FOREIGN EXCHANGE INTERVENTION AND CURRENCY CRISIS:
THE CASE OF KOREA DURING PRE-CRISIS PERIOD

By

Sung-Kyung Kang

THESIS

Submitted to
School of Public Policy and Management, KDI
in partial fulfillment of the requirements
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ABSTRACT

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This paper offers an analysis on the effectiveness of foreign exchange interventions during pre-crisis period in Korea. I review how central bank intervention influence the path exchange rates can take. During pre-crisis period many factors contributed on the excessive foreign exchange rate movements. And those factors also made the central bank intervention less effective than normal period. Especially due to the weak banking system and business sector at the time, central bank spent large amount of foreign reserves through interventions and liquidity supports to them. Under the more opened capital market conditions, the monetary authorities need to stabilize the macroeconomic conditions and to build its own credibility in the decision making process rather than frequent interventions.

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I. INTRODUCTION

Korea's currency crisis in 1997 has been resulting in substantial and structural changes in Korea's economic system. One of the most striking alterations was that Korean government introduced free floating exchange rate system. The market average exchange rate system has been blamed for major culprit of currency crisis. Much literature emphasized that the irrelevant central bank intervention[1] during pre-crises period exhausted foreign exchange reserves and failed to correct the overvaluation of Korean won, thus eventually insufficient reserves had damaged the credibility of economy as a whole.

Empirical research into the effectiveness of sterilized intervention[2] in industrial country currencies has found that such operations have at best only small and temporary effects on exchange rates. One explanation for the limited measurable effectiveness of sterilized intervention is that the scale of typical operations has been insufficient to counter the enormous pressures that can be marshaled by market forces. Another is that the assets bought and sold in intervention operations are such perfect substitutes in the minds of investors that they willingly accept changes in the currency composition of their holdings without compensating changes in asset prices or exchange rates. Others claim that intervention

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[1] The Bank of Korea implements intervention operations, although the decision to intervene can also be made by Ministry of Finance and Economy. Some press reported the disharmony that characterizes the relationship between the two bodies.

[2] Nonsterilized intervention operations are analogous to domestic open market operations, except that foreign rather than domestic assets are bought or sold. Because it affects the monetary base, it is generally assumed to have significant effects on exchange rates.

operations can be effective when they signal future monetary policy operations, which are perceived to be more effective in altering asset prices, including exchange rates. The problem with this view is that it means that sterilized intervention is not an independent tool that can be used to influence exchange rates. It needs a supporting policy stance to be effective.

The willingness of monetary authorities to support the commitment to defend the exchange rate using their own resources may help to modify the expectations of other market participants, thus affecting also the level of private supply and demand in the market. On the other hand, if private agents come firmly to the conclusion that official efforts to control an exchange rate through intervention – especially intervention unsupported by monetary policy – are unsustainable, large resources to carry out intervention may be viewed as a profit opportunity.

Edwards and Savastano (1999) indicate that most of economists' beliefs on the issues on exchange rates are based on limited evidence from industrial countries, and they argue that additional work on the developing countries is needed. Concerning the effectiveness of intervention, it is reasonable to expect that it will generally be more effective in countries where access to international capital markets is limited and, therefore, the authorities have relatively greater capacity to influence conditions in the foreign exchange market by directly buying or selling foreign exchange. For developing countries characterized by high international capital mobility, the effectiveness of sterilized interventions

is likely to be more limited, or larger interventions will be required to achieve a given effect.

According to the Bank of Korea's report[3], it heavily intervened in foreign exchange market to calm down the speculations on currency devaluation during pre-crisis period. Since the Korean government had tried to keep the daily foreign exchange rate band set by the market average rate system, it used to intervene in the market. It was generally believed that Seoul foreign exchange market was relatively controllable in accordance with government's intention than market forces. At least authorities thought so. The grounds for such conviction were that the trading volume of Seoul foreign exchange market was relatively small, and that government had traditionally predominant position compared to private players, especially domestic banks, in Korea's economic system.

This paper focuses on those factors that are suspected to bring about the ineffectiveness of intervention during pre-crisis period in Korea. However, it is hard to conclude, because of the lack of data on actual amounts and timing of intervention[4], what factors had caused the ineffectiveness through statistical approaches.

This paper is organized as follow. Section II reviews the evolution of Korea's exchange rate regime and the overview of central bank intervention. Section III then sets out the mechanics of sterilized intervention, emphasizing the various channels to influence the exchange

[3] Non-publicized report to National Assembly hearing on currency crisis.
[4] Dominguez and Frankel(1993) provide the practical reasons for why central banks prefer to keep intervention secret.

rates. Portfolio balance model and signaling theory will be discussed. Section IV considers interaction between currency crisis and central bank intervention. Conclusion offers the insights of this study on the operation of central bank intervention

II. FOREIGN EXCHANGE RATE SYSTEM AND INTERVENTION

The Choice of Foreign Exchange Rate Regime

Before discussing central bank intervention, it is helpful to understand the foreign exchange rate system. Exchange rate systems have tradeoffs between credibility and flexibility. In order to make a analysis those relationships, two highly simplified extreme cases can be considered: a fully flexible (or floating) exchange rate with minimal central bank intervention and a credibly (and irrevocably) fixed exchange rate. A flexible exchange rate system allows a country to have an independent monetary policy, providing the economy with flexibility to accommodate domestic and foreign shocks, including changes in external terms of trade and domestic interest rates. Lack of credibility results from this flexibility, however, contributes to high inflation and high real interest rates. For example, workers base their demands for wages on the expectation that the central bank will depreciate the domestic currency. State enterprises and government ministries incur deficits because they expect that the government will rescue them by pressuring or passing laws ordering the central bank to finance the deficits. Such behavior creates momentum for continued inflation.[1]

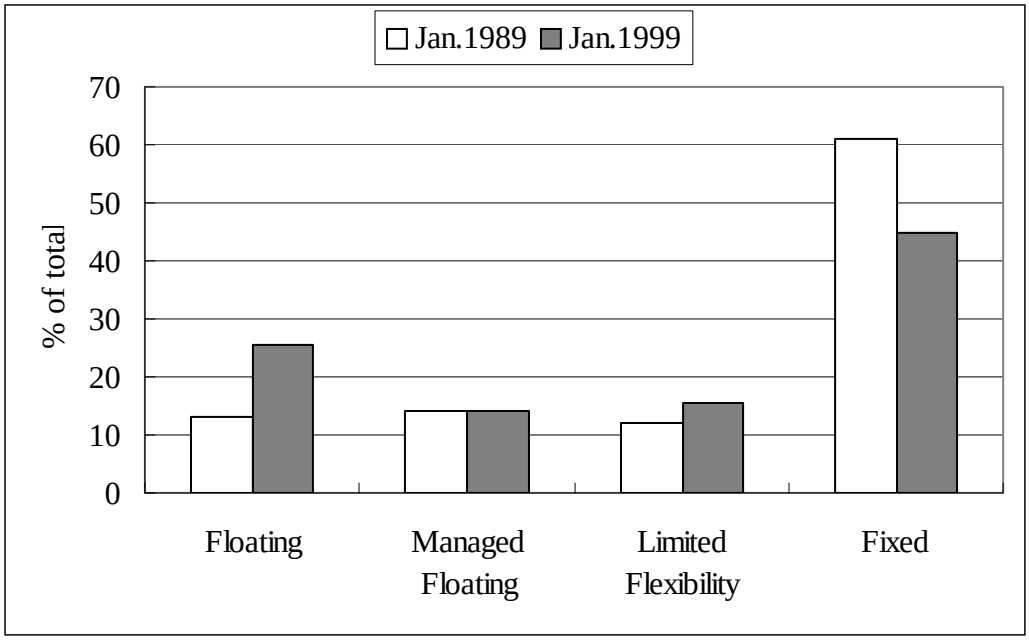
On the contrary, fixed exchange rate system reduce the degree of flexibility of the system but impart a higher degree of credibility to policy making. Since the public believes that, under fixed rates, the primary

[1] See Hanke and Schuler(1994), p.13.

object of monetary policy is to preserve the exchange rate parity, they moderate their wage and price expectations, thus allowing the economy to attain a lower rate of inflation.

However, purely floating and fixed exchange rate systems are only two of the possible exchange rate systems a country can choose. In reality, there are many layers

Figure 1. Exchange Rate Arrangement of the IMF Member Countries



* Number of countries: 1989(151), 1999(185)

** Source: reproduced from World Financial Markets(3Q 1999), JP Morgan

between these two extremes. Objectives differ by country, and even within a country exchange rate system may differ from one period to the next. Korea also has been experiencing several types of exchange rate system and currently employs the free floating exchange rate system since December 1997.

Recent currency crises revealed that pegged exchange rate systems are inherently crisis-prone for emerging market economies and that these countries should be

encouraged, in their own interest and for the broader interests of the international community, to adopt floating rate system. But a reasoned judgement on the desirable exchange rate system needs to be based not only on how it performs in a crisis, but how it performs on average over time in specific countries.

The figure 1 shows the set up of foreign exchange regimes as of January 1, 1989 and January 1, 1999, according to the IMF's classification. There are more countries around (at least as members of the IMF) than there were 10 years ago. Many of these countries are parts of the former Soviet Union. All other things equal, however, there would probably have been a bias to having more rather than less fixed currencies now than 10 years ago. Instead, the share of fixed exchange rates has fallen from about 60% to about 45%, while the share of floating currencies has risen from about 12% to 25%.

Brief History of Exchange Rate Systems in Korea

It was not until February 1980 that Korea changed its single currency peg[2] system to a multiple currency basket peg system, permitting the exchange rate to fluctuate against major currencies. Under the former system, over dependence on the U.S. dollar led to continuous misalignment[3] of the Korean won exchange rate as Korea's trade and financial ties to Europe and East Asia grew in the latter part of the 1970's

