = 24.1 − 0.94Δq − 0.94 Δf − 5.7 DK
    (13.1)   (12.9)   (54.0)   (2.3)
 	
−9.2 DM − 4.9 DP − 15.2 DR − 9.0 DT − 8.8 DW
    (3.6)   (2.0)   (6.1)   (2.6)   (3.6)
	0.98/5.5/1.28

(13e) ΔDA = 2850 − 1441 ΔQ − 0.89 ΔFA − 1156DK
    (7.4)   (5.5)   (13.9)   (2.5)
 	
−2996 DM−2788 DP−2599 DR −2661 DT−2493 DW
    (3.6)   (2.0)   (6.1)   (2.6)   (3.6)
	0.70/1098/1.50

(14e) m−p = 0.49 + 0.91 y − 0.004 i + 0.04 DK
    (7.4)   (5.5)   (13.9)   (2.5)
 	
−2.61 DM + 1.12 DP − 2.44 DR + 1.22 DT + 1.40 DW
    (3.6)   (2.0)   (6.1)   (2.6)   (3.6)
	0.99/0.05/0.48

Source: DK, DM, DP, DR, DT, and DW represent dummy variables identifying Korea,
    Malaysia, Philippine, Singapore, Thailand, and Taiwan.

the seven Asian countries as a group. The γ_2 coefficient estimated is −0.95. The estimated valuse of γ_{21} and γ_{22} are −0.94 and −0.89. The estimates of γ_{31} and γ_{32} are −0.94 and −1444. (Note that the estimate of γ_{32}, −1444 contains a value of scale factor). The estimated coefficients are statistically significant at the one percent level of significance. The estimated coefficients of net foreign assets variables, γ_2, γ_{21}, and γ_{22} are above −0.9 or higher. These estimates indicate that the degree of sterilization of the monetary authority is very high. This result appears to contrast with the estimate of sterilization, −0.41, reported by Fry (1993, pp. 153−56) for the six Pacific Basin economies−Indonesia, Korea, malaysia, Philippine, Thailand and Taiwan during 1970−1990. Both results are comparable from the fact that the sample of Fry's regression does not include the period 1991−96 when sterilization operations are heavily undertaken. Other things being equal an active sterilization effort would raise the size of the sterilization coefficient. This is supported by Kwack (1994) in the case of Korea. The sterilization coefficient estimate as reported in Appendix A, 0.97, is higher than the estimate of the sterilization coefficient, 0.8, during the sample period 1980−1990 in Kwack (1994). The estimated 0.63 in the sub−sample period 1980−85 is lower than the estimated 0.86 in the sub−sample period 1985−1990.

The estimated and statically significant coefficients of the money supply multiplier, γ_{31} suggests that the sterilization was undertaken to control the money supply rather than to control the monetary base. Hence, the sterilization relevant to Asian countries is a broadly defined sterilization. We run regressions for individual countries. The estimation results are given in Appendix A, and we find that $-1.04 \leq \gamma_{21} \leq -0.81$, and $-1.04 \leq \gamma_{31} \leq -0.74$. These individual country's estimates are comparable to the group's estimate.

APPENDIX A: $\Delta d = \gamma_1 + \gamma_{31}\Delta q + \gamma_{21}\Delta f$

Country	Coefficients			$\bar{R}^2$	SEE	DW
	γ_1	γ_{31}	γ_{21}			
Indonesia	23.9 (7.6)	−0.81 (4.2)	−0.99 (16.1)	0.96	7.53	1.76
Korea	19.2 (12.6)	−1.16 (12.9)	−0.97 (17.2)	0.97	3.69	2.16
Malaysia	12.7 (2.6)	−1.26 (2.3)	−0.99 (8.11)	0.96	8.61	0.52
Philippine	18.9 (10.1)	−0.74 (3.6)	−0.94 (19.9)	0.98	6.28	1.58
Singapore	8.72 (2.7)	−0.09 (0.4)	−0.99 (22.3)	0.98	3.53	1.11
Thailand	9.23 (5.7)	−0.84 (4.1)	−0.81 (20.4)	0.98	2.33	2.68
Taiwan	16.4 (14.4)	−1.42 (10.8)	−0.94 (60.3)	0.99	3.17	1.88

