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REGIME-DEPENDENT MONETARY POLICY RESPONSES AND WELFARE LOSSES UNDER GROWTH VOLATILITY: A REGIME-SWITCHING MS-VAR ANALYSIS FOR TÜRKİYE

Büyüme Oynaklığı Koşullarında Rejime Bağlı Para Politikası Tepkileri ve Refah Kayıpları: Türkiye İçin Rejim Geçişli MS-VAR Analizi

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Growth Volatility, Regime-Dependent Monetary Policy Responses, Markov-Switching VAR, Welfare Losses, Türkiye Economy

JEL Codes:
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Abstract

This study investigates whether monetary policy responses in Türkiye differ across growth volatility regimes and examines the implications for welfare-related macroeconomic stability losses. The analysis uses quarterly data from the first quarter of 2002 to the fourth quarter of 2024 and employs a reduced-form Markov-Switching Vector Autoregressive (MS-VAR) model. Monetary policy is modeled through an extended Taylor rule with regime-dependent reaction coefficients. Model parameters are estimated by maximum likelihood, and regime probabilities are obtained using the Hamilton filter. The regimes are estimated endogenously rather than predetermined based on historical periods. The findings indicate two distinct growth regimes: stability and high volatility. In the high-volatility regime, growth volatility increases and the monetary policy response to inflation weakens, while responses to the exchange rate and real economic indicators strengthen. The welfare analysis shows that welfare losses arising from fluctuations in inflation, output, and unemployment differ across regimes. The findings suggest that monetary policy responses and welfare-related macroeconomic stability outcomes may be sensitive to macroeconomic regime conditions.

Anahtar Kelimeler:
Büyüme Oynaklığı, Rejime Bağlı Para Politikası Tepkileri, Markov-Switching VAR, Refah Kayıpları, Türkiye Ekonomisi

JEL Kodları:
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Öz

Bu çalışma, Türkiye ekonomisinde para politikası tepkilerinin büyüme oynaklığı rejimlerine göre farklılaşıp farklılaşmadığını ve bu farklılıkların refahla ilişkili makroekonomik istikrar kayıpları üzerindeki etkilerini incelemektedir. Analizde, 2002 yılının birinci çeyreğinden 2024 yılının dördüncü çeyreğine kadar olan dönemi kapsayan çeyreklik veriler ve indirgenmiş form Markov-Switching Vektör Otoregresif (MS-VAR) modeli kullanılmıştır. Para politikası, rejime bağlı tepki katsayıları içeren genişletilmiş bir Taylor kuralı çerçevesinde modellenmiştir. Model parametreleri maksimum olabilirlik yöntemiyle tahmin edilmiş, rejim olasılıkları Hamilton filtresiyle elde edilmiştir. Rejimler tarihsel olarak önceden belirlenmemiş, model tarafından içsel olarak tahmin edilmiştir. Bulgular, Türkiye ekonomisindeki büyüme sürecinin istikrar ve yüksek oynaklık olmak üzere iki farklı rejim altında ayrıştığını göstermektedir. Yüksek oynaklık rejiminde büyüme oynaklığı artmakta ve para politikasının enflasyona verdiği tepki zayıflarken, döviz kuru ve reel göstergelere verilen tepkiler güçlenmektedir. Refah analizi, enflasyon, çıktı ve işsizlik dalgalanmalarından kaynaklanan refah kayıplarının rejimler arasında farklılaştığını göstermektedir. Bulgular, para politikası tepkilerinin ve refahla ilişkili makroekonomik istikrar sonuçlarının makroekonomik rejim koşullarına duyarlı olabileceğine işaret etmektedir.

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1. Introduction

Macroeconomic stability occupies a central place in modern monetary policy debates. The primary objective and priority of central banks is to ensure price stability by limiting fluctuations in inflation. In addition, volatility in the level of production constitutes a source of economic concern because it can create macroeconomic imbalances and generate negative effects on social welfare. Therefore, production/growth volatility constitutes a complementary factor in monetary policy analyses. However, evaluating the growth process only through average performance does not sufficiently reveal the welfare consequences of economic fluctuations. In the business cycle literature, it has long been emphasized that output fluctuations may generate high costs for household welfare. Within this framework, the relationship between growth volatility, the effectiveness of monetary policy, and social welfare emerges as a fundamental research area that should be addressed jointly in macroeconomic analysis.

In developing economies, this relationship exhibits a more complex structure. The relatively shallow nature of financial markets, high sensitivity to external shocks, and the volatility of capital movements make the maintenance of macroeconomic stability more difficult. Accordingly, monetary policy responses may exhibit a structure that is sensitive to economic conditions and the level of uncertainty. This situation leads analyses based on single-regime and linear policy assumptions to remain limited, particularly in explaining periods of high volatility.

In the existing macroeconomic literature, the effects of monetary policy are generally examined under a symmetric structure. This approach assumes that the responses of central banks to inflation and the output gap remain constant over time. However, during periods of high uncertainty, the balance between the objective of price stability and concerns about financial stability may change, and policy priorities may be reshaped. In this context, findings indicating that monetary policy behavior may differ across regimes and that policy responses may vary under different macroeconomic conditions are increasingly addressed in the literature.

Dynamic Stochastic General Equilibrium (DSGE) models are widely used in examining the macroeconomic effects of monetary policy due to their micro-founded structure. However, standard DSGE models generally construct a linear and single-regime framework. For this reason, they cannot clearly model the structure of economic dynamics that changes over time and transitions between regimes.

Regime-switching approaches provide an appropriate analytical framework for examining how monetary policy operates under various fluctuation environments. In the macroeconomic literature, studies addressing the regime-dependent effects of monetary policy together with the social welfare consequences of these effects are increasingly expanding.

This study investigates whether monetary policy responses differ across growth volatility regimes in the economy of Türkiye. For this purpose, a regime-switching Markov-Switching Vector Autoregressive (MS-VAR) model is employed to examine how policy response coefficients vary between stability and high-volatility periods and how these differences are associated with welfare-related macroeconomic stability outcomes.

In the literature on Türkiye, studies that jointly examine regime-dependent monetary policy behavior and welfare-related macroeconomic stability outcomes remain limited. This study seeks to contribute to this literature by comparatively evaluating welfare-related stability losses across

growth volatility regimes within a regime-switching MS-VAR framework that allows policy response coefficients to vary across regimes.

2. Theoretical Framework

This section addresses the theoretical framework of the study around three main axes. First, the relationship between growth volatility and macroeconomic stability is examined; then the effects of monetary policy on the real economy and its asymmetric nature are evaluated. Finally, the theoretical background regarding the welfare consequences of monetary policy within the framework of regime-switching approaches is presented.

2.1. Growth Volatility and Macroeconomic Stability

Macroeconomic stability has long been examined through the average level of economic performance. The level of growth rates and the level of inflation have been accepted as the main indicators. In contrast, the literature on cyclical fluctuations has drawn attention to the welfare costs of economic fluctuations. Lucas Jr. (1987: 26; 2003: 1) emphasizes that the effects of output fluctuations on welfare should theoretically be taken into account in economic analyses. Therefore, economic performance should be evaluated not only through average growth dynamics such as labor supply, productivity, technological progress, demographic structure, and institutional structure, but also through the dimension of growth volatility.

