An International Test for Reversal in the Signaling Effect of Foreign Exchange Market Intervention Considering the Threshold of Economic Fundamentals: Information Asymmetry and the Lucas Critique

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The signaling effect approach of foreign exchange market intervention emphasizes the information asymmetry between the central bank and market participants, who tend to have limited access to information. This paper analyzes whether this signaling effect varies according to the foreign exchange condition of the economy. The logic behind this variation is closely related to the Lucas critique, that is, the central bank's selling intervention to reduce the exchange rate provides the market with an unexpected signal indicating a deterioration of the foreign exchange condition of the economy and the central bank's efforts to stem foreign capital outflows. Clearly, this effect is less likely for advanced markets than for emerging markets, where there tends to be information asymmetry between the government and the private sector in terms of the foreign exchange condition of the economy. The estimation results for an error correction model considering the intervention effect provide some evidence that reversal of signaling effect due to the selling intervention exists for Korea, which is regarded as an emerging market. However, the results provide no such evidence for Japan, an advanced market.

Keywords : Foreign Exchange Market Intervention, Signaling Effect, Asymmetric Information, Lucas Critique

JEL Classification : C3, F4

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I. Introduction

It is well known that the primary purpose of the central bank's foreign exchange market intervention is the stabilization of the economy and the prevention of foreign exchange crises through the reduction of the volatility of foreign exchange rates.[1] In this regard, the usual paths through which foreign exchange market intervention influences foreign exchange rates may be decomposed into the following two paths: a direct path through changes in foreign exchange supply and an indirect one through conventional portfolio and signaling effects.

Clearly, if the foreign exchange condition is sound, then the central bank's selling of foreign exchange can directly imply increases in foreign exchange supply, which can lead to decreases in the foreign exchange rate. This paper focuses on the signaling effect, which suggests that foreign exchange market intervention is used as an instrument by central banks to signal their monetary policy direction or the long-term equilibrium foreign exchange rate to the market.[2]

In particular, for a small open economy whose currency is not a key currency, foreign exchange market intervention may signal the central bank's view of the foreign exchange condition.[3] This is because governments in emerging economies are less likely than those in advanced economies to release information on foreign exchange conditions, including data on foreign debt and foreign exchange market intervention, and thus, the private sector is more likely to have difficulty analyzing the foreign exchange condition for emerging economies than for advanced ones because of the lack of information.

As a result, in the case of emerging economies, the information asymmetry between the central bank and foreign exchange market participants may induce standard

[1] See Aristotelous (2001) and Secru and Uppal (2000) for relation between the foreign exchange rate volatility and real economy.

[2] The signaling under asymmetric information is well developed in the theory of signaling game. For instance, the education level is a signal for the ability of worker.

[3] For instance, the amount of foreign debt is often disguised in an emerging market.

inefficiencies in the economy (Akerlof, 1970), whereas in the case of advanced economies, information is shared among agents as public goods. This information asymmetry may be more severe during a crisis in which there are rapid changes in foreign exchange rates and a deterioration of information and policy transparency.

Further, this type of information asymmetry may result in outcomes that are inconsistent with the original intention of foreign exchange market intervention, which is explained by the classic Lucas critique (1976) of the policy effect.

More specifically, according to the theory of uncovered interest parity, the foreign exchange depreciation trend reduces the expected return for foreign investors in terms of foreign currencies and thus induces capital outflows. During this process, the selling of foreign exchange by the central bank to prevent increases in the foreign exchange rate may provide the market with a signal that the "central bank evaluates the foreign exchange status is deteriorating," resulting in further increases in the foreign exchange rate and accelerating foreign capital outflows.[4] This implies that the Lucas critique holds theoretically. That is, market participants' expectations can be changed by the government's intervention activity, that is, providing information and original policy intentions are no longer effective.[5]

This type of discrepancy between policy intentions and outcomes is more likely when economic fundamentals deteriorate, and a mechanical foreign exchange market intervention may lead to decreases in foreign exchange reserves and even foreign

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[4] Clearly, this possible ineffectiveness of foreign exchange market intervention has already been notified in the first generation foreign exchange crisis model in Krugman (1979). When the foreign exchange reserve is not sufficient and central bank can not sustain the target foreign exchange rate further, then there may be a speculative attack to sell the home currency in the foreign exchange market and eventually a foreign exchange crisis is induced.

