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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

SPILLOVER EFFECTS OF US MONETARY POLICY ON INFLATION RATE AND FX VOLATILITY IN TURKEY: A VECM ANALYSIS

ABD PARA POLİTİKASININ TÜRKİYE'DE ENFLASYON ORANI VE DÖVİZ KURU OYNAKLIĞI ÜZERINDEKİ YAYILMA ETKİLERİ

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Abstract

We aim to examine the effectiveness of the Central Bank of the Republic of Turkey's (CBRT) monetary policy tools in reducing inflation and exchange rate volatility, given the spillovers emanating from the Federal Reserve's (FED) policies between 2010 and 2022. Relying upon the vector error correction model methodology proposed by Johansen (1995), we found that the inflation rate, one of the main indicators of internal equilibrium conditions, is affected more strongly by global liquidity conditions than by the CBRT's policies. Moreover, the evidence suggests that the long-term US interest rate proves to be the most disturbing factor to the exchange rate volatility in Turkey. More particularly, we show that the destabilizing effects of increases in the long-term US rates are stronger than the ability of the CBRT's contractionary policies to fix internal and external disequilibria, which is evident in the erosion in the CBRT's credibility. Given the devastatingly high economic and social costs associated with these rate hikes, the CBRT may instead turn to ways for enhancing the effectiveness of its policy

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tools by abandoning its unconventional policies. In this regard, it may start with restoring its highly damaged credibility and introducing some regulations restricting the free capital mobility.

Keywords: Vector Error Correction Model, The US Spillover Effects, Monetary Policy, Exchange Rate Volatility, Inflation Rate

Öz

Bu çalışmada, Türkiye Cumhuriyet Merkez Bankası'nın (TCMB) para politikası araçlarının, 2010–2022 döneminde ABD Merkez Bankası'nın (FED) politikalarından kaynaklanan yayılma etkileri (spillover effects) çerçevesinde, enflasyon ve döviz kuru oynaklığını azaltmadaki etkinliğinin incelenmesi amaçlanmaktadır. Johansen (1995) tarafından geliştirilen vektör hata düzeltme modeli (VECM) metodolojisine dayanarak elde edilen bulgular, iç denge koşullarının temel göstergelerinden biri olan enflasyon oranının, TCMB'nin politikalarından ziyade küresel likidite koşullarından daha güçlü biçimde etkilendiğini ortaya koymaktadır. Ayrıca bulgular, uzun vadeli ABD faiz oranlarının Türkiye'de döviz kuru oynaklığı üzerinde en fazla bozucu etkiye sahip faktör olduğunu göstermektedir. Daha açık bir ifadeyle, uzun vadeli ABD faiz oranlarındaki artışların yarattığı istikrarsızlaştırıcı etkilerin, TCMB'nin iç ve dış dengesizlikleri gidermeye yönelik daraltıcı para politikalarının etkinliğinden daha güçlü olduğu tespit edilmiştir. Bu durum, TCMB'nin kredibilitesinde meydana gelen aşınmaya işaret etmektedir. Söz konusu faiz artışlarının yol açtığı son derece yüksek ekonomik ve toplumsal maliyetler dikkate alındığında, TCMB'nin politika faizini artırmak yerine, alışılmışın dışındaki politika uygulamalarından vazgeçerek para politikası araçlarının etkinliğini artırmaya yönelik adımlar atması daha uygun bir seçenek olabileceği değerlendirilmektedir. Bu kapsamda, öncelikle ciddi biçimde zedelenmiş olan kredibilitesini yeniden tesis etmesi ve sermaye hareketlerinin serbestliğini kısmen sınırlayan bazı düzenlemeleri gündeme alması önerilmektedir.

Anahtar Kelimeler: Vektör Hata Düzeltme Modeli, ABD Kaynaklı Yayılma Etkileri, Para Politikası, Döviz Kuru Oynaklığı, Enflasyon Oranı

1. Introduction

Central banks had adopted unconventional monetary policies in the aftermath of the global financial crisis (GFC). First, the Federal Reserve (FED) implemented quantitative easing by exponentially expanding its balance sheet, and other leading central banks, such as the Bank of England, the European Central Bank, and the Bank of Japan, followed the FED's lead by pursuing similar policies. Mirroring global trends toward experimental approaches to monetary policy, the Central Bank of the Turkish Republic (CBRT) introduced an 'interest rate corridor' at the end of 2010, under which multiple interest rates could be used as a monetary policy instrument. The interest rate corridor basically represents the band within which the overnight CBRT interest rate can fluctuate on a daily basis. In this corridor system, overnight borrowing and lending rates, as well as the weekly repo rate, have served as the CBRT's funding rates. Another feature of this policy is that the CBRT has become a net lender to the financial institutions ever since its adoption. As the local banking system has run an increasing liquidity deficit, its demand for short-term funding has been met by the CBRT.

