Does the Reserve Options Mechanism really decrease exchange rate volatility? The Synthetic Control Method Approach

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Abstract

After the invention of the Reserve Option Mechanism (ROM) by the Central Bank of Turkey, it has been debated whether it can help decrease the volatility of foreign exchange rate. In this study, I apply a new microeconometric technique, the synthetic control method, in order to construct a counterfactual foreign exchange rate volatility in the absence of the ROM. I find that, USD/TRY rate is less volatile under the ROM. However, the ROM has not worked efficiently after the announcement of FEDs tapering in May 2013. Furthermore, the ROM could have decreased the volatility of foreign exchange rate if FED had not started tapering.

JEL Codes: C31, E58, F31,

Keywords: FX Intervention, Synthetic Control Method, Required Reserves

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1 Introduction

The invention of the Reserve Option Mechanism (ROM) by the Central Bank of the Republic of Turkey (CBRT) has shed light on the alternative policy instruments, namely macro-prudential tools, which can be used to mitigate exchange rate volatility. Between its adaption in September 2011 and FED's tapering in June 2013, the level of USD-TR exchange rate and its volatility have both followed a steady path due to the automatic stabilizer feature of the ROM. However, FED's tapering caused capital outflows in Turkey like in other emerging countries and resulted in depreciation of the exchange rate. These developments led people to ask two main questions? Does the ROM really work? Would the ROM have worked as expected in the absence of the tapering?

The ROM basically allows banks to hold a certain ratio of their Turkish lira reserve requirements in foreign exchange and/or gold. It is designed in such a way that it will act as an automatic stabilizer during capital inflows and outflows. While capital inflows will make foreign exchange relatively cheaper and induce banks to hold more reserves in foreign exchange, capital outflows will make the Turkish lira relatively cheaper and induce banks to hold less reserves in foreign exchange. As a consequence, appreciation and depreciation pressure on the Turkish lira will be eliminated without a need of central bank intervention. Thus, the ROM has the potential to decrease exchange rate volatility and act as an automatic stabilizer. Figure 1 shows the behavior of USD-TRY exchange rate and its volatility.[1]. Both the level and volatility of the exchange rate are stabilized until the tapering. However, the Turkish lira kept depreciating and became volatile since the end of May 2013.

The depreciation of the exchange rate has been mainly caused by the capital outflows but the ROM should have abolished depreciation pressure as an automatic stabilizer. However, as Aslaner et al. (2015) argue, CBRT's systematic response to the tapering by increasing the short term interest rates deteriorated the ROM's automatic stabilizer feature unexpectedly. CBRT has been using overnight borrowing and lending interest rates in addition to its policy interest rate, which is 1-Week Repo rate. Table 1 presents the short term interest rates of CBRT since the establishment of ROM. CBRT initially increased overnight lending interest rate in July and August 2013 but increased all the short term interest rates drastically in January 2014. Although, CBRT's main intention was to avert capital outflows, it has also increased the cost of Turkish lira funding, which has led Turkish banks to hold more reserves in relatively cheaper foreign exchange. Figure 2 illustrates net capital flows and the utilization of the ROM. During the successful phase of the ROM, the amount of foreign exchange in the ROM increases as Turkey attracts capital flows. After the tapering, the amount of foreign exchange in the ROM decreases in response capital outflow as expected until August 2013.

[1]Volatility-1 and Volatility-2 are percent changes from 3 months and 1 month before, respectively

However, it started increasing again after CBRT raised the short term interest rates. As a result, the rise in the utilization of the ROM despite the capital outflows weakened the stabilizer mechanism of the ROM. In a similar sense, Aslaner et al. (2015) finds that the cost of Turkish lira funding is the underlying driving force behind the utilization of the ROM. Thus, the behavior of Turkish banks rules out the foreign currency liquidity concern, which enables the ROM to work as a stabilizer.

The only possible way of estimating the precise impact of the ROM is to construct a counterfactual exchange rate volatility and calculate the difference between the two. However, this would be only possible if we had two parallel universes, one with the implemented ROM and one without. We would also need another universe to investigate whether the ROM could have worked efficiently if FED did not have the tapering. The synthetic control method (SCM) offers a solution to this problem by constructing a counterfactual exchange rate volatility with a data-driven method. Thus, the SCM can be used to understand whether the ROM did really worked until the tapering and could have worked as an automatic stabilizer in the absence of the tapering

In this study, I construct a counterfactual exchange rate volatility using the SCM and estimate the impact of the ROM on the exchange rate volatility. I find that the ROM did work efficiently and stabilized the volatility of the exchange rate until the tapering. I also show that the ROM would have worked better in the absence of FED's tapering. My optimization algorithm and placebo tests confirm that my findings are robust. To the best of my knowledge, this is the first empirical study that utilizes the SCM in assessing the impact of ROM on exchange rate volatility.

The rest of the paper is organized as follows. While Section 2 details the literature review, Section 3 and 4 present the methodology and the data, respectively. Finally, Section 5 presents the findings and Section 6 concludes the paper.

