THE EFFECTIVENESS OF FOREIGN EXCHANGE INTERVENTION DURING THE TAPER TANTRUM: TURKISH CASE

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ABSTRACT

THE EFFECTIVENESS OF FOREIGN EXCHANGE INTERVENTION DURING THE TAPER TANTRUM: TURKISH CASE

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This study aims to examine the effectiveness of the foreign exchange intervention during the Taper Tantrum. The study covers the theoretical information about the foreign exchange intervention along with the transmission mechanism and the importance of the exchange rate in inflation targeting countries. The effectiveness analysis employs two-stage instrumental variables estimation to evaluate the intervention, especially the foreign exchange sales by the Central Bank of the Republic of Turkey from 2012 to 2016. This period is specifically chosen since the intervention data is published by the Central Bank of the Republic of Turkey on a daily basis. According to the results, excess volatility and depreciation are effective in the intervention decision of the Central Bank of the Republic of Turkey. The depreciation increases the probability of intervention, while volatility decreases. Statistically, intervention is not effective at the exchange rate level of the Turkish Lira. Contrary to the insignificant findings of the intervention in the level of Turkish Lira, it is weakly significant on the volatility. Although the effect is small and weakly significant, foreign exchange sales decrease the volatility.

Keywords: Foreign Exchange Intervention, Two-stage Instrumental Variables, Exchange Rate, Monetary Policy, Effectiveness

ÖZ

TAPER ASABİYETİNDE DÖVİZ MÜDAHALELERİNİN ETKİNLİĞİ:
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Bu çalışma Tapering döneminde yapılan döviz müdahalelerinin etkinliğini incelemeyi amaçlamaktadır. Çalışma, döviz müdahaleleri aktarım mekanizmasının yanı sıra döviz kurunun enflasyon hedeflemesi uygulayan ülkelerdeki önemi ile bağlantı içerisinde döviz müdahalelerine ilişkin teorik altyapıyı kapsamaktadır. Etkinlik analizi 2012-2016 döneminde Türkiye Cumhuriyet Merkez Bankası tarafından yapılan satış yönlü döviz müdahaleleri 2 aşamalı araç değişkenler yöntemi ile incelemektedir. Bu dönem Merkez Bankasının döviz müdahalelerine ilişkin bilgileri günlük olarak yayınladığı için seçilmiştir. Sonuçlara göre, yerli paranın değer kaybetmesi ve yüksek volatilite Merkez Bankasının döviz müdahalesine yönelik kararını etkilemektedir. Yerli paranın değer kaybetmesi döviz müdahalesi olasılığını arttırırken, yüksek volatilite döviz müdahalesi şansını düşürmektedir. İstatistiksel olarak, döviz müdahalelerinin döviz kuru seviyesine etkisi bulunmamıştır. Bunun tersine, müdahalelerin volatilite üzerinde zayıf bir etkisi bulunmaktadır. Etki küçük ve zayıf olmasına rağmen, döviz müdahalelerinin volatilite üzerinde düşürücü etkisi bulunmuştur.

Anahtar Kelimeler: Döviz Müdahalelileri, İki Aşamalı Araç Değişkenler, Döviz Kuru, Para Politikası, Etkinlik

Dedicated to my family

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CHAPTER 1

INTRODUCTION

After the 1990s' experiences of high inflation and currency crisis, many countries have chosen to act within the framework of inflation targeting. In this framework, central banks were held responsible for price stability, and other possible aims were ignored if there would be a conflict with price stability. Generally, most central banks have used short-term interest rates as the main instrument to conduct their monetary actions in order to sustain proper inflation in an economy. The idea behind the stable inflation is the belief that convenient and sustainable inflation is necessary for the health of an economy.

Theoretically, central banks make interest rate decisions based on monetary reaction function to sustain proper inflation. This reaction function is generally based on the Taylor Rule[1] in which central banks react to the difference between actual inflation from target inflation, and actual output from potential output. In addition to this reaction function and the behavior of central banks regarding the Taylor Rule, most countries choose to act with free capital flows. In the modern world where the free capital flow prevails, the capital mobility and the independent monetary policy, which is an obligation for inflation targeting regime, force monetary authorities to accept floating exchange rate according to the impossible trilemma[2] within this framework.

In this framework, the exchange rate is expected to float to absorb the possible shocks and eliminate the real effects on the economy (Frankel, 2003). However, constant

[1] Although the Taylor Rule has been evaluated in the literature many times, for the original study, see (Taylor J. B., 1993).

[2] In the literature also trilemma-dilemma discussion exists. For more discussion, see (Rey, 2015; Cömert, 2019).

fluctuations and downward/upward movements of the exchange rate strongly affect the inflation rate. Even in some countries, the exchange rate may become the main determinant of the inflation rate. Besides the effects on the inflation rate, it has significant impacts on financial stability.

By considering the importance of the exchange rate on the price stability, some of the central banks act within the framework of the extended version of the reaction function, which includes exchange rate deviations. Even if the reaction function does not include the exchange rate itself, central banks' reactions are indirectly affected by the lagged effect of exchange rate deviations. Meanwhile, the boom-and-bust cycle of the exchange rate or constant fluctuations pose a significant threat to the financial system besides the effects on the inflation rate.

Therefore, even in the inflation targeting regime where the authorities are committed to floating exchange rate, central banks have serious concerns about the consequences of the unstable exchange rate. This concern forms the "fear of floating"[3] behavior which leads to the intention to offset undesired developments of the exchange rate regarding the level, volatility, and market-disrupting incidents.

Central banks have a broad range of instruments to offset the undesired effects of the exchange rate. In principle, the short-term interest rate is the main instrument to offset the effects of the exchange rate on inflation since it is included in the extended version of the reaction function besides the strong correlation of the interest rate with the exchange rate (Taylor J. B., 2001). Meanwhile, the short-term interest rate can be complemented by other instruments such as reserve requirements or open market operations to offset the negative effects of the exchange rate deviations.

Although central banks generally use interest rate or open market operations to affect variables, central banks are sometimes obligated to take different measures. In the case of contradicting targets of the central banks, at least two different instruments should

[3] "Fear of Floating" behavior of central banks indicates that although they are committed to act within the floating exchange rate, they do not fully obey the commitment. For details, see (Guillermo & Carmen, 2000).

be used according to the Tinbergen Rule (Tinbergen, 1952). Besides, central banks can have some concerns about the transmission channels of interest rate or the adjustment period. In such cases, central banks may benefit from the foreign exchange intervention policy as a supportive instrument which represents different transmission channels.

Foreign exchange policy[4] has been subjected to long-lasting debate in the literature. However, most monetary authorities benefit from this policy. Central banks sometimes intervene to eliminate the appreciation pressure, while at other times, intervention policy is benefited in the period of depreciation. Besides, some interventions are performed to smooth the fluctuations or ensure an efficient foreign exchange market. Contrary to the aforesaid reasons for the intervention, central banks can intervene to create foreign currency reserves without any intention to affect the economy.

In principle, the foreign exchange policy[5] represents a different transmission mechanism from the interest rate channel. While the interest rate channel changes the money base, foreign exchange interventions keep the money base intact. Theoretically, foreign exchange policy works through three different channels, namely, the portfolio-balance channel, signaling channel, and microstructure channel (Sarno & Mark, 2001).

The effectiveness of the foreign exchange intervention is subjected to long-running debate in the literature. Especially the effectiveness of the sales operations is strongly questioned by many authors. In the literature, there are different opinions regarding the effectiveness of the intervention because of the challenging nature of the intervention and the exchange rate. Meanwhile, in practice, the policy is used by several central banks.

The main problem of the effectiveness analysis of the foreign exchange interventions is the simultaneity bias. The problem is that while the movement and the volatility of

[4] Foreign exchange policy, foreign exchange intervention and intervention terms stand for the same meaning.

[5] In the study, the foreign exchange intervention refers to the sterilized foreign exchange intervention unless otherwise stated.

the exchange rate can be caused by the intervention, the decision of the intervention is also dependent on the exchange rate (Kearns & Roberto, 2005; Tashu, 2014). As a solution to this issue, the two-stage instrumental variable methodology is applied in this study. First, central bank intervention reaction function[6] is estimated, and the predicted intervention variable is used in the exchange rate equation to evaluate the possible effects of the intervention in the exchange rate level and volatility.

To investigate the effectiveness of the foreign exchange interventions, the Turkish Case is evaluated by the two-stage instrumental variable model in the period of the "Taper Tantrum" when the depreciation pressure had an effect on developing countries[7]. For evaluating the behavior of the Central Bank of the Republic of Turkey(CBRT), the reaction function is constructed by considering similar studies and surveys that provide the reasons of the intervention for the first stage. Thereafter, the exchange rate equation is created from the theoretical assumptions of the determinants of the exchange rate with the intervention variable derived from the intervention reaction function.

This study aims to contribute to the literature by providing background information about the intervention. Additionally, the main goal of this study is to answer the following questions by benefiting from the effectiveness analysis of the Turkish Case:

- What is Turkey's stance on the foreign exchange intervention policy, especially during the Taper Tantrum?
- What are the reasons for the foreign exchange intervention? Does the CBRT have concerns about the level, volatility, or exchange rate misalignment?
- What is the tolerance limit of the CBRT regarding the variables included in the reaction function?

[6] Hereinafter, the reaction function indicates the central bank's intervention reaction function unless otherwise stated.

[7] This period is chosen mainly because of two reasons. The first one is the data availability of the Central Bank of the Republic of Turkey's Intervention during the period. The second one is, the intention for the evaluation of the sale side interventions.

- Can the CBRT affect the exchange rate by intervening in the foreign exchange market? Is there any level or volatility effect?

The outline of this study is as follows. In the second chapter, the theoretical background is provided for understanding the implication of the foreign exchange intervention. The inflation targeting regime and the relation with the exchange rate are covered, along with the significance of the exchange rate in a developing country. The central bank's views on the intervention are also provided. Following this, the transmission mechanism of foreign exchange policy is explained together with the conventional policy transmission mechanisms to grasp the difference and the possible benefits of the intervention. Thereafter, the reasons of the foreign exchange interventions are evaluated. Lastly, instrument/market preferences, timing issues, the importance of the market size and related topics are presented with the developing countries' intervention practices.

In the third chapter, the literature review is provided considering the studies on the effectiveness analysis of the foreign exchange intervention. This part examines methodologies and results of the studies. Additionally, the pros and cons of the methodologies are evaluated. Following the general literature analysis, the studies covering the Turkish Case are provided.

The fourth chapter explains the data, sources, and the reasons for the data selection. The data problem for the foreign exchange intervention is explained, besides the methodological solutions regarding the data problems for the effectiveness analysis. Following the data section of the fourth chapter, the stylized facts about the intervention data of Turkey are provided. Economic developments during the Tapering period are analyzed with the measures taken by the developing countries. Additionally, Turkey's reaction to the Tapering period is illustrated. After that, the two-stage instrumental variable approach is explained as the methodology for the intervention analysis of the Central Bank of the Republic of Turkey. The pros and cons of the method are discussed with the necessary explanations of the models and variables.

In the fifth chapter, the results of the estimations are analyzed. Firstly, the results of the first-stage reaction function are examined. Secondly, the estimation results of the second-stage exchange rate equation are provided.

In the final chapter, concluding remarks and policy suggestions are provided.

CHAPTER 2

THE THEORY OF THE FOREIGN EXCHANGE INTERVENTION

2.1. Introduction to the Theory of the Foreign Exchange Intervention

The decisions about the exchange rate regimes become one of the main challenges for countries after the Russian and Asian currency crises (Poirson, 2001). The reason is the globalized world in which the capital flow is one of the main causes of the crisis. In the literature, it is generally argued that the exchange rate has ability to absorb shocks and eliminate possible effects on real variables (Farrant & Peersman, 2006). Therefore, there is a strong tendency to shift to more flexible exchange rate regimes rather than some types of exchange rate pegs. However, some countries still benefit from the fixed exchange rate regimes because of the specific vulnerabilities or idiosyncratic factors (Edwards, 1996). In any case, the determination of the exchange rate regime by the authorities has significant consequences on the economy.

Countries choose the exchange rate regimes regarding a wide range of institutional, structural, and political factors. Additionally, the aims of the authorities are also important for this decision. For instance, a country with high currency mismatches on the borrower's balance sheet can prefer more stable exchange rate. On the contrary, a country with a strong balance sheet and low vulnerability to external shocks can choose to act within the framework of a more flexible exchange rate. Similarly, a country which has a desire to provide stable and low inflation rate performance can choose to act with a more stable exchange rate since it provides better inflation performance (Gosh, Ostry, & Tsangarides, 2010). Therefore, the aims and interior/exterior factors of a specific country are the main determinants of regime decisions.

Since the interconnected world prevails, countries generally comply with free capital flows instead of capital controls[8]. Thus, these countries are exposed to external shocks more than any other system because of the high capital mobility. To absorb the external shocks, the floating exchange rate is accepted as the best practice in terms of the framework with monetary independence by the mainstream theory. Hence, the prevailing system is free capital mobility, monetary independence, and floating exchange rate.

In fact, in the aforementioned monetary framework, many countries choose to benefit from the inflation targeting strategy. In theory, central banks only target the inflation rate and use the interest rate as the main tool with the floating exchange rate (Mishkin & Serletis, 2011). The only justifiable reason for the intervention to the exchange rate is the effect on the inflation rate in the inflation targeting framework. This effect is commonly called pass-through. Since the exchange rate can become one of the main determinants of the inflation rate because of the expectations and pass-through, central banks intervene to offset the effect of the exchange rate on inflation. Nevertheless, in practice, central banks have more concerns about the exchange rate movements because of other possible negative outcomes besides the inflation rate.

For all these reasons, the countries operating under the inflation targeting framework, intervene to affect the exchange rate together with having a target inflation (Domanski, Kohlscheen, & Moreno, 2016). As mentioned above, although the main instrument is the interest rate in the framework of inflation targeting to comply with the inflation target, central banks intervene to affect to exchange rate with different independent instruments because of the Tinbergen rule. Central banks intervene by selling or buying foreign exchange[9] without changing the money base by different methods such as by operating in the spot market or derivatives market. Additionally, they can change the relative supply of particular assets in the market or provide information to the market participants as intervention (Dominguez, 1998).

[8] At least, the main concern of this paper is the countries that allow free capital flow.

[9] Intervention can be done by buying or selling foreign currency denominated assets.

This chapter is created to enlighten the relationship between the exchange rate, the inflation targeting framework, and the reasons for the foreign exchange policy. Firstly, it addresses the inflation targeting framework, the exchange rate's importance for developing countries, and the central bank's view on the intervention. Secondly, the transmission mechanism of both the foreign exchange interventions and conventional mechanisms are provided for comparison. Lastly, the reasons and the intervention practices are explained regarding the relevant topics with the examples from developing country[10].

2.2. Inflation Targeting Framework and the Importance of Exchange Rate for Developing Countries within the Framework

Most studies covering inflation targeting framework are created to analyze advanced economies. Therefore, in these studies, the importance of the exchange rate is subordinated. However, the exchange rate of developing countries is one of the main sources of inflation and financial fragility.

Theoretically, the inflation targeting framework is generally defined by four characteristics (Bernanke & Mishkin, 1997; Masson, Savastano, & Sharma, 1997). First, an explicit quantitative target must be specified for the inflation rate for a specific period, and there should be an official commitment to this target. Second, inflation should be forecasted by benefiting from different models and variables. Third, monetary actions need to be taken by central banks with the specified monetary instrument regarding the forecasted inflation rate as the main intermediate target. Lastly, this target should be prioritized over any other conflicting target. Along with these characteristics of the framework, unconstrained monetary actions from the fiscal authority, sound financial system and absence of any other nominal target are one of the main requirements for the framework. These necessities are specified as pre-requisites of the inflation targeting framework (Masson, Savastano, & Sharma, 1997; Mishkin F. S., 2000).

[10] For more comprehensive study of the country-specific examples, see (Moreno, 2005; Chamon, Hofman, Lanau, Rawat, & Vari, 2019).

Regarding the first characteristic of the framework, the explicit quantitative target refers to the importance of determining the target. Authorities should base their target on the clearly explained price index. The aim of the authority can either be a number, interval, or the growth rate of an index. Besides, the target should be created for the specified period.

Since the expectation about inflation is one of the main variables of inflation itself regarding the Phillips Equation, credibility of the authority is crucial. Therefore, the first property of the framework serves as a creating force, for instance wage and price-setting behavior, of the expected inflation. In this regard, clearly announced target and an authority fully committed to the target help to anchor the expected inflation to the targeted inflation. There besides, the price index should be an index that is accepted as the real indicator of inflation by the public, and the target should be clearly explained to the society to create proper expectations.

The second characteristic indicates the monetary authority's ability to measure and forecast the inflation incidents. Since monetary action should be taken regarding the expected inflation rate, the prediction of inflation needs to be broad and various. For a comprehensive understanding of inflation, different types of price indexes are necessary. For instance, the external and internal factors should be separated. Since monetary authorities have less ability to stand against external shocks rather than domestic effects, this separation provides better understanding of the inflation reasons. Furthermore, the price index changes may have no relationship with the monetary decisions. For instance, increasing tax rates can change the price index. However, these types of incidents do not derive from the monetary action or the external factors. Although understanding of the monetary authority is necessary because of the above-stated reasons, public perception is as important as the understanding of the monetary authority. Therefore, inflation forecasts are not only crucial for the actions of the monetary authority, but also important for the explanations of the actions to the public for strong credibility.

Considering the third characteristic of the inflation targeting framework, a specified instrument should be used regarding the forecasted inflation. In theory, this instrument

is necessary to have direct effects on the target. Besides, the monetary authority must be able to use the specified instrument independently. The most preferred instrument of inflation targeting countries is the short-term interest rate. Regarding the high correlation of the interest rate with inflation and the high controllability by the monetary authority, central banks can set their forward-looking interest rate instrument in accordance with the forecasted inflation rate and the targeted inflation rate.

Lastly, the targeted inflation should be prioritized over any other objective. The presence of more than one target can confuse people's expectations. Therefore, one of the main aims of the monetary authority within the framework of inflation targeting, that is, anchoring the people's inflation expectations, does not work properly because of two different aims. Moreover, the existence of two different aims, such as money growth or nominal income, can erase the importance of the primary target. However, this framework can be constructed to keep the importance of primary target, which is price stability[11]. The monetary authority can act by keeping the priority of the main target in the case of conflicting targets.

In addition to the framework itself, the feasibility of the inflation targeting framework depends on the pre-requisites specified as three different requirements by the theory. The first pre-requisite is the independence of the monetary framework from the fiscal authority. The high government debt or the direct/indirect finance of the central bank to the government can cause the accommodation of the monetary policy to the fiscal authority. This "unpleasant monetarist arithmetic[12]" derives from the excess debt or the fiscal authority's ability to borrow from the central bank. This incident forces monetary authority to follow fiscal action. In such a scenario, inflation and the expectations about the future path of inflation become ruined because of the possible excess money supply. Therefore, the fiscal authority's reasonable amount of

[11] For example, the primary objective of the Central Bank of the Republic of Turkey is stated as "The primary objective of the Bank is to achieve and maintain price stability." However, if there is no conflicting target, the Central Bank of Turkey can support the government's policies as specified in the law on the Central Bank of the Republic of Turkey as follows; "The Bank shall, provided that it shall not conflict with the objective of maintaining price stability, support the growth and employment policies of the Government."

[12] Unpleasant monetarist arithmetic indicates the long-run dependency of the monetary authority to the fiscal authority. For detailed explanation, see (Sargent & Wallace, 1981).

indebtedness and the fiscal authority's commitment to the inflation target are necessary.

The second pre-requisite of the inflation targeting framework is a sound financial system which enables the transmission of the monetary actions to the economy. Since monetary authorities' decisions are transmitted through the banking system, a sound banking system is necessary (Mishkin & Savastano, 2001).

The last pre-requisite of the inflation targeting framework is the presence of only one target rather than multiple targets. Targeting any other nominal variable aside from inflation can cause contradiction or deterioration of the monetary authority's credibility. Especially, the nominal exchange rate target that exists with the inflation target can become inconsistent because the nominal exchange rate target subordinates the inflation target and becomes the dominant target. At least, the presence of two different targets stretches each other, and the authorities become unable to reach the targets.

2.3. Importance of Exchange Rate for Developing Countries and the Central Bank's Stance

The implicit belief behind the inflation targeting framework is that the excess demand is the reason for inflation (Benlialper & Cömert, 2015). Monetary authorities adjust the interest rate to affect the aggregate demand. Therefore, they can reach the specified inflation target by adjusting the interest rate and signaling the future stance of the monetary authority. However, demand is not the only source of inflation, but the supply side factors are significant determiners of inflation and credibility, especially for developing countries.

Regarding the inflation targeting framework, only the demand-pull factors of inflations can be effectively countered by the monetary authority (Benlialper & Cömert, 2015). Since the instruments, belonging to the monetary authority, are not effective against the supply shocks as they are effective to the demand shocks, monetary decisions can only accommodate the supply shocks or stay responsive to the supply shocks (Benlialper & Cömert, 2015). However, the reason for the inflation is

not only the demand-pull but also the supply-push shocks are equally prevalent, especially in developing countries. For instance, the price changes in energy, intermediate goods, or the decisions of developed countries (like interest rate) can be as effective as the demand factors. Moreover, the exchange rate can become the main source of supply shocks which can become the main source of inflation. Along with the effects of the exchange rate on inflation, it is also vital for a sound financial system, especially for developing countries.

The change in the nominal exchange rate influences the real exchange rate, and the real exchange rate creates the differences between the relative prices of domestic and foreign goods. Hence, this change has a significant effect on aggregate demand and inflation. Besides the direct effect of the nominal exchange rate on the aggregate demand, the nominal exchange rate directly affects the imported goods's prices which indirectly affect the aggregate demand and inflation. Furthermore, the changes in the exchange rate can increase/decrease the domestic prices of the intermediate goods, which ultimately affect the nominal wages and the domestically produced goods (Svensson L. E., 1999).

Along with the influence of the nominal exchange rate on the aggregate demand, the exchange rate significantly affects the financial system of an economy. It is generally claimed that the exchange rate fluctuations and rapid changes spoil the economy. First, the rapid rise of the exchange rate deteriorates the private sector's balance sheet, especially in developing countries (Mishkin & Calvo, 2003). The upward movement of the exchange rate can be devastating for a company that has liabilities denominated in foreign currencies. This situation is crucial, especially for a company that has costs and expenditures in foreign currency and has earnings in domestic currency. In this scenario, which is common in developing countries, the unhedged foreign currency denominated costs seriously affect the company's balance sheet.

Secondly, the rapid upward trend in the exchange rate deteriorates a country's current account. With a strong domestic currency, the goods that can be imported become cheaper. Similarly, domestic goods become more expensive when compared to foreign goods. Therefore, this incident in the exchange rate stimulates import and makes

export less attractive[13]. This situation generally becomes deficit of the trade account of an economy. Besides, appreciated currency generally improves credit conditions. This improvement in the credit condition can also lead to unhealthy asset prices and bubbles. Therefore, the economy marches on a boom-bust cycle.

Additionally, the main structure of the economy is important for the full grasp of the exchange rate's significance on the economy. For instance, in an economy where export-led growth is crucial, the effect of the exchange rate fluctuations on the current account through the export and import volumes is important. Moreover, in an economy dependent on intermediary goods or energy imports, the effect can be more crucial than in any other country. In general, the changes which do not reflect the economic fundamentals or rapid movements of the exchange rate are not welcomed by most authorities since it creates unexpected consequences in aggregate demand and inflation. Moreover, it creates vulnerabilities and eliminates the chance of optimal distribution of the sources.

Considering the importance of the exchange rate for developing countries, monetary authorities have serious concerns about the incidents of the exchange rate. Although the inflation targeting framework theoretically specifies the rules that the presence of two different targets' possible negative effects on the inflation target, authorities choose to react to the exchange rate developments. Therefore, the targeting framework generally becomes flexible rather than the strict one in which central banks only react to the price level deviations from the target.

In this regard, authorities take actions to eliminate mentioned unwelcomed changes, volatility, or market disruptions in the foreign exchange market (Moreno, 2005; Patel & Cavallino, 2019). These unwelcomed incidents can be partially controlled and manipulated by several ways. One of the main ways is interest rate, which is an essential policy tool of most central banks (Mishkin & Serletis, 2011; FitzGerald, 2004). In general, the high interest rate relative to the foreign interest rate appreciates the local currency by attracting more capital, and low interest rate relative to the foreign interest rate depreciates the exchange rate. Similarly, open market operations,

[13] Validity of the Marshall-Lerner Condition is accepted.

sterilized or unsterilized monetary operations and required reserve ratios can be benefited to change the unwelcomed movements of the exchange rate. However, if a monetary authority targets nominal exchange rate besides the price level purposes, two aims deteriorate each other since the necessary action can be different for two different targets (De La Peña, 2021). Especially, the interest rate cannot be an optimal instrument alone, for example, in an economy where a high inflation rate and strong capital inflow exist together. In such cases, increasing the interest rate, accepted as the essential policy instrument, to decrease the aggregate demand causes more inflow because of higher yields. On the contrary, decreasing the interest rate to repulse the capital flows leads to an even higher demand and inflation rate.

Since the inflation targeting framework and the interest rate instrument are designated to change the aggregate demand rather than the exchange rate, a requirement for another monetary tool and transmission mechanism appears to support the interest rate instrument. In this regard, the foreign exchange intervention becomes the side policy instrument along with the interest rate instrument.

2.4. Conventional Channels of Monetary Policy

As mentioned in the previous section, the actions of central banks have an influence over the economy. Regardless of the variable that central banks intend to influence, central banks take decisions, and the decisions have effects on the variables.

The decisions and actions of a central bank are transmitted through different channels. In theory, these channels are classified as interest rate, exchange rate, asset/equity, credit, and expectations channels (Butkiewcz & Ozdogan, 2009). However, the intervention through the foreign exchange represents a different channel so long as the effect on the money base is sterilized and the short-term interest rate is kept unchanged. In such a scenario, foreign exchange intervention can represent a different tool than monetary policy (Hünfer, 2003).

Since the pure foreign exchange intervention is separated from the conventional conduct of monetary policy, in this sub-section, the conventional channels are presented to enlighten the difference between foreign exchange intervention and other

monetary actions by central banks. Although the differences and the transmission mechanisms are explained below, the main difference is that the foreign exchange intervention keeps the money base intact to represent a different tool[14].

The conventional channels work through the effects of the interest rate decisions on the real variables. Since the interest rate is accepted as the main policy tool which central banks change to affect real variables, the decisions about the interest rate change the aggregate demand and expectations and then inflation. Therefore, interest rate decisions significantly affect the money base and expectations. However, the sterilized foreign exchange intervention policy needs to keep the money base unchanged.

The first mechanism that the decisions affect the real sector is the interest rate channel. Accepting the sticky prices of Keynes, decreasing short-term interest rate causes a decrease in the long-term interest rate and real interest rate. The decrease in the real interest rate increases economic activity by stimulating spending and investment. The increasing economic activity leads to higher aggregate demands (Mishkin F. S., 1996). Therefore, the monetary authority affects the real variables by changing the nominal interest rate since the nominal interest rate decision of the monetary authority can modify the long-term real interest rates.

The second mechanism is the exchange rate channel which operates through net exports. This channel also involves the interest rate effect (Mishkin F. S., 1996). An increase in money supply, which falls the domestic interest rates relative to the foreign interest rate, leads to the depreciation of the local currency. Thereafter, the depreciation stimulates the export because of the cheaper domestic goods. In this scenario, higher net export increases the aggregate demand. Similarly, the depreciation leads to more expensive foreign goods which cause inflationary pressure (Chileshe & Akanbi, 2017).

[14] Unsterilized foreign exchange intervention changes the money base. Therefore, foreign exchange intervention should be sterilized for being another tool.