B. Money Demand

Money demand equation specification is the same as (1). Aggregated output is represented by real GDP, interest rate by money market interest rates (listed in line 60a of IMF's. *International Financial Statistics*) and/or corporate bond yields. The price level is the implicit price deflator for GDP. The estimated equation for the Asian countries as a group are listed in Table 6. The estimated value of income elasticity, φ, is 1.49 and is significant at the one percent level of significance. As expected, the income variable is the most important determinant of money demand. An income elasticity estimate of larger than one, namely 1.4 suggests that the broad money is a 'luxury good' as found in most of the industrial countries including the United States and may reflect an increasing desire to hold wealth in the form of time−

deposits as private wealth rises. The estimated value of quasi interest rate elasticity, is −0.04 and significant at the five percent level. As given in Appendix B, the income elasticity estimates for individual countries are between 1.2 and 2.9. The income elasticity estimates for most of the countries are similar to the estimates for the respective countries reported in Tseng and Corker (1991. p. 18); the elasticity estimates for Indonesia and the Philippines, above 2, differ, however. The interest rate coefficients are insignificant for almost all of the countries.

C. Foreign Exchange Market Intervention

We use three closely related alternative measures for foreign exchange market intervention variables: Δf, BOPM, and BOP. Based

APPENDIX B: $m-p = a + \varphi y + \mu i$

Country	Coefficients			$\overline{R}^2$	SEE	DW
	a	φ	μ			
Indonesia	−6.1 (8.9)	2.06 (16.3)	0.004 (0.6)	0.96	0.04	0.58
Korea	−2.1 (15.4)	1.33 (47.9)	−0.002 (1.7)	0.99	0.01	2.27
Malaysia	−5.6 (12.4)	1.50 (16.3)	−0.011 (1.6)	0.93	0.03	1.18
Philippine	−6.0 (7.5)	2.86 (11.0)	−0.001 (0.4)	0.93	0.04	0.53
Singapore	−3.8 (9.3)	1.15 (14.4)	0.006 (0.8)	0.96	0.03	0.80
Thailand	−1.4 (17.3)	1.37 (59.1)	−0.002 (1.6)	0.99	0.01	1.34
Taiwan	−2.3 (21.4)	1.69 (54.3)	0.001 (0.1)	0.99	0.01	1.07

⟨Table 7⟩ Intervention in Foreign Exchange Market

Equation	R²/SEE/DW

(14e) Δe = 11.6 + 0.05Δp + 0.22Δpf − 0.05Δf − 7.1 DK
       (2.8)   (0.29)   (0.23)   (2.7)   (3.1)
 	
       −5.9DM − 3.8DP − 2.5DR − 5.5DT − 9.2DW
         (5.4)   (30.8)   (0.0)   (0.1)   (3.6)
	0.28/5.45/1.78

(15e) Δe = 6.5 + 0.12Δp − 0.05Δpf − 0.05 BOPM − 6.6 DK
       (2.5)   (0.63)   (0.54)   (2.88)   (2.9)
 	
       −5.2 DM − 2.9 DP − 7.7 DR − 4.8 DT − 8.1 DW
         (2.0)   (1.3)   (2.9)   (1.9)   (3.1)
	0.28/5.4/1.71

(16e) Δe = 6.6 + 0.10Δp + 0.04Δpf − 0.0004 BOP − 6.2DK
       (2.6)   (0.53)   (0.42)   (3.13)   (2.7)
 	
       −5.7 DM − 3.4 DP − 8.8 DR − 5.3 DT − 7.6 DW
         (2.2)   (1.5)   (3.4)   (2.2)   (2.1)
	0.30/5.37/1.68

(17e) Δe = 8.1 − 0.05 BOPM − 7.0 DK
       (5.1)   (2.88)   (3.2)
 	
       −6.1DM − 2.8DP − 8.6DR − 5.4DT −8.9DW
         (2.7)   (1.3)   (3.7)   (2.4)   (4.0)
	0.30/5.37/1.74

Source: DK, DM, DP, DR, DT, and DW represent dummy variables which identify Korea, Malaysia, Philippines, Singapore, Thailand, and Taiwan.

on equation (4), the following equations are specified:

