THE KOREAN ECONOMIC REVIEW
Volume 17, Number 1, Summer 2001

SELF-FULFILLING FEATURE OF THE CURRENCY CRISIS IN KOREA

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Using a non-linear model, this paper examines the respective roles played by the fundamental and self-fulfilling speculation in the outbreak of the currency crisis in Korea. The model, due to Jeanne (1997), emphasizes roles for fundamentals and for self-fulfilling speculation. Results suggest that Korea was vulnerable to self-fulfilling speculation as early as January 1997. An extended phase of multiple equilibria started in October 1997. The fundamentals for Korea remained in this crisis zone until March 1998. Korea briefly entered a multiple equilibria zone again in May and June 1998 before stabilizing in July 1998. Overall, results are supportive of models emphasizing a role for self-fulfilling speculation in currency crises in addition to the fundamentals.

JEL Classification: F33, F41
Keywords: East Asia crisis, Korean currency crisis, Self-fulfilling speculation

I. INTRODUCTION

Did the Korean currency crisis in 1997 occur because of the aggravation of fundamentals and because of structural background problems? Or was it a self-fulfilling crisis because of the animal spirit of the flow of global capital? If both of these explanations matter, how big a role did fundamentals and animal spirit, respectively, play in the outbreak of the crisis?

Recent financial and economic crises in East Asia have stimulated debate on the causes of currency crises. The debate in the literature has intensified over the extent to which fundamentals can explain currency crises or whether circumstances were such that self-fulfilling speculation is a contributing factor. Contributions to this discussion that speculation can to some extent be self-fulfilling include work by Eichengreen and Wyplosz (1995), Obstfeld and Rogoff

Received for publication: Dec. 13, 2000. *Revision accepted:* March 20, 2001.

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(1995), Obstfeld (1996), Cole and Kehoe (1996), and Radelet and Sacks (1998).[1]

It is argued below that there was a mixed picture with regard to the economic fundamentals in Korea in the period leading up to crisis at the end of 1997. Despite this, however, it is difficult to see why on the basis of fundamentals such a serious crisis took place at the time that it did.[2] It would seem that a satisfactory explanation for the Korean crisis should include a role for self-fulfilling speculation within a model that can be empirically implemented.

The objective in this paper is to estimate a non-linear model that allows for multiple equilibria for Korea for the period incorporating the crisis. This self-fulfilling currency crisis model is due to Jeanne (1997)[3]. It is an attractive model since it emphasizes a role for fundamentals together with self-fulfilling beliefs. In the model, underlying macroeconomic fundamentals determine the range of possible equilibria. The dependent variable is the market's expected probability of abandonment of the Korean won/ U.S. dollar foreign exchange rate peg. This variable is measured by proxy by the forward exchange rate premium of the won/dollar exchange rate using data from the Hong Kong NDF (non-delivered forward) market.

Estimation of the model by a non-linear Maximum Likelihood method provides some evidence of Korea having been in a zone of multiple equilibria and there having been self-fulfilling speculation during some period of 1997 and 1998. Results suggest that Korea was vulnerable to multiple equilibria and self-fulfilling speculation as early as January 1997 during the Hanbo bankruptcy. We find evidence that fundamentals for Korea entered into a crisis zone of multiple equilibria in October 1997 and remained in this zone until March of 1998.

Korea briefly entered a multiple equilibria zone again in May and June 1998, during currency crises in Eastern Europe and Latin America, before finally stabilizing in July 1998. The evolution of the fundamentals at that time was basically determined by two variables: the balance on current account and the effective real exchange rate.[4] Even though results are not clear cut (some

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[1] Jeanne and Masson (2000) review models of currency crisis that have recently appeared in the literature that give rise to multiple equilibria. These models provide support for the view that crises are partly self-fulfilling. Contributions to this literature include that by Obstfeld (1996), Sachs et. al. (1996), Jeanne (1997), and Chang and Velasco (1998). One of the first papers on multiple equilibria is by Obstfeld (1986).

[2] With regard to problems with the Korean economy, important underlying structural factors have been identified as contributing factors to the crisis. These explanations include excess debt financing, crony capitalism, weak regulation of financial intermediaries, and moral hazard difficulties due to asymmetric information (see Corsetti et al. (1998), Krugman (1998, 1999), Park and Rhee (1998), Shin (1998), Hahm and Mishkin (2000)). While these are important issues, it must be noted that these factors were not new in Korea at the end of 1997.

[3] Jeanne (1997) found evidence of self-fulfilling speculation during the 1992-93 crisis of the French franc.

[4] The current account deficit assumes a particularly significant role in explaining the private

estimates are of marginal significance), a model with the potential for multiple equilibria and of self-fulfilling speculation provides a more satisfactory explanation for the crisis in Korea than do models that solely emphasize fundamentals.

It is shown that a linear model using the same variables as those employed in the nonlinear model that allows self-fulfilling speculation does not perform well. Also, a cross-country probit model for the period 1972-1997 is not particularly helpful at suggesting crises were more likely in East Asian countries in 1997 than in 1996.[5] Also, there is evidence that probit model performance is much weaker at predicting currency crises in the 1990s than in the 1980s.

