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Systematic Managed Float for Exchange Rate Works or Not? Evidence from Turkey

Döviz Kuru için Sistematik Yönetimli Dalgalanma Etkin mi? Türkiye'den Kanıtlar

Tayfur BAYAT[1] ve İzzet TAŞAR[2]

[1] *Prof. Dr., İnönü Üniversitesi, İİBF, İktisat Bölümü, Malatya, tayfur.bayat@inonu.edu.tr, orcid.org/0000-0002-4427-0999*
[2] *Prof. Dr., Fırat Üniversitesi, İİBF, İktisat Bölümü, Elazığ, itasar@firat.edu.tr, orcid.org/0000-0001-9187-6910*

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Cointegration with structural breaks, foreign exchange market pressure index, exchange rate regimes, central bank

ABSTRACT

This study examines the dynamics of structural breaks in Turkey's foreign exchange market and exchange rate regimes using the index of foreign exchange market pressure (EMP) from January 2006 to October 2024. The low negative correlation between the nominal exchange rate and central bank reserves suggests a managed exchange rate regime during this period. The cointegration model with structural breaks identifies three key breaks: November 2008 (global financial crisis), February 2012 (European debt crisis), and February 2022 (post-pandemic economic transformation). From January 2006 to October 2008, a market-oriented floating exchange rate regime was in place. After November 2008, foreign exchange market interventions increased due to the global crisis, deviating from the floating exchange rate regime. Between February 2012 and January 2022, EMP peaked, and policies resembling a fixed exchange rate regime were pursued. In the most recent period (February 2022 to October 2024), foreign exchange interventions decreased, but exchange rate uncertainties remained. Furthermore, post-January 2022, the Japanese Yen was not used for arbitrage. Policy recommendations include strengthening the floating exchange rate regime, better management of foreign exchange reserves, and using reserves only during crises

Anahtar Kelimeler
Yapısal kırılmalı eşbütünleşme, döviz piyasası baskı endeksi, döviz kuru rejimleri, merkez bankası

ÖZ

Bu çalışma, Türkiye ekonomisinde Ocak 2006 ve Ekim 2024 arasında döviz piyasasında yapısal kırılmaların ve döviz piyasası baskı endeksi (EMP) ile kur rejimlerinin dinamiklerini analiz etmektedir. Nominal döviz kuru ile merkez bankası rezervleri arasındaki negatif ve düşük dereceli korelasyon ampirik analiz döneminde yönetilen kur rejiminin uygulandığını göstermektedir. Yapısal kırılmalı eşbütünleşme modeline göre, Kasım 2008**,** Şubat 2012 **ve** Şubat 2022 tarihlerinde üç önemli yapısal kırılma belirlenmiştir. Bu kırılmalar, küresel finansal kriz, Avrupa borç krizi ve pandemi sonrası ekonomik dönüşüm gibi kritik dönemlerle örtüşmektedir. İlk dönemde (Ocak 2006-Ekim 2008), piyasa odaklı bir dalgalı kur rejimi benimsenmiştir. Ancak, Kasım 2008 sonrası dönemde küresel krizle birlikte döviz piyasalarına müdahaleler artmış ve dalgalı kur rejiminden sapmalar gözlemlenmiştir. Şubat 2012- Ocak 2022 dönemi, EMP'nin en yüksek seviyelere ulaştığı ve sabit kur rejimine yakın politikaların izlendiği bir dönem olmuştur. Son dönemde (Şubat 2022-Ekim 2024), döviz müdahalelerinin azaldığı ancak kur belirsizliklerinin devam ettiği anlaşılmaktadır. Ocak 2022 sonrası dönemde Japon Yen'inin arbitraj amaçlı kullanılmadığı bulgusuna ulaşılmaktadır. Politika önerileri arasında dalgalı kur rejiminin piyasa mekanizmalarına uygun şekilde güçlendirilmesi, döviz rezervlerinin daha etkin yönetilmesi ve rezervlerin yalnızca kriz dönemlerinde kullanılması bulunmaktadır.

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Sorumlu yazar/Corresponding author: İzzet TAŞAR, itasar@firat.edu.tr

1.Introduction

Fluctuations in global financial markets and efforts to maintain national economic stability play an important role in the choice of exchange rate (hereafter ER) regime. Manageable floating ER system is among the policy preferences of CB (hereafter CB) as a mechanism that provides flexibility between free floating and fixed ER systems. ER preferences, which are discussed in the economic literature, are addressed with functions such as ensuring price stability and foreign trade balance, managing capital flows and preventing currency substitution, especially in open economies. While the floating ER system recognizes the efficiency of the free market mechanism, it allows CB to intervene in the foreign exchange market. Thus, it aims to limit excessive fluctuations in the financial market. Theoretically, the floating ER system aims to strike a balance between ER stability and the influence of market forces. The monetarist approach argues that fixed ER systems may cause economic imbalances by suppressing market dynamics in the long run. The Keynesian view, on the other hand, supports mitigating the adverse effects of financial market fluctuations on foreign trade and capital flows through CB interventions. The floating ER regime offers a theoretically pragmatic solution by incorporating elements of both approaches into the model. This regime prevents excessive ER volatility and allows the nominal ER to move according to economic fundamentals.