(14) $\Delta e = \beta_1 + \beta_2 \Delta p + \beta_3 \Delta pf + \beta_4 \Delta f$

(15) $\Delta e = \beta_1 + \beta_{21} \Delta p + \beta_{31} \Delta pf + \beta_{41} BOPM$

(16) $\Delta e = \beta_1 + \beta_{22} \Delta p + \beta_{32} \Delta pf + \beta_{42} BOP$

(17) $\Delta e = \beta_1 + \beta_{43} BOPM$

Where Δe and Δpf are in percent. pf is foreign prices in logarithms and foreign prices are a weighted average of the dollar-measured GDP price deflator of the United States and Japan (0.5 is assigned to

weight for the United States). BOPM is 100 x 0.001 x BOP x E/ MB-1, which is the ratio of the balance of payments to the monetary base in percent. BOP is the balance of payments in millions of U.S. dollars and MB is the monetary base in the billions of home currency (in the millions of home currency for Malaysia and Singapore).

Table 7 lists the equations estimated for the Asian counties as a group. The estimated coefficients for inflation at home and abroad are found to be insignificant. The estimated coefficients of three alternative indicators for the foreign exchange market intervention are found to be significant at the one percent level of significant. The estimated coefficients of three alternative indicators for the foreign exchange market intervention are found to be significant at the one percent level of significance. They are $\beta_4=0.05$, $\beta_{41}=0.05$ $\beta_{42}=0.0004$.[13] When the insignificant inflation variables are excluded, we obtain $\beta_{43}=0.05$,

APPENDIX C: $\Delta e = \beta_1 + \beta_{21} \Delta p + \beta_{31} \Delta pf + \beta_{41} BOPM$

Country	Coefficients				$\overline{R}^2$	SEE	DW
	β_1	β_{21}	β_{31}	β_{41}			
Indonesia	6.1 (0.1)	0.30 (0.6)	0.65 (1.2)	0.050 (0.2)	0.00	7.54	1.86
Korea	3.5 (0.7)	0.03 (0.0)	-0.06 (0.3)	-0.10 (3.4)	0.46	4.56	2.16
Malaysia	4.8 (2.3)	-0.76 (2.5)	-0.21 (1.1)	-0.028 (1.1)	0.29	3.22	2.29
Philippine	-9.7 (1.6)	1.14 (2.3)	0.48 (1.5)	-0.010 (0.1)	0.20	5.79	2.35
Singapore	1.62 (0.5)	-0.49 (1.2)	-0.13 (0.9)	-0.047 (1.0)	0.10	2.89	2.34
Thailand	13.3 (2.8)	-2.24 (1.8)	-0.52 (2.6)	-0.018 (0.3)	0.36	3.73	1.81
Taiwan	-5.27 (1.1)	1.63 (1.1)	-0.16 (0.4)	-0.020 (0.6)	0.10	6.03	1.33

which suggests that a one percent rise in the ratio of the change in
the net foreign assets to the monetary base at the beginning of period
leads to 0.05 percent appreciation. The effect of the intervention in the
foreign exchange market is estimated to be small. The result is
confirmed from the estimate of the balance of payments, $\beta_{42} = 0.0004$,
for equations (6); a one billion dollar rise in the balance of payments
leads to a 0.4 percent nominal exchange rate appreciation. APPENDIX
C provides regression equations for individual countries. Most of the
estimated coefficients for inflation and foreign exchange market
intervention variables were insignificant. This is not unexpected. Since
individual exchange rate behaviors do not greatly behave consistently
and systematically.[14]

D. Effects of Sterilization with Foreign Exchange Market
    Intervention

We find from the estimated regression equations that the
sterilization coefficient is very high and the intervention coefficient is
very small. This finding implies that the monetary authority took the
policy of a high degree of sterilization with small effect of intervention
on exchange rate. Based on analytical discussions we have made
earlier, it can be claimed that the policy leads for a capital inflow to
yield negligible effects on the exchange rate and small positive effects

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13) We calculate the value of β_{41} from the estimate of $\beta_{42} = 0.0004$ by utilizing
    the relation between BOPM and BOP, BOPM = 0.001146 BOP at the
    sample means. The calculated value of β_{41} is 0.035, which seems to be
    close to the estimate of $\beta_{41} = 0.05$ (actually it is 0.046).
14) For random walk hypothesis on exchange rates, see Adams and Chadha
    (1991). For general discussion, see Isard (1987).

on the money supply and the price level. Consequently, real exchange rates appreciate by a small amount. On the whole, the monetary authority succeeded in keeping exchange rates at desired levels and in limiting increases in monetary growth, despite a surge of capital inflows.