The third mechanism, according to the classification of Mishkin (1996), is the equity price channel. The expansionary monetary policy leads to higher stock prices since the public can have more money than they need. Therefore, they invest in the stock market. Meanwhile, the expansionary policies make the stock market's yield more than the bonds' yields because of the decreasing interest rate. According to Tobin's q[15] theory, this expansionary policy leads to a higher q level, which leads to more investment by the companies. Therefore, it leads to higher aggregate demand. Similarly, higher stock prices increase the wealth of the people. Therefore, higher stock prices lead to more consumption and then, more aggregate demand because of the increasing wealth.

Forth, the credit channel is one of the main transmission channels of the conventional monetary policy. A rise in the money supply leads to an increase in the available loan in the banks. Therefore, it leads to higher investment and consumption. Besides, the balance-sheet effect is another important impact in terms of the credit channel. The expansionary monetary policy, which induces higher asset prices, strengthens the balance sheet of a company. In this scenario, the company can have a higher amount of credit with less collateral. Hence, a strong balance sheet leads to high investment and aggregate demand. Also, higher interest rate causes adverse selection and moral hazard problems which restrict companies to reach available funds. Additionally, this scenario is not only valid for companies but also valid for the household.

Since the people in an economy are forward-looking, the expectation channel is another important channel in terms of monetary policy. The decisions of the people in an economy are based on expectations. Therefore, the expectations realize themselves. For this reason, the messages and the signals of the monetary authority change the investment and consumption behaviors that change aggregate demand.

2.5. The Transmission Mechanism of Foreign Exchange Intervention

Contrary to the conventional transmission channels, the mechanism of foreign exchange interventions has different features. In fact, central banks can act to influence the exchange rate in two different ways, namely, direct and indirect ways. Firstly, as

[15] Tobin's q is defined as total market value of a firm divided by total asset value of a firm.

mentioned above, the central bank can change the interest rate to affect the exchange rate indirectly. Secondly, central banks can intervene to influence the exchange rate directly.

In Indirect way, the changes in the exchange rate can be explained by the uncovered interest rate parity approach. Since the uncovered interest rate parity is the main argument for the effectiveness of the foreign exchange interventions, the uncovered interest rate parity approach is covered along with the failure of the parity. The parity and the connection with the transmission mechanism of the foreign exchange intervention are explained in this section.

According to the uncovered interest rate parity, returns through the investments on domestic and foreign deposits are equalized since the high foreign interest rate is matched with the depreciation of the foreign currency. The equal return derives from the arbitrage actions of the risk-neutral investors. Regarding the uncovered interest rate parity, the risk-neutral investors are indifferent between domestic and foreign deposits considering the equal return opportunities. If there is an interest rate difference between two countries, the investor chooses to invest in higher interest rate, and the corresponding currency depreciates. Therefore, the returns become equal. For the validity of the uncovered interest rate parity, there should be no restriction on investing abroad, and foreign and domestic investment opportunities should be perfect substitutes. For risk-averse investors, the risk premium can be added to the uncovered interest rate parity. In this way, the uncovered interest rate parity becomes applicable to all investors.

Since the main instrument of central banks is the short-term interest rate, central banks can control the short-term interest rate effectively to transmit the decisions. For this reason, central banks have the ability to influence the exchange rate by changing the interest rate benefiting from the interest rate differentials if the uncovered interest rate parity holds. Therefore, the exchange rate intervention is not a necessary instrument since central banks can manipulate the exchange rate through the interest rate instrument according to the uncovered interest rate parity.

In practice, the uncovered interest rate parity does not hold (Ismailov & Rossi, 2017; Ilut, 2012). The failure of the uncovered interest rate parity is known as the "Forward Premium Puzzle[16]. Hence, monetary authorities cannot fully manipulate the exchange rate by using the interest rate instrument. Moreover, the failure of the uncovered interest rate parity reveals the second way to manipulate the exchange rate, called the direct way, selling or buying the foreign currency assets (Hünfer, 2003).

Since the indirect interest rate effect on the exchange rate mainly changes the money base, the direct way, which is the direct foreign exchange sells and purchases, should not change the money base to be another monetary tool. In fact, central banks change the money base after the foreign exchange interventions. However, the effect of this action on the money base must be sterilized for being a foreign exchange intervention. Only this way, the instrument can be used differently (or complementarily) from the interest rate policy. In this case, the action of a central bank can be accepted as an independent tool, namely foreign exchange intervention.

Contrary to the conventional channels of monetary policy, which generally derive from interest rate decisions, the sterilized foreign exchange interventions have different channels to affect real variables. In theory, these channels are classified as portfolio balance, signaling and micro-structure channels (Canales-Kriljenko, Guimaraes, & Karacadağ, 2003).

According to the portfolio balance channel, foreign exchange interventions change the investors' currency composition. As mentioned previously, domestic and foreign assets are not the perfect substitutes. Therefore, the investors ask for premiums for the riskier assets as they are risk-averse. Since the sterilized foreign exchange intervention changes the relative supply of foreign and domestic assets, the agents change the currency composition of their portfolio, which in turn, changes the exchange rate. For instance, Federal Reserve intervenes to support the US Dollars against the Euro. Firstly, they purchase US Dollars with Euro, which decreases the money base of the US Dollars. After that, the US bonds are to be purchased to sterilize the intervention operation, which provides previous money base. In this way, the money base for the

[16] Forward Premium Puzzle is also known as Fama Puzzle.

US stays intact, but the amount of the US bonds becomes scarce relative to the foreign currency bond (Euro-denominated bonds). To hold a relatively large amount of foreign bonds, the risk-averse investor demands higher return. As long as the interest rate and the exchange rate do not change, an investor sells foreign bonds and purchases domestic bonds. Therefore, the US Dollar appreciates as intended by the Federal Reserve at the beginning (Archer, 2005).

Secondly, the signaling channel is the other way that the sterilized foreign exchange intervention works. The activities of central banks influence the public perception about the future stance of a central bank (Mussa, 1981). Since the exchange rate is the function of the expected exchange rate, the public perception can be accepted as another channel for foreign exchange intervention. For instance, in terms of the open mount operation to support the domestic currency, central banks can announce future expectations or possible future actions to the public. Moreover, central banks can intervene to buy the domestic currency to strengthen its credibility and the announced expectations. Although the effectiveness of the signaling channel depends on the credibility of a central bank, this central bank can take necessary actions to realize the signal that is given. For instance, if a central bank intervenes in the foreign exchange market by indicating its stance about the future and becomes unsuccessful, this bank can change the interest rate to be successful to defend its credibility (Canales-Kriljenko, Guimaraes, & Karacadağ, 2003). In such a case, the signals work through the behaviors of the public and the central bank itself.

Lastly, the micro-structure (or order-flow) channel is another important channel. The idea behind the order-flow channel is that the exchange rate movements (at least in the short-run) cannot be explained solely by the macro fundamentals. Rather, the traders' actions, trends and technical analysis are important determiners of the exchange rate movements. Also, the order flows transmit significant information about the exchange rate movements. In this regard, central banks can influence the exchange rate movements by their orders in the foreign exchange market. They can manipulate the trends and the information that is existed on the market. In this way, the information that the order flow is transmitted can be changed and the traders' expectations can be altered. Since the foreign exchange markets have the highest volume among the other

markets, the order-flow channel is mostly effective for the developing countries because of the relatively shallow markets.

2.6. Why to Intervene?

The importance of the exchange rate for developing countries is examined in the previous sections. This importance and the concerns of developing countries lead the monetary authority to intervene in the foreign exchange markets. The reason for the intervention varies depending on the situation and the vulnerabilities that the country has at a specific time. For instance, a country that experiences the capital inflow can intervene to increase foreign exchange reserves to curb the possible negative effects of the inflow. Contrary, a country that experiences downward pressure on the exchange rate can intervene to prevent the pressure on the exchange rate. However, in the same situation, a country exposed to strong pressure on the exchange rate might not intervene due to the lack of reserves. Therefore, the situation, vulnerabilities and structural features of a country can change the intervention reasons.

Generally, the reasons for intervention are classified around preventing depreciation/appreciation, correcting misalignment, calming the disorder market conditions, accumulating reserves, and supplying liquidity to the foreign exchange market (Canales-Kriljenko, Guimaraes, & Karacadağ, 2003). In more comprehensive approaches, the reasons can be extended to cover maintaining monetary stability, ensuring financial stability, discouraging sharp capital flows, managing reserves, smoothing the impact of commodity prices, providing hedging instruments and preventing shortages of funding to provide efficient markets for public (Mohanty & Berger, 2013).

Although some central banks concern about the effectiveness and durability of the interventions, foreign exchange policy actions are generally common among central banks. The durability, the validity of the portfolio balance channel and the intervention effects on the volatility are common concerns. Besides, according to the surveys, in the case of changes on the economic fundamentals, the intervention cannot be successful in the long-run. Moreover, since the financial integration increases constantly, the assets become perfectly substitutable, which makes the portfolio

balance channel disabled. Lastly, the intervention of central banks increases volatility, according to the surveys. These concerns are valid, especially in developing countries since the markets are not deep and liquid. Nevertheless, central banks benefit from the foreign exchange policy as an independent or complementary tool in their policies.

In this sub-section, the reasons for the intervention are examined by benefiting from the study of Patel and Cavallino (2019), which is based on the survey that collects the interpretations from 21 developing countries' central banks. In the survey, the goal and the intermediate objective segregation is applied for the intervention reasons. While the goal is the final target, the intermediate objective is the way to reach the final target. The related information is illustrated in Table 2.1 below. Since a similar survey is published annually and the challenges that the countries face with change on a yearly basis, results only represent a reference for the intervention objectives.

Table 2.1: Intervention Goals and Intermediate Objectives

Goals	**Intermediate Objectives**
Build Reserves	Influence the Exchange Rate Level
Capital Flows and Credit Spillover	Smooth the Path of Exchange Rate
Fx Funding Shortage	Limit the Volatility
Reduce Fx Speculation	Limit the Pressure Caused by International Investors
Price Stability	Smooth Commodity Price
External Competitiveness	Provide Liquidity

The countries' goals are shaped around the price stability, reserve accumulation, foreign exchange funding shortage and market speculations. The capital flows, credit spillovers and the external competitiveness goals come after the aforementioned reasons. In terms of intermediary objectives, limiting the exchange rate volatility, providing liquidity to the market, and limiting the pressure caused by international investors are the main objectives. Besides, influencing the level of the exchange rate, smoothing the path of exchange rate and reserve targets are following the former reasons.

In terms of the goals of the interventions, the price stability is one of the main reasons among the goals. Although the main instrument is the interest rate for the price stability for the inflation targeting framework, the exchange rate intervention is used as a secondary mean by central banks. Because of the pass-through and the effects of the exchange movements on expectations about the price level, interventions support the inflation targeting framework according to the survey. Additionally, the effect of the exchange rate intervention in the price level is faster than the interest rate effect (Svensson L. E., 1999; Hünfer, 2003).

Besides the price stability, the other goals are clustered around financial stability purposes. In this regard, the primary importance is given to reserve accumulation. To counter the risk-off periods, prevent the rapid capital outflow and ensure the credibility of the country, central banks accumulate reserves. Reserves are not only beneficial for the interventions but also beneficial for influencing the investors' perception. Some of the reserve ratios prevail in the determination of the credibility of the country. Reserve/GDP, debt/reserve or similar ratios are used by different institutions to rate the countries.

Funding foreign exchange shortage and reducing the market speculations goals of central banks come after the price stability and the reserve accumulation goals. The capital inflow or the outflow poses a significant threat to the financial system. The capital inflow causes unhealthy credit conditions, and the capital outflow causes deterioration of the balance sheets so that monetary authorities take measures to eliminate the rapid movements of the exchange rate by foreign exchange policy. Additionally, central banks occasionally intervene in different markets to provide hedging instruments and prevent market illiquidity.

Lastly, promoting competitiveness is not a prominent factor for the intervention. According to the BIS surveys, central banks that mention external competitiveness as a goal of foreign exchange policy have constantly been decreasing since 2012. Nevertheless, some central banks have an intention to use foreign exchange intervention for this goal.

To reach the ultimate goal, monetary authorities create intermediate objectives. In the survey, the intermediate objectives are classified as influencing the exchange rate level, smoothing the trend path, limiting the volatility/pressure, providing liquidity and reserve management purposes.

Starting with the most important and common intermediate objectives, smoothing the trend path, the limiting the volatility and pressure objectives are crucial for developing countries. Since developing countries have roughly similar structural problems, such as dollarization, weak balance sheet and fragility to rapid capital inflow-outflow, the central banks of developing countries have similar concerns and answers about the intermediate objectives. These objectives are followed by liquidity purposes. Regarding the structural problems of developing countries, the hedging needs and the vulnerabilities reveal the need for action in the illiquid market conditions.

Lastly, influencing the level of exchange rate objective is the most controversial reason of the intervention. Although the target of influencing the exchange rate level belongs to the variety of exchange rate pegs, some central banks have tolerable limits. Since the foreign exchange is expected to the float in the framework of the inflation targeting regime, intervention for influencing the exchange rate level rate brings the exchange rate regime into question. Such questions arise about whether the exchange rate regime is managed float, dirty float, crawling peg or fixed peg. The regime and the flexibility of a central bank contribute to the independence level of the monetary decision. Additionally, the perception of the public to the exchange rate regime can be crucial for the health of the inflation target.

Although the theory indicates the danger of two different target's, developing countries use some types of exchange rate bands with the inflation target, especially at the time of transmission to the inflation targeting regime. Chile and Israel benefited from the exchange rate band to reach the goal of an inflation targeting regime. In this strategy, these countries tried to create credibility and anchor the public's expectation. In the midst of the shocks, the band was widened and intervened to eliminate the pressures for price stability. In this sense, the priority of the inflation target showed,

and the possible confusion was eliminated (Stone, Shimizu, Nordstrom, Kışınbay, & Restrepo, 2009).

Additionally, other surveys and empirical studies exist in the literature. Although the authors' classifications can be different, the objectives for the intervention are almost similar. For instance, intervention reasons grouped into eight different categories, namely, ensuring competitiveness, preventing exchange rate misalignment, managing the volatility, supporting financial stability, managing the foreign exchange reserves, promoting price stability, slowing appreciation, and signaling the monetary policy by (Stone, Shimizu, Nordstrom, Kışınbay, & Restrepo, 2009). As two different surveys and studies are depicting almost similar consequences, the behavior of the developing countries' central banks matches.

2.7. How to Intervene?

The intervention aims and the transmission channels of the foreign exchange intervention are evaluated above. Meanwhile, central banks have different methods, tactics, and choices about performing the intervention in the market. The different methods and tactics reveal differences in the consequences of the intervention. Mainly, central banks have various instrument choices to intervene in the market. Secondly, the intervention can be executed in different markets via different instruments. Thirdly, the timing of the intervention causes a significant discussion in the literature. Fourthly, preference for transparency is another important point since the signaling channel is one of the main channels for the transmission of the central banks' decisions. Lastly, the rule-based or discretionary interventions are debated in the literature for the better implementation of the intervention.

In terms of central banks' preferences regarding the instrument and the market, interventions are mainly executed through spot markets. Regardless of the intention of a central bank, the spot market interventions are generally common because the spot markets are the most liquid foreign exchange markets in developing countries and have the highest proportion in terms of foreign exchange trade volumes (Archer, 2005; Canales-Kriljenko, Guimaraes, & Karacadağ, 2003). The general belief behind the

spot interventions is that spot market interventions send significant signals about the future stance of monetary authority because of the market size.

Naturally, central banks have limited sources to counter domestic currency depreciation, while limitless sources to counter appreciation. Therefore, the spot market interventions for the depreciation can lead to the depletion of reserves which causes high costs to the monetary authorities.

To overcome the problem of limited reserves for enabling the intervention for the depreciation trend of the domestic currency, (or to minimize the cost of spot interventions), derivatives and derivative markets are used as complementary to spot interventions in many countries (Canales-Kriljenko, Guimaraes, & Karacadağ, 2003). In fact, the derivatives can be much more beneficial for central banks since they can be settled in domestic currency rather than foreign currency. Thus, central banks can intervene with domestic currency to exchange rate without any limit. Meanwhile, in some countries, the derivatives market represents higher proportions of the foreign exchange markets[17]. Additionally, in the case of market disruption, the hedging need of the public increases. In such situations, central banks take action to involve in foreign exchange markets by providing hedging instruments to settle the disruptions. Therefore, the interventions by derivative products are used by many central banks. For the intervention in the derivatives market, swaps, options, futures, and forward products are used.

According to the theory, spot market interventions are weakly better instruments than derivative operations (Patel & Cavallino, 2019). Additionally, spot market interventions are believed to provide better signals. However, countries do not benefit from only one instrument. Rather, different instruments and markets are used to reach the objectives.

Second, timing is another issue that is subjected to debate in the literature. The main discussion about the timing is the benefits of pre-emptive interventions (Canales-Kriljenko, Guimaraes, & Karacadağ, 2003). While pre-emptive interventions can

[17] For instance, in Brazil, the derivatives market is bigger than the spot market.

prevent undesired situations, explaining these interventions to the public can be problematic. Besides, measuring the success of the pre-emptive intervention can easily become impossible. Therefore, in all surveys, pre-emptive interventions are not preferred and used by central banks. Additionally, most central banks intervene when the markets are deep and liquidity is high. Although some banks intervene out of working hours, the general practice shows that most central banks prefer to intervene during business hours when the market volume is high. Another reason for the intervention in the tradable times is the micro-structure channel of the intervention. As explained above, central banks can influence the exchange rate by changing the order flow. Therefore, the intervention during business hours becomes more beneficial, as the aforementioned surveys indicate.

Transparency is another important subject for executing the intervention. Some monetary authorities choose to keep interventions secret, whereas others disclose them instantly. Related to this, a central bank can intervene by informing the public in advance. However, the intervention data can be kept secret. Several central banks prefer to keep it secret and unveil the data ex-post[18]. Besides, the ex-post announcement of the intervention data differs among countries. While some countries publish the intervention data daily or weekly, others prefer to publish the data on a monthly or yearly basis. Moreover, authorities can choose agents to perform interventions on behalf of themselves to hide the presence of the central bank in the market.

The benefit of transparent interventions arises from the signaling channel. As explained above, the stance of a central bank is transmitted to the public by unveiling intervention data. However, non-transparent interventions can have crucial benefits for the success of the action (Hendrick, Magud, & Qureshi, 2019). The non-transparent interventions cannot be countered by speculative attacks, while the transparency can reveal a central bank's intention to reach some specific aim. Therefore, transparent interventions can be attacked by the market participants. Moreover, the possibility that a central bank's failure can be eliminated by keeping the intervention secret. However,

[18] For the data availability and the publication method of the countries, see the Appendix of (Adler, Kyun Suk, & Rui, 2021).

if central banks intervene transparently and cannot become successful, it deteriorates the credibility. In terms of reserve accumulation purposes by which central banks only intend to accumulate reserve, the pre-announcement and pure transparency can be beneficial to eliminate possible market disruptions and volatility.

The last discussion derives from the rule-based and discretionary interventions (Hendrick, Magud, & Qureshi, 2019). Central banks can specify the amount, time, and intervention objective to follow rule-based intervention. For instance, a central bank can announce foreign currency purchase auctions. In such a case, the interventions are accepted as rule-based. Contrary to rule-based intervention, central banks act when they believe it is necessary. For instance, a rapid deviation of the exchange rate from the fundamentals can trigger the intervention, and in this case, the intervention can be called discretionary.

Rule-based interventions create predictability, while central banks' discretionary interventions are naturally hard to predict. Therefore, rule-based interventions can be much more effective in eliminating volatility. Similarly, since discretionary policies are unpredictable, an intervention for preventing volatility can become the main source of volatility. However, the rule-based interventions can be inadequate. In contrast with the rule-based programs, the discretionary interventions provide better maneuver chances to central bank since there is no explanation before the intervention.

The different tactics and intervention methods are explained above. These methods and tactics have their pros and cons. Hence, central banks generally do not lean on one intervention method but try to benefit what fits to the objective. The most beneficial intervention method can change depending on the market sentiment, objective, and other exterior factors.

CHAPTER 3

LITERATURE REVIEW OF THE EFFECTIVENESS OF FOREIGN EXCHANGE INTERVENTION

3.1. Introduction to the Literature of Effectiveness Analysis

Foreign exchange interventions are analyzed many times by covering different subjects about it. Generally, effectiveness, cost, duration, time-inconsistency problems, methods and tactics, optimal intervention time, asymmetric stance of central banks, transmission mechanisms and many other relevant subjects are evaluated in the literature. These studies are conducted by using different econometrical methods and models to explore different subjects. Besides, since developed and developing countries have different market sizes, vulnerabilities and features, foreign exchange interventions reveal different consequences. Therefore, these studies are generally created for developed and developing countries separately.

Regarding the effectiveness of foreign exchange policy actions, there is prevalent debate over the effectiveness of foreign exchange interventions. In general, the debate arises from two significant problems in the studies, namely the data issues and the endogeneity. Moreover, the effectiveness of the intervention is closely tied to the unique situation of a country during the action of the intervention.

Central banks, especially in developing countries, do not publish intervention data because of the concerns about the transparency that is discussed above. Meanwhile, some public banks are authorized to act on behalf of a central bank to perform intervention. Therefore, the intervention data published by a central bank may not represent the real intervention in the market. In such scenarios where the high-

frequency data is unavailable, and the intervention data is kept secret, researchers apply to central banks' balance sheet instead of the real intervention data. Thus, the shortage and the accuracy of the intervention data may reveal different consequences about the effectiveness of the interventions.

The second important problem is endogeneity considering the foreign exchange interventions. For instance, a central bank intervenes to smooth the exchange rate by buying the foreign currency in a situation of appreciation. If the intervention is partially effective and the exchange rate continues to appreciate, the results can be misleading (Chamon, Hofman, Lanau, Rawat, & Vari, 2019). To overcome the endogeneity problem, different techniques and methods are applied in the literature to explore the effectiveness of the intervention. These different methods to overcome the endogeneity can be another source for the different consequences in the literature.

As the main concern of this study is the effectiveness of the foreign exchange interventions in developing countries, the relevant literature is presented in the next section. Thereafter, the studies that cover the Turkish Case are evaluated in detail. Since there are different methods and econometrical techniques available in the literature, the pros and cons of different methods are represented in this section besides the methodology section in the following chapter, which includes the chosen method for assessing the effectiveness of the intervention in Turkey.

3.2. Literature Review

Data issues and different methods along with the research period and the market sentiment lead to mixed results about intervention. As mentioned above, different results[19] exist in the literature for developing and developed countries. Mixed results for the effectiveness are found considering the level, volatility, and other related aims of central banks. Moreover, the studies naturally cover some specific times which cannot be generalized to all times. Besides the data issues, specific period and method differences, most studies are constituted on one specific country, although some studies are designed to cover many countries by a panel approach. Therefore, the

[19] For a detailed evaluation of the literature, see (Menkoff L. , 2013).

effectiveness of an intervention cannot be generalized to all countries at all times. In the light of these differences, some studies find significant results while others find that the influence of the intervention in the exchange rate is insignificant[20].

First studies, constructed to explore the effect of the sterilized intervention, generally cover developed countries. For instance, Dominguez (1998) evaluates the effectiveness of Japan, the United States and Germany's interventions regarding the volatility and finds mixed results about the effect of the intervention based on different situations. Additionally, the intervention can cause volatility, according to this article[21]. Ghosh (1992) also investigates the portfolio balance channel of the foreign exchange intervention by creating a model with expectations. The author aims to explore if the foreign exchange intervention represents an independent monetary tool[22]. This study concludes that the effect of the portfolio balance channel is not significant in the case of stable expectations. Kaminsky and Lewis (1993) examine the signaling effect of the interventions in the United States and find that the intervention affects the expectations adversely. Meanwhile, the signal about the future stance of the Federal Reserve is transmitted by the intervention, according to the authors. Therefore, the first studies are designed to find evidence of the transmission channels and the effects of the interventions in developed countries.

Following the studies covering advanced economies, a strong interest in developing countries becomes apparent in the literature. Generally, the first studies only cover one or two specific countries and try to find the effectiveness of the foreign exchange interventions as a beneficial tool against shocks. In some studies, the effectivity is not found, whereas others find significant effects on the volatility, level and other types of disruptions.

[20] Effectiveness analyses in the literature are summarized in Table 3.1.

[21] According to (Dominguez, 1998), the secrecy of the intervention increases volatility. Therefore, ex-ante interventions show better volatility performance.

[22] Author of the article indicates that if the foreign exchange intervention works through the portfolio balance channel rather than (or beside) signaling channel, the foreign exchange intervention can be accepted as an independent monetary tool.

Although some studies find insignificant effect of the foreign exchange intervention, most findings indicate that the foreign exchange interventions are a successful tool for either volatility, level or smoothing the exchange rate movements.

Domaç and Mendoza (2004) analyze the effectiveness using the GARCH model in Turkey and Mexico in the inflation targeting framework. By considering the intervention as a defensive tool against the pass-through in the inflation targeting framework, this study has a similar approach to us. They separate the effect of the interventions in terms of volatility and the level effect. They find that foreign exchange sales were both successful in terms of level and volatility, whereas the foreign exchange purchases were ineffective between 1996 and 2002[23]. Guimarães and Karacadag (2004) reveal similarly mixed results for the same countries with the ACT-GARCH model. While for Mexico, foreign exchange sales are statistically significant, the purchases and sales are not statistically significant for the Turkish case[24]. Additionally, they indicate that the intervention generally leads to an increase in the exchange rate volatility for both short- and long-term horizons.

Tapia and Tokman (2004)[25] examine the Chilean Case for the effectiveness of the intervention between the years 1998 and 2003 by using daily and intra-day data. They finalize the study with mixed results for different years. For instance, between the years 1998 and 1999 sales had a significant(weakly) effect on the level, whereas no significant effect was found in 2001. Additionally, they conclude that although the separation of the channels for the foreign exchange intervention is not applicable, the actual intervention is necessary for the portfolio balance channel. In contrast, there is no need for actual intervention after the announcement in terms of signaling channel.

[23] According to the study, even the presence of Central Banks in the foreign exchange market has significant effects on the exchange rate in both Mexico and Turkey.

[24] Since purchases of the foreign exchange reserves do not aim to increase volatility and influence exchange rate level, the results are consistent with the expectations of central banks during the study's analysis period.

[25] Authors also discuss the foreign exchange intervention in the floating regime. Therefore, this study is in line with our discussion.

Kamil (2008) analyzes Colombian Case in which the intervention is performed in line with the inflation targeting framework. This study uses the two-stage instrumental variable[26] method to find the effects of the intervention. It investigates discretionary intervention during the monetary easing (2004-2006) and concludes with a significant and desired effect on the level and volatility. During the period, the intervention supported the main instruments in the inflation targeting framework to resist appreciation pressure. Additionally, the intervention also supported the inflation target and the Central Bank of Colombia reached the target goal with the help of the intervention, according to the author during the period. However, after this period, no significant effect was found both on the volatility and level in this period. Additionally, the bank deteriorated the perception of the inflation targeting regime by creating two different conflicting targets, according to the author.

The spot and derivative interventions in Brazil between the years 2008 and 2009 to inject foreign currency liquidity to prevent market disruption is evaluated by (Stone, Walker, & Yasui, 2009). This study analyzes the intervention as a macro-prudential measure taken against market disruption during the crisis. They claim that the spot intervention had a significant effect, and swap lines decreased the volatility and prevented market disorder, especially swap lines with FED during the crisis.

Humala and Rodriguez (2010) create the study for the Peruvian Case with the GARCH model for the intervention to counter the excess volatility between the years 1994 and 2007. They claim that the interventions were successful during the excess volatility periods.