For the Central Bank of the Republic of Turkey (CBRT), the floating ER system is important as a strategic tool to ensure economic and financial stability. As an economy open to capital flows, Turkey is directly affected by ER fluctuations. In periods of high currency substitution, the ER pass-through effect paves the way for financial crises to turn into real sector crises. The CBRT's foreign exchange market interventions within the framework of the floating ER policy aim to manage foreign exchange reserves effectively and to build confidence in the markets. Moreover, this regime contributes to economic growth and financial stability by enabling the adoption of an ER strategy in line with inflation targeting and foreign trade policies. Understanding the effects of the floating ER system on the Turkish economy requires a comprehensive analysis of the dynamics of this regime in both theoretical and applied studies. This study aims to provide a deeper discussion of the importance of this ER regime in the context of the Turkish economy. In the financial literature, the EMP concept is generally used as an early warning system in financial crises or as a method to identify short-term nominal exchange rate pressures. Therefore, EMP is preferred to identify the dates of hot money outflows, international reserve losses and sudden nominal exchange rate movements. In this study, EMP is subjected to a multidimensional evaluation by including EMP in the analysis of long-term exchange rate regime responses in addition to monitoring sudden financial stresses. With this approach, it allows us to identify the reactivity of exchange rate regime preferences during periods of structural breaks over time. Moreover, the empirical tests used in this study help to provide systematic implications for EMP's monetary policy preferences not only in times of financial crises. Thus, the exchange rate regime choice is not only driven by technical reasons, but also as a monetary policy component that is reshaped over time.

Although there are many studies on CB international reserves and the nominal ER, the motivation for this study is the empirical model in Frankel (2019) and the evaluation of the application results. Frankel (2019) "Systematic Managed Floating" is an important academic study that examines how ER regimes are shaped in theory and practice. This study provides a theoretical and empirical framework for the managed floating ER regime, which lies between the free floating ER and the fully fixed ER and in which CB systematically intervene in market mechanisms. The study analyzes whether the floating ER regime provides a balance between market actors and macroeconomic objectives and how it works in practice. The main objective of Frankel's (2019) study is to evaluate the effectiveness of the floating ER regime and its potential to reduce ER volatility and ensure economic stability. The paper argues that floating ER systems generate less volatility than full floating ER regimes and that CB can create a more predictable economy through regular interventions in the foreign exchange market. It also provides strategic recommendations on when and how systematic interventions should be made, emphasizing that these interventions should be based on economic indicators rather than random.

1.1.Theoretical Background and Literature Review

The relationship between central bank reserves and the nominal ER is a theoretical and applied research area that is always on the agenda in the context of both international economics and monetary theory. This relationship is shaped by many macroeconomic factors such as ER preferences, trade balance, price stability and short/long-term capital flows. The effect of reserves on the nominal ER depends to a large extent on the preferred ER regime. Under a fixed ER regime, interventions in the foreign exchange market are usually realized through the use of international reserves. Under a fixed ER, monetary policy independence is limited and international reserves are used as a defense mechanism against external shocks. Under a floating ER regime, CB can intervene in foreign exchange markets if macroeconomic fluctuations threaten financial stability (Friedman, 1953). There are two important theoretical mechanisms that analyze the effect of international reserves on the ER. (i) Buffering Mechanism. Reserves are used to stabilize fluctuations in the trade balance and short-term capital flows. The theory of ER "overshooting" put forward by Dornbusch (1976) emphasizes that short-term capital flows can cause large fluctuations in the ER. The central bank can buffer such fluctuations by using its reserves. (ii) Precautionary Mechanism. Krugman (1979) argues that reserves serve as insurance against exogenous shocks. Reserves play a critical role in financing balance of payments deficits and boosting market confidence. This is especially important in developing countries to prevent currency crises. There are costs as well as benefits to accumulating reserves, so the cost-benefit trade-off should be optimized. The costs of accumulating reserves are associated with opportunity costs. When reserves are invested in low-yielding foreign currency, they can lead to a potential savings shortfall and hence a loss of growth opportunities (Rodrik, 2006). The benefits of holding reserves include providing liquidity in times of crisis, supporting CB' role as lender of last resort, stabilizing the ER and buffering against external shocks. Reserve accumulation strategies should be sustainable to reduce ER volatility. Over-utilization of reserves may dominate market speculators but may lead to reserve depletion in the long run. Therefore, reserve management needs to be supported by a careful cost-benefit analysis.

