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EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN MONETARY POLICY AND ASSET PRICES IN THE TURKISH ECONOMY[1][2]

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Abstract

This study aims to examine the dynamic relationship between monetary policy and asset prices in the Turkish economy. Asset price inflation refers to a situation in which the market values of financial assets rise faster than the general price level and can create significant effects on economic growth and financial stability. In particular, asset price increases driven by low interest rates may influence consumption and investment expenditures through the wealth effect, but at the same time, they may also pose risks of financial fragility. Within this scope, an empirical analysis was conducted using the Time-Varying Parameter Vector Autoregression (TVP-VAR) model for the 2011–2024 period, based on key variables such as monetary aggregates, the central bank funding rate, housing price index, exchange rate, BIST 100 index, and gold prices. The findings reveal that the effects of monetary policy shocks on asset prices have varied over time and that these effects have become more pronounced during periods of economic stagnation and uncertainty, particularly during global crises and structural disruptions. The results indicate that asset prices should be incorporated into the monetary policy framework to ensure financial stability.

TÜRKİYE EKONOMİSİNDE PARA POLİTİKASI İLE VARLIK FİYATLARI ARASINDAKİ İLİŞKİNİN AMPİRİK ANALİZİ

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Özet

Bu çalışma, Türkiye ekonomisinde para politikası ile varlık fiyatları arasındaki dinamik ilişkiyi incelemeyi amaçlamaktadır. Varlık fiyat enflasyonu, finansal varlıkların piyasa değerlerinin genel fiyat seviyelerinden daha hızlı artması durumunu ifade eder ve ekonomik büyüme ile finansal istikrar üzerinde önemli etkiler yaratabilir. Özellikle düşük faiz oranlarıyla teşvik edilen varlık fiyat artışları, servet etkisi üzerinden tüketim ve yatırım harcamalarını etkileyebilmekte, ancak aynı zamanda finansal kırılganlık risklerini de beraberinde getirmektedir. Bu kapsamda, 2011–2024 dönemi için para arzı, merkez bankası fonlama oranı, konut fiyat endeksi, döviz kuru, BIST 100 ve gram altın fiyatları gibi temel değişkenler kullanılarak Zamanla Değişen Parametreli Vektör Otoregresif (Time Varying Parameter Vector Autoregression - TVP-VAR) modeliyle ampirik analiz gerçekleştirilmiştir. Elde edilen bulgular, para politikası şoklarının varlık fiyatları üzerindeki etkisinin zaman içerisinde farklılaştığını ve bu etkinin özellikle ekonomik durgunluk ve belirsizlik dönemlerinde, küresel krizler ve yapısal kırılmaların daha da belirgin hâle geldiğini göstermektedir. Sonuçlar, finansal istikrarın sağlanmasında varlık fiyatlarının para politikası çerçevesine dâhil edilmesi gerektiğini ortaya koymaktadır.

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INTRODUCTION

Inflation is defined as a sustained increase in the general price level. Asset inflation, on the other hand, refers to a continuous rise in the prices of financial assets such as real estate, gold, bonds, and equities.

Many central banks have adopted inflation targeting regimes as part of their monetary policy frameworks to achieve the primary objective of price stability. In an effort to control inflation, central banks implement various policy tools. A historical review reveals that while central banks have sometimes achieved their inflation targets, at other times they have deviated from these goals. The effectiveness of monetary transmission mechanisms plays a critical role in achieving targeted inflation levels. In this context, numerous studies—including those by Borio and Lowe (2002), Neuenkirch and Tillmann (2014), and Mishkin (2001) have emphasized that asset prices can significantly influence the implementation and outcomes of inflation targeting, beyond the conventional transmission channels.

Unexpected and sharp fluctuations in asset prices can lead to serious instabilities within the financial system. For instance, during the real estate bubble in Japan in the 1990s, excessively inflated property prices led to a sharp expansion of bank balance sheets, which subsequently collapsed when the bubble burst, pushing banks to the brink of insolvency. During this period, Japan's inflation rates were 3.1% in 1990, 3.3% in 1991, 1.7% in 1992, 1.3% in 1993, and 0.7% in 1994 (WorldData). While achieving the inflation target is conducive to financial stability, suppressed demand may shift volatility away from goods and services prices toward credit aggregates and asset prices. Therefore, a monetary response targeted at credit and asset markets may be warranted to simultaneously maintain both price and financial stability.

The Japanese example illustrates that even in a low inflation environment, asset price bubbles can lead to financial instability and prolonged economic stagnation. This supports the argument by Borio and Lowe (2002: 3) that a sole focus on inflation targeting may be insufficient to ensure financial stability. Consequently, from a financial stability perspective, it is crucial not only to focus on inflation targets but also to incorporate credit policies that account for changes in asset prices.

Cecchetti et al. (2000) argue that central banks could achieve superior inflation control performance if they consider asset prices alongside traditional indicators such as goods price inflation and the output gap. Supporting this view, Wadhwani (2008) contends that asset price bubbles distort investment and consumption behavior, leading to excessive increases and subsequent declines in both real output and inflation. He suggests that moderate increases in interest rates when asset prices exceed their fundamental values—and corresponding decreases when prices fall below such levels—can help mitigate the impact of bubbles on inflation and output. This, in turn, may contribute to broader macroeconomic stability.

Claessens and Kose (2017) emphasize the bidirectional interaction between the real economy and the financial sector, noting that the link between asset prices and macroeconomic outcomes operates through this dual feedback mechanism. Shocks originating in the real economy can propagate through the financial system via asset prices, while financial market disruptions may amplify asset price shocks, leading to more pronounced macroeconomic fluctuations.