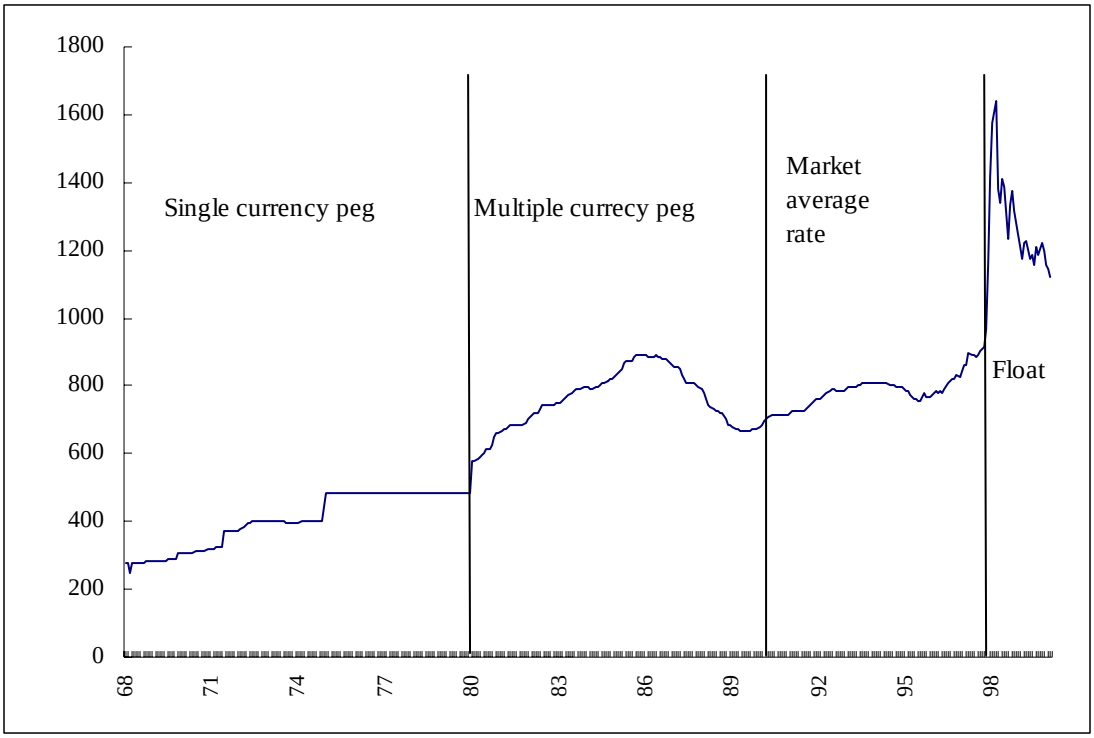
Under the multiple currency peg system, the basic exchange rate of the Korean won against the U.S. dollar was determined as the weighted average of two baskets, the SDR

[2] The terms fixed or pegged exchange rate can be used to refer to any system in which a monetary authority announces buying and selling rates for its currency in terms of a foreign currency and promises to trade in unlimited amounts at that rates

[3] In order to correct these imbalances, the Korean won had to be devalued four times: November 3, 1969(291.40 to 304.35, 4.3% devaluation); June 28, 1971(328.15 to 370.80, 11.5% devaluation), December 7, 1974 (399.00 to 484.00, 17.6% devaluation), January 12, 1980(484.00 to 580, 16.6% devaluation)

basket and a trade-weighted basket composed of major trading currencies, with the addition of an policy factor[4]. During this period, exchange rate did not reflect foreign exchange market conditions - supply and demand for foreign exchange – efficiently. And foreign countries, especially U.S. government, accused the Korean government of manipulating the policy factor variable to its advantage.

Figure 2. Exchange Rates and Exchange Rate Systems



* Basic exchange rates

In order to address these issues, the managed floating exchange rate system was newly adopted in the name of the market average exchange rate system in March 1990.

[4] Exchange Rate = α · SDR basket + β · TWB + P
where α + β =1, TWB : trade weighted basket, P : policy factor

The basic exchange rate under this system was the market average rate of the previous day, determined by the weighted average of the market exchange rate, where the weights were the volumes of each transaction. The interbank spot rate was allowed to move within an upper and a lower limit around each day's basic exchange rate[5].

In December 15, 1997, however, the daily limit of fluctuation for the interbank exchange rate was abolished and, thus, Korea's exchange rate system was shifted to a freely floating system. IMF(1998) indicated the maintenance for too long of pegged exchange rate regimes, which complicated the response of monetary policy to overheating pressures, and which came to be viewed as implicit guarantees of exchange value, encouraging external borrowing and leading to excessive exposure to foreign exchange risk in both the financial and corporate sectors.

Seoul Foreign Exchange Market

The foreign exchange market is the interface between the domestic financial market and foreign monetary areas. Generally speaking, the foreign exchange market is understood to mean the market for foreign currencies; for practical purposes, this mostly implies dealing by telephone in foreign currency balances payable abroad. The relationship ruling between supply and demand in the foreign exchange market determines the exchange rate of foreign currencies, which is expressed in Korea in terms of the Korean won price of one (or a hundred) unit(s) of the foreign currency.

An essential prerequisite of free foreign exchange dealing is the unrestricted

[5] Before adopting the free floating exchange rate system, the daily trading band was widened six times reflecting market pressures: March 1990(±0.4 percent of the basic rate), September 1991(±0.6), July 1992(±0.8), October 1993(±1.0), November 1994(±1.5), December 1995 (±2.25), November 1997(±10.0)

convertibility of the Korean won into other currencies; such a currency is called a convertible currency.

The foreign exchange market in Korea is divided into a customer market, where foreign exchange banks deal in foreign exchange with customers such as importers, exporters and travelers, and an interbank market, where foreign exchange banks deal in foreign exchange among themselves. The bulk of foreign exchange transactions in value terms are made in the interbank market, and it is here that the exchange rate is determined.

The participants in the foreign exchange market consist of the central bank, foreign exchange banks, business firms, and foreign exchange brokers. The central bank pursues a deliberate intervention policy in certain situation, notably to even out short-term fluctuations in exchange rates in the Korean won-dollar market, thus contributing to the maintenance of orderly market conditions. Foreign exchange banks mainly participate in it to dispose of open positions arising from transactions with non-financial sector customers such as firms. Meanwhile, firms enter the market to settle external transactions such as imports and exports. Foreign exchange brokers intermediate between foreign exchange banks without holding any positions. There was only a foreign exchange brokers, the Korea Financial Telecommunications & Clearings Institute (KFTC) at that time.

The one reason for the government’s frequent intervention in the foreign exchange market during pre-crisis period was the vulnerable and underdeveloped infrastructure of the Seoul foreign exchange market. Extremely thin trading volume in Seoul foreign exchange market did not provide for market participant to access the market. Central

bank's activities in 1997 could be interpreted as a kind of distribution of U.S. dollar to financial institutions rather than intervention. Especially, lack of forward market contributed to excess demand for U.S. dollar in spot market. There were no other ways for market participants, including banks, business firms, and even individual, to avoid the risk from imminent devaluation or collapse of exchange regime. If the band is broken, depreciation is likely to be substantial as private agent rush to cover their remaining foreign exchange exposures and as foreign and domestic capital attempts to flee the developing crisis. The authorities, with limited remaining reserves, are in a poor position to help stabilize the rate, and the market, which is not used to operating without official support tends to become illiquid and move erratically.

Tools for Policymakers to Influence Exchange Rates

As noted earlier, there were four devaluation episodes during the multiple currency basket system and six widening of band during the market average rate system period. Those policy actions corroborate that there were substantial pressures on existing exchange rates in those days, and that policymakers had very limited ability to keep the existing exchange rates or band from market pressures.

In fact, policymakers have a variety of tools at their disposal to influence the path exchange rates take. The first is domestic monetary policy. The authorities may use an open market operation, defined as an increase or decrease in the domestic monetary base brought about via a purchase or sale of domestic bonds. Unfortunately, assigning monetary policy the job of meeting some exchange rate objectives means that other goals such as inflation or unemployment may have to be sacrificed.

Another tool that can be used by policymakers to influence exchange rate movements is outright controls on capital movements or barriers to international trade. Such restrictions may be necessary to promote exchange rate stability in markets where the credibility of policymakers is low.

Finally, central banks may influence exchange rates by directly intervening in the foreign exchange markets. Intervention affects exchange rates through a various channels, which may be classified in two major categories. Direct channels stress the importance of the volume and intensity of the intervention operations themselves. And indirect channels emphasize the importance of market responses to the intervention operations and how private investors' expectations and positions may be altered.[6]

The degree of capital mobility, because it decides the authorities' status in foreign exchange market, affects the effectiveness of intervention. Tight capital control let the central bank be an unbeatable player in domestic foreign exchange market.

In reality, regardless of the type of exchange rate system, central banks often attempt to influence the exchange rate without fully committing monetary policy by using sterilized exchange market intervention. Floating does not preclude the use of official intervention and adjustments of monetary policy to influence the exchange rate. Unless a country has adopted a pure floating exchange rate and is prepared to absent itself fully at all times from the foreign exchange market, it will at least occasionally be participating in the foreign exchange market with a view to influencing the rate. However, efforts to tightly manage the exchange rate primarily through (sterilized) official intervention tend to recreate the risks and problems of a pegged exchange rate. According to Dominguez and Frankel (1993), whether or not sterilized intervention

[6] See Rosenberg(1996), pp276-7

offers an effective tool for influencing the exchange rate that is independent of monetary and fiscal policy, it may be dangerous for government officials to think that it does. Exchange rate movements are often signals of inappropriate monetary or fiscal policy. Government officials may be falsely lulled into believing that they can ignore such signals if they believe that they have an independent lever that can control the exchange rate. In recent currency crisis, Korea had implemented huge intervention operations in foreign exchange market rather than rebuilding its economic credibility. After IMF came, official intervention was usually strictly limited in the rescue program.

Because an exchange rate is a shared price between two countries, one country's policy toward its currency could have significant spillover effects on other countries. To prevent one country from unfairly manipulating its exchange rate to gain an unfair advantage over others, IMF has adopted a set of guidelines that it recommends its members follow in setting exchange rate policies. The IMF's guidelines, however, are not intended to discourage intervention. On the contrary, intervention is encouraged as long as it helps foster orderly conditions in the foreign exchange market.

Central Bank Intervention

Governments buy and sell foreign exchange for a variety of reasons, including financing embassies and foreign operations, altering the composition of reserves, and paying interest on foreign debts or receiving interest on foreign assets. Sometimes they undertake these transactions directly with each other, operation through their central banks and avoiding the private market. Intervention then refers only to those transactions undertaken specifically between governments and the private market to influence market exchange rates. Foreign exchange market intervention is a transaction

or announcement by an official agent of a government that is intended to influence the value of an exchange rate. In practice, central banks define intervention more narrowly as any official sale or purchase of foreign assets against domestic assets in the foreign exchange market.[7]

Central bank intervention is classified into several categories as follow: sterilized versus nonsterilized intervention, public versus secret (discreet or stealth) intervention, concerted (or joint) versus unilateral intervention, leaning against the wind versus with the wind.[8] According to this categorization, The Bank of Korea's intervention during pre-crisis period can be regarded as sterilized, secret, unilateral, and leaning against the wind intervention. Needless to say, it must be the most ineffective way out of various intervention combinations central banks can employ. However, that kind of intervention is also the most popular one central banks implement in practice because of simplicity.

Besides the decision of when and how to intervene, central banks have varied goals for their intervention operations. The Fed describes four different reasons for its interventions in foreign exchange market: to influence trend movements in exchange rates, to calm disorderly markets, to rebalance its foreign exchange reserve holdings, and to support fellow central banks in their exchange rate operations.[9] Rosenberg (1996) also summarizes the list of objectives as follow:

- Simple smoothing operations to limit potentially erratic short-run fluctuations in exchange rate.
- Operations to counter excessive speculation or market overreaciton to changes in economic fundamentals.
- Trend-breaking operations to put an end to a persistent uptrend or downtrend in a currency's value.

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[7] See Dominguez and Frankel (1993) and Dominguez (1999)
[8] Dominguez and Frankel(1993) explain the definition and category of intervention in detail.
[9] See Dominguez(1999)

    - Operations to counter excessive risk aversion
    - Exchange rate targeting operations designed to rigidly peg a currency's value to some specific level or range
- Resistance to exchange rate movements that exceed some threshold rate of change
- Intervention only to prevent large and persistent misalignments of exchange rates that might harm long-term international competitiveness
- Trend-indicating operations to help push a currency's value in a desired direction.