The role of international reserves in mitigating ER fluctuations is a common finding of many studies. Levy (1983) and Edwards (1983) show that in fixed and adjustable fixed ER regimes, reserves play an important role in stabilizing the ER and act as a buffer against sudden ER fluctuations. Heller and Khan (1978), Choudhry and Hasan (2008), Aizenman et al. (2020) find that the demand for reserves is higher in countries with fixed ER regimes because reserves are used more frequently to defend the ER in fixed regimes. Badiner (2004) and Fridriksson (2010) suggest that countries with fixed ER regimes should maintain high levels of international reserves. Fridriksson (2010) also finds that countries with floating ER regimes are less likely to accumulate reserves, but reserve holding strategies are still important against crisis risk. However, Grubel (1971) and Heller and Khan (1978) argue that in floating ER regimes, the demand for reserves decreases, but reserve accumulation should be maintained at certain levels depending on the volatility of foreign exchange markets. Bahmani-Oskooee and Brown (2002) argue that the adoption of floating ER regimes may reduce the demand for reserves, but this effect varies across countries. Vacaflores and Kishan (2014) provide some policy recommendations to improve reserve policy in ER regime choice. According to Vacaflores and Kishan (2014), countries with fixed ER regimes can optimize their reserve accumulation policies by taking remittances into account. In floating ER regimes, other stabilization tools should be strengthened, given the limited impact of remittances on reserve policies. Afzal (2010) reveals the stabilizing effect of reserve accumulation on ER fluctuations in countries that experienced the Asian crisis. Examples such as the 1997 Asian Financial Crisis and the 2008 Global Financial Crisis demonstrate the support of reserves in crisis management. In the Asian crisis, insufficient reserves made it difficult to maintain ER stability and led to large-scale devaluations. This led developing countries to accelerate their reserve accumulation strategies (Aizenman & Marion, 2003). According to Terada-Hagiwara (2005), in the aftermath of the 1997 Asian Financial Crisis, reserve accumulation strategies were used in Asian countries to prevent post-crisis balance of payments problems and to increase monetary policy flexibility. Nwachukwu et al. (2016) argue that ER volatility affects reserve accumulation behavior and this relationship becomes stronger at certain threshold levels. Nwachukwu et al. (2016) argue that reserve utilization increases when the nominal ER exceeds a threshold level. India-specific studies by Tiwari and Kyophilavong (2017) and Kalu et. al. (2019) show that foreign exchange reserves have a strong effect on ER stability in the short run, while this relationship may weaken in the long run if macroeconomic stability is achieved. The critical role of reserves in promoting ER stability in developing countries is also supported by Shrestha and Semmler (2015). According to Vieria and Silva (2022), developing countries prioritize the buffer function against crises in reserve accumulation, while developed countries use their reserves more as a financial safety mechanism. Ramachandran and Srinivasan (2007) argue that the Indian central bank intervenes more aggressively in periods of depreciation of the national currency and less in periods of appreciation of the national currency. The common conclusion from the studies examining the role of reserves in ER stabilization is that reserves are a tool to stabilize the ER and this function becomes more prominent especially in times of crisis. As mentioned earlier, EMP is based on the objective of detecting fluctuations in the foreign exchange market at an early stage. Thus, EMP allows analyzing the active or passive character of the exchange rate regime choice. Dornbusch's (1976) "overshooting model" emphasizes the sudden and severe fluctuations in the nominal exchange rate caused by hot money flows and argues that central banks' use of reserves to limit this volatility plays a stabilizing role. Krugman (1979), on the other hand, argues that the use of reserves in balance of payments crises can act as an "insurance mechanism" against sudden exchange rate shocks. Taken in this way, the EMP not only measures exchange rate volatility but also serves as an analytical tool to monitor whether central banks' responses to exchange rate choices are systematic.

The economic costs of reserve accumulation have been emphasized in many studies. Pina (2015) argues that reserve accumulation is effective in stabilizing ERs in emerging economies, but it can have side effects such as monetary expansion and opportunity costs. Keeping reserves liquid increases these costs and may have a limiting effect on economic growth in the long run. Levy (1983) and Shrestha and Semmler (2015) emphasize that the conditions under which the benefits of reserve accumulation offset the costs should be carefully evaluated. Moreover, the costs of reserve accumulation are not limited to direct economic effects. According to Sidaoui (2005), during the Tequila crisis, Mexico's reserve accumulation policies facilitated Mexico's access to financial markets and reduced external borrowing costs. Dominquez et al. (2012) argue that the economic costs of accumulating reserves may offset the benefits in dealing with the crisis. However, the benefits of holding reserves outweighed the costs during the crisis. Studies that examine the alternative cost of holding reserves suggest that reserve accumulation should be optimized to support economic growth.

With the advances in time series methodology, many studies have shown that thresholds of ER volatility and other macroeconomic variables have a differential impact on reserve demand. Nwachukwu et al. (2016) argue that reserve accumulation behavior changes above and below a given level of ER volatility, so reserve strategies should be tailored to these thresholds. Similarly, Tiwari and Kyophilavong (2017) emphasize that reserve use is more intensive during periods of high ER volatility, but managing this relationship can be costly. Using threshold cointegration analysis, Ahmand and Pentecosy (2009) find that above a certain threshold value of trade volume or economic size, the impact of reserves on ER volatility decreases, while below the threshold value, reserves play a critical role in ER stabilization. According to Wu et. al. (2014), Lee (2014), the lack of deepening of financial markets and restrictions on capital flows are the two biggest obstacles to the national currency becoming a reserve currency. Studies examining threshold effects differ according to countries' ER regimes, foreign trade volumes and financial market depth.

The relationship between reserve accumulation and monetary policy has been widely discussed in the literature. Ariyasinghe and Cooray (2021) find that reserve accumulation strategies in Sri Lanka support ER stability and contain inflation. Pina (2015) argues that reserve accumulation is associated with monetary easing. Interventions in the foreign exchange market through open market operations affect the monetary base. Therefore, foreign exchange interventions may increase the money supply and create inflationary pressures. According to Aizenman (2019), more international reserves can increase the monetary policy independence of developing countries, but this effect is limited and costly. Shrestha and Semmler (2015) argue that reserves limit monetary policy independence if they are used for ER interventions. Terada-Hagiwara (2005) argues that the aftermath of the 1997 Asian Financial Crisis limited the monetary policy independence of Asian countries, but increased financial stability during crisis periods. Badinger (2004) argues that mismatches between money supply and money demand increase the demand for reserves. Therefore, the use of reserves is relatively less in rule-based monetary policy. Lee and Yoon (2020) suggest harmonization between reserve policies and monetary policy instruments by taking into account the negative effects of ER volatility on economic sustainability in the long run, while Aizenman and Riera-Crichton (2008) and Makin (1974) suggest creating appropriate policy frameworks for financial/trade integration, trade volume and external debt burden.