The examination of these unorthodox policies has led to a vast literature focusing on spillovers from the FED's monetary policy to emerging market economies (EMEs). One consensus point was that the riskier an EME is, the more vulnerable it is to monetary policy shocks, which are directly transmitted through internal and external indicators such as inflation, external debt, international reserves, foreign-exchange (FX) volatility, foreign currency credit spreads, and local currency treasury rates.

In this study, we measure the effects of both the CBRT's and the FED's monetary policies on the inflation rate and the FX volatility in Turkey. While the inflation rate reflects internal equilibrium dynamics, FX volatility primarily stems from turbulence in the external equilibrium, which also creates feedback loops for domestic economic stability.

The aim of this study, primarily, is to evaluate the effectiveness of the CBRT's monetary policy tools between 2010 and 2022 and also its ability to absorb the adverse effects of the FED's tightening decisions. Secondly, to investigate how credit spreads on Turkish treasury securities denominated in US dollars and interest rates on 10-year government bonds denominated in Turkish Lira (TL) react to the Federal Reserve's monetary policy decisions. As one of the so-called 'vulnerable' EMEs, Türkiye provides a rich empirical laboratory for assessing the effectiveness of its domestic monetary policies in reducing inflation and FX volatility, given spillovers from the FED's policies.

Mandated by law, the CBRT has to maintain price stability, but it has also added to its job description the task of maintaining financial stability by allowing the exchange rate to fluctuate within a narrow band while paying lip service to the official floating exchange rate regime. [1] We run a vector error-correction model (VECM) with two cointegration equations: one for inflation and another for FX volatility. In line with the literature, the results indicate that a contractionary monetary policy action by the FED has aggravating effects on both internal and external indicators as the inflation rate, 10-year Treasury yields on TL terms, CDS premiums on 5-year Turkish government bonds, and exchange rate volatility of TL. The most important contribution of this study is to show that the effect of a change in expectations about future monetary tightening in the US on Turkish inflation is approximately 1.5 times as strong as the CBRT's grip on the domestic price level during the period when the latter followed the interest rate corridor policy. Therefore, we conclude that, in the absence of effective monetary policy, as reflected in the CBRT's resort to unconventional measures, global factors exert greater influence on both internal and external equilibrium than local monetary authorities in Turkey.

1 "Global turmoil has revealed the necessity for central banks to guard financial stability against economic imbalances and accumulated risks in addition to focusing on price stability." CBRT, Financial Stability Report, May 2011, vol 12.

2. Literature Review

The debate on international monetary policy spillovers in open economies dates back to the seminal papers of Mundell (1960) and Fleming (1962), which put forward the idea that flexible exchange rates in open economies could absorb cross-border shocks. Hausman and Wongswan (2011) find that, in open economies with less-flexible exchange rate regimes, U.S. monetary shocks elicit larger responses in interest rates and stock markets than in flexible exchange rate regimes. [2] By splitting the countries in the dataset used by Hausman and Wongswan (2011) by development level, Engler et al. (2023) show that flexible exchange rate regimes do not appear to be stronger than fixed exchange rate regimes in combating the spillover of US monetary policy to EMEs. Iacoviello and Navarro (2019) also find that flexible exchange rates do insulate economic activity from US monetary surprises in advanced economies but not in EMEs.

Recent studies show that flexible exchange rate regimes may fail to isolate countries from adverse global financial shocks. Obstfeld (2021) emphasizes that, despite its potential economic benefits, financial globalisation brings disadvantages to economies, since exchange rates alone cannot insulate economies from global financial cycles. This complicates the trade-offs facing monetary policy and necessitates new tools for macroeconomic and financial policy. This new trilemma forces "incompatibility of national responsibility for financial policy, international financial integration, and financial stability. It therefore impedes effective national prudential policies." Obstfeld agrees with Borio (2014), Bruno and Shin (2015), and Rey (2015) that, as a result of global financial cycles driven by the FED's policies, the traditional monetary policy trilemma should instead be considered a dilemma within the EME context in the absence of capital controls. Bluwstein and Canova (2016), Miranda-Agrippino and Rey (2020) also find no evidence that flexible exchange rate regimes provide protection against global financial cycles. Corsetti et al. (2021) show that flexible exchange rates could provide insulation for the euro area from US monetary shocks, but the rational strategy for an inflation-targeting central bank remains to adjust policy rates to steady exchange rate volatility, even at the cost of greater output volatility.

Especially after the FED's notorious tapering-off announcement in May 2013 which showed its intention to end the large scale asset purchases (LSAPs), the focus of the economic literature has shifted on the FED-oriented cross-border spillover effects on internal and external indicators of EMEs which are, in turn, affected in proportion to their risk levels defined by their vulnerabilities to global shocks (see, for example: Mishra et al., 2014; Eichengreen and Gupta, 2015; Carstens, 2015, 2019; Ahmed et al., 2017; Iacovillo and Navarro, 2019; Kalemli-Özcan, 2019; Hoek et al., 2022; Engler et al., 2023). Most studies focusing on the fragilities of EMEs to US-originated policy shocks use the following list of financial proxies to calculate countries' risk levels: Inflation rate, 10-year local currency (LC) treasury yields, dollar-denominated bond spreads, CDS premiums, exchange rate volatility, and dollar-denominated debt.

