Recent Experience of the Effects of Intervention on Exchange Rates*

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Recently, foreign exchange rates have been highly volatile all over the world. This article reports on an empirical examination of the effectiveness of foreign exchange market intervention in Tokyo foreign exchange market. In Japan, intervention in the foreign exchange market has occurred frequently and largely. In 2010, exchange rates fluctuated greatly, and the Japanese yen appreciated greatly against other foreign currencies. The Bank of Japan (BOJ) conducted an intervention in the foreign exchange market and bought massive USD to weaken the yen. They are expected to prevent too much appreciation of the yen, to promote export, and expansion of the economy. Recent foreign exchange market intervention in Tokyo has been effective in preventing the Japanese yen from appreciating against other currencies. Also, unsterilization has had a positive effect on depreciation of the yen. Moreover, news announcements by the Bank of Japan (BOJ) has led to depreciation of the yen. Effective announcements would increase the effects on markets. Sterilization in intervention and market communication are both taken into account in this article. The BOJ’s news announcements seem to convey to markets adequately and communication between the bank and markets functions well. Moreover, the past exchange rate (i.e., the signaling effect) also is important to the movement of exchange rates. On the other hand, portfolio channel is not found.

Keywords: exchange rate, financial policy, foreign exchange market, intervention, sterilization, Tokyo, unsterilization

Introduction

Recently, in contrast to practices in other countries, official interventions in the foreign exchange market have been increased in Japan. In 2010, exchange rates fluctuated greatly, and the Japanese yen appreciated greatly against other foreign currencies. The Bank of Japan (BOJ) conducted an intervention in the foreign exchange market and bought massive USD to weaken the yen on September 15, 2010, six and a half year since the previous intervention had been performed in Japan. The yen depreciated by about 3% on the same day. After that, the BOJ has repeatedly conducted interventions in the foreign exchange market. The number of times is many, and the volume also is large in Japan compared to that in other countries. Other countries, such as the

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United States, have not conducted interventions in the foreign exchange markets many times. There are some possibilities that they do not emphasize intervention as the effectiveness of such measures is not highly regarded.

Along with large fluctuations of exchange rates, Japan and some other countries intervene in the foreign exchange markets to attain stable exchange rates or to avoid too much currency appreciation. Many countries would like to make their own currencies depreciate to promote exports and attain economic growth. An examination of the effectiveness and influence on the markets become important. Some problems associated with such interventions should be examined along with the impact of intervention on exchange rates. One important aspect is to examine whether or not the interventions are sterilized, in which case the impact on exchange rates may be diminished, according to economic theory. Also, news announcements to markets should be carefully examined (Kim & Le, 2010). Effective announcements would increase the effects on markets. These problems have not been discussed fully in the literature.

Historically, the BOJ started to disclose its intervention data in July 2001. Since then, some studies have examined interventions; however, few have examined these effects for the recent period. The available data are limited, sample period is very short, and the deterministic elements of exchange rates are various and changeable; however, considerations of the possibilities in terms of the effects on foreign exchange rates becomes more difficult and more important.

Klein and Rosengren (1991), Dominguez (1992), Dominguez and Frankel (1993), Neely (2000), and Reitz and Taylor (2008) proposed that coordination of channels through intervention may be effective. Wang and Yang (2009) performed an unconditional rolling correlation analysis for relationship intervention and reserve. Kurihara (2011) indicated that foreign exchange market interventions influence the exchange rate level as expected. The intervention is not only effective in changing the exchange level, but the contemporaneous effect had a reverse sign. Park (2011) and Utsunomiya (2012) confirmed the presence of asymmetric volatility in the foreign exchange markets. For asymmetry, Suardi and Chang (2012) showed the importance of the threshold effect in the analysis of the effects of intervention because of the presence of asymmetry in the foreign exchange market. Chen, Watanabe, and Yabu (2012) also showed that purchases and sales of US dollars as an intervention cause correlation asymmetry in the United States but not in Japan and Germany. Also, the conditional correlation is stronger when intervention is conducted frequency and the amount of intervention increase. Sinwaka and Mkandawire (2012) used Markov-chain Monte Carlo methods and showed that a one trillion yen intervention moved the yen/dollar exchange rate 1.8%. Ito (2004) indicated that intervention reduced the probability of the exchange rate process staying in a regime characterized by disruptive tendencies. Kao and Wan (2012) analyzed the effectiveness of foreign exchange market interventions by the Reserve Bank of Malawi and indicated that net sales of US dollars by the central bank resulted in depreciation rather than appreciation. It means “leans against the wind”.

