



# Self-selection and treatment effects: Revisiting the effectiveness of foreign exchange intervention

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## ABSTRACT

Along the lines of the treatment effects literature, this paper empirically revisits the issue of the so-called “intervention effect”, i.e., the effectiveness of official foreign exchange intervention on the movement of the exchange rate. We specifically examine the effectiveness of official daily interventions by Japanese monetary authorities in the JPY/USD market over the period from 1 January 1999 to 31 December 2011. To achieve our aim, we extended in a continuous treatment setting the inverse probability weights estimator developed by Jorda and Taylor (2015) and Angrist, Jorda and Kuersteiner (forthcoming) et al. (2018) to control for self-selection bias. In accordance with existing evidence, this paper finds that periods of intervention characterized by large, infrequent and sporadic interventions are effective in moving the changes in the exchange rate in the desired direction for the full-sample period and across two of the three sub-samples. We also find evidence that once the exchange rate moves in the desired direction, the effect is not long-lasting, but, slightly longer, contrary to existing evidence.

## 1. Introduction

This paper evaluates the effectiveness of official foreign exchange intervention on the movement of the exchange rate, i.e., the so-called “intervention effect”. In line with the concept of “success” or effectiveness in the literature, we examine whether official foreign exchange intervention influence or push the changes in the exchange rate (daily exchange rate returns) in the desired direction. Specifically, we assess whether official daily amounts of interventions by Japanese monetary authorities in the JPY/USD market over the period from 1 January 1999 to 31 December 2011 move changes in the JPY/USD exchange rate in the correct or desired direction.

In general, the literature has not reached a definite conclusion on the effectiveness of foreign exchange intervention on the changes in the exchange rate, in fact at most times, suggesting the absence of any relation (e.g., Baillie and Humpage, 1992; Baillie and Osterberg, 1997; Hillebrand and Schnabl, 2004; Neely, 2008; Galati and Disyatat, 2005; Sarno and Taylor, 2001). Also, the survey papers of Edison (1993) and Almekinders (1995) conclude the lack of a firm relationship between intervention and exchange rate returns. In contrast, Dominguez and Frankel (1993), Ito (2003), Fatum and Hutchison (2006), Fatum and Hutchison (2010) find evidence that foreign exchange intervention tends to be effective when intervention operations are large and infrequent. Furthermore, based on results of surveys conducted among central banks, intervention is implicitly supported because it is generally believed that it is a useful and effective instrument (Neely, 2008).

With respect to Japanese official foreign exchange intervention in the JPY/USD market, ever since Japanese monetary authorities

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released data on their foreign exchange intervention activities in 2001, several studies have examined the effects of Japanese foreign exchange intervention on the daily changes of the JPY/USD exchange rate. Takagi (2014) reviewed 30 such studies that examined intervention data for the period April 1991 to March 2004, and reflective of the above general literature on this issue, finds contrasting evidence on its effectiveness. However, towards the end of his survey, Takagi (2014) suggested that, on average, Japanese official foreign exchange intervention moves the changes in the JPY/USD exchange rate in the desired direction when the scale is large, and intervention is infrequent.

Conducting our empirical examination for the full sample period and across three separate sub-samples (i.e., January 1999–December 2002; January 2003–March 2004; and, September 2010–December 2011),<sup>1</sup> we also find that Japanese official foreign exchange intervention influences the changes in the JPY/USD exchange rate in the desired direction (i.e., sales of JPY against purchases of USD leads to appreciation of the USD vis-à-vis the JPY) when the scale is large, and intervention is infrequent for the full-sample as well as across two of the three sub-samples. Furthermore, this study contributes to the literature in four different ways. First, previous studies that examined the effectiveness of Japanese official foreign exchange intervention have typically covered the period from April 1991 to March 2004. This study is one of the first<sup>2</sup> to investigate the issue of the effectiveness of Japanese foreign exchange intervention for the period of September 2010 to December 2011, that is, the period that followed the 6½ years of no intervention by Japanese monetary authorities since March 2004.