The outline of the paper is as follows. Section Ⅱ discusses the issue of the predictability of crises given the economic and financial fundamentals using a probit model. In section Ⅲ a model in which both fundamentals and self-fulfilling speculation play a role in currency crisis is presented. Section Ⅳ reports results from bringing this model to data on the recent crisis in Korea. Concluding remarks appear in section Ⅴ.

Ⅱ. PREDICTABILITY OF THE CRISIS

We now briefly turn to a more formal investigation of the ability of fundamentals to forecast crisis. This will be achieved using a cross country probit model developed by Frankel and Rose (1996) and Eichengreen et al. (1996) in which a number of economic variables are used to provide a single forecast probability that a crisis will occur. Data from Frankel and Rose (1996), comprising annual observations on 103 countries for the period 1972 to 1992, is supplemented with data for the period 1993-1997. This will allow the East Asian currency crises to be included in the analysis and also will allow examination of whether ability to forecast crises changed in the 1990s.[6]

In Frankel and Rose (1996), a currency crisis is said to have taken place if there is a nominal depreciation of the currency of at least 25% that is also at least a 10% increase in the rate of depreciation.

Results from estimating the probit model are reported in Table 1. The first column reports regression results across all countries over 1972-1997. The regressors are lagged one year. Thus, results indicate ability to predict crises

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sectors' perceived probability of sharp devaluation, and thus the possible existence of multiple equilibria. The large current account deficit in Korea has been given too little attention in the literature on the crisis. In 1996, the current account deficit for Korea swelled to over 20 billion dollars for the first time. This was a fundamental weakness in the economy. The gradual depreciation of the exchange rate from the end of 1996 failed to improve the current account balance rapidly enough, thus raising the probability of currency attacks.

[5] The application of a probit model to the study of currency crises has been pioneered by Frankel and Rose (1996) and Eichengreen et al. (1996).

[6] A comprehensive update of the Frankel and Rose (1996) has appeared in Park and Rhee (1998). They did not examine crises in the 1990s or in East Asia separately from the whole sample. I am grateful to Kiseok Hong for providing the data.

[Table 1] Probit Estimates for Total Sample and East Asia

	Total		East Asia	
	coefficient	t-value	coefficient	t-value
Real Per Capita Growth Rate	-2.0635	-1.96	-1.9752	-0.29
Budget Balance / GDP	-0.0064	-0.42	-0.1007	-1.22
Domestic Credit Growth	0.6457	1.99	-0.3027	-0.17
Current Account Balance / GDP	-0.0001	-0.01	-0.2772	-2.28
Real Exchange Rate	-1.6684	-3.48	-5.8834	-1.75
Reserve / Short-term Debt	-0.1381	-2.84	1.1121	1.29
Total Foreign Debt / GDP	-0.2372	-1.77	-0.7616	-0.46
Net FDI / GDP	-0.1153	-2.54	-1.4413	-2.51
Short-term Debt / Total Debt	0.0024	0.43	-0.0042	-0.21
H_0: $\beta_1 = \beta_2 = \cdots = \beta_9 = 0$	$\chi^2(9)$ Statistic	P-value	$\chi^2(9)$ Statistic	P-value
	34.5901	0.00	9.4750	0.39

Note: East Asia group in Frankel and Rose (1996) comprises Korea, Malaysia, Thailand, Indonesia, Philippines, China, Laos, Sri Lanka and Myanmar.

one-year in advance. A higher rate of growth in domestic credit and a slower rate of growth in per capita income result in statistically significant increases in the probability of a crisis. In line with the original results reported in Frankel and Rose (1996), current account and budget deficits in ratio to GDP do not have statistically significant effects in the regression across all countries. The real exchange rate and the ratio of foreign reserves to short-term debt have highly statistically significant coefficients. The ratio of FDI to GDP is also highly statistically significant. The ratio of total foreign debt to GDP is marginally significant and has the wrong sign. The ratio of short-term debt to total debt is statistically insignificant.

Results from the probit model for the nine countries in East Asia (this includes countries experiencing crises; Korea, Thailand, Philippines, Malaysia, and Indonesia) that appear in the Frankel and Rose (1996) data set are presented in the last two columns in Table 1. Results are less impressive than those for the full sample. A striking difference is that the current account deficit to GDP ratio is strongly associated with the eruption of crises in East Asia. It may be attributable to a characteristic in East Asia where international trade has served as a main source of economic growth. Also, different from results for the whole sample, output growth, domestic credit growth, and reserves to short term debt ratio are not significant in East Asia. These latter results may be sensitive to the exclusion of important economic entities (Hong Kong and Taiwan) from the Frankel and Rose sample of countries. The FDI to GDP ratio remains statistically significant, while the real exchange rate is only marginally significant.