Studies on ERs, international reserves and Central Bank policies in the Turkish economy generally focus on issues such as the reserve option mechanism, ER volatility, international reserve adequacy and the impact of foreign exchange reserves on market stability. In his study evaluating the effectiveness of foreign exchange reserves, Altuntaş (2019) examines the relationship between the reserve option mechanism and international reserves and emphasizes that this mechanism is effective in diversifying reserves. Similarly, Kurum and Oktar (2019) analyze the impact of the reserve option mechanism on the ER and find that this mechanism contributes to ER stability. Ören (2022) analyzed the ER volatility in Turkey and its relationship with central bank foreign exchange reserves and argued that ER volatility increases especially during crisis periods and the stabilizing effect of reserves on this volatility is limited. In a similar perspective, Çeştepe and Güdenoğlu (2020) examine the asymmetric relationship between foreign exchange reserves and ERs and find that the effect of reserve increases on ER stability decreases. Yurdal and Demirel (2021) analyze the effect of reserve adequacy on real ER volatility in an asymmetric framework and find that this effect is non-linear and the effect of changes in reserves on the ER exhibits an increasing structure. Öztürk and Özkul (2021) examine the relationship between Central Bank reserves and ER volatility and argue that reserves play a critical role in foreign exchange market stability. Focusing on gold reserves, Tatar (2021) analyzed the relationship between gold reserves and ERs and showed that the effect of gold on the ER varies depending on the size of foreign exchange reserves. Cengiz (2024) analyzed the relationship between CBRT reserves, ERs and current account deficit and emphasized that the effect of foreign exchange reserves on the current account deficit is bidirectional. Özek and Ergür (2022) discuss the adequacy of international reserves in preventing fluctuations in foreign exchange markets and argue that the stabilization capacity of reserves varies depending on market conditions. Moreover, Sertkaya and Yaman (2023) analyze the sources of ER instability using a time-varying causality approach and show that the effect of reserve policies on the ER is cyclical. In conclusion, the existing literature reveals that the relationship between foreign exchange reserves and the ER in Turkey is cyclical, asymmetric and changes depending on policy preferences. Most of the studies suggest that foreign exchange reserves contribute to market stability, but this effect may diminish during crisis periods.

The results from the literature review suggest that international reserves are an essential tool for ensuring economic stability and mitigating ER fluctuations. However, the opportunity costs of reserve accumulation, its effects on the monetary base and its relationship with ER preference suggest that reserve management should be carefully optimized. It is emphasized that reserve accumulation against external shocks is an economic necessity in developing countries, but this process should be carried out in a way that does not disturb the macroeconomic balance. The function of reserves as an economic defense mechanism in times of crisis increases the long-term benefits of these policies. In general, the common theme of these studies is that reserve management strategies should be adapted to ER regimes, foreign trade dynamics and macroeconomic conditions of the country.

2.Empirical Results

This study investigates the extent to which floating and fixed ERs were applied in the Turkish economy between January 2006 and October 2024, when the explicit inflation targeting regime was introduced. For this purpose, the methodology applied in Frankel (2019) will be followed. This study differs from other studies in two ways. First, it analyzes the effect of changes in reserves on the nominal ER. Second, it applies the cointegration test developed by Bai and Perron (2003, 2006) that takes into account structural breaks. In the study, net reserves in US dollars are used. Net foreign exchange reserves are calculated by subtracting total foreign exchange liabilities from the central bank's foreign assets and dividing by the monthly average US dollar ER. Other variables are M3 money supply, USD/TRY bid quotation, EUR/TRY bid quotation, JPY/TRY bid quotation, and SDR/TRY bid quotation as indicators of monetary base. $\Delta s \equiv$ the variation in the logarithmic representation of the foreign exchange valuation of the domestic currency, Δres be the change in the central bank's holdings of foreign exchange reserves, and MB be the monetary base;

$$\Delta s = \varphi \frac{\Delta res}{MB} \tag{1}$$

is calculated as the correlation coefficient. In Frankel (2019), a correlation coefficient close to one indicates a floating ER, while a correlation coefficient close to zero indicates a fixed ER. He also states that the correlation coefficient below the threshold value of 0.25 is a managed floating ER. In the light of these explanations, it is seen that the Turkish economy has a managed floating ER.

Table 1. Correlation

	(Δres)/MB
Δs	-0.226 (0.00)[a]

p<0.01 a

Frankel (2019) uses a simple regression method to determine the degree of systematic managed ER preference. For this purpose, reserve currencies from the global financial system and the foreign exchange market pressure index developed by Frankel and Wei (2008) are used. On the left-hand side of the regression is the SDR/TRY parity with its natural logarithm and then its first difference, and on the right-hand side is the reserve currencies and the index of foreign exchange market pressure (EMP) with its natural logarithm and then their first difference.