2 See also Klein and Shambaugh (2015).

Hoek et al. (2022) differentiate the spillover effects of the FED policies on EMEs by identifying two distinct shocks. Within the framework of the Taylor rule, the FED may decide to hike interest rates following a change in its reaction function or as a reaction to heightened inflation concerns, which present a pure 'monetary shock' to the global economy. Alternatively, the FED may tighten its policy stance as a response to strong economic activity, which is referred to as the 'growth shocks'. They provide evidence that monetary shocks have more malignant effects on EME asset prices than growth shocks, indicating the contingencies of the FED's policies. [3] The studies by Aizenman et al. (2026) and Cheng and You (2024) both highlight the significant impact of U.S. economic policies on emerging and developed markets. While Aizenman et al. (2026) focus on the broad effects of U.S. fiscal dominance, especially in emerging markets, Cheng and You (2024) show that U.S. monetary spillovers to EMEs vary by the nature of the underlying shock. These studies together stress the need to consider both the source and transmission mechanisms of U.S. policy shocks in a global context.

The conventional monetary policy tools, which are designed to affect long-term interest rates through manipulating the short-term interest rates, also affect market expectations about the future direction of monetary policy as well as equity prices, exchange rates, and terms of trade (Gürkaynak et al., 2005). This expectation-channel justifies our usage of the yield on 10-year US Treasury Bonds (T-Bonds) as a proxy for investors' expectations about liquidity-scarcity or abundance in the long run (Gurkaynak et al., 2020; Engler et al., 2023). Therefore, a rise in 10-year US Treasury yields is associated with heightened expectations of future relative scarcity of global liquidity and the resulting decline in risk appetite among financial investors. It is not surprising that, accompanied by an exodus of financial capital from EMEs, monetary tightening in the US tends to elevate the inflation rate in EMEs through the exchange-rate pass-through channel. Stranded in a hostile global environment in which financial capital flows uphill from EMEs to advanced countries, even contractionary policies pursued by local CBs in EMEs may not be able to cope with strong inflationary dynamics set by local currency depreciations attending the capital outflows.

3. Data and Methodology

3.1 Methodology

3.1.1 Model

The vector error correction model (VECM), which has an underlying vector autoregressive model (VAR), is based on modelling the long-run stationary equilibrium relationships among multivariate time series with a unit root process. The absence of covariance stationarity in time series may lead to the notorious spurious regression problem, thereby invalidating the VAR model in levels. However, some linear combinations of the series with a unit root may turn out to be stationary, indicating the existence of cointegrating relationships among them. By the Granger representation

3 See also Jarociński and Karadi (2020), and Cieslak and Schrimpf (2019).

theorem, every cointegrating relationship can be specified as an error correction model, which shows how the series adjusts to any deviation from its long-run equilibrium value.

We present our model as follows:

$$\Delta \boldsymbol{y_t} = \boldsymbol{\Pi y_{t-1}} + \sum_{i=1}^{p-1} \boldsymbol{\Gamma_i \Delta y_{t-i}} + \boldsymbol{\varepsilon_t}(1)$$

where is the first-difference operator, $\boldsymbol{y_t}$ is the kx1 vector of endogenous variables, $\boldsymbol{\Pi}$ is the kxk matrix of coefficients before the first lag of endogenous variables, $\boldsymbol{\Gamma_i}$ is the kpxkp matrix of short-run coefficients, and $\boldsymbol{\varepsilon_t}$ is the kx1 vector of error term which has zero mean, no serial correlation, and finite variance.

3.1.2 Unit root testing

To determine the existence of any cointegrating relationship among endogenous variables, we need to check out first whether all the series follow the random walk process or not, since the Johansen methodology can be applied to the difference stationary processes. After removing the mean from the series, y_t, we fit the augmented Dickey-Fuller regression by the demeaned variable, y_t^*:

$$\Delta \boldsymbol{y_t^*} = \boldsymbol{\alpha} + \boldsymbol{\beta y_{t-1}^*} + \sum_{j=1}^{k} \boldsymbol{\varsigma_j \Delta y_{t-j}^*} + \boldsymbol{\omega_t} \ (2)$$

where the $\boldsymbol{\omega_t}$ is the serially uncorrelated, zero-mean error term. By estimating equation (2) using the ordinary least squares estimator and setting the coefficient $\boldsymbol{\beta}$ equal to zero, we run the Dickey-Fuller – Generalized Least Squares unit root test, where the null hypothesis specifies that the series follows a random walk with drift process, and use the critical values provided by Cheung and Lai (1995).