The sale of the reserves by the Czech National Bank is examined with the weighted least squares method by (Domingues, Fatum, & Vacek, 2013). They show that the daily and frequent sales of the reserves were effective in terms of the level of the

[26] Since the author estimates the reaction function first and uses the predicted intervention data in second-stage estimations for both the volatility and the level effect on the exchange rate, this study is also methodologically similar to ours.

domestic currency[27] during the examined period. However, when the sales were executed irregularly, the interventions became ineffective.

The event study approach is one of the common methods to evaluate intervention's effect, especially sporadic interventions. Colombian monetary authority's interventions are analyzed by (Echavarria, Melo, & Villamizar, 2014). In this study, the authors created four different criteria for testing the intervention performed for eliminating the volatility. Additionally, the results are compared with Brazil as a counterfactual example. They find that volatility options were effective in terms of direction, reversal, smoothing and matching criteria. They also explore the differences between pre-announced and discretionary interventions in Colombia.

In terms of the validity of the microstructure channel, Peso/Dollar exchange market is analyzed with an event study approach by (Verdú-Garcia & Zerecero, 2013). They reveal that the intervention is significant in reducing the bid-ask spreads. Another study evaluates the microstructure of the BRL/USD. According to Kohlscheen (2013), the central bank can change the pricing behavior of the market participants by indirect damping channel[28].

Contrary to the findings of Kohlscheen (2013), swap interventions, analyzed with event study, in the BRL/USD market provides different results according to (Marins, Gustavo, & Vicnete, 2017). They conclude with no strong evidence of effectiveness of swaps on the exchange rate level and volatility. Trivedi and Srinivasan (2016) use event study to find the effect of the foreign exchange intervention. The intervention creates undesired movements of the exchange rate, according to the research. Fuentes, et al. (2014) prepare the event study analysis for Chile, Peru, Colombia, and Mexico. The rule-based intervention has a significance but transitory effect on the exchange

[27] The regular presence of the Czech National Bank in the foreign exchange market helped to increase the effectiveness of the intervention, according to the author. It is surprising since the pre-announced policy actions are expected to have less effect than the discretionary ones. This outcome is also important for our study since the Central Bank of the Republic of Turkey constantly existed in the foreign exchange market during the period chosen.

[28] For detailed information about the damping channel, see (Menkoff L. , 2008).

rate and volatility. For Peru, discretionary interventions are statistically significant but not long-lasting. In terms of the volatility, the Peruvian case presents mixed results.

The Propensity Score Matching method is another way to examine the effectiveness used by (Moura, Pereira, & Attuy, 2013). The researchers create counterfactuals to measure the effectiveness of the Central Bank of Brazil's intervention. Their results indicate that foreign exchange sales were effective, whereas the purchases were not significant for the level between the years 2004 and 2012. However, no uniform results were found for the volatility during the years between 2004 and 2012. The Central Bank of Brazil's two intervention programs are evaluated aftermath of the Taper Tantrum[29] by (Chamon, Garcia, & Laura, 2015). They indicate that the first intervention program was effective in terms of mitigating the depreciation of the currency, while the second program was not statistically significant.

Herrera-Catalan (2016)[30] finds no evidence of effectiveness on the exchange rate level in Guatemala, where the inflation targeting regime existed. However, the intervention decreases the volatility of the domestic currency, according to the author. The findings of Ding and Wang (2022) provide similar results for Vietnam with the Hierarchical Bayesian VAR model. In this study, the level effect of the intervention is not found significant, whereas the volatility is dampened by using the exchange rate policy.

Tobal and Yslas (2016) investigate the effectiveness with VAR models in Brazil and Mexico. According to the researchers, dollar purchases were significant both in Mexico and Brazil, but the effect was short-lived in the case of sterilized intervention during the investigation period. Lahura and Vega (2013) assess the asymmetric effects of the intervention by questioning the signaling channel between the years 2009 and 2011 with an event study and VAR models. During this period, the foreign exchange sales created an asymmetric effect on the spot exchange.

[29] This study analyzes roughly similar years to our analysis. Moreover, this analysis is also interested in the sales interventions since upward pressure on exchange rate was experienced during the period.

[30] Herrera-Catalan (2016) also mention the presence of the two different instruments with two different objectives. In this way, the study analyses the foreign exchange intervention by taking the inflation targeting regime into consideration.

Barroso (2014) uses realized volatility and non-parametric instruments for the effect of the spot and swap intervention during the years between 2007 and 2011. The model is run by the ordinary least squares, instrumental variables and weighted instrumental variables. It is found that the OLS model's results are biased, and the other estimations present accurate results. The effect of the spot and swap interventions were significant on the level both for sales and purchases during the years between 2007 and 2011.

The interventions' effectiveness through derivatives is another subject of the related literature. According to Kohlscheen and Andrade (2014), the rule-based currency swap auctions significantly affect the level. Nedeljkovic and Saborowski (2016) investigate the effectiveness of the spot and non-deliverable derivative contracts. They find that the spot market intervention is more likely to deal with the daily movements. However, the derivatives are used more to smooth the trend in the exchange rate, according to the authors.

Contrary to partially effective findings, Disyatat and Galati (2007) find a very weak effect on the exchange rate level and no impact on volatility for the Czech Case by using the instrumental variables to overcome the endogeneity problems. The authors indicate that the effectiveness of the intervention depends on the macro-economic fundamentals, and the deviation from the fundamentals creates room for central banks to intervene effectively. Moreover, Disyatat and Galati (2007)[31] enlighten the differences between developed and developing countries regarding the foreign exchange interventions. The relatively large size of the intervention in developing countries, the significance of the capital controls and the access to global markets provide more efficient intervention possibilities for developing countries, according to the authors.

Likewise, Roure and Reitz (2015)[32] reveal no significant effect of the intervention using the reduced form of the VAR model. In the model, capital controls are evaluated

[31] The author also concludes the study with the opinion that intervention cannot replace the monetary policy for addressing fundamental macro issues. However, the intervention can be useful against the short-term undesired fluctuations.

[32] This study also includes an analysis of the micro-structure channel.

along with the foreign exchange intervention. Another similar claim is made by Loiseau-Aslanidi (2011) who firstly uses the instrumental variables approach to estimate the reaction function of the central bank. Thereafter, the author gauges the effect by constructing the two-stage least squares and the GARCH-M model. According to the research, the intervention increases the volatility besides the prevention effect for the depreciation trend of the currency. Since the reaction function and the second stage are similar to our studies, this study is benefited for construction of our models.

There are also reverse effects relative to a central bank's announcements in the intervention literature. Tuna (2011) finds, by using E-GARCH Model, the sales operations increase the volatility, contrary to the announcements of the CBRT. Likewise, Tümtürk (2019) finds no significant effect of the intervention in the exchange rate regarding the Turkish Case with the model of GARCH[33].

Rincon and Toro (2010) evaluate both capital controls and foreign exchange interventions to understand effectiveness. By using the GARCH model with high-frequency data, excluding capital controls, they find no evidence of effectivity of the spot and derivative intervention. Conversely, the authors mention an increase in volatility as a side effect. However, Rincon and Toro (2010) reveal that orchestrated policy actions via intervention and capital controls are effective in preventing the depreciation of the currency and volatility.

In addition to the country-specific studies in the literature, there are also panel studies to compare and exhibit a comprehensive analysis of the effectiveness of the foreign exchange intervention. Besides the analysis of the effectiveness of the foreign exchange intervention, there is a vast literature that covers other relevant subjects in correlation with the effectiveness of the intervention.

[33] Regarding the Turkish Case, a detailed literature review is provided in the following section.

Adler and Tovar (2014)[34] use instrumental variables estimation for the fifteen economies from 2004 to 2010 to analyze sterilized intervention. The panel data is used for fifteen countries with the method of two-stage instrumental variables. This study is only applied to the purchases and concluded with a significant effect on the pace of appreciation. In this study, the foreign exchange intervention proxy is created from the central banks' balance sheets and used in the models. The change in the stock of international reserves of the central banks is used[35].

Tashu (2014) inspects the effectiveness with a similar instrumental variable estimation method for Peru. Firstly, this study estimates the Central Bank of Peru's foreign exchange intervention reaction function. Thereafter, the author uses the estimated results in the second specification for the effectiveness of the intervention. Therefore, he concludes with the intervention behavior of this Central Bank. Foreign exchange sales are effective in periods of depreciation and excess volatility according to the author. However, purchases are not effective for preventing appreciation pressures.

To counter the capital inflow, central banks use foreign exchange interventions. The effectiveness is questioned by (Blanchard, Adler, & Filho, 2015). The authors deal with the strong capital inflow and find the foreign exchange intervention effective for the pressures on the local currency. Similar results are found by (Adler, Lisack, & Mano, 2019). They find an effective level effect of the intervention in a panel approach with the two-stage instrumental variable approach. Additionally, the effect, while being persistent, is also significant for both purchases and sales, according to the researchers.

The credibility of a central bank another issue discussed by (Adler, Lama, & Medina, 2019). They develop a two-sector small economy model to evaluate the effect of the credibility of central banks' foreign exchange interventions. This study's conclusion

[34] The studies of Adler and Tovar (2014) and Tashu (2014) are one of inspiring analyses for this study. A similar method is used, and the differences are explained in the methodology section below.

[35] Since the data availability of the foreign exchange intervention is scarce because of the preferences of central banks, some proxies are used in the literature for the intervention data proxy. Change of stock of reserves (net and gross), net foreign asset position, international reserves and similar proxies are accepted as proxies in different studies in the literature.

is that the perfect credibility provides a more stable output and inflation. However, the imperfect credibility, although it provides stable output, increases the inflation volatility in the case of intervention.

In the literature, there are also studies using meta-analysis (Lozano-Arango, Menkoff, Novoa-Rodrigues, & Villegas-Villamizar, 2020). They investigate the effectiveness with a meta-analysis covering the years from 1970 to 2010. This study finds a significant effect of both purchases and sales.

Regarding the emerging markets and the exchange rate concerns, some of studies analyzed the simultaneous targets (Adler, Chang, & Wang, 2020). They find the simultaneous targets in the inflation targeting countries if the foreign exchange policy is applied. In these countries, the simultaneous inflation and the exchange rate target deteriorate the inflation expectations, according to the study. Meanwhile, this research indicates that foreign exchange interventions are biased toward purchases. Similarly, the presence of the two different instruments is examined by (Ghosh, Ostry, & Chamon, 2016). Additionally, the authors present the related literature on developing countries.

Daude, Yeyati and Nagengast (2016) constitute a comprehensive study for 18 emerging market economies from 2003 to 2011. According to this study, the intervention is effective considering that the exchange rate moves in the desired direction in general. The exchange rate deviation from the long-run average makes the intervention more effective. Besides, dollarization in the economy leads to more effective intervention results. Additionally, there is no asymmetry in the direction of the exchange rate.

In terms of macro-economic consequences of the intervention in relation to the effect on the exchange rate, Wang and Zhao (2021) provide a comprehensive analysis of 26 countries, including China. Although the intervention has no strong effect on the real exchange rate, it successfully prevents the exchange rate fluctuation. In this study, the flexibility of the exchange rate provides more secure consequences during external shocks and eliminates the chance conflicting targets.

Another comprehensive study created by (Fratzscher, Gloede, Menkhoff, Sarno, & Stöhr, 2017). They evaluate effectiveness by creating the effectiveness criterion for 33 countries. According to this study, the effectiveness increases if the intervention follows the exchange rate equilibrium. Moreover, the intervention toward the long-term trend makes itself more successful. Therefore, this study finds that the foreign exchange intervention is an effective tool for countries.

3.3 Literature of the Effectiveness Regarding the Turkish Case

Since the Turkish Economy is among in the developing countries, it shares similar concerns with other developing countries. Therefore, the CBRT's interventions are examined in many panel analyses. Meanwhile, the interventions are also investigated alone or with similar examples.

As mentioned above, Domaç and Mendoza (2004) and Guimarães and Karacadag (2004) analyze the Turkish Case by comparing with the Mexican Case. While the first study covers the years between 2001 and 2002, the latter covers 2001 and 2003. The first study's result is that sale operations significantly affect both the volatility and level. However, while foreign exchange purchases are insignificant, sales are significant for the volatility as well. The latter study provides insignificant result for level effect for both purchases and sales[36]. In terms of volatility, this study finds significant results for the short-term volatility. Nevertheless, the intervention causes higher volatility in the long run.

Another study that evaluates the Turkish Case is conducted by (Akıncı, Çulha, Özlale, & Şahinbeyoğlu, 2005). In this study, Central Bank's interventions are analyzed with the probit and Granger-Casualty models to present the causes and effects of the intervention. In this way, the research is similar to ours. According to the authors, the intervention is performed because of the volatility, and it is in line with the central bank's statements. Additionally, the signaling channel of the intervention is evaluated.

[36] These findings are in line with the statement of the Central Bank of the Republic of Turkey since it is not aimed to affect the exchange rate, according to the author.

In terms of the effects of the intervention, the level effect is not significant, similar with insignificant sales operations in terms of volatility. However, the purchases are partially significant for the high volatility.

Herrera and Özbay (2005) present a censored regression model for the years between 1993 and 2003. This study also distinguishes free-float and managed-float periods from 1993 to 2003. Although the intervention has no significant effect on both the level and volatility, a small effect on the volatility is detected during the free-float period.

Tuna (2011) provides another research for the Turkish Case using the E-GARCH model covering the years from 2001 to 2005. The study presents no significant evidence of the foreign exchange intervention for smoothing the volatility. Additionally, the rule-based interventions during this period were significant, although they increased the volatility contrary to the statements of the Central Bank.

Cicek (2014) evaluates the effectiveness of the daily intervention of the CBRT from 2009 to 2014 with the Exponential GARCH model. The study provides no effect of the intervention in the level of exchange rate in line with the central bank's announcements. Moreover, the author does not find the volatility effect of the bank's intervention during the period.

Tümtürk (2019) also examines the Central Bank of the Republic of Turkey's intervention as mentioned above. From 2012 to 2018, the intervention data were evaluated with the EGARCH model and conditional mean, and variance were analyzed. According to the author, the exchange rate returns were not affected by the intervention during this period. Both sales and purchases did not significantly affect the exchange rate returns. Moreover, while the purchase of the foreign exchange was insignificant, the sales operations increased the volatility which was an undesired consequence for the Central Bank of the Republic of Turkey.

Table 3.1: Summary Table for Literature

Literature	**Country**	**Period**	**Method**	**Results**
Dominguez (1998)	Japan, Germany, United States	1977-1994	GARCH	Secret interventions increase the volatility, but volatility can be decreased by intervention policy.
Ghosh (1992)	Germany	1980-1988	VAR	Transmission channels are tested. Portfolio balance channel weakly affects the exchange rate.
Kaminsky and Lewis (1993)	United States	1985-1990	VAR	Signaling channel is tested. Mixed results are found.
Domaç and Mendoza (2004)	Mexico, Turkey	1996-2002	GARCH,IV	Fx sales are effective but purchases are ineffective.
Guimaraes and Karacadağ (2004)	Mexico, Turkey	1996-2003	GARCH,IV	Interventions are not effective in Turkey, but sales are effective for Mexico.
Tapia and Tokman (2004)	Chile	1998-2003	2SLS	Mixed results are found for different years.
Kamil (2008)	Columbia	2004-2007	GARCH,IV	Mixed results are found for different years.
Stone, Walker and Yasui (2009)	Brazil	2008-2009	IV	Intervention reduces the volatility.
Humala and Rodriguez (2009)	Peru	1994-2007	Univariate and Multivariate Series	Intervention is effective on volatility.

Table 3.1: Summary Table for Literature (Continued)

Literature	**Country**	**Period**	**Method**	**Results**
Dominguez, Fatum and Vacek (2013)	Czech Republic	2004-2007	OLS	Intervention is effective when it is performed regularly.
Echavarria and others (2014)	Columbia	2000-2012	Event Study	Fx sales are effective for exchange rate level.
Verdu and Zerecero (2013)	Mexico	2008-2010	Event Study	Intervention reduces the bid ask spread.
Kohlscheen (2013)	Brazil	2002-2011	OLS	Intervention is effective on pricing behavior of participants.
Marins and Others (2017)	Brazil	2006-2013	Event Study	Intervention is ineffective.
Trivedi and Srinivasan (2016)	India	1996-2014	Event Study	Intervention is ineffective.
Fuentes and Others (2014)	Chile, Colombia, Mexico, Peru	2007-2011	Event Study	Mixed results are found for different countries. In general, intervention is ineffective.
Moura, Pereira and Attuy (2013)	Brazil	1999-2012	Propensity Score Matching	Mixed results are found for different periods.
Catalan-Herrera (2016)	Guatemala	2008-2012	IV	Intervention is significant on exchange rate volatility, but no effect is found on exchange rate level.

Table 3.1: Summary Table for Literature (Continued)

Literature	Country	Period	Method	Results
Ding and Wang (2022)	Vietnam	2009-2020	VAR	Intervention has little effect on the exchange rate level, but it has significant effects on the volatility.
Tobal and Yslas (2016)	Mexico, Brazil	2000-2013	VAR	Intervention is effective, but transitory.
Lahura and Vega (2013)	Peru	2009-2011	VAR and Event Study	Intervention is significant, but asymmetric effects are found.
Barroso (2014)	Brazil	2007-2011	GARCH,IV	Intervention is effective.
Kohlscheen and Andrade (2014)	Brazil	2011-2013	VAR,GARCH	Intervention by swap auctions is effective.
Nedeljkovic and Saborowsk (2016)	Brazil	2008-2013	Moments Estimator/IV	Intervention is effective for the volatility and level.
Disyatat and Galati (2007)	Czech Republic	2001-2002	IV	Intervention is weakly significant.
De Roure, Furnagiev and Reitz (2015)	Brazil	2009-2012	VAR	Intervention is not significantly affecting the exchange rate.
Loiseau-Aslanidi (2011)	Georgia	1996-2007	GARCH,IV	Intervention is effective for the level but increases the volatility.

Table 3.1: Summary Table for Literature (Continued)

Literature	**Country**	**Period**	**Method**	**Results**
Rincon and Toro (2010)	Columbia	1993-2010	GARCH,IV	Intervention is effective when it is used with capital controls.
Tashu (2014)	Peru	2010-2013	IV	Fx sales are effective, but purchases are insignificant.
Adler and Tovar (2014)	15 Countries	2004-2010	IV	Intervention is effective for the pace of appreciation.
Lozano and Others (2020)	19 Countries	1970-2010	Meta Analysis	Intervention is effective.
Daude, Yeyati and Nagengast (2016)	18 Countries	2003-2011	Error-Correction Model	Intervention is effective.
Wang and Zhao (2021)	26 Countries	2000-2020	VAR	Intervention is effective in short run.
Fratzscher and Others (2017)	33 Countries	1995-2011	Event Study	Intervention is effective.
Akıncı and Others (2005)	Turkey	2001-2003	Granger-Casualty	Purchases are effective for decreasing the volatility.
Herrera and Ozbay (2005)	Turkey	1995-2003	GARCH,IV	Intervention is insignificant.
Tuna (2011)	Turkey	2001-2005	EGARCH	Intervention increases the volatility.
Tümtürk (2019)	Turkey	2002-2018	EGARCH	Intervention is not significant for both level and volatility.
Cicek (2014)	Turkey	2009-2014	GARCH	Intervention is insignificant.

CHAPTER 4

ESTIMATION

4.1. Introduction to the Estimation

Analyzing the effectiveness of the intervention requires a comprehensive approach. One of the main problems of the analysis is data issues. Since central banks have concerns about data disclosure, the data source is important for analyzing the effectiveness. Researchers use a central bank's balance sheets to extract the intervention data. They adjust the data for valuation and interest rate effects and obtain proxies for the analysis. However, some countries publish the data with certain lags.

For the interpretation of the results and intervention data, the intervention period must be evaluated. The behavior of a central bank and external factors can only be understood by analyzing the features of the investigation period, economic developments, and the other central banks' actions.

Endogeneity is another important problem for the effectiveness analysis. Authors use different techniques and econometric models to overcome the endogeneity. While these different techniques and models create a rich intervention literature, the differences also reveal inconsistent results and lead to a discussion related to the effectiveness of the foreign exchange intervention.

This section is structured to provide necessary information about the above-mentioned issues. First, the data and sources are explained for the effectiveness analysis. Second, for a precise understanding of the effectiveness of the foreign exchange intervention during the years between 2012 and 2016, this period is briefly analyzed based on developed/developing countries and the Turkish Case.

In the Turkish Case section, the intervention data is analyzed in detail. The total amount of foreign exchange sales, the percentage of the presence of the CBRT in the foreign exchange market and other relevant information are analyzed. Besides, the interest rate and exchange rate movements are illustrated during this period.

Finally, the estimation models for the effectiveness analysis are illustrated. In this section, the estimation method and how this method solves the endogeneity are explained.

4.2. Data

The publication of the intervention data by central banks is rare since they have certain concerns about the performance, effectiveness, and the perception of the public to the intervention. Even if they disclose the data, it is generally published with certain lags. The limitation of the data makes the effectiveness analysis more complex.

In the literature, central banks' balance sheet is used to create proxies for the intervention to overcome data scarcity. To deal with the data problem, international reserves, gross exchange rate reserves, reserve flows from the balance of payment or changes in central banks' net foreign asset position are accepted as the intervention proxies. Some studies detect a high correlation between the actual foreign exchange intervention and the proxied intervention data. Therefore, in the analysis of the effectiveness of the foreign exchange intervention, some proxies are benefited.

In fact, the CBRT publishes the intervention data with fifteen day lag from 2012 to 2022 monthly. However, the daily data is unavailable after 2016[37] for the foreign exchange selling auctions[38]. Meanwhile, the monthly foreign exchange selling and buying amounts are available cumulatively.

[37] To see the statistics about the CBRT's transactions in foreign exchange markets; https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Statistics/Markets+Data

[38] The CBRT continued to intervene by " Foreign Exchange Deposits Against Turkish Lira Deposit Auctions" and "Turkish Lira Settled Forward Foreign Exchange Sale Auctions".

Since the main concern of this study is foreign exchange sales, the period between 2012 to 2016 is chosen. This period is appropriate for our study since high frequency(daily) intervention data is published by the CBRT with 15 days delay. In addition to the actual intervention data, the change of the net foreign asset position, international reserves, and the gross foreign exchange reserve of the CBRT are analyzed to understand if a proper proxy is possible. However, the correlation between the actual and proxied data is not satisfactory[39].

Besides the intervention data, many variables are used in the estimation models and graphs. All variables, sources and the necessary explanations are provided in the table below:

[39] Although it is adjusted for valuation and interest rate effects, the proxy is unsatisfactory since the correlation is too low. The analysis can be provided upon request.

Table 4.1: Data, Sources and Explanations

Data	Source	Explanation
Foreign Exchange Intervention Data	The Central Bank of the Republic Turkey Electronic Data Delivery System	Daily and Monthly Intervention Data Published By Central Bank of Turkey
Net Foreign Asset Position	The Central Bank of the Republic Turkey Electronic Data Delivery System	Central Bank of Turkey Analytical Balance Sheet (Daily and Monthly)
Central Bank's Foreign Exchange Reserves	The Central Bank of the Republic Turkey Electronic Data Delivery System	Central Bank's Gross Foreign Exchange Reserves (Monthly)
International Reserves	IMF e-Library Data and Central Bank of Turkey Electronic Data Delivery System	Data Template on International Reserves and Foreign Currency Liquidity (IRFCL)(Monthly)
Nominal Exchange Rate	Bloomberg	Nominal Exchange Rate (U.S. Bilateral)
Reel Effective Exchange Rate	Bloomberg	Daily Exchange Rate and Trade Weights From the BIS. Deflated with consumer Price Index
DXY	Bloomberg	USD Dollar Index
EMBI	Bloomberg	Emerging Market Bond Index
VIX	Bloomberg	The CBOE Volatility Index
Food Price[40]	Bloomberg	Wheat Price (CBOT)
Energy Price Index[41]	Bloomberg	Crude Oil Brent(ICE)
Metal Price Index[42]	Bloomberg	Cooper Cash (LME)
Commodity Index	Bloomberg	Bloomberg Commodity Index (CBOT)
Foreign Interest Rate	Bloomberg	Effective Federal Funds Rate
CDS	Bloomberg	5 Years CDS of Turkey
Domestic Interest Rate	The Central Bank of the Republic Turkey Electronic Data Delivery System	Central Bank of Turkey Weighted Average Funding Cost of Central Bank of Turkey Funding and Policy Rate
Central Banks' Policy Rates	Bank of International Settlement	Developing Countries' Central Bank Policy Rates

[40] For the food price, the wheat price is used as proxy.

[41] For the energy price, the crude oil price is used as proxy.

[42] For the metal price, the cooper price is used as proxy.

In addition to the illustrated data above, the intervention data for developing countries are obtained from the study of (Adler, Kyun Suk, & Rui, 2021). This date enables us to compare the Turkish Case with the same other developing countries. Since they provide the official and proxy intervention data monthly and quarterly, the study is used to illustrate the actions of the other developing countries.

4.3. Analysis of the Taper Tantrum Based on Developing Countries from 2012 to 2016

After the 2008 Global Financial Crisis, the world witnessed monetary easing by the advanced countries. Many advanced countries lowered their interest rate to the zero lower bound and used unconventional monetary policies to overcome the effects of the crisis (Sahay, et al., 2014).

In these years, many developing countries experienced strong capital flows from advanced countries[43]. In this sense, these developing countries were expected to show better growth performance and higher yields than advanced countries. During these years, the flows experienced by emerging markets created better credit conditions for both public and private companies (Chari, Stedman, & Lundblad, 2020). Although the strong domestic currency allowed to sustain high aggregate demand, in the following years, the deficit of emerging markets' current accounts became more apparent. Besides, these countries intervened to accumulate reserves against the possible outflows.

During the quantitative easing, many emerging markets abandoned the tight monetary policies to counter the negative effects of the flows. Besides, the current account deficit continued to expand, and short-term debt continued to increase. Therefore, the emerging markets became more vulnerable to external shocks during the quantitative easing after the Global Crisis (Sahay, et al., 2014).

[43]Emerging markets obtained half of the global flows during the years between 2010 and 2013. Additionally, China, Brazil, India, Turkey, and Mexico were the top 5 countries that experienced the most capital flows during these years, respectively (Sahay, et al., 2014).

Following the easing period, tapering signals of the asset purchases of the Federal Reserve led to a significant increase in the yield of the US bonds. As illustrated in Figure 4.1, long-term bond yields were almost doubled starting from May 2013.

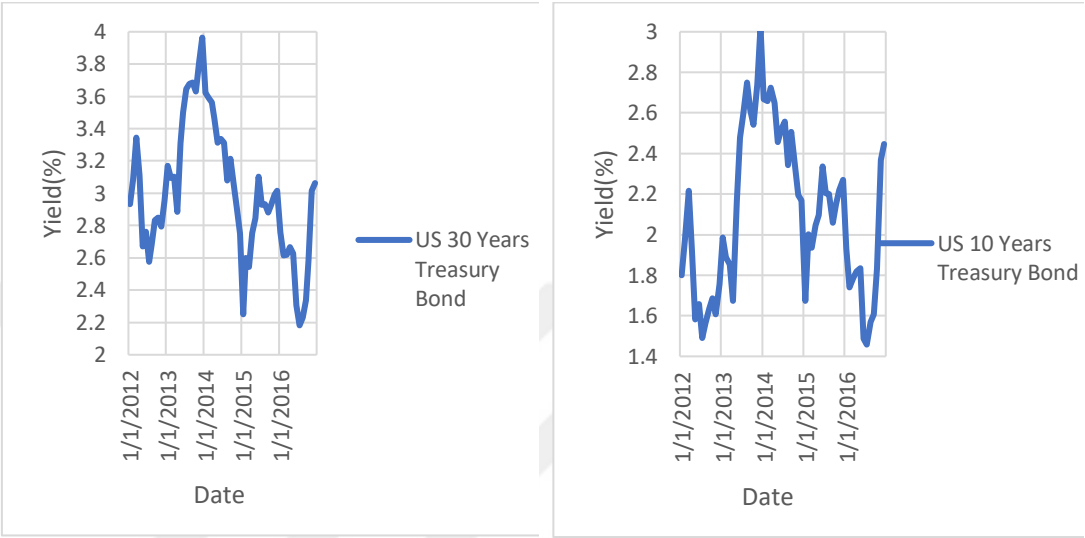


Figure 4.1 US Treasury Bond Yields

Source: Bloomberg

This hike shown related to the interest rate in the US and other advanced countries led to significant effects on Emerging Markets starting from May 2013. Expected higher yields in the advanced countries and high volatility led to the interruption of the flows to Emerging Markets. Following the slowdown of the flows, Emerging Markets experienced a significant drop in the asset prices and domestic currency depreciation.

