Spot and forward market intervention during the 1997 Korean currency crisis *

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1. Introduction

During the currency crisis period of 1997, the Korean monetary authorities intervened massively in the foreign exchange market on two occasions, resorting not only to spot but also to forward market operations.

The first important intervention was carried out during the months of January-March as international borrowings became difficult and the destabilizing movement of the Korean economy continued after the bankruptcy of Hanbo Steel Co. on 23rd January. To defend the Korean won, the Bank of Korea (BOK hereafter) sold out 6 billion dollars in the spot market and an additional 3.8 billion dollars in the forward market during the two months of February and March. Due to these intervention operations, the foreign exchange market regained tranquility and Korean won remained stabilized for a few months thereafter.

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As the currency crisis in Thailand was spreading to Indonesia and other Asian countries in August, however, the foreign exchange market again became turbulent. There was a widespread feeling that a serious crisis was imminent and the second massive intervention was mobilized. During the 4 months from August up until 21st November, when the Korean government finally decided to ask for an emergency loan from the IMF, the BOK spent a total of 18 billion dollars, 12 billion of which in spot market operations and 6 billion in forward market operations. These interventions were not helpful to defend the Korean won, but rather resulted in a deepening of the crisis. In addition, as pointed out by the World Bank (1999), the unsuccessful forward market interventions cost the BOK a spectacular price due to the plummeting value of the Korean won.

Why, then, did the Korean monetary authorities intervene in the forward market? Moreover, why was the same central bank intervention accompanied by forward market intervention operations successful in the first instance but not in the second? These questions merit detailed reexamination. This paper evaluates whether the central bank intervention operation was appropriate during the 1997 currency crisis in terms of stabilizing the Korean currency and tries to answer the above questions, focusing on the effectiveness of the forward market intervention operation. The monetary authorities used the forward market intervention perhaps because, when used together with spot market interventions, it can be an effective intervention instrument to squeeze bears (Garber and Spencer 1995 and 1996, Lall 1997). Another possibility may be that, as Moon and Rhee (2002) argue, the monetary authorities preferred forward intervention operations as they camouflaged the decline in foreign reserves. Moreover, the successful use of forward interventions in February-March might have contributed to the excessive use of forward intervention in October without due consideration of the risks. As Obstfeld and Rogoff (1996) indicated, however, the success of forward market interventions depends on the relationship between spot and forward exchange rates. If the covered interest parity condition holds, forward market interventions can be helpful in stabilizing the exchange rate. If not, it can create the opposite result, precipitating only the collapse of the exchange rate.

This paper contributes to the literature of central bank intervention in the foreign exchange market in three respects. Firstly, while there are ample studies on foreign exchange market intervention in de-

veloped countries,[1] research on emerging economies is almost nil, mainly because high quality data on intervention is not available. This paper uses the daily official intervention data of the BOK, whereas existing literature estimates the amount of intervention on the basis of daily or monthly foreign exchange reserve changes due to the lack of more accurate data. Secondly, there is little literature to explicitly address the effectiveness of foreign exchange market intervention in a crisis period. This paper examines the effectiveness of the intervention during the two currency crisis periods of 1997 in Korea and explains why the intervention succeeded in stabilizing the foreign exchange market on one occasion but failed on the other. Finally, in contrast to existing literature, we consider the effects of intervention in the spot and forward markets separately. In fact, this paper will be one of a very few case studies dealing with the empirical efficacy of forward market intervention operations.

The organization of this paper is as follows. Section 2 examines the exchange rate policy of Korea and the trend of the Korean won *vis-à-vis* the US dollar in 1997. Section 3 explains the model and data used for the empirical analysis in the paper. Section 4 presents empirical findings about the effects of spot and forward interventions on the spot exchange rate of the Korean won. The effects of spot and forward interventions are distinguished, and the results of the two crisis periods are compared. Section 5 focuses only on the effect of forward intervention on the forward exchange rate to specifically address its appropriateness. Finally section 6 concludes with a brief summary and implication.

2. The exchange rate policy during the 1997 currency crisis

In 1996, just one year before the eruption of the currency crisis, the current account deficit that had existed since 1990 reached a record 23 billion dollars. As a consequence, the Korean monetary authorities let the Korean won depreciate *vis-à-vis* the US dollar, with concern of the massive accumulation of foreign debts. At the start of 1997, however, this policy was reversed. With the new cabinet in office, the primary goal of the exchange rate policy was put to preventing the Korean won

[1] See Edison (1993) and Sarno and Taylor (2001) for the survey studies.

from losing its value and, to achieve this goal, the BOK started to intervene actively in the foreign exchange market.[2] In particular, as big Korean conglomerates began to collapse, following the bankruptcy of Hanbo Steel Company on 23rd January, and the foreign exchange market showed signs of nervousness, the BOK became much more active, intervening on a much greater scale. With a break during April-August, this massive intervention resumed in September and continued until 21st November.

The pattern of intervention operations during 1997 was different from the previous one in two respects. First, in the past, the Korean monetary authorities intervened to correct the current account deficit: when the Korean won tended to appreciate, intervention was used actively and when it moved in the opposite direction, the monetary authorities refrained from intervening (Rhee 1997). After 1997, however, this pattern changed. Intervention was largely used to cope with the depreciation of the Korean won rather than to prevent the appreciation of the Korean won. Thus, intervention was limited to the passive purchase of US dollars to replenish foreign reserves when the Korean won was stable or appreciating.

