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An Evidence for Ineffectiveness of Central Bank Foreign Exchange Interventions from Turkey

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Abstract

This study examines the effects of the Central Bank of the Republic of Turkey's foreign exchange interventions via auctions on the level and volatility of the Turkish lira/US dollar exchange rate between February 02, 2009 and January 31, 2014 with daily data. In order to study the impact of interventions on the Turkish lira, this study employs the Exponential GARCH (1,1) framework. The results suggest that interventions have no significant impact on the level of the exchange rate, ever so leading the Turkish lira to appreciate. Regarding volatility, the presence of the Central Bank in the market alone is not statistically significant, however, intervention volume has a weak significant impact on the exchange rate volatility in negative direction, although still the magnitude of impact is indifferent from zero. Also, the leverage effect is found insignificant, may be referring to non–active central bank intervention in the market during the period.

JEL classification numbers: E58, F31, G150, C310
Keywords: Central bank intervention, Foreign exchange rate markets, Exponential GARCH model, Heteroskedasticity

1 Introduction

After the collapse of Bretton Woods system, central banks intervened in the foreign exchange markets to calm disorderly market behaviour and since then an ongoing debate on the effectiveness of these foreign exchange interventions started among academicians. A sizeable literature has tried to assess whether central bank interventions can affect the mean and volatility of exchange rate changes, however, the empirical findings seem to concur in no clear evidence can be found. Existing theoretical and empirical work is quite

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mixed especially in emerging markets[2] and suggests that the effects of interventions on the volatility of exchange rates are unambiguous, while the effects on the mean are still debatable. In general, central bank interventions are expected to reduce exchange rate volatility. But yet, some studies in the literature conclude that interventions either have a positive effect rather than to reduce volatility or have no impact, others conclude that interventions have a negative impact on volatility as expected. Despite the fact that there is a common skepticism among academicians about the effectiveness of interventions, central banks seem to regard intervention as an effective policy tool ([4]).

According to [5], the effects of unsterilised interventions depend on the efficiency of the market; unsterilised interventions either have no effect or reduce the volatility in an efficient market, while interventions increase volatility and have significant effects on the mean in an inefficient market.[3] Also, the effects associated with secret and publicly known interventions (announced by central bank) are believed to be different; secret interventions have a significant positive effect on the mean and volatility and greater in magnitude than the effects of publicly known interventions, may be because of intensifying uncertaintyin the market. Hence, secret interventions generally increase volatility and contribute to the inefficiency of the market.[4]

After the crisis in 2001 in Turkey, the Central Bank of the Republic of Turkey (CBRT) announced a floating exchange rate regime and the foreign exchange rate is not a policy tool or target under inflation targeting. However, the CBRT has not been remaining unresponsive to the excessive appreciation or depreciation of the Turkish lira by taking into consideration financial stability is one of the preconditions for the its objective of price stability. In this context,although there is no exchange rate level target, in case of any unhealthy price formations in the exchange rates due to speculative behavior stemming from a loss in the market depth, the CBRT is intervening the market via flexible and transparent buying and selling auctions with pre–announced program, or via directly interventions.[5] If neccessary, the amount of daily auctions might be changed and the auctions might also be suspended. In short, the CBRT is intervening in the foreign exchange market to reduce expected or actual volatility of the foreign exchange market, while the exchange rate level is said to be market determined around fundamentals.The aim of this study is to test the effectiveness of the CBRT foreign exchange interventions on the level and volatility of exchange rates, given the fact that large and volatile capital movements to emerging markets have put the pressure on exchange rates after the global

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[2]The effects of foreign exchange interventions in emerging markets could be different from developed ones. Emerging markets tend to intervene more frequently in the foreign exchange markets and interventions might be more effective in these countries. See about interventions in emerging markets, for example, [1], [2], [3].

[3]See also [6], and [7].

[4]For detailed information about types of intervention, see [4], among the others.

[5]In addition to foreign exchange auctions and direct interventions, the CBRT has been used supportive monetary policy instruments, like export rediscount credits and reserve options mechanism (ROM). The ROM is the option to hold foreign exchange or gold reserves in increasing tranches in place of Turkish lira reserve requirements of Turkish banks, dated from November 2010. The ROM is a tool for the CBRT to support the foreign exchange liquidity management of the banking sector in case of internal or external shocks, to increase foreign exchange reserves of the CBRT and to limit the adverse effects of excess volatility in short-term capital movements. It is stated by the CBRT that this mechanism reduces the need for auctions and direct interventions.

financial crisis. This study investigates the impact of interventions via buying and selling auctions, not the impact of direct interventions.