3.1.3 Johansen test

When the matrix $\boldsymbol{\Pi}$ is rank-deficient, that is, $0 < rank(\boldsymbol{\Pi}) = r < k$, then there are as many cointegrating equations as r given that all the series in the $\boldsymbol{y_t}$ are integrated of order one. Then, the Johansen's likelihood ratio test basically checks whether the K-r eigenvalues of the matrix $\boldsymbol{\Pi}$ becomes equal to zero using a sequential procedure. Since the test statistic is based on the trace of the matrix $\boldsymbol{\Pi}$ which is the sum of the diagonal elements of its eigenvalue matrix, its asymptotic distribution is sensitive to the trend specification of the underlying model. In the absence of a first and/or second order time trend, we can model the cointegrating equations to be stationary around the mean. Then, our model (1) can be rewritten as follows:

$$\Delta \boldsymbol{y_t} = \boldsymbol{\alpha} \left[\boldsymbol{\beta^T} \ \boldsymbol{\mu}\right] \begin{bmatrix} \boldsymbol{y_{t-1}} \\ \boldsymbol{1} \end{bmatrix} + \sum_{i=1}^{p-1} \boldsymbol{\Gamma_i \Delta y_{t-i}} + \boldsymbol{\varepsilon_t} \ (3)$$

where the rank-deficient matrix $\mathbf{\Pi}$ is factorized as $\mathbf{\Pi} = \boldsymbol{\alpha}\boldsymbol{\beta}^{T}$ and we made use of the flexibility of the kxr matrix $\boldsymbol{\alpha}$ to add a rx1 vector of parameters $\boldsymbol{\mu}$. The factorization simply decomposes the matrix $\mathbf{\Pi}$ into a matrix of error-correction terms $\boldsymbol{\alpha}$ and a kxr matrix $\boldsymbol{\beta}$ whose columns are formed by the cointegration vectors**.** However, the matrices $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are of full column rank but are not unique, a fact which directly leads us to the so-called identification problem. In addition to imposing r^2 identifying restrictions offered by the Johansen methodology, we add further constraints on the matrix $\boldsymbol{\beta}$ based on the economic theory and test their significance.

Stability of the system

Inference on the error-correction terms in the matrix $\boldsymbol{\alpha}$ depends completely on the stationarity of the cointegrating equations, that is, $\boldsymbol{\beta}^{T}\boldsymbol{y}_{t-1}$ being integrated of order zero. Otherwise, the system degenerates into a bunch of nonstationary equations where no error-correction occurs as the matrix $\boldsymbol{\alpha}$ approaches to being a zero-rank matrix. The stability condition on the VECM can be ascertained by the eigenvalues of the kp x kp companion matrix of the underlying VAR model. Since the VECM specifies the k-r eigenvalues of the companion matrix of the underlying VAR model to have unit modulus, the remaining eigenvalues must have less than unit modulus. Otherwise, the true rank of the matrix $\mathbf{\Pi}$ might be less than r, or there might be more than k-r common stochastic trends.

3.1.4 Serial correlation

Just as was the case with the VAR models, the VECM is also based on the assumption of serially uncorrelated errors. However, no restriction is imposed on the covariance matrix of the underlying VAR model so that the contemporaneous innovations can be correlated with one another. Therefore, we need to have correct lag-specification to make sure that the model does not suffer from an autocorrelation problem (Gonzalo, 1994). In this regard, we should add as many lagged differences to the model (3) as necessary for remedying the serial correlation problem.

3.1.5 Normality

The model (3) is estimated by the maximum likelihood (ML) estimator as suggested by the Johansen methodology. Johansen (1995) proves that under the normality of the error term in (3), the ML estimator is both consistent and efficient in estimating the VECM. In the absence of normality, the ML estimator still continues to be consistent but ceases to be an efficient estimator. In that case, the model (3) is to be estimated by the quasi-likelihood estimator in a consistent way.

3.2 Data and Descriptive Statistics

Table 1: Variables included in the Vector Error Correction Model

Variables	Description	Source
Annual Turkish Inflation Rate	Annual % change in consumer price index, percentage points	TurkStat
Weekly Exchange Rate Volatility of TL	FX option volatilities (implied), annualized, percentage points	Refinitiv
Central Bank Funding Rate in Turkey	Weighted average short-term funding rate of the CBRT, percentage points	CBRT/EVDS
TL-term 10-year Treasury Yield	Interest rate on 10-year Turkish government bonds, percentage points	Refinitiv
Credit Default Swap Premium	The premium of Credit Default Swaps on 5-year dollar-denominated Turkish government bonds, percentage points	Refinitiv
10-year US Treasury Yield	Interest rate on 10-year US government bonds, percentage points	Refinitiv

Time series for all variables are obtained at monthly frequencies from the data providers (Table 1). Since weighted average funding rates of the CBRT have been available since January 2011, there are fewer observations available (Table 2). Except for this, the dataset covers a time range from February 2010 to January 2022.