[5] Conventional structural model always has this kind of risk. Neely(2005, p697) points out that "the innovative work of Kearns and Rigobon (2005) is potentially subject to the Lucas critique."

exchange crises. However, previous studies (e.g., Humpage, 1986; Klein & Rosengren, 1991; Obstfeld, 1991; Watanabe, 1994; Dominguez & Frankel, 1990) have not addressed this possibility. However, Kim (2010), by using monthly Korean data, found that selling foreign exchange may increase the foreign exchange rate when the current account deteriorates. This implies that policymakers may not achieve their policy objectives through foreign exchange market intervention when the current account is deteriorating and foreign exchange reserves are depleted.

However, Kim (2010) did not compare his results with the findings of studies considering advanced economies, and thus, it is not clear whether such a reversal of the intervention effect depending on economic fundamentals is unique to developing or emerging countries, where the availability of information tends to be limited.

For this purpose, this paper analyzes whether the foreign exchange rate effect of foreign exchange market intervention varies according to the soundness of economic fundamentals and information asymmetry by using quarterly data from the IMF's International Financial Statistics for Korea and Japan. The results indicate that the selling of foreign exchange by the central bank is likely to increase the foreign exchange rate for Korea when the current account is deteriorating, whereas no such effect is likely for Japan. This implies that Japan, an advanced economy, shows less information asymmetry than Korea.

The rest of this paper is organized as follows: Section Ⅱ discusses the theory and estimation model of foreign exchange market intervention. Section Ⅲ estimates the models, and Section Ⅳ concludes by summarizing the findings and providing their implications.

II. Error Correction Model Considering Foreign Exchange Market Intervention

2.1 Derivation of the Model

In this section, we suggest an error correction model considering the central bank's foreign exchange market intervention in the foreign exchange rate (KRW/USD or JPY/USD). We first define the foreign exchange rate at time *t* as e_t, the selling of foreign exchange by the central bank as I_t,[6] the variable for economic fundamentals influencing the foreign exchange rate as x_t, and the residual as η_t. Here we assume that the foreign exchange rate is determined as follows:

$$e_t = \delta\, x_{t-1} + \lambda(\cdot) I_{t-1} + \eta_t \ , \qquad (1)$$

where the coefficient $\lambda(\cdot)$ reflects the degree of the market's response to the central bank's intervention. In particular, it reflects the market's expectation of the future foreign exchange rate conditional on information Ω_{t-1} as follows:

$$\lambda(\cdot) \equiv \lambda\left[E\left(e_t \middle| \Omega_{t-1}\right)\right] ,$$

where the coefficient λ is not a constant but a variable reflecting changes in investors' expectation of the future foreign exchange rate induced by the central bank's intervention and Ω_{t-1} denotes known variables for the foreign exchange condition for predicting foreign exchange crises.

For simplicity, we assume that Ω_{t-1} is composed of f_{t-1} (e.g., the current account), which is an index representing the foreign exchange condition: [7]

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[6] In case of $I_t < 0$, I_t signifies the purchasing intervention.

[7] Park and Phillips (2000) also assume a similar index function.

$$\Omega_{t-1} = \{ f_{t-1} \} \ .$$

Further, we assume that the above coefficient $\lambda(\cdot)$ in Model (1) has the following nonlinearity, which indicates the degree of the market's response to the foreign exchange condition as a result of the central bank's foreign exchange market intervention and depends on the index f_{t-1}:

Assumption 1:

$$\lambda(\cdot) = \lambda_1 \quad \text{if} \quad f \to +\infty$$
$$\lambda_2 \quad \text{if} \quad f \to -\infty \qquad (2)$$

We may expect the sign of the coefficient λ in Equation (2) for an emerging economy to be as follows: First, $\lambda_1 < 0$, and $\lambda_2 > 0$. Thus, if the foreign exchange condition is favorable (that is, in the case of large f), then the selling of foreign exchange is likely to reduce the foreign exchange rate ($\Delta e_t / \Delta I_{t-1} < 0$). By contrast, if the foreign exchange condition is unfavorable (that is, in the case of small f), then the selling of foreign exchange is likely to increase the foreign exchange rate ($\Delta e_t / \Delta I_{t-1} > 0$).

More specifically, negative λ_2 implies that if the market evaluates the foreign exchange condition to be deteriorating, then the central bank's selling of foreign exchange, that is, supply of foreign exchange, is not likely to reduce the market foreign exchange rate. Instead, it signals that the foreign exchange condition is deteriorating (in this case, a foreign exchange shortage), which can induce excess foreign exchange demand and thus increase the foreign exchange rate.[8] Thus, it can nullify the effect of the

[8] Here the central bank intervention may induce anchor effect in Tversky and

central bank's intervention and more seriously, it can induce foreign capital outflows.

However, for developed countries (e.g., Japan), this effect may be weakened or sometimes reversed: $\lambda_2 \leq 0$. This is because if there is no information asymmetry between the central bank and investors, then the selling of foreign exchange by the central bank should reduce the foreign exchange rate.