In recent years, the Turkish economy has undergone significant structural transformations driven by both domestic dynamics and global shocks. In this context, the role of asset prices in shaping macroeconomic indicators has become increasingly visible, and the influence of monetary policy tools on these prices has emerged as an important research topic. Large-scale shocks—such as the

COVID-19 pandemic in 2020 and the devastating earthquakes centered in Kahramanmaraş on February 6, 2023—have significantly altered market behavior and expectations. These events highlight the possibility that the relationship between monetary policy and asset prices may vary over time.

Against this backdrop, the primary objective of this study is to analyze the dynamic relationship between monetary policy and asset prices—specifically housing, gold, and equities—in Türkiye using a Time-Varying Parameter Vector Autoregressive (TVP-VAR) model. The study aims to provide policy-relevant insights that can guide decision-makers from a financial stability perspective. The findings are expected to demonstrate how monetary policy instruments affect the broader economy through asset price channels, thus contributing to the policy formulation process with a financial stability lens.

The structure of the paper is as follows: following the introduction, the next section presents a review of the relevant literature. This is followed by a discussion of the methodology, the dataset, and the empirical findings. The study concludes with a summary and policy implications.

2. LITERATURE REVIEW

The literature in this field is broadly shaped by two main perspectives. The first, representing the conventional view, argues that central banks should focus solely on maintaining price stability (Gali, 2013; Posen, 2006; Filardo, 2001). The second approach highlights the implications of asset price bubbles and cycles for financial stability, advocating for monetary policy to be responsive to asset price developments (Borio & Lowe, 2002; Mishkin, 2001).

In recent years, models with time-varying parameters—such as TVP-VAR and TVP-SV-VAR—have revealed that the effects of economic shocks vary across different time periods, thereby making significant contributions to the literature (Paul, 2020; Braun et al., 2022). These studies consistently demonstrate the impact of monetary policy on asset prices. A selection of recent empirical research in this area is summarized in Table 1 below:

Table 1. Summary of Selected Literature

Author(s)	Year	Method	Key Findings
Lei, Mei & Zhang	2024	Proxy SVAR	China's monetary policy has significant spillover effects on both global and regional economies.
Demiralp & Bellier	2023	ADL Cointegration Test	There is a long-term cointegration relationship between interest rates and the BIST100 index. A 1% increase in interest rates results in approximately a 55-point drop in the BIST100 index.
Zhu, Bai & Wang	2022	TVP-SV-VAR	Liquidity affects asset price volatility; the impact of monetary policy changes over time.
Sun & Zhang	2022	TVP-VAR	Interest rate hikes by the Federal Reserve negatively affect emerging markets.
Braun, Kapetanios & Marcellino	2022	TVP-IV-SVAR	The impact of monetary policy shocks on financial variables varies over time; policy effectiveness has increased.
Paul	2020	TVP-VAR	The response of stock and asset prices to monetary policy shocks is stronger during economic crises.

Author(s)	Year	Method	Key Findings
Caraiani et al.	2020	DSGE	Credit policies play a crucial role in the deflation of asset bubbles.
Chen et al.	2019	VAR	Increases in interest rates typically suppress housing prices.
İncekara & Amanov	2019	ARDL	Interest rate decisions significantly affect stock prices.
Lyons	2018	ECM	In the case of Ireland, both credit costs and credit conditions influence equilibrium in the housing market.
Nocera & Ramo	2017	SVAR	Housing demand shocks impact economic and credit activity; monetary policy strongly influences house prices in the Eurozone, UK, and US.
Wang	2017	GARCH	Unanticipated rate cuts tend to raise stock prices, increase bond yields, and cause exchange rate volatility.
Shioiji	2015	TVP-VAR	A 25% depreciation of the Japanese yen leads to a 2% increase in prices of regularly purchased household goods.
Belke et al.	2010	VAR	High monetary growth does not immediately affect goods prices but leads to sharp increases in asset prices.
Gerlach & Assenmacher	2008	Panel VAR	Monetary policy has strong and predictable effects on real estate prices. A 25 basis point increase in short-term interest rates reduces real GDP by about 0.125% and housing prices by approximately three times that amount after one to two years.

Source: *Compiled by the authors.*

In summary, although the literature presents a range of findings, the second approach has gained greater prominence. In other words, there is growing consensus that asset price bubbles and cycles have significant implications for both financial and price stability.

3. METHOD:TVP-VAR (Time-Varying Parameter VAR) Model

In this study, the TVP-VAR model developed by Primiceri (2005) is used to observe the fluctuations in asset prices and the possible impact of asset price bubbles on monetary policy in Türkiye. This approach allows for the analysis of the effects of monetary policy on macroeconomic variables by taking into account time-varying coefficients, error term variances, and the volatility of structural shocks. The main objective of the study is to examine how monetary policy should be managed in Türkiye in the face of fluctuations in asset prices and potential asset price bubbles. In this context, the change in the effect of monetary policy on asset prices over time and the time-varying impact of asset prices on monetary policy should be analyzed through a dynamic model. The Primiceri (2005) model has the technical infrastructure to meet this need.

The TVP-VAR model assumes that both the regression coefficients and the variance-covariance matrix of the error term vary over time, whereas in the time-varying coefficient TVP-VAR model (Cogley & Sargent 2001, 2005), the variance and covariance are assumed to be constant, and only the coefficients vary over time. The Bayesian TVP-VAR model (Del Negro & Primiceri 2015) incorporates time-varying coefficients and variances and is estimated using Bayesian prior information. The Structural TVP-VAR (SVAR-TVP) model (Benati & Surico 2009) analyzes the time-varying effects of monetary policy by applying structural constraints (SVAR) within the TVP-VAR framework. In the Factor-Augmented TVP-VAR (FAVAR-TVP) model (Baumeister, Liu & Mumtaz 2010), the TVP-VAR model is combined with factor analysis and applied to high-dimensional data sets. In the TVP-VAR model with Stochastic Volatility (SV-TVP-VAR) (Nakajima, 2011), volatility changes over time and becomes stochastic.

