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Would Central Banks' Intervention Cause Uncertainty in the Foreign Exchange Market?

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Abstract

This paper investigates the effect of intervention by the central Banks of Australia, Turkey, and Russia on the Australian dollar, the Turkish lira, and the Russian ruble, respectively. This paper covers various sample periods, depending on data availability: Jan. 3, 1989-Dec. 12, 2014 for Australia, Jan. 2, 2002-Dec. 12, 2014 for Turkey, and Jan. 10, 2013-Dec. 10, 2014 for Russia.

The econometric method that is used in this paper is the GARCH (1, 1) model. This model is used to measure the effect of intervention by central banks on the volatility of the local currencies for the time periods described. In addition, this paper explores the estimation of the effect of official intervention on the amount of appreciation and deprecation of the three currencies.

The findings of this research are that intervention is related to significant volatility and uncertainty in the official exchange rate. This result was found for Australia and Russia but not for Turkey. One possible reason for that may be the nature of the frequency of intervention by the Central Bank of Turkey. In other words, the rare intervention of the central bank was associated with stability in the exchange rate.

Keywords: GARCH model, intervention, monetary policy, exchange rate volatility, Australia, Turkey, Russia

1. Introduction

The objective of this paper is to empirically analyze the relationship between intervention by the central banks of Australia, Russia, and Turkey and the exchange rates of these countries. There is a debate on whether intervention would affect the exchange rate positively or negatively. Thus, it is one of the objectives of this research to answer this concern and to find whether intervention by central banks, specifically purchasing and selling foreign currencies, are associated with depreciation or appreciation in the local currencies of these countries.

Some central banks use intervention by selling and purchasing in the foreign exchange market as a policy instrument to stabilize the economy. This issue is of importance because if intervention can affect the exchange rate, then this would give the monetary authority a policy instrument that is independent from other monetary policies.

Can one find out the most convenient time for the central bank's intervention? Friedman (1953) proposes that an easy way to decide when the central bank should intervene is when intervention will be profitable. That is the central bank should buy (sell) currencies when they are below (above) equilibrium values. On the other hand, the monetary authority is said to be effective if its intervention will return the exchange rate to the equilibrium level, or it will reduce the volatility of the exchange rate (Kim & Sheen, 2002).

The main objective of this paper is to investigate the effectiveness of the intervention by Reserve Bank of Australia, the Central Bank of Russia, and the Central Bank of Turkey on foreign exchange markets in Australia, Russia, and Turkey, respectively. Primarily, this research will answer the following questions. Have official interventions by central banks influenced the exchange rates of the Australian dollar, the Russian ruble, and the Turkish lira? Have those interventions increased or reduced the volatility of the exchange rates of these currencies? This research utilizes the model of Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH) to determine the effect of intervention on the volatility of the exchange rate. GARCH was found to be an effective method to measure uncertainty and volatility with data series that have a high frequency.

This paper is arranged in the following manner. Section 2 shows the historical statistics for interventions in the foreign exchange market in Australia, Russia, and Turkey. Section 3 presents some of the past methods and findings in the literature about the impact of interventions in the foreign exchange market. While section 4 explains the data and sources, section 5 demonstrates the methodology. In section 6, we present the results, and, section 7 gives the conclusions.

2. History of Intervention in the Foreign Exchange Market

2.1 Purchasing Activities

In this section, we review the history of purchasing intervention in Australia, Russia, and Turkey. It is essential to understand the reaction of exchange rates to official intervention, especially "purchasing activities", by the Reserve Bank of Australia, the Central Bank of Russia, and the Central Bank of Turkey.

Table 1. Summary of purchasing activities in the foreign exchange markets

	Australia	Turkey	Russia
	Jan. 3, 1989 - Dec. 12, 2014	Jan. 2, 2002 - Dec. 12, 2014	Jan. 10, 2013 - Dec. 10, 2014
Total working days of the sample	6,539	3,259	296
Number of days intervened	291	16	34
Average daily intervention	55	1629	98
Maximum value per day (US.$ million.)	461	5,441	204
% of days intervened to business day	4.5%	0.5%	11.5%
Total amount of interventions (US.$ m.)	15,915	26,059	3,322

Source: Author's calculations

Data show that Russia is heavily involved in purchasing activities in the foreign exchange market compared to Australia and Turkey. Russia is involved in purchasing activities for 11.5% of the days of the sample. On the other hand, Australia is involved in 4.5% of the sample, while Turkey participated in only 0.5% of their sample. The maximum single day of purchasing intervention was recorded for Turkey at US $5,441 million on February 15th, 2006. Though the percentage of intervention was the highest for Russia, the highest dollar amount of intervention was for Turkey at US $26,059 million.