[Table 2] Probit Estimates for the 1980s and 1990s

	1980s		1990s	
	coefficient	t-value	coefficient	t-value
Real Per Capita Growth Rate	-2.3396	-1.94	-0.3867	-0.15
Budget Balance / GDP	0.0359	1.49	-0.0499	-2.05
Domestic Credit Growth	0.6710	1.39	0.7783	1.59
Current account balance / GDP	-0.0045	-0.26	-0.0212	-0.75
Real Exchange Rate	-2.0347	-3.59	-1.1917	-1.03
Reserve / Short-term Debt	-0.1079	-1.85	-0.0971	-1.69
Total Foreign Debt / GDP	0.3211	1.54	-0.3843	-1.96
Net FDI / GDP	-0.0859	-1.49	-0.1587	-1.82
Short-term Debt / Total Debt	0.0148	2.45	$-0.53*10^{-5}$	$-0.72*10^{-3}$
H_0: $\beta_1=\beta_2=\cdots=\beta_9=0$	$\chi^2(9)$ Statistic	P-value	$\chi^2(9)$ Statistic	P-value
	31.9251	0.00	16.1056	0.06

Note: Dependent variable over period 1980-1989 for the 1980s and over period 1990-1997 for the 1990s.

Table 2 shows probit estimates for the model for 1980s and for 1990s. While the GDP growth rate, real exchange rate, and short-term debt to total debt ratio have stronger effects in the 1980s, the budget balance and FDI are more significant in the 1990s. Reserve to short-term debt ratio is marginally significant in both the 1980s and 1990s. For the 1980s the coefficient of the total debt to GDP ratio has the appropriate positive sign and is marginally statistically significant.

In contrast to the 1980s, the model has only marginal power to explain crises in the 1990s. For the 1990s, the null hypothesis that the coefficients on all nine explanatory variables are jointly zero cannot be rejected at the .05 level of confidence (it is rejected at the .10 level of confidence). It is argued in this paper that this may be due to the self-fulfilling feature of crises in the 1990s, possibly attendant on there being greater capital mobility in the most recent decade.

Ⅲ. THE MODEL

In models of fixed foreign exchange rate regimes with an opting out clause, it is usually assumed that the government attitude to maintenance of the regime is stochastic. There is some probability, μ, that the government will weigh the costs and benefits of maintaining the exchange rate regime. If the benefits of maintaining the peg exceed the costs the peg is maintained, and if the costs exceed the benefits the government devalues the currency. There is also some

probability, $1-\mu$, that the government will keep the fixed exchange rate regime under any circumstances. μ is known to the public. Cukierman and Liviatan (1991) note that μ may be subject to sudden change as the decision making group within the government changes views and composition.

The model with an opting out clause presented below utilizes the structure of those in Jeanne (1997). It is assumed that a country seeks to peg its currency to a foreign currency. At each time t the government decides either to defend the peg at some cost or to abandon it.

The loss function at time t is assumed to be dependent on the current account surplus (negative value means a deficit), s_t, relative to a target level for the surplus, $s^*>0$, and on the cost of abandoning the exchange rate regime should that happen, C_t.[7] The period loss function is given by

$$L_t=(s_t-s^*)^2+\delta_t C_t \tag{1}$$

where δ_t is dummy variable that assumes the value 0 if the exchange rate regime is maintained and the value 1 if the exchange rate regime is abandoned. The cost of opting out of the exchange rate regime is a loss in credibility and in prestige.

We assume that the current account deficit is related to the nominal exchange rate, e_t (defined as the log of the price in domestic currency of a unit of foreign currency), and the market expectation at time t-1 of the exchange rate likely to prevail in time t, $E_{t-1}e_t$.

$$s_t=\rho_s s_{t-1}+k(e_t-E_{t-1}e_t), \quad k>0 \tag{2}$$

If the government holds to the peg then $e_t=e_{t-1}+v$, where v is the anticipated devaluation under the terms of the peg. Government may be tempted to abandon the exchange rate regime (and devalue by an amount greater than expected given by Δe) since this would reduce the current account deficit.

Let's define π_{t-1} to be the perceived probability by the public that the government will devalue. By definition $E_{t-1}e_t=\pi_{t-1}\Delta e+v$. The superscripts m and d will be used to indicate maintenance of the peg and devaluation, respectively. The net gain from maintaining the peg is given by:

$$N_t=L^d-L^m=C_t+2k(\rho_s s_{t-1}-s^*)\Delta e+(k\Delta e)^2-2(K\Delta e)^2-\pi_{t-1} \tag{3}$$

The net gain from continuing the current exchange rate regime is seen to

[7] The deficit in the current account was of great concern in Korea for several years prior to the advent of the 1997 crisis. The Government was actively pursuing policies to promote exports and the deficit was slowly narrowing for some time prior to November 1997.

depend on the following: cost to reputation of a devaluation; the extent of devaluation; the surplus on current account; and on the perceived probability of abandonment of the peg. Thus, the net benefit of the peg depends upon economic conditions and on the public's view of government commitment to maintenance of the peg.