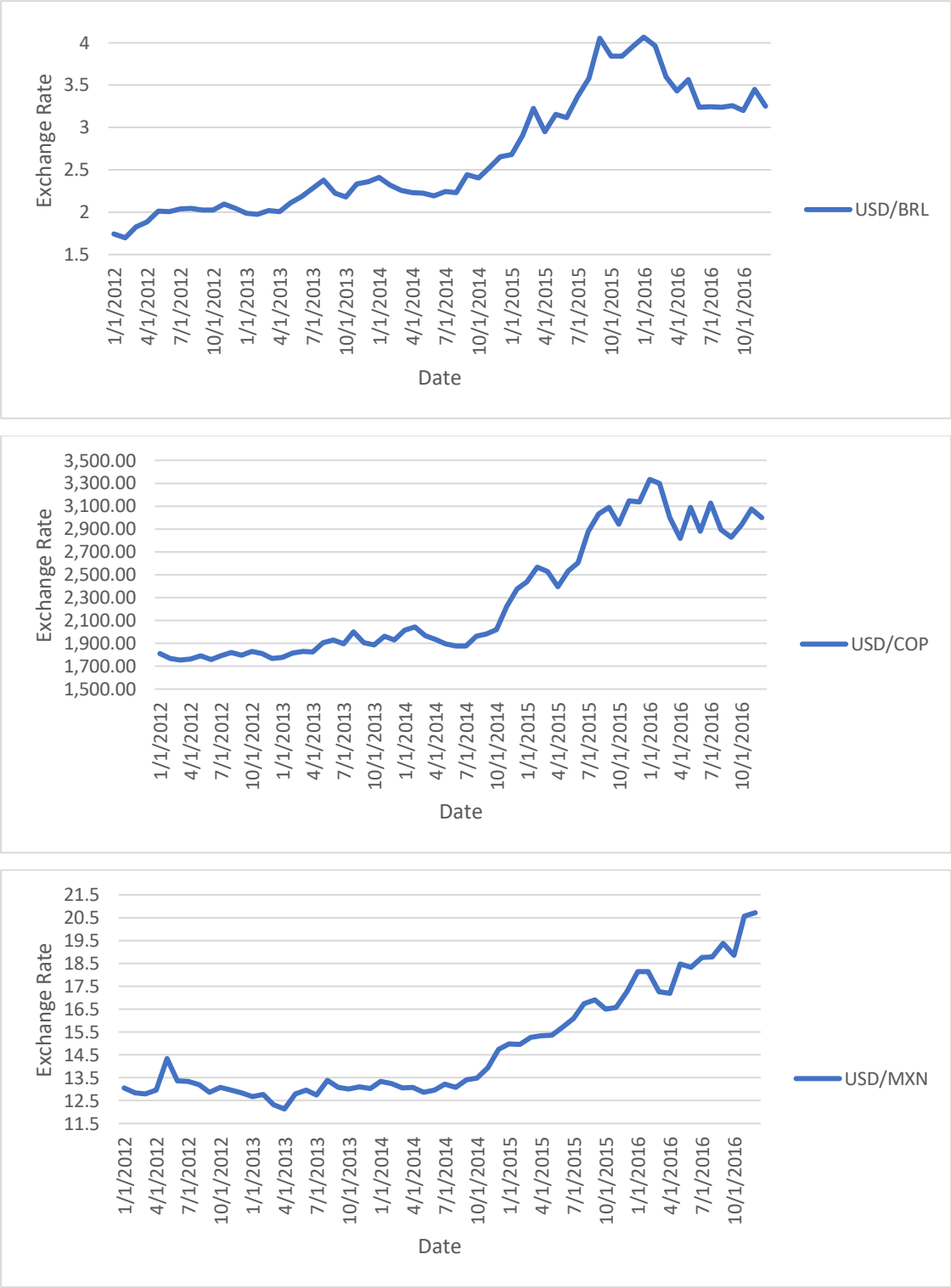
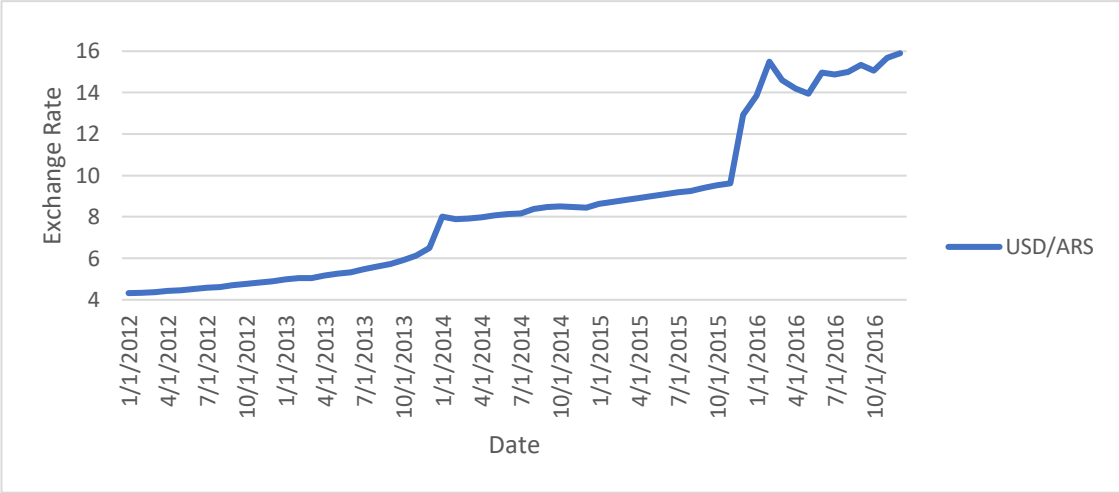
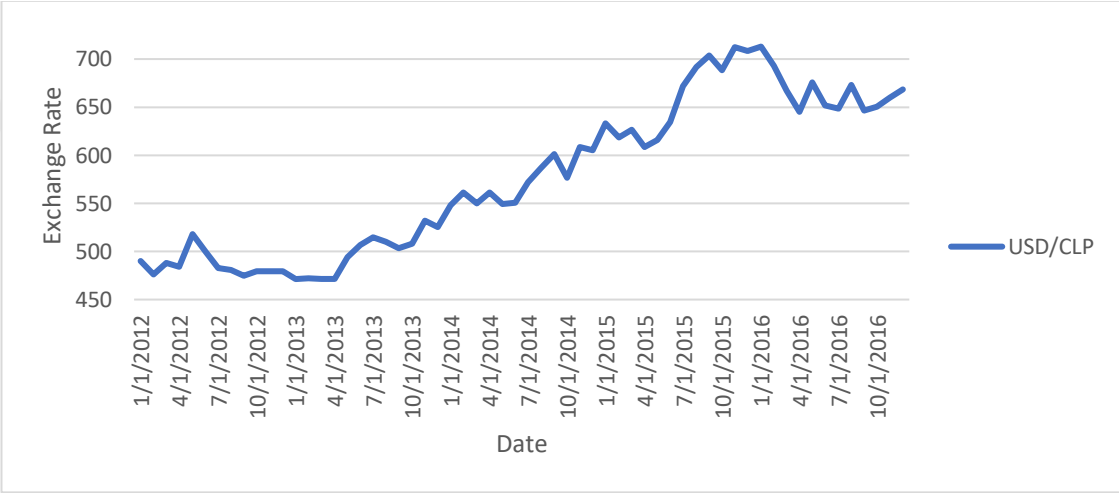


Figure 4.2 Exchange Rates of Troubled Ten Economies





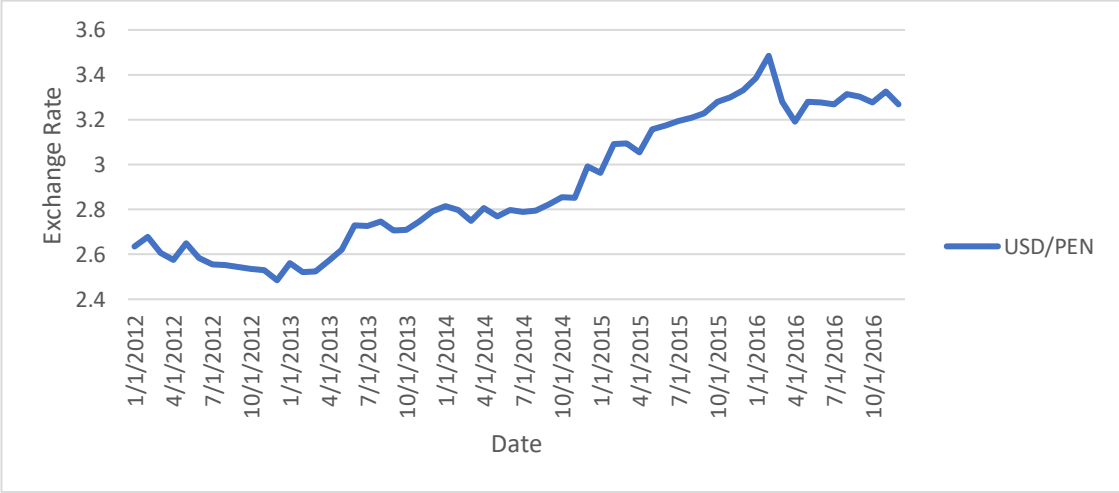
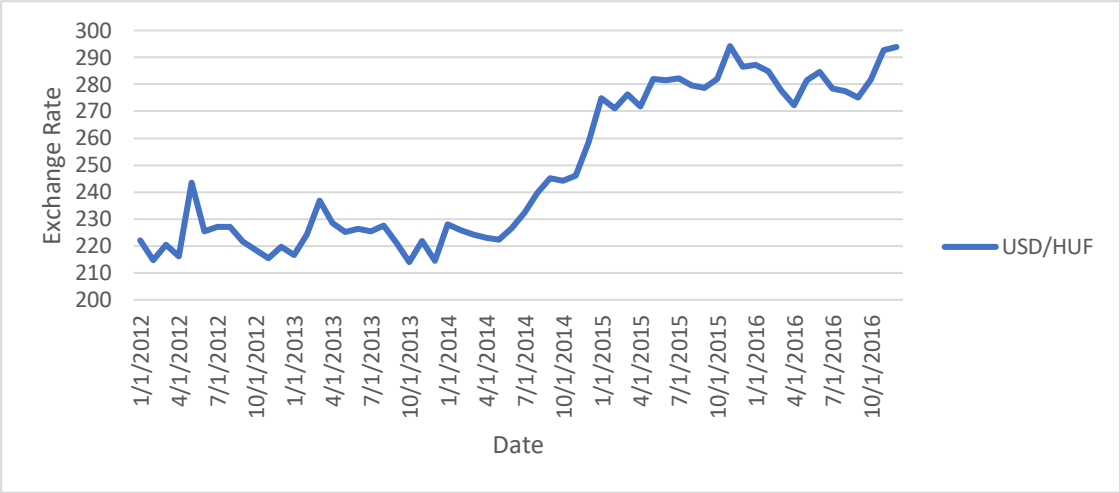
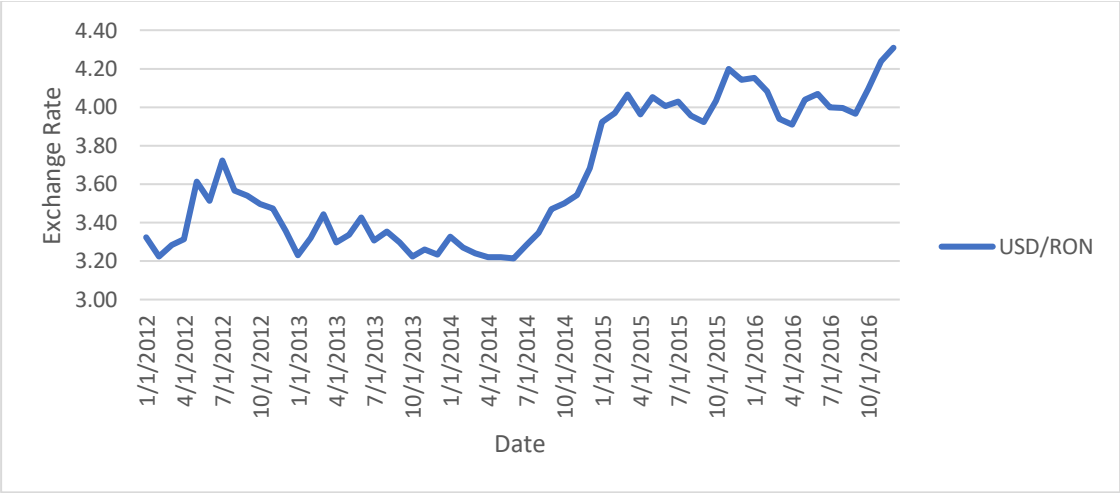


Figure 4.2 Exchange Rates of Troubled Ten Economies (Continued)





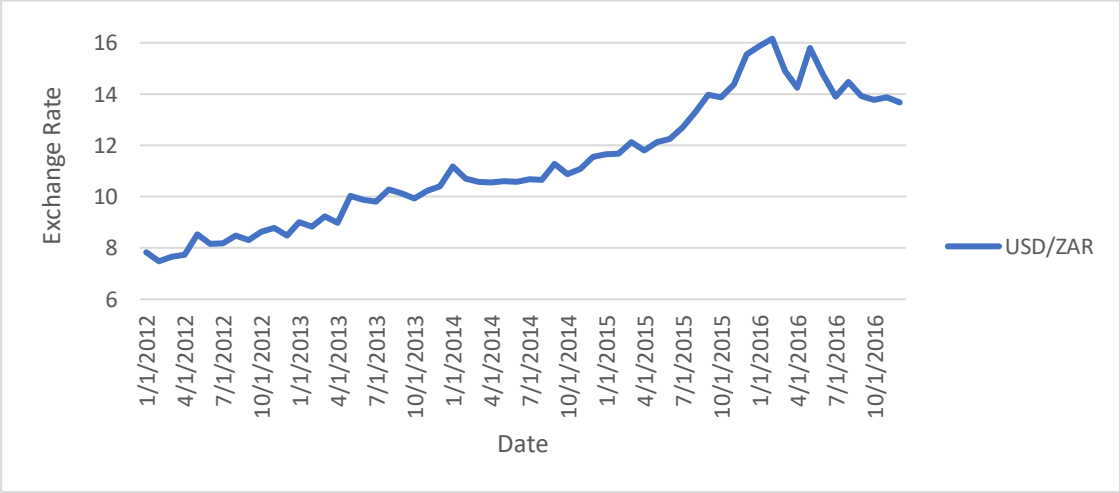
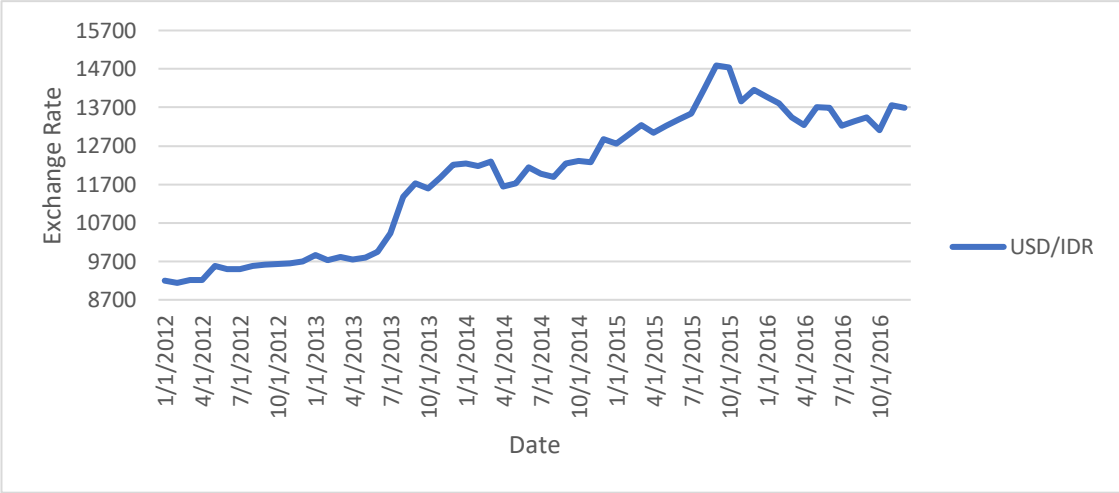


Figure 4.2 Exchange Rates of Troubled Ten Economies (Continued)



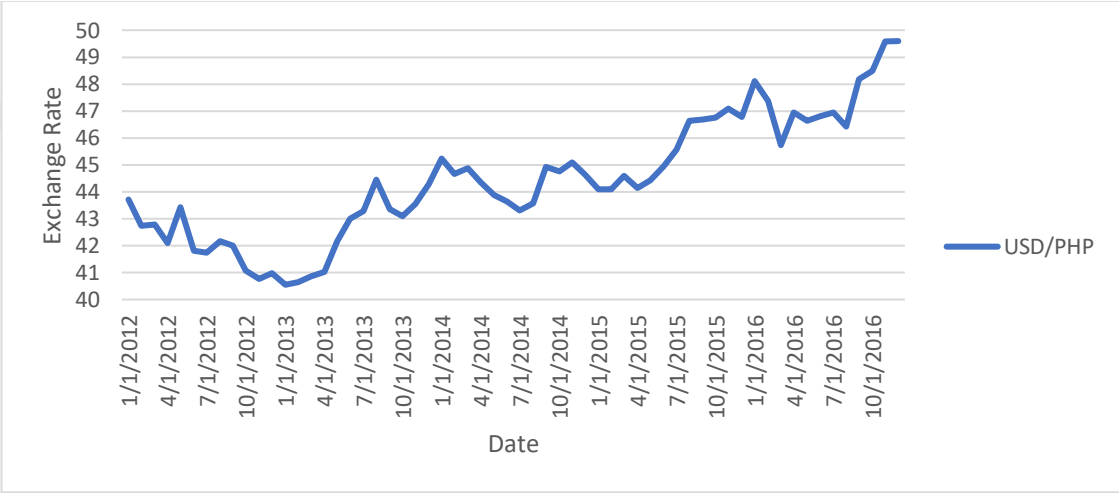


Figure 4.2 Exchange Rates of Troubled Ten Economies[44](Continued)

As depicted in Figure 4.2, "Troubled Ten" economies are chosen to depict the exchange rate movements in developing countries. These countries are specifically chosen because Turkey is included in this classification. All countries' exchange rates notably increased. In addition to the domestic currency depreciation, asset prices declined significantly (Chari, Stedman, & Lundblad, 2020).

To encounter the negative outcomes, many emerging markets took necessary steps to reverse the situation. Fiscal, monetary and macroprudential policies are put into practice. Besides, liquidity provision and other fiscal pressures were applied to sustain

[44] Brazil, Columbia, Mexico, Argentina, Chile, Peru, Hungary, Romania, South Africa, Indonesia, Philippine respectively. These countries are chosen since they are classified as "Troubled Ten". In addition to the "Troubled Ten", Argentina and Mexico are added to the list because of the similarity with Turkey.

the economy. One of the main practices was increasing the policy rates by the emerging markets.

Figure 4.3 Policy Rates of Troubled Ten[45]

Source: Bank for International Settlement

As depicted in Figure 4.3, many developing countries increased their policy rates to overcome the negative effects during the period. Brazil, Columbia, South Africa, Indonesia, and the Philippines increased the policy rate significantly. Meanwhile, cross-country differences can be seen since Hungary and Romania decreased their

[45] Argentina is excluded because it increased the policy rate by about 138%. This hike is not similar to other countries under investigation.

policy rate during the period. In terms of Peru and Mexico, the policy rate was lowered till the end of 2015. However, they increased their policy rates after 2015.

In addition to the measures mentioned above, many developing countries used foreign exchange intervention to prevent the damaging effects of the Taper Tantrum.

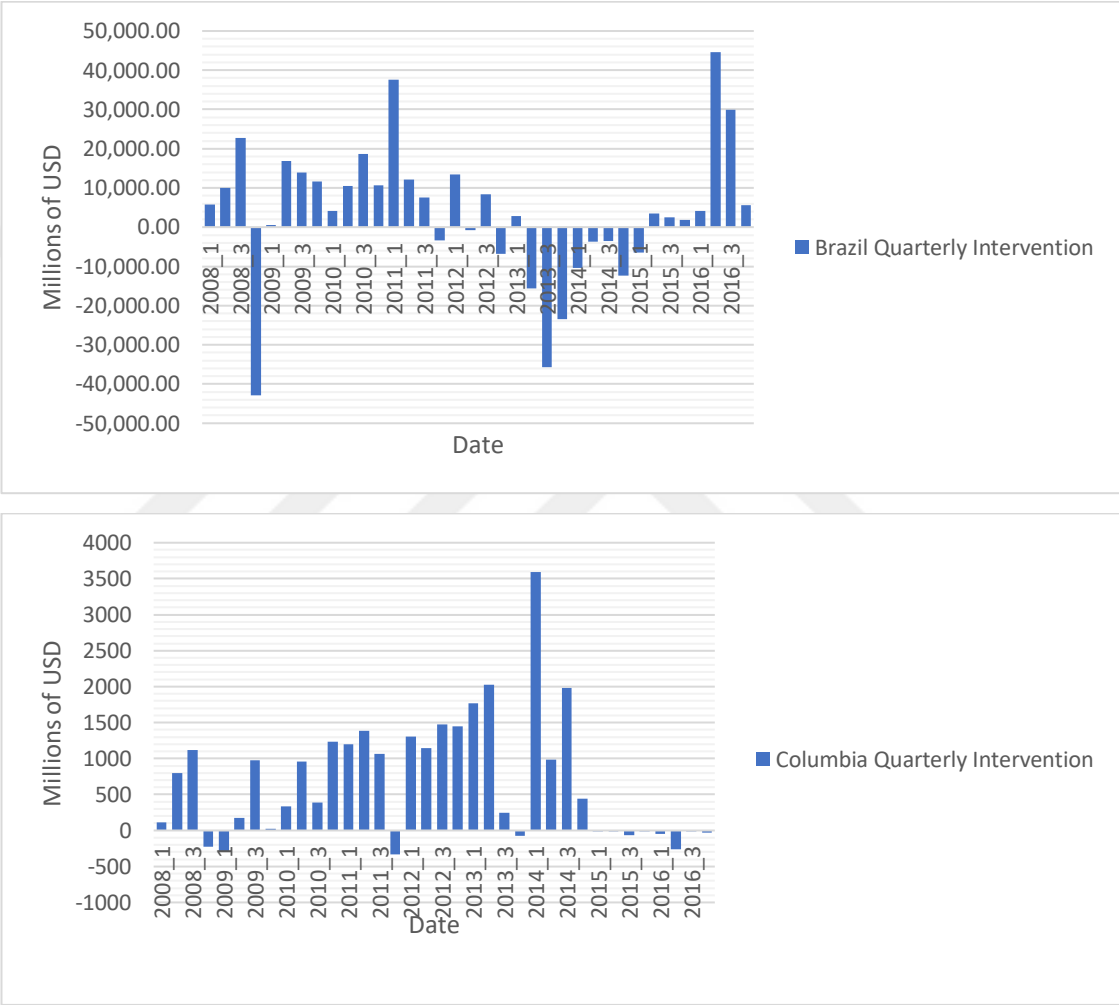
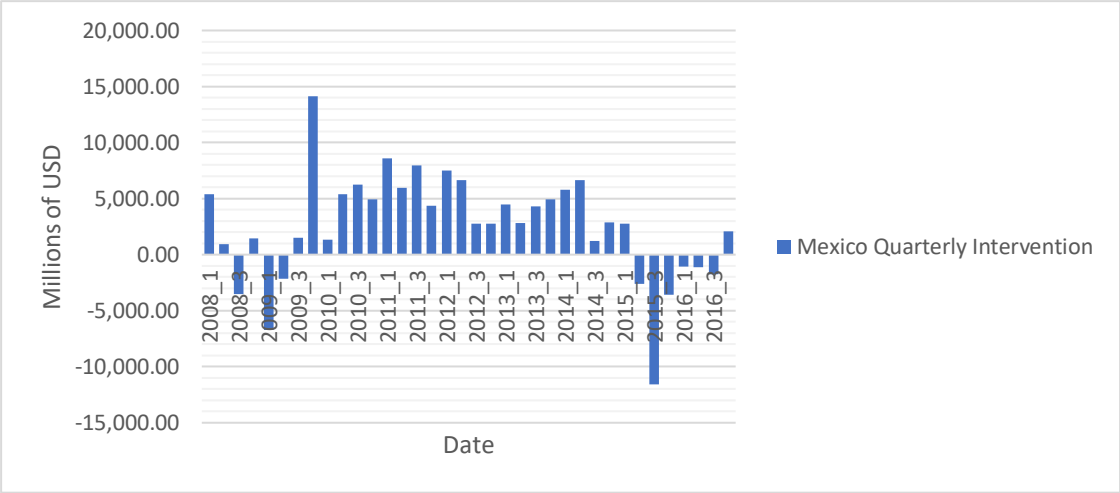
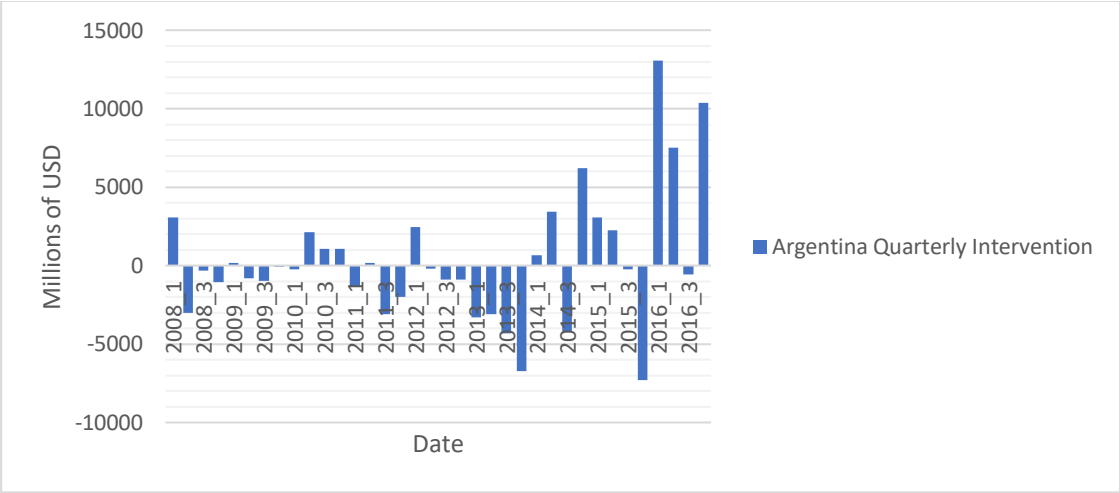


Figure 4.4 Foreign Exchange Interventions by Troubled Ten

Source: (Adler, Kyun Suk, & Rui, 2021)