The main differences of the TVP-VAR method from other TVP-VAR approaches are: firstly, it allows for changes not only in regression coefficients but also in the variance and covariance structure of the error term over time. This makes it possible to observe the time-dependent variation in the effects of shocks. Secondly, it is estimated within a Bayesian framework, and the probability distributions of the parameters are obtained using Markov Chain Monte Carlo (MCMC) methods. In this way, not only point estimates but also uncertainty intervals of the estimates can be measured. Thirdly, it allows impulse-response functions to vary over time. This is important for the study's aim of identifying asset bubbles and connectedness. Fourthly, the Primiceri approach is specifically designed to examine the time-varying effects of monetary policy shocks and is therefore frequently preferred in the literature. As a result, this method, which aligns with the hypotheses of the study and enables dynamic analyses, provides an effective analytical tool for identifying both asset price bubbles and the periodic effects of monetary policy.

Primiceri (2005) developed the TVP-VAR model to capture time-varying parameters and volatility in macroeconomic analyses. The model under consideration is expressed as follows:

$$y_t = c_t + \beta_{1,t} y_{t-1} + \cdots + \beta_{k,t} y_{t-k} + u_t \qquad t = 1, \ldots, T \tag{1}$$

Here, y_t denotes an $nx1$ vector of endogenous variables; c_t, represents an , $nx1$ vector of time-varying constant terms; $\beta_{i,t}, i = 1, \ldots k$ where i = 1,…k, refers to an nxn matrix of time-varying lagged coefficients; and u_t denotes the error term that contains unobservable shocks with heteroskedastic (time-varying variance) properties, whose variance-covariance matrix is Ω_t.

The variance-covariance matrix of the shocks, Ω_t, is expressed as follows:

$$A_t \Omega_t A_t' = \Sigma_t \Sigma_t' \tag{2}$$

Here, A_t**,** denotes a lower triangular matrix that captures the contemporaneous interactions of structural shocks. Σ_t represents a diagonal matrix that contains the time-varying standard deviations of each variable.

The lower triangular matrix,

$$A_t = \begin{bmatrix} 1 & 0 & \ldots & 0 \\ \alpha_{21,t} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ \alpha_{n1,t} & \ldots & \alpha_{nn-1,t} & 1 \end{bmatrix}$$

indicates the dynamics of the structural shocks.

Diagonal Matrix Σ_t:

$$\Sigma_t = \begin{bmatrix} \sigma_{1,t} & 0 & \dots & 0 \\ 0 & \sigma_{2,t} & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \vdots & 0 & \sigma_{n,t} \end{bmatrix}$$

Using the matrices defined above, the fundamental model can be expressed as:

$$y_t = c_t + \beta_{1,t} y_{t-1} + \cdots + \beta_{k,t} y_{t-k} + A_t^{-1} \Sigma_t \varepsilon_t \quad (3)$$

Here, $A_t^{-1} \Sigma_t \varepsilon_t$ represents the structural form of the shocks. The model can be rewritten in regression form as follows:

$$y_t = X_t' \beta_t + A_t^{-1} \Sigma_t \varepsilon_t \quad (4)$$

$$X_t' = I_n \otimes [1, y_{t-1}', \dots, y_{t-k}'] \quad (5)$$

In this expression, all lagged values are included in X_t'. The symbol $\otimes$ denotes the Kronecker product, allowing the matrix to be represented in an expanded form. This structure defines the matrix form that facilitates the estimation of the TVP-VAR model using Bayesian methods. For the estimation of the TVP-VAR model, Bayesian techniques such as the Gibbs Sampler and a filter similar to the Kalman Filter are employed.

4. DATASET

This study investigates how monetary policy should be managed in response to fluctuations in asset prices and potential asset price bubbles in the Turkish economy. Within this framework, the model incorporates several variables that are believed to influence both financial markets and macroeconomic stability: the money supply ($M2$), the housing price index (HPI), gold prices (measured by the London gold ounce price), the BIST 100 index, the weighted average cost of funding ($WACF$), the consumer price index (CPI), the real effective exchange rate ($REER$), and tax revenues(TR).

Through these variables, the study aims to analyze the bidirectional relationship between monetary policy and asset prices—namely, both the effects of monetary policy on asset prices and the influence of asset price movements on the conduct of monetary policy. To examine this dynamic and time-varying relationship, the Time-Varying Parameter Vector Autoregression (TVP-VAR) model is employed. Unlike traditional VAR models with fixed coefficients, the TVP-VAR model allows for the analysis of how the responses to shocks evolve over time.

The dataset comprises monthly observations spanning the period from December 2010 to December 2024. All data were obtained from official sources, including the Central Bank of the Republic of Türkiye (CBRT), the Turkish Statistical Institute (TurkStat), Borsa Istanbul (BIST), and the Ministry of Treasury and Finance.[5]