Second, we can moderate the first sign assumption as $\lambda_2 > \lambda_1 > 0$, which implies that although the coefficient λ_1 may be positive, it is smaller than the coefficient λ_2.

Third, if $\lambda_1 = \lambda_2 = \bar{\lambda}$, then the central bank's foreign exchange market intervention has no differential effect on the foreign exchange rate depending on the foreign exchange status.

Finally, if we consider the structure of Assumption 1 to be Equation (2), then Equation (1) may be rewritten as follows:

$$e_t = \delta\, x_{t-1} + \lambda(f_{t-1})I_{t-1} + \eta_t \tag{3}$$

Further, we assume that the economic variable x_t, which influences the foreign exchange rate, follows a generalized linear autoregressive model as

$$A(L)x_t = \zeta_t \ , \tag{4}$$

where L denotes a time lag operator, and assume that $A(L) = \sum_{i=0}^{m} A_i L^i$, where ζ_t denotes the error term.

We now construct an error correction model of Equation (4) by considering Equation (3) implicitly. For this, we consider the long-run equilibrium and the short-run adjustment

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Kahneman(1974).

jointly. Here we define the long-run equilibrium of the foreign exchange rate by following Engle and Granger's (1987) cointegration concept.

In short, we use changes in the foreign exchange rate as the dependent variable and plug Model (3) into Equation (4). Then we obtain the following error correction model, which includes foreign exchange market intervention additionaly:[9]

$$\Delta e_t = \alpha\, u_{t-1} + \sum_{i=1}^{m} \beta_i \Delta x_{t-i} + \lambda(f) I_{t-1} + \varepsilon_t \ . \tag{5}$$

Here, $u_{t-1} = e_{t-1} - \delta\, x_{t-1}$ is an error term defined from the long-run equilibrium, and α is a coefficient reflecting the short-run adjustment.[10]

Further, the function $\lambda(f)$ is a random function (e.g., a normal distribution) under Assumption 1, and thus, we may smooth it with a cumulative distribution function Φ as follows:

$$\lambda(f) = \lambda_1 \Phi(f) + \lambda_2 [1 - \Phi(f)] \ . \tag{6}$$

Here the selling intervention function $\lambda(f)$ for the foreign exchange market has the following properties: $\lambda(\infty) = \lambda_1$ and $\lambda(-\infty) = \lambda_2$. In an extreme case, it conceptually covers Assumption 1. Otherwise, $\lambda(f)$ becomes a linear combination of λ_1 and λ_2. Here the function $\Phi(f)$ increases as economic fundamentals f improve and is a weighting coefficient between λ_1 and λ_2.

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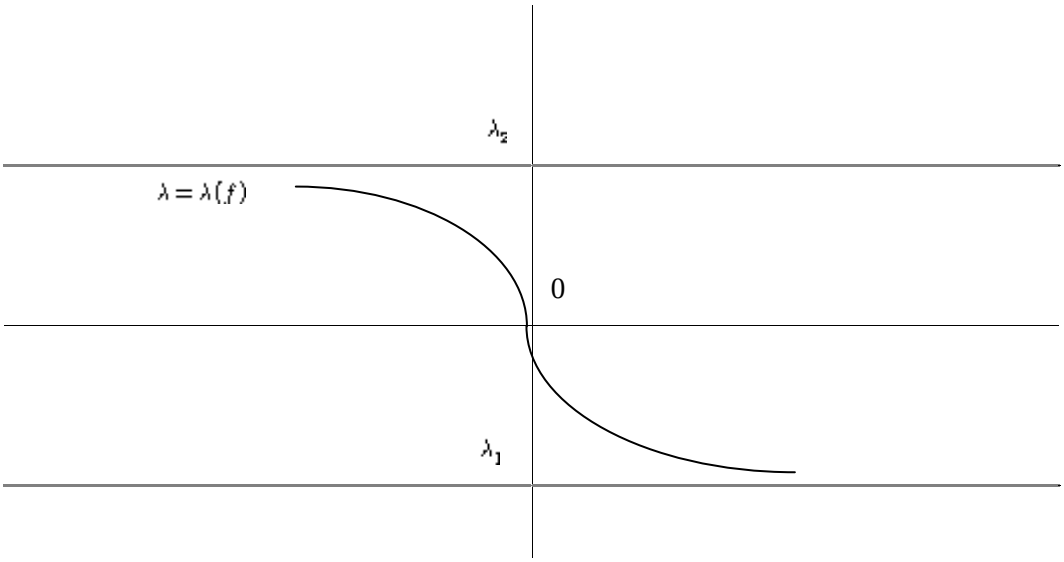
[9] Neely (2005) points out that the non-linearity may be utilized as an instrument to identify the structural model.