The rest of this study is organized as follows. Section 2 reviews the literature on the effectiveness of central bank interventions. Section 3 outlines the methodology used. Section 4 presents the data on the interventions conducted by the CBRT, with some descriptive statistics. Section 5 presents the empirical results. Section 6 is the conclusion.

2 Literature

As it is mentioned before, empirical literature on the effectiveness of central bank interventions presents mixed results. [8] claim that official intervention did not smooth exchange rate volatility of Australian dollar during 1983–1993. [5]examines the impact of interventions on daily and short–term behaviour of exchange rate volatility by the US, the Japanese and the German central banks using a GARCH model for the period ranged from 1977 to 1994 in the USD/JPY and the USD/DM markets. She reveales that central banks' interventions reduce exchange rate volatility only in the mid–1980s subperiod, however, generally lead to higher exchange rate volatility for the full sample period. According to the results of this study, interventions need not be announced by central bank in order to be effective. [6] investigate daily interventions undertaken by these three central banks over the period from August 1985 through March 1990 using a GARCH model and find no significant impact on the conditional mean and volatility in the spot exchange rates generally, though purchases of US dollars by the FED are associated with dollar depreciation. [9], applying a univariate regression approach to analyze effectiveness of interventions conducted by the FED and the Bundesbank, report that interventions might have influenced exchange rates during the mid–1980s. [10], analysing implied volatilities extracted from currency options data on the USD/DM and USD/JPY rates, find that interventions conducted by these two central banks generally either show no significant impact or even increase expected exchange rate volatility for the period from 1985 to 1991. Authors find weak evidence for the hypothesis that intervention is associated with reduced exchange rate volatility only for the subperiod from 1990 to 1991. These findings are also confirmed by [11] who find that interventions conducted during the years following the Louvre Accord were unsuccessful in reducing volatility. Similarly, [12] report significant positive intervention effects on exchange rate volatilities, applying a Tobit analysis to the USD/DM rate for the period from 1985 to 1989. [13]present an opinion that the finding of interventions were ineffective in the most researchs conducted in relation with the 1980s results from poor quality of the data used.

Also, the studies conducted by [14],[15] and [16] find that interventions generally increase foreign exchange volatility. Some studies, such as, [17] and [2] find positive and significant impact on exchange rate volatility, but no impact on exchange rate level. [18]find evidence that interventions tend to increase exchange rate volatility and exert an inccorrectly signed effect on the exchange rate level, testing the US, the German and the Japanese central bank interventions on the evolution and volatility of daily USD/DM and USD/JPY rates based on FIGARCH model.

[19] suggests that interventions conducted by the FED for three years following the Louvre Accord effectively smoothed the USD/DM and the USD/JPY spot rates. In this study, intervention is defined as effective in terms of smoothing exchange rate movements. According to the results, the probability of success is higher when

intervention is coordinated with other major central banks and when the dollar amount is large. [20] report that interventions conducted by the FED affected exchange rates in the USD/DM and the USD/JPY markets during the period from 1985 to 1990, and also concluded that when intervention is followed by inconsistent monetary policy, exchange rate tend to move in the unexpected direction.

[21]use the Exponential GARCH methodology to examine the effectiveness of daily reported interventions conducted by the Reserve Bank of Australia on the USD/AUD exchange rate for the period 1983–1997. Authors find evidence of a stabilising influence of sustained and large–scale interventions on the exchange rate in terms of the direction and volatility of exchange rate changes; purchases of Australian dollar tend to appreciate the currency and reduce its conditional volatility. The effect on the mean depends on the size of intervention; the larger is the size of intervention, the greater is the impact on the mean. Authors also find that official statements about intervention have little effect on the exchange rate in general, however, when there are some large swings in the exchange rate, the Reserve Bank of Australia’s official statements have a very significant destabilising effect. Thus, higher volatility is a result of interventions could be misleading. [22] document evidence for stabilizing effects of interventions over certain periods.

