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Does the simple microstructure model tell the time of the FX intervention? A one day analysis of the Japanese FX intervention

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ABSTRACT

Using tick data of the USD/JPY rate, I propose the method to detect the time of the FX intervention. I use the simple microstructure model and assume that the FX intervention causes regime-switching in the microstructure of the USD/JPY market, changes in adverse selection, and inventory effect. The time of the intervention is estimated endogenously by the Markov-switching model, and the actual starting time is well estimated. I also find that no market orders, except a large U.S. dollar purchase, convey any private information during the period of the intervention.

1. Introduction

For major currency pairs, such as the EUR/USD and the USD/JPY rates, the data that records the exact time of a foreign exchange (FX) intervention is usually unavailable.[1] The purpose of this paper is to detect this time with the tick-by-tick data of the USD/JPY rate. For this purpose, I use the simple microstructure model, which considers that the transaction of a market order conveys private information. I assume that the FX intervention affects the microstructure in the USD/JPY market, and adopt the Markov-switching model to capture this effect. The notable feature in this method lies in the endogenous determinant of the regime-switching period, which is possibly associated with the FX intervention. Moreover, the proposed method helps to know the time of an FX intervention at the tick-by-tick level, and to analyze the microstructure effect of that intervention, which may be quite short-lived and unobservable in low frequency data.

The vast literature examines the effects of FX interventions for various currency pairs. Menkhoff (2010) surveys some of the studies and focuses mainly on the ones that use high-frequency data to examine the microstructure effect of an FX

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[1] For example, the USD/JPY is the Japanese yen quoted against the U.S. dollar. The left currency is a base currency, which is a numeraire for the term currency on the right.

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intervention. The data that records the exact time of FX interventions is available in studies analyzing the relatively small currency pairs, like the USD/CHF (Fischer and Zurlinden, 1999), the USD/CAD (Beattie and Fillion, 1999), and the USD/RUB (Melvin et al., 2009). Meanwhile, most studies that analyze major currency pairs use relatively low frequency data (i.e., daily data) due to limited availability and/or lack of information about the intraday time of an FX intervention. Unfortunately, this leads the authors to consider no intraday microstructure effect of an FX intervention even though they reveal the daily effect of an FX intervention on the spread and volatility of the FX rate.

My tick data records the transaction of the USD/JPY rate, and the starting time of the FX intervention is available since the Japanese monetary authority announces it exceptionally in the ex-post media interview. My method detects the time as the regime-switching in the market. My assumption that the FX intervention affects the microstructure in the USD/JPY market is plausible, since it is well documented that the arrival of news about an FX intervention brings surprise to FX markets, and the intraday FX change, volatility, and trading volume are likely to be large (e.g., Pasquariello, 2007). Susai and Yoshida (2012) focus on the same Japanese FX intervention as this study, more specifically on the intervention via a limit order, and they construct the order flow from the limit orders to detect that intervention. Like them, I also consider the intervention via a limit order, although my empirical model focuses on the usual order flow constructed from market orders to detect the intervention via a market order.

My research covers only one day of the FX intervention, and the results are not conclusive and general. Nevertheless, I believe that a plausible microstructure effect of an FX intervention allows one to detect the time of the intervention. This information can be helpful in better understanding the intraday effect of the FX intervention, even when its time is not released. The method proposed here can be expanded to other data sets in which the time of the FX intervention is unknown. Another method of identification is the use of intervention press reports. However, as mentioned in Menkhoff (2010), several studies reveal the inaccuracy of these reports. For Japanese FX interventions, Frenkel et al. (2004) report that the probability that an intervention report correctly points to an actual intervention was only 60 percent between January 1995 and December 1999. Additionally, a reporting lag is plausible even when the report is correct. Therefore, I believe that the use of reports and the method proposed in this study play complementary roles in detecting the time of an FX intervention.

This paper is organized as follows. Section 2 explains the microstructure model and data, and expands the model into the Markov-switching model. Section 3 shows empirical results and considers possible limit orders of the FX intervention, which are not considered explicitly in the microstructure model. The empirical results indicate that the FX intervention brings a damping effect under which private (non-monetary authority) order flows convey no information. The Markov-switching model detects the possible starting time of the FX intervention with the large limit order. In this section, the relationship between the damping effect and the limit order of the FX intervention is considered. Section 4 concludes the paper.

2. Model and data

2.1. The model

In order to depict the microstructure of the FX market, I use the model developed by Glosten and Harris (1988). Huh (2014) also uses this model to estimate the price impacts of NYSE/AMEX-listed stocks. He uses high-frequency data and concludes that the estimated price impact outperforms the other low-frequency-based proxies as an illiquidity measure, because it can incorporate incremental information that comes out of high-frequency data. Based on Huh's (2014) suggestion, I also use tick-by-tick data, which records the transactions of USD/JPY rate via the electronic broking service (EBS).

For estimating the probability of the FX intervention, my idea is similar to that of Nyholm (2003) who develops the trade indicator model. This model considers that a NYSE specialist has a large quote revision in the next period when he/she takes into account that the last trade is driven by private information. Nyholm (2003) uses the Markov-switching model to estimate the probability of informed trade. I assume that the FX intervention amplifies the inventory and adverse information effects, and I employ the Markov-switching model to estimate the periods of those large effects. My adopted model separates the inventory effect from the adverse information one, although Nyholm (2003) lumps them together.

Glosten and Harris (1988) assume that the fundamental of an asset price reflects public and private information. The arrival process of the former information follows the random walk process, and each transaction via a market order conveys the latter one. With μ and ε being the fundamental and white noise respectively, the stochastic process of the fundamentals can be expressed as follows:

$$\mu_t = \mu_{t-1} + \lambda x_t + \varepsilon_t \quad \lambda > 0 \quad \varepsilon_t \sim N(0, \sigma^2), \tag{1}$$

where x_t is the order flow (net buyer initiating trade) and λ is the price impact. The market order x_t is positive (negative) when the tth transaction occurs at ask (bid) side. t is an event counter at which the tth transaction occurs. In this equation, the microstructure theory considers that only the market order transaction conveys private information. Alternatively, this implies that the limit order contains no private information. Kozhan and Salmon (2012) examine whether the information contained in the limit order book can realize economic gains, and find a negative result in the U.S. dollar/Sterling FX market. I follow their finding and use Eq. (1) assuming that only market orders convey private information. In the section below, I also discuss whether the Japanese monetary authority intervenes via a limit order and the effect of this FX intervention, although the above model does not consider the microstructure effect of limit orders.