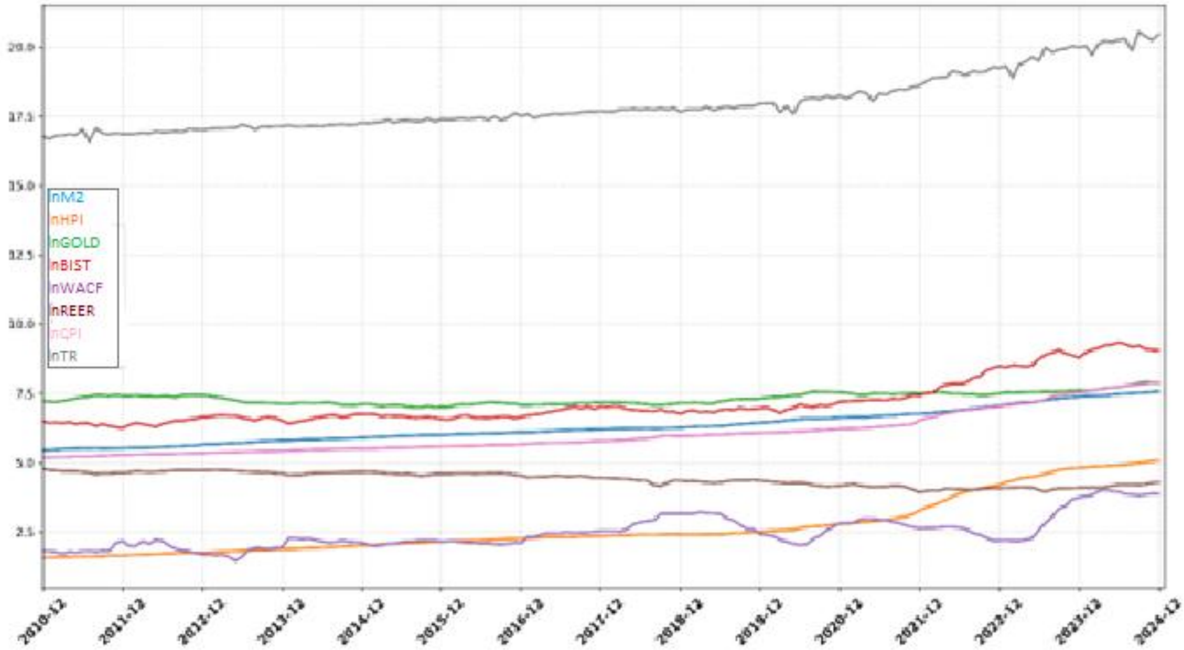
[5] Data were retrieved from the Central Bank of the Republic of Türkiye’s Electronic Data Delivery System (https://evds2.tcmb.gov.tr/) and the Turkish Statistical Institute’s official data portal (https://data.tuik.gov.tr/), as well as institutional reports and releases from Borsa Istanbul and the Ministry of Treasury and Finance.

All series have been seasonally adjusted and transformed into their natural logarithms prior to analysis. Variables that have been log-transformed are denoted with the prefix "ln" (e.g., `lnWACF`, `lnCPI`).

$$lm2_t = [lnHPI_t, lnGOLD_t, lnBIST_t, lnWACF_t, lnCPI_t, lnREER_t, lnTR_t, u_t]$$

In this study, graphical and econometric analyses were conducted using a combination of EViews, R, and Python software. Time series graphs of the variables used in the analysis are presented below.

Figure 1. Time Series Plots of the Variables



Source: Created by the authors.

As can be observed from the figures, all variables exhibit an upward trend over time. Notably, there are significant fluctuations in most variables following the year 2020, which can be attributed in part to the impact of the COVID-19 pandemic.

The descriptive statistics of the variables are calculated and summarized in Table 2 below.

Table 2. Descriptive Statistics

	lnM2	lnHPI	lnGOLD	lnBIST	lnWCAF	lnCPI	LnREER	lnTR
Mean	6.308	2.674	7.334	7.159	2.476	6.037	4.425	17.933
Median	6.212	2.358	7.313	6.860	2.321	5.788	4.469	17.634
Max.	7.565	5.046	7.896	9.273	3.966	7.885	4.789	20.617
Min.	5.460	1.581	6.976	6.256	1.509	5.203	3.918	16.624
Std. Dev.	0.582	1.005	0.213	0.825	0.584	0.734	0.242	0.999
Skewness	0.532	1.170	0.482	1.427	0.955	1.066	-0.269	1.060
Kurtosis	2.312	3.114	2.464	3.774	3.345	3.070	1.646	3.147
Jarque-Bera	11.247	38.428	8.505	61.193	26.353	31.823	14.875	31.606
Probability	0.004	0.000	0.004	0.000	0.000	0.000	0.000	0.000

Source: Created by the authors.

Table 2 presents the descriptive statistics of the variables used in the study. The table summarizes the mean, median, minimum, maximum, standard deviation, skewness, and kurtosis values of all variables. According to the Jarque-Bera test results, since the probability values are lower than 0.05, the null hypothesis of normal distribution is rejected for all variables under investigation, implying that the variables do not follow a normal distribution.

Additionally, the variables lnM2, lnCPI, and lnHPI appear to be more sensitive to economic shocks and policy changes compared to lnBIST and lnTR, while the lnREER variable exhibits negative skewness. The lnGOLD variable, on the other hand, demonstrates relatively lower volatility. In light of the descriptive statistics presented in Table 2, the distributional characteristics of the variables can be examined through their skewness and kurtosis values.

Skewness measures the asymmetry of the distribution; a value of zero indicates symmetry. Positive skewness implies a distribution with a longer right tail (i.e., prone to large positive deviations), whereas negative skewness implies a longer left tail (i.e., prone to large negative deviations) (Gujarati & Porter, 2009; Brooks, 2014). According to the table, the variables lnM2, lnHPI, lnGOLD, lnBIST, lnWACF, lnCPI, and lnTR exhibit positive skewness, indicating that these series are right-skewed and more inclined to exhibit large positive outliers. In contrast, only lnREER exhibits negative skewness, suggesting that this variable is left-skewed and more prone to negative extreme values.

Kurtosis, on the other hand, indicates the peakedness and tail heaviness of the distribution. The kurtosis value of a normal distribution is theoretically 3; a value above 3 indicates leptokurtic distributions (more peaked and sensitive to extreme values), while a value below 3 indicates platykurtic distributions (flatter and less sensitive to extreme values) (Wooldridge, 2013). In this regard, lnBIST, lnWACF, and lnTR show leptokurtic behavior, suggesting greater sensitivity to outliers. Conversely, variables such as lnM2, lnGOLD, and lnREER exhibit kurtosis values below 3, indicating a platykurtic nature with fewer extreme observations.