[23] and [24] report that interventions are effective to reduce the exchange rate volatility for the Reserve Bank of Australia and the Bank of Japan, respectively, while low frequency and officially announced interventions mainly affect the exchange rate level. Some studies, such as, [25], [26], and [27] conclude that central bank interventions have a significant impact on the exchange rate when it is coordinated, publicly announced, large and rare, at least in the short run. Some studies, such as, [28],[16] and [29] document that interventions affect the level of the exchange rate. Among these studies, for instance, [28] confirm that the central banks typically lean against the wind, with the finding that a sterilised purchase of US$100 million of Australian dollars by the RBA is associated with a 1.3–1.8% the Australian dollar appreciation but just a 0.2% the Japanese yen appreciation, estimating a nonlinear model of intervention with daily AUD/USD and JPY/USD rates. And, almost all of the impact occurs during the day intervention is conducted. Alike, [30], analyzing intra–daily and daily exchange rates of the G3, concludes that interventions have a negligible influence on the exchange rate level and volatility only within the day. More recently, [31], and [32] suggest that interventions have been able to reduce volatility in some cases. [33]examines the effect of intervention frequency on the JPY/USD market using daily intervention data from April 1991 to December 2005, estimating a nonlinear methodology. Author finds that high frequency interventions stabilize the exchange rate by reducing exchange rate volatility, especially when the yen appreciates. [34] compares the effects of daily interventions in four Latin American countries with inflation targets, namely, Chile, Colombia, Mexico and Peru, using GARCH–type models and finds that exchange rate volatility can be reduced by interventions, whereas their size plays a minor role.

When the time comes to Turkey, [35] find a positive and significant impact of interventions on the level of exchange rate for Turkey and Mexico, employing an Exponential GARCH framework to daily intervention data (the sample period studied for Turkey is February 22, 2001–May 29, 2002). Regarding volatility, authors conclude that both the amount and frequency of interventions have decreased the exchange rate volatility in these countries, however, reduction of volatility is a direct result of sale interventions. Examining same countries by an asymmetric component GARCH model, [36] report that interventions do not appear to affect the level of exchange rate, but reduce its short–term volatility and increase it over the long–term in case of Turkey, while foreign exchange sales have a small impact on the level of exchange rate and increase short–term volatility in case of Mexico. [37]suggest that large and isolated–purchase interventions seem to be effective in reducing exchange rate volatility, fitting the purpose of the CBRT, for the post crisis period from 2001 to 2003. Authors state that this result cannot be supported by sale interventions, based on Probit analysis, Granger causality tests and GARCH framework. Conversely, [38] conclude that foreign exchange interventions have not been effective in altering the exchange rate level or in stabilizing its volatility, but a slight impact on increasing volatility in Turkey, using various techniques for the period between November 1, 1993 and December 31, 2003. [39] test the impact of direct CBRT interventions on the exchange rate volatility during the 2002–2005 period by GARCH framework. According to the results of this study, direct interventions do not serve the purpose of decreasing volatility as announced by the CBRT. [40]examines the effects of the CBRT interventions on the exchange rate volatility for the period between January 4, 1999 and September 24, 2008 by ARFIMA–GARCH and ARFIMA–FIGARCH models. Author finds that interventions increase the volatility in Turkey, and suggest that due to currency shocks have no permanent characteristic, the CBRT should avoid intervening in the foreign exchange markets. It looks like the empirical evidence on the effects of interventions on the Turkish foreign exchange dynamics is mixed, as is the case with the literature.

3 Model

In this study, the impact of the CBRT foreign exchange interventions on the Turkish lira/US dollar (TRY/USD) exchange rate returns and return volatility is modelled as an Exponential GARCH (1,1) with Student's t–distribution process. [41]shows that GARCH–type models are important to capture the inherent features of exchange rate dynamics. [42]introduces the Exponential GARCH model in order to model the asymmetric behavior of volatility within the GARCH–type models. Taking into account asymmetries play a crucial role in volatility prediction, in order to capture asymmetric impacts of negative vs. positive return innovations, the Exponential GARCH model might be the best choice for this study, among the others. The estimated lower Akaike Information Criterion and the higher Log–Likelihood values reveal that the Exponential GARCH model relatively gives better estimates than another asymmetric model of the Threshold GARCH. When using the Exponential GARCH model, the Student's t–distribution outperforms the normal distribution in this study, because the log–likelihood function increases when the Student's t–distribution is used. It seems that the lag order (1,1) is sufficient to capture volatility clustering that is present in the data. Maximum likelihood estimates of parameters are obtained using the quasi–maximum likelihood estimator (QMLE).