2 Literature Review

Since the ROM is only used by CBRT, there are only a couple of papers in the literature. Alper et al. (2013) is a good starting point to understand how the ROM works. They introduce the ROM and compare it with alternative models. Their findings show that ROM can decrease the exchange rate volatility and it can be used as a useful policy tool for macroeconomic and financial stability. Kucuksarac and Ozel (2012) evaluate the ROM and exemplify the calculation of reserve option coefficients. They find that the break-even coefficients depend on the price of turkish lira and foreign exchange funds and the coefficients are sensitive to changes in the cost of funds.

The aforementioned papers present a theoretical perspective about the mechanism. It is also important to examine the effectiveness of the ROM from an empirical stand of view. Oduncu et al. (2013) is the first empirical paper in the literature. They basically estimate the effectiveness of the ROM on the exchange rate volatility using the GARCH model. They find that the ROM is an effective tool to decrease the volatility. Degerli and Fendoglu (2015) study the impact of the ROM on exchange rate expectations using the seemingly unrelated regression model. They find that the USD/TL expectations have exhibited lower levels of volatility after the implementation of the ROM. They also provide evidence that the ROM act as an automatic stabilizer of expectations. The newest paper is Aslaner et al. (2015), which finds that Turkish banks are more sensitive to the cost of Turkish funding rather than foreign currency liquidity.They also argue that CBRT's adjustment of short term interest rates as a response to capital outflows undermines the stabilizer feature of the ROM.

3 Methodology

The synthetic control method (SCM) developed by Abadie and Gardeazabal(2003) is a new microeconometric technique that has been widely used for comparative case studies. Abadie and Gardeazabal (2003) implement the SCM to evaluate the effect of terrorism in Spain, Abadie et al. (2010) estimate the effect of California Tobacco program on tobacco consumption, Lee (2011) studies the inflation targetting and Nannicini and Billimeier (2012) examine the effect of economic liberalization. Using this method, a weighted combination of control units, the synthetic units, can be used to approximate the characteristics of the treated unit. In other words, the counterfactual of the treated unit can be constructed in the absence of the intervention.

Suppose there are $J+1$ units and only the first unit ($j=1$) is exposed to intervention after the time T_0 while the other J units remain as control units. Set Y_{1t}^I as the outcome variable when the unit $j=1$ receives the treatment and Y_{1t}^N as the outcome variable in the absence of the treatment at time $t \in [T_{0+1}, T]$. In order to estimate Y_{1t}^I and Y_{1t}^N Abadie et al. (2010) offer to use the following model:

$$Y_{jt} = \delta_t + \tau_{jt} D_{jt} + \Theta_t Z_j + \lambda_t \phi_j + \epsilon_{jt} \tag{1}$$

where Z_j is a vector of independent variables, Θ_t is a vector of parameters, ϕ_j is a pair-specific unobservable, λ_t is an unknown common factor, ϵ_{jt} is a transitory shock with zero mean and D_{jt} is a dummy variable that takes value 1 for the treated unit, 0 for the control unit. Then the treatment effect, τ_{1t}, can be estimated for $t = T_0+1, T_0+2, ..., T$ by

$$\tau_{1t} = Y_{1t}^I - Y_{1t}^N = Y_{1t} - Y_{1t}^N \tag{2}$$

Even tough $Y_{1t}^I = Y_{1t}$ are observable, the estimation of the treatment effect becomes complicated because of the unobserved control unit Y_{1t}^N. Abadie and Gardeazabal (2003) consider a vector $W = (w_2, ..., w_{j+1})$ such that $w_j \geq 0$ for $j = 2, ..., J+1$ and $\sum_{j=2}^{J+1} w_j = 1$. In the vector W, each element represents a weight that will be used to construct a potential synthetic control unit that is approximately same as the treated unit before the intervention. Hence, for the pre-intervention period ($t \in [1, T_0]$), $W^* = (w_2^*, ..., w_{j+1}^*)$ is determined such that

$$Y_{1t} = \sum_{j=2}^{J+1} w_j^* Y_{jt} \tag{3}$$

$$Z_1 = \sum_{j=2}^{J+1} w_j^* Z_j \tag{4}$$

where Z_{jt} is a vector of observed covariates not affected by the intervention. Once W^* is determined, the treatment effect at $t = T_0 + 1, T_0 + 2, ...$ is estimated as

$$\tau_{1t} = Y_{1t}^I - \sum_{j=2}^{J+1} w_j^* Y_{jt} \tag{5}$$

As mentioned above, the weights have to be chosen that the synthetic unit is almost same as the treated unit before the intervention. Let $X_1 = (Z_1, Y_{11}, ..., Y_{1T_0}$ be a vector of pre-intervention characteristics for the unit j=1 and $X_0 = (Z_j, Y_{jt}, ..., Y_{jT_0}$ be a matrix of the same characteristics for the control units $j \epsilon [2, J+1]$. Then the vector W is chosen to minimize the distance between X_1 and $X_0 W$ subject to $w_j \geq 0$ for $j = 2, ..., J+1$ and $w_2 + ... + w_{J+1}$

$$\min_{W} \parallel X_1 - X_0 W \parallel_V = \min_{W(V)} \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \tag{6}$$

In order to solve this minimization problem Abadie et al. (2007) introduce a diagonal and positive semidefinite matrix V such that the mean squared prediction error of the outcome variable is minimized over the control period. The choice of V is very crucial since each diagonal entry reflects the relative importance of pre-intervention characteristics.