Second, to the best of our knowledge, the literature, including previous studies that investigated evidence of the effectiveness of Japanese official foreign exchange interventions on the duration of the effectiveness of foreign exchange intervention has been relatively scarce. An exception is the study by Nagayasu (2004) which examined earlier data on Japanese foreign exchange intervention over the period April 1, 1991 to September 28, 2001 and found, using GARCH-like specifications, of an intervention effect on the changes in the JPY/USD exchange rate which lasts only a day when the intervention take place. In contrast to Nagayasu (2004), our study covers a much later period of Japanese foreign exchange intervention. More importantly, while our study also finds that this intervention effect is short-lived, we obtain results over the full-sample period and across two of the three sub-samples, which indicate that the duration of this intervention effect is slightly longer, lasting for two days after the intervention takes place. Third, in line with the findings of Chaboud and Humpage (2005) and Fatum and Hutchison (2005, 2010) we find that for the sub-period of January 2003–March 2004, Japanese official foreign exchange interventions were ineffective in moving the changes in the JPY/USD exchange rate in the desired direction. However, we also obtain results which indicate that Japanese official foreign exchange interventions during this period had some undesired or “perverse” result of moving the exchange rate in an erroneous direction. The battery of robustness tests we conducted in this study tended to validate all these results.

Finally, we obtained the above results using a novel econometric method that address a particular source of endogeneity – self-selection bias – the bias that occurs when the decision to officially intervene in the foreign exchange market is not taken at random. Specifically, we employ a modern technique on the treatment effect literature to confront this problem of self-selection bias. The way the technique works is that it creates a pseudo-population that mimics a situation of “as if” the decision to intervene had been taken at random and then performing a weighted linear Local Projections (LP) due to Jorda (2005) to eventually uncover the causal effect of Japanese official foreign exchange interventions on the changes in the JPY/USD exchange rate in various horizons. This technique has been called the “doubly robust” inverse probability weighted (IPW) estimator based on the works of Jorda and Taylor (2015) and Angrist et al. (2018). In this paper, we extend the application of the IPW estimator in a continuous treatment setting.<sup>3</sup>

At the same time, we also note that careful attempt has been made to follow the method commonly employed in this literature to achieve a clear identification of the causal effect of Japanese foreign exchange intervention on the changes in the JPY/USD exchange rate. This involves adopting a two-stage estimation to control for another particular source of endogeneity (i.e., simultaneity bias or reverse causality) in which the predicted values obtained from a Japanese intervention reaction function estimated in the first-stage is used as an instrumental variable for contemporaneous intervention in the second stage estimation, which then links the changes in the JPY/USD exchange rate to the official Japanese foreign exchange intervention (e.g., Kearns and Rigobon, 2005; Galati and Melick, 2002; Galati et al., 2005; Fatum and Yamamoto, 2014). In addition, because there is a non-negligible proportion of zero values in the intervention data, we also adopted the strategy of modeling the intervention reaction function as a censored variable (e.g., Almekinders and Eijffinger, 1994; Humpage, 1999; Kim and Sheen, 2002; Rogers and Siklos, 2003; Brandner and Grech, 2005; Adler and Tovar, 2014).

Also, to the best of our knowledge, the technique we employed in this study to address the problem of self-selection bias is the first such application that investigates the effectiveness of foreign exchange interventions. The only previous study we can find related to ours which also employs the modern technique from the treatment effect literature is by Fatum and Hutchison (2010). However, unlike ours, this study uses propensity score and matching techniques to assess the effectiveness of Japanese foreign exchange intervention. Their method is carried out by also first estimating an intervention reaction function, but instead of using the actual

<sup>1</sup> Aside from being established by previous studies, we would see later on in the analysis that these three subsamples were determined based on a careful analysis of the raw intervention data and by formal structural break analysis.

<sup>2</sup> Another study that we are aware of which looked at this same period is Fatum and Yamamoto (2014) which used non-temporal threshold analysis to investigate the exchange rate effects of large and small interventions.

<sup>3</sup> Following the treatment effects literature, treatment refers to the decision by monetary authorities to intervene in the foreign exchange market. The extension is made in a continuous treatment setting because the actual daily amounts of intervention is used in the construction of the inverse probability weights rather than converting the intervention data as an indicator variable that takes on the value of 1 on days when there is intervention and 0 otherwise. More discussion on this aspect follows in subsequent sections.

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