



# Exchange rate management in emerging markets: Intervention via an electronic limit order book

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## ARTICLE INFO

### Article history:

Received 11 June 2008

Received in revised form 15 May 2009

Accepted 25 June 2009

### Keywords:

Foreign exchange market microstructure

Limit order book

Electronic crossing network

Exchange rate intervention

## ABSTRACT

This paper describes and analyzes the implementation of a crawling exchange rate band on an electronic trading platform. The placement of limit orders at the central bank's target rate serves as a credible policy statement that may coordinate beliefs of market participants. We find for our sample that intervention increases exchange rate volatility (and spread) for the next minutes but that intervention days show a lower degree of volatility (and spread) than non-intervention days. We also show for intraday data that the price impact of interbank order flow is smaller on intervention days than on non-intervention days. These stabilizing effects, however, rely on the conditions of large currency reserves and the existence of capital controls; an electronic market seems to support this goal.

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## 1. Introduction

The bulk of central bank intervention activity nowadays occurs in emerging markets which also play an increasingly important role in current global imbalances. Moreover, foreign exchange (FX) markets have changed their organizational structure to increasingly move to electronic markets and this structural change is taking place in emerging markets, too. This study is the first to analyze the workings of an emerging market's central bank intervention aimed at targeting exchange rates via electronic markets by way of a case study relying on unusually detailed information.

The rise of emerging economies is not yet adequately reflected in the literature on exchange rate management. There is a wealth of studies on foreign exchange interventions but almost all of them refer to industrialized economies and most of them deal with the few main floating exchange rates.<sup>1</sup> Considering the changing institutional features of the FX market, it is worthwhile considering how a central bank could use an electronic trading venue to manage exchange rates. It is also important to note that in recent years, exchange rate management in general and interventions in particular occur mostly in emerging market economies. The share of all reserves held by emerging countries has increased from about 35% to 75% between 1988 and 2007 (according to IMF data). Second, effective exchange rate arrangements in the form of

crawling pegs or bands dominate floating exchange rates by far, according to Reinhart and Rogoff (2004), and have further gained importance over the last two decades up to a share of more than 30% among all exchange rate arrangements during the last years. Third, much foreign exchange trading has migrated to electronic markets, a technological evolution that applies to emerging markets as well. Therefore, our case study on interventions in an electronically traded emerging market currency seems to address an increasingly important but up to now neglected field of real world exchange rate management.

We report and analyze a unique type of foreign exchange (FX) market intervention by the Russian Central Bank which occurred by placing limit orders on an electronic limit order book to set an upper bound on the rouble price of a dollar (USDRUR). This could be a credible statement of a crawling band that signals a firm commitment of the Bank to spend or accumulate reserves as needed to keep the exchange rate within the band.<sup>2</sup> Indeed, the Russian exchange rate arrangement is classified as a “de facto crawling band” and thus belongs to the important broader category of “limited flexibility” (see Reinhart and Rogoff, 2004).<sup>3</sup>

Our research covers 5 days of interventions and is thus a case study whose results cannot just be taken as completely conclusive and general. Nevertheless, the unusually detailed information about the complete order book allows studying intervention effects in an almost “ideal” microstructure setting: we analyze about 2700 central bank

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<sup>1</sup> Among the several surveys, Sarno and Taylor (2001), Edison (1993), Almekinders (1995) and Neely (2005) cover the key issues.

<sup>2</sup> We do not use the term “target zone” here as the formal assumptions of the Krugman (1991) model, in particular no capital controls, are not satisfied.

<sup>3</sup> Among the 31 countries in the “de facto crawling band that is narrower than or equal to +/− 2%” category are further transformation economies (e.g. Czech Republic, Lithuania), middle-income African economies (e.g. Algeria, Kenya), a few South-American economies (e.g. Argentina) and emerging Asian economies (e.g. India, Malaysia, Philippines).

transactions within a total sample of more than 56,000 orders, among them about 30,000 transactions. This data has three distinct advantages: first, it provides knowledge of the exact time of central bank activity which the prior literature has usually inferred from news reports or actual price movements.<sup>4</sup> Thus we can analyze precisely the effects of intervention in terms of the impact of central bank decisions to intervene and the consequent exchange rate effects of purchases or sales of currency.<sup>5</sup> Second, the analysis undertaken in our paper is unique in that we study what could be called “automated intervention” in that the central bank determines a desired band for the exchange rate and then places very large limit orders to keep the exchange rate inside this band. Third, the data allows analyzing order flows which is quite new to the intervention literature.<sup>6</sup>

We find that intervention increases exchange rate volatility (and spread) for the next few minutes but that intervention days show a lower degree of volatility (and spread) than non-intervention days. We also show for intraday data that the price impact of interbank order flow is smaller on intervention days than on non-intervention days. Finally, we reveal that informed banks take different positions than uninformed banks as they tend to trade against the central bank – which reflects a rational stance. Despite this position taking, the targeted exchange rate band holds and volatility, spread and price impact go down. Overall, the intervention band seems to realize stabilizing effects. The success of such a regime for an emerging market currency is likely to depend on the conditions of large currency reserves and the existence of capital controls – conditions which were met for the Russian case under consideration. In 2002, capital controls in Russia were quite strict. The rigid controls in existence were imposed after the 1998 financial crisis. For instance, business firms had to apply on a case-by-case basis for permission prior to international transfers of capital. Exporters were required to sell 50% of their foreign currency proceeds to the central bank. Following the 1998 crisis, firms had a strong preference to hold convertible, reserve currencies like the U.S. dollar or euro, so the currency surrender requirement was viewed as essential to provide liquidity to the domestic foreign exchange market. Foreigners traded the rouble in the offshore non-deliverable forward (NDF) market and could not participate in the onshore market. In 2007, the rouble moved to deliverable status but foreign entities still preferred to trade offshore in many cases due to credit and political concerns. To this day, there is an active NDF market for the rouble.