This article examines the motivation for authorities and the effectiveness of intervention. Watanabe and Yabu (2009) examined interventions in the foreign exchange market in Japan in an often-cited study. However, exchange rates have fluctuated greatly and above all, interventions have been conducted often since 2010. In 2010, an intervention was conducted after six and a half years without any interventions, as mentioned above.

The purpose of this article is to examine the intervention in the Tokyo Foreign Exchange Market. Contrary to previous studies, market communication and sterilization in intervention are both taken into account. Little
research has focused on or included these aspects.

This article is structured as follows: Section two presents a theoretical model; Section three shows the empirical analysis with a focus on effectiveness of interventions. Finally, this article ends with a summary.

**Theoretical Model**

The exchange rate \( s_t \) (log) reflects the discounted value of market participants’ expectations about future fundamentals \( s_{t+1} + j \):

\[
st = (1 - \Psi) \sum_{i=0}^{\infty} \Psi^i \left( s_{t+1} + i | \Omega t \right)
\]

where \( \Psi \) is the discount factor and \( \Omega \) is the information set available to participants. \( t \) denotes time. Foreign exchange risk premium \( \rho \) is the return demanded by market participants in excess of the no-risk return, which is the sum of the interest rate differentials at domestic country \( i \) relative to foreign country \( i^* \) (Sarno & Taylor, 2001). Some experts believe it is natural that intervention has significant effects on market participants’ (fundamentalists’) confidence, regardless of whether the forecasting method relies on purchasing power parity (PPP) only or on a PPP plus uncovered interest rate parity (UIP) condition. The interest rate differential can affect the exchange rate changes by influencing the demand orders of the short-run fundamentals.

The dynamic model can be stipulated as:

\[
\Delta s_{t+1} = (i - i^* + \rho) + (1 - \Psi) \sum_{i=0}^{\infty} \Psi^i E_t + 1 \left( s_{t+1} + 1 + i | \Omega t + 1 \right) - E_t \left( s_{t+1} + 1 + i | \Omega t \right)
\]

Which means that the change in the spot exchange rate has an expected element—the first term on the right-hand side—and an unexpected element—the second term on the right-hand side, which is the new information concerning fundamental elements that affect exchange rates. This equation reflects the hypothesis of rational expectation for exchange rates.

Three channels affect exchange rates: (a) portfolio balance channel; (b) signaling channel; and (c) communication channel.

For (a), interventions in the foreign exchange market can be understood to affect the exchange rate by altering the foreign exchange rate risk premium \( \rho \) as noted by Reitz and Taylor (2012), for example. This situation presents evidence of some effectiveness of official interventions that use the portfolio balance channel. The risk-premium approach to exchange rate determination is one of the best known theories along with purchasing power parity (PPP), monetary, and portfolio approaches.

The signaling channel (b) has recently received much attention. Interventions affect the expectations of market participants and currency (asset) prices by signaling the information of either market participant. The second term of the equation reflects this.

Finally, for (c), communication between policymakers and markets may affect currency prices, namely, exchange rates. This channel implies that public announcements by financial authorities function as an element that alters market views to cause exchange rates to move in a particular direction.

The addition of these three elements takes into account sterilization in foreign exchange markets, which have a strong impact on the foreign exchange market.

To illustrate these functions, the following modified model is employed for empirical analysis:

\[
\Delta s_{t+1} = a_0 + a_1 \Delta s_t + a_2 (i - i^*) + a_3 \text{INTERVENTION}_t + a_4 \text{POLICY}_t + a_5 \text{ACCOUNT}_t
\]

The second term, \( \Delta s \), on the right-hand side, checks the existence of the signaling channel exist. The third
term, \( i - i^* \), is the portfolio balance channel. The empirical analysis examines whether or not the premium exists. For this analysis, the term \( \alpha_0 \) is included in the equation. The fourth term directly checks the effects of intervention \( i \) on the foreign exchange market. The fifth term, \( POLICY \), means the communication channel. The final term, \( ACCOUNT \), confirms the effects of sterilization/unsterilization. \( ACCOUNT \) is the change in the current account balance at the BOJ. To check the effect of sterilization, equation (4), based on Watanabe and Yabu (2009), is checked before equation (3) is regressed:

\[ \Delta ACCOUNT_{t+2} = \beta_0 + \beta_1 INTERVENTION_t \]  

\[ (4) \]

**Empirical Estimation**

In the 1990s, Japan experienced serious economic and financial crises after the bubble economy (huge rises in stock and land prices) burst in 1991. To overcome these severe economic situations, the BOJ conducted the zero interest rate policy from February, 1999, to August, 2000. The BOJ decided to “flexibly provide ample funds and encourage the uncollateralized overnight call rate (interbank interest rate) to move as low as possible”.