Figure 1 shows the relationship between the exchange rate of the Korean won against the US dollar and the amount of foreign exchange intervention carried out by the BOK ('+' for purchasing US dollars) during the first crisis period of 3rd January through 31st March 1997. There was a slight depreciation trend of the Korean won, against which the BOK poured out a massive amount of foreign reserves totaling 9.5 billion dollars in the foreign exchange market (5.7 billion dollars in spot operations and 3.8 billion dollars in forward operations) for the two months of February and March.[3] It is worthwhile to note

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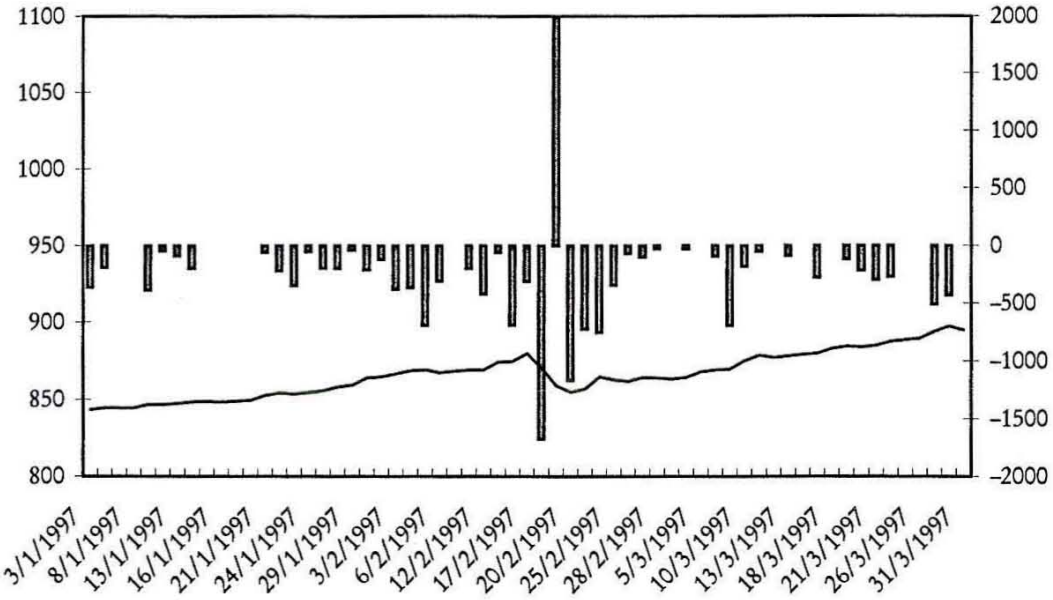
[2] There have yet been no official reports about why the government had to suddenly change its exchange rate policy, fixing rigidly the exchange rate of the Korean won. Some have speculated the new prime minister tried to help the then president Kim Young-Sam keep one of the promises that he had made during the presidential election campaign of 1992, i.e., to double the per capital GNP within 5 years from $10, 000 in 1992 to $20, 000 in 1997. In fact, there are some who argue that, if the trend of depreciation had continued, Korea might have been able to avoid the sudden collapse of its currency.

[3] It is worth noting two unique features of these interventions by the BOK. First, the scale of intervention was enormous, often reaching 500 million US dollars and a couple of times over 1.7 billion US dollars, and accounted for a very huge fraction of the then daily trading volume of 2 billion US dollars. Second, there were only sales of US dollars in the period except one day, which was to adjust the position. These are

FIGURE 1

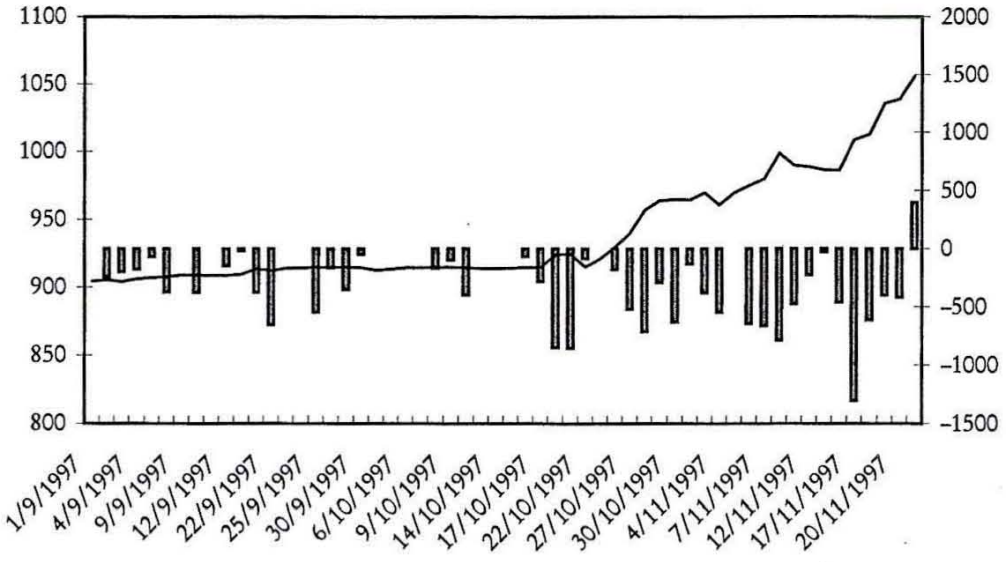
FOREIGN EXCHANGE INTERVENTION
AND WON-DOLLAR EXCHANGE RATE
(January-March 1997)



Note: exchange rate = left axis; foreign exchange intervention = right axis ($ million).
Source: BOK (1997).

FIGURE 2

FOREIGN EXCHANGE INTERVENTION
AND WON-DOLLAR EXCHANGE RATE
(September-November 1997)



Note: exchange rate = left axis; foreign exchange intervention = right axis ($ million).
Source: BOK (1997).

that this amounted to one third of the total official foreign reserves in Korea, which only amounted 30 billion US dollars.[4] As a consequence, the depreciation trend of the Korean won stopped and the exchange rate could soon be stabilized. From April, the exchange rate remained stable, around the level of 890 won/$ until the middle of August. During this period, the foreign exchange market was calm and there was a net purchase of 4.5 billion US dollars to replenish foreign reserves depleted in previous months.