The estimated model for the TRY/USD exchange rate returns is described by the following specification:

$$R_t = \varphi_0 + \varphi_1 VOL_t + \varphi_2 DUM_t + \varphi_3 CDS_t + \eta_t . \sum_{i=1}^{n} R_{t-i} + \varepsilon_t \tag{1}$$

$$\varepsilon_t = \sigma_t z_t \tag{2}$$

$$z_t | \Omega_{t-1} \sim \psi(0,1,\upsilon) \tag{3}$$

$$\log \sigma_t^2 = \omega + \sum_{j=1}^{p} \beta_j \log \sigma_{t-j}^2 + \sum_{i=1}^{q} \alpha_i \left| z_{t-i} - E(z_{t-i}) \right| + \sum_{k=1}^{r} \gamma_k \log(z_{t-k}) + \delta_1 VOL_t + \delta_2 DUM_t + \delta_3 CDS \tag{4}$$

where $z_{t-i} = \dfrac{\varepsilon_{t-i}}{\sigma_{t-i}}$.

In equation 1, φ_0 is constant; R_t is the TRY/USD exchange rate returns, i.e. the first–difference of the TRY/USD exchange rate log levels; VOL_t is the CBRT foreign exchange intervention volume variable (millions of USD); DUM_t is dummy variable representing intervention days that is equal to 1 on days with dollar purchases, –1 on days with dollar sales, and 0 otherwise (included to test for whether the presence of central bank in the market alone can explain the same day exchange rate returns and return volatility, regardless of the magnitude of the actual intervention); CDS_t is the log first difference form of the Turkey CDS (credit default swap) prices (used as a proxy for risk measurement); R_{t-i} is the lagged values of the TRY/USD exchange rate returns (added to ensure that the errors are free of serial correlation). Intervention variables (VOL_t, DUM_t) appear both in the mean equation (Equation 1) and the variance equation (Equation 4), whereas the lagged values of the TRY/USD exchange rate returns don't appear in the variance equation.

The α parameter (ARCH coefficient) in Equation (4) denotes the magnitude effect or the symmetric effect. β (GARCH coefficient) measures the persistence in conditional volatility. When β is relatively large, then volatility takes a long time to die out. βandα are the coefficient of the lagged value of the conditional variance and the lagged value of the squared residual term, respectively. For an Exponential GARCH (1,1) model, the GARCH and ARCH coefficients are expected to be positive. The γ parameter measures the asymmetry or the leverage effect, and the impact is asymmetric, if $\gamma \neq 0$; and leverage effect is present, if $\gamma < 0$. The leverage effect refers to the generally negative relation between asset returns and their current or future volatility. Therefore, the leverage coefficient is expected to be negative; i.e. when $\gamma < 0$, unanticipated negative shocks (bad news) should increase the volatility than positive shocks (good news). If $\gamma > 0$, positive shocks are more destablizing than negative shocks. The conditional density function for z_t follows Student's t–innovation distribution with mean 0, variance 1 and degrees of freedom υ. In Equation (4), σ_t^2 is conditional variance; z_t is the standardized shock. $\psi(.)$ marks a conditional density function and υ denotes a vector of parameters needed to specify the probability distribution.

In this study, the intervention model given in Equation 4 and 5 is also estimated for purchase interventions and sale interventions separately, considering purchases and sales might affect the exchange rate asymmetrically. Thus, intervention variables are constituted based upon the relevant estimation.Such as, for purchase interventions, VOL_t contains only the CBRT foreign exchange intervention purchases volume (millions of USD); DUM_t takes the value of 1 on days with dollar purchases, and 0 otherwise. The intervention variables of sale interventions are constituted in the same way. It must be stated that the

Exponential GARCH (1,1) with Student's t–distribution process is also found preferable for these two estimations.

4 Data

The foreign exchange buying and selling auction data consist of official daily volumes of buying and selling auctions carried out by the CBRT in the Turkish lira/US dollar foreign exchange market from 2nd February 2009 to 31st January 2014. The exchange rate is defined as the value of Turkish lira per one USD. The TRY/USD exchange rate data are daily closing prices in the Turkish spot market, giving a total of 1305 observations. Both the auction data and the exchange rate data are obtained from the CBRT; the Turkey CDS prices data used to control risk factor (instead of interest rate differential) are obtained from the BloombergHT. The comovement of the Turkey CDS prices and the exchange rate can be seen from the "Figure in Appendix".

"Table 1" provides the summary statistics of the foreign exchange buying and selling auction data by years as well as for the full sample period. According to "Table 1", of the 1305 trading days, auctions in the TRY/USD market occured on a total of 741 days, for which 475 were dollar purchases and 266 were dollar sales. Average daily amount of total purchased[6] is 53,9 million dollars and daily amount ranges from 30 million dollars to 140 million dollars. Average daily amount of sold is 127,3 million dollars and daily amount ranges from 20 million dollars to 2,250 billion dollars. The maximum daily amount purchased is observed in 2010, and the maximum daily amount sold is observed in 2013. There is no buying auction as from 2012, and there is no selling auction only in 2010.