Table 2. Summary of selling activities in the foreign exchange markets

	Australia	Turkey	Russia
	Jan. 3, 1989 - Dec. 12, 2014	Jan. 2, 2002 - Dec. 12, 2014	Jan. 10, 2013 - Dec. 10, 2014
Total working days of the sample	6539	3259	296
Number of days intervened	177	12	164
Average daily intervention	157	502	548
Maximum value per day (US.$ million.)	1,305	1,865	11,272
% of days intervened to business day	2.7%	0.4%	55.4%
The total amount of interventions	27,850	5,522	89,938

Source: Author's calculations

2.2 Selling Activities

Generally, central bank intervention involves more selling activities than purchasing. This shown by the larger numbers and percentage for most indicators reported in Table 1 and 2. Instead of intervening for 11.5% of the days with purchasing activities, this percentage for Russia is 55.4% for selling activities. This might be considered an attempt by the Russian government to protect the Russian rubble from further depreciation. During the 23 months of the sample data, the ruble lost more than 40% of its value.

The maximum single day of selling intervention was recorded for Russia in the amount of US $11,272 million on March 4th, 2014. The biggest amount of intervention was recorded by Russia for approximately US $90,000 million. Australia recorded a total of selling activities equal to US $27,850 during the entire sample timeframe. Turkey recorded the smallest total amount of selling activities of only US $5,522 million, even though it had the most dollars of purchasing activities among all countries.

3. Literature Review

In this section, we review some of the research papers that dealt with the issue of the impact of intervention on the foreign exchange markets. Simatete (2004) has studied the impact of the intervention by the central bank of Zambia. The author used the GARCH (1, 1) model to measure the impact of intervention on the exchange rate. She found that this intervention by the monetary authority increases the level of the exchange rate, but it reduces its volatility.

Isshi et al. (2006) studied foreign exchange interventions in Mexico and Turkey. They indicated that interventions in developing economies might be more effective than those of developed economies. They claimed that some emerging market countries intervene in amounts that are large relative to market turnover. They used different foreign exchange and banking regulations that effectively restrict the size of the market and can increase the central bank's control. On the other hand, Egert (2007) investigated the effect of foreign exchange intervention on the level and volatility of the exchange rates for some emerging economies in Europe using event study analysis. The finding of this paper asserts that appropriate central bank communication might improve the effect of intervention.

Goyal and Arora (2010) stated that the aim of the Indian exchange rate policy is to decrease volatility. In their study of the Indian economy, they used daily and monthly data sets. Using the GARCH model, they found that foreign exchange intervention by the Central Bank of India (CBI) was effective for the period under examination. This result is consistent with the stated goal of the CBI. Though the CBI's tools have a lot of potential, they were found to be ineffectively used.

Broto (2012) studied the central bank interventions in four Latin American countries, Colombia, Chile, Peru, and Mexico. She found that the result of intervention was different whether selling or purchasing foreign currency. Also, she found that volatility is decreased by interventions; however, the intervention's size does not play a major role in that matter.

Takeshi (2012) examined the causal relationship between central bank intervention and the exchange rate in India. He used monthly data for the period December 1997 to December 2011 with the CCF approach. The empirical findings suggested that there was causality-in-variance, in one direction, from exchange rate to intervention by the central bank. These results were robust whether the exchange rates were measured by the spot rate or the forward rate. So this research suggested that the volatility was not influenced by central bank purchases of foreign currency in the market. On the other hand, Mohanty (2013) found that there was no agreement about the effectiveness of foreign exchange intervention. In many cases, intervention had no constant effects on the exchange rate and might have even worsened exchange rate volatility.