High volatility may delay investment decisions through uncertainty and may adversely affect capital accumulation. This situation may lead to the establishment of a negative relationship between growth volatility and long-term growth performance (Ramey and Ramey, 1995: 1138; Aghion and Howitt, 1998: 141-142). It is also indicated in theoretical and empirical studies that, in an uncertain environment, firms' risk-averse attitudes strengthen and the allocation of resources becomes inefficient (Dixit and Pindyck, 1994: 5-6; Bloom, 2009: 625).

The limited depth of financial markets, dependence on external financing, and sudden reversals in capital flows cause macroeconomic fluctuations to be experienced more severely in developing economies. In this context, growth volatility is considered not only a cyclical outcome for developing economies but also a structural factor that shapes the design of macroeconomic policy (Acemoglu et al., 2003: 50; Aghion et al., 2010: 247; Loayza et al., 2007: 344).

2.2. Monetary Policy and the Asymmetric Transmission Mechanism

The effects of monetary policy on the real economy occur through many transmission channels such as the interest rate, credit, expectations, and the exchange rate. Within the traditional New Keynesian framework, it is accepted that central banks can generate a systematic effect on inflation and the output gap by using the policy interest rate. One of the main reference points of this approach is the Taylor rule, which defines the response of monetary policy to inflation and the output gap as a systematic policy function (1993: 195). This structure argues that the predictability and stability of monetary policy can enhance macroeconomic functionality (Clarida et al., 1999: 3). This framework has become a standard structure in policy analyses through micro-founded New Keynesian DSGE models. In particular, Smets and Wouters (2007:

586-587) show that the macroeconomic effects of monetary policy can be consistently examined within the DSGE framework under nominal rigidities and multiple structural shocks.

In its simplest form, this relationship can be expressed as follows:

$$i_t = \alpha + \beta_\pi \pi_t + \beta_y y_t + \beta_e e_t + \varepsilon_t \quad (1)$$

This formulation reflects an established approach that represents central bank behavior under a linear and time-invariant structure (Taylor, 1993: 202). However, such a framework generally assumes that policy responses remain symmetric across different cyclical conditions and macroeconomic environments. The theoretical literature suggests that this assumption may become less realistic during periods of uncertainty and financial stress, when the effectiveness of the interest rate channel may weaken, and financial frictions become more prominent (Bernanke and Gertler, 1988: 4-5; Kiyotaki and Moore, 1997: 213). As a result, the real effects of monetary policy may differ across economic conditions, giving rise to regime-dependent and asymmetric transmission mechanisms (Gertler and Gilchrist, 1994: 314; Mishkin, 1996: 15).

An increase in the level of uncertainty further complicates the transmission mechanism of monetary policy. During periods of high uncertainty, households and firms respond more cautiously to policy signals, which may limit the expected effects of monetary policy (Bloom, 2009: 624; Fernández-Villaverde et al., 2011: 2533-2534).

2.3. Regime Transitions, Monetary Policy and Welfare

In macroeconomic theory, the concept of regime is based on the idea that economic dynamics may exhibit different structural characteristics over time. Regime-switching approaches developed by Hamilton (1989: 357) have shown that economic series may display different mean and variance properties during certain periods. This approach theoretically supports the view that the effects of macroeconomic policies are not uniform and time-invariant (Kim, 1994: 1-2).

The regime-dependent effectiveness of monetary policy is particularly addressed in the context of the distinction between high-volatility and stability periods. During high-volatility periods, the policy priorities of central banks may change, and the objective of price stability may be evaluated together with concerns for financial stability. This situation may lead to a strengthening of the responses of monetary policy to exchange rate movements and capital flows (Calvo and Reinhart, 2002: 379; Ghosh, Ostry and Qureshi, 2015: 241-243). Therefore, the production of different outcomes of monetary policy under different regimes constitutes a theoretically consistent expectation.

The theoretical foundations of welfare losses are based on the question of the extent to which monetary policy can limit economic fluctuations. The New Keynesian literature shows that, due to nominal rigidities and market imperfections, monetary policy may play a decisive role in welfare (Woodford, 2003: 381-383). An increase in economic fluctuations may lead to welfare losses through consumption volatility and labor supply decisions. For this reason, evaluating the regime-dependent effects of monetary policy together with welfare outcomes occupies an important place in macroeconomic policy analysis (Schmitt-Grohé and Uribe, 2007: 1703; Galí, 2015: 29).

3. Literature Review

In this study, the literature review is constructed based on the assumption that monetary policy responses and their macroeconomic outcomes may differ across growth volatility regimes, and that these differences are closely related to welfare losses. In this context, the review focuses on studies that address growth volatility, regime-dependent monetary policy responses, and welfare effects together, and that examine these relationships through regime-switching or nonlinear DSGE models. The literature search was conducted in the Web of Science, Scopus, EconLit, JSTOR, and Google Scholar databases, and studies not related to the research topic were excluded from the review.

Initial studies on the subject focused on macroeconomic variability and social welfare costs and examined them within a theoretical framework. Lucas Jr. (1987) examined macroeconomic fluctuations within a general equilibrium framework based on representative agents with rational expectations who act in full coordination; under the assumption of low volatility, he showed that the welfare costs of these fluctuations are limited. However, the assumption of a linear structure in the study overlooks the possibility that policy effects may differ under high volatility and regime changes.

Hamilton (1989) developed a Markov-switching autoregressive model, making it possible to examine regime-dependent and nonlinear dynamics in economic time series. In this approach, it is assumed that important characteristics such as the average growth rate and variance may change over time across unobserved regimes. Regime shifts cannot be directly observed and are estimated probabilistically based on the realized behavior of the series. This framework indicates that macroeconomic variables may exhibit different dynamics in different periods.

Krolzig (1997) systematically addressed the econometric properties of MS-VAR models and demonstrated in detail how regime-switching models can be applied in the analysis of macroeconomic time series. In the study, estimation and inference methods for MS-VAR models were developed under the assumption that the mean, variance, and dynamic relationships of economic series may change across unobserved regimes. Krolzig showed that this approach provides a powerful tool particularly for the analysis of business cycles, monetary policy behavior, and macroeconomic fluctuations.

Early evidence on the asymmetric effects of monetary policy on the real economy was presented by Gertler and Gilchrist (1994). Analyses based on U.S. data showed that monetary tightenings lead to larger output losses for financially fragile firms. These results indicate that monetary policy may produce unequal effects under conditions of growth volatility.

Bernanke et al. (1999) examined the effects of monetary shocks on the real economy and welfare by incorporating the financial accelerator mechanism into a DSGE framework. The findings obtained using a linear DSGE model show that, in the presence of financial frictions, monetary shocks may deepen welfare losses by increasing output volatility.

Sims and Zha (2006) examined the time-varying behavior of monetary policy using a regime-dependent structural VAR method. The findings revealed that monetary policy responses differ between crisis and normal periods and that this differentiation is decisive for output and welfare dynamics.

Emphasizing the importance of nonlinear DSGE approaches, Fernández-Villaverde and Rubio-Ramírez (2010) showed that regime-switching DSGE models produce more successful

results than standard DSGE models during periods of large shocks and high uncertainty. Model results estimated using Bayesian methods reveal that the effects of policy shocks vary depending on the regime and significantly affect welfare losses.

Following this line of literature, DSGE applications developed for emerging economies have come to the fore. Elekdag et al. (2006) examined the effects of global financial shocks on output volatility and welfare using a Small Open Economy DSGE model, and showed that financial shocks deepen macroeconomic fluctuations and increase welfare losses.