In September, however, Korea once again started to face a depreciation of its currency. Despite some worries surrounding the spreading of the currency crisis that broke out in Southeast Asia to neighbouring Asian countries, the depreciation of the Korean won was relatively slow until mid-October with the intervention of the BOK in the foreign exchange market (Figure 2). After October 20th, however, the fall in the value of the Korean won turned explosive, forcing the BOK to sell an ever greater amount of US dollars. Even though the BOK sold a half a billion to a billion dollars on a daily average (2-3% of total foreign reserves), the steep fall of the Korean won continued. All the efforts of the Korean government to defend the currency, mobilizing all possible means including forward intervention and the secret support of emergency loans to foreign branches of Korean banks, failed and the Korean won collapsed. During this period, the BOK spent a total of 15.4 billions dollars (3.7 billion in September, 5.2 billion in October and 6.5 in November), which resulted in the complete depletion of its foreign reserves. The Korean monetary authorities had to give up any further intervention and asked the IMF for the emergency loan on 21st November. After that, the value of the Korean won further plummeted, exceeding 2000 won/$ in mid-December.[5]

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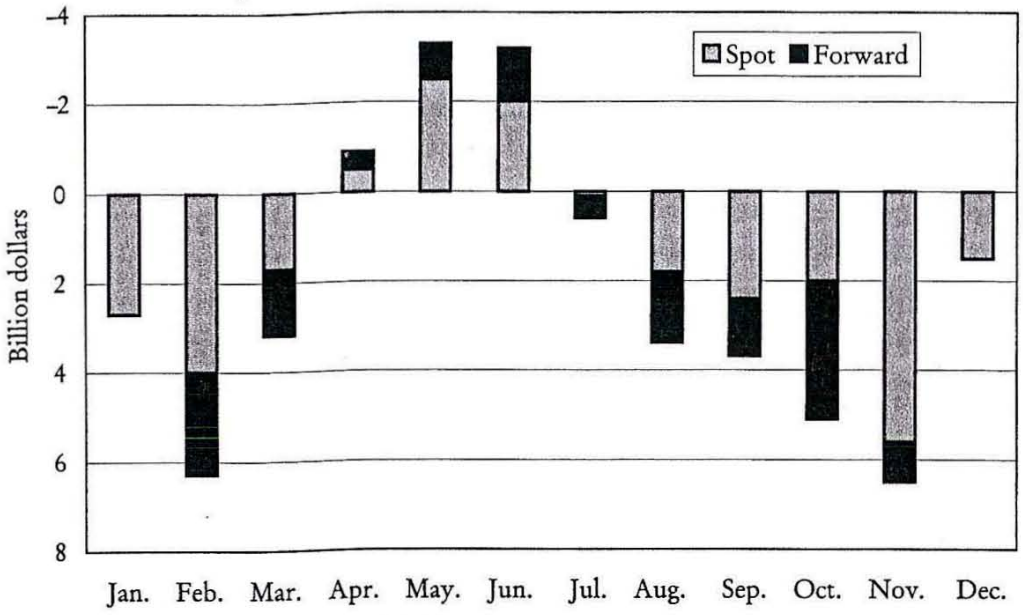
quite different from typical intervention in developed countries and believed to reflect the crisis situation at that time.

[4] If we add 4.2 billion dollars of foreign reserves used to support foreign branches of Korean banks in February, then about half of all foreign reserves were spent out (Moon and Rhee 2002).

[5] See Moon (2000), Park and Rhee (1998), Shin (1998) and BOK (1999) for the development of 1997 currency crisis in Korea.

FIGURE 3

SPOT AND FORWARD MARKET INTERVENTION
(monthly basis)



Note: Negative values imply selling US dollars.
Source: BOK (1997).

The second difference of the 1997 interventions is that, while there had been intervention only in the spot market before then, the BOK simultaneously used both spot and forward intervention operations in 1997. During the year, the BOK sold out a net total of 26 billion dollars in the foreign exchange market, out of which the forward market selling accounted for 8.9 billion dollars. Figure 3 shows the trend of spot and forward interventions on a monthly basis. The first intervention operation in the forward market was carried out on 11th February 1997, and from then on was extensively used, reaching a peak of two thirds the size of spot market interventions by 31st March. For example, when the Korean won tended to depreciate in February and March 1997, the BOK sold a total of 3.8 billion US dollars in the forward market (2.3 and 1.5 billion respectively in February and March), compared to 5.7 billion in the spot market. As the exchange rate was stabilized, the BOK managed to replenish foreign reserves by the net purchase of US dollars in the forward market during the months of April to June. However, as the value of the Korean won began to plummet in mid-October, there was again a massive selling of US dollars in the forward market. In retrospect, the forward market interventions after mid-October, which reached 3 billion dollars, only

resulted in fueling the speculation and precipitating the collapse of the Korean won.

3. Model and data

3.1. *Model*

Regarding the empirical test about the efficacy of intervention, the first question to consider is which kind of transmission channel is more appropriate. Academic literature mentions two channels, portfolio balance and signaling channels, through which intervention can affect the exchange rate.[6] According to the portfolio channel, market participants diversify their portfolio holdings between domestic and foreign assets on the basis of return and risk. Thus, as long as foreign assets are incomplete substitutes for domestic assets, an intervention that changes the relative supply of domestic and foreign assets induces a change in the exchange rate through the changes in the relative returns of these two kinds of assets. However, the empirical research so far does not strongly support this hypothesis.[7] In contrast, the signaling channel approach states that intervention operations can be used by a central bank as a means of signaling to the market about future fundamentals such as monetary policy. If the market participants believe the central bank's signal, then the expectation of future fundamentals changes, which will lead to revised expectations of future exchange rates. It brings about current exchange rate changes. For instance, if the BOK sells US dollars in support of the Korean won, it is interpreted as a signal for future tight monetary policy and market participants would try to buy Korean wons and sell US dollars, expecting the value of the Korean won to increase. Thus, the current value of the Korean won will appreciate. In fact, many recent empirical studies

[6] See Dominguez and Frankel (1993a), Edison (1993), Sarno and Taylor (2001) among others.