Let us assume that there is a rise in the balance of payments. We can calculate the effects on the money supply, the rate of inflation, and the exchange rate by making use of equations (8)–(10). Let us assume that the estimate of the sterilization coefficient $\gamma = 0.95$ and the estimate of the coefficient of exchange market intervention $\beta = 0.05$. A one percent rise in the ration of a change in the balance of payments to the monetary base increases the ratio of a change in net foreign assets to the monetary base by 0.83 percent (as measured at the mean values during the sample period 1985–1996 and in regressions). The contribution to the money supply is about 0.4 percent additional money supply growth. No contribution is made to the exchange rate, since $(1-\gamma-\beta)$ is close to zero. The contribution to the rate of inflation is about 0.4 percent additional inflation, which is about 6 percentage point of actual rate of inflation.

Suppose that there is $10 billion additional capital inflows into Asia. Let us assume other things are equal and no change in income, interest rates, and the current account. This additional $10 billion in capital inflows would bring about the additional rise in the rate of inflation by 0.4 percent and real exchange rate would appreciate by 0.4 percent. The calculated numerical values should be read with caution, because the estimated parameter values are subject to an error. Nevertheless, they clearly illustrate the direction of effects of monetary policy changes.

VI. Conclusions

This paper shows that the seven Asian countries as a group took the operation of a high rate of sterilization with small effect of intervention on exchange rate. Consequently, they attained the primary objective of monetary policy during the period of a surge in net capital inflows to their economies. The monetary authority maintained both their desired monetary growth and managed exchange rates. The monetary policy allowed the rate of inflation to increase slightly, the nominal exchange rates to be affected very little and, as a result, real exchange rates appreciated to some extent.

An additional small real exchange rate appreciation resulting from the monetary policy implemented to cope with capital inflow surges would bring about additional current account deficits.

Increase capital inflows themselves would enable more investment and imports, which in turn would cause the current account deficits to widen. Both net capital inflows and the implemented monetary policy caused the current account to rise over time. Widening current account deficits over time would help in forming investor's expectation that the current account deficits will not be sustainable. This expectation is likely to have positively contributed to the occurrence of the Asian crisis in 1997.[15]

15) Widening current account deficits reflected in increasing capital inflows in Asia. A substantial portion of capital inflows was in the form of short-term borrowing. This left Asian countries vulnerable to external shocks. It is useful to understand the hypothesis on a crisis. The first hypothesis on a balance of payments crisis is that of Krugman (1979). If a country with a pegged exchange rate expands domestic credit to finance a budget

Capital flows are sensitive to economic and political development at home and abroad. A change in foreign financial market conditions would reverse capital inflows. The sudden reversal of capital flows can cause a severe turmoil in the economy, especially in an economy with high short-term external liabilities. It is uncertain when capital flows reverse. Asian countries desired to keep the effect of a capital flow shock on the economy at a minimum level and, therefore, took the policy of a high degree of sterilization and stable exchange rates. The policy resisted a large appreciation in nominal exchange rates. But it brought small real exchange rate appreciation and significant

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deficit and investors prefer to hold a foreign currency, international reserves fall. When speculators assume that the country will no longer be able to defend the exchange rate, a speculative attack on the currency will occur. This hypothesis emphasizes macroeconomic policies inconsistent in the rong run with the fixed exchange rate and is called the first-generation models. The second hypothesis is given by Flood and Garber (1984) and Obstfeld (1986). This hypothesis argued that a crisis may develop without a significant change in economic fundamentals. There are two possible equilibria, which depend upon the expectations of marker participants about monetary authority's actions in the event of a speculative attack. The state of the economy and the stability of the banking system are the factors that would provide conditions for a self-fulfilling speculative attack. In "What happened to Asia?", Krugman (1998) noted that Asian banks are managed with implicit government guarantees. The government guarantees can lead to an over-borrowing and an excessively high price of assets including land. As the degree of government guarantees decreases, the price of assets falls, which in turn leads to loan defaults. This generates self-fulfilling pessimism and hence a financial crisis. For literature review, see Flood and Marion (1998) and for crisis in emerging markets, see Dooley (1998).

sterilization costs.