Dornbush (1998) also indicates why central banks try to affect exchange rates. Probably the main reason is the belief that many capital flows represent merely unstable expectations and that the induced movements in exchange rates cause unnecessary changes in domestic output. The second reason for intervention is a central bank's attempt to move the real exchange rate in order to affect trade flows. The third reason arises from the effects of the exchange rate on domestic inflation. Central banks sometimes intervene in the exchange market to prevent the exchange rate from depreciating, with the aim of preventing import prices from rising and thereby helping to slow inflation.

Above mentioned list of objectives and reasons show why the Bank of Korea intervened in market so aggressively before currency crisis.

Sterilized and Nonsterilized Intervention

In discussing intervention, it is necessary to distinguish between sterilized and nonsterilized intervention because the difference in that category causes more substantial difference in effectiveness of intervention than other classifications do. In the case of sterilized intervention a central bank, say, buys foreign exchange, issuing domestic money. But then the increase in home money is reversed by an open market sale of securities. This process can be explained by the simplest version of the central

bank balance sheet. It shows that a change in reserve money (H), or the monetary liabilities of the central bank, is identically equal to the change in its assets, which in turn equals the sum of changes in domestic credit (DC) and in foreign assets (FA) of the central bank.

$$\Delta H \equiv \Delta DC + \Delta FA$$

In the sterilized intervention case, therefore, the home money supply is kept unchanged. In the case of nonsterilization, by contrast, there is a change in the money stock equal to the amount of intervention. It is widely agreed that nonsterilized intervention, because it changes the money supply, will affect exchange rates. There is widespread skepticism, however, about the effectiveness of sterilized intervention.

While there is no detailed information on whether any particular intervention was sterilized or not, central banks in industrial countries have in practice routinely offset the impact of foreign exchange interventions on the stance of monetary policy. Because monetary policy has typically been used for achieving low rates of inflation rather than for a particular exchange rate objective. In the case of Japan, for instance, the impact of both yen selling and buying operations ordered by the Ministry of Finance on domestic liquidity is offset by the open market operations of the Bank of Japan in order to maintain its desired level of daily excess reserves. In fact, with recent zero interest rates, sterilizing foreign exchange interventions has become particularly important to the Bank of Japan, as markets have tended do focus on the level of excess reserves as an implicit indicator of the stance of monetary policy. Likewise, directives to the Foreign Exchange Desk of the Federal Reserve to sell dollars are simultaneously combined with directives to the Open Market Desk to mop up the resulting excess liquidity. This does not, however, imply that conditions in the foreign exchange market have had no influence on

the monetary policy of industrial countries. Rather, the decision to change the stance of monetary policy, which could be influenced in part by exchange rate development, has been separated in practice from the decision to intervene in the foreign exchange market.[10]

Countries that adhere to monetary targets are generally assumed to engage chiefly in sterilized intervention operations (Dominguez and Frankel 1993). As the Bank of Korea doesn't release the intervention data on volume and timing, we don't know when and how to offset the effects of intervention on money stock in Korea. But we know that the Bank of Korea sold US dollar to support Korean won on a massive scale in Seoul foreign exchange market during pre-crisis period and also had maintained ease monetary policy. The monetary authorities were reluctant to raise domestic interest rates, as this will further undermine already weak banks and businesses. The Bank tried to offset the decrease of money stock, which was resulted from foreign exchange selling/Korean won buying intervention operation, by ease monetary policy.

The Bank of Korea used to sterilize the increase(decrease) of money stock by issuing (buying) monetary stabilization bonds (MSBs). Because bond markets in Korea is less developed, the central bank buy and sell its own securities for the purpose of open market operations.[11]

Because Korea adopts monetary aggregate as a target instrument, central bank used to absorb the change in monetary aggregate result from international sector such as surplus or deficit in current and capital account. Several studies on the central bank

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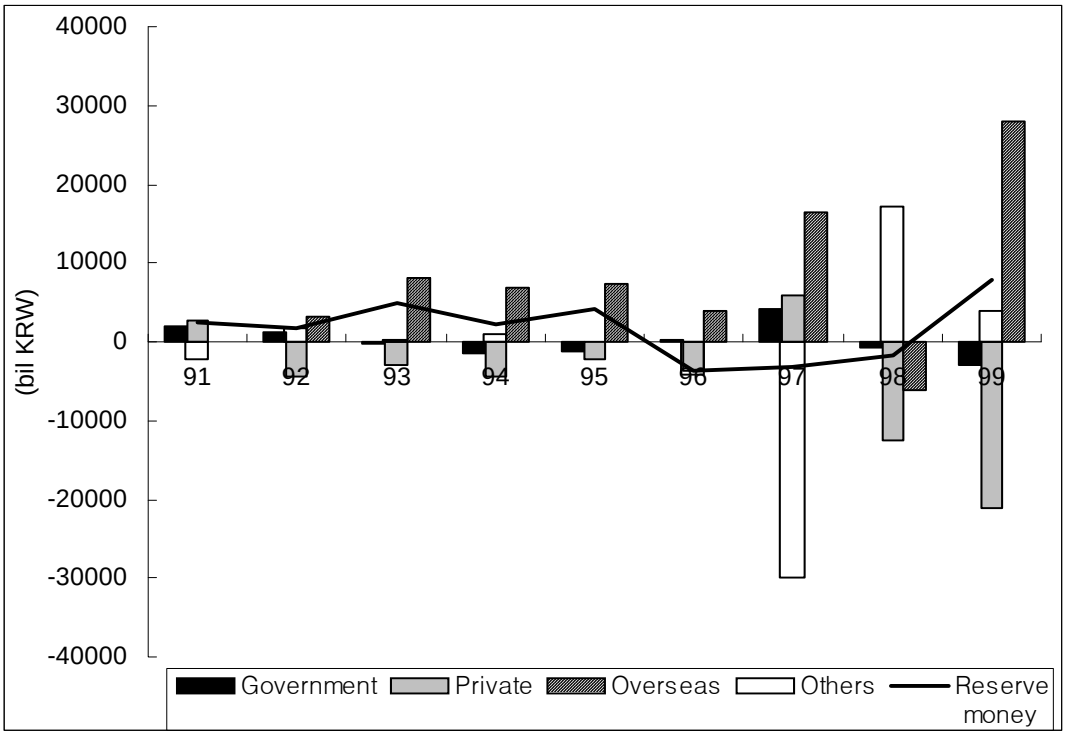
[10] See Ramaswamy and Samiei (2000), p.8

[11] Some countries issued foreign currency denominated government bonds to fund the intervention money. For example, the Carter bonds was issued by the United State in Germany and Switzerland between 1978 and 1980.

intervention support this fact (Choi,1995, Hwang, 1999). Figure 3 shows that reserve

Figure 3. Reserve Money by Sectors



Source : The Bank of Korea

money was mainly increased by overseas sector due to capital inflows in 1990s. In order to offset the overseas effects, central bank used to reduce other sectors.

In a world of N countries and N policy tools (the individual countries' monetary policies), it is only by accident that N domestic objectives and N-1 exchange rate targets can be simultaneously attained in the short run. Unless N-1 additional policy instruments are available, conflicts between internal and external balance are bound to arise. Sterilized foreign exchange intervention furnishes N-1 additional policy tools with the potential to be useful complements to monetary policies. If sterilized intervention,

which changes the relative supplies of foreign and domestic assets in private portfolios but leaves the monetary base unchanged, can influence the exchange rate, authorities have a second instrument with which to achieve internal and external targets simultaneously.

The Use of Currency Option Market

Although the development in derivatives markets has widened the array of instrument available to central banks to achieve their policy goal, most central bank intervention occurs mainly in spot and forward currency market. But recently, there have been reports that several central banks have intervened in currency option markets.[12] Without considering derivatives markets, it becomes more difficult to interpret or explain what happened in the market.

Buying Options

A central bank might consider purchasing put options on its own currency in order to defend the domestic currency. Should a speculative attack occur and the domestic currency depreciates as a result of it, the options will be in-the-money and can be exercised by the central bank. This allows the central bank to purchase foreign currency for domestic currency below the current market exchange rate. The cheaply acquired foreign reserves could then be sold in the spot market to defend the domestic currency.

[12] Beyond normal intervention, the authorites may resort to the forward market (Thailand and Korea, 1997) or futures market (Brazil, 1987-98), or they may exchange domestic currency debt for foreign currency linked debt (Mexico, 1994; and Brazil, 1997-98), or they may loan official reserves to domestic institutions experiencing financing difficulties (Korea, 1997).

Hence, this scheme cannot be used to prevent a speculative attack, but would be employed to arrest the deep depreciation that typically follows the abandonment of a peg.

Breuer (1999) analyzes advantages and disadvantages of central bank's use of currency option markets. He raises several drawbacks of purchasing put options as insurance against a speculative attack. First, the cost of options to be bought by the central bank may be higher than expected. It is questionable whether selling options to the central bank with low implied volatility, that is low option price, would be an attractive business for commercial banks. It is more likely that a commercial bank would demand a significantly higher implied volatility as it would have to price the probability of a speculative attack on a underlying currency into the option. Second, through its impact on the option market, the proposed scheme would contribute to an instantaneous depreciation of the domestic currency. Establishing a hedging position for the put options, a market maker would sell domestic currency. This may lead to immediate downward pressure on the domestic currency when the central bank purchases put options. Third, while establishing a hedge to short put option positions triggers an initial depreciation of the domestic currency, the continuous adjustment of the hedging positions increases volatility by amplifying exogenous spot price movements. Fourth, if the counterparties to the option purchases are domestic banks, exercising the options may exacerbate a domestic banking crisis. Considering many difficulties of commercial banks in the currency crisis, such as an interest rate risk stemming from assets and liabilities mismatches, increasing non-performing loan and so on forth, additional losses from the option exercise by central bank might be intolerable. Fifth, central bank purchases of put options on the domestic currency may have an

adverse impact through the signaling channel. In addition, the profitability of options raises a moral hazard problem.

Selling Options

Alternative option strategy is selling options. Selling options to commercial banks may prompt them to engage in volatility reducing hedging, while exposing the central bank to an unlimited loss potential. The type of options to be sold would depend on the specific situation of the country. Options could be used by central banks to boost the credibility of its commitment to a currency band. By combining short put and short call option positions a ‘strangle’ can be created, resembling a target zone. The central bank incurs losses if the exchange rate increases beyond the strike price of the short call option or falls below the strike price of the short put option. If the exchange rate stays between these two points the central bank will keep the premium it collects up-front for the option sales without further losses. Hence, it creates a target band for the exchange rate.