The zero interest rate policy seemed to contribute to economic recovery. The BOJ stopped the zero interest rate policy. However, the economy again became troubled. The BOJ then conducted a more aggressive financial easing policy. On March 19, 2001, the BOJ decided to increase the outstanding balance of the current accounts at the BOJ. This is called a quantitative easing policy. This policy has been conducted in some developed countries since then. The main operating target for financial market operations in Japan changed from the uncollateralized overnight call rate to the outstanding balance of the current account at the BOJ.

First, equation (4) is estimated in this study. The data are daily. For reasons explained later in this paper, the sample period is from March 19, 2001, to December 31, 2012. The estimated result is as follows:

\[ \Delta ACCOUNT_{t+2} = 33.6017 + 0.6186 INTERVENTION_t \]  

\[ (5) \]

\( Adj. R^2: 0.0242; \ Prob (F\text{-statistic}): 0.0000; \ Durbin-Watson: 2.1242. \)

The figures in parentheses are \( p \)-values.

The results show that \( \beta_1 \) is about 0.6 and significant (however, the constant term is insignificant). This result means that about 40% of the volume of interventions is sterilized and 60% is nonsterilized. This analysis sets the term \( ACCOUNT \) to 1 if \( \Delta ACCOUNT_{t+2} / INTERVENTION_t \geq 0.5 \), and the term \( ACCOUNT \) to 0 if \( \Delta ACCOUNT_{t+2} / INTERVENTION_t < 0.5 \).

\( POLICY \) is 1 if the BOJ changed financial policy and announced the change or 0 otherwise.

The data for interest rates are the money market rate (3-month). All the data are daily. The data source for interest rates and the BOJ’s current account are from *NIKKEI NEEDS*. \( INTERVENTION \) data are from the Web site of the Japan Ministry of Finance Japan and \( POLICY \) data are from the BOJ Web site.

The sample period is from 1991 to 2012 because of data availability, and the period is divided into two. The break point is March 19, 2001, which was the starting time of the new quantitative easing policy. Since then, the BOJ has conducted aggressive financial policy to combat deflation and recession. However, the data for the BOJ current account was not available for the full sample period (from 1991 to 2012), so the analysis for this effect is from March 19, 2001, to the end of 2012.

The empirical method is OLS and generalized method of moments (GMM), which is a robust estimator in
that, unlike maximum likelihood estimation, GMM does not require information about the exact distribution of the disturbances. Instead of $F$-statistic, Hansen’s $J$ statistics test is performed. This test checks whether or not the model’s moment matches the data. In a GMM context, when there are more moment conditions than parameters to be estimated, this test can be used to test the over-identifying restrictions. This method requires a decision about which variables to use as instrumental variables. In equation (3), the lagged values of dependent and explanatory variables are used as instrumental variables. The model is the equation (3) described in the previous section. The results are shown in Tables 1 and 2.

Table 1

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>GMM</td>
</tr>
<tr>
<td>$C$</td>
<td>-0.0295 (0.2481)</td>
<td>-0.0235 (0.5615)</td>
</tr>
<tr>
<td>$\Delta s$</td>
<td>0.0302 (0.1358)</td>
<td>-0.9367 (0.0000)</td>
</tr>
<tr>
<td>$i-i^*$</td>
<td>-0.0086 (0.1613)</td>
<td>-0.0505 (0.0000)</td>
</tr>
<tr>
<td>INTERVENTION</td>
<td>-2.04E-05 (0.3506)</td>
<td>-2.77E-05 (0.5713)</td>
</tr>
<tr>
<td>POLICY</td>
<td>-0.0137 (0.9527)</td>
<td>0.2842 (0.3380)</td>
</tr>
<tr>
<td>Adj.$R^2$</td>
<td>0.0213 (0.9527)</td>
<td>-0.9794 (0.3380)</td>
</tr>
<tr>
<td>Prob ($F$-statistic)</td>
<td>0.1653</td>
<td>-</td>
</tr>
<tr>
<td>$J$-statistic</td>
<td>-</td>
<td>0.0266</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>1.9994</td>
<td>0.9533</td>
</tr>
</tbody>
</table>

Note. Figures in parentheses are $p$-values.