Table 2: Descriptive statistics

Notation	Observation	Mean	Std. Dev.	Min.	Max.
Inflation	144	11.14	3.48	6.17	24.05
WeeklyFXVolatility	144	14.28	10.12	4.90	98.78
CBFR	133	11.26	5.35	4.84	24.52
Bond10y	144	11.35	3.48	6.17	24.05
CDS	144	2.70	1.15	1.20	5.82
US10y	144	2.19	0.69	0.62	3.85

4. Results and Discussion

Since the VECM models the stationary relationships of the nonstationary models, we first determine whether the endogenous variables in the model contain a unit root process or not. The asymptotic distribution of both unit root and cointegration tests is, however, quite sensitive to the trend specification, so we first have to ascertain if the series contains any linear or nonlinear time trends.

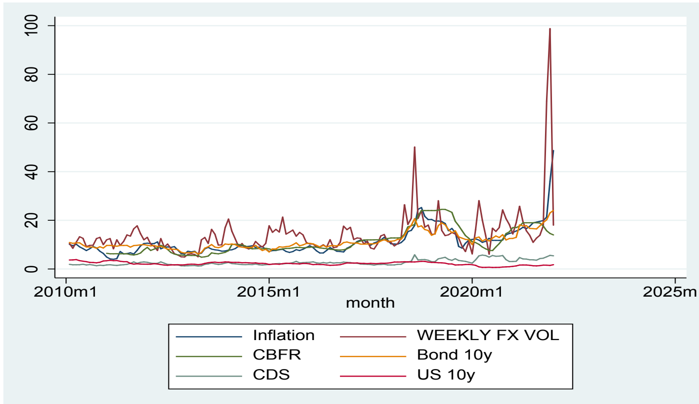

Figure 1: The trajectory of endogenous variables over time

Plotting the series in the same graphs reveals two points. First, the series seems to follow a random walk process. Second, their joint movement over time also suggests that they might contain common stochastic trends so that there could be long-run equilibrium relationships among them. When taken a more granular look at the individual series (available upon request), we can conclude that despite the large shocks to the series, they do not include any first-order or second-order time trend in levels.

The determination of the time trends is of great significance since they directly affect the critical values of both unit root and cointegration tests. Therefore, we can test whether the series follows a random walk model with drift. The nonrejection of the null hypothesis in the DF-GLS test attests to the nonstationarity of the series (Table 3).

Table 3: The DF-GLS unit root test

Lags	%5 Critical Value	Inflation	Weekly FX Volatility	CBFR	Bond10y	CDS	US10y
		Test Statistic					
13	-1.962	0.355	-0.641		-0.436	-0.122	-0.74
12	-1.972	0.928	-0.506	-0.57	-0.596	-0.268	-0.816
11	-1.983	0.555	-0.744	-0.804	-0.393	-0.073	-0.777
10	-1.993	0.209	-1.152	-1.226	-0.507	-0.102	-0.779
9	-2.003	0.497	-1.353	-1.466	-0.297	-0.413	-0.677
8	-2.013	0.625	-1.011	-1.696	-0.01	-0.573	-0.617
7	-2.023	0.503	-1.283	-1.722	0.216	-0.799	-0.75
6	-2.032	0.543	-1.299	-1.898	0.38	-0.785	-0.8
5	-2.041	0.602	-2.004	-2.032	0.096	-0.908	-0.841

4	-2.05	0.899	-2.26	-2.024	0.189	-0.887	-0.747
3	-2.058	0.655	-2.751	-2.091	-0.174	-1.247	-0.856
2	-2.065	1.071	-3.071	-1.668	-0.413	-1.395	-0.752
1	-2.073	0.695	-6.179	-1.517	-0.167	-1.519	-0.762

Inflation	Opt Lag (Ng-Perron seq t) = 13 with RMSE 1.586586 Min SC = 1.256258 at lag 2 with RMSE 1.771746 Min MAIC = 1.127396 at lag 13 with RMSE 1.586586
Weekly FX Volatility	Opt Lag (Ng-Perron seq t) = 6 with RMSE 8.518018 Min SC = 4.447783 at lag 2 with RMSE 8.738405 Min MAIC = 4.458496 at lag 12 with RMSE 8.303371
CBFR	Opt Lag (Ng-Perron seq t) = 11 with RMSE .7032518 Min SC = – .4822667 at lag 1 with RMSE .7550064 Min MAIC = – .5189283 at lag 12 with RMSE .6947219
Bond10y	Opt Lag (Ng-Perron seq t) = 4 with RMSE 1.078353 Min SC = .2648028 at lag 1 with RMSE 1.099614 Min MAIC = .2057813 at lag 1 with RMSE 1.099614
CDS	Opt Lag (Ng-Perron seq t) = 0 [use maxlag(0)] Min SC = – 1.256767 at lag 1 with RMSE .5138488 Min MAIC = – 1.27733 at lag 1 with RMSE .5138488
US10y	Opt Lag (Ng-Perron seq t) = 1 with RMSE .1667497 Min SC = – 3.507637 at lag 1 with RMSE .1667497 Min MAIC = – 3.557945 at lag 1 with RMSE .1667497

Since we have strong evidence that the series are integrated of order 1, we next check out whether their linear combinations are stationary or not. Under the restricted constancy assumption that cointegrating equations are stationary around an intercept parameter, we run the Johansen cointegration (trace) test. The results of the rank test indicates that there are two cointegrating equations in the VECM (Table 4).