4 Data

Our sample includes 14 emerging countries (Argentina, Brazil, Chile Colombia, Czech Republic, Hungary, India, Indonesia, Mexico, Poland, Romania, Russia South Africa, and Turkey) and the Euro group. These countries are selected since they have a similar pattern of current account deficits in the last decade. Our data set includes monthly observation of exchange rate, interest rate differential, inflation differential, asset transfer from the US, and CDS variables for those countries from 2001 M6 to 2014 M9.[2] All the exchange rates are expressed in terms of US dollar. Interest rate differential is defined as the difference between US and home country interest rate. Inflation differential is also defined in the same manner. Since Argentina, Romania and Russia are excluded in the estimations since they have either no or larger number of missing values in interest rate differential.

The measure of exchange rate volatility is critically important since it will influence how well the synthetic unit approximates the treated unit. While year-over-year changes are too smooth, monthly changes are too volatile. Thus, I prefer using percentage changes of exchange rates from 3 months before as the volatility measure.

Exchange rates and inflation are obtained from the IMF. CDSs and interest rates are from Bloomberg. Finally, asset transfer, which shows financial asset transaction data between the US and a home country, from the US Treasury TIC data. Asset transfers are normalized with monthly US personal income that is obtained from the BEA since monthly US GDP data is not available.

5 Results

5.1 The Choice of Control Period

The main purpose of this paper is to estimate the counterfactual trajectory of TR-USD exchange rate volatility by a convex combination of other currencies. This counterfactual is the hypothetical TR-USD exchange rate volatility which is assumed to would have existed if the Central Bank of Turkey had not adopted the ROM after 2011 October. Thus, the period between 2011 October and 2014 November becomes the treatment period. Choosing the appropriate control period is vital as the optimal weights of other currencies are estimated in the control period.

One approach in the literature is to use the whole period before the treatment as the control period. However, it not easy to assume that the whole period before the treatment is the best control period to approximate the trajectory of TR-USD exchange rate volatility. Cheung et al. (2005) argues that even well-defined exchange rate models do not work in all sample periods. Thus, I implement a "rolling optimization" algorithm in order to find the appropriate control period. That is, regressions are run over a period window by keeping window size same, then the window is moved up one month forward until the treatment period. The "rolling optimization " is implemented over 1-year, 2-year, 3-year, 4-year and full (the whole period

[2] Although we have observations before 2001 M6, we exclude those because Turkey had a severe financial crises over 2000-2001 and has switched to flexible exchange rate regime in 2001 M2. Our sample starts from 2001 M6 because of high volatility of exchange rate between 2001 M2 and 2001 M6. Changing the starting period from 2001 M6 to 2001 M2 does not affect our results

before the treatment) control periods to find the best approximate of the treated exchange rate volatility. As Inoue (2012) argues the main issue in the optimization process is the explanatory power of the control period. The explanatory power of control periods is measured by Root Mean Squared Prediction Erros (RMSPE)[3] that is provided after the SCM estimations. The smaller RMSPE is a sign of better approximation of the treated volatility. Additionally, I also check correlation and Adjust R^2 between the treated and synthetic volatility.

It is very important how the optimization works since the estimation of control unit weights and the synthetic exchange rate volatility purely depends on it. The optimization algorithm minimizes the difference between observed variables and the synthetic variable that is the weighted average of control units over the control period. While observed variables, which are shown with subscript j, are the actual observations of Turkey, the synthetic variable, which is shown with subscript k, are the weighted average of control countries' observations. $CPI_{j(k),t}$ is the CPI based inflation differential at time t between the US and the country j (k), $r_{j(k),t}$ is the interest rate differential at time t between the US and the country j (k), $Asset_j(k)$ is the net asset transaction between the US and the country j (k) divided by US personal income, $CDS_j(k)$ is the CDS of country j (k) at time t. JPY_t is the TR-USD percent change from 3 months before at time t and $S_{j,t}$ is the weighted of control currencies' percent change from 3 months before at time t. The upper bar on variables represents a simple average over the control period. The optimization algorithm used for the estimation of optimal weights is as follows;

$$\min_{w_2,\ldots,w_j+1} \left\| \begin{matrix} \overline{CPI_j} - \sum_{k=2} w_k \overline{CPI_k} \\ \overline{r_j} - \sum_{k=2} w_k \overline{r_k} \\ \overline{Asset_j} - \sum_{k=2} w_k \overline{Asset_k} \\ \overline{CDS_j} - \sum_{k=2} w_k \overline{CDS_k} \\ JPY_0 - \sum_{k=2} w_k S_{k,0} \\ JPY_1 - \sum_{k=2} w_k S_{k,1} \\ \vdots \\ JPY_{T_0} - \sum_{k=2} w_k S_{k,12} \end{matrix} \right\| \tag{7}$$

