

[研究ノート]

# Intervention in the Foreign Exchange Market and Exchange Rates in Japan

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## Abstract

This paper employed the GARCH model to examine the effect on exchange rate of the Bank of Japan's (BOJ's) daily foreign exchange market intervention in Japan. BOJ's foreign exchange market interventions influence the exchange rate level. These interventions are effective in changing the level of exchange. The purchase (or sale) of the US dollar results in depreciation (or appreciation) of the Japanese yen. Also, there is no evidence of statistically significant day-of-the-week effects.

## 1. Introduction

Foreign exchange market intervention by central banks have a strong influence on exchange rate movements. The purpose of foreign exchange market interventions is to moderate exchange rate misalignment or to avoid exchange rate volatility from excess movements in the foreign exchange

market. An accumulation of foreign exchange reserves and showing future monetary policy to various stakeholders are also their taken measures. Excess exchange rate movements have negative effects on financial capital flows, international trade, investment, output, and so on. It is likely that higher exchange rate volatility increases risks by increasing uncertainty about future earnings and should be avoided.

Because of recent higher economic risks that stem from exchange rate volatility, attention has shifted to an examination of the effects of central bank interventions on exchange rate volatility.<sup>1</sup> Central bank intervention in foreign exchange markets is considered effective only if it helps to contain exchange rate volatility.

This paper examines effectiveness of foreign exchange market interventions. Many papers have been published about intervention. Among these, this study examines day-of-the-week effects in the Tokyo market. The paper is structured as follows: Section 2 provides a theoretical view to support the empirical analysis. Section 3 gives empirical results and analysis based on the previous section's method. Finally, this paper ends with a brief summary.

## **2. Empirical Method**

This paper employs the empirical GARCH (generalized autoregressive conditional heteroskedasticity) model to examine the effect of BOJ's interventions on exchange rate. GARCH is designed to model and forecast conditional variances. The variance of the dependent variable is modeled as a function of past values of the dependent variable and independent or exogenous variables.

To control other activity of the central bank that could affect exchange

rate, short-term interest rate (INTEREST; money market overnight rate), foreign reserves to import (RESERVE), and the expectation of exchange rate (EXPECT) are included in the equation. Foreign reserves to import means the capacity for intervention.

$$\text{Exchange}_t = \alpha_0 + \sum_{i=1}^5 \alpha_i \text{Dit} + \alpha_6 \text{Intervention}_t + \beta V(Z)$$

where Exchange is percent log difference of Japanese yen/US dollar exchange rate;  $D_{1,t}$ ,  $D_{2,t}$ ,  $D_{3,t}$ ,  $D_{4,t}$ , and  $D_{5,t}$  are day-of-the-week dummy variables for Monday, Tuesday, Wednesday, Thursday, and Friday, respectively with Saturday as a reference point.<sup>2</sup> Intervention is BOJ's intervention in the foreign exchange market (a positive value means net purchase of foreign currency in US dollars).  $V(Z)$  is the vector of other relevant explanatory variables.

### 3. Empirical Results

Before estimating the GARCH model, it is necessary to understand the impact of the BOJ's intervention on exchange rate volatility. The results of Granger's causality test show unidirectional causality between BOJ's intervention (Intervention) and unconditional exchange rate volatility (Volatility). Volatility is measured by the squared log difference of the exchange rate.

After getting information on the direction of causality, time series properties of the data are examined. Except for log of the exchange rate, all of the data are stationary according to the augmented Dickey-Fuller (ADF) test. The log of the exchange rate is integrated at order one and thus becomes

stationary.

The table below shows the results of GARCH model.

Model A shows that all variables are not significant in the equation and reveals no evidence of statistically significant day-of-the-week effects. The purchase (sale) of the US dollar causes depreciation (appreciation) of the Japanese yen.

Model B includes relevant exogenous explanatory variables in the equation. They have a significant effect on this equation. The signs of INTEREST and RESERVE are negative and significant. The increase (decrease) in the interest rate results in appreciation (depreciation) of the exchange rate. The higher foreign reserve is linked with appreciation of the exchange rate level and vice versa. The expectation of the exchange rate has

Table. Results of Intervention in the Japanese Foreign Exchange Market

	Model A		Model B	
	Coefficient	t value	Coefficient	t value
Constant	-0.00065	-0.20		
Monday	0.0132	0.28		
Tuesday	0.0105	1.09		
Wednesday	0.0231	1.10		
Thursday	0.0158	0.62		
Friday	0.0130	0.45		
Intervention	0.0005**	3.21		
Intervention(-1)			-0.0009**	-3.08
INTEREST			0.0015***	-6.03
RESERVE			-0.0009*	-2.18
EXPECT			-2.0512***	5.03

Note. \*\*\* denotes significant at 1%, \*\* at 5%, and \* at 10% respectively

a significant impact on changes to the exchange rate.

## 4. Conclusion

This paper employed the GARCH model to examine the effect of BOJ's daily foreign exchange market in Japan on exchange rate. BOJ's foreign exchange market intervention influences the exchange rate level. This intervention is effective in changing the level of exchange, but the contemporaneous effect had a reverse sign.<sup>3</sup> However, evidence is mixed as findings. For example, the findings of Fatum and Hutchison (2003) and Fatum and Pederson (2009) supported this notion and Aguilar and Nydalh (2000) did not.

The selected exchange rate, the sample period examined, and the empirical method or theoretical model employed could change the results.<sup>4</sup> Also, coordination channeled through foreign exchange market interventions may be effective by catching up with the fundamentals. Moreover, some studies have shown that central bank interventions tend to increase exchange rate volatility.<sup>5</sup>

There may be some room for further research.

## Notes

1. Some studies have focused on sterilized intervention in foreign exchange market. See Klein and Rosengren (1991), Dominguez (1993), and Laminsky and Lewis (1996). Taylor (1994) and Reiz and Taylor (2008) proposed that the coordination channel through intervention may be effective. Bertoli et al. (2010) employed the exchange market pressure (EMP) index developed by Eichengreen et al. (1994) and suggested that the index is sensitive to some assumptions behind the information available, especially when markets are involved. Kim and Le (2010) also suggested that the

- interventions conducted during periods of oral intervention were in general more effective in moving exchange rate in the desired direction.
2. Yamori and Kurihara (2006) examined day-of-the-week anomalies in foreign exchange markets.
  3. Shah et al. (2009) showed the same results in the case of Pakistan. Breedon and Vitale (2010) suggested that the strong contemporaneous correlation between order flow and exchange rates is largely due to portfolio-balance effects. Marsh (2010) also indicated that strong contemporaneous correlation between order flows and exchange rate changes essentially disappears on days when the bank of Japan intervenes.
  4. On the other hand, there is no day-of-the-week effect. This shows that the market has been efficient.
  5. See Benie et al. (2007, 2009), for example. However, other studies, for example, Eijffinger and Gruijters (1991), Dominguez (1992), and Pasquariello (2010) have shown that foreign exchange intervention reduces exchange rate volatility.

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