[10] ε_t Note market intervention I_{t-1} may be an endogenous variable correlated with the error and we will consider it later in estimation.

Figure 1 shows the form of the function $\lambda(f)$ for different values of economic fundamentals f. As economic fundamentals f improve (or deteriorate), the function approaches λ_1 (or λ_2).

<Figure 1> **Graph of the function $\lambda(f)$**



Finally, if we plug Equation (6) into Equation (5), then the estimation equation can be rewritten as

$$\Delta e_t = \alpha\, u_{t-1} + \sum_{i=1}^{m} \beta_i \Delta x_{t-i} + \lambda_2 I_{t-1} + (\lambda_1 - \lambda_2)\Phi(f_{t-1}) I_{t-1} + \varepsilon_t \ . \qquad (7)$$

2.2 Decomposition of Factors Inducing Variations in the Foreign Exchange Rate

Note that Equation (7), which explains changes in the foreign exchange rate (Δe_t), is

composed of an error correction term $(\alpha\, u_{t-1})$ representing the short-run adjustment; $\left(\sum_{i=1}^{m} \beta_i \Delta x_{t-i}\right)$, which determines changes in the monetaristic model variables; the effect of foreign exchange market intervention $(\lambda_2 I_{t-1} + (\lambda_1 - \lambda_2)\Phi(f_{t-1})I_{t-1})$; and an error term (ε_t).

Furthermore, the effect of foreign exchange market intervention may be decomposed into the pure effect of increases in foreign exchange supply $(\lambda_1 I_{t-1})$ and the residual signaling effect induced by the information asymmetry between the government and the private sector, which can be understood in terms of the Lucas critique as $[(\lambda_2 - \lambda_1)(1 - \Phi(f_{t-1}))I_{t-1}]$.

To be more specific, we revise Equation (7) as

$$\Delta e_t = \alpha\, u_{t-1} + \sum_{i=1}^{m} \beta_i \Delta x_{t-i} + \lambda_1 I_{t-1} + \varepsilon_t \quad . \tag{8}$$

In the general case of $\lambda_1 < 0$ for Equation (8), if the central bank sells the foreign exchange $(I_{t-1} > 0)$, then there is a decrease in the foreign exchange rate $(\Delta e_t < 0)$ regardless of the foreign exchange condition index f. This situation may arise if the selling occurs in the private sector: Selling foreign exchange does not signal any differentiated information on the foreign exchange condition, reflecting the foreign exchange supply effect.

Under this assumption, the difference between Equations (7) and (8) implies the effect of changes in the foreign exchange rate when the party selling foreign exchange changes from the private sector (which does not have the ability to signal changes in the foreign exchange condition) to the government (which has the ability to signal changes in the foreign exchange condition):

$$(7)-(8)\equiv(\lambda_2-\lambda_1)(1-\Phi(f_{t-1})I_{t-1})\ . \tag{9}$$

Note that Equation (9) may generally be positive because $\lambda_2-\lambda_1>0$.

III. Empirical Analysis

We estimated the error correction model (7) with foreign exchange market intervention. Further, to determine the variable for the long-run equilibrium of the foreign exchange rate, we used x_t from Lucas's (1982) monetaristic foreign exchange rate determination model; the short-term interest rate added to Lucas's model [Bilson's (1978) flexible price model]; and the long- and short-term interest rates added to Lucas's model [Frankel's (1979) model]. These models cover money and the difference between the growth of the economy and that of long- and short-term interest rates as explanatory variables, reflecting the monetary approach and international capital flows considering uncovered interest parity (UIP). [11]

The variables for determining the foreign exchange rate for the estimation were GDP as the income variable and M1 as the monetary variable.[12] Further, we used the money market rate as the short-term interest rate; the mortgage rate as the long-term interest rate; the end of foreign exchange rates; and total reserves (to compute the foreign exchange intervention amount) from International Financial Statistics. Further, we transformed all

[11] Engel, Mark and West (2007) also assert that monetary variable should be included as an important variable for the foreign exchange rate determination.

[12] Here a reason why we used M1 as a monetary variable is that foreign exchange rate is mainly affected by the transaction demand in international trades, then M1 is composed of demand deposit and cash while those are determined by the transaction demands. So we point out that the money with higher liquidity is a more appropriate one to determine the foreign exchange rate.

the variables (except for interest rates and the current account) by taking the natural logarithm.