[7] See Rogoff (1984), Humpage (1991), Edison (1993), Sweeny (1995). Dominguez and Frankel (1993b) is an exception in favour of significant portfolio balance effects.

support the argument that intervention is effective through this signaling channel.[8]

Reflecting a widely held view in the literature that

> "if intervention [...] is effective at all through either of the traditional channels of influence, it will in future be effective primarily through the signaling channel" (Sarno and Taylor, 2001, p. 862),

this paper relies on Dominguez (1992, 1993) to test the effect of intervention operation on the exchange rate of the Korean won. Since high frequent (e.g. daily) exchange rate changes tend to follow ARCH processes with temporal clustering in the variance of the exchange rate (Hsieh 1989), the estimation model can be specified as the following GARCH model:

$$\Delta s_t = \beta_0 + \sum_{k=1}^{3} \beta_k I_{t-k} + \beta_4 \Delta p_{t-1} + \beta_5 \Delta s_{t-1} + \beta_6 NEWS_t + \beta_7 D_t + \varepsilon_t \quad (1)$$

$$\varepsilon_t | \Omega_{t-1} = N(0, h_t) \quad (2)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} + \alpha_3 |I_{t-1}| + \alpha_4 |NEWS_t| \quad (3)$$

where Δs is the log change in the spot exchange rate of the Korean won against the US dollar (exchange rate at closing time), I the log of BOK intervention operations at time t ($ million: '+' for purchasing US dollars), Δp the log change in stock price (KOSPI base), *NEWS* a dummy variable capturing the news that affect the exchange rate and D a holiday dummy variable. If there is a news that supports Korean won, it is equal to 1, if there is some news against the Korean won, it has a value of -1, and otherwise a value of 0.[9] Also, if the foreign exchange market is closed for weekend or holidays, it has a value of 1 on the following day, otherwise a value of 0. This is to catch the holiday effect. Finally, $|\ |$ is the absolute value operator and ε is the disturbance term.

The GARCH model allows us to investigate the effect of intervention both on the level and the volatility of exchange rates. First, the

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[8] Dominguez (1993), Dominguez and Frankel (1993a), Watanabe (1992), Lewis (1995), Kaminsky and Lewis (1996), Fatum and Hutchison (1999) provide good references.

[9] Appendix provides more detailed list of events that would affect the exchange rate.

effect of intervention on the level of exchange rates is represented by the mean equation 1. In this equation, we included the intervention variables, news dummy and holiday dummy, together with one fundamental variable. Unlike Dominguez (1992 and 1993), who used interest spread as the fundamental variable, we considered the change in stock prices (i.e., stock return) as the fundamental variable. The reason for this is that during 1997 the domestic bond market of Korea had not yet opened to foreign investors, so it is difficult to think that capital movement occurred to take advantage of the differentials in domestic and foreign interest rates. In contrast, the stock market was to a larger extent open to foreign investors and the movement of Korean stock prices significantly depended on the inflows and outflows of foreign capital. Thus, the exchange rate is considered to reflect more the change in stock prices than the interest rate differential. Moreover, in the mean equation, we take the lag effect of the exchange rate into consideration. Regarding the signs of the coefficients in equation 1, we expect that β_1 through β_3 will have positive signs, if intervention is to be effective. β_4 is expected to be negative because, when there is an increase in stock price returns, it will induce foreign capital inflows and thereby raise the value of the Korean won. β_6 is also expected to be negative, but the signs of β_5 and β_7 are ambiguous.

Secondly, the effect of intervention on the volatility of exchange rates is reflected in the variance equation 3. In this variance equation, the signs of α_3 and α_4 should be negative, if intervention and news contribute to stabilizing the exchange rate. However, we cannot rule out the case where the intervention and news deepen the turbulence of the market and, if it is the case, α_3 and α_4 could have positive signs.[10]

3.2. *Data*

Data on daily official intervention of a central bank in the foreign exchange market have rarely been available. Because most central banks, including the BOK, do not release such daily data,[11] many studies have relied on proxy variables that can help to estimate the real amount of

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[10] For example, see Bonser-Neal (1996), Huang (1995), Lastrapes (1989).

[11] However, such daily data is available in the US with a year lag and Germany and Japan recently followed the US example. Unlike others, Switzerland releases the data at the time interventions occur.

central bank intervention in the foreign exchange market. Monthly data on foreign exchange reserves are available in most central banks' statistical publications, and have often been used as the proxy. However, the effect of intervention tends to be short-lived and the dynamic activity of intervention cannot be represented by movements in monthly data. Instead of monthly foreign reserves, Lee, Rhee and Choi (1998) use daily changes in the foreign exchange position, which is defined as the difference between foreign assets and foreign liabilities by the BOK. One advantage of their data is that it can catch the intervention operation through the so-called hidden reserves, which are regularly used by a number of central banks. But clearly this data include plenty of noises such as interest income, re-evaluation of assets, etc., which make it practically impossible to disentangle the correct amount of intervention from the data.

A more serious problem is that these proxy variables (foreign reserve change and foreign exchange position change) do not reflect some operations, such as forward intervention and the secret support of foreign reserves to foreign branches of Korean commercial banks, which do not show any corresponding change in the book value of foreign reserves. As Table 1 confirms, changes in foreign reserves do not exactly equal the amount of actual intervention. It is worthwhile to note that the difference between foreign reserve change and actual intervention widened, especially in February-March and September-October, when there were massive forward intervention operations. This means that the proxy variable is of no use in the examination of the effect of intervention during the period of currency crisis.

To overcome these problems, we use the daily official intervention data of the BOK in investigating the effect of intervention. This data comes from a report to the Special Investigation Commission on the Causes of the Economic and Currency Crisis, which was established in the National Assembly on 15th January 1999.[12] This data contains daily spot and forward sales and purchase of US dollars made by the BOK. The data, however, include only those interventions during the first crisis period of 3rd January-31st March and during the second crisis period of 1st September-30th December. The data for the period

[12] The commission started a very broad range of hearings until 13th February 2000 and 31 institutions in total were required to provide related documents, the total number of documents being 1346, and 9 institutions had to report on the hearings during one month period.

TABLE 1

CHANGE IN FOREIGN RESERVES AND AMOUNT OF FOREIGN EXCHANGE INTERVENTION
($ billion)

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Foreign reserves	31.0	29.8	29.1	29.8	31.9	33.3	33.7	31.1	30.4	30.5	24.4	20.4
Change in foreign reserves	-2.3	-1.2	-0.7	0.7	2.1	1.4	0.4	-2.6	-0.7	0.1	-6.1	-4.0
Usable foreign reserves	27.2	20.5	17.3	18.5	22.4	25.5	25.1	21.0	19.4	16.4	1.1	3.0
Change in usable foreign reserves	-2.3	-6.7	-3.2	1.2	3.9	3.1	-0.4	-4.1	-1.6	-3.0	-15.3	1.9
Exchange market intervention	-2.7	-6.3	-3.2	1.0	0.3	3.3	-0.7	-3.4	-3.7	-5.2	-6.5	-1.5

Sources: BOK (1997) and Ministry of Finance and Economy.

of April-August are missing. But given that April-August was the period when the exchange rate was most stable during 1997, this omission is not likely to affect our results very much. Also, in our estimation, we do not consider the period after 21st November because the Korean government asked the IMF for an emergency loan on that day and the BOK gave up any further serious intervention.