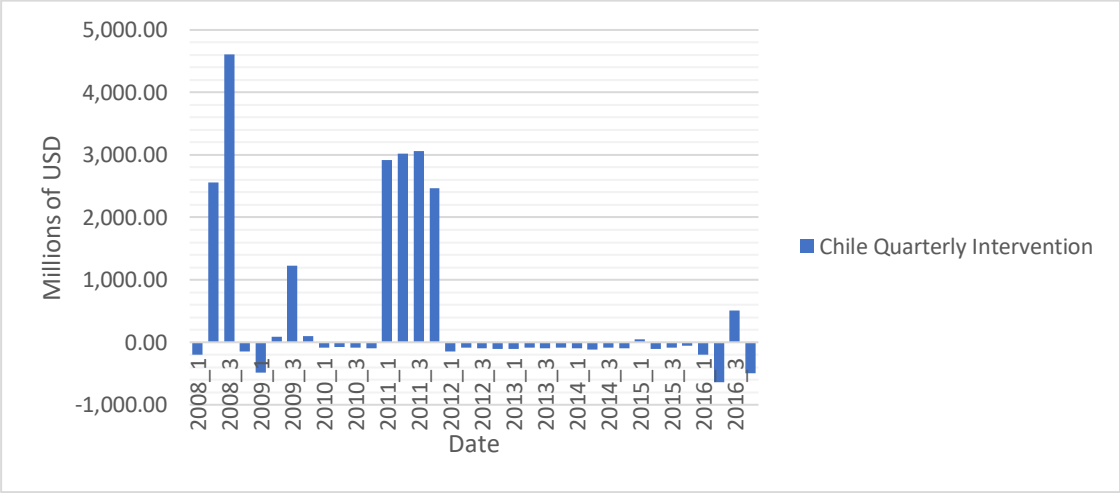
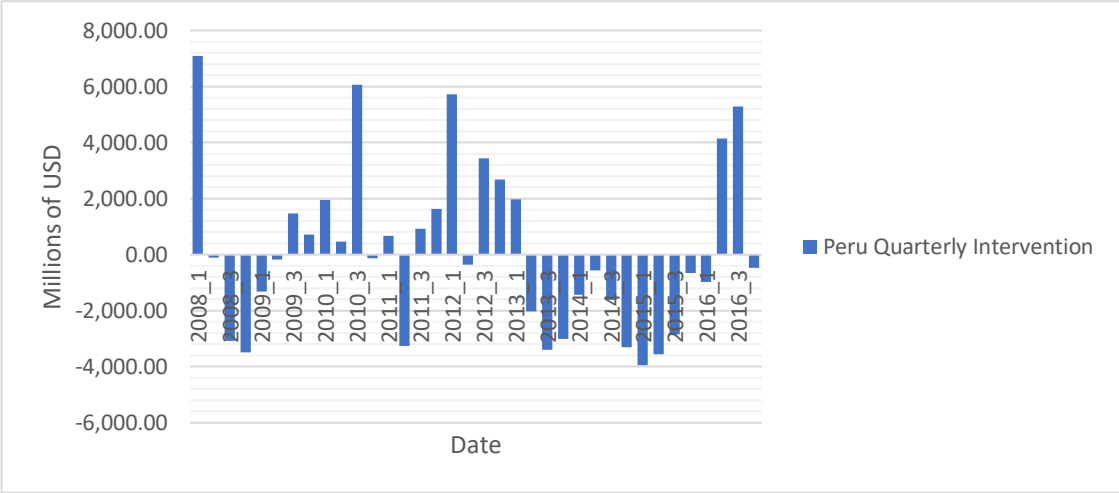
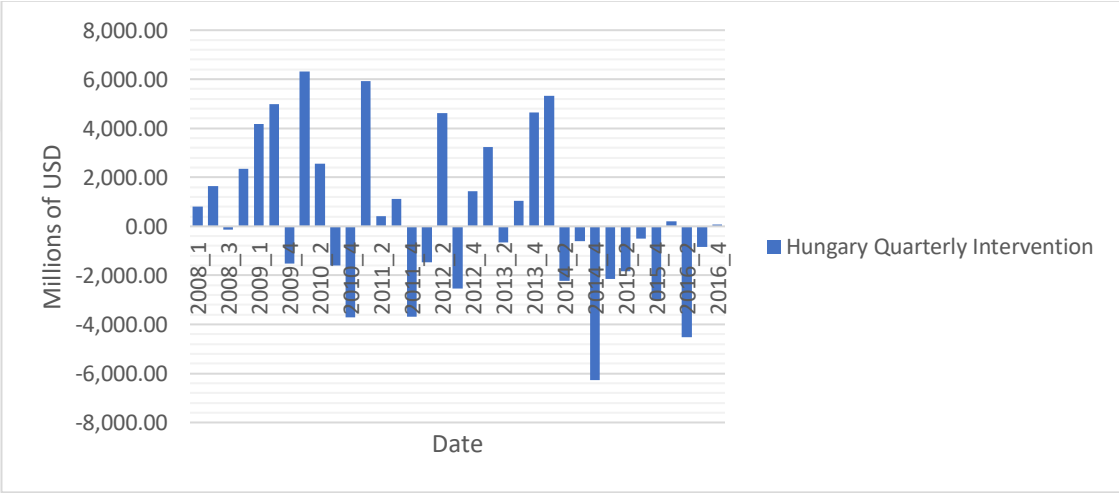


Figure 4.4 Foreign Exchange Interventions by Troubled Ten (Continued)

Source: (Adler, Kyun Suk, & Rui, 2021)





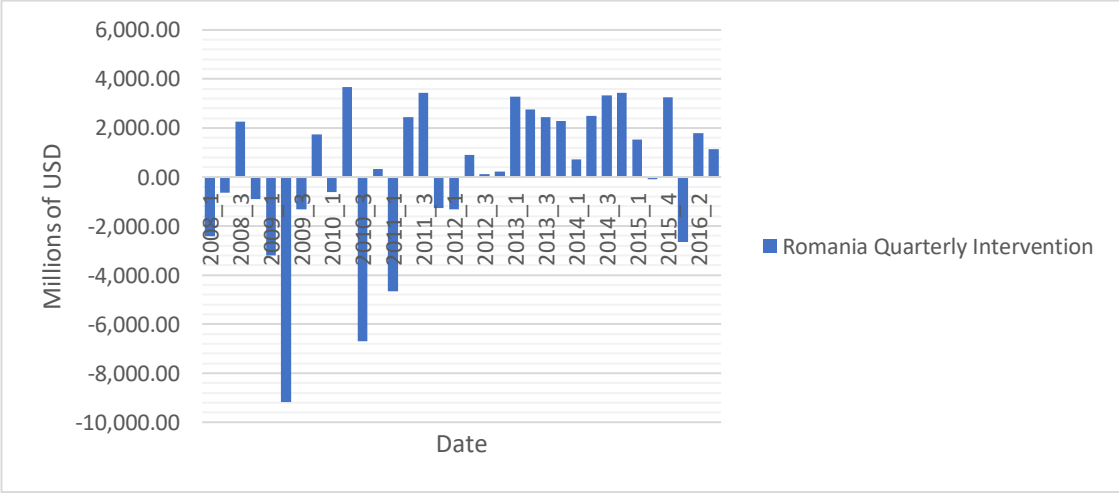
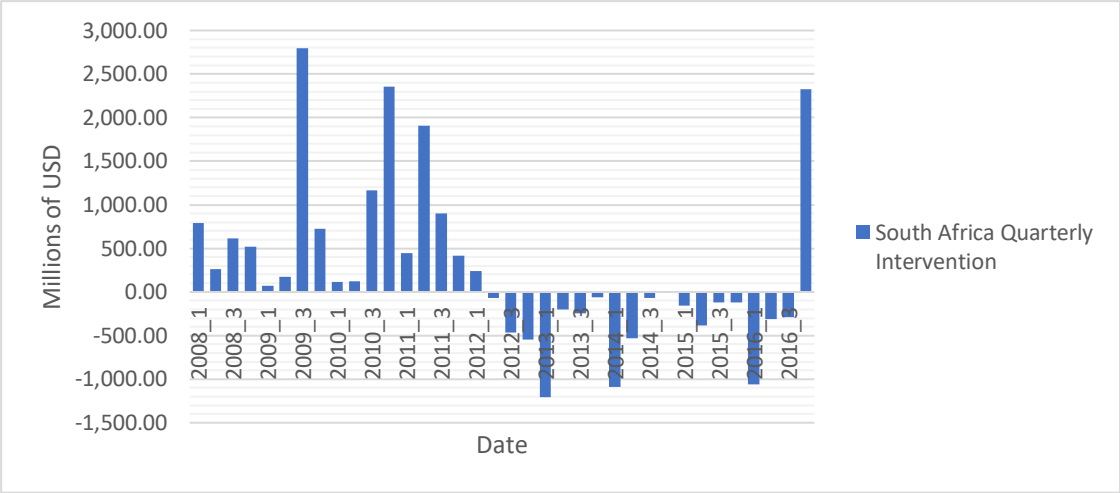
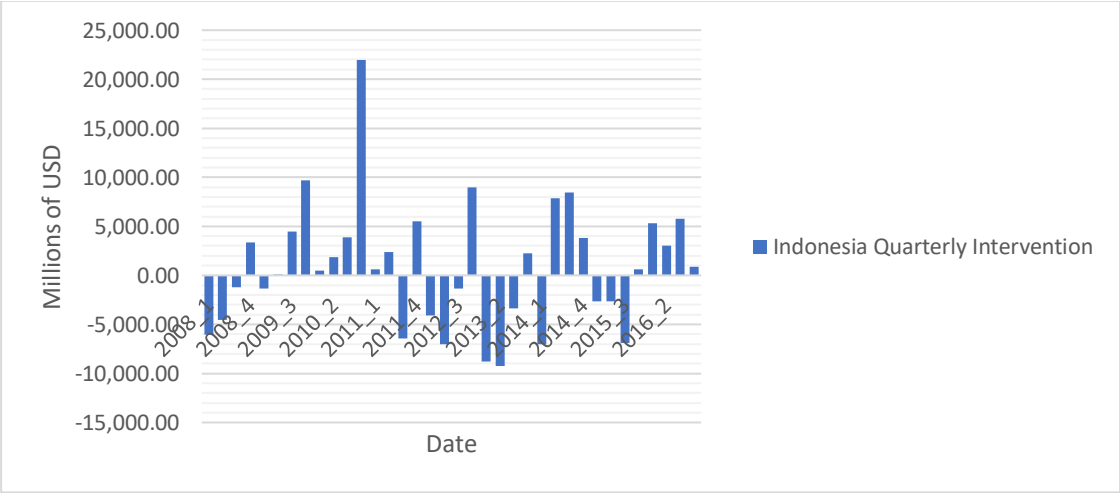


Figure 4.4 Foreign Exchange Interventions by Troubled Ten (Continued)

Source: (Adler, Kyun Suk, & Rui, 2021)





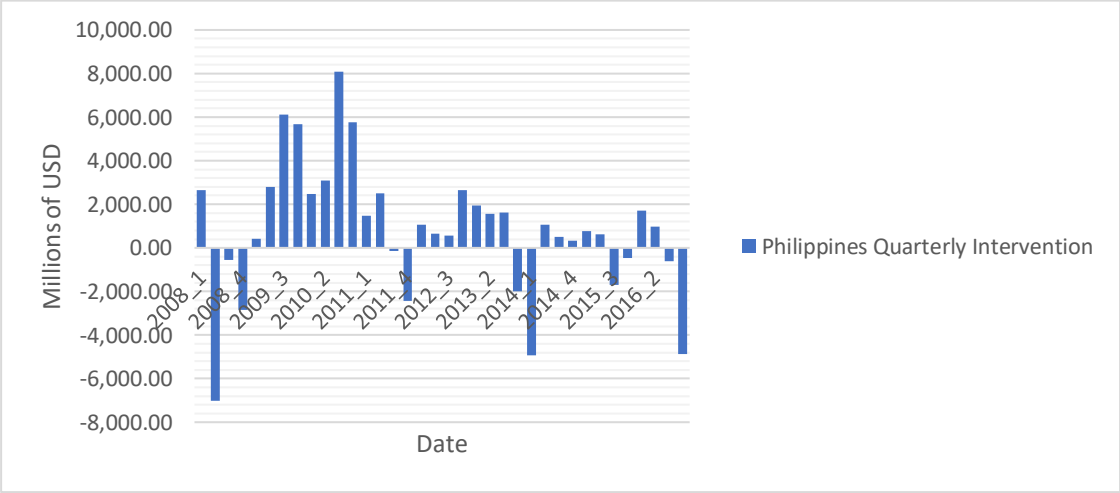


Figure 4.4 Foreign Exchange Interventions by Troubled Ten[46] (Continued)

Source: (Adler, Kyun Suk, & Rui, 2021)

[46] Negative values in the charts indicate foreign exchange sales.

As illustrated in Figure 4.4, many emerging markets under consideration intervened in the foreign exchange market before and during the Tapering Tantrum. Before the Tapering period, many countries accumulated foreign exchange reserves. Contrary to this, when the tapering began, many countries intervened inversely to prevent possible negative impacts of the shock. Although some of them continued purchases, Brazil, Argentina, Peru, Hungary, South Africa, Indonesia, the Philippines intervened intensely during the Tapering period. Following the Taper Tantrum, the presence of the emerging markets in the foreign exchange markets continued, but the intervention intensity depended on the country-specific factors.

4.4. Turkish Case and Evaluation of the CBRT's Foreign Exchange Interventions From 2012 to 2016

Turkey was not a unique example since it experienced similar upward pressure on the exchange rate and took similar measures against the shock. After the Global Crisis, Turkey became one of the main destinations for capital flows. Therefore, till the beginning of the Tapering period, the Turkish Lira was stable, although the trend was upward. During this period, the CBRT intervened in the foreign exchange market to strengthen its foreign exchange reserves. Thus, the CBRT intended to create foreign exchange buffers for the possible negative outcomes of the rapid outflows.

However, after May 2013, strong upward pressure was experienced on the Turkish Lira. As depicted in Figure 4.5, while the dollar index, which measures the value of the dollar against a basket of six foreign currencies, was increasing, the USD/TRY rate also accompanied from 2012 to 2016.

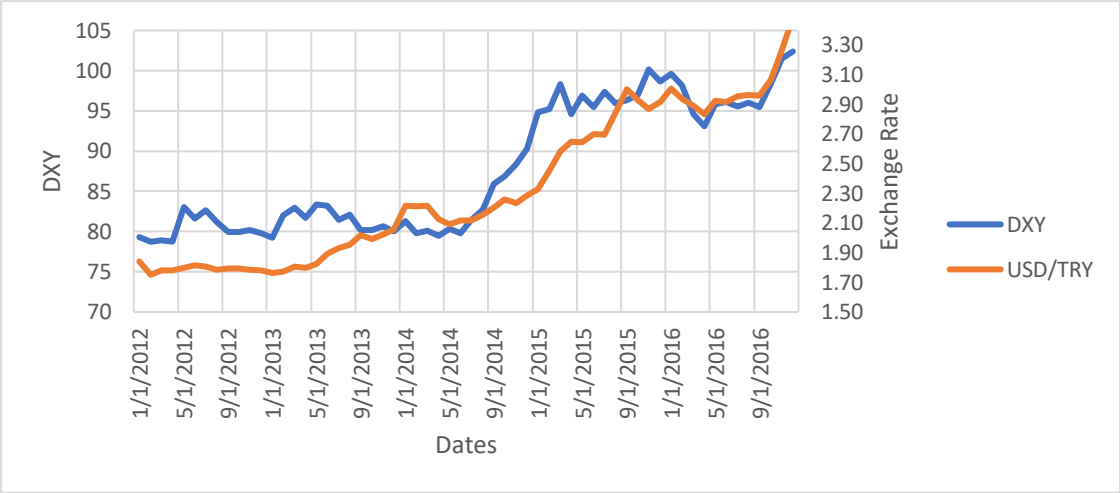


Figure 4.5 USD/TRY and DXY Index

Source: Bloomberg

Turkish authorities took measures to avoid the possible destructive outcomes of the rapid outflows and accompanying increase in the exchange rate. Firstly, the policy interest rate and, consequently, the average cost of the funding were increased significantly. As depicted in Figure 4.6, the policy rate was kept stable till the end of 2013. However, at the end of 2013, the interest rate was increased by the CBRT by about 55%. Following this period, the rate was gradually decreased.

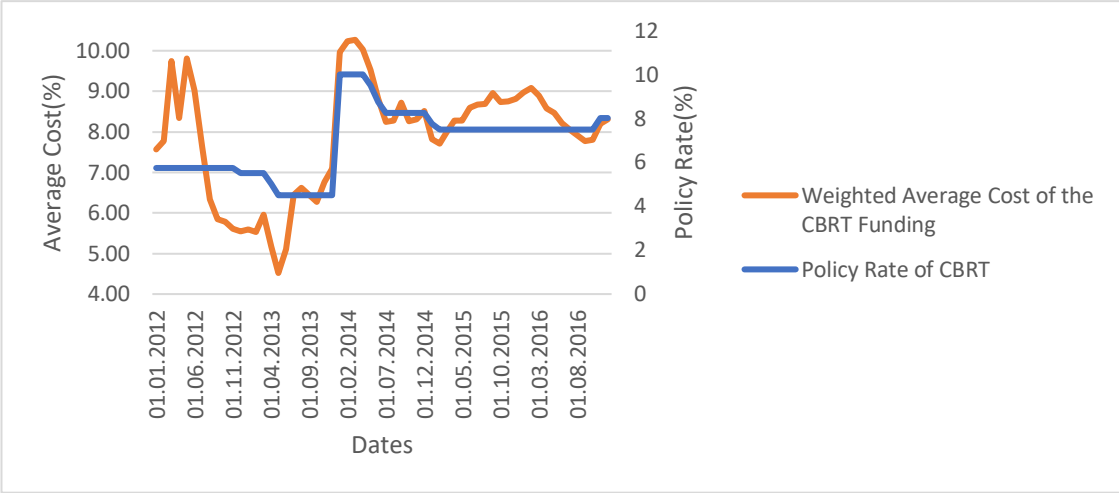


Figure 4.6 CBRT's Policy Rate and Weighted Average Cost of Funding[47]

Source: CBRT Electronic Data Delivery System

As mentioned in the first section of the study, an acceptable reason for the intervention can be an upward pressure in the exchange rate since the exchange rate fluctuations can deteriorate the inflation target. Although the effects of the exchange rate do not appear immediately, the price index does not show any significant increase during the intervention period, as depicted in Figure 4.7. Therefore, intervention reasons can be the macro-prudential and financial stability purposes to comply with the inflation targeting regime.

[47]The weighted average cost of the CBRT Funding indicates the CBRT's realized interest rate for funding the market. Therefore, it is much more realistic than the policy rate.

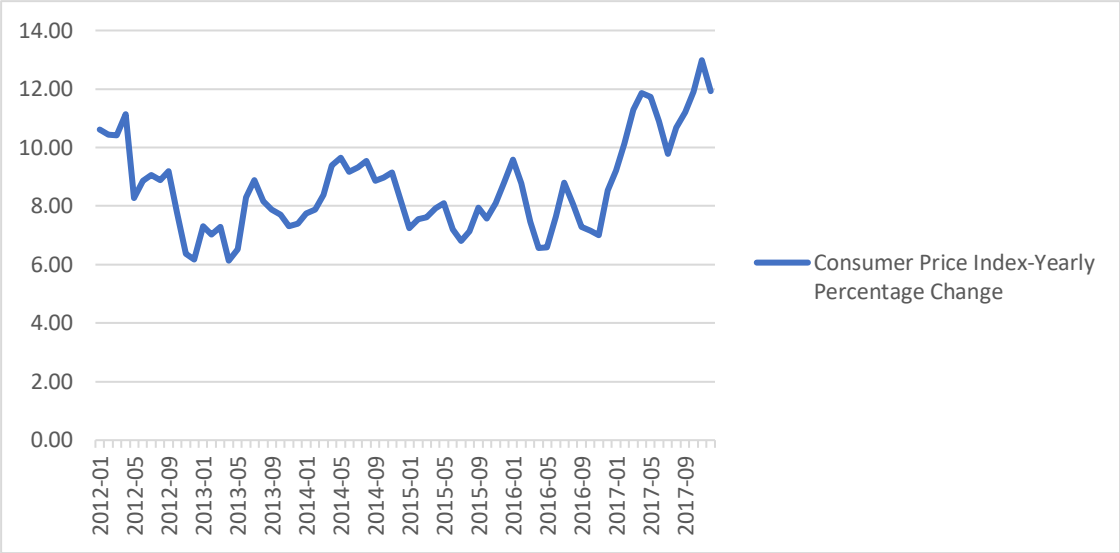


Figure 4.7 Consumer Price Index[48]

Source: Turkish Statistical Institute

Similar to other developing countries, the CBRT used foreign exchange intervention during the period. As the upward trend of the exchange rate started in mid-2013, the intervention was intensified according to the data published by the CBRT (see Figure 4.8). Starting from 2014, the intervention amount decreased, but the presence of the CBRT in the foreign exchange market continued. Thereafter, the intervention frequency and amount gradually decreased.

[48] The price index is calculated as year to year percentage change.

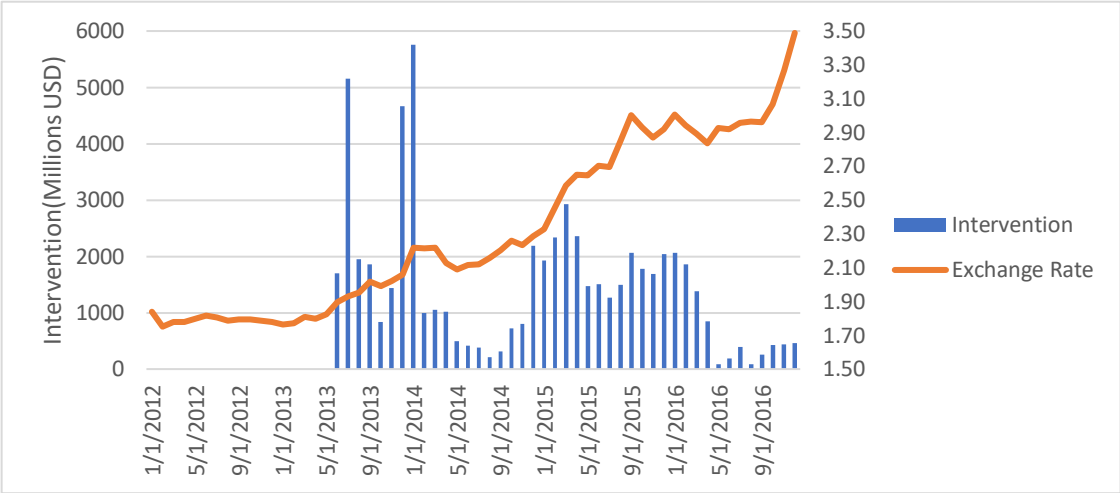


Figure 4.8 USD/TRY Exchange Rate and Foreign Exchange Sales

Source: Bloomberg and the CBRT Data Delivery System

The detailed information regarding the published intervention data is illustrated in Table 4.2 below.

The publication of the daily data is in daily frequency starting from 2002 to 2021 as a "Direct Foreign Exchange Intervention". However, the selling auctions are not published after 2016. Besides this data, cumulative data is provided in monthly frequency within three different categories, namely "Foreign Exchange Sales to the State-Owned Enterprises", "Direct Foreign Exchange Selling Intervention against Turkish Lira", and "Foreign Exchange Auctions against Turkish Lira" for sales. For purchases, the interventions are classified as "Foreign Exchange Buying Auctions against Turkish Lira", "Export Rediscount Credits", and "Direct Foreign Exchange Buying Interventions against Turkish Lira"[49].

Between 2012 and 2016, CBRT mainly applied to Foreign Exchange Selling Auctions besides Direct Foreign Exchange Sales and Sales to State-owned Enterprises. However, for the purchases, the CBRT bought foreign exchange through Export

[49] For all published data, see the link from the official website of the Central Bank of the Republic of Turkey
https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Statistics/Markets+Data/

Rediscount Credits which provides Turkish Lira credits to firms[50]. In maturity, the payments are made in foreign exchange.

The foreign exchange intervention has no universal definition. We do not include the Export Rediscount Credits in the intervention data because these transactions are not carried out in the market, and the payments of the credits are relatively stable over the time[51].

Table 4.2: Descriptive Table for Daily Intervention Data of the CBRT

CBT Intervention Data	**2012**	**2013**	**2014**	**2015**	**2016**
Intervention Frequency (% of Business Day)	**6.32%**	**49.60%**	**99.20%**	**98.81%**	**33.47%**
Daily Highest (Million USD)[52]	**676**	**2250**	**3351**	**60**	**60**
Daily Lowest (Million USD)	**50**	**20**	**9**	**20**	**20**
Total Amount Sold (Million USD)	**2,456**	**17,610**	**13,030**	**12,366**	**3,400**
Total Intervention (Percent of GDP)	**0.28%**	**1.78%**	**1.45%**	**1.43%**	**0.40%**
Daily Average (Million USD)	**153.5**	**137.18**	**54.58**	**49.38**	**41.19**

Note:

- Intervention Frequency: The % of the CBRT existence in the FX Market (Sum of the Business Day/Days that the Foreign Exchange Intervention applied
- Daily Highest: Maximum amount of USD that is sold in a day
- Daily Lowest: Minimum amount of USD that is sold in a day
- Total Amount: Total amount sold in a year
- Total Intervention: Sum of intervention amount during the year(divided by the GDP)
- Daily Average: Sum of Intervention amount divided by the day's amount

Regarding the published daily data, Table 4.2 is provided above. During these periods, illustrated in Table 4.2, the CBRT intervened with foreign exchange auctions and

[50] The CBRT explains the Rediscount Credit as "Pursuant to the CBRT Regulations on Rediscount which were issued in the scope of Article 45 of the Central Bank Law, firms can obtain rediscount credits from the CBRT through intermediary banks with a maturity of maximum 360 days by presenting FX or TL bills for rediscount.".

[51] Indeed, Adler, Kyun Suk and Rui (2021) accepts the Export Rediscount Credit as an intervention through derivatives. However, in this study, this intervention method of intervention is excluded.

[52] Daily intervention amount converges to the daily average, although there are some outliers as depicted in the Table 4.2.

direct foreign exchange sales. The intervention was carried out in the spot market, contrary to similar emerging market examples, which also benefited from derivatives[53].

First, the CBRT intervened in the foreign exchange market from 2012 to 2016. While the daily presence, which is the % of business days relative to the total business days, of the CBRT was %6 in 2012, the percentage gradually increased from mid-2013 till the end of the period. Between 2013 and 2015, the CBRT intervened in the market almost every business day.

Secondly, the maximum amount significantly increased from 2013 to 2014. While the daily intervention amount was the same in 2012, 2015 and 2016, the CBRT intensified the intervention with high amounts as the market volatility increased in 2013 and 2014. Except for 2012 and 2016, CBRT constantly intervened in the foreign exchange market with 20 million USD as the minimum amount during the period.

Consequently, CBRT intervened in the foreign exchange market to prevent the negative outcomes of the Tapering, although the bank committed to the floating exchange rate. Since the only available daily data belongs to the period between 2012 and 2016 to evaluate the effectiveness of the foreign exchange sales, this period is chosen where the foreign exchange sales were dominant[54].

4.5. Methodology

The effectiveness of the sterilized foreign exchange intervention is analyzed by different methods and specifications. These methods are generally shaped around ordinary least squares, generalized autoregressive conditional heteroskedasticity, maximum likelihood, two-stage least squares, order-flow approach, and structural vector autoregressive models. Besides, the literature resorted to event study and

[53]Intervention through derivatives started in 2017 in Turkey. For instance, the Turkish Lira settled forward foreign exchange auctions are one of the main intervention methods of the CBRT.