Further, following Kim (2010), we used the lagged current account as the foreign exchange condition index f_t. The quarterly data for the period from January 1990 to April 2009 were drawn from the IMF's International Financial Statistics.

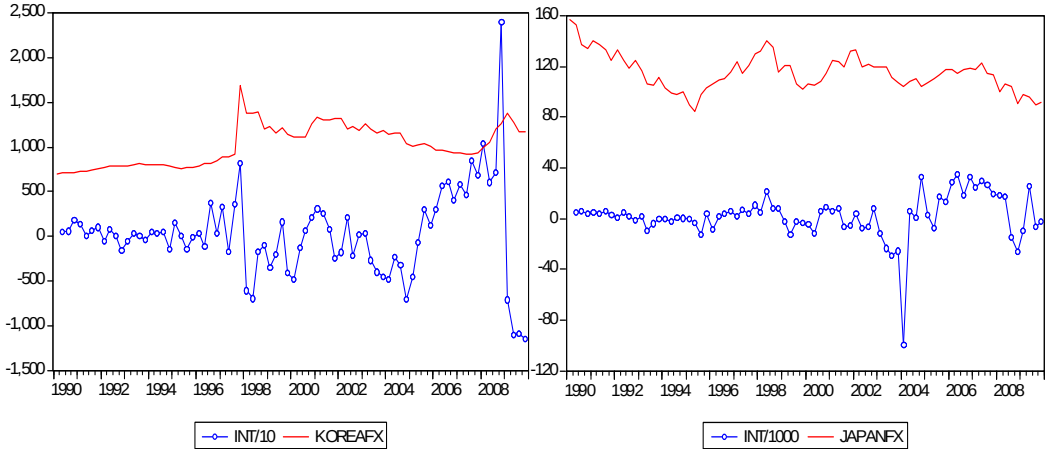
Finally, the Bank of Korea and the Bank of Japan provided no data on the level of the selling intervention (I_t) for this period, and thus, following Kim (2010), we approximated it by subtracting short-term interest revenues from the change of foreign exchange reserves to obtain the foreign exchange market intervention.[13] Based on these data, we conducted the following statistical analyses and model estimation.

3.1 Statistical Analysis

Figure 2 shows the trends in the foreign exchange rate (KOREAFX, JAPANFX) and foreign exchange market intervention (INT) for Korea and Japan since the 1990s. Korea intervened by selling foreign currencies when it faced large current account deficits, particularly during the Asian financial crisis of 1997 and the recent global financial crisis. However, Japan did not show a similar aggressive pattern of foreign exchange market intervention.

[13] Denote res_t and i_t^* as the foreign exchange reserve and short run interest rate of the US. Then the selling intervention amount is estimated as $I_t = -\left[res_t - res_{t-1} - i_t^* \times (res_t + res_{t-1})/2\right]$.

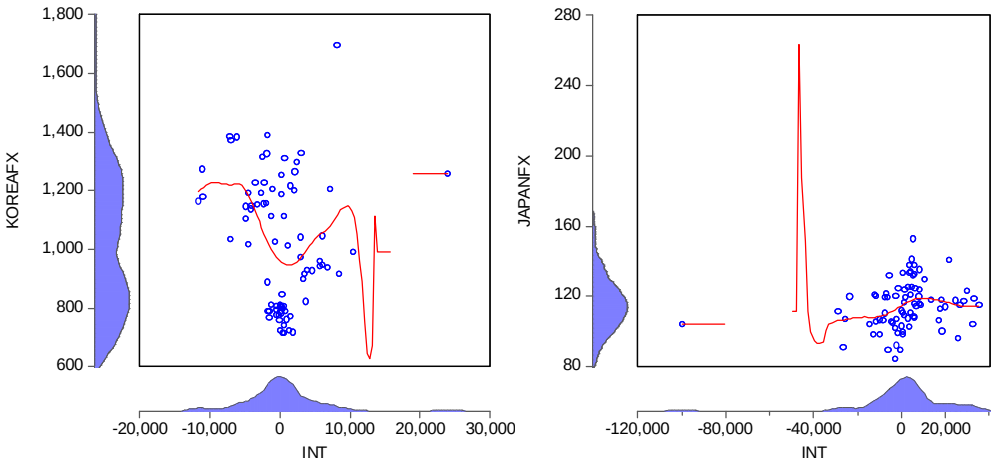
<Figure 2> Trends in the foreign exchange rate and foreign exchange market intervention



<Korea> **<Japan>**

Figure 3 shows the estimation results of the kernel regression of the foreign exchange rate on the intervention. The selling intervention increased the foreign exchange rate, whereas the purchasing intervention increased the foreign exchange rate for Korea, which is consistent with our theoretical expectation. However, Japan showed no such patterns.