Table 1: Buying and Selling Auctions in the TRY/USD Market
(Feb 02, 2009–Jan 31, 2014)

	2009		*2010*		*2011*		*2012*		*2013*		*Jan. 2014*		*Full Period*	
	P	*S*	*P*	*S*	*P*	*S*	*P*	*S*	*P*	*S*	*P*	*S*	*P*	*S*
Number of Intervention Days	97	18	238	–	140	79	–	20	–	125	–	24	*475*	*266*
Total Amount	4314	900	14865	–	6450	11210	–	1450	–	17610	–	2700	*25629,4*	*33870*
Average Daily Amount	44,5	50	62,5	–	46	141,9	–	72,5	–	140,9	–	112,5	*53,9*	*127,3*
Maximum Daily Amount	60	50	140	–	50	750	–	350	–	2250	–	400	*140*	*2250*
Minimum Daily Amount	30	50	30	–	30	20	–	50	–	20	–	50	*30*	*20*
Std. Dev.	12,8	0	31,5	–	6,9	181,9	–	67,8	–	250,2	–	66,3	*24,8*	*201,4*

Notes:"P" and "S" denote "Purchases" and "Sales", respectively.
All amounts are in millions of USD.

[6]Purchased in auction plus optional amt. purchased.

"Figure 1" shows the daily amount of interventions undertaken by the CBRT along with the TRY/USD exchange rate. Purchases of USD have positive sign (positive interventions) and sales of USD have negative sign (negative interventions). As it can be seen from "Figure 1", the CBRT tends to purchase the USD when the Turkish lira relatively appreciates (decrease in the exchange rate) and sell the USD when the Turkish lira depreciates (increase in the exchange rate).

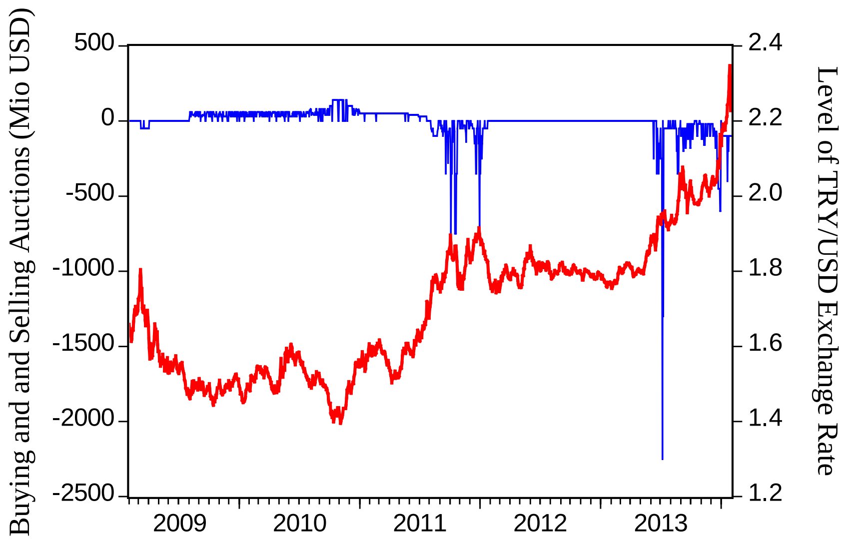

Figure 1: Buying and Selling Auctions and TRY/USD Exchange Rate

The difference in the logarithm of the exchange rate gives the continuously compounded daily returns (denoted as ΔlogTRYUSD) for the TRY/USD exchange rate. "Table 2" summarizes the descriptive statistics of the daily returns overall the period. The mean of exchange rate returns is positive, implying that the TRY depreciates against the USD. There is evidence of positive skewness, excess kurtosis and non–normality in the TRY/USD exchange rate returns. Positive skewness indicates that returns are skewed to the right, i.e., the right tail is long relative to the left. As shown "Table 2", the sample kurtosis is greater than normal distribution value of 3, meaning that the return series show leptokurtosis (that is, they exhibit fat tails). Positive skewness with high kurtosis would suggest the potential for large gains in this market with a low degree of probability. High Jarque–Bera statistic indicates non–normality. As an indication of ARCH, the Ljung–Box test statistics up to the 1st order suggest that the residuals aren't uncorrelated but the squared residuals show autocorrelation. That is, the squared returns, a proxy for volatility, are serially correlated which are consistent with the presence of volatility clustering (large changes in exchange rates tend to be followed by further large changes, and small changes tend to be followed by further small changes) in the data. This indicates a strong conditional heteroskedasticity, providing support for the use of GARCH models. Further, the Engle's [43] Lagrange Multiplier (LM) testfor examining the null hypothesis of homoscedasticity against the alternative hypothesis of heteroskedasticity provides evidence as to the presence of ARCH effect in the exchange rate returns data at %1 significance level. Visual inspection of "Figure 2" also clearly reveals that volatility clustering is a feature of the data, indicating that the GARCH models will be suitable for the TRY/USD exchange rate returns.