The expression for net benefit of maintaining the exchange rate regime is now in a form that will allow discussion of multiple equilibria and self-fulfilling speculation. It is convenient to re-write net benefit in equation (3) as the following:

$$N_t = G_t - \alpha\pi_{t-1} \tag{4}$$

where G_t groups terms in equation (3) exclusive of π_{t-1}, and $2(k\Delta e)^2$ has been defined to be α. The first term on the right hand side of equation (4) is the component of the net benefit that can be thought of as depending on objective economic variables, and will be referred to as the "fundamental" component. The second term on the right hand side of equation (4) captures the influence on the net benefit of the peg of the government's credibility. Lower credibility (a higher value for π_{t-1}) lowers the net benefit of the peg.

It will be assumed that innovation in G_t, given by

$$v_t = G_t - E_{t-1}G_t = G_t - \phi_{t-1} \tag{5}$$

is independently and identically distributed. By definition $\phi_t = E_t G_{t+1}$ is the expected value at time t of the fundamental at time $t+1$. Rational expectations requires that public's evaluation of the probability of devaluation must be equal to the probability that the authority will abandon the peg. The condition is that

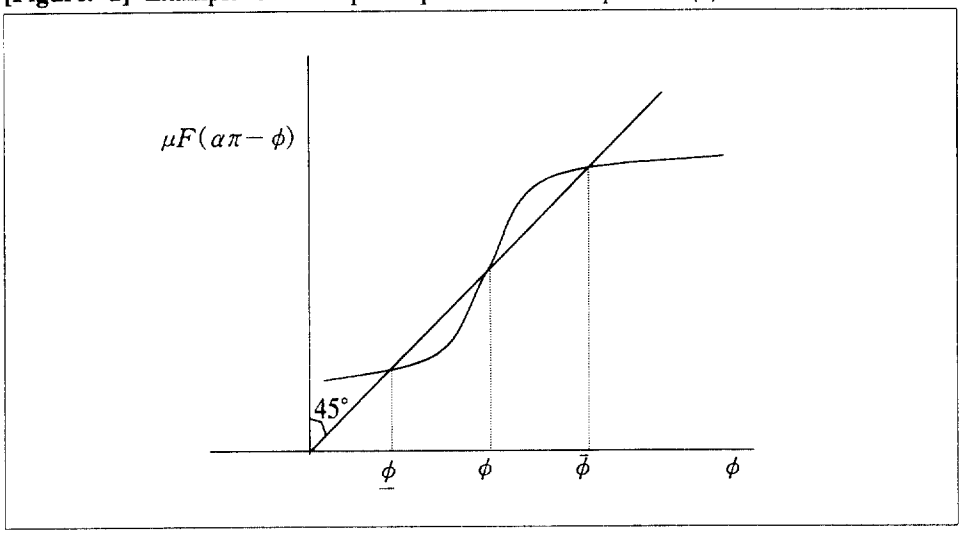
$$\pi_t = \mu \Pr ob_t[N_{t+1} < 0] = \mu \Pr ob_t[v_{t+1} < \alpha\pi_t - \phi_t] = \mu F(\alpha\pi_t - \phi_t) \tag{6}$$

where $F(\bullet)$ is the cumulative distribution of the density function for v_t. $f(\bullet)$ will be defined as the probability density function for v_t.

Both sides of equation (6) are increasing in π. Thus, multiple equilibria, or multiple solutions to equation (6), may be possible if certain conditions are met. Since the right hand side of equation (6) depends upon the expected value of the fundamental, it is also possible that under certain circumstances, the fundamental will influence the nature of the equilibria that arise. It is easily established that if $\mu\alpha f(0) < 1$, the public's view of the probability of devaluation is uniquely determined by equation (6) and by the value taken by $\phi_t = E_t G_{t+1}$.

If on the other hand, $\mu\alpha f(0) > 1$, then there exists a range of values for $\phi_t = E_t G_{t+1}$ for which there are three values for the public's view of the probability of devaluation. The case in which multiple equilibria arise is

[Figure. 1] Example of Multiple Equilibria from equation (8)



illustrated in Fig.1. Thus, when $\mu\alpha f(0)>1$, multiple equilibria arise for the range of fundamentals $\phi\in(\underline{\phi}, \bar{\phi})$. If the fundamentals are good ($\phi>\bar{\phi}$), then the devaluation probability is uniquely defined and close to zero. If the fundamentals are weak ($\phi<\underline{\phi}$), then the devaluation probability is uniquely defined and high. The next section applies this model to the data on Korea.

Ⅳ. EVIDENCE ON MULTIPLE EQUILIBRIA

In this section the non-linear Maximum Likelihood procedure to be used to test for multiple equilibria will be outlined, the data underlying the test will be described, and results will be presented and discussed.