Among 380 control groups, I chose 2 periods from 1-year, 2-year, 3-year and 4-year control periods that have the lowest RMSPE, highest Adj_R^2 and highest correlation. I also include full control period. Table 2 presents 9 optimal control periods and reveals that correlations and Adj_R^2s are similar while RMSPE decreases when the window size expands. Thus, I choose the period over 2007M3-2008M2 as the control

[3]RMSPE is estimated as $\frac{\sqrt{\sum_t^T (Y_{1t}^I - Y_{1t}^N)^2}}{n}$

period since it has the minimum RMSPE, high correlation and Adj_R^2. The weights that are obtained for the control period is presented in Table 3. Based on the minimization process, the volatility of TR-USD exchange rate can be duplicated by the convex combination of the Brazilian Real, the Czech Krone and the South African dollar. The estimated weights are 0.74, 0.126, and 0.134, respectively.

The weights of the control currencies are estimated using predictor variables of the TR-USD exchange rate, which are interest rate spreads, asset transfers, CPI inflation differential, and the volatility of the TR-USD exchange rate at different periods. Both predictor variables and the outcome variable are well balanced during the optimization process between the synthetic control and treatment units. In other words, the difference between actual and synthetic values of these variables are very close to each other. The predictor balance over the optimization process and the importance of each variable are presented in Table 4. Importance of a variables represents the relative importance of each predictor variable, which are normalized weights in constructing the synthetic control units. Volatility of TR-USD exchange rate in different periods seem to be relatively important compared to the macro variables. While the normalized weight of macro variables are smaller than 1 percent, the volatility of TR-USD exchange rate in each month has a normalized weight of 10 percent on average.

5.2 Average Treatment Effects

In Figure 4 and 5, I calculate the average treatment effect of the reserve option mechanism by taking the difference between the actual and synthetic volatility TR-USD exchange rate. The positive(negative) sign of ATE stands represents that the ROM works efficiently (not efficiently). The effect of the ROM is evaluated as efficient when TR-USD exchange rate has a lower volatility. Thus, smaller depreciation and appreciation under the ROM will be both considered as efficient. However, there are some periods that while the actual TR-USD exchange rate depreciates, the synthetic one appreciates. For these periods, the absolute value of the volatility is taken and then the difference is estimated in order to be consistent with the evaluation criterion.

It is shown that ATEs are mainly positive until the FED's tapering in May 2013 and mainly negative after that. The average of ATEs until May 2013 is 2.5 percent and it becomes -1.15 afterwards, which is an evidence that the ROM works. These results confirm that the ROM had worked efficiently as an automatic stabilizer and decreased the volatility until the FED's Tapering. The findings here are consistent with those in Oduncu et al (2013) and Degerli and Fendoglu (2013). I re-calculate the synthetic TR-USD exchange rate by including the credit swap defaults (CDS) as a predictor variable the findings are very similar. Likewise the first estimation, ATEs are mainly positive until the FED's tapering and they become negative afterwards.

While the average of ATEs until May 2013 is 2.28 percent, it becomes -1.34 afterwards. The alternative estimation with CDSs confirm my initial findings that the ROM had worked efficiently until May 2013.

The puzzle that why the ROM stopped working efficiently after May 2013 is worth investigating. Aslaner et al. (2015) investigate the the determinants of ROM utilization and find that foreign currency liquidity is not an important parameter for ROM utilization, which is in contrast to the mechanism of ROM. As argued in Alper et al (2013), the ROM is expected to work as an automatic stabilizer if banks act accordingly with foreign currency liquidity constraint. They also argue that the policy induced movements in the short term interest rates may mitigate the efficiency of the ROM. Thus, the puzzle can be investigated by examining how the CBRT changed its short term interest rates after the FED's tapering. The CBRT has mainted a stable monetary policy between the implementation of ROM and the FED's tapering. It kept the policy interest rate, which 1 week repo interest rate and the interest corridor, which is overnight borrowing and lending interest rates around the same level. Thus, there was a small variation in interest rates during the efficient phase of the ROM. However, after August 2013, the CBRT started increasing short term interest rates to stop capital outflows, which is induced by the FED's tapering. The increase in the short term interest rates raised the cost of Turkish lira funding that is believed to be the important driving force of high ROM utilization of Turkish banks after the FED's tapering. As a result, the increase in short term interest rates during capital outflows deteriorated the automatic stabilizer function of the ROM.

5.3 A World without the FED's tapering

The puzzle caused by the CBRT's respond to capital outflows can be investigated by estimating the synthetic TR-USD exchange rate if the CBRT had not increased the short term interest rates. Since the ROM had worked efficiently between October 2011 and August 2013, this period can be used a control period and the synthetic TR-USD exchange rate can be re-estimated for the period after July 2013. Likewise, the length of optimization period is vital since the weights estimated in the optimization period will be used for the construction of synthetic TR-USD exchange rate. I re-optimze the control periods for different 1-year periods and full control period. The estimated RSMPE's and Adj_R^2s are given in Table 5. Among 12 optimizations, the control period between 2012 M6 and 2013 M5 has the smallest RSMPE and relatively high Adj_R^2. The weights that are estimated using this control period are given in Table 6. Thus, the synthetic volatility of TR-USD exchange rate can be calculated by the convex combination of Chilean Peso, Colombian Peso, the Euro, Hungarian Forint and Mexican Peso. The estimated weights are 0.136, 0.643, 0.049, 0.78 and 0.94, respectively. Predictor balance of the new optimization is given in Table 7. Like the ROM optimization, most important variables for the optimization process are volatility of the exchange rate at different period rather than macro variables.