According to Breuer (1999), selling options firstly provides a channel for reducing volatility in exchange rate markets without sending an adverse signal to the market. Market makers with long positions in the domestic currency options would buy or sell the domestic currency in a manner that may reduce the impact of exogenous price movements and therefore could reduce exchange rate volatility. Second, selling options is free of moral hazard problem. In the case of ‘strangle’, if the exchange rate deviates from either of the two strike prices, the central bank can choose between allowing the rate to float and accepting a loss on the option contract or intervening in the spot market to keep the rate in the target zone. This is similar to a spot market intervention, which

leans against the wind at either end of the band. Third, the losses a central bank may face on the option contracts could be less than losses stemming form intervention in the spot market because gains are enhanced and losses reduced by the amount the central bank collects as option premium. However, spot market interventions allow the central bank to abandon its target level at any time, whereas the use of options commits it until expiration. Forth, selling options eliminates the credit risk as is the case when it buys options.

One of possible drawbacks is that by selling options the monetary authorities pre-commit their foreign reserves at established levels. If this information becomes available to traders they may have an incentive to test those levels. Another drawback is that it may make it easier for policy makers to postpone important decisions.

The Mexican Case

Banco de Mexico began to use the option market to acquire foreign reserves from July 1996. The scheme is that the Banco de Mexico would sell U.S. dollar put / peso call options which confer the right to the bearer to sell dollars to the Bank within the month immediately following the auction of the options. Its strike price is not fixed at inception but is the peso fixing rate of the previous business day and is exercisable only when the previous day's fixing rate has appreciated more than the average exchange rate of the preceding 20 working days. This ensures that Banco de Mexico will be acquiring dollars through the exercise only when the peso is appreciating. By June 1997 this amount had risen to 300 million U.S. dollar a month.

The scheme is designed to raise foreign reserves without affecting the spot market. As of July 26, 1996 Mexico's foreign reserves were 15.91 billion U.S. dollar, most of

which was borrowed from the IMF. The option scheme allows the authorities to acquire a maximum of 3.6 billion U.S. dollar a year (300 million U.S. dollar a month). Given that an estimated 5 billion U.S. dollar a day traded in the peso spot market, the average daily acquisition amount of 4.3 million U.S. dollar is sufficiently small to be conducted on a regular basis in the spot market. The fact that the authorities utilize the option market can be interpreted as a desire to test the market and explore opportunities for selling options with a larger notional amount in the future. The scheme succeeds in acquiring foreign reserves without sending an adverse signal which may trigger a speculative attack against the peso. With this scheme Banco de Mexico only buys dollars when the peso has appreciated.

The scheme probably had little effect on the stability of the peso, since market participants had little experience with the pricing of such options. It seems that the scheme is mostly used by Mexican commercial banks to off-load long dollar positions. The central bank uses it to acquire foreign reserves without moving the market. This episode represents the rare case of a central bank’s official participation in a currency option market.

III. EFFECTIVENESS OF FOREIGN EXCHANGE INTERVENTION

The Portfolio Balance Channel

As noted in introduction, the portfolio channel and signaling channel are two most important channels of sterilized intervention to influence the path exchange rate can take.

According to the portfolio balance theory of exchange rate determination, the equilibrium exchange rate is determined by the supply of and demand for domestic and foreign bonds, and a wealth owner cares about the riskiness of a portfolio as well as the expected return that it offers. Since bonds of different currency denomination are perfect substitutes for risk averter only under very unlikely circumstances, a change in outside asset supplies generally alters the risk characteristics of the market portfolio and thus requires an equilibration adjustment in currencies' relative expected returns.

Consideration of risk make it reasonable to assume that an individual's demand for domestic bonds increases when the interest(r) they offer rises relative to the domestic currency return on foreign bonds $\left[r^{*}+(E^{e}-E)/E\right]$. Put another way, an individual will be willing to increase the risk of his portfolio by investing more heavily in domestic bonds only if he is compensated by an increase in the relative expected return on those bonds.

The existence of foreign exchange risk premium is what distinguishes the portfolio balance approach from other theories. It can be interpreted as the additional yield that must be paid to asset holders. A zero risk premium would imply that domestic and foreign bonds are perfect substitutes, which would mean that relative bond supplies play

no role in exchange rate determination. A nonzero risk premium would imply that domestic and foreign bonds are not perfect substitutes, and hence shifts in relative bond supplies will influence exchange rates.

The risk premium (ρ) is defined as

$$\rho = r - r^* - (E^e - E)/E ,$$

that is, as the expected return difference between domestic and foreign bonds. Therefore, the private sector's net demand for domestic bonds is an increasing function of ρ. According to the above equation, an increase in ρ caused by a rise in domestic bond supply relative to foreign bond supply may result either in a rise in r, a decline in r^*, a decline in E^e (i.e., a decline in the expected future value of the foreign currency), a rise in E (i.e., a rise in the foreign currency's spot value), or some combination of the above. Thus the transmission mechanism running from sterilized intervention to the exchange rate is somewhat ambiguous.

Many economists assume that since sterilized intervention leaves the monetary base unchanged, such actions will have no impact on either r or r^*. Moreover, since it is often assumed that the expected future value of a currency (E^e) is determined by long-run forces such as purchasing power parity, sterilized intervention should not affect E^e. Thus if r, r^* , and E^e are assumed unchanged, changes in relative asset supply brought about by sterilized intervention should only affect E. If that is the case, then sterilized purchases (sales) of foreign exchange should lead to a depreciation (an appreciation) of the domestic currency's value.

However, Rosenberg(1996) indicate that it is probably not realistic to assume that the values of r, r^*, and E^e will be completely unchanged. If they are altered in any way by changes in relative asset supply, it is probably safe to say that for a given level of

intervention, nonsterilized intervention operations should have a more powerful direct impact on exchange rates than sterilized operations.

Imperfect Asset Substitutability between Domestic and Foreign Bonds

The distinguishing feature between the monetary models of exchange rate determination and the portfolio balance model is the issue of the degree of substitutability between domestic and foreign bond. In the monetary approach, they are considered to be perfect substitutes, while in the portfolio balance approach they are regarded as imperfect substitutes. The distinction is of considerable importance because it is only by assuming that domestic and foreign bonds are imperfect substitutes that the effects of monetary policy and foreign exchange intervention become different and consequently that sterilized intervention which represents the difference between the two operations can exert exchange rate effects. (Pilbeam 1991)

One approach to explaining imperfect substitutability is to assume that asset holders are totally indifferent to the currency of denomination or country of issue of the bonds in their portfolios but that capital is not perfectly mobile. Typically, however, for developed countries with highly integrated capital market, capital mobility is regarded as being rather high if not quite instantaneous.

An alternative approach to modeling imperfect asset substitutability and that which lies behind the portfolio balance view of exchange rate determination is to assume that capital is perfectly mobile but that domestic and foreign bonds are imperfect substitutes mainly due to perceived differences in riskiness between domestic and foreign bonds. If assets are regarded as equally risky then with perfect capital mobility they must be perfect substitutes.

When domestic and foreign currency bonds are perfect substitute, the foreign exchange market is in equilibrium only if the interest parity condition holds as

$r = r^* + (E^e - E)/E$.

When domestic and foreign currency bonds are imperfect substitutes, the condition above does not hold in general. Instead, equilibrium in foreign exchange market requires that the domestic interest rate equal the expected domestic currency return on foreign bonds plus risk premium, ρ, that reflects the difference between the risk of domestic and foreign bonds:

$r = r^* + (E^e - E)E + \rho$

The risk premium on domestic assets rises when the stock of domestic bonds available to be held by the public rises and falls when the central bank's domestic assets rise. Private investors become more vulnerable to unexpected changes in the home currency's exchange rate as the stock of domestic bond they hold rises. Investor will be unwilling to assume the increased risk of holding more domestic bonds, however, unless they are compensated by a higher expected rate of return (Krugman and Obstfeld 1996)

Domestic and foreign bonds may be imperfect substitutes due to the fact that instability of domestic monetary policy has made domestic bonds relatively more inflation risky than foreign bonds. Alternatively, it may be the case that instability of foreign monetary policies has made foreign bonds relatively inflation risky. In both cases, domestic and foreign bonds will be imperfect substitutes but our policy recommendation in the former case is likely to be to stabilize domestic monetary policy and this itself may eliminate the reason for imperfect asset substitutability. On the other hand, in the second case, we may advocate that the domestic authorities exploit the imperfect asset substitutability to pursue separate exchange rate and monetary policies

so as to isolate the domestic economy from the effects of the unstable foreign monetary policy.

A common feature of the portfolio balance literature is that it tests and rejects the joint hypothesis that assets are perfect substitutes and that expectations are rational. Because it is a joint hypothesis, we cannot conclude that assets are imperfect substitutes, which is the basic supposition of the portfolio balance approach (Edison 1993).

The Signaling Channel

Sterilized intervention is ineffective within the standard monetary model of exchange rate determination. The process of sterilizing intervention, however, alters the amount of publicly held government debt, and therefore could affect exchange rates through portfolio balance model. Direct examination of the portfolio balance mechanism requires data on holdings of government securities and thus is limited to monthly frequencies or lower. The most recent such study is Dominguez and Frankel(1993) who find significant impacts of U.S. and German intervention in the early 1980s. However, Edison (1993)'s comprehensive survey of this approach reports many findings of statistical or economical insignificance (Baillie, Humpage, and Osterberg 1999).

However, much research suggests that intervention might sometimes affect exchange rates and that the impact might be related to informational asymmetries. If true, the only way intervention operations can be successful is if the central bank's action can somehow serve as a signal to alter private investors' expectations enough that it prompts them to reposition their portfolios consistent with the goals of the monetary

authorities. Sterilized intervention may affect exchange rates thorough a signaling, or expectations, channel, whether or not domestic and foreign bonds are imperfect substitutes.

Early work on signaling followed Mussa(1981) who suggested that central banks might signal future changes in monetary policy through interventions, with sales or purchases of foreign exchange implying, respectively, monetary tightening or ease. Such signals could be particularly credible because the intervention would give the monetary authorities an open position in a foreign currency that would result in a loss if they failed to validate their signals.

Besides signaling future monetary policy, there are other signaling mechanisms. If the central bank has consistently better information than do private traders, intervention might cause them to modify their prior estimates of the distribution of exchange rate changes. Bhattacharya and Weller (1997) construct a theoretical, asymmetric information model of the foreign exchange market that explicitly incorporates intervention. In their model, central bank can make accurate inferences about speculators' private information, and speculators get better – but in complete – information from observing the interventions of the central banks.

In this sense, central bankers' preference for secrecy is all the more puzzling in the context of the signaling hypothesis. How can intervention signal future monetary policy intentions if the market does not hear the signal? In practice, even though central banks do not publish intervention data, traders are well aware of central bank intervention activity most of the time. Cukierman and Meltzer (1986) also indicate a degree of policy ambiguity may be optimal. Intuitively, if the market cannot perfectly distinguish between the effects of intervention policy and other factors that move exchange rates

(which the central banks do not control), ineffective intervention policy may be less likely to damage central bank credibility. That is, if intervention policy is sometimes ineffective due both to inconsistent central bank policy and other factors, the market is more likely to give the central bank the benefit of the doubt when they cannot distinguish the source of the problem

Dominguez and Frankel (1993) provide evidence to suggest that the effect of signaling on exchange rates can be significant and tends to dwarf the impact on exchange rates attributable to portfolio balance effects. So important is the signaling effect that "news" of intervention that never in fact transpires may actually have a greater impact on exchange rates than actual intervention that is kept secret.