1. The Maximum Likelihood Model

A Maximum Likelihood procedure developed by Jeanne (1997) is used to estimate the model and to test for multiple equilibria and evidence of self-fulfilling speculation in the Korean data.[8] Equations to be estimated are the following:

$$\pi_t=\hat{\pi}_t+\varepsilon_t \tag{7}$$

$$\hat{\pi}_t=\mu F(\hat{\pi}_t-\phi_t) \tag{8}$$

[8] I am grateful to Olivier Jeanne for providing us with the programs for running this Maximum Likelihood method.

$$\phi_t = \gamma' \chi_t \tag{9}$$

Equation (7) indicates that the perceived probability of abandonment of the peg is equal to model prediction of that probability plus an error term. The error term is assumed to be i.i.d. normal with variance σ_ε^2. In equation (8), α has been normalized at unity and $F(.)$ is the cumulative distribution function of a normal distribution with variance σ^2. In equation (9), χ is a vector of economic variables (the fundamental) and γ is a vector of coefficients.

If it is determined that $\mu\alpha f(0)>1$ and $\phi \in (\underline{\phi}, \bar{\phi})$ the perceived probability of abandonment of the peg can jump between states. It is assumed that the state selection mechanism is independent of the fundamental. A selection mechanism for movement between states is provided by the 3×3 Markov process.

The exogenous parameters of the model, γ, μ, $z=\mu\alpha f(0)$, and Ω, are to be estimated. Given that the state transition process is independent of the fundamental, the likelihood function can be expressed as the product of the likelihood function of the model prediction error and that of the state (y):

$$L = L_\varepsilon L_y, \tag{10}$$

where $L_\varepsilon = \frac{1}{(\sigma_\varepsilon \sqrt{2\Pi})^T} \exp\left(-\frac{1}{2\sigma_\varepsilon^2}\sum_1^T \varepsilon_t^2\right)$

and

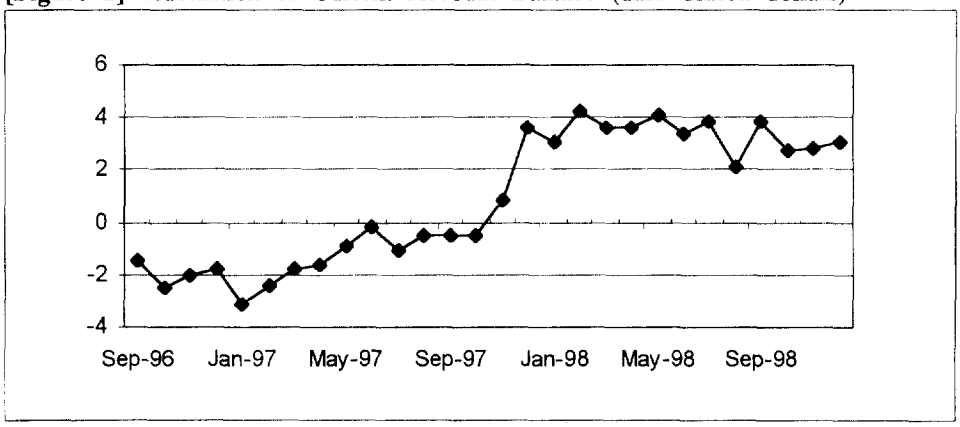
$$L_y = \Pi \varphi(y_{t-1}, y_t)$$

The model allows identification of the sequence of states given γ, μ, z and the data, estimation of the state transition process, and maximization of $\log L$ over z, μ, and γ.

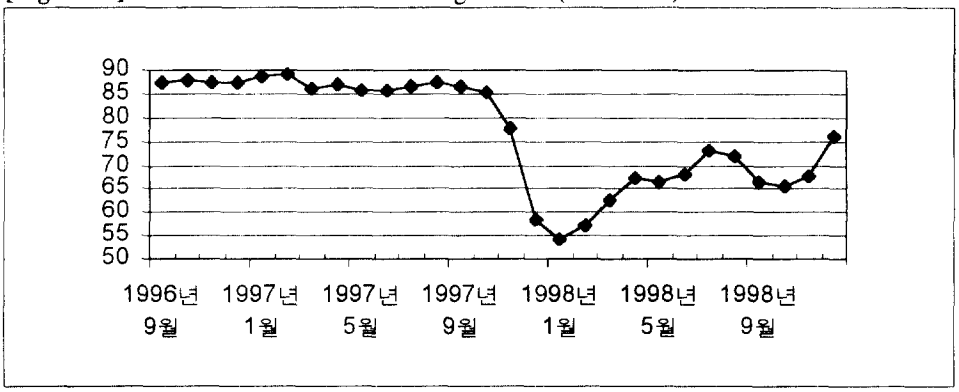
2. Data

The current account balance, the real exchange rate and the unemployment rate will represent the fundamental variables in the analysis. These variables are shown in Fig.2, 3, and 4 for the period September 1996 over December 1998. The balance on current account, denominated in U.S. dollars, and the real exchange rate are obtained from the Bank of Korea. The rate of unemployment is seasonally adjusted and provided by the National Statistical Office in Korea. As a proxy for the public's view of the probability that Korea would abandon the exchange rate peg that it operated against the U.S. dollar, we will use the forward exchange rate premium of the Korean won relative to the U.S. dollar. Data from the non-delivered forward (NDF) market in Hong Kong to construct