Finally, Garc á-Verd úy and Zereceroz (2014) have assessed the effectiveness of two kinds of interventions. The "dollar auctions with minimum price" were applied for the period October 2008 to April 2010, and the "dollar auctions without minimum price" was implemented from March to September 2009. Their analysis followed the event study microstructure approach. They used the bid-ask spreads as a measure of liquidity. The results demonstrated no sign of an effect in the bid-ask spread for the first kind of intervention and showed a significant decline in the spread for the second kind of intervention. They concluded that the aims of these two interventions were, respectively, to give liquidity and to support the situation in the foreign exchange market.

4. Data

The research utilizes the series of daily interventions by the central banks of Australia, Russia, and Turkey, and the official exchange rates of these countries. This paper covers various sample periods, depending on the availability data: Jan. 3, 1989-Dec. 12, 2014 for Australia, Jan. 2, 2002-Dec. 12, 2014 for Turkey, and Jan. 10, 2013-Dec. 10, 2014 for Russia. As Table 1 shows, this sample covers: 6,539, 3,259, and 296 working days for Australia, Turkey, and Russia, respectively. The sources of the data are the official web sites of the Reserve Bank of Australia, the Central Bank of Turkey, and the Central Bank of Russia (www.rba.gov.au; www.tcmb.gov.tr; and www.cbr.ru).

5. Methodology

This research paper utilizes the method of Generalized Autoregressive Conditional Heteroskedasticity (GARCH).

This method is considered useful and effective to study volatility with daily data series. GARCH can estimate both the mean and variance (Edison and Liang, 1999). The first-order (p=q=1) GARCH model is an appropriate model to study daily and high frequency data (Taylor, 1986). In this paper, we utilized the following model:

$$\Delta XR_t = \alpha + \beta\, INTERVENTION_t + \varepsilon_t \quad (1)$$

$$\varepsilon_t \mid I_{t-1} \sim N(0,h_t) \quad (2)$$

$$h_t = \gamma_o + \sigma\, \varepsilon^2_{t-1} + \delta\, h_{t-1} \quad (3)$$

where XR_t is the log of the exchange rate at time t; Δ is the first difference; I_{t-1} is information set through time t-1; $INTERVENTION_t$ is the intervention variable at time t that is represented by purchasing activities (*PURCHASE*) and selling activities (*SALE*); and h_t is the conditional variance of ε_t. I_{t-1} and $INTERVENTION_t$ are statistically independent.

Equation 1 calculates the effect of intervention in the foreign exchange market on exchange rates. Equation 2 shows that regression residuals will have GARCH model assumptions. Equation 3 explains the variance where σ and δ are ARCH and GARCH terms, respectively. The ARCH term, ε^2_{t-1}, represents volatility and is calculated as the lag of the squared residual from the mean equation. The GARCH term, h_{t-1}, shows the forecast of the variance of the previous period.

6. Empirical Results

6.1 Unit Root Test

It is important to test variables that enter in any time series model for a unit root. In other words, we test whether these variables are stationary or not. To test stationarity, the Augmented Dickey-Fuller (ADF) test will be applied. For a time series like Y_t, we have the following model:

$$\Delta Y_t = a_0 + \gamma Y_{t-1} + \sum_{i=2}^{p} \beta_i (\Delta Y_{t-i+1}) + t + \varepsilon_t \quad (4)$$

where Y_t is the dependent variable, Δ is a difference operator, a_0 is an intercept, t is time, and ε_t is the error term. The null hypothesis of a non-stationary series will be tested against the alternative one of a stationary series, or no unit root. If the coefficient γ equals zero, then the variable has a unit root. In addition, the optimal lag is chosen by utilizing Schwarz Information Criterion.

The results for the ADF test are shown in Table 3 and Table 4. They show that the exchange rates of the Australian dollar, the Turkish lira, and the Russian ruble have unit roots; the three variables are no stationary on the logarithmic level. These results were confirmed whether we include "an intercept" or "an intercept and a time trend" in the unit root test. When the first difference is taken, all variables become stationary, and the null hypothesis for unit root is rejected at the 1% level.

Table 3. Unit root test results (with intercept)

Variables	ADF (level)		ADF (first difference)		
Log (XR_AUSTRALIA)	-1.6793	[0]	-81.1831	[0]	*
Log (XR_ TURKEY)	-0.6053	[0]	-55.4784	[0]	*
Log (XR_RUSSIA)	2.8102	[2]	-10.0007	[1]	*

Table 4. Unit root test results (with intercept and time trend)

Variables	ADF (level)		ADF (first difference)		
Log (XR_AUSTRALIA)	-2.2071	[0]	-81.1830	[0]	*
Log (XR_ TURKEY)	-1.8600	[0]	-55.4904	[0]	*
Log (XR_RUSSIA)	1.2232	[2]	-10.4231	[1]	*

1) The * indicates rejection null hypothesis of non-stationarity at 1% significant level.