Table 2: Descriptive Statistics on Daily Returns to the TRY/USD Exchange Rate

Mean	0.0245
Maximum	3.0399
Minimum	–3.3402
Std. Deviation	0.6647
Skewness	0.0136
Kurtosis	5.6789
Jarque–Bera	389.9883 (0.0000)
Q(1)	0.0929 (0.761)
$Q^2(1)$	33.506 (0.000)
ARCH–LM (1)	41.999 (0.0000)

Notes: Numbers in brackets are the *p*–values. *Q(1)* and $Q^2(1)$are the *Q*statistics for the Ljung–Box test.

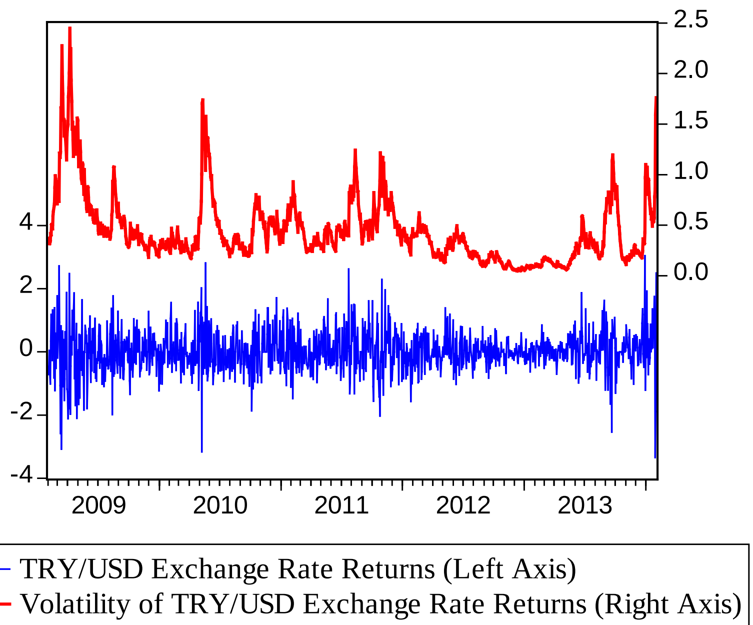

Figure 2: TRY/USD Exchange Rate Returns and Volatility

Here it is investigated the stationary properties of the TRY/USD exchange rate and the Turkey CDS prices. The results from the ADF (Augmented Dickey-Fuller), PP (Phillips-Perron) and KPSS (Kwiatkowski–Phillips–Schmidt–Shin) stationarity tests, with and without a trend, are provided in “Table 3”. All these tests unable to reject the null of a unit root both in the two series at the 1% level of significance. This evidence about the non–stationary time series property of the TRY/USD exchange rate and the Turkey CDS affirms the use of the first difference of the logarithm of the variables. It is noted that the TRY/USD foreign exchange rate returns are stationary.

Table 3: Unit Root Test Results

	No Trend		*Trend*	
Variables	*Test Statistic*	*1% Critical Value*	*Test Statistic*	*1% Critical Value*
		ADF Test		
logTRYUSD	0.6375	–3.4351	–2.1019	–3.9651
Δ*logTRYUSD*	–34.7565	–3.4351	–34.8458	–3.9651
logCDS	–2.9004	–3.4351	–2.6070	–3.9651
Δ*logCDS*	–33.0759	–3.4351	–33.1186	–3.9651
		PP Test		
logTRYUSD	0.6093	–3.4351	–2.1442	–3.9651
Δ*logTRYUSD*	–34.7384	–3.4351	–34.8214	–3.9651
logCDS	–2.8060	–3.4351	–2.4235	–3.9651
Δ*logCDS*	–32.9817	–3.4351	–33.0798	–3.9651
		KPSS Test		
logTRYUSD	3.5674	0.7390	0.3729	0.2160
Δ*logTRYUSD*	0.3866	0.7390	0.0628	0.2160
logCDS	0.7484	0.7390	0.2952	0.2160
Δ*logCDS*	0.2980	0.7390	0.0829	0.2160

Notes: The null hypothesis of the ADF and PP tests is that the variable has a unit root. The null hypothesis of the KPSS test is that the variable is trend stationary, to the contrary the null hypothesis of the ADF and PP tests.