4. Empirical results: the effect of intervention on the spot exchange rate

We first examine the effects of intervention using the combined data (sum of spot and forward market interventions) and then, unlike the existing literature that does not distinguish between spot and forward intervention operations, we examine the effects of spot and forward market interventions separately.

4.1. *Combined intervention*

Table 2 presents the effects of combined intervention on the level and volatility of the spot exchange rate for three sample periods on the basis of the GARCH (1,1) represented by equation 1 to 3. The results in column 2 show that the effect of combined intervention on the exchange rate for the whole sample period, including both the first and second crisis periods, is not statistically significant. This result might be due to structural differences between two sub-periods. Therefore, we conduct the same estimation for these two sub-periods separately. The results in column 3 for the first crisis period of January-March show that the intervention initially destabilizes the exchange rate with negative β_1 for I_{t-1}. But β_2 for I_{t-2} and β_3 for I_{t-3} are positive and the sum of β_1 through β_3 become positive, which suggests that the intervention is eventually effective for abating the depreciation pressure of the exchange rate. On the other hand, the coefficients are never statistically significant in the second crisis period. The effect of intervention, if any, is that it has a destabilizing effect on the exchange rate in the second period. The exchange rate shows a clustering movement in the variance, but the intervention does not affect the volatility of the exchange rate in any period.

TABLE 2

EFFECTS OF COMBINED INTERVENTION

Coefficient	Whole sample	First crisis period	Second crisis period
β_0	-0.000167 (-0.16)	0.000550 (0.54)	-0.000744 (-0.62)
β_1	-0.000233 (-1.42)	-0.000281 * (-1.71)	-0.000294 (-1.36)
β_2	3.68E-05 (0.23)	4.03E-05 (0.28)	5.81E-05 (0.22)
β_3	8.87E-05 (0.50)	0.000362 ** (2.47)	-0.000284 (-1.28)
β_4	-0.025006 (-1.21)	0.022480 (1.30)	-0.061204 ** (-2.42)
β_5	0.089357 (0.72)	0.273162 * (1.81)	-0.062855 (-0.38)
β_6	-0.001769 (-1.32)	-0.001593 (-0.97)	-0.001653 (-0.39)
β_7	0.003937 *** (3.84)	0.002629 *** (2.77)	0.004003 * (1.93)
α_0	5.71E-06 * (1.76)	3.66E-06 * (1.93)	-4.93E-07 (-0.11)
α_1	0.165646 * (1.82)	0.132272 (1.23)	0.080968 (0.47)
α_2	0.082600 *** (4.48)	0.758000 *** (3.35)	0.936000 *** (3.70)
α_3	-9.04E-07 (-1.07)	-4.20E-07 (-0.63)	4.96E-07 (0.26)
α_4	-6.41E-08 (-0.01)	-1.27E-06 (-0.16)	-5.39E-06 (-0.96)
R^2 DW	0.14 1.85	0.28 1.99	0.19 1.67

Note: Figures in parentheses are the values of z and *, ** and *** mean that the coefficients concerned are significant at 10%, 5% and 1% levels, respectively.

4.2. *Spot market intervention*

Since the effects of spot and forward market interventions may be different, we separately estimate their effects. Table 3 presents the effects of spot market intervention. Overall, the results look similar to

TABLE 3

EFFECTS OF SPOT MARKET INTERVENTION

Coefficient	Whole sample	First crisis period	Second crisis period
β_0	8.86E-04 (1.39)	0.001536 * (1.88)	0.000214 (0.23)
β_1	1.77E-05 (0.15)	6.17E-05 (0.48)	–0.000220 (–0.77)
β_2	1.59E-04 (1.26)	0.000372 ** (2.34)	–0.000151 (–0.63)
β_3	0.000166 (0.91)	0.000148 (0.67)	9.04E-05 (0.39)
β_4	–0.020531 (–1.23)	0.018823 (1.10)	–0.054913 ** (–2.34)
β_5	0.124267 (0.94)	0.293243 * (1.67)	0.008930 (0.07)
β_6	–0.002421 ** (–1.97)	–0.003112 (–1.55)	–0.001709 (–0.93)
β_7	0.003888 *** (4.30)	0.002183 * (1.94)	0.004260 ** (1.97)
α_0	1.74E-06 * (0.75)	1.58E-06 (1.09)	1.24E-06 (0.24)
α_1	0.167002 * (1.69)	0.146738 (1.33)	0.098130 (0.49)
α_2	0.860000 *** (8.19)	0.803000 *** (6.95)	0.901000 *** (2.95)
α_3	–3.59E-07 (–1.42)	–1.50E-07 (–0.62)	3.50E-07 (0.19)
α_4	8.78E-08 (0.02)	3.47E-06 (–0.54)	–5.33E-06 (–0.64)
R^2 DW	0.10 1.72	0.26 1.73	0.18 1.71

Note: Figures in parentheses are the values of z and *, ** and *** mean that the coefficients concerned are significant at 10%, 5% and 1% levels, respectively.

those for the combined data. But the results in this table more strongly illustrate that the spot market interventions were effective in the first crisis period, with all the coefficients including statistically significant β_2 of intervention operation being positive; but they were not effective in the second period. This suggests that the significant effect of combined intervention in Table 2 would be attributed to the

effect of spot market interventions. The effect of intervention on the volatility of exchange rates is not significant, as in the case of combined intervention.

4.3. *Forward market intervention*

Table 4 shows the effects of forward market interventions. It is clear that the effect of forward market intervention is effective in moving neither the level nor the volatility of the exchange rate for any of these three periods.

In sum, the results in Table 2 through Table 4 show that spot market interventions turn out to be significantly effective for abating the depreciation pressure of the exchange rate in the first period, whereas forward market intervention has no positive role in any case. The question therefore is, why did the BOK so heavily intervene in the forward market in 1997? This necessitates understanding the structure of the forward market and the behaviour of the forward exchange rate during the 1997 currency crisis in Korea.