Davig and Leeper (2007) investigated how monetary policy operates under different macroeconomic regimes within a regime-dependent New Keynesian DSGE framework. The findings show that Taylor rule parameters may change over time and that the effects of monetary policy on output and inflation differ depending on the regime.

Del Negro and Schorfheide (2008) examined the inflation targeting period in Chile using a small open economy DSGE model. Using Bayesian estimation and the DSGE-VAR method, they investigated the characteristics of the policy rule and the transmission of external shocks. The findings show that this framework is functional for policy evaluation in short sample periods.

Alba et al. (2011) compared the welfare outcomes of different monetary policy regimes in the context of the global crisis using DSGE simulations. The findings reveal that different policy regimes may show welfare superiority depending on countries' openness and import dependency.

Ma (2016) estimated a DSGE model including a nonlinear policy rule for China. The study indicated that the central bank follows a nonlinear reaction function. The finding shows that nonlinear policy rules may produce different outcomes in terms of stability and welfare.

Basu and Bundick (2017) examined the effects of uncertainty and volatility shocks on macroeconomic variables and welfare using a New Keynesian DSGE model. The study shows that increases in uncertainty reduce output and spending and lead to significant welfare losses.

Zamarripa (2021) investigated how the monetary policy reaction function changes over time for Mexico using a small open economy DSGE model. The findings show that responses to output and the exchange rate differ across periods.

Chen et al. (2023) examined the transmission mechanism of monetary policy in emerging economies using a DSGE model that includes foreign exchange market frictions and exchange rate interventions. The results reveal that policy responses and the balance between targets vary according to country-specific financial conditions.

Studies focusing on Türkiye show that the effects of monetary policy on the real economy exhibit an asymmetric and cyclical structure. Sengonul and Thorbecke (2005) examined the functioning of the credit channel through bank balance sheets and showed that monetary tightenings reduce credit supply more strongly in banks with weaker liquidity. Similarly, in another study, Elekdağ and Tchakarov (2007) showed, using a small open economy DSGE model, that the welfare outcomes of alternative monetary policy rules in emerging economies such as Türkiye vary depending on the nature and magnitude of shocks. Alpanda and Honig (2010) and Çebi (2012) show that monetary policy responses are not linear and that monetary tightening and easing do not produce symmetric outcomes. Karabıyık and Nart (2020) examined whether the effect of monetary policy on output is asymmetric during expansion and contraction periods using a Markov regime-switching model. It was concluded that the effects of monetary policy in

Türkiye are asymmetric. In addition, it was revealed that the effectiveness of monetary policy remains limited during recession periods.

However, studies that address the welfare outcomes of regime-dependent differences in monetary policy behavior and policy responses in a holistic manner within a structural DSGE framework remain limited.

The existing literature reveals the welfare costs of macroeconomic volatility and uncertainty and provides growing evidence that monetary policy responses may differ across regimes. However, studies that jointly examine regime-dependent monetary policy responses and welfare-related outcomes under conditions of growth volatility remain relatively limited, particularly in the context of emerging economies and Türkiye. This study examines the relationship between growth volatility, regime-dependent monetary policy responses, and welfare losses jointly for Türkiye under a regime-switching MS-VAR model.

4. Dataset and Econometric Method

This study examines growth volatility, regime-dependent monetary policy behavior, and welfare-related macroeconomic stability outcomes within an integrated empirical framework. However, the findings obtained are limited by the assumptions of the established MS-VAR model and the regime classifications derived from the data. The regimes were not assigned to historical periods in advance but were estimated by the model based on the data.

4.1. Dataset and Variable Definitions

In this study, quarterly time series data covering the period 2002Q1-2024Q4 are used to examine growth volatility in the Türkiye economy, regime-dependent monetary policy behavior, and the welfare-related implications of these regime differences.

The data were obtained from the Central Bank of the Republic of Türkiye (CBRT) Electronic Data Delivery System (EVDS), the Turkish Statistical Institute (TURKSTAT**),** and the Federal Reserve Economic Data (FRED) databases. The unemployment rate is based on series consistent with the OECD methodology; monetary policy indicators, the output gap, and exchange rate data were obtained from CBRT-EVDS; real GDP and inflation data were obtained from TURKSTAT.

The main variables in the model are the real GDP growth rate, the inflation rate (CPI), the policy interest rate, the nominal exchange rate change, the unemployment rate, and the output gap. The policy interest rate series was constructed by combining the overnight lending rate for the 2002-2009 period and the one-week repo auction rate for the 2010-2024 period. This approach reflects the changes in the operational monetary policy framework of the CBRT over time and provides a consistent policy rate series covering the entire sample period. The resulting series is intended to capture the official monetary policy stance of the CBRT throughout the period examined.

The output gap was obtained by decomposing the real GDP series into its trend and cyclical components using the Hodrick-Prescott filter ($\lambda = 1600$). Although the HP filter is widely used in the New Keynesian literature to measure the output gap, it is known to have sensitivity problems,

particularly at the endpoints of the sample (Hodrick and Prescott, 1997: 5; Galí, 2015: 51). For this reason, the output gap is used not as a structural target variable but as an auxiliary indicator intended to capture regime-dependent macroeconomic conditions and monetary policy responses. Nevertheless, the potential endpoint sensitivity of the HP filter should be taken into account when interpreting the empirical findings.

All tables and figures included in this study were produced by the author using the dataset and the estimation results obtained from the regime-switching MS-VAR model.

During the examined period, global financial shocks, the pandemic process, and large fluctuations originating from monetary policy observed in the Türkiye economy make it difficult to represent macroeconomic dynamics within a linear and time-invariant structure. This situation constitutes the main methodological reason for selecting a regime-switching modeling approach in this study. The inclusion of the output gap and the unemployment rate in the model allows a more direct examination of regime-dependent monetary policy behavior and the welfare-related implications of these regime differences. These variables assume an analytical role particularly in tracking the regime-dependent differentiation of labor market frictions and demand conditions.

To evaluate the robustness of the empirical findings, additional analyses were conducted using alternative output gap measures. In addition to the baseline Hodrick-Prescott (HP) filter, output gaps obtained from a quadratic trend specification and the Hamilton (2018) filter were employed. The results remained qualitatively unchanged across these alternative specifications, indicating that the main findings are robust to the choice of output gap measure and are not driven by the endpoint sensitivity associated with the HP filter. The corresponding estimation results are presented in Table 1.

Table 1. Robustness Analysis Using Alternative Output Gap Measures

Output Gap Measure	F-statistic	p-value	N
Hodrick-Prescott (Baseline)	37.02	< 0.001	90
Hodrick-Prescott (Re-estimated)	22.89	< 0.001	90
Quadratic Trend	21.55	< 0.001	90
Hamilton (2018) Filter	70.55	< 0.001	81

Note: The regime asymmetry remains statistically significant at the 1% significance level across all alternative output gap measures.

Table 1 demonstrates that the main findings regarding regime-dependent monetary policy asymmetry remain robust across alternative output gap measures. The joint Wald test remains statistically significant at the 1% level under all specifications, including the baseline Hodrick-Prescott filter, the re-estimated Hodrick-Prescott filter, the quadratic trend specification, and the Hamilton (2018) filter. These results indicate that the evidence of regime-dependent asymmetry is not driven by the choice of output gap measure or by the potential endpoint sensitivity associated with the Hodrick-Prescott filter. Accordingly, the robustness analysis provides additional support for the reliability of the empirical findings.