5 Empirical Results

"Table 4" shows the estimation results of the mean and volatility equations for the entire purchase and sale interventions, only purchase interventions and only sale interventions. In the mean equation, the intervention variables are insignificant in all estimations; to be more precise, the level of the exchange rate returns are not significantly influenced by the presence of intervention, though interventions seem to appreciate the Turkish lira against the US dollar according to the coefficient of intervention dummy variable.

The estimated coefficient of φ_0 is insignificant and has a positive sign, indicating that recent interventions were not systematically associated with the TRY/USD exchange rate changes during the period. The lagged value of the TRY/USD exchange rate returns is significant at 10% level in all estimations. The CDS variable is significant at 1% level and has a positive sign in all estimations, indicating that rising risk causes the TRY/USD exchange rate to increase, i.e the deppreciation in the TRY against the USD.

In the variance equation, the intervention volume variable is significant at 5% level and conveys correct (negative) sign in purchases plus sales estimation, indicating that an intervention purchase (sale) of the USD is, on average, systematically associated with a same–day appreciation (depreciation) of the TRY against the USD. However, the size of this coefficient is indifferent from zero. When only purchase interventions are considered, the intervention volume variable is insignificant and has wrong (positive) sign. This indicates that intervention purchases, on average, do not effective in influencing the same day exchange rate volatility. Conversely, when only sale interventions are considered, intervention volume variable is significant at 10% level and has correct (negative) sign, showing that intervention sales, on average, effect the same day exchange rate volatility, ever so this impact is indifferent from zero.

Table 4:TRY/USD Exchange Rate and Interventions

Mean Equation: $R_t = \varphi_0 + \varphi_1 VOL_t + \varphi_2 DUM_t + \varphi_3 CDS_t + \eta_t . \sum_{i=1}^{n} R_{t-i} + \varepsilon_t$

	PURCHASES+SALES		*PURCHASES*		*SALES*	
	Coefficient	*Prob.*	*Coefficient*	*Prob.*	*Coefficient*	*Prob.*
φ_0	0.0214 (0.0146)	0.1427	0.0161 (0.0159)	0.3122	0.0100 (0.0140)	0.4720
φ_1	0.0001 (0.0002)	0.6423	–5.39x10^{-5} (0.0005)	0.9190	0.0001 (0.0002)	0.6571
φ_2	–0.0305 (0.0260)	0.2572	–0.0176 (0.0366)	0.6300	–0.0605 (0.0530)	0.2541
φ_3	7.0175*** (0.4405)	0.0000	6.9205*** (0.4391)	0.0000	6.9372*** (0.4401)	0.0000
η_t	0.0432* (0.0260)	0.0969	0.0431* (0.0259)	0.0961	0.0433* (0.0262)	0.0987
Variance Equation: $\log \sigma_t^2 = \omega + \sum_{j=1}^{p} \beta_j \log \sigma_{t-j}^2 + \sum_{i=1}^{q} \alpha_i \left\| z_{t-i} - E(z_{t-i}) \right\| + \sum_{k=1}^{r} \gamma_k \log(z_{t-k}) + \delta_1 VOL_t + \delta_2 DUM_t + \delta_3 CDS$						
ω	–0.2170*** (0.0352)	0.0000	–0.2127*** (0.0345)	0.0000	–0.2182*** (0.0385)	0.0000
β	0.9657*** (0.0110)	0.0000	0.9700*** (0.0106)	0.0000	0.9643*** (0.0121)	0.0000
α	0.2231*** (0.0357)	0.0000	0.2314*** (0.0354)	0.0000	0.2205*** (0.0364)	0.0000
γ	0.0263 (0.0212)	0.2156	0.0297 (0.0214)	0.1655	0.0246 (0.0211)	0.2435
δ_1	–0.0003** (0.0001)	0.0259	0.0001 (0.0002)	0.6183	–0.0003* (0.0001)	0.0662
δ_2	0.0202 (0.0148)	0.1734	–0.0102 (0.0172)	0.5529	0.0064 (0.0276)	0.8151
δ_3	1.8184*** (0.6518)	0.0053	2.0437*** (0.6409)	0.0014	1.7467*** (0.6417)	0.0065
R–squared	0.1595		0.1590		0.1600	
S. E. of reg.	0.6121		0.6123		0.6119	
LogL	–1049.254		–1053.389		–1048.666	
DW	2.2170		2.2149		2.2155	
AIC	1.6304		1.6368		1.6295	
F–Stat.	20.400***	0.0000	20.324***	0.0000	20.487***	0.0000
ARCH–LM(1)	0.5918	0.4418	0.2488	0.6179	0.9439	0.3299
$Q^2(1)$	0.6278	0.428	0.2735	0.601	0.9928	0.319
$Q^2(5)$	4.2290	0.517	4.4808	0.482	4.0821	0.538
$Q^2(10)$	8.7503	0.556	7.5434	0.673	7.9893	0.630