The fact that the majority of the analyzed variables display asymmetric distributions and contain extreme values highlights the importance of accounting for these characteristics in the econometric modeling process (Gujarati & Porter, 2009; Brooks, 2014; Wooldridge, 2013).

5. EMPIRICAL FINDINGS

As is standard in all econometric applications, the variables included in the TVP-VAR analysis must exhibit stationarity. Accordingly, unit root tests were conducted for all variables prior to model estimation. In this context, three widely employed tests were utilized to assess the presence of unit roots: the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test, and the Zivot-Andrews (ZA) test, which accounts for potential structural breaks in the series

Table 3: Unit Root Test Results

	LnM2	lnHPI	lnGOLD	lnBIST	lnWCAF	lnCPI	lnREER	lnTR
ADF^d	1.112	-0.498	-1.113	-0.676	-2.433	0.631	-1.961	1.415
PP^d	0.747	-0.099	-0.617	-0.703	-2.560	1.196	-1.974	-2.241
ZA^d	-3.008	-4.161	-4.103	-4.170	-4.154	-3.870	-3.715	-3.703
ADF^1	-12.631***	-4.730***	-10.019***	-11.951***	-6.143***	-7.138***	-10.565***	-4.897***
PP^1	-12.903***	-4.428***	-9.930***	-11.916***	-8.801***	-7.051***	-9.211***	-50.869***
ZA^1	-6.968***	-6.849***	-10.662***	-12.617***	-5.165**	-7.444***	-8.532***	-6.753***

Note**: ADF^d, PP^d, and ZA^d denote test statistics at level form; ADF^1, PP^1, and ZA^1 indicate the first-differenced form of the variables.* ***, **, and ** *represent statistical significance at the 10%, 5%, and 1% levels, respectively.*

Source: Created by the authors.

After applying all three unit root tests, it was concluded that none of the variables are stationary at levels, but all become stationary after first differencing. Subsequently, the Time-Varying Parameter Vector Autoregressive (TVP-VAR) model was estimated using the Markov Chain Monte Carlo (MCMC) method, which incorporates Bayesian inference.

Table 4: TVP-VAR Estimation Results

Parameters	Mean	Std. Error	%95 Credible Interval		Geweke	Inefficiency Factor
			Üst Sınır	Alt Sınır		
$(\boldsymbol{\Sigma}_h)_1$	0.438	0.229	0.937	0.221	0.985	2.120
$(\boldsymbol{\Sigma}_h)_2$	0.498	0.414	0.499	0.232	0.519	7.010
$(\boldsymbol{\Sigma}_h)_3$	0.338	0.120	0.573	0.198	0.795	7.160
$(\boldsymbol{\Sigma}_h)_4$	0.477	0.332	0.543	0.263	0.896	21.980
$(\boldsymbol{\Sigma}_h)_5$	0.613	0.435	0.659	0.272	0.584	1.240
$(\boldsymbol{\Sigma}_h)_6$	0.315	0.051	0.412	0.256	0.669	9.500
$(\boldsymbol{\Sigma}_h)_7$	0.448	0.164	0.754	0.251	0.771	15.680
$(\boldsymbol{\Sigma}_\beta)_1$	0.721	0.328	0.731	0.287	0.853	11.320
$(\boldsymbol{\Sigma}_\beta)_2$	0.779	0.113	0.772	0.583	0.845	12.600
$(\boldsymbol{\Sigma}_\beta)_3$	0.517	0.095	0.767	0.591	0.832	18.790
$(\boldsymbol{\Sigma}_\beta)_4$	0.756	0.102	0.791	0.576	0.801	15.840
$(\boldsymbol{\Sigma}_\beta)_5$	0.753	0.108	0.796	0.575	0.798	6.850
$(\boldsymbol{\Sigma}_\beta)_6$	0.760	0.098	0.778	0.580	0.800	6.990
$(\boldsymbol{\Sigma}_\beta)_7$	0.748	0.105	0.853	0.601	0.966	24.062
$(\boldsymbol{\Sigma}_\alpha)_1$	0.632	0.901	0.871	0.500	0.885	4.212
$(\boldsymbol{\Sigma}_\alpha)_2$	0.635	0.900	0.651	0.440	0.683	10.241
$(\boldsymbol{\Sigma}_\alpha)_3$	0.636	0.905	0.663	0.437	0.681	9.881
$(\boldsymbol{\Sigma}_\alpha)_4$	0.621	0.097	0.990	0.508	0.475	5.712
$(\boldsymbol{\Sigma}_\alpha)_5$	0.622	0.107	0.968	0.796	0.660	11.480
$(\boldsymbol{\Sigma}_\alpha)_6$	0.636	0.104	0.674	0.577	0.765	4.700
$(\boldsymbol{\Sigma}_\alpha)_7$	0.626	0.110	0.684	0.561	0.799	7.550

1. lnHPI, 2. lnGOLD, 3. lnBIST, 4. lnWCAF, 5. lnREER, 6. lnCPI, 7. lnTR

Source: Created by the authors.

In Table 4, (Σ_h), denotes the covariance matrix of the error term, (Σ_β), indicates the time variation in the coefficients, and (Σ_α) reflects the time variation in the intercept. The optimal lag length was determined as 1 based on the Akaike Information Criterion (AIC). The model estimation was conducted using 10,000 simulations implemented in Python programming language. According to the results of the Geweke convergence diagnostic at the 95% confidence level, all values are below 1 and remain well under the critical threshold of 1.96. This confirms that the model demonstrates strong convergence properties. Furthermore, the null hypothesis suggesting that the sampled parameters are clustered within the 95% confidence interval could not be rejected, which implies a high-quality convergence of the Markov Chain Monte Carlo (MCMC) sampling.