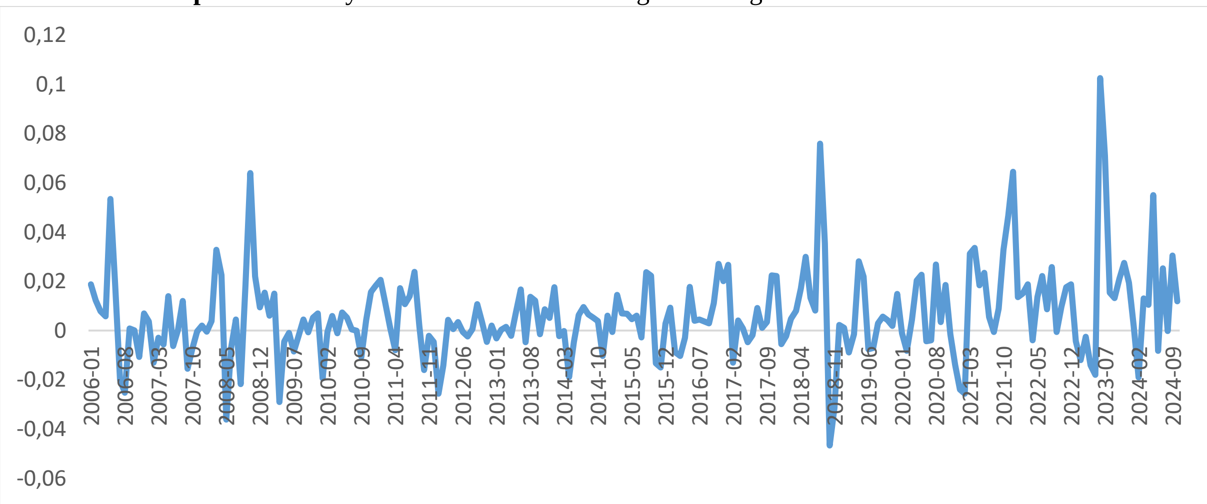
$$\Delta logH_t = c + \sum_{j=1}^{k}\left(w_j \Delta logX_{j,t}\right) + \beta \Delta EMP + +u_t \qquad (2)$$

H_t denotes SDR/TRY parity, $X_{j,t}$ denotes USD/TRY, EUR/TRY and JPY/TRY parities, respectively. The change in the foreign exchange market pressure index is obtained by summing the increase in the value of the national intermediate unit in foreign currency and the increase in foreign exchange reserves.

$$\Delta EMP \equiv \Delta logH_t + \frac{\Delta res}{MB_t} \qquad (3)$$

is obtained as. If (β_1) the parameter of the EMP is 1, it indicates a floating ER, and if it is close to 0, it indicates a fixed ER.

Graphic 1. January 2006-October 2024 Foreign Exchange Market Pressure Index



Note: Calculated by authors.

Graphic 1, which includes the foreign exchange market pressure index, shows a significant increase since the end of 2008 and the beginning of 2009. The global financial crisis led to capital outflows and pressure on ERs in emerging economies such as Turkey. During this period, the Central Bank made efforts to support the market through interest rate cuts, liquidity support and the use of its reserves. The US Federal Reserve's signal that it would taper monetary easing (Tapering 2013) led to capital outflows from emerging markets. During this period, the Turkish economy experienced pressure in the foreign exchange market due to its high current account deficit and dependence on short-term debt. In the second half of 2016 (July 15 coup attempt), uncertainty in the markets and foreign investors' risk perception of Turkey increased. 2018 saw one of the index's highest levels. Political tensions with the US (the Brunson crisis) led to a depreciation of the Turkish lira. In August 2018, the lira depreciated sharply against the dollar. The Central Bank tried to stabilize the market by raising interest rates and using reserves. In 2020 and 2021, uncertainty in global markets increased with the pandemic. In Turkey, demand for foreign currency increased, tourism revenues declined and economic activity slowed down. Significant foreign currency sales were made from the Central Bank reserves. In late 2021 and early 2022, the CBRT cut interest rates one after another, causing inflation to rise sharply and the TL to depreciate rapidly. Although the introduction of the currency-protected deposit system somewhat reduced the demand for FX, the pressure in the FX market was quite high during this period. Chart 1 clearly shows how the foreign exchange market reacted to critical events in the Turkish economy. Each peak period is caused by either exogenous shocks (global crisis, pandemics) or endogenous uncertainties (political crises, economic policy changes). Increased pressure in the foreign exchange market led to the depletion of reserves and severe fluctuations in the Turkish lira. These events highlight Turkey's dependence on the ER and the critical role of the Central Bank in the market. The economic policy decisions taken during this period, while providing relief to the market in the short term, brought with them the risk of reserve depletion in the long term.

Table 2. Unit Root Test Results

Tests	*Variables*	*Constant*	*Constant and Trend*
Panel A. ADF (1981)	EMP	-10.544 (0.00)[a]	-11.204 (0.00)[a]
	ln(USD/TRY)	2.687 (0.99)	-0.707 (0.97)
	ln(EUR/TRY)	2.809 (0.99)	-0.073 (0.99)
	ln(JPY/TRY)	1.532 (0.99)	-1.010 (0.93)
	lnH_t	-10.936 (0.00)[a]	-11.614 (0.00)[a]
		Model A	*Model C*
Panel B. ZA (2002)	EMP	-8.845[a] [March 2021]	-8.879[a] [February 2021]
	ln(USD/TRY)	-3.788 [October 2021]	-3.092 [April 2017]
	ln(EUR/TRY)	-2.658 [October 2021]	-3.492 [January 2017]
	ln(JPY/TRY)	-3.168 [October 2012]	-3.798 [October 2012]
	lnH_t	-8.810[a] [March 2009]	-8.930[a] [December 2017]
Panel C. LS (2003)	EMP	-10. 478[a]	-11.527 [a]
		[October 2016 and May 2021]	[April 2018 and April 2021]
	ln(USD/TRY)	-1.581	-6.136[a]
		[April 2009 and July 2018]	[September 2013 and October 2021]
	ln(EUR/TRY)	-1.763	-6.248[a]
		[July 2008 and March 2019]	[Octeber2015 and Temmuz 2021]
	ln(JPY/TRY)	-1.818	-4.211
		[July 2018 and November 2021]	[October 2011 and October 2015]
	lnH_t	-11.405[a]	-12.005[a]
		[October 2021 and March 2022]	[July 2021 and March 2022]