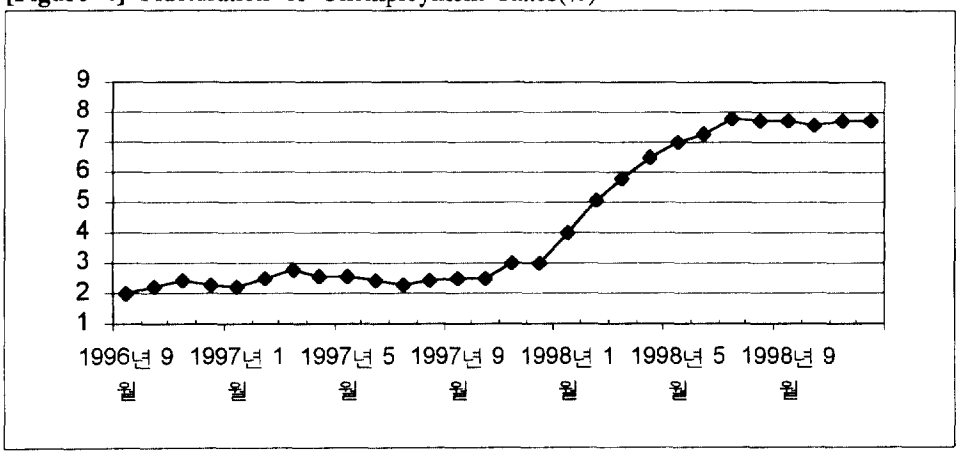
[Figure 2] Fluctuation of Current Account Balance (unit: billion dollars)



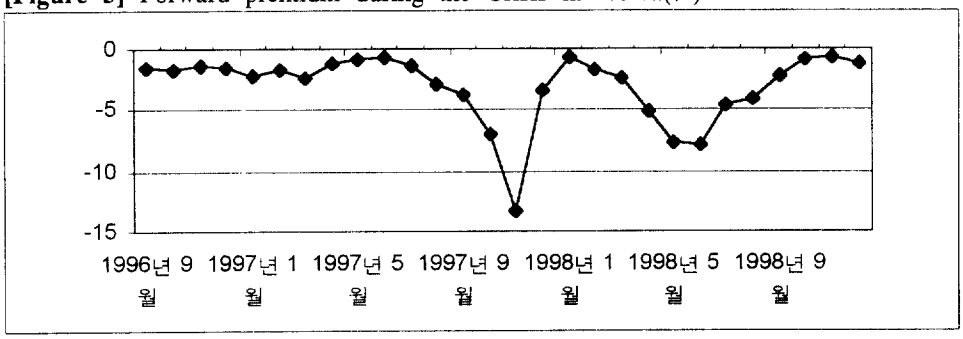
[Figure 3] Fluctuation of Real Exchange Rate (1995=100)



[Figure 4] Flucturation of Unemployment Rates(%)



[Figure 5] Forward premium during the Crisis in Korea(%)



[Table 3] Estimation Results for the Linear and Non-linear Models

	Non-Linear Model	Linear Model
Coefficient		
γ_{cu}	0.0158	0.0027
	(0.0488)	(0.0291)
γ_{γ}	-0.3882	0.0234
	(0.0885)	(0.1139)
γ_{u}	3.7714	-0.0046
	(0.3771)	(0.1877)
probabiliy "soft" Government		
μ	0.0007	
Log-likelihoods		
log L^{*}	207.57	0.00
log $L^{*}_{z=1}$	205.42	
Transition Probabilities		
$\varphi(1, 1)$	0.38	
$\varphi(1, 3)$	0.62	
$\varphi(3, 1)$	0.44	
$\varphi(3, 3)$	0.56	

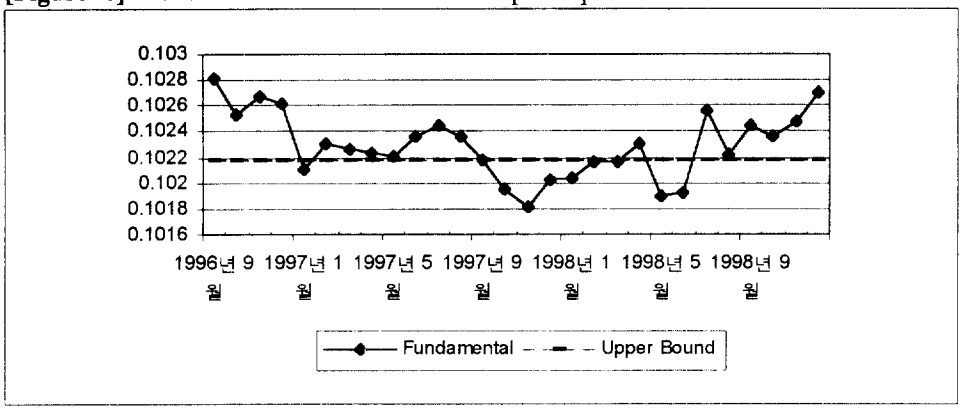
Note: Reported coefficients, γ_{cu}, γ_{r}, and γ_{u}, all scaled up by multiple of 10.

the forward exchange rate premium for the won/dollar exchange rate. The NDF forward exchange rate premium for the won/dollar exchange rate is shown in Fig.5.