4.2. Economic Model: Regime-Switching Structure and Monetary Policy Rule

The theoretical background of the study is based on the New Keynesian DSGE literature. The New Keynesian DSGE approach, due to its micro-founded structure, allows the effects of monetary policy on the real economy to be analyzed in a consistent and systematic manner (Woodford, 2003: 10; Galí, 2015: 4). The aim of this study is to empirically examine the real effects of monetary policy and the welfare outcomes of these effects under growth volatility regimes.

However, the empirical analysis does not involve the estimation of a structural DSGE model. Instead, the New Keynesian DSGE literature is used as a theoretical motivation for interpreting regime-dependent monetary policy behavior and welfare-related macroeconomic stability outcomes. Consistent with this objective, the empirical analysis is conducted within a reduced-form regime-switching MS-VAR framework, which enables the examination of how policy responses and macroeconomic dynamics differ across growth volatility regimes.

In the New Keynesian literature, the macroeconomic effects of monetary policy are explained through the interaction of households, firms, and the central bank. While households make consumption and labor supply decisions, they act in a way that ensures utility maximization. Firms, on the other hand, produce under conditions consistent with monopolistic competition and make their price decisions within the framework of nominal rigidities.

Central bank behavior is modeled with an extended Taylor rule. The policy interest rate is defined in a way that responds systematically to developments in inflation, the output gap, and the exchange rate. The assumption of a standard linear policy response is not adopted. Instead, it is accepted that monetary policy may take shape according to different priorities under various macroeconomic conditions.

Within this framework, the policy reaction function of the central bank is defined as follows in a way that allows coefficients to vary depending on the regime:

$$i_t=\rho S_t\, i_{t-1}+(1-\rho S_t)[\, r^*+\pi_t+\beta_{\pi,S_t}(\pi_t-\pi^*)+\beta_{y,S_t}(x_t)+\beta_{e,S_t}(\Delta e_t)+\beta_{u,S_t}(u_t-u^*)] \quad (2)$$

In Equation 2, i_t denotes the policy interest rate, i_{t-1} the lagged policy interest rate, r^* the long-run equilibrium real interest rate, π_t the realized inflation rate, and π^* the inflation target. x_t represents the output gap, Δe_t the change in the nominal exchange rate, and u_t-u^* the unemployment gap. $S_t \in \{1,2\}$ is the unobserved regime variable and allows the policy reaction coefficients to differ across regimes. The coefficient ρS_t reflects the regime-dependent structure of the central bank's interest rate adjustment behavior. This specification allows differences in monetary policy responses across alternative macroeconomic regimes to be empirically examined.

The welfare dimension of the model is addressed through the expected utility loss experienced by the representative household. Welfare losses are measured through a loss function reflecting the social costs of fluctuations in inflation, output, and unemployment. This approach is considered a widely used method that makes welfare comparisons more transparent and interpretable, particularly in applied monetary policy analyses (Woodford, 2003: 383; Schmitt-Grohé and Uribe, 2006: 4).

4.3. Model Estimation and Regime Identification Method

In this section, the estimation process of the MS-VAR model used in the study, the definition of the regime variable, and the econometric methods followed in the calculation of the model parameters are explained.

4.3.1. Structure of the MS-VAR Model and the Regime Variable

MS-VAR models are based on the assumption that economic time series may exhibit different dynamic characteristics in different periods (Hamilton, 1989; Krolzig, 1997). In this approach, the assumption that model parameters are constant is abandoned, and certain parameters are allowed to vary depending on an unobserved regime variable. Thus, it becomes possible to empirically examine whether the economic system may display different behavioral patterns under different macroeconomic conditions.

The estimated MS-VAR system includes six endogenous variables: real GDP growth, inflation, the policy interest rate, exchange rate changes, the unemployment rate, and the output gap. These variables are jointly modeled within a regime-switching framework in order to capture the interactions between macroeconomic conditions and monetary policy responses across different growth volatility regimes.

Within the MS-VAR framework, the regime variable S_t is defined as an unobserved state variable that can change over time. This variable determines which regime the parameters in the model belong to and represents two different economic regimes in the form $S_t \in \{1,2\}$. Since the regimes cannot be directly observed, the values that this variable may take in each period are estimated using probabilistic methods.

The evolution of the regime variable over time is modeled by a Markov process. Under this assumption, the probability of the economy moving from one regime to another depends only on the regime in which it was in the previous period. In other words, regime transitions are determined by a first-order Markov process. This process is represented by the following transition probability matrix:

$$P = \begin{pmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{pmatrix} \quad (3)$$

In Equation (3), p_{ij} denotes the probability of the economy moving to regime *j* in period *t*, conditional on being in regime *i* in period *t-1*. $i,j \in \{1,2\}$ represent the relevant regimes. The diagonal elements p_{11} and p_{22} represent the probabilities of remaining in the same regime, while the off-diagonal elements represent the probabilities of transition between regimes. Through this structure, it becomes possible to empirically analyze which regime the economic system is in during different periods and the transition dynamics between regimes.

This framework provides a suitable analytical structure for examining behavioral patterns of monetary policy that may vary under different macroeconomic conditions. In particular, the assumption that policy responses may differ during periods of growth volatility and macroeconomic uncertainty can be empirically tested through regime-switching models.

4.3.2. Parameter Estimation and Calculation of Regime Probabilities

The parameter estimation of the MS-VAR model was carried out using the Maximum Likelihood Estimation (MLE) method. Since the parameters in regime-switching models depend on an unobserved regime variable, the likelihood function of the model exhibits a nonlinear structure that includes latent state probabilities. Therefore, parameter estimation was performed through an iterative maximum likelihood procedure.

In the model estimation, the *Expectation-Maximization (EM)* algorithm, which iteratively updates the conditional probabilities of the latent regime variable, was employed. The EM algorithm conducts the estimation process through a two-stage structure. In the first stage (Expectation step), the probability distribution of the regime variable is calculated under the current parameter estimates; in the second stage (Maximization step), the model parameters are re-estimated using these probabilities and the log-likelihood function is maximized. This process is iteratively continued until the log-likelihood values converge.

The Hamilton (1989) filter was applied in the calculation of regime probabilities. The Hamilton filter calculates the conditional probabilities of the unobserved regime variable for each period and allows the probability of the economy being in a particular regime in the relevant period to be determined. In this process, two different sets of probabilities are obtained for each observation. Filtered probabilities refer to the regime probabilities calculated using only the information observed up to that period, while smoothed probabilities indicate the regime probabilities obtained retrospectively using the entire sample information. In the study, smoothed regime probabilities are predominantly used in the analyses in order to interpret the evolution of regime dynamics over time more clearly.

All model estimations and regime filtering procedures were carried out using the *Python* programming language. For the estimation of the MS-VAR model and the calculation of regime probabilities, the *Statsmodels* econometric library, which is widely used in the Python environment, was utilized.

The empirical analysis is conducted using a two-regime MSIAH-VAR specification (Markov-Switching Intercept Autoregressive Heteroskedasticity). Within this framework, regime changes are allowed to affect the intercept structure and the variance of the system, thereby enabling the identification of distinct macroeconomic environments characterized by different levels of volatility and policy behavior.