[54] For future studies, the CBRT intervened intensely in the foreign exchange market starting from 2021. Although there are some concerns about the accuracy of the published data, the intervention data is also published daily after 2021.

synthetic control approaches. The main reason for the different techniques is the endogeneity problem. Authors utilize different methods to overcome this problem. Moreover, the available data for the intervention analysis are generally not sufficient. Therefore, researchers find some proxies or extract the data through different methods from the balance sheet of central banks.

The effectiveness analysis is challenging because of the above-mentioned simultaneity or endogeneity. To eliminate these problems, different methods are used to obtain informative results. On the purpose of finding a solution to the simultaneity biases, researchers used the lagged intervention variables. However, in this method, the results can be underestimated since the actual effects can be explained in the lagged explanatory variables (Galati, Melick, & Micu, 2005). Another solution to the problem is the event study approach. In this approach, the pre-and post-intervention periods are specified for the regression. Identifying the exact intervention periods is one of the main problems of this method. However, it is not applicable in some cases since the intervention periods cannot be defined exactly. For instance, a central bank can instantly intervene in response to daily shocks. Additionally, to use this method, there should be high-frequency data which is unavailable for many countries for a sufficient period (Tashu, 2014). Besides, by this method, only the short-term effects can be analyzed.

Another way to avoid the simultaneity problem is the instrumental variable estimation. Many authors preferred this method in their studies and referred to the benefit of this method (Disyatat & Galati, 2007; Kamil, 2008; Adler & Tovar, 2014; Barroso, 2014; Adler, Lisack, & Mano, 2019; Tashu, 2014).

In this study, the two-stage estimation procedure is preferred following the related instrumental variables literature. Central banks' foreign exchange intervention reaction function is constructed as the first stage. In this stage, equation is constructed considering the possible behaviors of central banks for the intervention[55]. Second, the

[55] The reaction function is inspired by previous studies and the surveys of BIS. Since one of the common intervention reasons is the volatility and the exchange rate level, these variables are included in the first stage of the model.

exchange rate equation is constituted. In this equation, the exchange rate's determinants are included besides the control variables. In the second stage, the predicted value of the intervention from the first stage is used in the exchange rate equation. For analyzing the effectiveness of the intervention, the first model is estimated with the Probit model since the intervention is accepted as binary. After that, the second stage is estimated with the two-stage least squares method to find the effect of the intervention on the level and volatility.

Estimating a two-stage model is not only necessary for effectiveness analysis, but also provides useful results in interpreting the intervention behavior of the CBRT. The possibility of the intervention actions of the central bank can be interpreted from the first equation. For instance, if a reaction equation includes the volatility and depreciation as explanatory variables, the central bank's possible actions considering the volatility and depreciation can be interpreted. Similarly, if a reaction function includes news from the Federal Reserve as an explanatory variable, the intervention probability of central banks regarding the news can be explained. In other words, the results of the reaction function reveal significant information about the reasons of the interventions. From the second stage, the explanatory variables' effects on the dependent variable can be interpreted, including the intervention of central banks. Likewise, the determinants of the exchange rate (the level and volatility in our case) can be understood besides the effect of the intervention variable. Therefore, the results provide better knowledge about the behavior and the effect of the intervention.

In fact, creating a proper exchange-rate equation is a challenging task. Some variables cannot be included because of the lack of data. For instance, the indexes that include price levels are not published on a daily basis. Therefore, the data cannot be included in the models constructed with daily variables.

Endogeneity is another concern about the analysis of the effectiveness in the literature. The intervention affects the exchange rate; meanwhile, intervention decisions also depend on the exchange rate. In other words, the simultaneity of these two variables causes a significant problem for the analysis. Therefore, the need for the identification of the intervention variable becomes apparent. Following the identification of Kearns

and Roberto (2005) and the others mentioned below, the intervention variable is instrumented and used in the exchange rate equation. At the same time, the intervention variable is transformed by the first equation as exogenous in the second equation[56].

In terms of econometrics, the coefficient of the intervention, in the exchange rate equation, is expected to be biased due to the above-mentioned problem. In this scenario, where the instrumental variable approach is not applied[57], the covariance of the intervention variable and the error term cannot be equal to zero. In the instrumental variable approach, the endogenous variable is estimated with the new variables[58], and the predicted value is obtained. In this way, the predicted intervention variable only includes exogenous information when estimated on other variables[59]. Thereafter, the predicted value is used in the second stage, which provides an unbiased term because the predicted intervention is exogenous and uncorrelated with the error term of the second equation.

In fact, the significance of all variables, including the intervention variable, depends on the preciseness of the exchange rate equation. However, the determinants of the exchange rate are a matter of a long debate. Additionally, some specific factors can have strong impact on a specific country's exchange rate. Therefore, constructing a correct exchange rate equation can be challenging, as mentioned above.

Following (Adler, Lisack, & Mano, 2019; Tashu, 2014), we constructed the first stage model as below:

$$INT_t = A_0 + A_1(e_t - e_t^*) + A_2(\theta_t - \theta_t^*) + A_3 INT_{t-1} + A_4 INT_{t-2} + \varepsilon_t$$

[56] For detailed explanation, see (Kearns & Roberto, 2005).

[57] For instance, if the model is run by OLS, the covariance of the intervention variable with the error term cannot be zero in the case of endogeneity.

[58] One of the main challenges is finding the proper variables to explain the dependent variable in the first stage. The general statements of the central banks are used for the first stage's explanatory variables.

[59] In the first stage, the dependent variable, which intervention in our case, should be clearly explained with the independent variables.

In this equation, INT is the amount of intervention in the country that is generally not published by the authorities. Therefore, we used the intervention data from 2012 to 2016 because of the availability of the daily data in this period.

The dependent variable is used as a binary variable which takes "1" when the CBRT intervenes and takes "0" when the CBRT does not intervene on a daily basis. To see the clustering effect, the 1 and 2 lags of the actual intervention data are included in the equation[60].

e_t term indicates the log of the nominal exchange rate, whereas the e_t* term represents the log of tolerable exchange rate limit calculated based on the historical moving averages. The historical values are calculated as 7, 30, 150, 180, 300, 360, 540 and 720 days of the moving averages. After that, one standard deviation is added to the historical trend to find the tolerance level of the CBRT (Standard deviations are calculated and added regarding the moving averages. For instance, 360-day historical standard deviation is added to the 360-day moving average). The model is run by all different variables to find the best model to explain the behavior of the CBRT. In this way, the CBRT is assumed to have a specific tolerance limit that triggers the intervention. Additionally, this variable is named as "Excessive Depreciation".

θ_t and θ_t^* terms are the volatility and volatility tolerance limit calculated by moving averages. Since higher volatility can be the reason for the intervention, the historical (similarly 7, 30, 150, 180, 300, 360, 540 and 720 days) standard deviations are calculated and accepted as the volatility tolerance. To find the daily volatility, the absolute value of the daily exchange rate deviation from the 7, 30, 150, 180, 300, 360, 540 and 720 days moving averages are calculated. Thereafter, the difference between these two variables is accepted as the second variable of the equation. The term A_2 refers to the CBRT's responses to the volatility gap between the actual and tolerance volatility. Similarly, the CBRT is assumed to have a specific tolerance limit for the volatility. In the following sections, the variable is used as "Excessive Volatility".

[60] Details of the estimation strategy are explained in the result section below.

Although it is not included in the main models and estimations, the reel exchange rate deviation is calculated to investigate if the CBRT reacts to the deviation of the reel exchange rate from its historical average, considering the model of (Adler & Tovar, 2014). Similar to the calculations of other explanatory variables, the historical average is assumed to be as tolerance limit of the CBRT. Therefore, the difference between the actual reel exchange rate and tolerance limit is included in the models. The historical averages are calculated as 7, 30, 150, 180, 300, 360, 540 and 720 days of the moving averages. The variable is named as "Exchange Rate Misalignment" and used in the models.

As explained in different chapters, the main concern of this study is the effectiveness of foreign exchange sales. Between the years 2012 and 2016, the published data indicates that sales were predominant. Therefore, the first stage is estimated by the Probit model since the dependent variable only takes "1" or "0". After that, the predicted intervention variable is used in the second equation provided below.

For the second stage, the exchange rate equation[61] is constructed as follows:

$$e_t = B_0 + B_1(i_{t-1} - i^*_{t-1}) + B_2DXY + B_3CDS + B_4EMBI + B_5P^M + B_6P^E + B_7P^F + B_8VIX + B_9INT_{t,predicted} + \varepsilon_t$$

The exchange rate equation is run by the two-stage least squares method for two different dependent variables. For the level effect, e_t term is defined as the log differences between two consecutive days. For the volatility, the e_i term is defined as the difference between two consecutive day's volatility.

i_t and i_t^* terms illustrate the local and foreign interest rates, respectively. While the Federal Fund Effective rate is used for foreign interest, the local interest is the weighted average cost of the CBRT's Funding. Therefore, this difference indicates the

[61] Following the (Adler & Tovar, 2014; Adler, Lisack, & Mano, 2019), second-stage equation is constructed.

interest rate differential, which is one of the main reasons for the capital flows according to the uncovered interest rate parity.

CDS is the indicator of the risk premium of a specific country. Since the high CDS is expected to cause depreciation of the local currency, the β_3 is expected to have a strong impact on the dependent variables.

P^M, P^E and P^F denote the price indexes indicating metal, energy and food prices, respectively. These variables are included as control variables. Additionally, since the prices can have determination over the exchange rate, these variables can be beneficial. For instance, oil price can be an important variable for a country without energy sources. The dependency on energy imports can create exchange rate sensitivity to energy prices. In addition to these prices, the model is run with the commodity index.

DXY denotes the dollar index referring to the valuation of the US Dollar relative to the basket of US trade partners' currencies. Therefore, the β_7 term indicates the effect of the DXY on the dependent variables.

VIX is included in the equation for the evaluation of the market sentiment. Similarly, the EMBI index is also included in the model.

Finally, the term INT denotes the intervention of the CBRT. This term is used as the predicted value from the first stage of the estimation process. Therefore, simultaneity is not a case in the process.

Since the variables are calculated for different time periods, different models are run to obtain robust results. Besides the main models, other estimations are illustrated in the Appendix to explore the effectiveness and the intervention reasons. Although the model is inspired by the mentioned studies, this study provides a more comprehensive approach regarding the calculated periods and other variables.

CHAPTER 5

RESULTS

5.1. Introduction to the Results

The effectiveness of the foreign exchange intervention is discussed many times in the literature. However, researchers who are working on this subject are far from reaching a consensus about the effectiveness. The effect of the intervention can change depending on the specific country, time, and other mentioned external/internal factors as mentioned above. Besides, the different methods and estimations can be the source of mixed results of the effectiveness of the intervention.

In this section, the results of the estimations are provided for the CBRT's intervention between the years 2012 and 2016. In the following part, the first stage estimation results are provided. From these results, the intervention behavior of the CBRT is interpreted. Additionally, the predicted value of the intervention variable is obtained for the second stage. After that, the results of the second stage are explained. In this part, the level and volatility effects of the intervention are examined.

5.2. Estimation Results of the CBRT's Intervention Reaction Function

The reaction function of the CBRT is estimated with the probit model since the dependent variable is binary. While the main reason for estimating the reaction function is to obtain the predicted variables of the CBRT's interventions, the first stage provides important information about how the CBRT reacts to excess the volatility, excess depreciation, and exchange rate misalignment[62].

[62] Results that include the exchange rate misalignment, defined as the deviation of the reel exchange rate from its historical average, are provided in the Appendix.

As mentioned in the methodology section, the different tolerance limits are specified for the CBRT. The limits are calculated by the historical trends, which are 7, 30, 150, 180, 300, 360, 450 and 720 days moving averages. In the literature, 360-day and 180-day are used for the level limit, whereas shorter terms are used for the limit of volatility, such as 7-days[63]. However, this study uses many other limits for a better understanding of the behavior of the CBRT. In addition to the excessive depreciation, excessive volatility and exchange rate misalignment variables, the lagged intervention variables are added to the model to see the clustering effect of the intervention during the period. Although the main model only includes the 150-day historical average[64] (it is used as the predicted variable in the second stage), the model is estimated with other limits to understand the reaction of the CBRT[65].

As the first stage, the reaction function is estimated with the actual intervention data. The results are provided in Table A.1 in the Appendix. However, the coefficients of the excess depreciation and volatility are insignificant in all models. Since the CBRT intervened almost every business day during the period under investigation, the excess depreciation and volatility assumptions do not explain the intervention behavior of the CBRT.

In this sense, intervention data is adjusted to capture the reasons of the overreactions of the CBRT. Since the CBRT intervened in the foreign exchange market constantly (especially after May 2013, when the tapering started till the end of 2015) from 2012 to 2016, the intervention data is adjusted to capture more intense interventions. The binary dependent intervention variable is adjusted according to the yearly average intervention amount. The intervention amount that is less than the yearly average is accepted as “0”, while the intervention amount that is more than the yearly average is accepted as “1”. In this way, the reasons of the over-reactions of the CBRT can be interpreted. Therefore, the main models are estimated with the adjusted intervention.

[63] For instance, Tashu (2014) uses 360-days and 180-days for the level limit. For the volatility, 7-day is used by the author. For other calculations, see (Disyatat & Galati, 2007; Galati, Melick, & Micu, 2005; Sarno & Mark, 2001).

[64] As depicted in Table 5.1, this model is chosen as the main model since it provides significant coefficients with a high R square.

[65] For the different estimation results as mentioned in the methodology section, see the Appendix.

Firstly, the reaction function is run by using the excess volatility variable calculated on the short-term horizon (7 and 30 days) and the intermediate-term (180 and 360 days) for the excess depreciation, in accordance with the literature. However, these models reveal insignificant coefficients for the volatility variable (see Table A.2 in the Appendix). Therefore, we expand our research to cover more time horizons, especially for the volatility variable. These results are illustrated in Table 5.1. below.

For the interpretation of the coefficients of the Probit estimations, the marginal effects table is provided. Since the coefficients of the probit regression do not represent the constant effect on the dependent variable, the coefficients are not directly interpretable. Therefore, the average marginal effects[66] are provided as they produce a single quantity summary that reflects the full distribution of the independent variables rather than an arbitrary prediction (Leeper, 2017).

In addition to the marginal effects table, the variance inflation factor table is illustrated. This table is beneficial for evaluating possible multicollinearity between the explanatory variables. According to (James, Witten, Hastie, & Tibshiran, 2013), a VIF value that exceeds 5 or 10 indicates a problematic amount of collinearity.

The results for the first stage are provided in the table below:

[66] The average marginal effect indicates the average change in the probability, when X increases by one unit. For detailed information, see (Cameron & Trivedi, 2010).

Table 5.1: Results of Estimations –First-Stage Results-1

	150-Day	180-Day	300-Day	360-Day
Dependent Variable				
Intervention(Adjusted)				
Independent Variables				
Excessive Depreciation	0.5073616	0.4083996	0.0256236	0.0168761
	(3.82)***	(3.64)***	(0.48)	(0.32)
Excessive Volatility	-0.050773	-0.038735	0.0233377	0.025611
	(-2.59)**	(-2.18)*	(2.17)*	(2.60)**
Foreign Exchange Sale Lag1	1.759092	1.744178	1.764634	1.746351
	(10.31)***	(10.21)***	(10.32)***	(10.17)***
Foreign Exchange Sale Lag2	1.097818	1.092473	1.106075	1.075055
	(6.39)***	(6.37)***	(6.41)***	(6.19)***
Constant	-1.638911	-1.760953	-2.342983	-2.427306
	(-10.3)***	(-11.3)***	(-14.6)***	(-14.8)***
Model Statistics				
Number of Observation	1,256	1,256	1,256	1,256
LR chi2(4)	794.69	797.28	793.73	794.72
Prob > chi2	0	0	0	0
Pseudo R2	0.6563	0.6585	0.6556	0.6564

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.
- Intervention variable is adjusted.

Regarding the models in Table 5.1, which takes the 150, 180, 300 and 360 days' historical moving averages into account, the explanatory powers of the models are satisfactory. The likelihood ratio and pseudo R square values show that the models are significant, and the variables are proper to explain the intervention reaction of the CBRT.

Considering the results given in Table 5.1, the excess depreciation coefficients are insignificant for the 300 and 360 days, despite the significant coefficients of the excess

volatility variable. However, 150 and 180 days' models reveal significant coefficients for the level effect together with the significant volatility variables.

According to the results, the excess volatility seems to increase the intervention probability of the CBRT, whereas the excessive depreciation variable is insignificant in the models with 300 and 360 days' models. However, excessive depreciation and volatility variables are significant in 150 and 180 days' models together. According to these models, the excessive depreciation increases the probability of the intervention. Contrary to this, the excessive volatility decreases the intervention possibilities. Since two explanatory variables are significant simultaneously, 150 and 180 days' models are accepted as main models and used in the second stage.

The average marginal effects and variance inflation factor tables are provided below:

Table 5.2: Tables of Average Marginal Effects and VIF Values

Variable **Average Marginal Effects**	**Excessive Depreciation**	**Excessive Volatility**	Variable **Variance Inflation Factors**	**Excessive Depreciation**	**Excessive Volatility**
150 Days	0.04	-0.004	***150 Days***	4.540	4.110
180 Days	0.035	-0.003	***180 Days***	5.200	4.830
300 Days	0.002	0.002	***300 Days***	5.860	6.710
360 Days	0.001	0.002	***360 Days***	5.280	6.240

Note:

- The values should be considered with the first stages estimation results (Table 5.1) as all the variables are not significant.

Regarding the average marginal effects[67], although Table 5.2 illustrates all values, only significant variables' values should be interpreted. In terms of 150- and 180-day models, one unit of excess depreciation increases the probability of intervention by about 4.4% and 3.5%, respectively. In terms of the excess volatility, one unit of excess volatility decreases the intervention probability by 4% and 3%, according to Table 5.2.

[67] The marginal effects at the mean can be provided upon request.

In addition to the marginal effects, strong multicollinearity is not found according to Table 5.2.

Moreover, the estimations are expanded more to cover 7, 30, 540 and 720 days' models. From 7-day to 720-day, the likelihood ratio and the pseudo R square values are satisfactory. The goodness of the model is stable for all models. However, the significance of the coefficients decreases regarding the short-term and long-term horizons[68] (especially 7, 30, 540 and 720 days). For this reason, it seems that the CBRT pays more attention to the intermediate-horizons (150 and 180 days). Among all the created tolerable limits, the 150-day tolerance limit represents the main model since it provides significant coefficients with a high R square.

Additionally, the main model includes only the excessive depreciation and excessive volatility. However, the exchange rate misalignment variable is also added to the model since one of the main concerns of central banks is fundamental deviations of the exchange rate according to the BIS surveys.

Regarding the model, including the exchange rate misalignment, the same high R squares can be seen. However, the exchange rate misalignment variable is insignificant in almost all models. The coefficient of the variable is weakly significant in only 30 and 360 days' models. Therefore, this variable is not included in the main model. The results of the models including the exchange rate misalignment are illustrated in Table A.4 in the Appendix.

In terms of the excessive depreciation, excessive volatility, and exchange rate misalignment (in the Appendix), the reaction of CBRT is generally shaped around the excessive depreciation and excessive volatility in the intermediate-horizon. In the intermediate-horizon, the exchange rate misalignment does not show significance compared to the other variables. Therefore, the deviation of the reel effective exchange rate from the historical average seems not to have an impact on the intervention

[68] Additionally, 8,20,50 and 100 days are calculated and run with similar method for robustness. Besides, two standard deviation is used for the calculation of the explanatory variables. However, results do not change.

decisions. Also, it can be claimed that the CBRT does not have any tolerance limit regarding the real exchange rate. Considering the other time horizons, the significance of the variables is varied and generally insignificant in terms of 7,30, 540 and 720 days. Therefore, the CBRT's tolerance limit assumption is to be on the intermediate-horizons such as 150-and 180-day. Besides, the lagged intervention variable is also significant in all models. Therefore, it illustrates the clustering effect of the intervention.

In general, almost all models are significant, and the variables are enough to explore the behavior of the exchange rate intervention. Statistically, the models present that the CBRT is more likely to act considering the intermediate-horizon since the excessive volatility and the depreciation variables are found significant. However, the exchange rate misalignment is found insignificant(weakly significant in the two models).

Moreover, the excess volatility decreases the probability of the intervention, while the excess depreciation increases in the intermediate-horizon. Since depreciation is expected to increase the intervention probability, the findings comply with our expectations. However, the volatility gap decreases the chance of intervention, which contradicts to our expectations. However, some studies found that the interventions can increase volatility as mentioned in the literature section. For instance, (Dominguez, 1998; Guimarães & Karacadag, 2004; Moura, Pereira, & Attuy, 2013; Rincon & Toro, 2010) show that the intervention can increase the volatility even if it is not intended by the authorities. In this sense, the CBRT's drawbacks can be understood since the intervention can increase the volatility more, according to the literature.

5.3. Estimation Results of the Foreign Exchange Intervention

As mentioned in the methodology and the first stage section, the predicted values of the reaction function are used as an instrumented variable in the second stage. Since endogeneity is one of the main concerns, the instrumentalization of the intervention variable is common in the literature. Following (Tashu, 2014; Adler & Tovar, 2014), the effectiveness is evaluated for the level and volatility in this part.

The main model illustrated in Table 5.3 is run with the main model's variable as the second stage. Since the determinants of the exchange rate are not universally accepted, the possible variables that can have an effect on the exchange rate are included based on the literature.

Moreover, the model's correctness depends on the specification. Especially, since the volatility is calculated with specific historical trends, different results can be found. Thus, different time horizons are provided beside the main model. Additionally, determining the exchange rate level is challenging since the determinants generally do not have daily data, as explained above.

The main model is constructed with the average intervention as explained. The predicted values (obtained from the 150-day model) are included in the level effect equation below. The dependent exchange rate is included as log of the daily differences. Additionally, the lagged actual intervention variable is included to understand whether the lagged intervention is effective or not.

Table 5.3 illustrates the results for the level effect of the intervention. While the Estimation-1 depicts the equation with the DXY, interest rate difference, VIX, CDS and commodity prices, the second column is constructed with the commodity index instead of the commodity prices. Similarly, in Estimation-3, the same estimation is constructed with the lagged intervention variable, whereas the fourth column does not include the commodity prices. Lastly, the fifth column is estimated with the EMBI variable. The different variables and combinations are included to capture if the intervention has an effect on the level of the exchange rate. The intervention variable is instrumented from Probit estimation with 150-day model.

Table 5.3: Results of Estimations – Second-Stage Results for Level-1

150-Day Dependent Variable *Log Exchange Rate (Level)* **Independent Variables**	**Estimation - 1**	**Estimation - 2**	**Estimation - 3**	**Estimation - 4**	**Estimation - 5**
Intervention (Instrumented)	-0.000166	-0.0002197	-0.0003172	-0.0003943	0.0000692
	(-0.59)	(-0.78)	(-1.04)	(-1.31)	(-0.24)
DXY	0.0001666	0.0000868	0.0001686	0.0001017	0.0001705
	(3.69)***	(2.59)**	(3.73)***	(-3.53)***	(4.55)***
Interest Rate Difference Lag1	-0.0001907	-0.0001574	-0.0001817	-0.0001501	-0.0000437
	(-2.65)**	(-2.24)*	(-2.52)*	(-2.14)*	(-0.59)*
VIX	-0.0025849	-0.0015158	-0.0025646	-0.0014434	-0.0043339
	(-4.13)***	(-2.60)***	('-4.10)***	(-2.94)**	(-5.26)***
EMBI					-0.0000188
					(-4.79)***
CDS	0.00000623	0.00000626	0.000006	0.00000604	0.0000193
	(2.40)*	(2.47)*	(2.31)*	(2.38)**	(5.22)**
Commodity Index		-0.00000515			-0.0000481
		(-0.40)			(-3.08)*
Food Price	-0.00000341		-0.00000324		
	(-2.83)**		(-2.68)**		
Metal Price	-0.000000463		-0.000000437		
	(-1.99)*		(-1.88)*		
Energy Price	0.00003		0.0000283		
	(2.32)*		-2.18		
Lagged Intervention			0.00000113	0.00000142	
			-1.7	(2.14)*	
Constant	-0.0056966	-0.0033836	-0.0060783	-0.0054805	0.0038904
	(-1.29)	(-0.82)	(-1.37)	(-3.16)**	(-0.89)

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.

In every model[69], including the models provided in the Appendix (see, Table B.1 in the Appendix), the intervention variable shows no significant evidence of an impact on the exchange rate level. Although the DXY, the interest rate difference VIX and

[69] The same model is run by other instrumented intervention variables obtained from different time-horizons. Results can be provided upon request.

EMBI variables have significant coefficients, the significance of the intervention does not change for almost all models estimated. Additionally, the variables included in the model present true signs as expected. For instance, the coefficient of the DXY is expected to be positive, and the results comply with the expectations.

In addition to variables' significance, the overall significance of the model can be low or even negative similar to the study of Tashu (2014) and many others. Since the specification for the exchange rate level and volatility are run by two-stage least squares with the instrumental variables, the R squares are meaningless (Sribney, Wiggins, & Drukker, 2021). Therefore, these values are not provided.

In terms of the volatility, the dependent variable is calculated as differences between two consecutive days with respect to the 150-day average as calculated in the reaction function. The 150-day time horizon is specifically chosen to be consistent since the instrumented intervention variable is obtained from the 150-day model.

The results are provided in the Table 5.4 below:

Table 5.4: Results of Estimations - Second-Stage Results for Volatility-1

150-Day Dependent Variable *Log Exchange Rate (Volatility)* **Independent Variables**	**Estimation - 1**	**Estimation - 2**	**Estimation - 3**	**Estimation - 4**	**Estimation - 5**
Intervention (Instrumented)	-0.0027606	-0.0030235	-0.0159401	-0.017468	-0.0015864
	(-1.71)	(-1.87)	(-2.41)*	(-2.55)*	(-0.97)
DXY	0.0005455	0.0003036	0.0005616	0.0004344	0.0007196
	(2.10)*	(1.58)	(2.10)*	(2.55)*	(3.35)***
Interest Rate Difference Lag1	-0.0010468	-0.0008738	-0.0011561	-0.0010108	-0.0003083
	(-2.53)*	(-2.17)*	(-2.69)**	(-2.41)*	(-0.73)
VIX	-0.0102638	-0.0072252	-0.0108576	-0.0060253	-0.021242
	(-2.85)**	(-2.16)*	(-2.92)**	(-2.08)*	(-4.50)***
EMBI					-0.0000935
					(-4.16)***
CDS	0.0000312	0.0000301	0.0000386	0.0000382	0.0000948
	(2.09)*	(2.07)*	(2.44)*	(2.48)*	(4.47)***
Commodity Index		-0.0000631			-0.0002769
		(-0.85)			(-3.09)***
Food Price	-0.0000119		-0.0000111		
	(-1.72)		(-1.57)		
Metal Price	-0.00000169		-0.00000193		
	(-1.26)		(-1.40)		
Energy Price	0.0000743		0.0000701		
	(1.00)		(0.92)		
Lagged Intervention			0.0108328	0.0120577	
			(2.06)*	(2.21)*	
Constant	-0.0100523	-0.001544	-0.0089694	-0.0233435	0.0346353
	(-0.40)	(-0.07)	(-0.34)	(-2.29)	(1.38)

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.

Since the intervention probability increases with the 150-day historical average, the volatility calculated with the 150-day moving average is considered as the main model. Meanwhile, other estimations using different time horizons are also provided in Table B.2 in the Appendix. Additionally, the model is run with a short-term volatility variable to comply with the literature. However, our research expands the time-horizon to capture if the intervention has effect on the long-term volatility.