<Figure 3> Kernel regression of the foreign exchange rate on foreign exchange market intervention



<Korea> **<Japan>**

However, this type of analysis has limited implications, and thus, we analyzed the effect of foreign exchange market intervention on the foreign exchange rate by controlling for other variables and by using an error correction model with an intervention term.

3.2 Error Correction Model Analysis

Following the Schwarz information criterion (SIC), we set the order (m) of Model (7) as one; the change in the order did not influence estimation results.[14]

According to the ADF test of model variables for Korea and Japan, the null hypothesis of a unit root for most model variables could not be rejected at the 5% level of significance for Korea and Japan, but it was rejected for the current account and foreign exchange

[14] The order model was not affected even if the Akaike Information Criterion (AIC) criterion was used.

market intervention at the 5% level.[15]

We conducted the Johansen cointegration test using the VAR model for the variables in Frankel's (1979) model. The results in Table 1 show that the null hypothesis of no cointegration was rejected at the 5% level for Korea and Japan.

<Table 1>m **Johansen cointegration test results**

	Korea		**Japan**	
Number of cointegration relationships	Trace Statistic	p-value	Trace Statistic	p-value
None	85.7*	0.000	67.9*	0.009
At most 1	36.8	0.104	38.8	0.068
At most 2	16.9	0.312	20.3	0.144
At most 3	6.3	0.392	6.9	0.326

Note: * denotes significance at the 5% level.

We estimated the error correction model (7) for Korea by using nonlinear least squares (NLS) (Table 2). We used the lagged current account as the foreign exchange condition variable and used the normal distribution function as Φ. The estimation results for Korea are consistent with the theoretical expectations.

Note the λ_2 was positive at the 5% level of significance for Korea when the lagged current account was used as the variable for foreign exchange fundamentals.[16] This implies that when the market evaluates the foreign exchange condition to be deteriorating,

[15] It seems to be natural that the current account is stationary for non-key currency country.

[16] This result confirms Kim (2010).

the central bank's selling intervention is likely to increase the foreign exchange rate.

However, λ_2 was negative at the 20% level of significance for Japan when the average of the current account lagged once and twice was used as the variable for foreign exchange fundamentals. This is because if there is no information asymmetry between the central bank and investors in an advanced economy, then the selling intervention is likely to reduce the foreign exchange rate.[17]

Further, the coefficient $\lambda_1 - \lambda_2$ was negative for Korea at the 10% level, and thus, the coefficient λ_1 was positive but smaller than the coefficient λ_2. This suggests that the selling intervention is more likely to increase the foreign exchange rate when the foreign exchange condition is unfavorable than favorable.

However the estimation results for Japan, which has a well-developed foreign exchange market, indicate that Japan has a more stable error-correcting mechanism than Korea. More specifically, the estimators of the lagged cointegration error u_{t-1} were negative, implying the existence of an error-correcting mechanism. Thus, if the exchange rate is greater (less) than its long-run equilibrium, then the exchange rate decreases (increases). However, these estimators were significant for Japan but nonsignificant for Korea. Further, the coefficient for the lagged rate of change in the foreign exchange rate (Δe_{t-1}) was significant only for Korea.

[17] Here the central bank intervention may induce the anchor effect of Tversky and Kahneman(1974).

<Table 2> **OLS estimation results**

	Korea			Japan		
Fundamentals	BOP(-1)	BOP(-2)	CA	BOP(-1)	BOP(-2)	CA
u_{t-1}	-0.015	-0.019	-0.018	-0.085***	-0.071**	-0.075**
	(-0.489)	(-0.615)	(-0.581)	(-2.026)	(-1.800)	(-1.941)
Δe_{t-1}	-0.345***	-0.344***	-0.321***	0.055	0.044	0.055
	(-2.918)	(-2.837)	(-2.632)	(0.452)	(0.370)	(0.461)
$\Delta m_{t-1}^{USA} - \Delta m_{t-1}^{country}$	0.262*	0.303*	0.292*	-0.292*	-0.313**	-0.288*
	(1.440)	(1.634)	(1.595)	(-1.582)	(-1.748)	(-1.603)
$\Delta i_{t-1}^{S,USA} - \Delta i_{t-1}^{S,country}$	-0.001	-0.001	-0.000	0.015	0.020	0.016
	(-0.138)	(-0.154)	(-0.021)	(0.434)	(0.571)	(0.460)
$\Delta i_{t-1}^{L,USA} - \Delta i_{t-1}^{L,country}$	0.014	0.017	0.014	-0.012	-0.018	-0.015
	(0.828)	(0.999)	(0.836)	(-0.324)	(-0.477)	(-0.399)
$\Delta gdp_t^{USA} - \Delta gdp_t^{country}$	0.093	0.062	0.069	-0.213**	-0.210**	-0.197*
	(0.887)	(0.590)	(0.652)	(-1.669)	(-1.651)	(-1.547)
λ_2	0.015***	0.006***	0.008***	-0.001	-0.002	-0.002*
	(2.691)	(2.014)	(2.674)	(-0.597)	(-1.062)	(-1.269)
$\lambda_1 - \lambda_2$	-0.010**	-0.001	-0.004	0.001	0.002	0.002
	(-1.784)	(-0.259)	(-1.030)	(0.534)	(1.000)	(1.201)
R^2	0.212	0.177	0.188	0.078	0.088	0.093
Schwarz criterion	-1.875	-1.831	-1.845	-2.426	-2.436	-2.442
Durbin-Watson	2.040	2.058	2.052	1.947	1.916	1.918