The lag length was determined using the Bayesian Information Criterion (BIC), which selected a first-order autoregressive specification (AR(1)) as the optimal model. Accordingly, an AR(1) lag structure was adopted within the regime-switching estimation framework to identify growth volatility regimes. The selected lag structure provides a parsimonious representation of the data while ensuring statistically reliable regime identification and subsequent estimation of regime-dependent monetary policy responses.

4.3.3. Model Comparison and Determination of the Number of Regimes

One of the important methodological issues in regime-switching models is the determination of the number of regimes to be used in the model. For this purpose, the linear VAR model and MS-VAR models including different numbers of regimes were compared. Thus, it was

evaluated whether economic dynamics are better represented under a single linear structure or under a regime-dependent structure.

In model comparisons, *log-likelihood* values together with the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) were used (Akaike, 1974: 716; Schwarz, 1978: 461). These criteria allow the comparison of alternative model specifications by considering the balance between model fit and model complexity. Higher log-likelihood values and lower AIC and BIC values indicate that the model explains the data better.

In addition, a Likelihood Ratio (LR) test was applied in order to evaluate the difference between the linear VAR model and the regime-switching VAR models. This test examines whether the model fit improves significantly when the parameter restrictions of the linear model are relaxed. The results of the LR test make it possible to evaluate whether the regime-switching model represents the data better than the linear model.

Within this framework, alternative MS-VAR models including different numbers of regimes were estimated and the model fit criteria were compared. The results obtained indicate that the two-regime model specification provides a more appropriate structure in terms of both log-likelihood values and information criteria (AIC and BIC) and is supported by the model selection criteria. For this reason, the MS-VAR model in which economic dynamics are examined under two different regimes was taken as the basis for the analyses. In model selection, the information criteria were evaluated together, and the balance between model fit and model complexity was taken into account. The regimes obtained were evaluated not only as statistical separations but also as economically interpretable regimes in terms of macroeconomic volatility and growth dynamics. In addition, the estimated transition probabilities reveal that the regimes tend to persist for a certain period and show that the regime separation obtained by the model has statistically meaningful persistence. This finding supports that the regime separation does not arise only from temporary fluctuations specific to the sample and reflects the structural differences observed in economic dynamics.

To evaluate the robustness of the empirical findings, a comprehensive set of robustness analyses was conducted. These analyses included alternative lag length specifications, alternative regime specifications, alternative output gap measures, alternative welfare weight calibrations, and sub-sample analyses. Across these alternative specifications, the main empirical findings remained qualitatively unchanged, providing additional evidence that the reported results are robust to reasonable changes in model specification and measurement choices. An additional robustness check based on the Weighted Average Cost of Funding (WACF) as an alternative policy rate measure could not be implemented because a consistent series covering the entire sample period was not available. This issue is acknowledged as a limitation and suggested as a direction for future research.

4.4. Modeling the Regime-Switching Structure

In this study, regimes are defined not based on pre-determined periods or observation-based classifications, but on differences in means and variances estimated by the model. Therefore, the regime separation reflects a statistically determined structural distinction rather than an interpretative labeling. The two-regime structure was selected by considering both the widespread

use in the theoretical literature and the clear distinction between periods of low and high volatility in growth variability in the Türkiye economy.

The fact that growth volatility in the Türkiye economy changes significantly over time and that monetary policy responses accompany these changes limits the explanatory power of linear time series models. Therefore, the regime-switching MS-VAR model is adopted in this study. Regime-switching models are based on the assumption that economic dynamics may exhibit different structural characteristics in different periods (Hamilton, 1989: 358). For this reason, they provide an important analytical advantage in the analysis of different volatility regimes.

Model estimations show that economic dynamics differ under a regime characterized by relatively low volatility and a second regime characterized by higher volatility and uncertainty. Regimes are defined through an unobserved state variable. The evolution of this variable over time is determined by a Markov process. Allowing both the mean and the variance to vary across regimes enables the joint examination of jumps in growth volatility and differences in policy responses (Hamilton, 1989: 358).

In this study, asymmetry in monetary policy is examined not through the distinction between positive and negative shocks, but through regime-dependent differences in policy responses under alternative macroeconomic conditions. Monetary policy responses are analyzed by allowing the policy reaction coefficients in the extended Taylor rule to differ across regimes. In this context, it is tested whether the central bank's responses to inflation, the output gap, and the exchange rate vary depending on the prevailing economic conditions. This approach is consistent with the regime-dependent macroeconomic modeling literature showing that monetary policy may produce different outcomes under different macroeconomic regimes (Davig and Leeper, 2007: 608; Fernández-Villaverde and Rubio-Ramírez, 2010: 4).

Regime transition probabilities and regime durations are determined endogenously during the model estimation process. This structure allows the statistical identification of periodic differences in growth volatility and monetary policy behavior in the Türkiye economy. Thus, regime-dependent monetary policy behavior and the associated welfare-related macroeconomic stability outcomes can be analyzed within a consistent empirical framework. This framework demonstrates that economic dynamics may exhibit different behavioral patterns under different regimes over time and that transitions between these regimes can be modeled probabilistically.

4.5. Theoretical and Methodological Framework of the Welfare-Related Stability Loss Indicator

In the New Keynesian DSGE literature, welfare-based loss functions are generally derived from the expected utility of the representative household and are used to evaluate the welfare implications of monetary policy under structural model assumptions (Juillard et al., 2006: 6-7). However, the present study does not estimate a structural DSGE model. Instead, the New Keynesian welfare literature is used as a theoretical reference point for constructing a welfare-related stability loss indicator within a reduced-form MS-VAR framework. Accordingly, the analysis does not aim to measure the absolute level of social welfare or to derive a structural welfare loss function from household utility maximization. Rather, it aims to compare the relative macroeconomic stability costs associated with fluctuations in inflation, the output gap, and unemployment across different growth volatility regimes.

In applied DSGE studies, welfare analysis goes beyond simple linear or ad hoc loss functions. Juillard et al. (2006: 20, 22) state that such loss functions may represent welfare incompletely and recommend the use of measures based directly on the expected value of the utility function in policy evaluations. This approach makes it possible to include in welfare analysis not only the effects of policy responses on macroeconomic fluctuations but also their effects on the average levels of macroeconomic variables.

In DSGE models with labor market frictions, the scope of welfare losses expands. Ravenna and Walsh (2011: 132, 143-144) show that, in addition to price rigidities, search and matching frictions cause the unemployment rate to deviate from its efficient level, and this creates direct costs for welfare. For this reason, a term representing unemployment fluctuations is included in the welfare-related stability loss indicator in addition to inflation and the output gap.

4.5.1. Determination of Indicator Weights and the Literature Basis

In this study, a welfare-related stability loss indicator is constructed in a manner broadly consistent with the New Keynesian literature. The indicator is used as a comparative measure reflecting the relative macroeconomic stability costs associated with fluctuations in inflation, the output gap, and the unemployment rate across different growth volatility regimes. Accordingly, the indicator is not intended to measure the absolute level of welfare but rather to provide a comparative assessment of regime-specific stability conditions.

Within this framework, the welfare-related stability loss indicator used in the study is defined in Equation (4). In the indicator, the coefficient of inflation fluctuations is normalized to a unit value.

$$L = Var(\pi) + \lambda_x Var(x) + \lambda_u Var(u) \quad (4)$$

In Equation (4), π represents the inflation rate, x the output gap, and u the unemployment rate. The operator $Var(\cdot)$ denotes the regime-specific fluctuation level of the relevant variable. The coefficients λ_x and λ_u represent the relative weights assigned to output gap and unemployment fluctuations within the welfare-related stability loss indicator.