The volatility of actual and synthetic TR-USD exchange are plotted in Figure 7. I also calculate the average treatment effect for the treatment period by taking the difference between the actual and synthetic volatility TR-USD exchange rate, which is shown in Figure 7. ATEs are positive until the last two months, which confirms that the ROM would have worked efficiently if the CBRT had not increased short term interest rates systematically. The average of ATEs for the treatment period is 2 percent. When the estimation is iterated by including the credit swap defaults (CDS) as a predictor variable, I estimate similar results. Thus, the findings are robust.

5.4 Placebo Study

Using the SCM, I estimate the counterfactual USD-TR exchange rate volatility, which is percent changes from 3 months before, by a convex combinations of currencies of 10 different countries. There is a possibility that my estimation could be driven by chance. Thus, I run placebo tests to check the robustness of my estimates. The placebo test helps answering whether I would estimate similar effects if I had chosen a random country from the dataset.

Following Abadie and Gardeazabal (2003) and Abadie et al. (2010), I estimate the synthetic exchange rate volatility for countries in the control group. If the placebo studies generate similar results for other currencies, then the volatility of USD-TR exchange rate was stabilized by other factors than the automatic stabilizer feature of the ROM. Otherwise, my results provide significance and robust evidence for the ROM's ability to decrease the exchange rate volatility.

Table 8 shows pre RMSPE, post RMSP, the ratio of post and pre RSMPEs and average ATE for Turkish lira and other currencies. The average gap between the synthetic and actual volatility of the exchange rate is expected to be close or less than 0 for other currencies. Especially, Brazillian Real, Czech Krone and South African Rand are of importance since their weights are different than 0 in the construction of synthetic volatility of USD-TR exchange rate. While the average gap is negative for Brazillian Real and South African Rand, it is very close to zero for Czech Krone. Based on the placebo tests, we can confirm that my estimation are robust in estimating the impact of the ROM on the exchange rate volatility.

The placebo test results for the tapering are shown in Table 9. The average between rhe synthetic and actual volatility of the USD-TR exchange rate is 2 percent and the average gap for control currencies that are Chilean Peso, Columbian Peso, the Euro, Hungarian Forint and Mexican Peso should be smaller. As shown in Table 9, the average gap for control currencies is smaller than 2 percent and is close to zero for the most of them. Another important measure is the post/pre RSMPE ratio and the ratio for Turkish lira is greater than control currencies. These results reveal that I chose the right control currencies in my optimization process. Thus, my estimation are significant and robust, which confirms that the ROM could have worked efficiently in the absence of the tapering.

6 Conclusion

The ROM is an important macroprudential tool, which has been used by the CBRT to stabilize the exchange rate volatility.It had worked efficiently and decreased the volatility of the USD-TR exchange rate until the FED's tapering in May 2013 . However, CBRT's change in short term interest rates as a response to stop capital flows deteriorated the automatic stabilizer feature of the ROM. Thus, the volatility of the exchange rate was not stabilized after the tapering. In this paper, I use the Synthetic Control Method to confirm that the ROM had worked as an automatic stabilizer until the tapering. To the best of my knowledge, this is the first application of that methodology to investigate the ROM.

My results indicate that the ROM decreased the exchange rate volatility by 2 percentage points on average and the estimated cumulative effect is around 50 percentage points between September 2011 and August 2013. However, the ROM did not work efficiently after August 2013 caused by the behavior of Turkish banks in response to changes in short term interest rates. My estimates also reveals that the ROM could have worked as expected and stabilized the exchange rate volatility in the absence of the tapering. The ROM could have decreased the exchange rate volatility by 2 percentage points on average and volatility could have been decreased by 32 percentage points cumulatively after the tapering. Robustness of both results are confirmed via placebo study as well.

Our results are consistent with the general view in the literature that the ROM can decrease exchange rate volatility. However, the ROM can work efficiently when CBRT does not change short term interest rate during capital outflows. The reason is that the behavior of the Turkish banks is strongly determined by the cost of Turkish lira funding.