Note : 1) The t-statistic is in parentheses. *, **, and *** denote significance at the 20%, 10%, and 5% levels, respectively.

2) The long-run equilibrium is defined from Frankel's (1979) model.

3) CA=[BOP(-1)+BOP(-2)]/2 where BOP denotes the current account.

4) Δm_t, Δi_t^S, Δi_t^L, Δgdp_t denotes the difference of variable at time t of M1, short-term interest rate, the long-term interest rate and gdp respectively [country = Korea, Japan].

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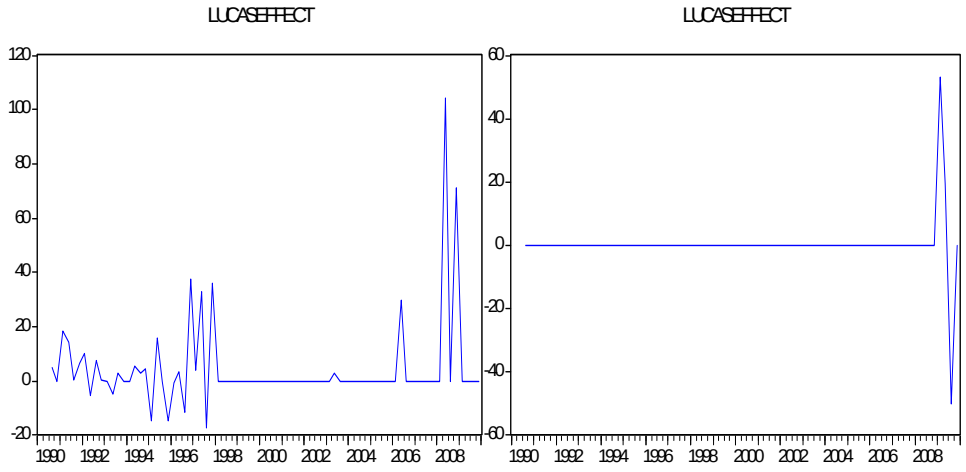
In Section 2.2, we have discussed that the effect of the government's foreign exchange market intervention may be decomposed into the effect of increases in foreign exchange supply and the effect of information asymmetry, as indicated by Equation (9) (hereafter "the Lucas effect"), because of the signaling effect induced by the information asymmetry between the government and the private sector.

Figure 4 clearly shows the Lucas effect on Korea, particularly during the Asian financial crisis (1997-1998) and the recent global economic crisis (2007-). However, there was no such effect on Japan (except for a short period during the recent global economic crisis).

<Figure 4> Lucas effects of foreign exchange market intervention



<korea> **<Japan>**

3.3 Robustness Checking

We considered the instrumental variable estimation method because the variable for

foreign exchange market intervention (I_t) may be endogenously correlated with the equation error of changes in the foreign exchange rate. For this, we considered a GMM estimation method with lagged intervention variables I_{t-2}, I_{t-3}, and I_{t-4} as the instruments. According to the estimation results in Table 3, the estimator of the coefficient λ_2 was positive (as in the OLS estimation) and significant at the 5% level for Korea.