Effectiveness of Intervention

It is useful to identify the various channel of influence of intervention before analyzing what factors contributed to the ineffectiveness of intervention during pre crisis period. There are direct and indirect channel for intervention to influence the path exchange rates take. The direct channels stress the importance of the volume and intensity of the intervention operations themselves, while the indirect channels stress the importance of market responses to the intervention operations and how private investor expectations and positions may be altered.

In the class of asset market models using the portfolio balance approach, domestic and foreign assets are deemed to be imperfect substitutes. In these models, asset holders allocate their portfolios to balance exchange rate risk against expected rates of return, which are affected by relative supplies of assets. In the class of asset market models

using monetary approach, domestic and foreign assets are deemed to be perfect substitutes. This approach makes portfolio shares infinitely sensitive to changes in expected rates of return. In contrast to portfolio balance models, monetary models typically focus on the demand for and supply of money, bond supplies being irrelevant when all bonds are perfect substitutes.

The portfolio balance approach has commonly been used to assess the effectiveness of intervention because it identifies a direct channel through which intervention can influence the exchange rate. It predicts that sterilized intervention will affect the exchange rate. It predicts that sterilized intervention will affect the exchange rated by altering the supplies of domestic and foreign assets. The monetary approach, by contrast, predicts that sterilized intervention will have no direct effect since the monetary base is unchanged. Both approaches permit intervention to affect the exchange rate indirectly, however, by providing information about the views and intentions of the monetary authorities and thus influencing the expectations of exchange market participants. This indirect influence is described as the signaling effect, of signaling channel.[1]

In fact, in industrial countries the volume of intervention is often quite small relative to the daily turnover of foreign exchange activity, the stock of money held by the private sector, and the stock of publicly traded domestic and foreign bonds in private portfolios. Thus, most studies conclude that the direct effect of intervention on exchange rates is either statistically insignificant or quantitatively unimportant. Unlike the experiences in most industrial countries having freely floating exchange rates, intervention in the foreign exchange market could be effective in the case of those developing countries which adopted managed floating systems. Various studies on the effectiveness of

[1] See Edison(1993), pp. 3-4.

intervention in Korea during the managed floating system also confirmed that sterilized intervention had at least a short-run effect.[2] Choi (1995) indicates that two individual operations, selling foreign currency and buying domestic bonds, have different life cycle. The foreign currency bought by central bank is not necessarily sold as time passed. The monetary stabilization bonds is, however, redeemed at maturity, thus it increased the money stock in the long-run.

[2] See Park, Chung and Wang(1999) pp.106-7.

IV. CURRENCY CRSIS AND FOREIGN EXCHANGE INTERVENTION

Currency Crisis

According to the IMF (1998), a number of broad types of economic or financial crisis can be classified into four categories: currency crisis, banking crisis, systemic financial crisis, and foreign debt crisis.

Currency crisis may be said to occur when a speculative attack on the exchange value of a currency results in a devaluation (or sharp depreciation) of the currency, or forces the authorities to defend the currency by expending large volumes of international reserves or by sharply raising interest rates. Although, the authorities successfully defended exchange value by intervening heavily in the foreign exchange market, or by raising interest rates sharply, or by other means, those policy responses can also have profound negative effects on investment, unemployment, the government budget deficit and the domestic distribution of income.[1]

A banking crisis refers to a situation in which actual or potential bank runs or failures induce banks to suspend the internal convertibility of their liabilities or which compels the government to intervene to prevent this by extending assistance on a large scale. Kaminsky and Reinhart (1999) find the peak of the banking crisis most often comes after the currency crash, suggesting that existing problems were aggravated or new ones created by the high interest rates required to defend the exchange rate peg or the foreign exchange exposure of banks. Mishkin (1996) indicates how dangerous a pegged exchange rate regime can be for a developing country if it has a fragile banking system, short duration debt contracts and substantial amounts of debt denominated in

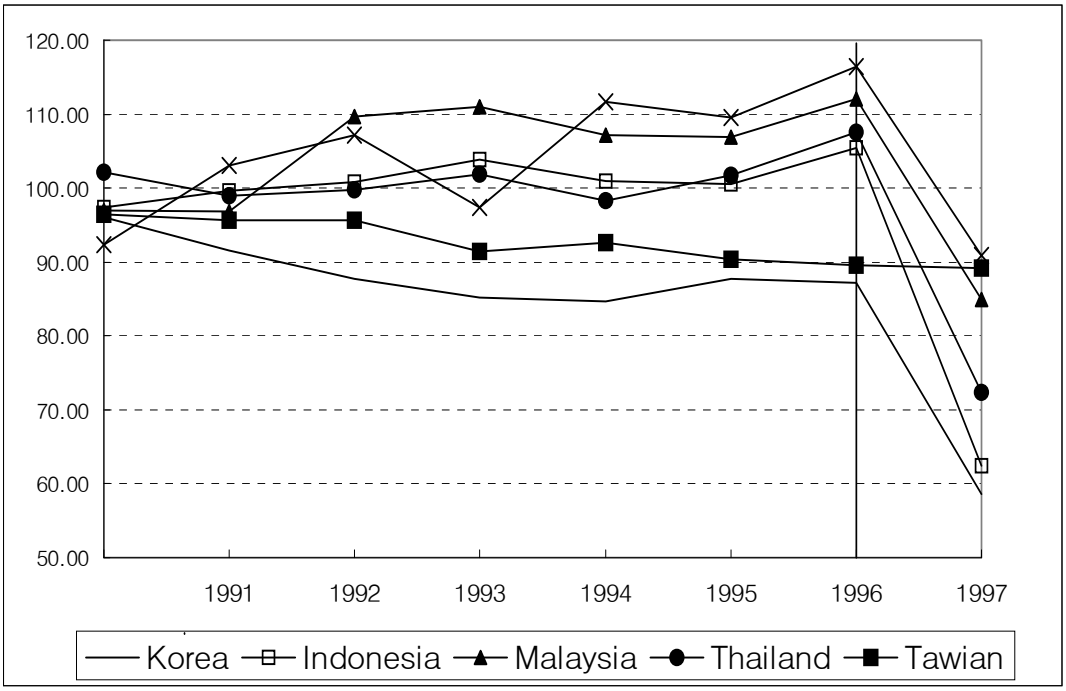
[1] See Obstfeld and Rogoff(1995)

foreign currencies.

Although Korea's crisis in 1997 can not be described as any single type of crisis, it is also meaningful to analysis a type of crisis individually rather than together. In this paper, currency crisis is more emphasized to show the ineffectiveness of intervention when the foreign exchange market is situated at currency crisis.

There were various hypotheses and interpretations to explore what caused Asian currency crisis. Corsetti, Psenti and Roubini (1998) point out two main approaches to this matter. According to one view, sudden shifts in market expectations and confidence were the key sources of the initial financial turmoil, its propagation over time and regional contagion. According to other view, the crisis reflected structural and policy distortions in the countries of the region. Fundamental imbalances triggered the currency and financial crisis in 1997, even if, once the crisis started, market overreaction and herding caused the plunge of exchange rates to be more severe than warranted by the initial weak economic conditions.

Figure 4. Real Exchange Rates(end of year)



Source: JP Morgan. The Base figure (100) is the average for the year 1990

Maybe all literatures about crisis episodes indicate that a significant real exchange rate appreciation may be associated with a loss of competitiveness and a structural worsening of the trade balance, thus jeopardizing the sustainability of the current account. Figure 4 shows that the currency depreciated in real term in Korea and Taiwan. This suggests that with the important exception of Korea, all the currencies that crashed in 1997 had experienced a real appreciation. That reflected the fact that Korea followed a more flexible exchange rate regime than others do. In fact, the choice of the exchange rate regime against US dollar was a key factor in the observed real exchange rate appreciation.[2] Countries with more rigid policy rules experienced a much larger real appreciation.

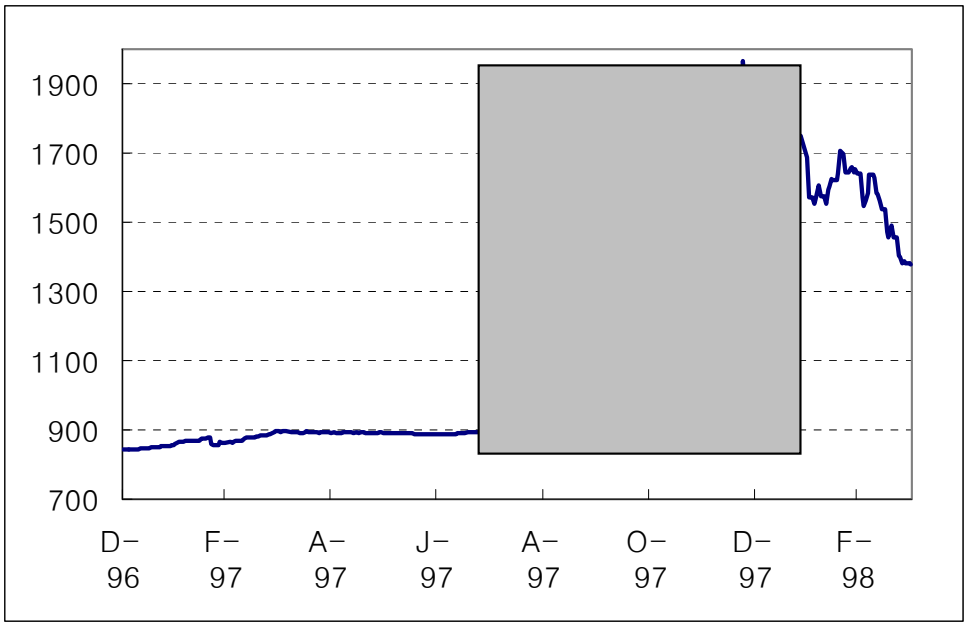
The speculative pressure in October 1997 first affected Taiwan, then Hong Kong,

[2] Only Hong Kong had actually a currency board with the parity tied to that of the US dollar. Other countries were formally pegging their exchange rate to a basket of currencies. However, the effective weight of the US dollar in the basket was so high that their policies could be characterized as an implicit peg to the US currency.

but not the Korean won. Since during the 1990s the won had depreciated in real terms as shown in the Figure 4, Korea had suffered less from the devaluation in the region, in comparison to Taiwan. Most importantly, the won had been on a gently declining path in 1996 and had also lost its value between the beginning of 1997 and the end of September.

By the end of October, a policy of gradual adjustment in the parity had led the won to a very contained depreciation relative to December 1996. This implied that, relative to the currencies of Thailand, Indonesia, Malaysia and Philippines, the won had appreciated. Moreover, Singapore and Taiwan (which competed directly with Korea in a wide range of export products) had allowed their currencies to depreciated more substantially than the won; this had put Korea – a country in a serious economic crisis since the middle of 1996 – at a rather severe competitive loss.