In this study, the coefficients λx and λu included in the indicator are determined in line with the calibration approach commonly used in the relevant literature. Based on the New Keynesian welfare literature, the weights assigned to output gap and unemployment fluctuations are calibrated as λ_x = 0.5 and λu = 0.5. This calibration is broadly consistent with studies evaluating the macroeconomic stability implications of monetary policy and is informed by the welfare-based policy evaluation frameworks discussed by Woodford (2003) and Galí (2015). The coefficients are treated as fixed parameters throughout the analysis and are used to facilitate comparisons across different growth volatility regimes. To assess the robustness of the results, a sensitivity analysis was conducted using alternative values for the weighting parameters (λ_x and λ_u) ranging from 0.25 to 1.00. The findings remained qualitatively unchanged across all alternative weighting schemes, indicating that the main conclusions are robust to reasonable variations in the assumed calibration parameters.

Importantly, these weights are not estimated from the MS-VAR model itself but are adopted as calibration parameters from the relevant literature. Therefore, the resulting measure should be interpreted as a comparative welfare-related stability indicator rather than as a structural

welfare measure derived from a fully specified DSGE model. Since the objective of the analysis is to compare relative regime-specific stability costs rather than to estimate absolute welfare levels, the indicator is used as a comparative analytical tool within the reduced-form framework adopted in this study.

4.5.2. Normalization of the Welfare Measure and Comparison Across Regimes

The welfare-related stability loss indicator used in this study is designed to facilitate comparisons across growth volatility regimes rather than to measure the absolute level of welfare. The indicator combines regime-specific fluctuations in inflation, the output gap, and unemployment into a single comparative measure of macroeconomic stability costs. Accordingly, the calculated values should be interpreted as relative indicators that reflect the comparative cost of macroeconomic instability under different regime conditions. This approach provides a consistent framework for comparing regime-specific outcomes within the reduced-form MS-VAR structure adopted in the study.

The findings obtained in the study indicate that the welfare-related stability indicator differs significantly across regimes. In particular, the indicator increases considerably during periods characterized by high inflation volatility. This outcome largely reflects the prominent contribution of inflation variance to the indicator. In the Türkiye economy, periods of positive growth may still be associated with elevated indicator values when inflation volatility remains high, indicating that macroeconomic instability costs may persist even when growth performance appears relatively stable.

This result suggests that the implications of macroeconomic instability are not limited to periods of economic contraction. High inflation volatility may also be associated with elevated values of the welfare-related stability indicator, even during periods when growth remains positive. Accordingly, the findings indicate that inflation volatility constitutes an important component of regime-specific macroeconomic stability outcomes in the Türkiye economy.

5. Empirical Findings

In this section, the findings obtained from the econometric analysis are presented. First, descriptive statistics are provided in order to reveal the main characteristics of the macroeconomic variables used in the analysis. These statistics reveal the temporal variability in growth volatility and monetary policy behavior and provide an initial framework for the subsequent regime identification and policy response analyses.

5.1. Descriptive Statistics

Table 2 summarizes the descriptive statistics of the macroeconomic variables included in the study. The mean, standard deviation, minimum, and maximum values reported in the table indicate that both real and nominal variables exhibited significant fluctuations in the Türkiye economy during the period examined.

Table 2. Descriptive Statistics (2002Q1-2024Q4, N = 92)

Variable	Observation	Mean	Std. Dev.	Min.	Max.
Real GDP Growth (%)	92	5.12	4.85	-12.90	22.20
Inflation (CPI, %)	92	21.45	19.82	6.20	85.50
Policy Interest Rate (%)	92	18.75	13.40	4.50	59.00
Unemployment Rate (%)	92	10.45	1.82	8.80	14.50
Exchange Rate Change (%)	92	6.24	8.45	-5.50	35.10

Source: TURKSTAT national accounts statistics (quarterly GDP and expenditure-based GDP) and Consumer Price Index (CPI) data; interest rates (overnight rate and one-week repo auction rate), exchange rates (US dollar and euro), and balance of payments statistics (BPM5 and BPM6) published within the CBRT-EVDS system; the Türkiye unemployment rate series provided in the FRED database by the FRED.

Note: The descriptive statistics reported in the table are calculated using quarterly data covering the period 2002Q1-2024Q4. The real GDP growth rate and expenditure components are obtained from chained volume indices. The inflation rate is calculated as the annual percentage change in the Consumer Price Index (CPI). The policy interest rate series is constructed by combining the overnight interest rate and the one-week repo auction rate applied in different periods. Exchange rate change is defined as the average of the periodical percentage changes in the US dollar and euro exchange rates. All series are seasonally adjusted and do not include any estimation or interpolation.

The descriptive statistics presented in Table 2 indicate that macroeconomic variables exhibited high volatility during the period examined. In particular, the relatively high standard deviation values associated with real GDP growth, inflation, and exchange rate changes indicate that significant fluctuations occurred in the growth process and in nominal variables. The wide range of fluctuations in the policy interest rate indicates that monetary policy responses may differ across periods. The statistics related to the unemployment rate, on the other hand, indicate that real fluctuations are reflected in the labor market with more limited but persistent effects.

These findings indicate that analyzing macroeconomic dynamics within a linear and time-invariant structure may be limited. In addition, they support the preference for a regime-switching approach in order to capture the changing characteristics of growth volatility and monetary policy behavior over time.

5.2. Determination of Growth Regimes

In this subsection, based on the assumption that the growth process in the Türkiye economy does not exhibit a uniform structure over time, it is examined how growth volatility differs across different regimes. Descriptive statistics indicate that the high variability observed in the real growth rate and the related macroeconomic variables makes it difficult to analyze growth dynamics within a linear and time-invariant framework. Accordingly, growth regimes are determined on the basis of differences in the mean and variance that are estimated endogenously by the model, without relying on pre-determined periods. This approach makes it possible to capture the evolution of growth volatility over time.

5.2.1. Main Characteristics of the Regimes

The main characteristics of the growth regimes identified as a result of the Markov-Switching analysis are summarized. The distinction between regimes arises not only from the

average levels of growth rates, but mainly from the pronounced differentiation in growth volatility.

The characteristic features of the growth regimes are presented in Table 3. The findings in Table 3 indicate that the growth dynamics of the Türkiye economy are statistically grouped under two distinct regimes. This differentiation arises mainly from the pronounced difference in growth volatility between the two regimes rather than from the average growth rates. During stability periods characterized by high growth and low uncertainty, a growth performance of 7.12% is observed, whereas an economic contraction of -1.45% occurs during periods of high volatility. In addition, the growth variance in the high-volatility regime is estimated at 52.30, which is 8.94 times higher than that of the stability regime.

Table 3. Characteristic Features of Growth Regimes

Parameter	Regime 1: Stability Regime	Regime 2: High-Volatility Regime
Average Growth	%7.12	-%1.45
Variance (Volatility)	5.85	52.30
Probability of Remaining in the Regime	0.94	0.76
Average Duration	~16 Quarters	~4 Quarters
Descriptive Feature	High Growth, Low Uncertainty	Negative Growth, High Variance

Note: The table reports the average growth rates, growth variances, probabilities of remaining in the regime, and average regime durations for the two growth regimes identified as a result of the Markov-Switching analysis. The variance parameter is reported as the statistical measure of growth volatility.