3. The Results

Results from estimating the non-linear Maximum Likelihood model for monthly data for Korea are given in Table 3. The expected signs of the

[Figure 6] Fundamental and Zone of Multiple Equilibria



coefficients are $\gamma_{ca}>0$, $\gamma_r<0$, and $\gamma_u<0$. The fundamental ϕ should be increasing with the current account balance, decreasing with the real exchange rate (a real appreciation of the won indicates an increase in the real exchange rate), and decreasing with the unemployment rate (although a rise in unemployment while reducing growth will raise the balance on current account). As can be seen in Table 3, the coefficients on the current account and on the real exchange rate have the expected signs and are statistically significant at the 5% level and at the 10% level, respectively. The coefficient on the unemployment rate has the wrong sign, but is not statistically different from zero. It may be that in the case of Korea during this period, the influence of the unemployment rate on the fundamental is indirect through the effect of the unemployment rate on the balance on current account.

Within the context of the model, in order for self-fulfilling speculation to have been at work in Korea it is also necessary to show that the fundamental fell in a critical range ($\phi_t \in (\underline{\phi}, \bar{\phi})$) during the time of the crisis. Fig.6 shows the estimated fundamental, $\hat{\phi}$, together with the estimated threshold level $\bar{\phi}$. The level of $\underline{\phi}$ is too low to depict in Fig.6. There are three sub-periods during which $\hat{\phi}<\bar{\phi}$. During 1996 the fundamental ϕ is high enough to prevent the emergence of self-fulfilling speculation. In January 1997 the fundamental for Korea went below the threshold level. The bankruptcy of Hanbo Steel corporation was a shocking event at this time. However, the fundamental in Korea rose above the critical zone within one month.

In October 1997, the fundamental again enters the zone where self-fulfilling speculation could arise and remained there for some time. Evolution of the fundamental was determined by the current account deficit and the real exchange rate. From July 1997 capital inflows slowed and then became negative. The current account deficit had to be financed from central bank reserves. The Korean won started to experience speculative attacks, financial institutions had increased difficulty in rolling over short-term foreign debt, and the forward

exchange rate premium of the won-dollar rate increased in absolute value from August 1997.[9]

By the end of 1997 the current account balance had turned positive due to the collapse of imports attendant on a rising unemployment rate and an inability of firms to obtain the foreign exchange necessary to purchase inputs from overseas. These changes together with a substantial fall in the real exchange rate were reflected in an improvement in the estimated value of the fundamental, with the result that by February and March 1998 $\hat{\phi}$ was close to $\bar{\phi}$ in value. The fundamental was out of the multiple equilibria zone in April 1998.

The last sub-period is in May and June 1998. Difficulty with the forward exchange rate premium at this time can be laid at the door of currency crises in Latin America and Eastern Europe. During this period, the Korean economy is tested on whether it could accomplish economic reform.

The non-linear Maximum Likelihood model provides some evidence of Korea having been in a zone of multiple equilibria and there having been self-fulfilling speculation during the 1997 crisis. Even though some results are not clear cut (some estimates are of marginal significance) the possibilities of bifurcation in the fundamental, of multiple equilibria, and of self-fulfilling speculation provides more sensible outcomes than a simple linear model. For example, consider application of the following linear regression model[10]:

$$\pi_t = \sum b_t \Psi_t + \varepsilon_t \tag{13}$$

where π_t is the perceived probability of abandoning the peg, Ψ_t represents the fundamental (the unemployment rate, the balance on current account, and the real exchange rate), and ε_t is an error term. OLS results from estimating the linear model in (13) are reported in the last column in Table 3. In the linear model the coefficient on the current account (γ_{ca}) should be negative, the coefficient on the real exchange rate (γ_r) should be positive, and the coefficient on the unemployment rate (γ_u) should be positive.

The coefficient on the balance on current account is significant at the 5% level of confidence, but has the wrong sign. The other variables are not statistically significant.

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[9] A complication not explicitly captured by the forward premium in the won-dollar exchange rate is the behavior of the won-Japanese yen rate. Unlike the won-dollar exchange rate, the Korean won appreciated against the Japanese yen well into 1997. This is why the real effective exchange rate index was at 85.5 as late as October 1997 compared to 87.6 in September 1996. It may be that fluctuations of the yen relative to the dollar influence the Korean won through portfolio actions.

[10] Linear regression models have been used to analyze the macroeconomic determinants of realignment expectations by a number of authors including Rose and Svensson (1994), Eichengreen et al. (1995), and Agenor and Mason (1999) without great success.

V. CONCLUSION

It has been argued in this paper that although there was a mixed picture with regard to economic and financial fundamentals in Korea in the period leading up to crisis at the end of 1997, a satisfactory explanation for the currency crisis should include a role for self-fulfilling speculation. A model was presented in which fundamentals and self-fulfilling beliefs have a role in explaining currency crises.