5. Motives of forward market intervention

There is no official comment or report on the reason why the BOK adopted a policy of forward market intervention.[13] However, we infer that there might be two reasons.

First, as Garber and Spencer (1995 and 1996) and Lall (1997) indicated, it can be an effective intervention instrument to squeeze bears in some situations, if it is used together with spot market intervention. For instance, when speculators sell a weak currency, the Korean won, in the forward market expecting its depreciation to exceed the forward premium on the US dollar, the banks in the market provide these speculators forward contracts to pay US dollars and receive the Korean wons. To cover the position, the banks will buy US dollars in the spot market and the demand for US dollars will increase, which puts

[13] The Special Investigation Commission on the Causes of Economic and Currency Crises did not express any opinion about it.

TABLE 4

EFFECTS OF FORWARD MARKET INTERVENTION

Coefficient	Whole sample	First crisis period	Second crisis period
β_0	0.000802 (1.61)	6.40E-04 (1.40)	0.001600 (1.34)
β_1	1.43E-05 (0.07)	−7.26E-05 (−0.34)	4.51E-05 (0.13)
β_2	0.000195 (1.03)	0.000157 (0.90)	−0.000153 (−0.50)
β_3	0.000149 (0.87)	0.000137 (0.63)	0.000321 (1.29)
β_4	−0.030113 * (−1.68)	0.025320 (1.34)	−0.061587 ** (−2.07)
β_5	0.110805 (0.79)	0.237409 (1.24)	−0.033252 (−0.21)
β_6	−0.001816 (−1.53)	−0.001847 (−1.11)	−0.001604 (−0.74)
β_7	0.003721 *** (3.67)	0.002325 *** (3.07)	0.003838 * (1.76)
α_0	6.55E-07 (0.42)	1.82E-06 ** (1.99)	2.86E-05 (0.23)
α_1	0.167173 (1.58)	0.241994 (1.29)	0.115906 (0.90)
α_2	0.848000 *** (3.99)	0.654000 *** (2.97)	0.905000 ** (2.10)
α_3	−2.13E-07 (−0.26)	3.66E-07 (0.48)	−3.84E-07 (−0.15)
α_4	3.22E-06 (0.88)	−5.41E-06 (−1.19)	−5.37E-06 (−0.54)
R^2 DW	0.11 1.80	0.14 1.68	0.17 1.67

Note: Figures in parentheses are the values of z and *, ** and *** mean that the coefficients concerned are significant at 10%, 5% and 1% levels, respectively.

further downward pressure on the spot Korean won. To offset this pressure, the central bank will intervene in the forward market, selling US dollars against Korean wons. If the banks expect a stable exchange rate and the forward rate is equal to or lower than their expectation, they will buy US dollars forward from the central bank. The banks can cover their short forward position with the speculators through a

long forward position with the central bank and earn the bid-ask spread on these forward contracts. Thus, forward market intervention can be an effective tool for stabilizing the spot market exchange rate.[14]

However, when they see a deviation of the forward rate from their estimation of the future spot rate, they as well as the speculators also want forward contracts to sell Korean wons and buy US dollars, not for position covering but for speculative profits. In this case, the central bank which tries to squeeze bears ends up being itself squeezed by bears, and both spot and forward rates of the US dollar are skyrocketed.

To examine whether the forward market interventions were effective in stabilizing the expectation of future exchange rate during the crisis period, we estimate the effects of the forward market intervention on the forward exchange rate itself. Table 5 presents the results. The estimation equations are the same as 1-3 in the previous case. The only difference is that the dependent variable is not the spot rate but the forward rate represented by the 3-month NDF bid rate.

Concerning the first crisis period, it seems that the forward market intervention had little effect on the expectation of future exchange rate. The effects of intervention coefficients (β_1, β_2, β_3) are all insignificant. On the other hand, the forward market intervention turned out destabilizing the expectation in the second crisis period, with the coefficient β_1 being significantly negative. This means that during the second crisis period, the forward interventions did nothing but fuel the speculation in the forward market, accelerating the depletion of foreign reserves in the BOK. What then was wrong with the forward market intervention in the second period? To answer this question, we now look at whether the covered interest parity condition holds.

Figures 4 and 5 show the trend of forward premium (measured by the log difference between forward and spot rate) minus interest rate differential during the two crisis periods of 1997. The 3-month forward premium was close to the interest rate differential in the first crisis period and the covered interest differential (= forward premium – interest rate differential) remained around zero. Although the cov-

[14] In general, it is known that forward market intervention operations have the same effect as sterilized spot market intervention operation, if exchange markets are stable and the interest parity condition holds (Obstfeld and Rogoff 1996). In Korea, however, asymmetric regulation on the position-takings of banks contributed to reducing the efficacy of this intervention.

TABLE 5

EFFECTS OF FORWARD MARKET INTERVENTION ON FORWARD EXCHANGE RATE

Coefficient	First crisis period	Second crisis period
β_0	0.002178 *** (3.09)	−0.000653 (-0.27)
β_1	−0.000194 (−0.70)	−0.002458 *** (−2.77)
β_2	0.000284 (1.40)	0.000884 (1.33)
β_3	1.38E-04 (0.54)	−1.35E-05 (−0.02)
β_4	0.001406 (0.05)	0.046080 (0.64)
β_5	−0.283696 ** (−2.54)	0.243414 ** (2.30)
β_6	0.002734 (0.60)	−0.011686 *** (−2.90)
β_7	0.001157 (0.87)	−0.003144 (−0.96)
α_0	1.98E-07 (0.34)	−9.55E-06 (−0.21)
α_1	−0.012707 (−0.23)	0.032832 (0.16)
α_2	0.776510 *** (4.56)	0.993081 ** (2.10)
α_3	9.48E-07 (1.04)	3.08E-06 (0.50)
α_4	3.49E-05 (0.80)	1.34E-05 (0.50)
R^2	0.00	0.25
DW	1.34	1.77