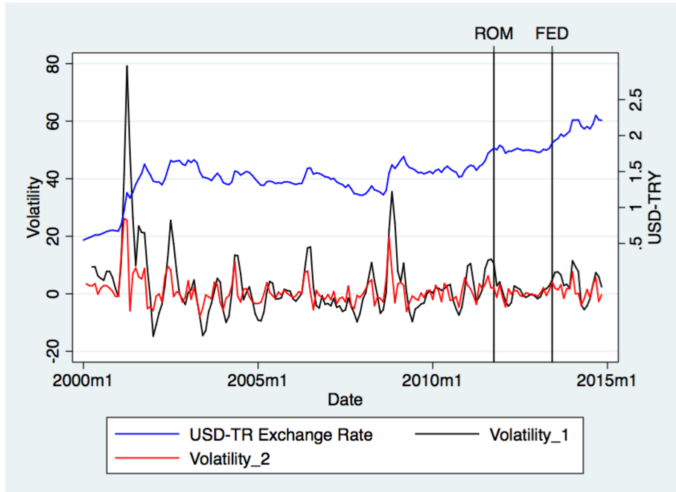

Figure 1: USD-TRY Exchange Rate

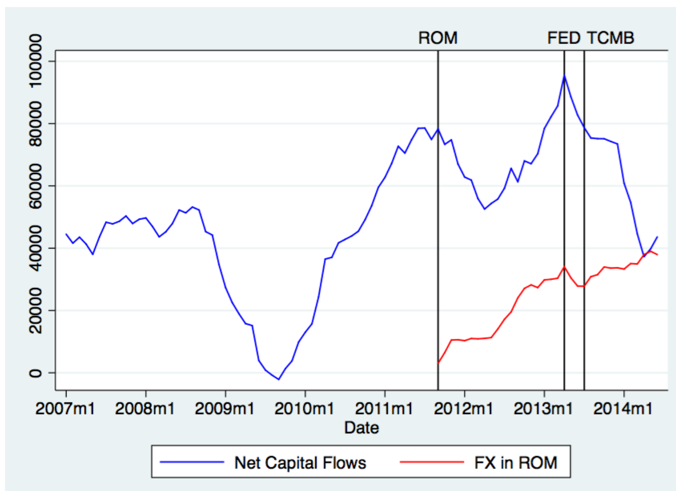

Figure 2: Capital Flows and FX Reserves in ROM. Source: CBRT

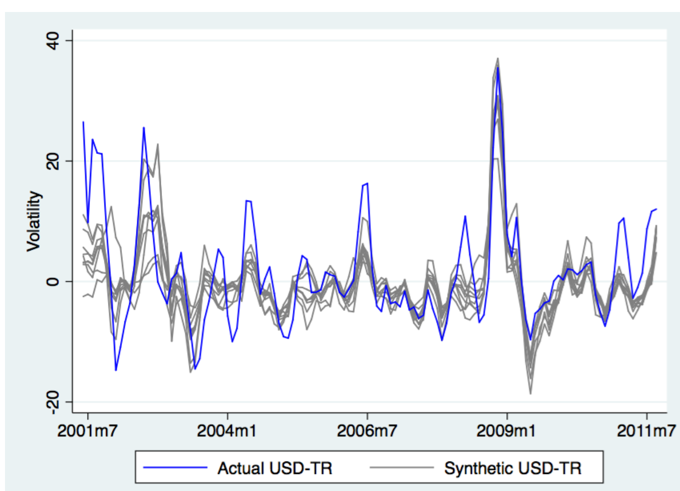

Figure 3: Optimized Control Periods for ROM

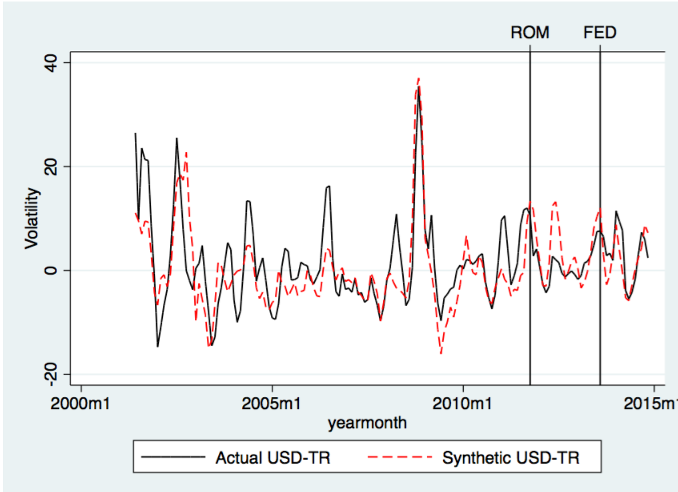

Figure 4: Actual and Synthethic USD-TR Exchange Rate

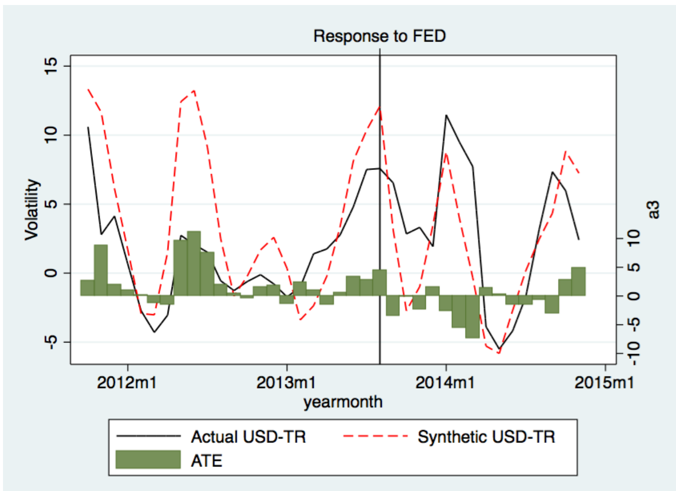

Figure 5: Actual and Synthethic USD-TR Exchange Rate and Average Treatment Effects