Table 2

<table>
<thead>
<tr>
<th>Method</th>
<th>OLS</th>
<th>GMM</th>
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<tbody>
<tr>
<td>$C$</td>
<td>-0.0228 (0.2159)</td>
<td>-0.0089 (0.3298)</td>
</tr>
<tr>
<td>$\Delta s$</td>
<td>-0.0419 (0.0202)</td>
<td>0.8653 (0.0000)</td>
</tr>
<tr>
<td>$i-i^*$</td>
<td>-0.0069 (0.3502)</td>
<td>-0.0045 (0.1104)</td>
</tr>
<tr>
<td>INTERVENTION</td>
<td>4.12E-05 (0.0000)</td>
<td>4.09E-05 (0.0000)</td>
</tr>
<tr>
<td>POLICY</td>
<td>0.0024 (0.9682)</td>
<td>0.0318 (0.6372)</td>
</tr>
<tr>
<td>STERILIZATION</td>
<td>0.1880</td>
<td>0.1703</td>
</tr>
<tr>
<td>Adj.$R^2$</td>
<td>0.0089 (0.0089)</td>
<td>0.0062 (0.0062)</td>
</tr>
<tr>
<td>Prob ($F$-statistic)</td>
<td>0.0000</td>
<td>-</td>
</tr>
<tr>
<td>$J$-statistic</td>
<td>-</td>
<td>0.0516</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>1.9966</td>
<td>2.9954</td>
</tr>
</tbody>
</table>

Note. Figures in parentheses are $p$-values.

The results are almost as expected, and those derived using GMM are better than those from OLS, as expected. GMM should be employed. The results show that interventions have recently generally been effective.
in influencing the level of the yen-US dollar exchange rate. However, the results show that sterilization should be taken into account as Watanabe and Yabu (2009).

The signaling channel ($\Delta s$) is confirmed to exist for both sample periods. However, the portfolio balance channel ($i - i^*$) does not exist. Rapid integration of financial markets and enormous increases in foreign exchange markets seem to make this approach less effective. The findings for the communication channel (POLICY) are not significant; however, the coefficients are positive, which indicates acceleration in the depreciation of the Japanese yen as expected. Finally, the sterilization effect (STERILIZATION) is positive and as expected. Unsterilization effects seem to exist strongly.

**Conclusions**

This article focused on interventions in the foreign exchange market in Japan. The empirical results show that interventions have been conducted effectively. However, they depend on unsterilization to some degree. To achieve effective and efficient interventions in foreign exchange market, it appears important to consider and conduct sterilization or unsterilization in some cases. However, it is difficult and dangerous to judge that the intervention policy was good. For example, in spite of the fact that the coefficient was opposite from the expectation, there may some cases in which this approach might be able to prevent too strong appreciation/depreciation of the yen to some degree. In such cases, interventions would be successful even if the coefficients were not as expected.

The past exchange rate (i.e., the signaling effect) also is important to the movement of exchange rates. On the other hand, it is interesting to note that portfolio channel was not found. However, this model hypothesized rational expectation for exchange rates, so there is some possibility that the model does not fit well in the real world.

The communication channel did not exist. However, exchange rate control is not the BOJ’s objective. The Act stipulates the Bank’s principle of currency and monetary control as follows: “Currency and monetary control by the Bank of Japan shall be aimed at achieving price stability, thereby contributing to the sound development of the national economy”. The Ministry of Finance of Japan investigate, plans, and drafts matters concerning foreign exchange and international monetary systems and their stability; adjustment of balance of payments; management of the foreign exchange special account; foreign exchange rates; international organizations related to economic cooperation or development; overseas loans and investment, and so on. However, the coefficients were positive in the direction of depreciation of the yen. They are expected to prevent too much appreciation of the yen, to promote export, and expansion of the economy.

In Japan, the frequency and volume of interventions have changed greatly. Compared to the past, the number of times has decreased; on the other hand, the volume of one-time interventions has increased. Also, the effects of interventions may have appeared later or sooner depending on the market situations. These elements should be considered.

Recently, many countries have considered devaluation of their own currencies. The risk of such a strategy is that it becomes incompatible if several economies pursue competitive devaluation to maintain or gain competitiveness. However, there is not only the issue of consistency and conflict among policymakers who attempt to pursue similar forward exchange market transactions via intervention. Sometimes coordination among
countries should be taken into account. This study has not considered this aspect.

Interventions have pros and cons, of course. Interventions sometimes may lose effectiveness, in which case, financial policy, allocation or distribution of capital, and costs should be taken into account. Further study is needed in this field.

References