The majority of industrial counties allow their exchange rates to float and unrestricted capital flows. Under the world conditions, it is expected for capital inflows as well as capital outflows to occur unsystematically. Hence, the monetary authority in Asian countries could have taken the view that capital flows are of a permanent nature and could have accepted that sterilized intervention policies are effective over a short period and become costly if policies last a long period of time. If the monetary authority took into account these important useful information, certainly it is expected that the monetary authority would have floated the exchange rate and allowed it to respond to market forces. If this happened, an appreciation of the nominal exchange rate would have occurred and the exchange rate would have fluctuated widely. Increased uncertainty might have discouraged highly speculative and reversible capital inflows. There-fore, Asian countries could have avoided the financial crisis.

Capital flows can be troublesome and can be very beneficial. In the world economy with a high degree of capital mobility, the best policy combination can not prevent the occurrence of the swings in capital flows. The appropriate policy combination can narrow the scope of the swings. What countries in Asia should do first, in order to take advantage of the world economy, is to fully make a market-incentive driven system operational. Marking full operation of such a system is the cheapest way the countries can cope with shocks originated from abroad.

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國文要約

‒1997년 아시아 지역 국가들의 금융위기 전까지 많은 양의 자본이 아시아 지역 국가로 유입되었으며, 다량의 자본유입은 아시아지역국가 통화당국의 통화관리 및 정책에 대한 관심을 증가시킴과 동시에, 그만큼 큰 부담으로 작용하였다. 이 보고서는 아시아 금융통화당국이 1985~1996년까지 자국으로 유입되는 자본을 어떻게 관리하고 대처하였는지를 실증적으로 분석함으로써, 아시아 금융위기의 원인과 결과 및 앞으로 나아갈 방향을 제시하고자 한다.

‒자본유입이 물가·통화량·환율 등 거시변수들에 미친 영향과 정책대응에 관한 이론적·실증적 연구로서, 다량의 자본유입이 당국의 통화정책 및 외환시장 개입정책에 끼친 영향을 분석하고자 하며, 이러한 분석을 통하여 아시아 7개국(인도네시아, 한국, 말레이시아. 필리핀, 싱가포르, 타일랜드, 대만)이 어떻게 국제자본의 유입을 관리하였는지 실질적인 사실과 데이타를 기초로 분석하였다.

‒아시아 국가들이 외환시장개입 및 불태화정책을 적절히 활용함으로써 통화정책의 독립성을 유지할 수 있었으나, 불태화정책의 유효성은 단기간에 한정됨으로 말미암아 시장참여자들이 이들 국가의 고정환율이 지속되지 못할 것이라는 기대를 형성함에 따라 결국 금융위기로 치닫게 되었다.

‒이 연구의 주된 발견은 아시아 국가들이 급증하는 해외자본의 유입에 대하여 불태화정책에 크게 의존한 반면 외환시장개입의 환율효과는 미미하였다는 점이다. 그 결과 환율의 과대평가와 경상수지적자 확대가 귀결되었고 환율평가절하에 대한 기대감을 확산시킴으로써 위기의 원인으로 작용하였다.

郭承濚

서울대학교 상대 졸업(1959)

미국 버클리대학(University of California at Berkeley) 경제학 박사(1968)

한국정부 부흥부 기획국(1959~61)

미국 브루킹스연구소(1968~71), 재무성(1971~73), 연준리(Board of Governors of the Federal Reserve System)(1973~78) 연구위원

미국 하워드대학 경제학과 교수(1981~현재)

E-mail: skwack@fac.howard.edu

主要 著書 및 論文

· *The U.S. Economy in Interdependent Nations of the World* (Washington, D.C.: Board of Governors of the Federal Reserve System, 1984, 공저)

· *The Korean Economy at a Cross Road—Development Prospects, Liberalization, and South-North Economic Integration* (Westport, Connecticutt: Praeger Publishing Company, 1994)

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