Figure 5. KRW/USD Exchange Rate Movement



* Basic Exchange Rates

The Evidence of Ineffective Intervention

There are several ways to gauge the effectiveness of central bank intervention. Firstly, from the perspective of portfolio theory we examine that intervention operations that change the composition of outside assets can influence the exchange rate because they lead investors to rebalance their portfolios. To avoid some difficulties[3] of this approach, others test whether changes in asset supplies help to explain the expected or predictable component of ex post excess returns in foreign exchange market. Second way is that examine the profitability of intervention as Milton Friedman suggests. The idea is that if intervention is to be stabilizing, then the central bank must be buying when the currency value is low and selling when it is high, in which case it should make profits in the market. Thirdly, according to the one of major purposes of intervention, calming disorderly markets, we examine that intervention can influence the variance of exchange rate change as well as the level of exchange rates.

In this paper, I used to assume that the central bank intervention in pre-crisis period was ineffective simply because we don't know inputs - the precise amount and timing of intervention. Thus I just try to explain the effectiveness of intervention by showing simple exchange rate figure rather than testing above-mentioned methods. Of course, there were many other sources to influence the exchange rate, the exchange rate movement in the second half of 1997 shows excessiveness in terms of level and variance contrary to intention of intervention. Even though intervention may succeed in control the exchange rate in the short-run, at least several minutes after intervention operations, overall trend could be justified as an unsuccessful intervention.

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[3] See Dominguez and Frankel (1993). pp.104-5

In addition to that, the unusual amount of intervention is an indirect evidence of ineffectiveness. The fact that the Bank of Korea was forced to intervene day by day despite of very limited reserves implicitly shows ineffectiveness of intervention.

The Management of Foreign Reserves

Reserves represent the ammunition that the central bank can utilize to defend its currency when attacked. Countries with high reserves will typically have a better chance to withstand such an attack. This logic implies that countries with high reserves will less likely be attacked in the first place, as investors realize that the chances of success are low.[4]

Foreign Exchange Reserves and The Scale of Intervention

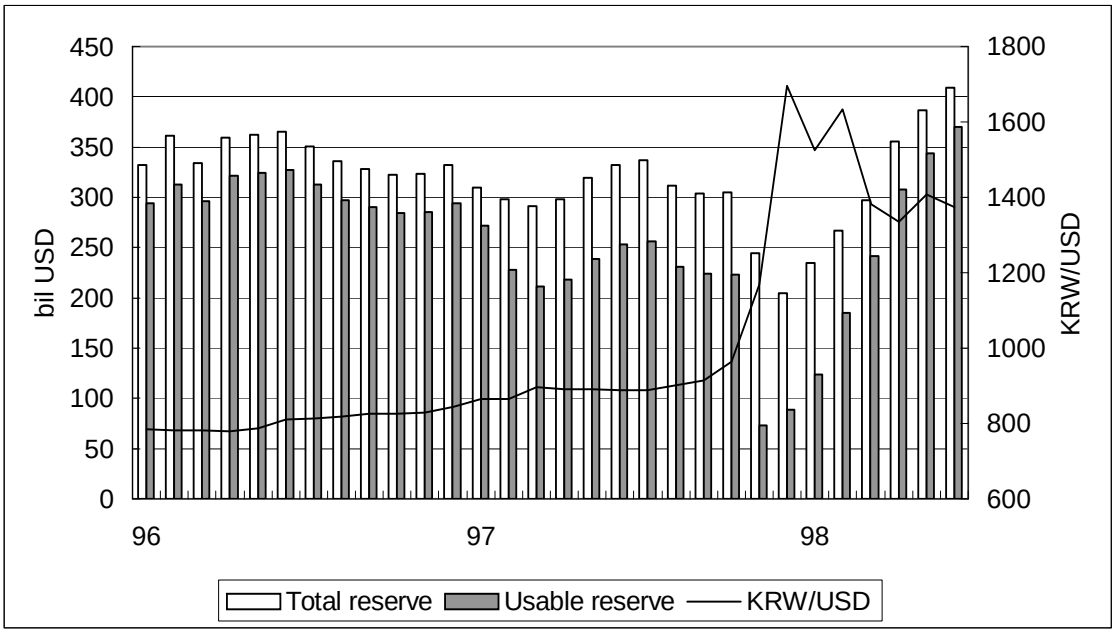
While the stock of foreign exchange reserves held by industrial countries has increased over time, those increases have not kept pace with the dramatic increases in foreign exchange trading or gross financial flows. Thus, in a relative sense, the effective stock of foreign exchange reserves held by industrial countries has actually declined. In case of Korea, the size of Seoul foreign exchange market was not so big as the Korean won had no international convertibility. But the amount of capital flows was massive. Large interest rate differentials and the overhauling of the previous heavy regulations on capital movements were major contributing factors in triggering massive capital inflows into Korea during 1990s. The sudden collapse of investors' confidence caused capital

[4] It is arguable, however, how reserve stocks should be scaled to provide a meaningful measure of reserve adequacy. In the past, economists used to consider import coverage(the number of months of imports of goods and non-factor services that reserves cover) as the most appropriate measure. Such measure was indeed adequate when the channel of transmission for currency attacks was the current account. But given the opening of capital accounts in recent years, scaling against some measure of broad liquid monetary liabilities appears more appropriate

outflows, which were reflected in sharp decline of the rollover ratio of short-term external borrowing during the crisis. Though Korea's reserves had been increased over time, it was too little to back up the financing difficulties of the financial institutions.

Korean government allowed their foreign exchange reserves to fall almost to zero in 1997. The Bank of Korea had spent huge amount of reserves in market intervention to shore up the exchange rate including forward intervention. According to the Bank of Korea's non-publicized report to the National Assembly hearing on financial crisis, the Bank sold about 26 billion U.S. dollar including forward sale 8.9 billion U.S. dollar in 1997.[5] The Bank bought about 7.8 billion U.S. dollar between April and June 1997. But rest of the year the bank sold U.S. dollar. Especially on October and November 1999, the bank sold 5.3 and 6.5 billion U.S. dollar respectively. The amount the Bank intervened was nearly whole amount of its foreign reserves at that

Figure 6. Foreign Reserves and Exchange Rate



Source: The Bank of Korea

[5] See Younhap News Agency (Jan. 20, 1999)

time. Before seriously considering the final outcomes of such an unprecedented huge amount of intervention, government was forced to intervene the market to foster orderly conditions in the foreign exchange market.

Some additional U.S. dollar had been extended as loans to financial institutions encountering difficulty in accessing foreign currency loans offshore. Strictly, the latter did not represent loss to reserves. But practically speaking, since these loans were not liquid (i.e., cannot be called back on demand given difficulties among financial institutions), it would be safer to exclude them as reserves readily available to the central bank.

The Bank of Korea's practice of placing deposits with foreign branches of domestic banks actually began in the late 1980s, but the discrepancy between total and usable reserves stayed relatively small even through 1996. Figure 6 shows the growing gap between total and usable reserves as the crisis approached. The discrepancy increased during 1997 as the Bank of Korea extended additional liquidity support to troubled off-shore branches of Korean banks. By the end of June, 1997, the gap between official and usable reserves had grown to 8 billion US dollar. By the end of November, the gap had risen to 17 billion US dollar.

Further (potential) losses in liquid reserves were expected since Korea had committed to lend 500 million US dollar to Thailand as part of lending arrangement spearheaded by the IMF.

The unwillingness of foreign lenders to extend new credits or to roll over existing credits to emerging markets is thought to have been an important precipitating factor in the Asian crisis. Aizenman (1999) indicates that when the expected reserve position of

emerging markets is large relative to the potential bailout in a bad state of nature, reserve volatility is unimportant. The same amount of reserve volatility can cause a large reduction in the offered supply of international credit if the emerging market's foreign debt is large enough or if the collapse of output forces the private sector to downgrade its priors regarding repayment possibilities.

Once it became clear that the authorities are caught in a situation where they want to defend the exchange rate, but dare not raise domestic interest rates (credibly and substantially), and are running short of reserves, then speculative pressures against the exchange rate become overwhelming. Choi (1999) insists that if the daily band of foreign exchange rate set by market average rate system had been widened earlier, the sudden massive fall in the exchange value of the Korean won toward the end of 1997 could have been avoided in favor of a gradual depreciation. In contrast, a number of countries (Taiwan and Singapore, for example) introduced greater exchange rate flexibility without exhausting their foreign exchange reserves. These countries did not suffer the same violent downdrafts in their foreign exchange markets. In recent years Hong Kong, Taiwan, and China have all accumulated substantial stocks of foreign exchange. While the motives for these bulidups were not all economic, they may helped these economies to weather financial turbulence at less cost than other emerging market economies in the region.

This fact raise the matter of technical feasibility of central bank intervention when reserves are not enough to calm down a massive series of speculative attacks. Obstfeld and Rogoff (1995), however, indicate that there are no insurmountable technical obstacles to fixing exchange rates. Most central banks have access to enough foreign exchange resources to beat down a speculative attack of any magnitude, provided they

are willing to subordinate all the other goals of monetary policy. By reducing its monetary base sufficiently, the central bank can raise interest rates to a level so high that speculators will find it prohibitively expensive to go short in the domestic currency.

The management of Foreign Reserves in Practice

Foreign reserves are costly in two ways. First, accumulating reserves by having exports exceed imports requires a cut in domestic consumption an investment. Second, when the government buys foreign currency from its exporters and issues domestic bonds in exchange, it generally pays a much higher rate of interest on its domestic bonds that it receives on its reserve, which it usually invests in very safe assets such as U.S. Treasury bills. If a country accumulate reserves by borrowing abroad, it can also be quite expensive because of yield spread between borrowing and investing.

Central banks nowadays are under more pressure to actively manage their foreign reserves than in the past; besides defending the exchange rate, they have to search for better returns as well. But the capacity to intervene places high demands on the liquidity of the assets the foreign reserves are invested in. The liquidity requirement not only restricts the choice of possible asset, it also restricts the choice of possible currencies and their relative distribution. After these factors have been taken into consideration, the management of the foreign reserves must be conducted in accordance with “best practice” in business and risk management. This means that the foreign reserves shall be managed so as to achieve the highest possible return within the authorized limits for risk-taking and with possible future intervention in mind (Ragnartz, 1999)

A country could substantially lower the net cost of holding reserves by investing them in liquid assets with higher yields than short-term US Treasury bills. In this case,

however, the value of the investment portfolio in mainly affected by three factors: exchange rate developments, the degree of credit risk and the exposure to interest rate risk. Thus, central banks or other institutions involved in foreign reserves management must well recognize these risks on their investment portfolio so as not to hurt the value of their precious resources.

Eichgengreen and Mathieson (2000) find the striking stability over time not just of the currency composition of reserves but also of the relationship between the demand for reserves denominated in different currencies and its principal determinants: trade flows, financial flows and currency pegs. But it is also true that these gradual movements have culminated into some notable changes in the currency composition of international reserves over the last few decades. The dollar's share has fallen over the last quarter century from its position of unrivaled dominance in the Bretton Woods period.