The inefficiency factors of all parameters are below 100, indicating that the number of iterations was sufficient for a stable and reliable estimation of the TVP-VAR model. Accordingly, the parameter estimates obtained from the model are deemed effective. Notably, a high inefficiency factor indicates high parameter volatility. In this context, the tax revenues (lnTR) variable exhibits the highest coefficient volatility, suggesting that its impact has fluctuated over time. This is followed by the lnBIST and lnWACF variables.

The high volatility in tax revenues can be attributed to frequent shifts in fiscal policy and major macroeconomic developments in Türkiye. Between 2013 and 2018, several significant socio-political events, currency shocks, and increasing inflation contributed to fluctuations in economic growth. The lack of growth stability has also caused instability in tax revenues. In 2017 and 2018, when inflation transitioned from single to double digits, the increasing tax burden led to a rise in the informal economy. Additionally, in periods of high inflation, the share of indirect taxes within total tax revenues tends to increase, amplifying volatility in economic growth (Karaer, 2024: 4).

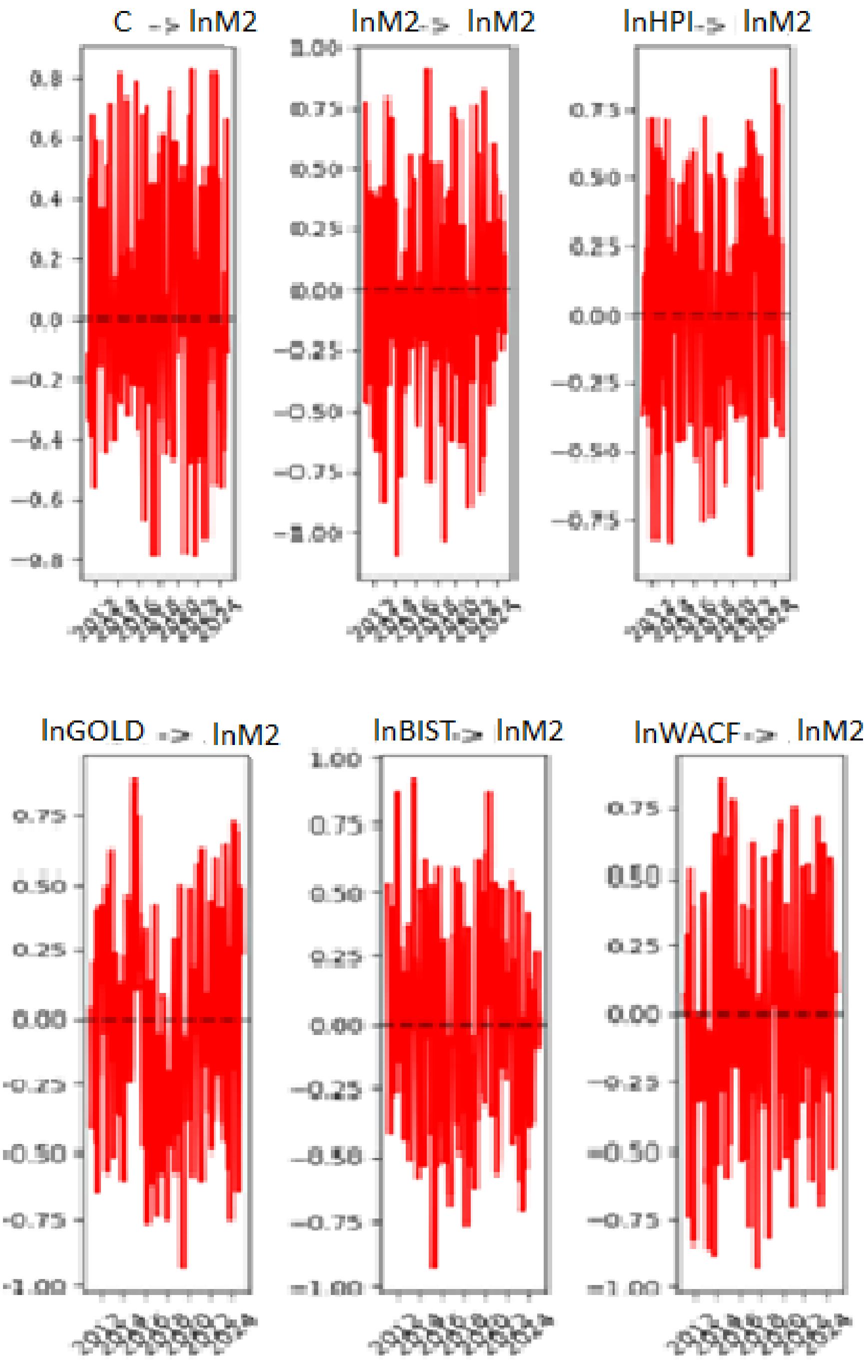
In 2018, Türkiye experienced a major currency crisis, during which the exchange rate surged from approximately 3.77 TRY/USD in January to 7.20 TRY/USD by August 13, 2018 (Investing.com). In response, the Central Bank of the Republic of Türkiye (CBRT) raised its policy interest rate from 13.5% to 16.5% in May 2018, and further to 24% in September 2018. Although these interventions helped stabilize the exchange rate to some extent, they were largely ineffective in controlling inflation. The prevailing economic uncertainty during this period led to stagnation and a contraction in GDP in the final quarter of 2018. All these dynamics, including interest rate hikes, rising inflation, and currency depreciation, caused significant volatility in the Borsa Istanbul.