Table 4: Johansen trace test for cointegration

Maximum rank	Parameters	Log Likelihood	Eigenvalue	Trace statistic	5% critical value
0	36	-955.46	-	149.96	102.14
1	48	-921.52	0.404	82.09	76.07
2	58	-901.43	0.264	41.9*	53.12
3	66	-890.86	0.149	20.77	34.91
4	72	-885.3	0.081	9.66	19.96
5	76	-881.77	0.052	2.59	9.42
6	78	-880.48	0.019		

Trend: Restricted constant
Number of observations: 131
Lags: 2

Then, we estimate the model (3) by the quasi-likelihood estimator (Table 5). In addition to the Johansen normalisation restrictions, we add two more constraints for identification of the cointegration vectors in accordance with the economic literature. First, the coefficient before the CDS is constrained to be zero in the inflation equation. Second, the coefficient of the Bond10y variable is set to zero in the weekly FX volatility equation. The likelihood ratio test indicates the validity of these additional restrictions on the VECM model.

Table 5: Cointegration equations [4]

		Coef.	Std. Err.
_ce1			
	Inflation	1	.
	WeeklyFXVolatility	0	(omitted)
	CBFR	2.1406***	0.4712972
	Bond10y	-4.9326***	0.8297723
	CDS	0	(omitted)
	US10y	-3.5073**	1.587244
	_cons	26.8353***	6.585228
_ce2			
	Inflation	0	(omitted)
	WeeklyFXVolatility	1	.
	CBFR	0.27277**	0.1148565
	Bond10y	0	(omitted)
	CDS	-5.8232***	0.7094439
	US10y	-5.9854***	1.037959
	_cons	11.7225***	3.088368
LR test of identifying restrictions:		chi2(2) = 1.185	
Prob > chi2 = 0.553			
Equation		Parms	chi2
_ce1		3	44.2***
_ce2		3	95.5***

The VECM output (Table 5) establishes that the long-run coefficients are statistically significant at 5% at the very least. When we write the cointegrating equations in matrix form, it becomes easier to see that both the sign and significance of the adjustment coefficients point to a quick error-correction process. [5]

4 * means significant at 90% confidence level, ** means significant at 95% confidence level, and *** means significant at 99% confidence level.

5 *means significant at 90% confidence level, ** means significant at 95% confidence level, and *** means significant at 99% confidence level.

$$\begin{pmatrix} -0,106 & 0,135 \\ (0,022)^{***} & (0,039)^{***} \\ 0,009 & -0,801 \\ (0,172) & (0,305)^{***} \\ -0,018 & -0,023 \\ (0,014)^{*} & (0,025) \\ 0,029 & 0,012 \\ (0,023) & (0,04) \\ 0,008 & -0,001 \\ (0,01) & (0,018) \\ -0,0002 & 0,019 \\ (0,003) & (0,006)^{***} \end{pmatrix} \begin{pmatrix} 1 & 0 & 2,141 & -4,933 & 0 & -3,507 & 26,84 \\ & (omitted) & (0,471)^{***} & (0,829)^{***} & (omitted) & (1,587)^{**} & (6,58)^{***} \\ 0 & 1 & 0,273 & 0 & -5,823 & -5,985 & 11,72 \\ (omitted) & & (0,114)^{**} & (omitted) & (0,709)^{***} & (1,037)^{***} & (3,088)^{***} \end{pmatrix} \begin{pmatrix} Inflation \\ Weekly\ FX\ volatility \\ CBFR \\ Bond10y \\ CDS \\ US\ 10\ y \\ 1 \end{pmatrix}$$

$$Inflation = -2,141\ x\ CBFR + 4,933\ x\ Bond10y + 3,507\ x\ US10y - 26,84$$

$$Weekly\ FX\ volatility = -0,273x\ CBFR + 5,823\ x\ CDS + 5,985\ x\ US10y - 11,72$$

The first cointegration equation confirms both the disinflationary effects of contractionary policies and the Fisher effect, which relates nominal interest rates to inflation, while the effect of the yield on 10-year US government bonds on the domestic inflation rate turns out to be significantly positive. What is more important is that the coefficient before the US long-term interest rates dominates that of the CBRT's effective policy rate in absolute terms, indicating that the domestic inflation is more responsive to market expectations about the future direction of the FED's monetary policies. Being one of the main indicators of internal equilibrium conditions, the inflation rate is affected more strongly by global liquidity conditions than by the CBRT's policies. A rise in the US long-term interest rate might closely be associated with net capital outflows, which tend to trigger depreciation-led inflationary dynamics in Turkey.