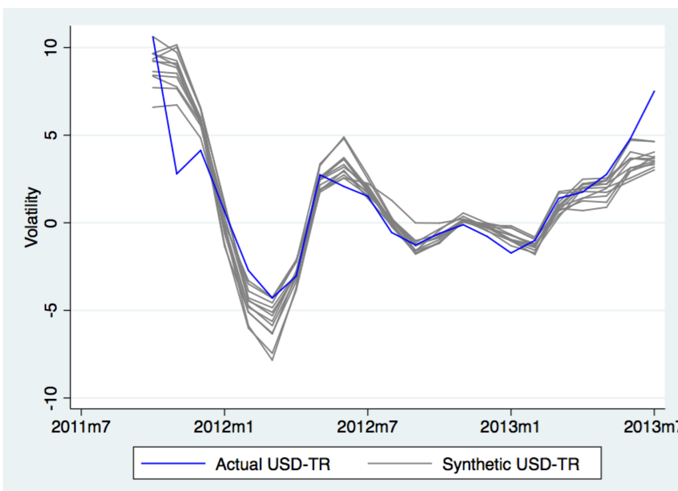

Figure 6: Optimized Control Periods for FED

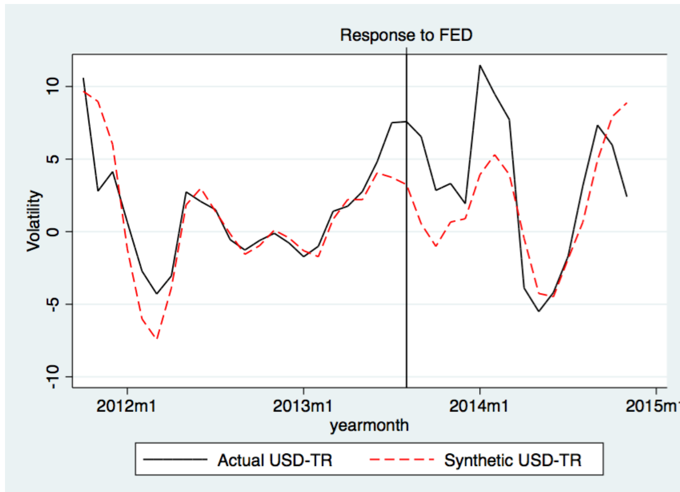

Figure 7: Actual and Synthethic USD-TR Exchange Rate and Average Treatment Effects

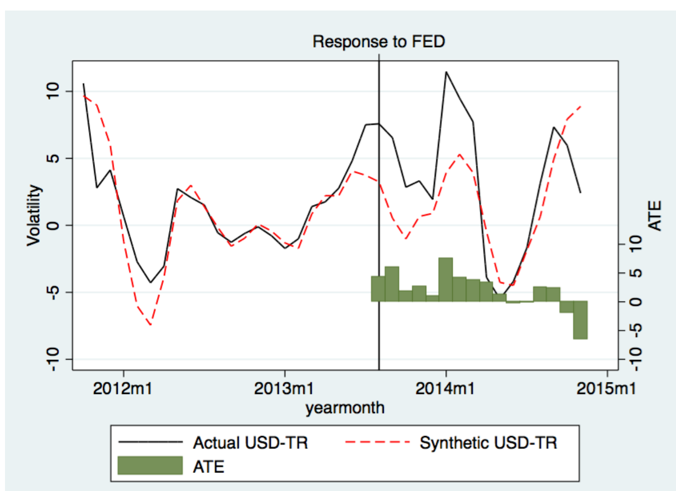

Figure 8: Actual and Synthethic USD-TR Exchange Rate and Average Treatment Effects

Table 1: CBRT Interest Rates

Date	Overnight Borrwing	Overnight Lending	1 Week Repo
17.12.10	1.50	9.00	6.50
21.01.11	1.50	9.00	6.25
05.08.11	5.00	9.00	5.75
21.10.11	5.00	12.50	5.75
22.02.12	5.00	11.50	5.75
19.09.12	5.00	10.00	5.75
19.10.12	5.00	9.50	5.50
21.11.12	5.00	9.00	5.50
23.01.13	4.75	8.75	5.50
20.02.13	4.50	8.50	5.50
27.03.13	4.50	7.50	5.50
17.04.13	4.00	7.00	5.00
17.05.13	3.50	6.50	4.50
24.07.13	3.50	7.25	4.50
21.08.13	3.50	7.75	4.50
29.01.14	8.00	12.00	10.00
23.05.14	8.00	12.00	9.50
25.06.14	8.00	12.00	8.75
18.07.14	7.50	12.00	8.25
28.08.14	7.50	11.25	8.25
21.01.15	7.50	11.25	7.75
25.02.15	7.25	10.75	7.50

