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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

THE RELATIONSHIP BETWEEN EXPECTED INFLATION AND CREDIT RATES IN A REGIME-SWITCHING FRAMEWORK

REJİM DEĞİŞİMLERİ ÇERÇEVESİNDE BEKLENEN ENFLASYON VE KREDİ FAİZLERİ İLİŞKİSİ

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Abstract

This paper examines the regime-dependent link between expected inflation and credit rates under classical Fisher and Neo-Fisherian hypotheses. Using monthly commercial (TICKREDI) and consumer (TUKREDI) loan rates alongside 12-month inflation expectations (ETUFE) for 2013:M02–2024:M12, nonlinearity is first established via the BDS test, followed by stationarity checks using ADF and PP tests. Two Markov-switching models are then estimated. In the Fisher framework, the ETUFE→TUKREDI coefficient is 1.085 with σ≈10.6% and an average regime duration of 17 months in high-uncertainty periods and 0.253 with σ≈3.1% over 15.6 months in low-uncertainty periods; for TICKREDI, coefficients are 0.894 (σ≈10.2%; 7.6 months) and 0.181 (σ≈2.5%; 11.6 months). Under the Neo-Fisherian setup, commercial rates yield 0.657 (σ≈10.2%; 6 months) and 0.183 (σ≈2.7%; 28 months), while consumer rates are 0.619 (σ≈10.6%; 8.7 months) and 0.187 (σ≈2.9%; 37 months). Results demonstrate that both the Fisher and Neo-Fisherian effects intensify under high-uncertainty regimes, underscoring the relevance of regime-switching analysis and regime-contingent policy design.

Keywords: Expected Inflation, Credit Interest Rates, Fisher Hypothesis, Neo-Fisherian Effect, Markov-Switching Model.

JEL Classification: E31, E44, C22.

Öz

Bu çalışmada, beklenen enflasyon ile kredi faiz oranları arasındaki ilişkinin klasik Fisher ve Neo-Fisherian hipotezleri çerçevesinde rejime bağlı değişimi incelenmiştir. 2013:M02–2024:M12 dönemi aylık ticari (TICKREDI) ve tüketici (TUKREDI) kredi faizleri ile 12 aylık enflasyon beklentisi (ETUFE)

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verileri kullanılarak önce doğrusal olmayanlık BDS testiyle tespit edilmiş, ardından durağanlık ADF ve PP testleriyle kontrol edilmiştir. Her hipotez için iki ayrı Markov Rejim-Geçiş modeli tahmin edilmiştir. Fisher analizinde yüksek belirsizlikte ETUFE→TUKREDI katsayısı 1,085 (σ≈10,6%; ortalama rejim süresi 17 ay), düşük belirsizlikte 0,253 (σ≈3,1%; 15,6 ay) bulunmuştur; TICKREDI için ise katsayılar sırasıyla 0,894 (σ≈10,2%; 7,6 ay) ve 0,181 (σ≈2,5%; 11,6 ay) olarak tespit edilmiştir. Neo-Fisherian modelinde ticari faizler için 0,657 (σ≈10,2%; 6 ay) ve 0,183 (σ≈2,7%; 28 ay), tüketici faizleri için 0,619 (σ≈10,6%; 8,7 ay) ve 0,187 (σ≈2,9%; 37 ay) katsayıları elde edilmiştir. Bulgular, hem Fisher hem de Neo-Fisherian etkilerin yüksek belirsizlik rejimlerinde güçlendiğini göstererek rejim-geçiş analizlerinin ve rejime özgü politika tasarımının önemini vurgulamaktadır.

Anahtar Kelimeler: Beklenen Enflasyon, Kredi Faizleri, Fisher Hipotezi, Neo-Fisherian Etkisi, Markov Rejim Değişim Modeli.

JEL Sınıflandırması: E31, E44, C22.

1. Introduction

In countries where central banks follow an inflation targeting policy, a drop in inflation below the target usually leads to lower policy interest rates to boost demand. Conversely, rising inflation often prompts rate hikes to control price pressures. According to economic theory, the Fisher hypothesis suggests a long-run, one-to-one relationship between nominal interest rates and inflation. It assumes that changes in trend inflation are fully reflected in nominal rates if the expected real interest rate remains stable (Fisher, 1930). On the other hand, the Neo-Fisherian view proposes a reversed direction of causality: a sustained increase in the policy rate can lead to higher inflation, assuming strong coordination between monetary and fiscal policies (Bullard, 2010; Cochrane, 2016; Crowder, 2020).

Most empirical studies have tested these theories using linear models with constant parameters. However, they often overlook the possibility that the relationship between inflation and interest rates may vary under different economic conditions, especially in periods of high and low uncertainty. This oversight is particularly important for emerging markets like Türkiye, where economic volatility is common. Understanding whether the link between credit rates and inflation changes across regimes can help policymakers design more effective strategies.

This study employs monthly data on commercial and consumer loan rates and 12-month inflation expectations from February 2013 to December 2024. First, nonlinearity is assessed using the BDS test, followed by stationarity checks via the ADF and PP tests. Subsequently, two separate Markov Regime-Switching (MRS) models are estimated to evaluate the Fisher and Neo-Fisherian hypotheses. This study aims to address three main questions: how the direction and strength of the relationship between expected inflation and credit interest rates vary across high – and low-uncertainty regimes; under which conditions the Fisher and Neo-Fisherian hypotheses more effectively explain the inflation–interest rate nexus in credit markets; and how volatility and the average duration of regimes differ between periods of elevated and subdued uncertainty.