In terms of the variables, specifically the intervention variable, the intervention is seemed to have only a little effect on the volatility, contrary to the level effect from the previous model. In general, the instrumented intervention variable is only weakly significant in some models. However, the variable does not show significance, especially when the regression is constructed with the long- and short-term horizons. Since the variable has a negative coefficient in the main model, the volatility decreases when the CBRT intervenes during the period.

The effect of the intervention variable on the volatility depends on the specification of the volatility variable. The different results for different volatility calculations, such as 180 and 360 days, are provided in the appendix below[70]. In the long-term horizon, the significance of the variables, except for the intervention, varies. However, in the short run, no variable is able to explain the volatility, including the intervention variable.

Regarding the main model, the intervention decreases the volatility in the intermediate-term. However, the effect is not only too small but also the variable is only weakly significant for all models. Although the high volatility decreases the probability of the intervention, the volatility decreases when the CBRT intervenes.

In summary, the results depend on the variables and time-horizon. Therefore, results should be evaluated considering all the unique features explained above. According to this study's specifications and the main models, intervention probability increases when the local currency depreciates. On the other hand, intervention probability decreases when the volatility increases. Meanwhile, the exchange rate misalignment is not a concern for the CBRT. These results are only valid for intermediate-term since other models, including the short and long-term variables, do not have significant coefficients. Since central banks have concerns about the level of the exchange rate, as explained above, the intervention behavior of the CBRT is in line with the literature. In terms of actions regarding the volatility, intervention can be the source of the high volatility, according to the literature. In this sense, the CBRT may have deterred

[70] Estimation is run by all different variables. However, models only with the significant variables are provided.

because of the high volatility and preferred low volatility for the intervention during the period. Therefore, the results are reasonable since the excess volatility decreases the probability of the intervention.

Regarding the effects of the intervention in the level and volatility, the interventions do not show any impact on the level of the exchange rate regardless of the model and time-horizon. These findings not only comply with the literature, but also in line with the studies covering Turkish Case (Guimarães & Karacadag, 2004; Akıncı, Çulha, Özlale, & Şahinbeyoğlu, 2005; Cicek, 2014; Tümtürk, 2019). Although the CBRT does not intervene by taking the high volatility into account, the volatility decreases (in the intermediate-term) when the bank intervenes. Although the effect of the intervention is small and weakly significant in some models, the results are in line with the mentioned literature.

The reasons of the unsuccessful interventions are not the main concern of this study. However, the possible reasons can be explained by considering the transmission mechanism of the foreign exchange policy and other discussions provided above. First, the constant presence of the CBRT can be the source of the insignificant results since it deteriorates the benefits of the discretionary intervention. Second, the insignificant results can be the consequences of external factors. For a more comprehensive analysis, the interventions of the CBRT should be compared with similar countries that intervened during the same period. Third, the presence of two different targets can eliminate the success of the intervention. Since the CBRT is one of the inflation targeting central banks, the success of the interventions can be restricted by the inflation target, as explained above. As discussed, the results cannot be generalized since one country in a specific period cannot be the source of general interpretations. Meanwhile, an external factor or a specific feature of a country can be the source of results. Therefore, the results should be evaluated by considering the investigation period, country and other external factors.

CHAPTER 6

CONCLUSION

The effect of the exchange rate is one of the main concerns of developing countries. It is important not only for the price stability but also for the financial stability. Since the consequences of the exchange rate movements can be dangerous for an economy, many countries use foreign exchange interventions as a supportive instrument to the conventional monetary actions. Although many countries prefer inflation targeting regime with a floating exchange rate, intervention is common among developing countries.

Foreign exchange policy is debated, especially in the inflation targeting framework. Accepting the free capital flows' prevalence, the exchange rate is expected to float since the monetary independence is necessary for central banks to struggle with the inflation rate. In this framework, foreign exchange intervention raises questions about the validity of inflation targeting because inflation is expected to be the only target. If a central bank intervenes, doubts can arise about the existence of two different targets. In the case of conflicting targets, one of the targets dominate the other one. In this sense, different targets cannot be accomplished at the same time. Therefore, foreign exchange intervention reveals questions about the validity of the inflation targeting framework.

Besides the questions about the validity of the inflation targeting framework, the interventions can become unsuccessful because of two different targets as mentioned above. Furthermore, the transmission mechanism is also questioned since the foreign exchange policy has different channels to influence the exchange rate. Therefore, the effectiveness of the foreign exchange interventions is examined several times in the literature.

In the literature, in addition to the effectiveness analysis, the duration, instrument/market preferences, intervention amount, intervention cost, duration, transparency and many other relevant subjects are evaluated. Besides, the transmission channels are gauged many times.

Since the CBRT is one of the inflation targeting central banks, the effectiveness of the foreign exchange policy of the CBRT is examined in this study. This study covers the period between the years 2012 and 2016. In this period, the sales operations were dominant because of the "Taper Tantrum". In addition to the effectiveness analysis, the theoretical information, reasons for the intervention, literature on the effectiveness and the analysis of the "Taper Tantrum" are provided.

To understand the effectiveness of the intervention of the CBRT, the theory of foreign exchange policy is discussed in this study. The importance of the exchange rate for developing countries and the relationship with the inflation targeting regime are covered. Following these, the transmission mechanism of foreign exchange policy is evaluated together with the conventional channels. These channels are classified as portfolio balance, signaling and micro-structure channels. Due to the different transmission mechanisms, foreign exchange policy is broadly discussed in the literature.

Since there is a vast literature on the effectiveness, the studies covering developing countries are examined in this study. The methods of the studies and the results are presented. Later, the literature on the Turkish case is provided.

Following the literature, necessary analyses for evaluation of the effectiveness are provided. First, the intervention data of the CBRT is examined. Lack of data is one of the main problems for the effectiveness analysis because of central banks' general intention to keep the data secret. However, the intervention data of the CBRT is published from 2012 to 2016 on a daily basis. Therefore, this data is used in the evaluation. Additionally, all data sources and explanations are provided in this study.

Second, the Tapering Period is analyzed based on developing and developed countries since our study covers the years between 2012 and 2016. Starting from May 2013, the interest rate in developed countries increased because of the tapering signals from the Federal Reserve. Following this, developing countries' domestic currencies devaluated. Thereafter, these countries took measures to prevent possible negative outcomes of the devaluation. Since the Taper Tantrum put strong pressure on developing countries' currencies, many central banks intervene in the foreign exchange markets during the period. Hence, this intervention policy of the developing countries is analyzed in line with the Turkish Case.

The CBRT showed similar intervention practices with other developing countries. The bank used foreign exchange policy to prevent hazardous market events. Especially, the CBRT intervened in the foreign exchange market between the years 2012 and 2016. In this period, sales were predominant, and the CBRT existed in the market intensely. Therefore, the CBRT's foreign exchange interventions are analyzed, together with other similar developing countries.

The effectiveness of the intervention is not commonly accepted in the literature. Due to the data problems and the endogeneity, the authors reveal different results. In addition to these issues, the effectiveness depends on the intervention method, intervention period, and many other exterior factors. To overcome the endogeneity and enlighten the effectiveness of the intervention, two-stage instrumental variable estimation procedure is used in the study. First, the intervention reaction function is run by the Probit model. After that, the instrumented intervention variable is used in the second stage.

According to this study's assumptions, the CBRT's intervention decisions are accepted to be influenced by the excessive depreciation and volatility. In this context, the tolerance limit assumption is made for the estimation, following the literature. Therefore, different tolerance limits are calculated based on historical averages for the excess depreciation and volatility. Additionally, the exchange rate misalignment is included in the estimations.

The reaction function is run by the Probit model since the dependent intervention variable is accepted as binary. Initially, the actual intervention is used as the dependent variable. In this case, the intervention behavior of the CBRT could not be explained by the excessive depreciation and volatility. The reason is that the CBRT intervened in the foreign exchange market almost every business day from 2012 to 2016.

After that, the intervention variable is adjusted to include only over-reactions of the CBRT. The yearly average intervention amount is calculated, and the intervention amount which is less than the yearly average is accepted as "0" and which is more than the yearly average "1".

According to the results considering all time horizons and the adjusted intervention variable, the CBRT's over-reactions can be explained by the excess depreciation and volatility. In the intermediate-term, the volatility and depreciation are found significant. However, the exchange rate misalignment is insignificant in almost all models. The excess depreciation motivates the CBRT to intervene, while the excess volatility decreases the probability of the intervention during the period under investigation. Additionally, coefficients are not significant in other estimated horizons. Therefore, the intermediate-term is accepted as the main model in this study.

Following the reaction function estimation, the exchange rate equation is estimated with two-stage least squares. In this part, the intervention's level and volatility effects are evaluated. Regarding the level effect of the intervention, no effect is found on the exchange rate level. Considering all time horizons and specifications, the instrumented intervention variable is insignificant for all models. In terms of the volatility, the instrumented intervention variable is only significant for intermediate terms. However, the effect is small, and the variable is only weakly significant. In this context, the volatility decreases when the CBRT intervenes, according to the results calculated for the intermediate-term.

This study's first contribution to the literature is the estimations with different time-horizons. The study calculates different time-horizons, from short-term to long-term, to capture the behavior of the CBRT. By running the model with different time-

horizons, this study specifies the best model for explaining the intervention behavior. The second contribution is the intervention amount adjustment. Since the CBRT intervened almost every day during the period under investigation, the adjustment of the intervention data enables to capture over-reactions of the CBRT. Therefore, the triggering condition for the over-reaction is captured in this study. Moreover, the over-reactions' effect on the exchange rate level and volatility is evaluated.

The reasons of the unsuccessful interventions could be listed as follows: First of all, the presence of the inflation target can eliminate the foreign exchange intervention's effectiveness because of two different targets. The intervention does not directly mean that a central bank targets the exchange rate, but the two different targets can deteriorate each other. Additionally, regarding the impossible trinity, the exchange rate cannot be controlled by the authorities if the free capital flow and independent monetary policy are used in the monetary framework. Secondly, the CBRT intervened almost every day from 2012 to 2016. Furthermore, interventions are pre-announced, which eliminates taking advantage of the discretionary interventions as explained above. Therefore, the CBRT may not have sent the correct signals to the markets during this period.

In addition to the above-mentioned reasons, the success of the intervention depends on external/internal incidents, time, country-specific features, and many other factors, as mentioned in the study. Therefore, these findings should not be generalized to all countries.

Although generalization is not suggested, there are some policy implications based on the results of this study. In the inflation targeting framework, the foreign exchange interventions should carefully be evaluated before the action. According to results and the literature, interventions are not always successful. Meanwhile, sometimes, they create volatility without any level effect on the exchange rate. Therefore, the cost of the intervention should be clearly examined. Since the intervention is not always successful, intervention can only mean the depletion of reserves which can cause a high cost to an economy.

For further research, one can focus on the CBRT's interventions in 2021. Since the CBRT intervened in both the spot and derivatives market at the same time, the analysis of these actions can be beneficial. Additionally, this analysis can be expanded to cover other developing countries with a panel approach. Moreover, the reasons of the successful/unsuccessful intervention can be evaluated. Lastly, the transmission mechanism of the foreign exchange policy can be explored in Turkey.

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APPENDICES

APPENDIX A: Results of First Stage Estimations

Table A.1: Results of Estimations – First-Stage Results-2

	7-Day	30-Day	150-Day	180-Day	300-Day	360-Day	540-Day	720-Day
Dependent Variable								
Intervention								
Independent Variables								
Excessive Depreciation	0.2790943	0.2025808	0.112855	0.0759276	-0.0613264	-0.0488743	0.0456347	0.0588095
	(1.19)	(1.69)	(1.24)	(0.98)	(-0.91)	(-0.71)	(0.66)	(1.07)
Excessive Volatility	0.0137645	-0.0124403	-0.0050703	-0.0017716	0.0243019	0.0206883	0.0029805	-0.0000642
	(0.19)	(-0.45)	(-0.29)	(-0.11)	(1.72)	(1.61)	(0.28)	(-0.01)
Foreign Exchange Sale Lag1	2.32305	2.340599	2.28997	2.289049	2.272414	2.268788	2.273109	2.269681
	(9.42)***	(9.59)***	(9.26)***	(9.24)***	(9.20)***	(9.18)***	(9.18)***	(9.14)***
Foreign Exchange Sale Lag2	2.161132	2.164326	2.082621	2.073258	2.052832	2.043108	2.029518	2.030506
	(8.57)***	(8.70)***	(8.38)***	(8.34)***	(8.28)***	(8.22)***	(8.11)***	(8.11)***
Constant	-2.258522	-2.239905	-2.199694	-2.230214	-2.528182	-2.519422	-2.297601	-2.227928
	(-13.75)***	(-14.21)***	(-10.08)***	(-10.43)***	(-11.10)***	(-11.15)***	(-8.58)***	(-8.47)***
Model Statistics								
Number of Observation	1,256	1,256	1,256	1,256	1,256	1,256	1,256	1,256
LR chi2(4)	1493.86	1495.39	1495.76	1495.22	1496.74	1496.46	1495.17	1495.3
Prob > chi2	0	0	0	0	0	0	0	0
Pseudo R2	0.8718	0.8727	0.8729	0.8726	0.8735	0.8733	0.8726	0.8726

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.
- Intervention variable is not adjusted.

Table A.2: Results of Estimations – First-Stage Results-3

	Level 180-Day Volatility 7-Day	Level 180-Day Volatility 30-Day	Level 360-Day Volatility 7-Day	Level 360-Day Volatility 30-Day
Dependent Variable				
Intervention(Adjusted)				
Independent Variables				
Excessive Depreciation	0.1807512	0.1774454	0.1332553	0.1302371
	(5.18)***	(4.99)***	(4.85)***	(4.71)***
Excessive Volatility	0.0271928	0.012174	0.0329914	0.0194035
	(0.61)	(0.73)*	(-0.74)	(1.17)**
Foreign Exchange Sale Lag1	1.774507	1.773516	1.794919	1.788648
	(10.41)***	(10.40)***	(10.55)***	(10.50)***
Foreign Exchange Sale Lag2	1.134013	1.12662	1.154482	1.141548
	(6.63)***	(6.59)***	(6.76)***	(6.67)***
Constant	-2.063935	-2.044676	-2.133425	-2.11137
	(-19.86)***	(-20.78)***	(-19.82)***	(-20.65)***
Model Statistics				
Number of Observation	1,256	1,256	1,256	1,256
LR chi2(4)	792.53	792.69	788.47	789.27
Prob > chi2	0	0	0	0
Pseudo R2	0.6546	0.6547	0.6512	0.6519

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.
- Intervention variable is adjusted.
- The model is constructed with short-term time horizon for volatility and intermediate-term for depreciation.

Table A.3: Results of Estimations – First-Stage Results-4

	7-Day	30-Day	540-Day	720-Day
Dependent Variable				
Intervention(Adjusted)				
Independent Variables				
Excessive Depreciation	0.2093121	0.0965476	0.0969167	0.0818347
	-1.34	-1.07	-1.81	(2.22)*
Excessive Volatility	0.0354004	0.0210583	0.0071083	0.0067881
	-0.73	-1	-0.85	-1.16
Foreign Exchange Sale Lag1	1.943779	1.923385	1.766481	1.777754
	(11.46)***	(11.34)***	(10.26)***	(10.38)***
Foreign Exchange Sale Lag2	1.319526	1.273529	1.082154	1.109173
	(7.75)***	(7.48)***	(6.18)***	(6.40)***
Constant	-1.94585	-1.939405	-2.186786	-2.218903
	(-20.05)***	(-22.06)***	(-11.60)***	(-12.52)***
Model Statistics				
Number of Observation	1,256	1,256	1,256	1,256
LR chi2(4)	764.78	766.49	788.9	789.73
Prob > chi2	0	0	0	0
Pseudo R2	0.6317	0.6331	0.6516	0.6523

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.
- Intervention variable is adjusted.
- Model's results are provided regarding to the short-term and long-term.

Table A.4: Results of Estimations – First-Stage Results-5

	7-Day	30-Day	150-Day	180-Day	300-Day	360-Day	540-Day	720-Day
Dependent Variable								
Intervention(Adjusted)								
Independent Variables								
Excessive Depreciation	0.0161869	-0.1079192	0.4789163	0.3804686	-0.0260514	-0.0064775	0.103646	0.0612822
	(0.09)	(-0.84)	(3.48)***	(3.23)**	(-0.45)	(-0.12)	(1.96)*	(1.60)
Excessive Volatility	0.0467306	0.0313648	-0.0510904	-0.0382418	0.0251931	0.0246343	0.004267	0.0063291
	(0.97)	(1.46)	(-2.60)**	(-2.15)*	(2.29)*	(2.48)*	(0.51)	(1.11)
Exchange Rate Misalignment	-0.0022583	-0.0012911	-0.0002093	-0.0001894	-0.0005643	-0.00055	-0.000416	-0.000514
	(-2.37)*	(-2.20)*	(-0.76)	(-0.73)	(-2.39)*	(-2.62)**	(-1.89)	(-1.85)
Foreign Exchange Sale Lag1	1.941842	1.921682	1.764143	1.748814	1.735271	1.708463	1.739307	1.756385
	(11.40)**	(11.35)***	(10.33)***	(10.23)**	(10.11)***	(9.91)***	(10.06)***	(10.22)***
Foreign Exchange Sale Lag2	1.335239	1.304737	1.107233	1.099544	1.072925	1.038792	1.060249	1.090817
	(7.78)**	(7.64)**	(6.43)***	(6.40)**	(6.20)***	(5.97)***	(6.05)***	(6.29)***
Constant	-2.01485	-2.046751	-1.646481	-1.769154	-2.403991	-2.478602	-2.22302	-2.34224
	(-19.49)***	(-19.59)***	(-10.30)***	(-11.19)***	(-14.12)***	(-14.46)***	(-11.74)	(-12.30)***
Model Statistics								
Number of Observation	1,256	1,256	1,256	1,256	1,256	1,256	1,256	1,256
LR chi2	770.43	771.42	795.27	797.82	799.61	801.73	792.54	793.20
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.6363	0.6371	0.6568	0.6589	0.6604	0.6622	0.6546	0.6551

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.
- Exchange rate misalignment variable is included.

Table A.5: Tables of Average Marginal Effects

Variable **Average Marginal Effects**	**Excessive Depreciation**	**Excessive Volatility**	**Exchange Rate Misalignment**
7 Days	0.0014854	0.0042882	-0.0002072
30 Days	-0.0098563	0.0028646	0.0001179
150 Days	0.0418874	-0.0044685	-0.0000183
180 Days	0.0330274	-0.0033197	-0.0000164
300 Days	-0.0022371	0.0021634	-0.0000485
360 Days	-0.0005537	0.0021056	-0.000047
540 Days	0.0090004	0.0003706	-0.0000362
720 Days	0.0053175	0.0005492	-0.0000446

Note:

- Average Marginal Effects of the regression result 5 depicted in the Table A.4.

Table A.6: Tables of Value Inflation Factors

Variable **VIF Values**	**Excessive Depreciation**	**Excessive Volatility**	**Exchange Rate Misalignment**
7 Days	1.41	1.11	1.32
30 Days	2.96	1.58	2.24
150 Days	4.82	4.39	2.06
180 Days	5.40	5.27	2.22
300 Days	6.09	6.99	2.19
360 Days	5.38	6.50	1.84
540 Days	3.86	4.01	0.44
720 Days	3.47	3.02	1.89

Note:

- Value Inflation Factors of the regression result 5 depicted in the Table A.4.

APPENDIX B: Results of Second-Stage Estimations

Table B.1: Results of Estimations - Second-Stage Results for Level-2

180-Day	**Estimation - 1**	**Estimation - 2**	**Estimation - 3**	**Estimation - 4**	**Estimation-5**
Dependent Variable					
Log Exchange Rate (Level)					
Independent Variables					
Intervention (Instrumented)	-0.0001518	-0.0001991	-0.0003004	-0.0003716	0.0000818
	(-0.54)	(-0.71)	(-0.98)	(-1.23)	-0.29
DXY	0.0001664	0.0000868	0.0001684	0.0001013	0.0001706
	(3.68)***	(2.59)**	(3.73)***	(3.51)***	(4.55)***
Interest Rate Difference Lag1	-0.0001903	-0.0001569	-0.0001814	-0.0001497	-0.0000432
	(-2.64)**	(-2.23)*	(-2.52)*	(-2.13)*	(-0.59)
VIX	-0.0025814	-0.0015083	-0.0025613	-0.0014399	-0.0043353
	(-4.12)***	(-2.58)**	(-4.09)***	(-2.94)**	(-5.26)***
EMBI					-0.0000188
					(-4.80)***
CDS	0.00000618	0.00000621	0.00000595	0.00000599	0.0000193
	(2.38)*	(2.44)*	(2.29)*	(2.36)*	(5.22)***
Commodity Index		-0.00000495			-0.0000481
		(-0.38)			(-3.08)**
Food Price	-0.00000341		-0.00000324		
	(-2.84)**		(-2.69)**		
Metal Price	-0.000000461		-0.000000436		
	(-1.98)*		(-1.87)		
Energy Price	0.00003		0.0000283		
	(2.32)*		(2.18)*		
Lagged Intervention			0.00000112	0.0000014	
			-1.68	(2.11)*	
Constant	-0.0056895	-0.0034133	-0.0060657	-0.0054453	0.0038879
	(-1.29)	(-0.83)	(-1.37)	(-3.14)	-0.89

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.
- Second Stage Estimation Results for Level Effect, 180-day model is used instead of main model which uses 150-day

Table B.2: Results of Estimations - Second-Stage Results for Volatility-2

180 and 360 Day Dependent Variable *Log Exchange Rate (Volatility)* **Independent Variables**	**Estimation - 1**	**Estimation - 2**	**Estimation - 3**	**Estimation - 4**	**Estimation - 5**
Intervention (Instrumented)	-0.015764	-0.014031	-0.0156999	-0.0145904	-0.0067004
	(-2.29)*	(-2.04)*	(-2.30)*	(-2.10)*	(-1.00)
DXY	0.0001826		0.0001586	0.0005562	0.000483
	(2.17)*		(0.66)	(3.22)**	(2.39)*
Interest Rate Difference Lag1	-0.0011036	-0.0009003	-0.0011524	-0.0011908	-0.0002625
	(-2.64)**	(-2.36)	(2.13)**	(-2.80)**	(-0.59)
VIX		0.0016583		-0.0083539	-0.0083184
		(1.34)*		(-2.84)**	(-2.23)*
EMBI	-0.0000177	0.00000951	-0.0000155		-0.0000205
	(-1.06)	(0.73)	(-0.73)		(-1.25)
CDS	0.0000339		0.0000302	0.0000461	
	(2.04)*		(1.59)*	(2.95)**	
Commodity Index					-0.0000825
					(-0.96)
Food Price			-0.0000047		
			(-0.68)		
Metal Price			0.000000395		
			(0.30)		
Energy Price			-0.00000539		
			(-0.06)		
Lagged Intervention	0.0113044	0.01014	0.0113468	0.0102861	0.0055918
	(2.09)*	(1.87)*	(-2.65)*	(1.85)	(1.06)
Constant	-0.0074141	0.0005341	-0.0042547	-0.0291786	-0.0035916
	(-1.24)	(0.15)	(-0.15)	(-2.82)**	(-0.14)

Note:

- The value in parentheses indicates Z values. * Significant at 10%; ** Significant at 5%; and *** Significant at 1%.
- The first, second and third columns depict the 180-day volatility calculated with 180-day model. The fourth and fifth columns use 360-day volatility.

C. TURKISH SUMMARY / TÜRKÇE ÖZET

1990'larda dünyada yaşanan çeşitli döviz ve enflasyon krizleri sonrasında, birçok gelişmekte olan ülkede enflasyon hedeflemesi rejimine geçme eğilimi gözlenmiştir. Bu rejimde merkez bankaları enflasyondan sorumlu tutulmuşlar ve enflasyon hedefi en önemli öncelik haline getirilmiştir. Enflasyon hedeflemesi rejiminin sebebi, fiyat istikrarının ekonominin sağlığı için en önemli olgulardan biri olduğunun kabulüne dayanmaktadır. Merkez bankaları fiyat istikrarını sağlamak için genel olarak faiz aracından yararlanmaktadır.

Teorik olarak, merkez bankaları kararlarını Taylor Kuralı çerçevesinde faiz aracını kullanarak vermektedirler. Taylor Kuralı çerçevesinde, gerçekleşen enflasyonun hedeflenen enflasyondan sapması ve gerçekleşen çıktı açığının hedeflenen çıktıdan sapması uyarınca merkez bankaları faiz aracını kullanmaktadırlar. Söz konusu yapı içerisinde, faiz aracının bağımsız olarak kullanılmasını gerektirmektedir. Diğer taraftan, günümüz ülkeleri sermaye hareketlerini serbest bırakmayı tercih etmektedirler. Dolayısıyla, merkez bankaları günümüzde serbest sermaye hareketleri, bağımsız para politikası ve beraberinde dalgalı döviz kuru çerçevesinde hareket etmektedir. İmkânsız üçlü hipotezi uyarınca, bağımsız para politikası ve serbest sermaye hareketleri seçimi; beraberinde dalgalı döviz kurunu da kabul etmeyi gerektirmektedir. Bu çerçevede, döviz kurunun merkez bankaları tarafından kontrol edilemeyeceği teorik olarak kabul edilmiş bir husustur.

Dalgalı döviz kurunun çeşitli faydaları bulunmakla beraber, gelişmekte olan ülkeler açısından birçok probleme de yol açabilmektedir. Bunların başında döviz kurundaki dalgalanmaların enflasyon üzerindeki etkisi bulunmaktadır. Diğer taraftan, döviz kuru dalgalanmalarının finansal sistem üzerinde de zarar verici etkileri bulunabilir.

Merkez bankaları yukarıda belirtilen kaygılar sebebiyle döviz kurunda meydana gelen aşırı hareketlere karşı da faiz kararları alabilmektedir. Bu durum sonucunda, merkez

bankalarının davranışları Taylor kuralına döviz kuru sapmalarının da eklenmesiyle açıklanabilir. Zira döviz kurunun enflasyon hedefi ve finansal sistem üzerinde tehlikeli etkileri bulunabilmektedir. Bu durum enflasyon hedeflemesi çerçevesinde meşru hale gelebilmektedir. Çünkü, döviz kuru geçirgenliği ve beklentilerin etkilenmesi enflasyon beklentilerini de olumsuz yönde etkileyebilmektedir. Diğer taraftan, finansal sistem üzerinde tehlikenin bulunması, enflasyon üzerinde de ciddi baskılar oluşturabilmektedir.

Yukarıdaki fikirler ışığında, merkez bankaları enflasyon hedefine veya finansal sisteme tehlike arz edebilecek döviz kuru gelişmelerini (örnek olarak; yüksek volatilite, likidite problemleri veya ani dalgalanmalar) önlemek için çeşitli adımlar atabilmektedir. Bu gelişmeleri önleyebilecek en önemli araç ise ana politika aracı olan faiz oranı olarak karşımıza çıkmaktadır. Ancak faiz aracı; zorunlu karşılıklar, açık piyasa işlemleri veya benzeri araçlar ile desteklenebilir.

Genel olarak, merkez bankaları istenmeyen gelişmeleri faiz aracı veya açık piyasa işlemleri ile önlemeye çalışmaktadır. Ancak çeşitli durumlarda, farklı önemler alınması veya farklı araçların kullanılması zorunluluğu doğabilmektedir. Çatışan iki amacın varlığı halinde merkez bankalarının iki farklı araç kullanması zorunlu hale gelebilir. Bu durum Tinbergen Kuralı çerçevesinde açıklanabilir. Kurala göre, iki farklı amacın varlığı durumunda en az iki farklı aracın kullanılmasına ilişkindir. Bu çerçevede, merkez bankaları ayrı bir aktarım mekanizması bulunan döviz müdahalelerinden yararlanabilmektedir.