In order to reveal the temporal pattern of regime differentiation, the period-by-period distribution of the probabilities is presented in Figure 1. Figure 1 shows that the probabilities associated with the high-volatility regime cluster over time and that transitions between regimes form certain concentration periods. This temporal clustering indicates that regime conditions should be evaluated separately in the analysis of monetary policy.

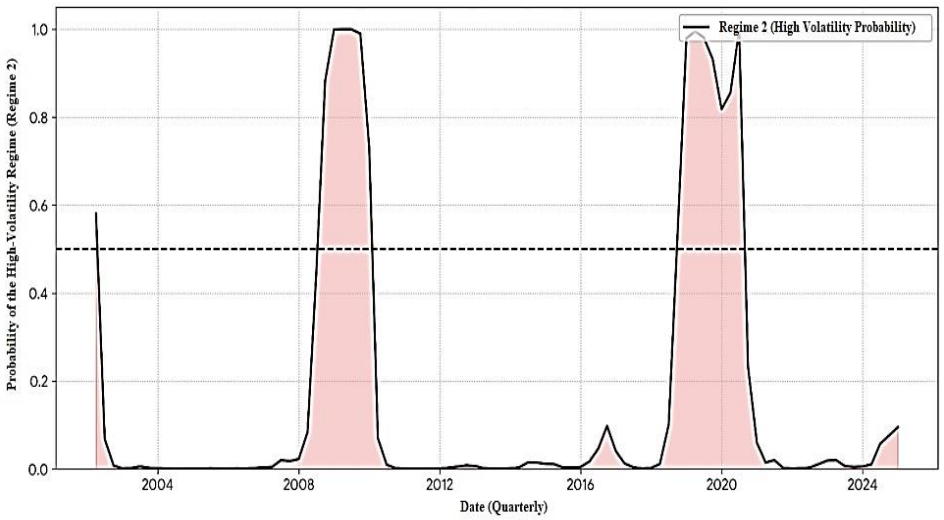


Figure 1. Smoothed Probabilities of the High-Volatility Regime, 2002Q1-2024Q4

Figure 2 provides a visual representation of the regime classification obtained from the Markov-switching model by superimposing the identified high-volatility periods on the real GDP growth series. The shaded areas correspond to observations classified as the high-volatility regime and illustrate that this regime is associated with episodes of unusually large fluctuations in economic growth, including both sharp contractions and rapid recoveries.

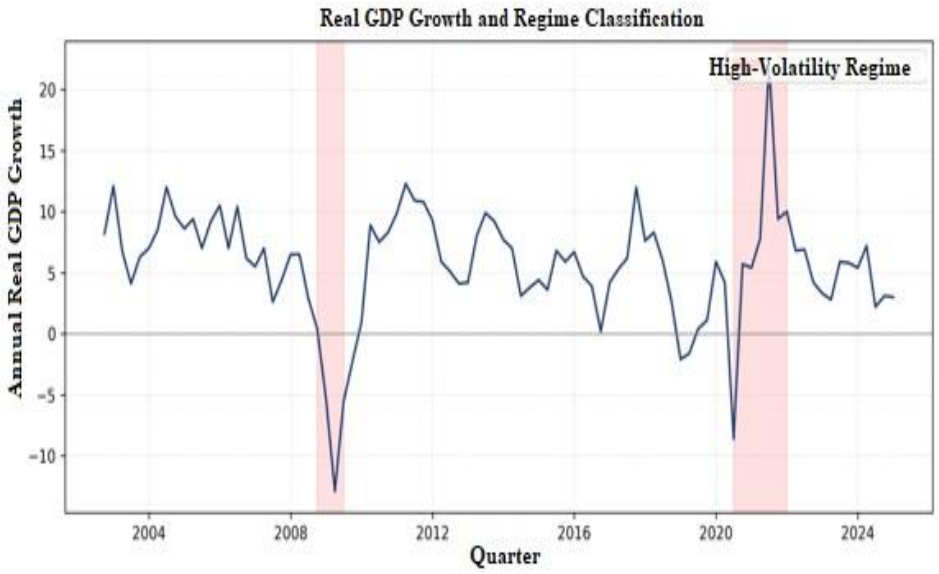


Figure 2. Real GDP Growth and Regime Classification (Shaded Areas Indicate the High-Volatility Regime)

5.2.2. Stability Regime

The stability regime represents periods in which the real GDP growth rate follows a relatively high and more stable average, and growth volatility remains limited. The regime-specific estimates presented in Table 3 reveal that the average level of the growth rate in this regime is approximately 7.1%, and that the growth variance exhibits a structure consistent with low volatility.

Under this regime, the growth process follows a path closer to the level of potential output, and deviations around growth remain quite limited. The high probability of remaining in the regime estimated for the stability regime (approximately 0.94) suggests that this regime has a relatively more persistent character over time. The fact that the average duration of remaining in the regime is calculated as approximately 16 quarters (around 4 years) also indicates that the growth process follows a stable path during certain periods.

5.2.3. High-Volatility Regime

The high-volatility regime represents periods in which the real GDP growth rate fluctuates significantly and the growth process acquires a more uncertain character. The results reported in Table 3 show that the average level of the growth rate in this regime declines to a negative value (approximately -1.5%) and that the growth variance is approximately nine times higher than in the stability regime.

Under the high-volatility regime, deviations in the output gap are observed to occur more frequently and at larger magnitudes. This situation leads to an increase in fluctuations in the growth process. The probability of remaining in this regime is relatively lower, at 0.76. The average duration of remaining in the regime reported in Table 3 is limited to 4 quarters, corresponding to 1 year. Therefore, these findings indicate that this regime exhibits a short-term structure characterized by high fluctuations.

5.3. Regime-Dependent Monetary Policy Responses

In this section, it is examined whether the effects of monetary policy on macroeconomic variables differ across growth regimes. The clear separation of growth dynamics between stability and high-volatility periods suggests that monetary policy responses may also exhibit regime-based differences. Within this framework, it is questioned whether monetary policy responses are shaped independently of time and around a single average behavior.

The policy behavior of the central bank is modeled using an extended Taylor rule. The response coefficients to inflation, the output gap, the exchange rate, and unemployment are allowed to differ across regimes. In this way, it is evaluated whether monetary policy responses differ across alternative growth volatility regimes.

The reported coefficients are not obtained directly from the Markov-switching model. Instead, the growth regimes identified in the first-stage MS-AR(1) estimation are incorporated into a regime-interaction specification of the extended Taylor rule estimated by ordinary least squares (OLS). Heteroskedasticity and autocorrelation consistent (HAC-Newey-West) standard errors are employed, and coefficient differences across regimes are formally evaluated using Wald tests. This procedure allows all available observations to be retained while providing statistically consistent inference on regime-dependent policy responses.

The estimated coefficients of the regime-dependent extended Taylor rule, together with the corresponding Wald test statistics, are reported in Table 4. The coefficient estimates and Wald test results indicate that policy responses differ statistically across growth regimes. The Wald test examines the null hypothesis that the policy coefficients are equal across the two regimes. The p-values reported in the table indicate whether this hypothesis can be rejected (Greene, 2002: 488-489).