Even though the exchange rate risk is more substantial in portfolio management, most central banks maintain their currency composition relatively fixed and do not actively managed. The reason why the exchange rate risk is not actively managed is that the each individual central bank is just one of many central banks; and if each central bank actively managed the exchange rate risk, this could disrupt the monetary and exchange rate policies of other central banks. Furthermore, the capacity for intervention may be affected negatively if the currency distribution was actively managed. Therefore, central banks are more likely to concentrate on interest rate risk management.

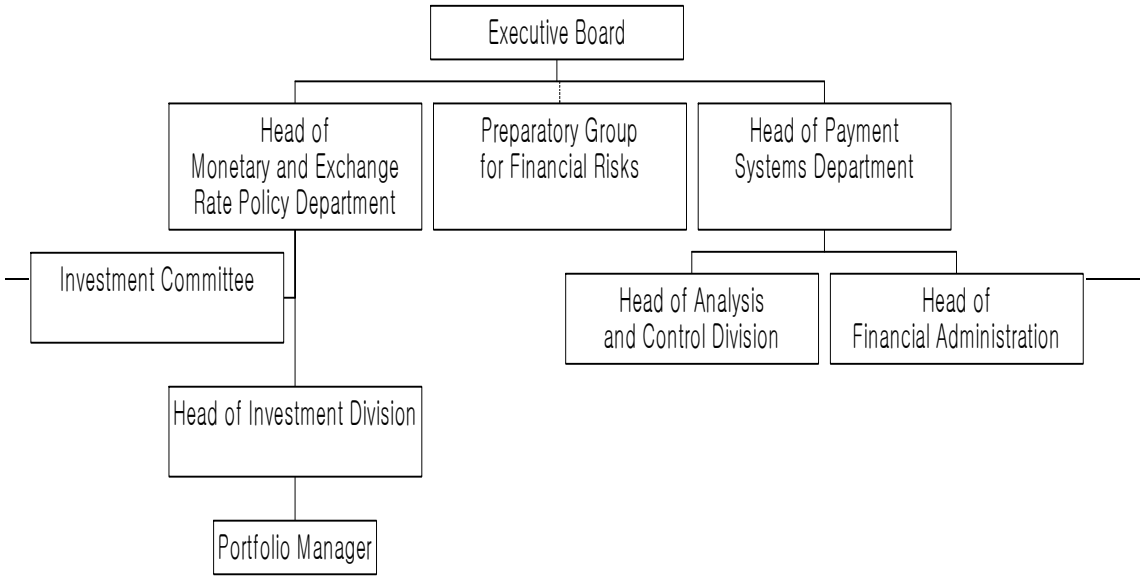
Interest rate risk can be measured and controlled by the choice of the portfolio's 'modified duration'[6]. Thus, the question of the level of interest rate risk exposure for the

[6] Modified duration can be interpreted as the approximate percentage change in price for a 100 basis point change in yield (Fabozzi, 1993).

foreign reserves mainly concerns the choice of modified duration for the investment portfolio. The choice of duration for a portfolio is simplest if the investor has a clear investment horizon. Matching the duration of assets and liabilities can immunize the market risk. But if a clear investment horizon is lacking, the choice of duration will always be associated with certain amount of subjectivity. Asset managers without a clear investment horizon are thus faced with the choice of either investing in accordance with a strategy which maximizes results over time or investing in accordance with a strategy that enables a more stable reported results.

To avoid excess subjectivity in portfolio management, the benchmark portfolios

Figure 7. Division of Responsibility for Investment and Risk Control Operations



$$Modified \quad duration = \frac{Macaulay \quad duration}{(1+y)} \qquad (2)$$

Substituting equation (2) into equation (1)

$$\frac{dP}{dy}\frac{1}{p} = -Modified \quad duration \qquad (3)$$

where P = price of bond, C = semiannual coupon interest (in $)
y = one-half the yield to maturity or required yield
n = number of semiannual periods (number of years x 2)
M = maturity value (in $)

Source: Ragnartz (1999)

are used because it is obviously important to be able to evaluate and monitor portfolio management against some form of standard. A specific portfolio should be chosen for benchmarking. The return of this portfolio can then serve as a basis for comparison. An interval is set around the duration of benchmark portfolio to enable active management. The size of the interval was based more on each central bank's experience than on exact criteria.[7] However, the entire mandate is used only in exceptional cases and only then in connection with very strong views and assessments of the trend in interest rates. Ragnartz (1999) explains the case of Riksbank. The investment committee is authorized to change the interest risk exposure of the investment portfolio within the duration interval set by the Executive Board, while individual investors have individual mandates to change the interest rate risk, albeit in line with the decisions taken by the investment committee. However the total interest rate exposure of the investment portfolio must never deviate from the duration interval set by the Executive Board (See Figure 7).

The Bank of Japan's Policy Board established 'Basic Guidelines for the Management of External Assets Held by Bank of Japan'[8] to improve the safety and efficiency of the management of external assets as well as increasing transparency on March 28th 2000. According to this guideline, foreign reserves are divided into two types: liquidity portfolio and investment portfolio. Liquidity portfolio is invested in

[7] The average interest rate risk of Riksbank, expressed as modified duration, was approximately 5.5 per cent, which thus became the guideline for the investment portfolio. An interval was set around this level to enable active management. In order for active management to be meaningful, it required a mandate enabling changes to the modified duration of the investment portfolio within an interval of 2.5 per cent, and thus a duration interval of 4.0-6.5 percentage points for the entire investment portfolio.

[8] See http://www.boj.or.jp/en/about/bsiope02.htm.

assets with extremely high liquidity (securities and deposits with maturity not exceeding one year) in preparation for international financial cooperation. Investment portfolio is invested in assets with high liquidity (securities and deposits with maturity not exceeding 5 years denominated in the US dollar, euro and pound sterling), taking return into consideration. For the purpose of interest rate risk control, each currency assets can not deviate, beyond a certain limit, from that of the government securities market (maturity of 1-5 years) as a whole.

So far there has been no critical assessment on the Bank of Korea's foreign reserves management in practice. Ironically, however, the fact that the huge foreign reserves were easily liquidated at such a turbulent market situation demonstrates relatively good practice in foreign reserves management.

Asset Substitutability and Financial Crisis

Individuals and businesses domiciled in a particular country may have a desire to hold both domestic and foreign currency balances as part of their total money holdings. Domestic currency balances may dominate the holdings of resident portfolio because of habit, custom, or regulations. Domestic residents, however, may still wish to hold a portion of their money holdings in foreign currency balances because such balances might provide unique monetary services that domestic balances are incapable of performing or because they might provide similar services as domestic balances at a lower opportunity cost.

During periods of exchange rate stability, there is little incentive or urgency to maintain diversified currency holdings since the chances of exchange rate loss are

perceived to be small and the cost of switching potentially large. In addition, the traditional services that monies provide – the medium of exchange and store of value services – should be roughly similar among competing currencies if exchange rates are expected to be stable. Thus, during periods of exchange rate stability, investors will tend to be indifferent in terms of holding domestic versus foreign currencies. However during periods of actual or expected exchange rate instability, private and official holders may find that competing monies will no longer provide similar monetary services. Some currencies will now provide better store of value services than others will. Under such conditions, private and official holders will take the time and expense to switch their currency holdings in favor of those currencies that provide a more stable store of value.

Above-mentioned phenomena were prevailed in Korea during pre-crisis period. Then, we might say the substitutability between Korean won and US dollar was prohibitively low, and the possibility of successful (sterilized) intervention was relatively high. Despite of such a favorable environment (imperfect asset substitutability) the sterilized intervention was proved ineffective to turn over the market direction. One possible explanation about that can be emerged from the investors' reaction to the changed composition of domestic and foreign currency

Table 1. Forward Exchange Rate and Spread in 1997

(KRW/USD)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NDF Rate	885	881	912	902	899	896	909	940	948	1,082	1,233	1,803
Spread	57	63	72	85	85	85	90	120	119	269	277	693

(bp)												

* end of month Source: Bloomberg

denominated assets. The investors knew the imminent collapse of Korean won with certainty, but no one predicted how much it plummeted with certainty. Therefore the only safe option for investors was wait and see strategy until everything is clear.

The services Korean won and US dollar could provide were definitely different especially in terms of store of value. As the probability of Korean won devaluation had been increasing, it was natural that nobody wanted to keep the Korean won in their vaults. In this extreme case, investors are more likely to sell Korean won as much as they can before announcement of devaluation. Therefore, the US dollar central bank supplied to market by means of intervention had easily absorbed by investors, who are believed that current value of US dollar was fairly cheap in terms of Korean won. The increase of US dollar assets compare to Korean won assets, that is an increase of risk of US dollar asset, in the market failed to raise the investors' required return in the form of US dollar weakness against Korean won. This can be shown at table 1. The non-delivery forward (NDF) rate for Korean won against U.S. dollar was nearly approached to 2,000 in December 1997 despite of huge central bank intervention.

The capacity of individuals and businesses to alter the composition of their money holdings between domestic and foreign currencies is known as currency substitution. The more highly substitutable domestic and foreign currencies are in investor portfolios, the more volatile exchange rates may be in response to even small changes in underlying economic fundamentals.

The issue of currency substitution is important in terms of setting official exchange

rate policy. If currencies are highly substitutable in investor portfolios, it may prove difficult, if not impossible, for domestic policymakers to pursue independent monetary policies.

As I explained in previous section, the issue of asset substitutability is deterministic factor to decide whether portfolio balance channel is effective or not. There are several difficulties, such as measuring expected rates of return, measuring asset supplies, and simultaneity bias between exchange rates and asset supplies variable, in setting up an appropriate test of the portfolio balance theory (Dominguez and Frankel 1993).

Currency substitution can be expected to play a role in exchange rate determination in both developed and less developed countries. In developed nations, the more open an economy is, the greater will be the demand for foreign currency balances to facilitate international trade. Currency substitution has often been widespread in less developed countries. That is because in such countries the extent of domestic financial market liberalization is fairly modest. Hence, there are few adequate domestic inflation hedges available to residents in less developed countries. The risk of higher domestic inflation provides a strong incentive on the part of individuals and business to diversify their money balances between domestic and foreign currencies. If the perceived cost of holding domestic currency rises, the incentive to switch to hard foreign currency balances will correspondingly rise. Choi (1994) supports the hypothesis that the asset substitutability between domestic and foreign assets in Korea is imperfect. The data he used are during March 1990 and December 1993.

In this paper, I used descriptive way to evaluate the degree of asset substitutability rather than statistical methods. Considering the difficulties of getting appropriate data, it can be a way to understand what happened in investors' behavior at that time.

Monetary policy and Signaling effects

If intervention provides a signal of future monetary policy, then the intervention should indeed be followed by changes in monetary policy variables. But if central banks intervene to maintain the monetary policy that is inconsistent with their targets of the exchange rate, changes in monetary policy with domestic targets in mind may induce counterproductive movements in the exchange rate. These movements in the exchange rate may, in turn, induce central banks to intervene in order to try to lean against wind.