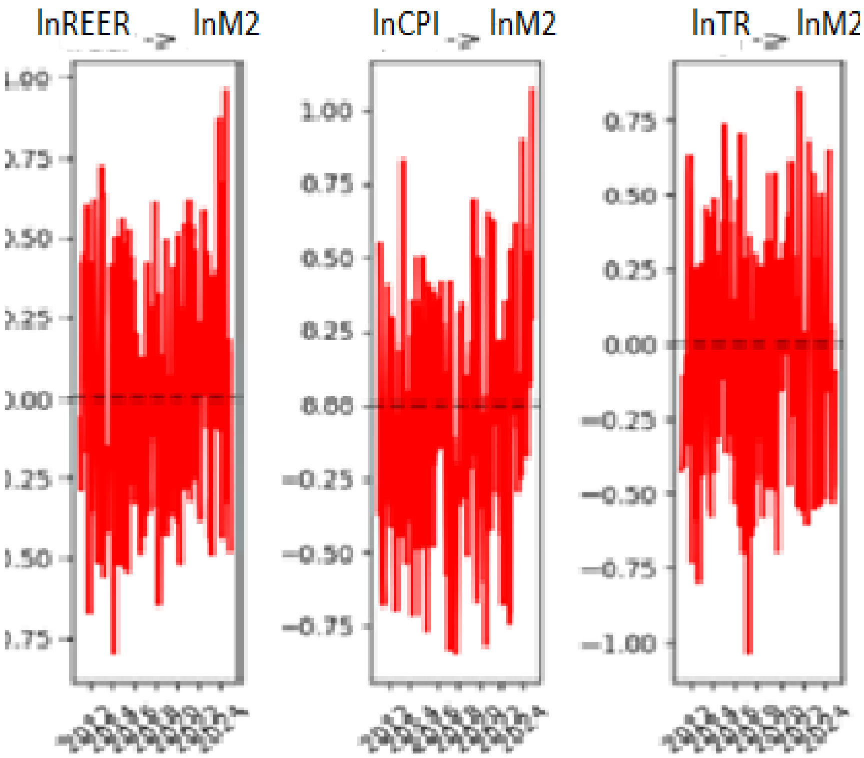
In 2020, the COVID-19 pandemic prompted central banks around the world to adopt expansionary monetary policies to support liquidity and stabilize their economies. By 2021, global supply chain disruptions resulting from the pandemic led to a contraction in production, contributing to a surge in food prices. At the same time, the CBRT's expansionary stance and supply constraints triggered demand-side inflationary pressures. Persistently low interest rates also encouraged dollarization among domestic investors.

The outbreak of the Russia-Ukraine war in 2022 further escalated global energy and food prices, causing significant economic disruptions. Apart from energy and food sectors, equity prices in other industries experienced notable declines. Consequently, investors increasingly turned to traditional safe havens such as gold and the U.S. dollar, leading to sharp drops in the stock market. Persistently high inflation rates heightened expectations of further interest rate increases, which, in turn, raised borrowing costs and negatively affected corporate valuations. As a result, investors began to withdraw from equity markets under rising interest rate environments.

Fluctuations in interest rates and inflation directly affect stock returns in a negative manner (Fama & Schwert, 1977: 144). According to the Fisher Effect theory, nominal interest rates are expected to move in tandem with inflation expectations. The observed high volatility in the lnBIST variable confirms this relationship and aligns with the empirical findings in the literature, highlighting the substantial influence of global events and domestic policy shifts on stock markets.

Figure 2: Time-Varying Coefficient Changes of the Variable





Source: Created by the authors.

The primary aim of this study is to understand the impact of asset price fluctuations on monetary policy and the possible policy responses. In this context, the analysis primarily focuses on the money supply variable and investigates the effects of relevant asset prices (housing, gold, stock market, investment funds) and macroeconomic variables (inflation, exchange rate, taxation) over time.

Money supply is placed at the center of the analytical framework as it is a key indicator that directly reflects central bank policies and is used as the dependent variable. This enables the establishment of a bidirectional relationship between asset prices and monetary policy and allows the observation of time-varying effects.

In this regard, the graphs above illustrate that the effects of the variables follow a dynamic process. The impact of the housing price index on money supply changes over time, fluctuating between positive and negative values, indicating that the relationship between the housing market and money supply differs across periods. The effect of gold prices on money supply is highly volatile; in certain periods, it appears to be negative, while in others, it is positive. Since gold is often considered a safe haven during crisis periods, its relationship with money supply has at times reversed.

The influence of the stock market index on money supply is also volatile, with some periods showing a pronounced negative effect. This suggests that the impact of capital market movements on money supply is uncertain and can operate in different directions depending on the period. Similarly, the impact of investment funds on money supply is generally fluctuating and changes over time. This relationship may be affected by various financial market policies and interest rate adjustments.

The effect of the real effective exchange rate on money supply shows significant volatility over time. Exchange rate fluctuations may alter their impact on money supply depending on central bank policies and the trade balance. The influence of inflation on money supply also demonstrates notable variation over time. Shifts between positive and negative effects imply that central bank policies and inflation expectations influence the money supply differently across periods.

The impact of tax revenues on money supply also changes periodically. In some periods, the effect is positive, while in others, it is negative. This suggests that fiscal policies and public expenditures can alter the direction of this relationship.

Overall, the analysis results indicate that the effects of money supply shocks within the system vary over time both in direction and magnitude, and that the monetary policy transmission mechanism in Türkiye operates in a dynamic and time-sensitive manner rather than a fixed one. In this framework, the time-varying parameter structure offered by the TVP-VAR model provides a robust tool for analyzing temporary or structural transformations that conventional models may fail to capture.

The existence of autocorrelation in the TVP-VAR model was tested using the Breusch-Godfrey LM test, and the results are summarized in Table 5.