The paper is organized as follows. In the next section the institutional details of the electronic crossing network will be presented along with a detailed overview of the data available for analysis. Then in [Section 3 Effects of central bank limit orders](#), an empirical examination of the limit orders placed by the central bank is undertaken with a focus on its effect on volatility, spread, price impact of order flow and order choice. [Section 4 Implications for the central bank](#) discusses implications for the central bank and, finally, [Section 5 Summary and conclusions](#) offers a summary and conclusions.

<sup>4</sup> Exceptions to this are the Swiss National Bank, which has made its data public, see Fischer and Zurlinden (1999), Payne and Vitale (2003), and Pasquariello (2007). Fischer (2006) shows that Reuters news reports of Swiss intervention are often erroneous and bring into question the accuracy of such news for timing Swiss interventions. Data sets from Denmark (Fatum and Pedersen, 2009) and Canada (Beattie and Fillion, 1999; Fatum and King, 2005) have been studied, but are not available to the public.

<sup>5</sup> Starting with Dominguez and Frankel (1993) more recent studies find an impact of intervention, including Humpage (1999) and Dominguez (2003) for the US, Ito (2002, 2007) for Japan, Fatum and Hutchison (2003) for Germany (and the US), Kearns and Rigobon (2005) for Australia and Disyatat and Galati (2007) for the Czech Republic. Also communication can be effective (Fratzsch, 2006) or even falsely rumored interventions (Dominguez and Panthaki, 2007).

<sup>6</sup> To our knowledge there are two other studies analyzing interventions in an order flow approach: Scalia (2008) has to estimate intervention timing and thus aggregates data to hourly frequency, Girardin and Lyons (2007) use customer order flow of a large bank on a daily frequency.

## 2. Institutional details

### 2.1. The SELT system

Local interbank trading in the rouble occurs on an electronic limit order market at the MICEX in Moscow and, at the time of interest to this study, March 2002, this market determined the official exchange rate of the USDRUR. This country-wide trading at the MICEX is called the “unified trading session” or UTS. The structure is that of a multiple dealer market without designated market makers. While an interbank market, it is expected that much of the trading reflects customer orders received by the participating banks. During the period analyzed, the UTS took place for 1 h a day from 10:30–11:30 Moscow time and the only instrument traded was the USDRUR spot rate.<sup>7</sup>

MICEX FX trading occurs on the SELT electronic system that is similar to the electronic brokerage systems of Reuters or EBS.<sup>8</sup> Like EBS or Reuters, participants on SELT just see the top of the book or the best bid and ask prices with associated order size.

Foreign exchange trading within Russia appears to have a local information component.<sup>9</sup> Banks in the financial centers of Moscow and St. Petersburg are more likely to see the customer order flow of the large Russian corporate clients than banks in other cities. The banks on the periphery are also less likely to be as well informed on economic policy developments as the banks in the financial centers. Menkhoff and Schmeling (2008) show that there is more likely to be a permanent price impact of trades originated by Moscow and St. Petersburg banks than banks on the periphery. This is consistent with the trades from the financial centers reflecting private information compared to the transitory price impact associated with the trades originated by other banks. Following these earlier findings, we will structure some of our empirical analysis to take account of this institutional feature of the Russian market.

Participants on the system see the best bid and offer price plus respective quantities. They also see the cumulative buy and sell volumes for the current trading session and the last transaction quantity and price. Trades occur anonymously and then post-trade counterparty identities are revealed. The fact that the central bank learns the identities of private banks that trade at its limit order may serve as a form of central bank monitoring that helps to enforce the desired crawling band with a minimum of reserve loss.

It is likely that using an electronic limit order book as a vehicle for maintaining a crawling band is effective only in a case where that crossing network accounts for a very significant part of the overall market. In the case of Russia, this was made possible by the controls on foreign exchange trading. Foreigners traded roubles in an offshore market in the form of non-deliverable forward contracts. So the domestic market was segmented from foreign participation and this allowed the central bank to effectively target the exchange rate with limit orders on the MICEX.<sup>10</sup> Such a mechanism is unlikely to be of much use to a country with a convertible currency and open financial markets given the current structure of the foreign exchange market. For instance, electronic trading in the major developed currencies is split across several different platforms and there is no one crossing

<sup>7</sup> Trading was later extended to a four hour session and forward contracts.

<sup>8</sup> A marginal difference for SELT is that only limit orders, specifying price and quantity desired, or cancellations may be submitted. Unlike Reuters or EBS, there are no market orders specifying desired quantity at the best price in the order book. To receive immediate execution, an order must be submitted that crosses the best price in the order book. Such marketable or crossing limit orders are the equivalent of market orders on the SELT.

<sup>9</sup> See Menkhoff and Schmeling (2008).

<sup>10</sup> We thus observe and analyze the trading dynamics of the domestic market. Within domestic markets, the UTS provides much higher liquidity than regional bourses which are only open to banks from the respective regions. Moreover, the central bank determines via its interventions the official exchange rate at the UTS which is then binding to others. Thus the UTS is the core market to exchange information among domestic players.

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