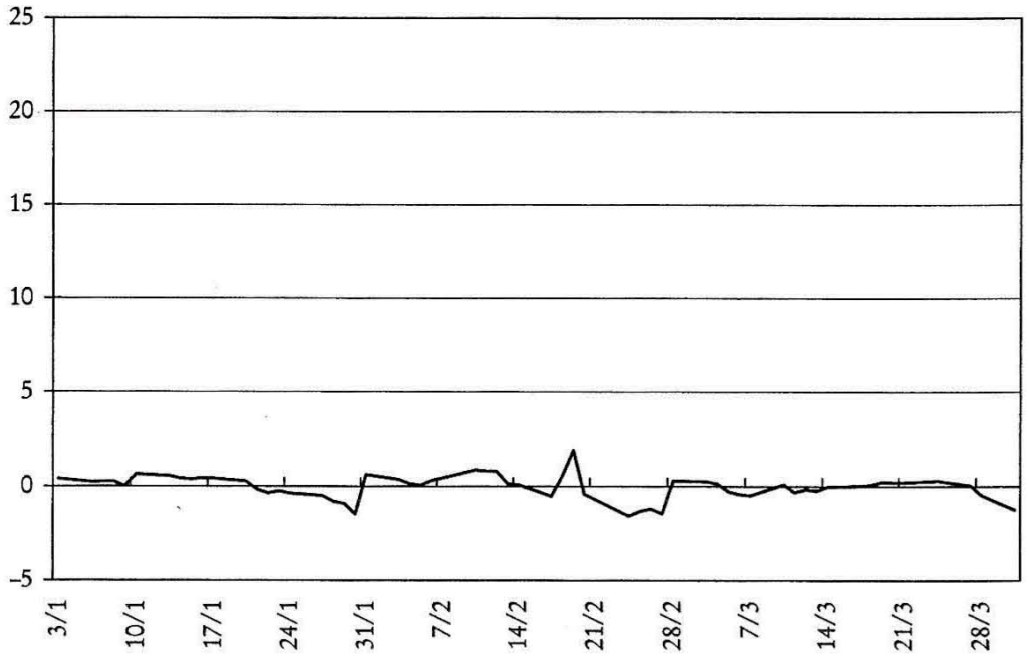
Note: Figures in parentheses are the values of z and *, ** and *** mean that the coefficients concerned are significant at 10%, 5% and 1% levels, respectively.

ered interest differential was positive in the second crisis period, it fluctuated around 1 ~ 1.5% and the covered interest parity did not seem to be seriously violated until 20th October. From then, however, it jumped to more than 7%, reaching up nearly 20% by early November. It was already clear that any further forward intervention by

the BOK could not affect the expectation of market participants (banks and speculators alike) on the level of the future spot rate. Nevertheless, the BOK continued to intervene, helping to amplify the opportunities for speculative profit.[15] In fact, even after the forward premium skyrocketed, the BOK intervened in the forward market for another month until 17th November and wasted about 3 billion dollars in forward market operations alone. It rapidly dried up foreign reserves held by the BOK. On 4th December, when the Korean government reached an agreement to borrow an emergency bail-out loan from the IMF, it turned out that there remained nothing more than 0.4 ~ 0.5 billion dollars in the hands of the BOK.

FIGURE 4

FORWARD PREMIUM LESS INTEREST RATE DIFFERENTIAL
(January-March)



Source: BOK (1997).

[15] Frankel (2001) conjectures in a similar vein to this as follows: when an emerging market country suffers a turnaround in capital flows (as reflected by reserves peaking and then starting to decline), it has about a year in which to adjust, whether by devaluation or expenditure-reduction. If it does not adjust – if it merely intervenes in the foreign exchange market to postpone adjustment – then it will suffer a full speculative attack when its reserves run low, and at that point no combination of adjustment policies will avoid a deep recession.

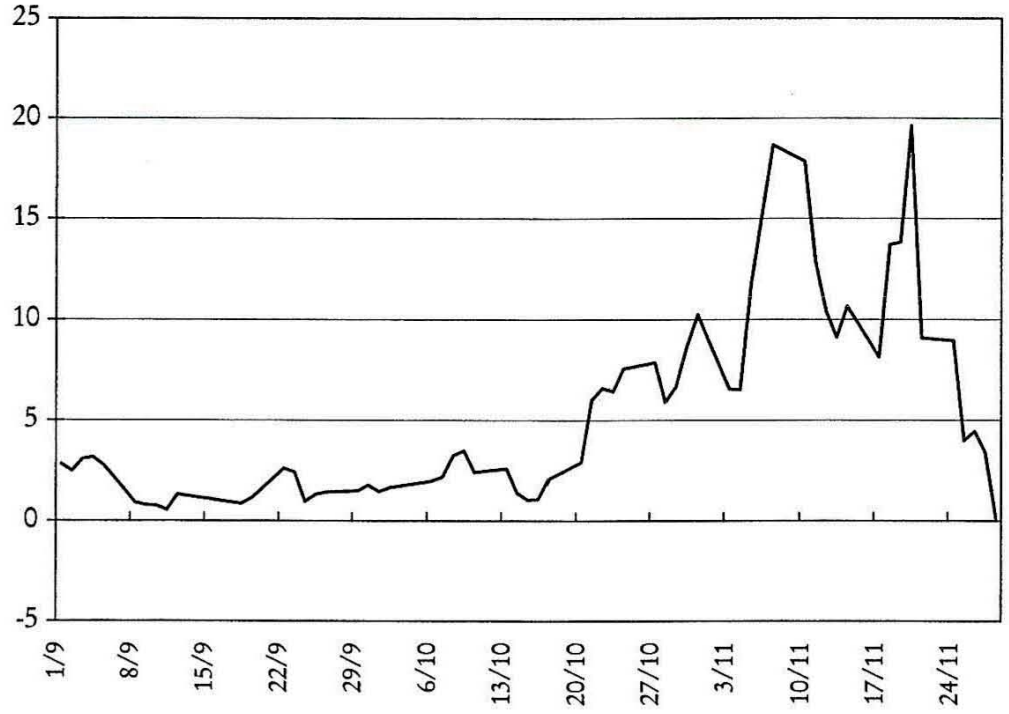
The second reason we infer for the forward market intervention by the BOK is that, as Moon and Rhee (2002) indicated, there might be a motive for the Korean monetary authorities to camouflage the decline in foreign reserves. For this purpose, the monetary authorities relied on two strategies: to use the secret support system of the foreign branches of Korean banks and to use the forward market interventions because of their off-balance transaction nature. In itself, these are not always to blame.[16] The problem is that the BOK intervened in the forward market even after it became quite clear that the exchange rate was no longer defendable. Why did it do so?