The second cointegration equation relates the exchange-rate volatility to the CBRT's effective policy rate, the default premium on 5-year Turkish government bonds denominated in foreign currency, and the yield on the US 10-year Treasury bonds. In line with the literature, we found that a higher default risk is related to more volatile exchange rates, while the monetary tightening by the CBRT may play the role of stabilizing the foreign exchange market. However, the long-term US interest rate proves to be the most disturbing factor to the exchange rate volatility, given the sign and magnitude of its coefficient.

In sum, we can conclude that both internal and external equilibrium (as proxied by inflation rate and exchange-rate volatility, respectively) are highly sensitive to global investors' perceptions about the relative abundance of liquidity in the financial markets over the long-term. The absolute sizes of the coefficients before the CBFR and US10y (-2,141 vs 3,507 in the inflation equation and – 0,273 vs 5,985 in the FX-volatility equation respectively) suggest that the destabilizing effect of the yield on 10-year US government bonds on inflation rate and foreign exchange market seems stronger than the ability of the CBRT's contractionary policies to fix internal and external disequilibria, which is a clear sign of the erosion in the credibility of the CBRT. Since these hikes inevitably bring devastatingly high economic and social costs, the CBRT may instead turn to ways for enhancing the effectiveness of its policy tools. In this regard, it may start with restoring its highly damaged credibility and introducing some regulations restricting the free capital mobility in light of recent literature.

The VECM with 6 endogenous variables and 2 cointegrating equations, as we have above, imposes, by construction, 6-2=4 unit moduli on the eigenvalues of the companion matrix of its underlying VAR model. The eigenvalue stability test provides information about the stationarity of cointegrating equations and the true rank of the matrix $\mathbf{\Pi}$ in equation (1) so that we can ascertain if the number of common stochastic trends is correctly specified in the VECM or not. Figure 2 shows that all the eigenvalues of the companion matrix lie within the unit circle, satisfying the stability condition of the model.

Table 6: Eigenvalue stability condition

Modulus
1
1
1
1
0.83929
0.83929
0.829283
0.726647
0.726647
0.706098
0.706098
0.670132
0.670132
0.665247
0.665247
0.592501
0.592501
0.501423
0.501423
0.469855
0.454671
0.454671
0.342973
0.342973
The VECM specification imposes 4 unit moduli

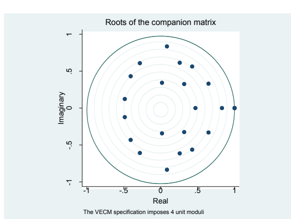

Figure 2: Unit circle and eigenvalues

An analysis of the residuals of the cointegration equations also reveals information about the historical path of the series. Figure 3 does not have any time trend except for the period between 2011 and 2013. That period also corresponds to the second wave of the quantitative easing policy pursued by the central banks in the advanced countries, only to be ended by the taper tantrum in May 2013 with the announcement of a reversal in this nonconventional stance by the US's Federal Reserve. We also see a large shock in August 2018 with the eruption of the pastor Brunson crisis, but it quickly died away as a result of tightening in credit markets. We can also observe downward shocks in March 2021 and September 2021, representing the end of Mr. Naci Agbal's tenure in the Central Bank of the Republic of Turkey (CBRT) and the beginning of the expansionary monetary policies by the new CBRT management, respectively. Figure 4 presents the stationarity of the cointegrating equation for the weekly FX volatility. However, we witnessed a significant shock hitting the exchange rate in September 2021, most likely prompted by the reaction of financial markets to the monetary easing policies implemented by the CBRT in the face of accelerating inflation.

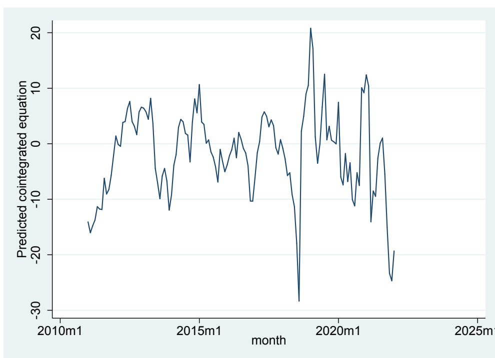

Figure 3: Residuals of the inflation equation

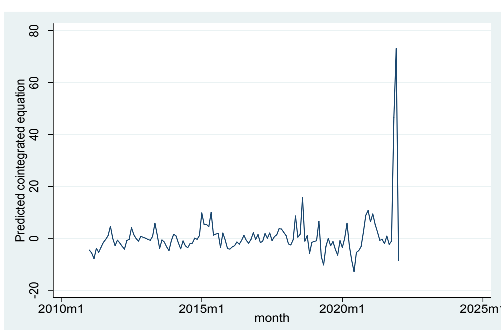

Figure 4: Residuals of the weekly volatility equation

The VECM model is constructed on the assumption of no serial correlation, while it allows for contemporaneous correlations among innovations. To make the error terms serially uncorrelated, we add up to the fourth lag of endogenous variables to the underlying VAR model and run the Lagrange-multiplier (LM) test for the autocorrelation. Table 7 reports the non-rejection of the null hypothesis that there is no autocorrelation at the first two lag orders.