Notes: ADF (1981) Augmented Dickey and Fuller (1981), ZA (1992) Zivot and Andrews (1992), LS (2003) Lee and Strazicich (2003), p<0.01 a, () probability, [] break dates, 1%, 5% and 10% critical values are -5.43, -4.80 and -4.58 for Model A, -5.57, -5.08 and -4.82 for Model C in ZA (1992) test. In LS (2003) test, -4.545, -3.842 and -3.504 for Model A; Model C: -5.823, -5.286 and -4.989.

Table 2 presents both conventional and structural break unit root test results. According to ADF (1981), EMP and lnHt variables do not suffer from unit root problem at the level value. Other variables, on the other hand, have unit roots in both models. EMP, which expresses exchange rate pressure, responds quickly to monetary policy changes and maintains its long-run trend without being affected by shocks. lnHt, on the other hand, shows that the central bank's reserve management policy is in a stable intervention regime on the nominal exchange rate. In the ZA (1992) unit root test taking into account structural breaks, the alternative hypothesis claiming that there is no unit root and structural break is accepted for EMP and lnHt variables. Accordingly, EMP experienced a structural break in February and March 2021, while lnHt experienced a structural break in March 2009 in Model A and December 2017 in Model C. The LS (2003) test yields similar results for these two variables. EMP has structural breaks in October 2016 and May 2021 in Model A and April 2018-2021 in Model C. lnHt has structural breaks in October-July 2021 and March 2022. February and March 2021 are a clear reflection of the change in the Central Bank governor on FX markets. The March 2009-December 2017 period reflects the volatility and market changes in the reserve currency in the aftermath of the 2008 global economic crisis. The breaks in the 2021-2022 periods show the return to negative values in reserves in the post-pandemic period and the dependence on swaps in reserve management. On the other hand, other variables (parities) show a persistent response to endogenous/exogenous shocks, but these shocks show their effects before and after structural breaks. This empirical result indicates that the Central Bank can have a short-term effect on the exchange rate but not a stable effect in the long run. The break dates reflect the reflections of the global financial crisis on the Turkish economy (March 2009), the decline in global risk appetite and hot money inflows and the central bank's switch to the interest rate corridor (October 2012), and the perception of political risk caused by the constitutional amendment ((April 2017), The Central Bank's resort to unconventional monetary policy tools such as the late liquidity window (December 2017), the change of the central bank governor (May 2021), exchange rate pressure before the transition to the government system (April 2018-2021), volatility created by exchange rate-protected deposits (October 2021) and intervention with negative reserves and swaps (July 2021-March 2022) can be summarized. Again, following Frankel (2019), cointegration test taking into account structural breaks is applied. In the Bai and Perron (2003,2006) unit root test with structural breaks, the number of breaks and break dates should be determined first. Bai and Perron (2003) test for structural breaks sequentially and consider a multi-regime linear model that takes into account an unknown number and period of structural breaks. y_t is a vector of dependent variables, x_t is a vector of independent variables and β_j is the parameters of the jth regime; $y_t = \dot{x}_t\beta_j + \varepsilon_t$ where $T_{j-1} < t \leq T_j$ and j=1,2,...,m+1. . $T_j(j = 1, \ldots, m)$denotes the break dates and m denotes the number of breaks. The model assumes that m number of breaks are divided into m+1 sub-periods. The SSR minimum is used to determine the break periods;

$$\min_{T_1,\ldots,T_m} \sum_{j=1}^{m+1} \sum_{t=T_{j-1}+1}^{T_j} \left(y_t - \dot{x}_t\widehat{\beta}_j\right)^2 \tag{4}$$

To increase the reliability of the test, we take precautions against deviations from the OLS assumptions. Thus, the test can detect breaks in both the constant and the slope.

Table 3. Structural Break Test Statistics

Hypotheses	F statistic	%1 Critical Value
H_0: No structurel break		
H_1: November 2008	24.87791	22.40
H_0: November2008		
H_1: November 2008, February 2012	29.47323	24.42
H_0: November 2008, February 2012		
H_1: November 2008, February 2012, February 2022	64.96784	25.53
H_0: November 2008, February 2012, February 2022		
H_1: -	8.326953	26.17

Notes: Trim count is %10, Newey-West estimator is used.