Table 4. Regime-Dependent Monetary Policy Reaction Coefficients

Variable	Regime 1 (Stability)	Difference (Regime 2- Regime 1)	Regime 2 (High Volatility)	Wald p-value
Constant	0.063	+7.062	7.125	< 0.001
Lagged policy interest rate (i_{t-1})	0.902***	-0.255	0.647	0.044
Inflation (π_t)	0.064	-0.069	-0.004	0.544
Output gap (x_t)	-0.033	+0.175	0.141	0.042
Exchange rate change (Δe_t)	0.053	-0.166	-0.113	0.053

Note: HAC (Newey-West) heteroskedasticity and autocorrelation consistent standard errors are employed. *** $p < 0.001$. The Wald p-value tests the null hypothesis that the corresponding coefficient is equal across regimes. The joint Wald test rejects the null hypothesis that all regime differences are jointly zero ($F = 37.02$, $p < 0.001$). $R^2 = 0.94$; $N = 90$.

The inflation coefficient is 0.064 in the stability regime and -0.004 in the high-volatility regime. Although the estimated coefficient becomes slightly negative under high-volatility conditions, the Wald test indicates that the difference between the two regimes is not statistically significant ($p = 0.544$). Therefore, the findings do not provide statistical evidence that the monetary policy response to inflation differs across growth volatility regimes.

While the output gap coefficient is -0.033 in the stability regime, it increases to 0.141 in the high-volatility regime. The difference between the two regimes is statistically significant according to the Wald test ($p = 0.042$). This finding indicates that the monetary policy response to real economic conditions becomes relatively stronger during periods of high growth volatility.

The exchange rate coefficient is 0.053 in the stability regime and -0.113 in the high-volatility regime. The Wald test yields a p-value of 0.053, indicating that the difference between the two regimes is marginally significant. This finding suggests that the role of exchange rate developments in monetary policy responses may vary across growth volatility regimes, although the statistical evidence remains relatively weak.

Overall, when the coefficient magnitudes and statistical significance levels are evaluated together, the findings suggest that monetary policy responses differ across growth volatility regimes. While the degree of interest rate smoothing weakens and the policy response to the output gap becomes relatively stronger during high-volatility periods, the response to inflation does not differ significantly across regimes. Therefore, it is analytically important to take the prevailing growth regime into account when evaluating regime-dependent monetary policy behavior.

5.4. Welfare Loss Analysis

In this section, regime-specific social losses calculated using the welfare-based loss function are analyzed. Welfare losses comparatively present the social costs caused by fluctuations in inflation, the output gap, and unemployment under different growth regimes.

Table 5 presents the total welfare losses obtained under the stability regime (Regime 1) and the high-volatility regime (Regime 2), together with the components of these losses. When the results in Table 5 are examined, during the Regime 1 process representing the stability condition, inflation loss, output loss, and unemployment loss were 12.5, 8.4 and 4.2, respectively; the total welfare loss was 25.1. In the Regime 2 process representing the high-volatility condition, inflation loss increased 5.2 times to 65.2, output loss increased 3.9 times to 32.6, and unemployment loss increased 4.3 times to 18. In this process, the total welfare loss increased 4.6 times to 115.8. This increase indicates that the social costs of macroeconomic fluctuations rise during periods when growth volatility increases.

Table 5. Social Welfare Loss by Regime (L)

Regime	Inflation Loss	Output Loss	Unemployment Loss	Total Welfare Loss
Regime 1	12.5	8.4	4.2	25.1
Regime 2	65.2	32.6	18.0	115.8

Note: L represents the welfare-based loss function defined in the study.

From the perspective of the components, welfare losses arising from inflation, the output gap, and unemployment are all higher in the high-volatility regime. In particular, the increase in losses caused by fluctuations in inflation and unemployment indicates that the effect of nominal and real instabilities on welfare increases in this regime.

The variation of welfare losses across regimes indicates that growth volatility increases the cost dimension of macroeconomic instability. When this finding is evaluated together with the regime-based policy differences obtained in the previous section, it indicates that the welfare outcomes of monetary policy are also sensitive to regime conditions.

6. Conclusion and Evaluation

This study examines the relationship between growth volatility, regime-dependent monetary policy responses, and welfare-related outcomes in the Türkiye economy within a regime-switching MS-VAR framework. The model, estimated using data for the period 2002-2024, provides an opportunity to evaluate to what extent the assumption that monetary policy exhibits average and time-invariant behavior holds under different volatility environments.

The findings show that growth dynamics are statistically grouped under two regimes that exhibit separation: the stability regime and the high-volatility regime. In the high-volatility regime, growth variance increases and average growth performance weakens. This situation reveals that the macroeconomic environment does not exhibit a homogeneous structure and that economic behavior may change depending on volatility conditions.

The findings suggest that monetary policy responses vary across regimes under different volatility conditions. While the degree of interest rate smoothing weakens and the monetary policy response to the output gap becomes relatively stronger during high-volatility periods, the response to inflation does not differ significantly across regimes. In addition, the response to exchange rate developments exhibits only marginal statistical significance across regimes. This finding shows that representing monetary policy with fixed coefficients may remain limited, especially during periods of high uncertainty.

The welfare analyses indicate that the social costs of macroeconomic fluctuations increase in the high-volatility regime. The simultaneous increase in losses arising from inflation, output, and unemployment shows that total welfare loss increases compared to stability periods. This result indicates that growth volatility is a determining factor not only in terms of real performance but also in terms of welfare costs. In addition, when the components of welfare losses are examined, the findings show that the effect of inflation volatility on total welfare cost is more pronounced compared to other macroeconomic variables. This situation indicates that welfare costs in the Türkiye economy are strongly affected not only by fluctuations in growth performance but especially by increases in inflation volatility. In this framework, the results reveal that ensuring price stability plays a critical role not only in terms of nominal stability but also in terms of protecting social welfare.

When the findings are evaluated together, they indicate a statistically significant relationship between growth volatility and regime-dependent monetary policy responses. This relationship suggests that the effectiveness of monetary policy may change sensitively according to the level of volatility in the economic environment and that welfare outcomes may also be affected by regime differences. Within this framework, the study indicates that single-regime and

time-invariant representations in monetary policy analyses may remain limited, especially during periods of high uncertainty, and that regime-sensitive frameworks may provide more consistent evaluations.

However, the findings are limited by the MS-VAR model specification and the welfare measurement framework used. The regimes were not assigned to historical periods in advance but were determined endogenously by the model. Under different alternative modeling choices, quantitative results may change. Therefore, the findings should be interpreted not as a normative evaluation of specific policy periods but as an analytical representation of regime-dependent structural behavior differences.

As a result, this study indicates that examining the relationship between growth volatility, regime-dependent monetary policy responses, and welfare-related outcomes within a regime-sensitive framework provides an alternative analytical perspective compared to linear and single-regime approaches. In this respect, the findings show that these three elements constitute three complementary fundamental dimensions of the relationship within the context of the Türkiye economy.

Declaration of Research and Publication Ethics
This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researcher's Contribution Rate Statement
I am a single author of this paper. My contribution is 100%.

Declaration of Researcher's Conflict of Interest
There is no potential conflicts of interest in this study.

Artificial Intelligence Usage Declaration
During the preparation of this study, the author used OpenAI on a limited basis to support language refinement, improve readability, and review methodological and technical consistency. The author independently reviewed and verified the suggestions provided and assumes full responsibility for the content of the published article.

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