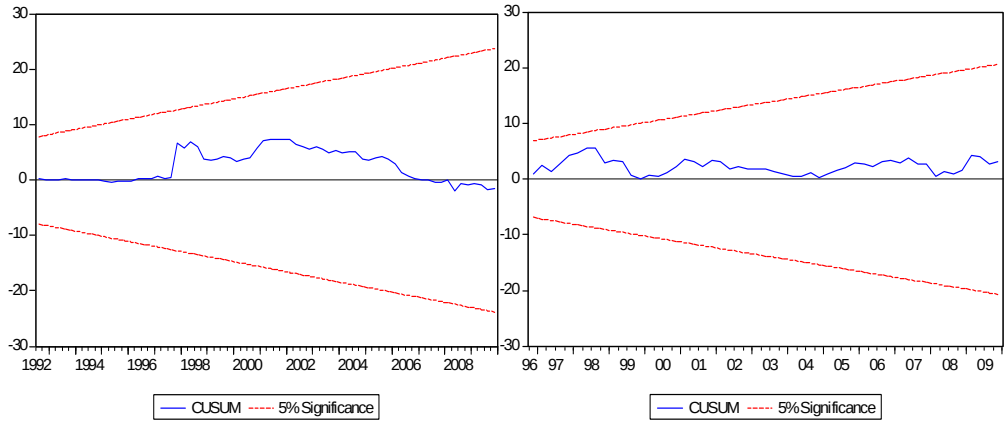
These results did not change when foreign exchange fundamentals were defined by the current account lagged once or twice. On the other hand, the estimator of the coefficient $\lambda_1 - \lambda_2$ was significant at the 20% level for Korea when foreign exchange fundamentals were defined by the current account lagged twice.

<Table 3> **GMM estimation results**

	Korea			Japan		
Fundamentals	BOP(-1)	BOP(-2)	CA[3)]	BOP(-1)	BOP(-2)	CA
u_{t-1}	0.006	0.002	0.011	-0.123***	-0.086***	-0.090***
	(0.215)	(0.099)	(0.409)	(-2.619)	(-2.089)	(-2.314)
Δe_{t-1}	-0.365***	-0.349***	-0.352***	0.061	0.037	0.048
	(-5.997)	(-6.563)	(-5.984)	(0.814)	(0.499)	(0.621)
$\Delta m_{t-1}^{USA} - \Delta m_{t-1}^{country}$	0.098	0.074	0.012	-0.283**	-0.355***	-0.328**
	(0.390)	(0.295)	(0.049)	(-1.829)	(-2.626)	(-2.270)
$\Delta i_{t-1}^{S,USA} - \Delta i_{t-1}^{S,country}$	-0.000	0.000	0.000	0.020	0.033	0.028*
	(-0.069)	(0.079)	(0.022)	(0.410)	(0.689)	(0.573)
$\Delta i_{t-1}^{L,USA} - \Delta i_{t-1}^{L,country}$	0.008	0.011***	0.011	-0.016	-0.028	-0.025
	(0.744)	(1.110)	(1.109)	(-0.347)	(-0.604)	(-0.532)
$\Delta gdp_t^{USA} - \Delta gdp_t^{country}$	0.082***	0.082**	0.076**	-0.275***	-0.287***	-0.275***
	(2.034)	(1.953)	(1.828)	(-2.514)	(-2.546)	(-2.399)
λ_2	0.011***	0.005***	0.005	-0.003	-0.001	-0.001
	(2.239)	(2.127)	(1.596)	(-0.992)	(-0.418)	(-0.666)
$\lambda_1 - \lambda_2$	-0.002	0.003*	0.003	0.003	0.000	0.001
	(-0.623)	(1.628)	(0.950)	(0.895)	(0.308)	(0.535)
R^2	0.158	0.118	0.086	0.088	0.097	0.104
Durbin-Watson	2.005	1.992	2.008	1.965	1.971	1.974

Finally, we addressed the possibility of structural breaks during the sample period, and thus, we conducted CUSUM tests based on the OLS method (once lagged current account as fundamentals for Korea and the average of two periods' current account as fundamentals for Japan) but could not find any significant structural breaks for both countries at the 5% level (Figure 5).

<Figure 5> **CUSUM test results for structural breaks**



<Korea> **<Japan>**

IV. Conclusion

The signaling effect approach of foreign exchange market intervention emphasizes the information asymmetry between the central bank and market participants, who tend to have limited access to information. This paper analyzes whether this signaling effect varies according to the foreign exchange condition of the economy. The logic behind this variation is closely related to the Lucas critique, that is, the central bank's selling intervention to reduce the exchange rate provides the market with an unexpected signal indicating a deterioration of the foreign exchange condition of the economy and the

central bank's efforts to stem foreign capital outflows. Clearly, this effect is less likely for advanced markets than for emerging markets, where there tends to be information asymmetry between the government and the private sector in terms of the foreign exchange condition of the economy. The estimation results for an error correction model considering the intervention effect provide some evidence that variation of variation due to the selling intervention exists for Korea, which is regarded as an emerging market. However, the results provide no such evidence for Japan, an advanced market.

Future research should compare this study's results with those obtained using real intervention data when such data become available.

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