Döviz müdahalelerinin etkinliği literatürde ciddi tartışmalara sebebiyet vermiştir. Ancak buna rağmen birçok merkez bankası döviz müdahalelerini aktif olarak kullanmaktadır. Merkez bankaları döviz kuru üzerinde yukarı yönlü baskı olduğunda satış yönlü bir müdahalede bulunabilmekte veya aşağı yönlü bir hareket olduğunda döviz kurunun istenmeyen şekilde değerlenmesini engellemek adına alış yönlü bir müdahalede bulunabilmektedir. Bununla beraber, döviz kuru üzerinde bir etki istenmeden, rezerv biriktirme veya güçlendirme adına da müdahalelerde gözlemlenebilir.

Tartışmaların temelinde ise sterilize edilen döviz müdahaleleri bulunmaktadır. Sterilize edilmeyen döviz müdahaleleri para tabanını değiştirdiğinden klasik bir para politikası aracı olarak değerlendirilmiştir. Ancak sterilize edilen döviz müdahaleleri para tabanını değiştirmediğinden, döviz kurunu etkileyebilmesi için farklı bir aktarım mekanizmasına ihtiyaç duyar. Bu bağlamda, portföy denge kanalı, sinyal kanalı ve mikro-yapısal kanal (micro-structure) döviz kuru politikasının aktarım mekanizmasını oluşturmaktadır.

Diğer taraftan, müdahalelerin etkinliği konusunda literatürde bir fikir birliği bulunmamaktadır. Bazı araştırmacılar, döviz kuruna müdahalenin etkin olmayacağı çünkü dalgalı döviz kurunun; bağımsız para politikası ve serbest sermaye hareketleri çerçevesi içerisinde etkilenemeyeceğini ileri sürmektedir. Buna ek olarak, bazı araştırmacılar aktarım mekanizmasını oluşturan kanalların artan globalleşme sonrasında işlevselliğini yitirdiğini ifade etmektedir. Buna karşıt olarak, döviz müdahalelerinin etkin olduğu ve gerekli görüldüğünde ana politika araçlarını destekleyecek şekilde kullanılabileceği literatürde birçok araştırmacı tarafından dile getirilmiştir.

Döviz müdahalelerinin etkinliğin araştırılması ve analiz edilmesi; veri ve içsellik problemleri sebebiyle zorlayıcı bir süreçtir. Öncelikli olarak, merkez bankaları çeşitli kaygılar sebebiyle müdahaleleri açıklamaktan kaçınabilmektedir. Bazı merkez bankaları ilgili müdahale verilerini günlük açıklarken, diğerleri müdahaleleri kümülatif şekilde açıklayabilmektedir. Bunun yanında, gün içi veriye ulaşabilmek yazarlar için zorlayıcı olmuştur. Müdahale verilerini yayınlamayan merkez bankaları için ise, ilgili bankaların bilançoları kullanılarak çeşitli veri setleri oluşturulmuştur. Bu bağlamda literatürde; net döviz pozisyonu, net uluslararası pozisyon, net/brüt rezerv ve benzeri değerlerden döviz müdahaleleri veri setleri oluşturulmuştur.

Etkinlik analizi için diğer bir önemli sorun ise içsellik problemidir. Döviz müdahalelerinin kur üzerindeki etkileri incelenirken, müdahale sebebinin de kurda gerçekleşen gelişmeler olması içsellik problemini ortaya çıkarmaktadır. Söz konusu probleme çözüm olarak, literatürde farklı metotların kullanıldığı birçok çalışma bulunmaktadır.

Bu çalışmada, literatürde bulunan tartışmalara katkıda bulunabilmek adına, Türkiye Cumhuriyet Merkez Bankası'nın 2012-2016 yıllarında satış yönlü yaptığı döviz müdahalelerinin etkinliği incelenmiştir. Bu dönemde, Tapering sebebiyle gelişmekte olan ülkelerin yerli para birimlerinin değer kaybettiği ve bu sebeple gelişmekte olan ülkelerin çeşitli önlemler aldığı görülmüştür. Bu önlemlerden en önemlilerinden biri de döviz müdahaleleri olmuştur.

İlgili dönem boyunca TCMB de döviz müdahalelerinde bulunan gelişmekte olan ülkelerden biri olmuştur. Bu sebeple, müdahalelerin etkinliği iki aşamalı araç değişkenler yöntemi kullanarak incelenmiştir. Etkinlik analizi, müdahalelerin döviz kurunun seviyesine veya volatiliteye etkisinin incelenmesinden oluşmaktadır. Diğer taraftan, içsellik probleminin çözülebilmesi adına, TCMB'nin döviz kuru müdahale fonksiyonu oluşturulmuş ve ilgili model tahmin edilerek hem TCMB'nin müdahale davranışları incelenmiş hem de ikinci aşama için müdahale değişkeni araç değişken haline getirilerek içsellik problemi giderilmiştir.

Bu çalışmanın literatüre en büyük katkısı, satış yönlü müdahalelerin döviz kuru üzerinde yukarı yönlü baskı olduğu dönemde incelenmesidir. Literatüre bakıldığında genel olarak yalnızca döviz satış müdahalelerinin incelendiği çalışmaların sayısının yetersizliği fark edilebilir. Diğer taraftan, söz konusu dönem içerisinde TCMB'nin aşırı tepkileri tespit edilerek, ilgili müdahalelerin döviz kuru seviyesi ve volatilite üzerindeki etkilerinin incelenmesi önem arz etmektedir. Son olarak, çok çeşitli zaman dilimleri dikkate alarak hesaplanan ortalamalar kullanılmış, döviz müdahalelerinin farklı zaman dilimleri içerisindeki etkinliği araştırılmaktadır. Bunun yanında, yine aynı zaman dilimlerinde TCMB'nin döviz müdahaleleri konusundaki yaklaşımı değerlendirilmiştir.

Çalışmamız teorik altyapının sağlandığı ikinci bölüm, literatür taramasının yapıldığı üçüncü bölüm; veri, ekonomik model ve 2012-2016 Tapering döneminin analizinin yapıldığı dördüncü bölüm; tahmin sonuçlarının açıklandığı ve yorumlandığı beşinci bölüm ve sonuç kısımlarından oluşmaktadır.

İkinci bölümde, öncelikli olarak döviz kurunun gelişmekte olan ülkeler için önemi ve bununla beraber enflasyon hedeflemesi içerisindeki önemi ifade edilmiştir. İlgili bölümde, döviz kurunun enflasyonun temel belirleyicisi haline gelebileceği ve finansal sistem üzerinde ciddi riskler oluşturabileceği ifade edilmiştir. Devamında ise, bu riskler sebebiyle merkez bankalarının çeşitli zamanlarda döviz müdahalelerinde başvurabileceği ve müdahalelerin hangi sebeplerle gerçekleşebileceği anlatılmıştır. İlgili açıklamaların ardından, döviz müdahalelerinin kur üzerindeki etkisini anlayabilmek için aktarım kanalları açıklanmıştır. Karşılaştırma yapılabilmesi adına, klasik para politikası aktarım kanallarına da kısaca değinilmektedir. Aktarım kanallarına ilişkin kısımları takiben, (Patel & Cavallino, 2019) çalışmasından yola çıkarak, merkez bankalarının müdahale sebepleri ve öncelik sıralamalarına dair tartışmalar yapılmıştır. Son olarak; müdahale pratiklerine ilişkin teorik tartışmalara yer verilmektedir. Müdahale için spot/türev piyasa ayrımı ve beraberinde spot veya türev ürünlerin tercih edilmesi, müdahale zamanlaması, gizlilik, kurallara bağlı müdahale ve benzeri konulara ilişkin tartışmalara ve literatürde bulunan fikirlere değinilmiştir.

Üçüncü bölümde ise literatür taraması yer almaktadır. Literatür taraması genel olarak gelişmekte olan ülkeler için yapılan etkinlik analizlerini içermektedir. Bu bölümde, araştırmacılar tarafından kullanılan farklı metotlara, zaman aralıklarına ve sonuçlara yönelik açıklamalardan bulunulmuştur. Buna ek olarak, tek veya iki ülkeyi inceleyen çalışmalar ve panel veri kullanarak birçok ülkeyi inceleyen çalışmalara değinilmiştir. Takip eden kısımda ise, Türkiye örneğine ilişkin yapılan etkinlik analizlerine yer verilmektedir.

Çalışmamızın dördüncü bölümünün ilk kısmı ise, kullanılan verilere ilişkin bilgilerin sağlandığı bölüm olmuştur. Bu bölümde, müdahale verileri, modellerde kullanılan verilerin açıklamaları ve kaynakları açıklanmaktadır. Devamında ise, inceleme dönemi olan 2012-2016 dönemi gelişmekte olan ülkeleri merkeze alarak kısaca incelenmektedir. Söz konusu dönemde, gelişmekte olan ülkelerde, Tapering sinyali sonrasında yoğun bir sermaye çıkışı gözlenmiş ve beraberinde döviz kurlarında yukarı yönlü hareketler gözlemlenmiştir. Gelişmekte olan ülkeler de döviz müdahaleleri dahil çeşitli önlemler alarak, döviz kurundaki yukarı yönlü hareketleri engellemeyi amaçlamışlardır. Türkiye de Tapering dönemini benzer şekilde deneyimlemiştir.

Benzer şekilde gelişmekte olan ülkelerin aldığı önlemler Türkiye örneğinde de görülebilmektedir. Bu bağlamda, gelişmekte olan ülkelerin incelendiği dönem arkasından, Türkiye ve TCMB'ye ilişkin müdahale verileri incelenmiştir. Müdahale verilerinin incelenmesinde, TCMB'nin müdahale tutarları, piyasada bulunma oranı ve benzeri betimleyici istatistiki bilgilere yer verilmiştir.

Dördüncü bölümde son olarak, etkinlik analizinin yapıldığı ekonometrik modellere ilişkin açıklamalar yapılmaktadır. Öncelikli olarak merkez bankası müdahale reaksiyon fonksiyonu tanıtılmış ve belirlenen açıklayıcı ve açıklanan değişkenlere ilişkin açıklamalar yapılmıştır. Açıklanan değişken olan müdahale değişkeninin iki koşullu (1 veya 0) olarak kabul edilmesine ilişkin açıklamalar yapılmıştır. Diğer taraftan, TCMB için tarihsel verilerin hareketli ortalamalarından yararlanılarak tolerans limitleri oluşturulmuştur. Bu tolerans limitleri; 7, 30, 150, 180, 300, 360, 540 ve 720 günlük hareketli ortalamalardan oluşmaktadır. İlgili ortalamalar ile döviz kuru seviyesi ve volatilitesi için TCMB tolerans limitleri oluşturulmuştur. Bu bağlamda reaksiyon fonksiyonunun ilk açıklayıcı değişkeni için döviz kuru tolerans seviyeleri, yukarıdaki günleri baz alarak hesaplanan hareketli ortalamalara yine aynı günleri dikkate alınarak eklenen bir standart sapma ile oluşturulmuştur. Bunun akabinde ilk açıklayıcı değişkeni oluşturmak için gerçekleşen günlük döviz kurunun ilgili tolerans limitinden sapması hesaplanmıştır. İlgili değişken, "aşırı değersizleşme" olarak isimlendirilirken, TCMB'nin müdahalelerinin hesaplanan tolerans limitinden sapmalar tarafından açıklanabileceği varsayılmıştır.

Benzer şekilde volatilite değişkeni için de tolerans limitleri yine 7, 30, 150, 180, 300, 360, 540 ve 720 günlük hareketli ortalamalar kullanılarak hesaplanan standart sapmalar ile oluşturulmuştur. İkinci açıklayıcı değişkeni oluşturabilmek adına, günlük döviz kurunun hareketli ortalamalardan sapmalarının yine tarihsel verilerden oluşturulan standart sapmalardan farkı ikinci değişkeni oluşturmaktadır. İlgili değişken "aşırı volatilite" olarak adlandırılıp, bu değişkende oluşan hareketlerin TCMB'nin müdahale kararını verirken etkili olduğu varsayılmıştır.

Yukarıdaki iki değişkenin yanında, reel döviz kurunun yine tarihsel ortalamalardan sapması da hesaplanarak, döviz müdahalesi tahmin modellerine eklenmiştir. İlgili

değişken için de yukarıda belirtilen tarihsel hareketli ortalamalar kullanılmıştır. Söz konusu değişken "döviz kurunun yanlış ayarlanması" olarak isimlendirilip, TCMB'nin müdahale kararlarında etkili olabileceği düşünülmüştür.

Yukarıdaki varsayımlar ve modeller ile tahmin edilen merkez bankası reaksiyon fonksiyonundan iki çıkarımda bulunulması hedeflenmiştir. Bunlardan birincisi, merkez bankasının döviz müdahalelerini tetikleyen sebeplerin bulunmasına ilişkindir. İkincisi ve daha önemlisi ise, içsellik probleminin çözülebilmesi için, müdahale değişkeninin araç değişken haline getirilmesidir. İlgili modeller tahmin edilerek, müdahale değişkeni dışsal hale getirilmiştir. Dolayısıyla birinci bölüm tahmini sonucunda elde edilen araç değişken, modelimizin ikinci bölümünde kullanılmıştır.

Dördüncü bölümün sonunda ise, tahmin modelinde ikinci aşama olan iki aşamalı en küçük kareler yöntemi ile tahmin edilen döviz kuru modelleri tanıtılmaktadır. Söz konusu modeller iki farklı bağımlı değişken için oluşturulmuştur. Bunlardan; günlük döviz kuru farklarının bağımlı değişken olarak kabul edildiği seviye modeli ve günlük volatilite değişimlerinin bağımlı değişken kabul edildiği volatilite modeli olarak belirlenmiştir. İlk model ile müdahale açıklayıcı değişkeninin döviz kuru seviyesi üzerinde etkisi araştırırken; ikinci model ile döviz müdahalelerinin volatilite üzerindeki etkileri araştırılmaktadır.

Yukarıda belirlenen iki model de müdahale değişkeninin yanı sıra diğer benzer değişkenler ile oluşturulmuştur. Döviz kuru seviyesi ve volatilitesi üzerinde etkili olabileceği düşünülen; DXY, VIX, EMBI, CDS, yabancı ve yerli faiz farkı seviyesi, emtia fiyatları açıklayıcı değişkenler olarak modellere dahil edilmiştir. İlgili değişkenlerin seçilmesinde literatürde yapılan çalışmalar dikkate alınmıştır.

Beşinci bölüm sonuçların paylaşıldığı ve yorumların yapıldığı ana bölüm olarak oluşturulmuştur. Müdahalelerin etkinliği bu bölümde sorgulanmaktadır. İlgili bölümde ilk olarak TCMB için oluşturulan müdahale reaksiyon fonksiyonu kullanılmaktadır. Bu bölümden elde edilen araçsallaştırılmış müdahale değişkeni de ikinci bölümde kullanılmıştır.

Söz konusu model öncelikle gerçekleşen gerçek müdahaleler ile tahmin edilmiştir. Yukarıda belirtildiği üzere müdahale değişkeni iki koşullu (1 veya 0) olarak belirlendiğinden, Probit modeli yardımı ile tahmin edilmiştir. Tahminin ilk aşamasında, model açıklanan değişken olarak döviz müdahaleleri gerçekleşen müdahaleleri olduğu gibi kabul ederek tahmin edilmiş ve yukarıda belirlenen bağımsız değişkenlerin, müdahale değişkenini açıklayamadığı görülmüştür. Bunun en önemli sebebi, inceleme döneminde TCMB'nin, özellikle 2014 ve 2015 yıllarında, neredeyse her gün müdahalede bulunmuş olmasıdır.

Bu çerçevede, müdahale değişkeni TCMB'nin aşırı reaksiyonları tespit edebilecek şekilde ayarlanmıştır. Öncelikle her yıl için günlük ortalama müdahale tutarları hesaplanmıştır. Günlük ortalama müdahalenin altında kalan müdahale tutarları "0" ve üstünde kalan müdahale tutarları ise "1" olarak kabul edilip, model Probit ile yeniden tahmin edilmiştir.

Aşırı reaksiyonları içerecek şekilde güncellenen döviz müdahale verisi, belirlenen açıklayıcı değişkenler ile açıklanabilmektedir. Farklı zaman dilimleri ile tahmin edilen modeller içerisinde 150 ve 180 günlük ortalamalar ile hesaplanan modellerden en önemli sonuçlar elde edilmiştir. İlgili modellerde, aşırı değersizleşmenin müdahale olasılığını arttırdığı ve aşırı volatilitenin de müdahale ihtimalini düşürdüğü sonucu elde edilmiştir. Diğer taraftan, kısa dönem ve uzun dönem hareketli ortalamaları ile hesaplanan tolerans limitleri ile tahmin edilen modellerdeki döviz müdahalesi değişkeni, belirlenen açıklayıcı değişkenler ile genel olarak açıklanamamıştır.

Yukarıda belirtilen fikirler ile ilgili model farklı zaman dilimleri ve döviz kurunun yanlış ayarlanması değişkeni ile de tahmin edilmiştir. Ancak kısa dönemde ve uzun dönemde (7, 30, 300, 360, 540 ve 720 günlük hareketli ortalamalar) değişkenlerin anlamlılık derecesi düşmektedir. Bununla beraber, %1 ve %5 anlamlılık düzeylerinde en iyi sonuçlar 150 ve 180 günlük ortalamalar ile hesaplanan modellerde oluşmaktadır. Dolayısıyla 150 ve 180 günlük ortalamalar ile hesaplanan modeller ana modeller olarak kabul edilmiştir. Son olarak, reel döviz kuru ile hesaplanan döviz kurunun yanlış ayarlanması değişkeninin, istatistiksel olarak anlamlı olmadığı ortaya

konulmuştur. Bu bağlamda, TCMB'nin müdahalede bulunurken reel döviz kurunu dikkate almadığı veya herhangi bir tolerans limit olmadığı iddia edilebilir.

Sonuç olarak ilk modelin tahmin edilmesiyle, TCMB için oluşturulan tolerans limiti varsayımlarının 150 ve 180 günlük ortalamalar ile hesaplandığında anlamlı sonuçlar ortaya çıkardığı ve bu sebeple, istatistiksel olarak, TCMB'nin orta vadeli tarihsel veriler ışığında müdahale kararlarında bulunduğu tespit edilmiştir. Orta vadede ortaya çıkan sonuçlar ışığında, aşırı değersizleşmenin müdahale ihtimalini arttırdığı ve aşırı volatilitenin de müdahale ihtimalini düşürdüğü ortaya konmuştur. Ancak, yine istatistiksel olarak, TCMB'nin müdahale için reel döviz kurunu dikkate almadığı veya tolerans limiti varsayımının reel döviz kuru için geçerli olmadığı anlaşılmıştır.

İlk modelin tahmin edilmesi sonrasında, müdahale değişkeni araçsallaştırılmış ve ikinci model içerisinde kullanılmıştır. Araçsallaştırmanın yapıldığı model, yukarıda bulunan açıklamalar sebebiyle, 150 ve 180 günlük hareketli ortalamaları dikkate alan modeller olarak belirlenmiştir.

İkinci model ise belirtildiği üzere, döviz kuru seviyesi ve döviz kuru volatilitesi üzerinde müdahale değişkeninin etkisi anlayabilmek adına oluşturulmuştur. Öncelikli olarak bağımlı değişkenin döviz kuru seviyesini ifade edecek şekilde oluşturulduğu model iki aşamalı en küçük kareler yöntemi ile tahmin edilmiştir.

Söz konusu modelin tahmini sonucunda, müdahale değişkeninin döviz kuru seviyesine etkisinin olmadığı görülmüştür. Tahmin sonuçlarını kesinleştirebilmek adına, farklı zaman dilimleri ile hesaplanan araçsallaştırılmış döviz müdahalesi değişkeni kullanılmış ve bununla beraber, farklı açıklayıcı değişkenlerden yararlanılmıştır. Ancak istatistiksel olarak, hiçbir modelde müdahale değişkeninin döviz kuru seviyesini açıklayamadığı ve etkisinin olmadığı görülmüştür.

İkinci model ise döviz müdahalelerinin volatilite üzerindeki etkilerini ölçmek için oluşturulmuştur. Ana modelin yukarıda belirtilen sebepler ile yine 150 ve 180 günlük ortalamalar ile hesaplanan müdahale değişkeni olmasına rağmen, sonuçları kesinleştirebilmek adına, yine benzer şekilde farklı zaman dilimleri dikkate alınarak

hesaplanan araçsallaştırılmış döviz müdahale değişkenleri de modellerde kullanılmıştır.

Volatilite üzerindeki müdahale etkisi ise döviz kuru seviyesi üzerindeki etki kadar açık olmamakla beraber, orta vadede, volatiliteyi düşürücü etki yapabileceği tespit edilmiştir. Müdahalenin etkisi çok küçük ve istatistiksel olarak düşük anlamlılık düzeylerinde anlamlı olmasına rağmen, orta vadede volatilite üzerinde düşürücü etkisi bulunmaktadır. Diğer taraftan, kullanılan diğer modeller için, kısa vadede volatilite üzerinde etkisinin bulunmadığı ve uzun dönemde de karışık sonuçlar bulunurken, yine düşük anlamlılık düzeylerinde volatiliteyi arttırabileceği de ortaya konmuştur.

Sonuç olarak bütün modeller ve sonuçlar değerlendirildiğinde, TCMB müdahale reaksiyon fonksiyonu için ana model olarak 150 ve 180 günlük modeller açıklayıcı değişkenlerin %1 ve %5 anlamlılık düzeylerinde anlamlı olması sebebiyle tercih edilmiştir. Bununla beraber, diğer modellerde yüksek anlamlılık düzeylerinde güçlü açıklayıcı değişkenler elde edilememiştir. Gerçekleşen müdahale verileriyle tahmin edilen model için anlamlı sonuçlara ulaşılamamış, bu sebeple müdahale verisi, TCMB'nin aşırı reaksiyonlarını kapsayacak şekilde güncellenmiştir. Bunun sonucunda, aşırı değersizleşme ve aşırı volatilite değişkenlerinin müdahale verisini yüksek anlamlılık derecelerinde açıklayabildiği görülmüştür. Aşırı değersizleşmenin TCMB'nin müdahale etmesi ihtimalini arttırdığı; ancak aşırı volatilitenin müdahale ihtimalini düşürücü etkide bulunduğu tespit edilmiştir.

İkinci modelde ise müdahalenin, döviz kuru seviyesi ve volatilitesi üzerinde etkiler analiz edilmiştir. Farklı zaman dilimlerinde de test edilmiş olmasına rağmen, ana model olarak yine 150 ve 180 günlük hareketli ortalamaları temel alan modeller kullanılmıştır. İstatistiksel olarak, aşırı müdahalelerin döviz kuru seviyesi üzerinde herhangi bir etkisi tespit edilememiştir. Buna karşın, volatilite üzerinde istatistiksel olarak düşük ve %1 anlamlılık derecesinde önemli olmasına rağmen çeşitli modellerde volatilite üzerinde azaltıcı bir etki yapabildiği ortaya konmuştur.

2012-2016 döneminde yapılan döviz müdahalelerinin genel olarak başarısız olmasının sebepleri bu çalışmanın ana konusu olmamakla beraber, teoriden yola çıkarak çeşitli

açıklamalar geliştirilebilir. Enflasyon hedeflemesi rejimi içerisinde, serbest sermaye hareketleri ve bağımsız para politikasının kullanılması beklenmektedir. Bu yapı içerisinde, imkânsız üçlü hipotezi uyarınca, döviz kurunun kontrol edilemeyeceği ifade edilmektedir. Dolayısıyla yapılan müdahalelerin döviz kurunu etkilemeyi amaçlaması sebebiyle, döviz kuru seviyesinde etkin olmaması teoriyle uyumludur. Diğer taraftan, TCMB'nin yüksek volatilite durumunda müdahaleden kaçınması, yine müdahalelerin volatiliteyi arttırabileceğini ifade eden çalışmalar ile uyum içerisindedir. Buna rağmen çeşitli modellerde müdahalelerin volatilite üzerinde düşürücü etkisi bulunması teoriye uyumludur.

TCMB inceleme dönemi içerisinde enflasyon hedeflemesi rejimi uygularken, aynı anda döviz müdahalelerinde bulunmuştur. Bu durumda, TCMB'nin iki farklı hedefinin bulunabileceği algısı piyasa katılımcıları tarafından oluşturulmuş olması beklenebilir. Dolayısıyla, iki farklı hedefin varlığı durumunda, bunlardan birinin başarısız olması beklenebilecek bir sonuç olarak karşımıza çıkmaktadır.

Çalışmamızda genel olarak genellemelerin yapılamaması ve model oluşturmanın zorluğuna ilişkin iki durum bulunmaktadır. Genel olarak müdahalelerin etkinliği; analiz dönemine, ilgili ülkenin yapısal özelliklerine ve kırılganlıklarına, dünya ekonomisinin durumuna ve benzeri birçok dışsala bağlı olarak değişebilmektedir. Dolayısıyla sonuçların bütün ülkeler ve tüm zamanlar için genellenmesi sakıncalı olabilir. Sonuçlarımız ilgili dönem, seçilen ülke ve çalışmanın diğer bütün özellikleri dikkate alınarak değerlendirilmesi önem teşkil etmektedir.

Göz önünde bulundurulması gereken diğer bir konu ise, döviz kurunu günlük veriler kullanarak açıklamaya çalışan modellerin içermesi gereken değişkenleri, bütün verilerin günlük yayınlanmaması sebebiyle modele dahil edilememesinden kaynaklanmaktadır. Örneğin günlük döviz kuru seviyesini inceleyen modelimizde, yerli ve yabancı fiyat seviyeleri bulundurulamamış bunun yerine temsili emtia fiyatları değerlendirilmiştir. Fiyat seviyeleri genellikle aylık periyotlar ile açıklanmakta ve bu sebeple günlük verilerin bulunduğu modellere dahil edilememektedir. Dolayısıyla bu durum modelliğin açıklayıcılığını etkileyebilecek bir husus olarak ortaya çıkmaktadır.

Literatürde başarılı müdahalelerin olduğu gibi başarısız müdahalelerin varlığı da oldukça yaygındır. Başarı kriteri için merkez bankalarının hedefleri dikkate alınarak yorumlarda bulunulmalıdır. Ancak merkez bankaları, özellikle satış yönlü müdahaleler için, maliyet analizlerini dikkatle yerine getirmelidir. Zira başarısız müdahaleler sonucunda rezervlerin harcanması sonucunu doğurabilecektir.

Bu çalışmadan elde edilen bilgiler ve çıkarımlar ile gelecek çalışmalar için çeşitli fikirler oluşmuştur. Bunlardan ilki, analizin benzer bir gelişmekte olan ülke ile beraber yapılabileceğidir. Karşılaştırmalı olarak incelenen döviz müdahaleleri, sonuçların daha keskin şekilde yorumlanabilmesine olanak tanıyacağı düşünülmektedir. Bu çerçevede, aynı dönem içerisinde ve benzer yapısal özelliklerin bulunduğu iki ülke için çalışmanın uygulanması gelecek analizler için önemli olabilecektir.

Diğer bir fikir ise, 2021 yılından itibaren TCMB'nin yaptığı müdahalelerin incelenmesine ilişkindir. 2021 yılından başlayarak TCMB yükselen döviz kuru karşısında döviz müdahalelerinde bulunmuştur. Verilerin günlük olarak açıklanması sebebiyle gelecek çalışmalar için faydalı olacağı değerlendirilmektedir. Bununla beraber, çalışmamızda inceleme döneminde yalnızca spot piyasada yapılan müdahaleler incelenmiştir. Ancak TCMB; swap başta olmak üzere diğer türev enstrümanlarla da müdahalelerde bulunmuştur. Gelişmekte olan ülkelerin bazıları da döviz müdahaleleri için türev ürünlerden faydalandığından, TCMB'nin türev ürünler kullanarak yaptığı döviz müdahaleleri başka bir inceleme konusu olarak değerlendirilebilir.

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