Notes:***, ** and * denote significance at 1, 5 and 10% levels, respectively. Numbers in brackets are the standart errors. Ljung–Box Q–statistics on the squared residuals at 1st, 5th and 10th lags are reported.

The insignificant and wrong (positive) coefficient of intervention dummy variable in intervention purchases plus sales estimation and intervention sales estimation indicates that central bank presence alone cannot explain the same day exchange rate volatility, if the magnitude of intervention is neglected. This coefficient has correct sign but statistically insignificant in intervention purchases estimation. The coefficient of CDS variable, δ_3, is positive and highly significant as is the case with the mean equation, suggesting that an increase in risk tend to rise the exchange rate volatility. The constant, ω,is negative and significant at 1% level in all estimations, indicating that recent interventions systematically reduce the TRY/USD exchange rate volatility. The findings of this study are partially in accordance with the results of [38] on Turkey.

The estimated β and α coefficients are positive and significant at the 1% level in all estimations. This evidence satisfies the nonnegativity of the conditional variances for the Exponential GARCH models. Since the β coefficients in all estimations are quite high, the response functions to shocks are rather persistent, in contrast to [40]. The asymmetry or leverage effect coefficient, γ, is positive unexpectedly and insignificant for all estimations, indicating the absence of the leverage effect in returns during the period. There is no significant evidence of presence of asymmetric return volatility that is a positive return innovation causes higher volatility than a negative innovation of equal magnitude. It may be refer to non–active central bank interventions in the market.

"Table 4" also reports the results of diagnostic tests that are Engle's ARCH–LM (1) test on the standardized residuals and the Ljung–Box Q^2–statistics for the standardized squared residuals of all the Exponential GARCH (1,1) estimations. The insignificant ARCH–LM (1) test results show no evidence of remaining ARCH effect, suggesting that the Exponential GARCH (1,1) process is successful at modeling the conditional variance of the TRY/USD exchange rate returns. The reported insignificant Ljung–Box Q^2–statistics at 1, 5 and 10 autocorrelation lags don't reject the null hypothesis of no autocorrelation for all estimations. All these results provide strong support for the Exponential GARCH (1,1) model assuming Student's t–innovation for the residuals is working to remove autocorrelation, the models have captured all of the ARCH effects, and the models are well–specified.

6 Conclusion

The foreign exchange interventions undertaken by the CBRT seem to have not been effective in Turkish lira appreciation/depreciation during the period from 2nd February 2009 to 31st January 2014, in line with the official statement of the CBRT which announces that there is no exchange rate level target, and so, not supporting the leaning against the wind hypothesis. As for the volatility, although the empirical results from Exponential GARCH (1,1) model weakly suggest consistency with reduced–volatility goal (except purchase interventions) from the intervention volume perspective, the size of impact on volatility is indifferent from zero (–0.0003). Bracingly and more importantly, the presence of the Central Bank in the market is found statistically insignificant, if the size of intervention volume is ignored. The CBRT has failed in reducingexchange rate volatility during the period, whereas the aim of the CBRT is to decrease it. Also, there is no significant evidence of presence of asymmetric volatility.

It can be thought that the CBRT interventions are credible and unambigous, or foreign exchange markets in Turkey are efficient, due to Central Bank intervening in the market appears to not have a significant impact both on the level and volatility of the exchange rates. Consequently, the CBRT might take into consideration instruments other than foreign exchange interventions under the inflation targeting regime, like policy interest rates.

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Appendix

Comovement of Turkey CDS Prices and TRY/USD Exchange Rate