2) The lag length of the unit root test (ADF) is specified in brackets [ ].

3) The lag length of the unit root test (ADF) is based on the Schwarz Information Criterion (SIC) for appropriate lag length.

6.2 GARCH Results

6.2.1 Conditional Mean Equation

Table 5, 7, and 9 show the results of equation 3 of the conditional mean for the purchasing activities by Australia, Turkey, and Russia, respectively, in the foreign exchange markets. The results show that purchasing US dollars by the central banks of Australia, Turkey, and Russia appreciates the Australian dollar, Turkish lira, and the Russian ruble, respectively. These results were significant for the Australian and Russian cases but not for the Turkish one. Table 6, 8, and 10 show the results of equation 3 of the conditional mean for selling activities in the foreign exchange markets for the three countries, respectively. The results show that selling US dollars appreciates the Australian dollar, the Turkish lira, and the Russian ruble. These results were, again, significant for the Australian and Russia cases but not for the Turkish one.

Table 5. Australia: results of GARCH model (case of purchase in foreign exchange market)

Conditional Mean Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	-1.23 E-05	317 E-05	-0.3876	0.6983
P_AUSTRALIA	-0.000235	0.000132	-1.7764	0.0757

Variance Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	7.47E-08	1.15E-08	6.5239	0.0000
RESID(-1)^2	0.06445	0.0042	15.2095	0.0000
GARCH(-1)	0.92877	0.0045	208.1106	0.0000

Table 6. Australia: results of GARCH model (case of sale in foreign exchange market)

Conditional Mean Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	-7.04E-05	3.13E-05	-2.248318	0.0246
S_AUSTRALIA	0.0017	0.00014	11.8425	0.0000

Variance Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	6.95E-08	1.08E-08	6.429740	0.0000
RESID(-1)^2	0.0629	0.0041	15.2616	0.0000
GARCH(-1)	0.9307	0.0043	214.5789	0.0000

The previous results seem to be unusual especially, for Australia and Russia, though the results for Turkey were found to be insignificant. These results disagree with the classical economic theory about the role of intervention in the foreign exchange market. In other words, we expect purchasing US dollars by central banks to be associated with depreciation in the local currency. However, by reviewing literature, we find that the result here is not unique. For instance, Edison and Liang (1999) found that when the central bank sells foreign currency with the intention of appreciating the local currency, the local currency depreciates instead. In addition, Simwaka and Mkandawire (2006) explain this result as 'leaning against the wind'. In other words, foreign exchange sales are meant to reduce the rate of depreciation of the currency. Yet, Mohanty (2013) found that there was no consensus about the effectiveness of foreign exchange intervention. Intervention was viewed as an instrument that could potentially reduce volatility and support market functioning. However, many participants were sceptical about its effectiveness in the exchange rate market.

Table 7. Turkey: results of GARCH model (case of purchase in foreign exchange market)

Conditional Mean Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	-3.10E-05	4.64E-05	-0.6672	0.5046
P_ TURKEY	-0.00069	0.00049	-1.4147	0.1572

Variance Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	2.60E-07	3.26E-08	7.95680	0.0000
RESID(-1)^2	0.1503	0.0095	15.8556	0.0000
GARCH(-1)	0.8391	0.0076	110.059	0.0000

Table 8. Turkey: results of GARCH model (case of sale in foreign exchange market)

Conditional Mean Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	-3.50E-05	4.62E-05	-0.75789	0.4485
S_ TURKEY	0.00062	0.00077	0.80270	0.4221

Variance Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	-3.50E-05	4.62E-05	-0.75789	0.4485
RESID(-1)^2	0.00062	0.00077	0.80270	0.4221
GARCH(-1)	-3.50E-05	4.62E-05	-0.75789	0.4485

One way to interpret these results is that the Reserve Bank of Australia's and the Central Bank of Russia's purchases are simply meant to reduce the rates of appreciation of the Australian dollar and the Russian ruble, respectively. Another way to interpret these results, broadly speaking, is that one of the aims of the intervention by central banks is to provide liquidity and to encourage systematic conditions in the foreign exchange market (Garc á-Verd úy & Zereceroz, 2014).