The BOK seemed to be afraid that if it did not intervene, then the depreciation of the Korean won would be costly because of its existing forward contracts. Given that the intervention in the spot market became more and more difficult in the face of rapidly declining for-

FIGURE 5

FORWARD PREMIUM LESS INTEREST RATE DIFFERENTIAL

(September-November)



Source: BOK (1997).

[16] If a central bank expects that the need for intervention will be short-lived and will be reversed, then a forward market intervention may be conducted discreetly, with no effect on foreign exchange reserves data (Neely 2001).

eign reserves in its hand (due to capital outflows and foreign reserve support to foreign branches of Korean banks), the BOK might have judged forward market interventions to be the only available instrument to defend the depreciating Korean won. In fact, 3.2 billion dollars were wasted in the forward market in one month from 20th October defending the Korean won. This is equivalent to one third of the total amount of forward market interventions carried out during 1997. The need to camouflage the decline in foreign reserves was more important than in any other period just because there were little reserves left. Moreover, the small success of forward interventions in February-March might have contributed to the excessive use of the forward interventions without due consideration of the risks. If the BOK had taken the risk of further forward market interventions into account, it would have had to give up earlier.[17]

In fact, as the World Bank report (1999) indicated, the BOK is said to have lost a huge amount of money, in the region of 5 to 15 billion dollars, as a result of its inappropriate forward interventions. This amount may be a little exaggerated. It is nonetheless true that the BOK incurred a substantial loss, given that there were still 5.8 billion dollars' worth of forward contracts to settle at the end of December 1997, when the value of the Korean won had plummeted to the bottom. According to our calculations, it is estimated that the BOK lost about 2 to 3 billion dollars from forward interventions in the second crisis period alone. Although it may be controversial that the profitability represents a valid test of the effectiveness of intervention, the loss of the intervention accompanying destabilizing effects additionally suggests that forward market interventions were not appropriate in the second crisis period.

[17] The literature says that a secret intervention is favoured when fundamentals are inconsistent with the intervention objective, when the monetary authority has poor credibility for sending trustworthy signals and when it simply wants portfolio adjustments (Dominguez and Frankel 1993a, Neely 2001 and Sarno and Taylor 2001). But the experience of the BOK in 1997 shows that a central bank in a developing country may favour a secret intervention to hide the drain of foreign reserves, especially in a crisis period.

6. Summary and conclusion

This paper evaluated the central bank intervention policies during the 1997 Korean currency crisis, focusing especially on forward intervention operations. This paper used the daily official intervention data of the BOK to test the efficacy of spot and forward market interventions on stabilizing the exchange rate. This paper is the first attempt to examine the effects of foreign exchange market intervention using the daily official intervention data of the BOK, which was not available so far to researchers. In addition, reflecting the unique situation in Korea, this paper investigated the effects of spot and forward market interventions separately and tried to answer the question as to why the forward market interventions were successful in the first crisis period but only resulted in aggravating the situation in the second crisis period.

This study shows that, among the two crisis periods of 1997, January-March and September-November, the spot market interventions were effective in stabilizing the Korean currency in the first period, whereas there is no evidence that the forward market interventions were effective in either of these two periods. If anything, the forward market interventions resulted in a destabilization of the exchange rate. This result may be due to excessive use of forward market interventions from 20th October, when the forward premium tended to show amplifying movement. Although it was clear that the Korean won was no longer defendable by forward market interventions, the Korean monetary authorities intervened in vain to defend the Korean currency. The forward market intervention seemed to be heavily used because the BOK believed its efficacy of a bear squeeze and wanted to camouflage the drain in foreign reserves. However, wasting foreign reserves in this operation proved too costly for the BOK and the Korean economy.

The result of this study suggests that, only when forward premiums are maintained within some margin, forward market interventions may be an effective instrument for stabilizing the foreign exchange market; otherwise it can create unwanted results, precipitating only the collapse of the exchange rate and aggravating the drain of foreign reserves, especially in a crisis period.

APPENDIX
Major news during 3 Jan.-30 Mar. and 1 Sep.-21 Nov.

Date	Major events	Exchange rate	Dummy
23.1	Collapse of Hanbo Steel, Co.	852.1 → 853.6	-1
30.1	Inappropriate comment by Economic Secretary to the President on the Korean economy	857.5 → 863.3	-1
1.2	Governor of BOK announces to support foreign reserves to the foreign branches of Korean banks	863.1 → 867.5	. 1
20.2	Moody's downgrades 3 Korean banks	859 → 855	-1
19.3	Bankruptcy of Sammi. Co.	879.8 → 883.8	-1
31.3	Announcement to accelerate the capital market liberalization	892.9 → 895.5	1
4.9	Announcement of measures to stabilize financial markets	904.0 → 906.6	1
9.9	Bankruptcy of Jinro, Co.	907.4 → 908.4	-1
22.9	Bankruptcy of Kia, Co. (applying for debt reorganization)	909.3 → 913.4	-1
2.10	S&P cuts the credit ratings of 3 Korean banks	913.5 → 914.4	-1
8.10	Indonesia calling for IMF support	914.2 → 914.5	-1
13.10	Announcement to support the stock market and to extend the ceiling to foreign ownership of Korean stocks	914.7 → 914.3	1
15.10	Bankruptcy of Ssangbangul, Co.	914.3 → 914.6	-1
22.10	Debt reorganization of Kia. Co. announced	924.4 → 915.1	1
23.10	Collapse of Hong Kong Stock	915.1 → 921	-1
24.10	S&P cuts the credit ratings of Korea	921 → 929.5	-1
28.10	Moody's lowers the credit ratings of Korea	939.9 → 957.6	-1
31.10	Moody's lowers the credit ratings of 4 Korean banks	964.8 → 964.6	-1
1.11	Bankruptcy of Haetae, Co.	965.1 → 968.2	-1
3.11	Extending the ceiling to foreign ownership of Korean stocks	965.1 → 968.2	1
19.11	Announcement of broad measures to stabilize financial markets	990.6 → 1068	1
21.11	Calling for IMF bail out	1035.5 → 1109.4	-1

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