The model was implemented with data on the Korean economy. The dependent variable in the analysis, the market's expected probability of abandonment of the won/dollar exchange rate, was measured by proxy by the forward exchange rate premium in the won/dollar exchange rate using data from the Hong Kong NDF market. The evolution of the fundamental is given by the surplus in current account, the real effective exchange rate, and the rate of unemployment.

The model provides evidence of self-fulfilling speculation during 1997 and 1998. Results suggest that Korea was vulnerable to multiple equilibria and self-fulfilling speculation as early as January 1997. An extended phase when multiple equilibria were possible started in October 1997. The fundamentals for Korea remained in this crisis zone until March 1998. Korea briefly entered a multiple equilibria zone again in May and June 1998 during currency crises in other parts of the world. The economy finally stabilized in July 1998.

It is found that behavior of the fundamentals on their own do not provide a satisfactory explanation for the crisis. A linear model did not perform well. A cross-country probit model is not useful for suggesting crises were more likely in East Asian countries in 1997 than in 1996. In addition, the evidence is that the probit model is less useful at predicting crises in the 1990s than in the 1980s. This may be due to the greater degree of openness in financial sectors in more recent years, thus providing greater scope for self-fulfilling speculation. Overall, results are supportive of models emphasizing a role for self-fulfilling speculation in currency crises in addition to the fundamentals.

REFERENCE

Agenor, Pierre and Paul Masson, (1999), "Credibility, Reputation, and the Mexican Peso Crisis." *Journal of Money, Credit and Banking*, February, pp. 70-84.

Chang, Robert and Andres Velasco, (1998), "Financial Crises in Emerging Markets: A Canonical Model." Fedral Reserve Bank of Atlanta, working paper 98-10.

Cole, Harold and Timothy Kehoe, (1996), "A Self-fulfilling Model of Mexicos 1994-1995 Debt Crisis." *Journal of International Economics*, vol. 41, pp. 309-330.

Corsetti, Giancarlo, Paolo Pesenti and Nouriel Roubini, (1998), "Paper Tigers? A Model of the Asian Crisis." Mimeo, New York University.

Cukierman, Alex and Nissan Liviatan, (1991), "Optimal Accommodation by Strong Policymakers under Incomplete Information." *Journal of Monetary Economics*, vol. 27, pp. 99-127.

Eichengreen, Barry and Charles Wyplosz, (1995), "Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks." *Economic Policy*, vol. 21, pp. 251-312.

Eichengreen, Barry, Andrew Rose and Charles Wyplosz, (1996), "Contagious Currency Crisis: First Tests." *Scandinavian Journal of Economics*, vol. 98(4), pp. 463-84.

Frankel, Jeffrey and Andrew Rose, (1996), "Currency Crashes in Emerging Markets: An Empirical Treatment." *Journal of International Economics*, vol. 41, pp. 351-66.

Hahm, Joon-Ho and Frederic Mishkin, (2000), "Causes of the Korean Financial Crisis: Lessons for Policy." NBER working paper 7483.

Jeanne, Olivier, (1997), "Are Currency Crises Self-Fulfilling? A Test." *Journal of International Economics*, vol. 43(3), pp. 263-86.

Jeanne, Olivier. and Paul Masson, (2000), "Currency Crises and Markov-switching regimes." *Journal of International Economics*, vol. 50, pp. 327-350.

Krugman, Paul, (1979), "A Model of Balance of Payments Crises." *Journal of Money, Credit and Banking*, vol. 11, pp. 311-25.

_____, (1999), "Balance Sheets, the Transfer Problem, and Financial Crises." Mimeo, M.I.T..

Obstfeld, Maurice, (1986), "Rational and Self-Fulfilling Balance-of-Payments Crisis." *American Economic Review*, vol. 76(1), pp.72-81.

_____, (1991), "Destabilizing Effects of Exchange Rate Escape Clauses." NBER working paper, 3603.

_____, (1996), "Models of Currency Crises with Self-fulfilling Features." *European Economic Review*, vol. 40(3), pp. 1037-47.

Obstfeld, Maurice and Kenneth Rogoff, (1995), "Exchange Rate Dynamics Redux." *Journal of Political Economy*, vol. 103, pp. 624-60.

Park, Daekeun and Changyong Rhee, (1998), "Currency Crisis in Korea: Could

It Have Been Avoided?." Mimeo, Seoul National University.

Radelet, Steven and Jeffrey Sachs, (1998), "The Onset of East Asian Financial Crisis." NBER working paper 6680.

Rose, Andrew and Lars Svensson, (1994), "European Exchange Rate Credibility Before the Fall." *European Economic Review*, vol. 38, pp.1185-216.

Sachs, Jeffrey, Aaron Tornell and Andres Velasco, (1996), "The Mexican Peso Crisis: Sudden Death or Death Foretold?" *Journal of International Economics*, vol. 41, pp. 265-283.

Shin, Inseok, (1998), "Korean Currency Crisis: The Mechanism of Taking Place." *Policy Research of Korea Development Institute*, vol.43.