Considering the F statistics, the null hypothesis stating that there are three structural breaks in the last stage (November 2008, February 2012, February 2022) is accepted. The 2008 global financial crisis originated from the mortgage market in the US and put a great pressure on the financial system worldwide. Developing countries such as Turkey were indirectly affected by this crisis. In particular, there was a slowdown in capital flows, volatility in ERs and loss of confidence in the financial system. In Turkey, the pressure on foreign exchange reserves increased and the CBRT tried to stabilize foreign exchange markets through tight monetary policies and foreign exchange interventions. The index of foreign exchange market pressure (EMP) indicates that a managed floating ER regime was adopted during this period. To mitigate the impact of the crisis, the CBRT made its reserve management and interest rate policies more flexible. In addition, stimulus packages and liquidity enhancing measures were implemented to support economic growth. 2012 was a period in which the effects of the Eurozone debt crisis were felt intensely. Turkey was indirectly affected by this crisis due to its large trade volume with the European Union. Moreover, Turkey's current account deficit and the increasing demand for foreign exchange put pressure on ERs. In this period, foreign exchange reserves were used more frequently and the EMP index reached its highest level. An intervention policy similar to a fixed ER regime was pursued, which limited ER fluctuations but weakened market mechanisms. To ease the pressure in the foreign exchange market, the CBRT actively sold foreign exchange and used foreign exchange corridors. However, these policies led to a rapid decline in reserves. This coincides with a period when the effects of the COVID-19 pandemic have subsided and the global economy has started to recover. However, problems such as supply chain disruptions and rising energy prices pushed inflation higher on a global scale. Turkey faced rising inflation and demand for foreign exchange during this period. As of February 2022, the CBRT's nominal ER interventions were reduced. However, high inflation and external financing needs led to continued ER fluctuations. During this period, Turkey continued to implement a low interest rate policy and introduced innovative instruments such as the currency-protected deposit system. These policies alleviated the pressure on the market but also increased the demand for foreign exchange. Accordingly, the parameters obtained from regression (2) are presented in Table 3

Table 4. Bai and Perron (2003, 2006) Structural Break Cointegration Test Results

Variable	January 2006-October 2008	November 2008-January 2012	February 2012-January 2022	February 2022-October 2024
ln(USD/TRY)	-0.075891	0.117406	0.007487	
	(0.16)	(0.00)[a]	(0.71)	-0.212072 (0.26)
ln(EUR/TRY)	0.051834	0.018174	0.011577	0.132803
	(0.43)	(0.55)	(0.68)	(0.65)
ln(JPY/TRY)		-0.002573	-0.016238	0.074699
	0.220074 (0.00)[a]	(0.89)	(0.13)	(0.73)
EMP		0.732178	1.043691	0.470126
	0.716474 (0.00)[a]	(0.00)[a]	(0.00)[a]	(0.00)[a]
Constant	-0.019636	-0.02796	-0.002448	0.018064
	(0.26)	(0.00)[a]	(0.54)	(0.68)
$\bar{R}^2$	0.810	Ramsey Reset (t)	3.730 (0.00)[a]	
F statistics	51.793 (0.00)[a]	LM test	2.138 (0.12)	
AIC	-6.849	Heteroskedasticity	4.128 (0.00)[a]	
SC	-6.546			

Notes: p<0.01 a, AIC Akaike, SC Schwartz information criteria, Breusch-Godfrey for serial correlation, Breusch-Pagan-Godfrey tests for heteroskedasticity.

After determining the break dates of November 2008, February 2012 and February 2022, four different periods emerge. The coefficient of determination is in line with Frankel (2019). The model as a whole is statistically significant at the 1% significance level. The model is free of autocorrelation and model building error, but there is no problem of changing variance. In the January 2006-October 2008 period, the parameters for USD/TRY and EUR/TRY parities are statistically significant. JPY/TRY parity has a positive effect on the dependent variable. Although the foreign exchange market pressure index is 0.71, it is observed that a managed floating ER is applied. In the November 2008-January 2012 period, only USD/TRY parity is statistically significant. In this period, the parameter of the foreign exchange market pressure index indicates that the floating ER is far from being implemented. The period between February 2012 and January 2022 is the period in which the FX market pressure index reaches the highest value and clearly indicates a fixed ER. The period between February 2022 and October 2024 is the period with less nominal ER intervention compared to other periods. Frankel (2019) focuses on the feasibility of a floating ER system in emerging economies and provides important implications for open economies such as Turkey. In this context, the findings for the Turkish economy include (i) ER volatility: ER volatility threatens economic stability in countries like Turkey that are open to capital flows and dependent on external financing, and a floating ER regime can be effective in limiting ER volatility. (ii) central bank interventions: The CBRT's foreign exchange market intervention strategies do not fully follow the systematic approach envisaged in theory. The CBRT's intervention in the market by using its foreign exchange reserves provides short-term stability but is not found to be sustainable in the long run as it may lead to a loss of reserves. (iii) the relationship between inflation and ERs: The shortcomings of an ER policy compatible with inflation targeting in Turkey were emphasized. It is concluded that the impact of ER fluctuations on price stability is higher than anticipated. (iv) foreign trade and competitiveness: it is stated that a floating ER regime can improve Turkey's foreign trade balance, but the lack of ER stability limits these benefits. Despite its comprehensive theoretical framework, Frankel's (2019) study is considered to have some shortcomings for the Turkish economy. These shortcomings are; (i) macroeconomic dependencies: The high external borrowing ratios of the Turkish economy and its dependence on short-term capital flows are not discussed in sufficient detail in the study. These factors are considered to be critical factors that directly affect the effectiveness of ER policies. (ii) reserve management strategy: Practical recommendations on how and to what extent the CBRT should utilize its foreign exchange reserves remain limited. The study lacks a deeper analysis on the sustainability of intervention strategies. (iii) Turkey-specific socio-political dynamics: The study does not take into account Turkey-specific factors such as Turkey's geographical location, political instabilities and regional economic influences. These factors play a decisive role in the success of ER policies. It does not take into account Turkey-specific factors such as Turkey's geographical location, political instabilities and regional economic influences. These factors play a decisive role in the success of ER policies. (iv) commodity dependence: The Turkish economy's desire for high growth is particularly sensitive to fluctuations in energy prices. (v) microeconomic effects: The impact of the floating ER regime on firms and the dynamics of the real sector have not been sufficiently analyzed. The microeconomic consequences of ER fluctuations are particularly important in fragile economies such as Turkey.