6.2.2 Variance Equation

One of the purposes of this paper is to know if intervention causes volatility and uncertainty in the foreign exchange market. ARCH term (ε^2_{t-1}) calculates volatility from the previous period determined as a lag of the squared residual in Equation 1. The GARCH term (h_{t-1}) gives the variance forecast of the previous period. GARCH models are helpful in explaining a number of important aspects usually noticed in most financial time series models, such as volatility clustering and/or leverage effects (Islam, 2013).

Table 9. Russia: results of GARCH model (case of purchase in foreign exchange market)

Conditional Mean Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	0.0004	0.0002	2.8728	0.0041
P_ RUSSIA	-0.0010	0.0005	-2.2265	0.0260

Variance Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	7.42E-07	3.49E-07	2.1263	0.0335
RESID(-1)^2	0.2431	0.0487	4.9965	0.0000
GARCH(-1)	0.7180	0.0710	10.11307	0.0000

Table 10. Russia: results of GARCH model (case of sale in foreign exchange market)

Conditional Mean Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	-0.0002	0.0002	-0.9004	0.3679
S_ RUSSIA	0.0008	0.0003	2.6526	0.0080

Variance Model

Variables	Coefficient	Std. Error	z-statistic	Probability
Constant	8.60E-07	3.74E-07	2.299701	0.0215
RESID(-1)^2	0.2950	0.0600	4.9142	0.0000
GARCH(-1)	0.6648	0.0735	9.0468	0.0000

The estimated results for the GARCH model for Australia and Russia show that the null hypotheses of no existing of ARCH effect and of no existing of GARCH effect were rejected at the 1% significance level. These results reveal that intervention causes uncertainty and volatility in exchange rate to increase. One way to interpret this result is that intervention causes market participants to be more concerned about the stability of the market. When central banks intervene in the market, they enhance the degree of uncertainty concerning the persistence of the policies of the intervention (Doroodian & Caporale, 2001). This result is supported by the discussion about the risk of exchange rate intervention found by Mohanty (2013) and Schwartz (1996).

Regarding Turkey, the results of the previous two null hypotheses were not rejected at any accepted significance level. This means that the Central Bank of Turkey's intervention in the market does not increase the degree of uncertainty concerning the policies of the intervention. Such a result is consistent with the findings of other research, such as Takeshi (2012) who found that volatility has not been influenced by central bank intervention.

The previous result is also consistent with the behavior of intervention by the Central Bank of Turkey. Table 1 and 2 show that intervention by the Central Bank of Turkey did not exceed 0.5% of the total working days during the sample period. On the other hand, the purchasing intervention activities by the Reserve Bank of Australia was about 4.5% of the working days during the sample period, while the Central bank of Russia intervenes frequently in the foreign exchange market, more than 50% of the working days. This proves that Australia and Russia affect the foreign exchange market in a way that creates volatility and uncertainty in the market.

7. Conclusion

This article examined the effectiveness of foreign exchange market interventions implemented by the central banks of Australia, Russia, and Turkey during the periods: Jan. 3, 1989-Dec. 12, 2014 for Australia, Jan. 2, 2002-Dec. 12, 2014 for Turkey, and Jan. 10, 2013-Dec. 10, 2014 for Russia. The results show that selling and purchasing US dollars by these institutions correspond to depreciation in the Australian dollar and Russian ruble and appreciation in the Turkish lira. One way to interpret this result of the interventions of the central banks is that the purpose of intervening by central banks, in many cases, is merely to reduce the levels of fluctuation of their local currencies.

In addition, the results of this study find that intervention is related to a significant expansion in the uncertainty and volatility of both the Australian and Russian exchange rates. However, that was not the case for Turkey. This result was found to be related to the number of days of intervention by the central bank; the more the bank intervenes in the foreign exchange market, then the higher volatility and certainty in the exchange rate.

It worth to mention that the methodology used for evaluating the interventions' effects is subject to some arbitrariness. It might be possible that Central Banks use other measures in assessing intervention's effectiveness. Finally, the paper recommends conducting more research on this topic to cover samples of other countries to see how would the results change and to extract useful findings that should benefit policymakers of how would their policies affect the foreign exchange market.

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