Table 2: Control Periods for ROM

Control Period	Correlation	R^2	RSMPE
2007M3-2008M2	0.74	0.54	1.06
2010M1-2010M12	0.65	0.42	1.06
2005M8-2007M4	0.64	0.40	2.79
2008M12-2010M11	0.57	0.32	2.57
2003M9-2006M8	0.76	0.57	6.06
2005M11-2008M10	0.75	0.56	6.17
2003M4-2007M3	0.75	0.56	6.22
2006M9-2010M8	0.73	0.54	6.29
2001M6-2011M9	0.74	0.54	6.41

Table 3: Currency Weights for ROM

Country	Weight
Brazil	0.74
Chile	0
Colombia	0
Czech Rep	0.126
Euro	0
Hungary	0
India	0
Indonesia	0
Mexico	0
Poland	0
South Afr	.134

Table 4: Predictor Balance for ROM

Variable	Treated	Synthetic	Importance
CPI_jt	-5.37875	-1.238373	0.0014311
r_jt	-12.1515	-5.625667	0.0090698
$Asset_jt$	0.1489167	0.8200997	0.0002259
TRL_1	-1.611773	-1.412259	0.0434617
TRL_2	-4.708365	-4.227849	0.0367692
TRL_3	-4.235464	-4.788174	0.0581586
TRL_4	-6.125362	-5.846677	0.1186323
TRL_5	-5.604718	-5.7288	0.1100892
TRL_6	-1.424283	-0.4320435	0.1139845
TRL_7	-4.476481	-2.150733	0
TRL_8	-6.718748	-4.50028	0
TRL_9	-9.733842	-9.755344	0.1953708
TRL_10	-6.910238	-6.187835	0.1180902
TRL_11	-1.842542	-1.563376	0
TRL_12	0.4212296	-0.5087929	0.1947169

Table 5: Control Periods for Tapering

Control Period	Correlation	R^2	RSMPE
2011M10- 2012M9	0.86	0.33	1.84
2011M11- 2012M10	0.85	0.31	2.18
2011M12- 2012M11	0.87	0.37	1.43
2012M1-2012M12	0.89	0.35	0.72
2012M2-2013M1	0.83	0.34	0.69
2012M3-2013M2	0.83	0.37	0.88
2012M4-2013M3	0.86	0.37	0.72
2012M5-2013M4	0.87	0.37	0.50
2012M6-2013M5	0.88	0.38	0.52
2012M7-2013M6	0.88	0.40	0.49
2012M8-2013M7	0.90	0.39	0.52
2011M10- 2013M7	0.88	0.34	0.96

Table 6: Currency Weights for Tapering

Brazil	0
Chile	0.136
Colombia	0.643
Czech Rep	0
Euro	0.049
Hungary	0.078
India	0
Indonesia	0
Mexico	0.094
Poland	0
SouthAfr	0

Table 7: Predictor Balance for Tapering

Variable	Treated	Synthetic	Importance
CPI_jt	-5.892749945	-1.096001252	0.003252353
r_jt	-4.5625	-4.178979167	0.000867505
$Asset_jt$	0.074749999	1.774817674	0.003129851
TRL_1	2.073987722	2.992437652	0.167915658
TRL_2	1.515155435	1.388604458	0.148532986
TRL_3	-0.554938436	-0.154901435	0.075683661
TRL_4	-1.26304245	-1.559012551	0.088507803
TRL_5	-0.608072817	-0.96258864	0
TRL_6	-0.111612357	0.102147762	0.170925237
TRL_7	-0.778639555	-0.428438492	0.052595833
TRL_8	-1.724138975	-1.311571795	0.039031752
TRL_9	-1.005586982	-1.723676525	0
TRL_10	1.401343942	0.850259734	0.12109443
TRL_11	1.754387021	2.2130692	0.128462931
TRL_12	2.765238523	2.204274861	0

Table 8: Placebo Test Results for ROM

	Turkey	Brazil	Chile	Columbia	Czech Rep	Euro	Hungary	India	Indonesia	Mexico	Poland	South Africa
pre RSMPE	6.55	7.48	5.21	4.44	3.49	3.06	3.84	4.21	5.91	4.86	3.93	7.96
post RSMPE	4.58	5.96	2.16	5.06	2.18	3.56	4.13	4.54	4.74	3.18	2.27	5.11
post/pre	0.70	0.80	0.41	1.14	0.62	1.17	1.08	1.08	0.80	0.65	0.58	0.64
Average ATE	2.50	-2.04	-0.09	1.78	0.18	1.16	-1.30	-1.78	2.36	-1.67	-1.05	-1.26

Table 9: Placebo Test Results for Tapering

	Turkey	Brazil	Chile	Columbia	Czech Rep	Euro	Hungary	India	Indonesia	Mexico	Poland	South Africa
pre RSMPE	2.13	3.25	1.95	3.09	2.56	3.43	3.45	2.08	3.47	2.48	2.00	4.63
post RSMPE	3.82	4.18	3.21	5.02	3.04	1.59	1.16	3.72	6.43	3.21	2.38	4.07
post/pre	1.79	1.28	1.65	1.62	1.19	0.46	0.34	1.79	1.85	1.29	1.19	0.88
Average ATE	2.00	2.55	1.33	0.27	0.67	-0.22	0.18	-0.65	2.52	-1.81	0.57	-0.53

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