Table 7: LM test for autocorrelation

lag	chi2	df	Prob > chi2
1	35.314	36	0.50103
2	29.4555	36	0.77149

H_0: no autocorrelation at lag order

Following the Johansen methodology, we estimate the VECM by the ML estimator, which assumes that the error terms follow a normal distribution, so their distribution has zero-skewness and kurtosis of 3. The Jarque-Bera test shows the non-normality of the residuals in the VECM (Table 8). Since the ML estimator is still a consistent estimator for the VECM under the non-normality of residuals, this poses no problem for our estimation strategy.

Table 8: Jarque-Bera normality test

Equation	chi2	df	Prob > chi2
D_Inflation	7.889	2	0.01936
D_WeeklyFXVolatility	286.389	2	0
D_CBFR			
16.196			
2			
0.0003			
D_Bond10y	37.949	2	0
D_CDS	37.811	2	0
D_US10y	2.682	2	0.26154
ALL	388.918	12	0

5. Conclusion

A part of the huge monetary stimulus provided by the FED and other central banks in the advanced countries after the great financial crisis in 2007-8 has "leaked" to the EMEs in the form of strong capital inflows, which exacerbate their exposure to the boom-bust cycles of hot money. During this period, the central banks in the EMEs, which have sustained immense global shocks after the GFC, have turned to unconventional monetary policies to deal with the new challenges presented to them. The CBRT, under the political pressure from the above, adopted the interest rate corridor policy, which aimed to minimize the adverse effects of global financial shocks on inflation as well as exchange-rate volatility by fine-tuning the overnight rates while keeping the policy rate untouched.

Mandated by law, the CBRT has to maintain price stability, but it has also added to its job description the task of maintaining financial stability by letting the exchange rate fluctuate within a narrow band while paying lip service to the official floating exchange rate regime. We evaluate the policy effectiveness of this so-called dirty-float regime by running a VECM, which takes the US spillover effects into account.

From the start of the interest rate corridor policy through 2022, the effect of the CBRT average funding rate on inflation and exchange rate volatility has been less than that of the yield on 10-year US T-Bonds, which reflects the Federal Open Market Committee announcements and the market expectations about the direction of future monetary policy in the United States. The literature also reaches a consensus about the malignant effect of the US monetary tightenings on asset prices in EMEs, and our paper provides fresh evidence in this regard. The original contribution of this paper lies in the finding that inflation rate and exchange rate volatility in Turkey have been more sensitive to the FED policies, given the ineffectiveness of the CBRT policies.

With its high CDS premia, uncontrolled inflation rate, and large exchange rate volatility compared to its peer countries, Turkey has long belonged to the "fragile countries", so its high exposure to the global financial shocks should not be surprising. Moreover, the fallouts of the great financial crisis, especially its spread to the European capital markets, as well as the taper-tantrum triggered by the FED's announcement about its phasing out the quantitative easing policies in May 2013, led to quite an unfavorable environment for EMEs in terms of their access to the global loanable funds. Faced with serious global challenges, policy-makers in Turkey have added salt to injury by derailing the usual monetary policy regime and eroding the autonomy of monetary authorities by sacking governors of the CBRT. Taking its cues from the executive power, the policies of the CBRT have become more and more incompatible with global financial trends, sapping its ability to maintain domestic price stability.

On the other hand, the long-run equilibrium relationships obtained from the VECM indicate that contractionary monetary policies by the FED result in a rise in the yield on the 10-year government bond denominated in local currency and the CDS premium for Turkey, in line with the literature.

The case of Turkey, as presented in this study, shows that the floating exchange rate regime officially adopted by many developing country central banks, including the CBRT, fails to absorb global financial shocks in the presence of free capital mobility within the context of EMEs. The extraordinary impact of the US monetary shocks, as evidenced in this study, also indicates that inflation rate, exchange rate volatility, and the cost of sovereign debt move in the same direction as the investors' expectations about the future scarcity of liquidity in the US money markets, as proxied by the yield on 10-year US T-Bonds. Since these hikes inevitably entail devastating economic and social costs, the CBRT may instead turn to ways to enhance the effectiveness of its policy tools. In this regard, it may begin by restoring its severely damaged credibility and introducing regulations restricting capital mobility, in light of recent literature.

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