One reason sterilized intervention may send more informative and more credible signals than announcements or other public debt-management policies centers on the effect of unanticipated exchange-rate changes on the government's net worth. (Mussa, 1981)

There are other signaling mechanisms beyond the one suggested by Mussa. More generally, if the central bank has consistently better information than do private traders, intervention might cause them to modify their prior estimates of the distribution of exchange rate changes. Bhattacharya and Weller (1997) indicate that the central bank can make accurate inferences about speculator's private information, and speculators get better – but incomplete – information from observing the interventions of the central bank.

Market participants react differently to the foreign exchange transactions of central banks than they do to trades between dealers or customers. One reason for the difference is that central banks are likely to have more information than the market about their own future policy intentions, and interventions may serve to convey (or

signal) this private information. Naranjo and Nimalendran (1998) hypothesize that interventions create significant adverse selection problems for dealer. They find evidence that dealers increase exchange rates spreads around interventions and suggest that in doing so they protect themselves against the greater informational asymmetry around interventions.

Both the Federal Reserve and the Bank of Japan have for some years now conducted their intervention operations openly and directly in the dealer market, typically with the foreign exchange desks of large commercial banks. The interventions are usually reported soon after they occur on Reuters and other news agencies, and then receive prominent coverage in the financial press the next day. It is possible that some traders in market will learn that a central bank is in the market before the story appears in financial news services such as Reuter. It is indeed likely that the trading desks in the first bank (or banks) with which the central bank purchases or sells foreign exchange will know about the intervention before all the other banks. Therefore, although we can assume that all traders know about the intervention when Reuters' report is released, it is possible that some (or even the bulk) of the influence of intervention will occur before the Reuters' time-stamp.

Though it is true that the central bank really try to defend exchange rate regime at any cost, the perceived competing policy goals are major hurdle to persuade the investors to revise their future expectation of exchange rates. During 1997, Korea had suffered a bankruptcy crisis shaking the large domestic conglomerate sector. The string of bankruptcies and financial distress that affected the Korean corporate sector in 1997 translated into serious financial difficulties for the banking system, hitting especially the merchant banks first. These banks had heavily intermediated external funds, borrowing

in foreign currency and lending to domestic chaebols in domestic currency. Actually, Korea experienced a serious deterioration of the macroeconomic conditions already in 1995-96. The current account deficit dramatically widened from 1.5% of GDP to 4.8% in 1996, leading to an unprecedented accumulation of short-term foreign debt. Export growth fell sharply, especially after negative terms of trade shocks hit the economy in 1996. The 1996 growth rate of industrial production halved relative to the previous year. On average, the profitability of the large Korean chaebols, characterized by very high debt/equity ratios, was low and falling (Corsetti, Psenti, and Roubini, 1998).

In this case, therefore, one of remaining options for government, provided that it maintains the exchange regime, is capital control that Krugman (1998) suggested. The weak banking system and economy are hampered by high interest rates, but under high capital mobility, a reduction in these rates would further depreciate the exchange rate. For Korea with high stock of liabilities denominated in foreign currency, a depreciation would then be recessionary, via the increasing burden of foreign debt. Controls on capital flows allow domestic policy makers to break the links between interest rates and exchange rates, so that interest rates can be lowered without incurring the cost of a currency devaluation.

From the perspective of investors including foreign and domestic, it was so obvious that the Korea's central bank was unable to resolve the current situation without such above-mentioned radical approaches. But Korea had persistently intervened the market without considering other approaches.

Along with reports of central bank intervention, the Reuters data include announcement of various macroeconomic statistics, statements by central bank and government officials and reports of major economic events. The shaky conditions of

Korean economy had been analyzed in detail by the international financial news services and foreign investment banks before the eruption of the crisis.

Lim (1999) indicate that government was not credible to persuade the investors, thus the signaling effects of intervention may not be expected.

Institutional Aspects of Korea's Intervention

A brief overview of foreign exchange interventions are conducted in major countries provides a useful starting point for analysis. In case of Japan, the authorization of the foreign exchange operations, as well as the financing of intervention, is the responsibility of the Ministry of Finance. The Bank of Japan implements the actual intervention operations in the foreign exchange market. In the United States, the Federal Reserve and the Treasury have independent legal authority to initiate foreign exchange interventions. Nevertheless, the primary responsibility in practice for initiating interventions has rested with the Treasury. The Federal Reserve implements the actual interventions through the operations of the Foreign Exchange Desk of the Federal Reserve Bank of New York. The financing of interventions is shared between the Treasury and the Federal Reserve.

In executing an intervention, the Federal Reserve either deals directly with commercial banks as counterparties or goes through the brokers' market, using a commercial bank as its agent. In dealing directly with commercial banks, the counterparty can make the information about the intervention public. In dealing through the brokers' market, however, the agent bank can not reveal that it is acting on behalf of the Federal Reserve. The broker knows and announces only the names of two

commercial banks that are party to the transaction. Hence, intervention through the brokers' market gives the Federal Reserve a greater degree of anonymity, which under certain circumstances might influence the effectiveness of an intervention. Prior to the mid-1980s, the Federal Reserve typically operated through the brokers' market. Now it usually deals directly with banks.

The Federal Reserve commonly enters the New York markets, but may intervene in a foreign market either directly with foreign commercial banks or by using foreign central banks as an agent. Usually, the Unites States intervenes in the New York market while the European markets are still open.

Developing countries' condition for foreign exchange intervention is quite different from developed countries' one. In general, these countries have less developed foreign exchange and financial market, and are more vulnerable to external shocks. If a country has well-developed foreign exchange and financial market, smooth fund flows between financial institutions redistribute the fund efficiently, thus foreign exchange rates and interest rates were also decided by the market efficiently. In this case, central bank need not intervene frequently.

During the pre-crisis period Korea's foreign exchange and financial market was not functioning well. As a result, central bank had played bigger role in the market in the form of foreign exchange intervention. The market average rate system was a kind of managed floating rate system with daily band. As long as government seek to maintain the existing exchange rate system, central bank can nothing but spend its limited foreign reserves.

Before onset of currency crisis, there were severe conflicts between the Bank of Korea and the Ministry of Finance and Economy on the revision of the Bank of Korea

Act. Those conflicts were a matter of common knowledge to market participants. Because the foreign exchange intervention operations were the biggest interests of market, some publicized disagreement between two bodies made more uncertainty on Korean won's future.

It is still unknown how two organizations reach to the agreement on practical operations in the market in detail. According to Ministry of Finance and Economy's report to the national assembly's special committee on currency crisis, the Bank of Korea and the Ministry of Finance and Economy used to exchange views on foreign exchange rate movements, and practical operations were conducted by the Bank of Korea. Especially during pre-crisis period there were frequent working-level talks between two bodies through telephone communication. But there were no documented records for discussion.

Different views on the state of foreign exchange market can be existed in any country, but the decision making process is much more transparent and well recognized by market participants in the developed countries, not so as to set off confusion. For example, the conflicts between the objectives to fight inflation by the Fed and to keep the dollar from strengthening, deemed desirable by the Treasury, became evident in meetings of Federal Open Market Committee. During early 1989, debate increased among the governors on the Federal Reserve Board concerning intervention carried out at the behest of the Treasury and the appropriateness of its signal toward monetary policy. By the FOMC meeting on May 16, 1989, intervention had become an important item of discussion as large purchases of foreign currency assets by the New York Federal Reserve Bank had increased its holdings beyond the legal limit. By the August 22 FOMC meeting, many governors were critical of the intervention policy. Governor

Angell and Johnson dissented on a move that would allow further intervention stating “intervention confuses market participants concerning the policy commitment toward price stability.”

Enoch (1998) indicates that the foreign exchange market is particularly relevant with regard to the issue of transparency because foreign exchange market policy seems frequently to have become dominated by non-economic factors, with political pressures, or the desire to maintain the credibility of the exchange rate regime. That policy causing central banks to maintain exchange rates that could not be justified by market fundamentals. One possible explanation for secrecy in central bank intervention may be where the central bank has limited credibility (or limited reserves) and where it is concerned that its appearance in the markets may in fact prompt increased market pressures against it.

Choi(1995) indicates the majority of intervention was lean against the wind type in Korea. When the Korean won is weak, government intervened in market rather passively than they do when the Korean won is strong. In addition, the main instrument used in sterilization process was monetary stabilization bond (MSBs), which was a central bank’s own liability. The interest payments of MSBs used to be the one of main reason of monetary base increase. The critical point is that the central bank paid the costs, that is interests payment, of sterilization. In the end, This sterilization process might induce inflationary expectation

But during pre-crisis period, maybe all interventions were to protect the Korean won from the rapid depreciation. Those interventions reduced domestic monetary base, so the inflation expectations were different from the former interventions.

V. CONCLUSION

If the foreign exchange markets is thin and dominated by a relatively small number of agents, it is likely that the exchange rate will be volatile if the authorities do not provide some guidance and support. This problem is compounded if, as is often the case, there is no long track of record of stable macroeconomic policies that can firmly anchor market expectations about future monetary and exchange rate policy. Also underdeveloped and incomplete financial markets imply that hedging against exchange rate risk is usually costly and sometimes impossible. As a result, the costs exchange rate volatility can be substantial for individual agents and for the economy as a whole. In particular, economies with weak financial sector regulation and supervision, and where banks and corporations have a large exposure to foreign currency borrowing, can be highly vulnerable to unexpected fluctuations in the exchange rate.

As I explained in section II, there are various policy tools to influence the path exchange rates can take. Foreign exchange intervention is one of the most direct approaches out of those policy measures.

In general, foreign exchange intervention has been successful when at least one of the following requirements are fulfilled. First, currency had already started to turn around. Second, the main fundamental drivers of the extreme valuations were already running out of steam. Third, short-run speculative positions were on the other side of the trade. Fourth, the developed countries, especially the United States, had good reasons to join in turning currencies trend around. However, none of these conditions were met in 1997.

During pre-crisis period, Korea’s intervention type was the most ineffective one out

of various intervention combinations. The leaning against wind intervention to support Korean won during pre-crisis period exhausted the foreign reserves. Given the weak banking system and business sector, sterilization to maintain the interest rates low was unavoidable policy decision. Though Korean won was not an international currency, Korean won forward rates in non-delivery forward market showed short-term speculative positions were insurmountable among international investors.

As Korea has opened much of its capital market after currency crisis, it seems that foreign investors drove stock market. Whenever they buy and sell, its impact on market is much greater than that of domestic players. As long as they hold the money in Korean won, exchange rates will not be affected by foreign investors' activities. And the foreign reserves that Korean government has accumulated since currency crisis provides somewhat credible background for Korean won.

It is true that the environment for central bank intervention has been much improved since currency crisis. But so far, it is also true that those favorable conditions depend mainly on foreign investors' attitude and huge foreign reserve not on sustainable economic and financial stability. Considering the fickle foreign investor and the unsolved difficulties in financial sector, Korean won's future is still unclear. In order to avoid the ineffectiveness of central bank intervention, monetary authorities – the Bank of Korea and the Ministry of Finance and Economy – should stabilize the shaky economic conditions, and also improve their skill of policy operations as well. The Bank of Japan used to fail to correct Japanese yen rate despite of much bigger intervention size compare to the Federal Reserve Bank. Without supports of monetary policy and economic fundamentals, the central bank intervention do nothing but waste the foreign reserves.

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