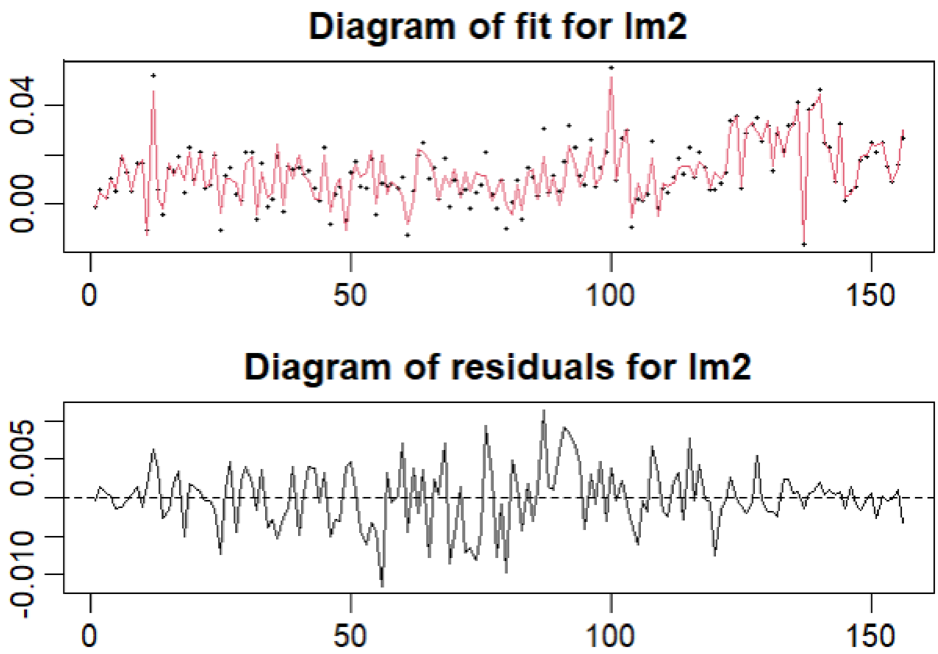
Table 5: Breusch-Godfrey LM Test Results

	lnM2	lnHPI	lnGOLD	lnBIST	lnWCAF	lnCPI	lnREER	lnTR
LM test stat.	0.018	1.489	1.374	1.145	0.180	1.220	1.604	1.127
P- value	0.893	0.222	0.241	0.285	0.671	0.269	0.205	0.289

Source: Created by the authors.

According to the results, the null hypothesis (H_0) indicating the absence of autocorrelation could not be rejected for all models, suggesting that there is no autocorrelation. The fit of the estimates obtained from the TVP-VAR model can be observed using the graphs below. The upper part of Figure 3 displays the predicted and actual values derived from the parameters estimated by the TVP-VAR model, while the lower part shows the residuals.

Figure 3: Fit and Residual Graphs of the Variable Based on the TVP-VAR Model



Source: Created by the authors.

The close alignment between actual observations (represented by black dots) and predicted values (represented by the red line) indicates the overall success of the model. Nevertheless, the presence of abrupt deviations suggests that structural breaks or regime shifts may have occurred over time. The residuals fluctuate with relatively small oscillations around a zero mean, which is considered a favorable outcome. However, during certain periods, the residuals exhibit high volatility. This pattern implies that the model may have been affected by external shocks or regime changes during those intervals.

Although the TVP-VAR model is effective in capturing time-varying relationships, it may produce larger forecast errors for variables that experience high volatility during specific periods. The presence of substantial residuals in some episodes suggests that fluctuations in money supply may have been influenced by unpredictable factors. These deviations are likely attributable to external influences such as policy shocks, financial market crises, or sudden changes in central bank decisions.

6. Conclusion

The primary objective of this study is to examine how the relationship between money supply and selected financial and macroeconomic variables evolved over the period 2010–2024 in the Turkish economy. For this purpose, a Time-Varying Parameter Vector Autoregression (TVP-VAR) model was employed.

In this context, not only conventional indicators such as inflation and exchange rates, but also asset prices—namely housing price index, gold prices, and stock market performance—were incorporated to provide a comprehensive assessment of monetary policy impacts. The findings contribute to a deeper understanding of the time-varying nature of these variables and their dynamic effects on money supply.

The results indicate that monetary supply shocks influence asset prices such as housing, gold, stocks, and exchange rates; however, the direction and magnitude of these effects vary significantly over time. The sensitivity of housing prices to monetary policy changes highlights the fragility of the housing market. This is consistent with the expectations that the housing market is responsive to macroeconomic variables such as interest rates and exchange rates (Goodhart & Hofmann, 2008; Agnello & Schuknecht, 2011). Furthermore, gold prices, while volatile, often play a shock-absorbing role, particularly in times of crisis. This behavior can be attributed to gold's role as a "safe haven" asset (Baur & Lucey, 2010; Balcilar et al., 2013).

Another important finding is the increased volatility of time-varying parameters, particularly during crisis periods. This underscores the inadequacy of traditional models with constant coefficients and the necessity of incorporating structural changes over time. The period following 2013, marked by heightened economic and political uncertainty, appears to have intensified parameter volatility in the model. These findings align with the literature highlighting the time-dependent nature of monetary policy effectiveness (Benati & Surico, 2009; Baumeister et al., 2010). The results are also consistent with Borio and Lowe (2002), who argue that focusing solely on price stability is insufficient, and that financial stability should also be a policy objective. The periodic vulnerabilities observed in housing and financial asset prices emphasize the importance of designing policy responses that are sensitive to temporal dynamics. Additionally, Zhu, Bai, and Wang (2022) found that liquidity-related conditions had a significantly increased impact on financial markets in the post-pandemic era.

In conclusion, this study demonstrates that the effects of monetary and fiscal policies on financial markets are not constant but rather evolve over time. Accordingly, policymakers should adopt a holistic and dynamic approach that considers not only internal factors such as inflation, growth, and public finance, but also external shocks including global crises, commodity price volatility, and geopolitical risks.

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