3.Conclusion and Policy Recommendations

3.1.Conclusion

The claim that reserves are used to control the nominal ER has recently been at the center of economic policy criticism. This study seeks to answer the question of whether international reserves were used to control the nominal ER in Turkey between January 2006 and October 2024. The empirical analysis follows the methodology used in Frankel (2019). Clearly, international reserves are used to control the nominal ER throughout the entire period. The period in which international reserves are mostly used for ER control is February 2012-January 2022. Contrary to expectations, the period between February 2022 and October 2024 is the period with the least intervention. In the January 2006-October 20108 and November 2008-January 2012 periods, the price stability brought by the inflation targeting strategy prevents the ER pass-through effect. Therefore, fluctuations in international reserves do not attract the attention of financial markets.

On the other hand, the study has some limitations. These limitations stem from Frankel (2019). Frankel (2019) does not provide a comprehensive picture of the economic behavior of economic agents, especially in emerging economies. These limitations are (i) Frankel (2019) uses SDR as the dependent variable. However, economic actors in emerging economies follow the USD/TRY parity, which is the reserve currency. Moreover, the importance of the national currency interest rate and cross-parities in the arbitrage transaction, which is called Japanese housewives in the finance literature, is higher than previously thought. (ii) Frankel (2019) uses daily data in his study. The econometric tests used in the empirical analysis overfits high-frequency data. This situation manifests itself as the coefficient of determination being one. The model-building error in this study is perhaps due to the incorrect specification of the economic model. (iii) The use of gross international reserves in Frankel (2019) does not fully reflect the reserve policy in developing countries. National CB may overstate gross reserves through swap agreements with other CB that they perceive as close in global eco-politics. (iv) The last shortcoming concerns the foreign exchange market pressure index. Studies measuring the FX market repression index are initially monetary models and later indices that take into account changes in reserves, ERs and interest rates. The FX market repression index used in Frankel (2019) does not sufficiently meet expectations.

3.2.Policy Recommendations

(i) Strengthening the Floating ER Regime: The Mundell-Fleming model emphasizes that in economies with free capital mobility, a floating ER regime is more effective in achieving internal and external equilibrium. A system driven by market dynamics should be adopted by reducing foreign exchange interventions. Instead of using foreign exchange reserves to stabilize ER fluctuations, interest rate policies should be employed. However, these policies must be supported by long-term structural reforms to enhance market confidence. Additionally, regulations limiting the private sector's foreign currency borrowing should be implemented to minimize ER risks.

(ii) Efficient Use of Foreign Exchange Reserves: Keynesian theory underscores the role of public authorities in providing liquidity to prevent excessive volatility in foreign exchange markets. Reserve management strategies should be revised to prevent the overuse of reserves. Foreign exchange reserves should primarily be utilized during financial crises, and trade surpluses and foreign direct investments should be encouraged to increase reserves. Policies to reduce import dependency, particularly in the energy sector, and accelerate renewable energy investments are also critical for the long-term preservation of reserves.

(iii) Developing Mechanisms to Reduce ER Risks: The theory of risk-sharing advocates the development of derivative products and insurance mechanisms to enable efficient transactions during periods of uncertainty and volatility. The banking system should encourage the use of derivatives such as foreign exchange forwards, options, and swaps. Incentives should also be provided to support the use of hedging mechanisms by exporting SMEs. Improving transparency in foreign exchange market access and strengthening the risk management capabilities of market participants are vital steps.

(iv) Structural Reforms and Export-Oriented Policies: The Balassa-Samuelson hypothesis suggests that increasing exports can contribute to economic growth and the sustainability of foreign exchange reserves. Sector-specific incentives and tax reductions should be implemented to boost exports. Programs that reduce the reliance on imported intermediate goods in industrial production should be developed. Additionally, expanding free trade agreements would diversify export markets and enhance competitiveness.

(v) Enhancing Transparency and Confidence in Monetary Policy: Taylor's rule posits that transparent and predictable monetary policies build market confidence. The independence of the central bank should be strengthened to ensure monetary policies are insulated from political influences. An effective inflation-targeting policy should be pursued, providing clear communication to market participants. Moreover, monetary policy decisions should be based on data and regularly explained to the public to foster trust.

(vi) Managing Exchange Market Pressure (EMP) Values: Krugman’s theory on currency crises highlights that increasing market pressures may lead to crises if excessive interventions are employed. During periods of high EMP values, long-term structural reforms should be prioritized over short-term solutions like reserve sales. Regulations that limit the private sector's foreign exchange borrowing should be introduced to mitigate foreign exchange pressures. Policies encouraging domestic production and reducing dependency on critical imported goods are also essential to decrease foreign exchange demand.

Central bank reserves are a fundamental tool for managing ERs and mitigating ER pass-through effects. The impact of reserves on ERs depends on the choice of ER regime, capital mobility, interest rate differentials, and the current account balance. The theoretical framework underscores that reserves play a crucial role as a defensive mechanism, particularly during crises, to maintain ER stability. However, the opportunity costs of accumulating reserves should be managed carefully, ensuring an optimal balance between stability and economic efficiency.

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