Traditional monetary policy studies often assume a fixed relationship between interest rates and inflation. However, such static models do not fully capture the economic fluctuations, shocks, or structural changes that can occur over time. In particular, during periods of high uncertainty—such as financial crises, geopolitical tensions, or sudden policy changes—the way interest rates and inflation interact may be very different from normal times. Using models with constant parameters in these situations can lead to misjudging the effects of policy decisions, which may result in missed targets or unintended consequences. For this reason, it is important to study how the response of credit interest rates to inflation expectations changes under different levels of uncertainty. Türkiye has experienced multiple episodes of acute inflationary shocks and rapid policy reversals over the last decade—most notably during the post-2018 currency crisis and the COVID-19 pandemic. In these episodes, headline inflation briefly exceeded 20 percent, real rates turned deeply negative, and conventional policy rules lost traction. Static, single-regime models cannot capture how banks' lending rates respond under such widely different conditions.

The study estimates four separate models—two based on the Fisher hypothesis and two on the Neo-Fisherian approach—to analyze regime-specific dynamics in detail. The findings are presented using both tables and visual figures. One limitation is that the study uses monthly data only, covering the period from February 2013 to December 2024. Another limitation is the single-country scope. Future research could improve the generalizability of the findings by using cross-country data or higher-frequency observations and by applying MS-VAR or Bayesian regime-switching approaches.

Existing empirical work largely relies on single-regime linear models and seldom considers how uncertainty affects the inflation–interest rate link. To date, no study has explicitly examined the Fisher and Neo-Fisherian hypotheses under different uncertainty regimes using Turkish credit-market data. By incorporating regime shifts, this study fills an important gap and offers insights relevant for policy design in environments where economic conditions change rapidly.

In addition, the study contributes to the literature in several important ways. First, it provides regime-dependent evidence on the Fisher and Neo-Fisherian mechanisms, showing that the classical Fisher effect becomes one-to-one under high uncertainty, while Neo-Fisherian feedback emerges only in these conditions. Second, by focusing on commercial and consumer loan rates rather than policy rates, the analysis captures the actual credit-market channels through which monetary policy influences households and firms. Third, it applies Markov Regime-Switching models to Türkiye's loan-rate and inflation-expectation data for the first time, revealing nonlinear dynamics and distinct regime durations. Finally, by estimating transition probabilities and regime persistence, the study offers regime-specific policy guidance, including timely interest-rate adjustments when uncertainty thresholds are exceeded.

The remainder of the paper is organized as follows. Section 2 presents the theoretical background, discussing both the classical Fisher and Neo-Fisherian hypotheses and reviewing the relevant empirical literature. Section 3 describes the data and outlines the Markov Regime-Switching (MRS) model and its estimation procedure. Section 4 reports the empirical findings, focusing on regime-specific coefficients, transition probabilities, average regime durations, and graphical representations. Section 5 concludes by summarizing the key results, emphasizing the study's contributions, and outlining the main policy implications.

2. Theoretical Framework and Literature Review

The relationship between interest rates and inflation has been widely discussed in economics, especially through the Fisher Hypothesis. In his influential book The Theory of Interest (1930), Irving Fisher argues that nominal interest rates move in line with expected inflation, while real interest rates remain unaffected (Fisher, 1930). This idea has become a key reference point in economic policy and financial decision-making. Nominal interest rates reflect the total interest paid on a loan, while real interest rates are adjusted for inflation. According to the Fisher Hypothesis, the nominal interest rate is simply the sum of the real interest rate and expected inflation. In this sense, nominal rates include both the compensation for the time value of money (real rate) and the expected loss in purchasing power due to inflation (Mitchell-Innes et al., 2007).

According to Fisher (1930), the nominal interest rate (i_t) is the sum of the real interest rate (r_t) and expected inflation (π_t^e). This can be expressed mathematically as:

$$i_t = r_t + \pi_t^e \tag{1}$$

In Equation 1, i_t represents the nominal interest rate, r_t denotes the real interest rate, and π_t^e stands for expected inflation. According to the Fisher Hypothesis, the nominal interest rate is composed of the sum of the real interest rate and expected inflation. Within this framework, it is argued that economic agents take into account both real return expectations and inflation expectations when determining interest rates. This implies that nominal interest rates are shaped by anticipated inflation and expected real returns (Nusair, 2008).

$$r_t = i_t - \pi_t^e \tag{2}$$

In Equation (2), r_t represents the real interest rate, i_t: denotes the nominal interest rate, and π_t^e: refers to expected inflation. The real interest rate is the nominal interest rate adjusted for expected inflation. Therefore, it is calculated by subtracting expected inflation from the nominal rate. The presence of the Fisher hypothesis implies that the real interest rate is stationary (Kasman et al., 2006).

The stability of real interest rates has important effects on international trade and capital flows. Differences in real interest rates between countries can influence exchange rates, as investors often move their capital to countries offering higher returns. When real interest rates are high, a country may attract more foreign investment, increasing demand for its currency. In contrast, low real interest rates can lead to capital outflows, putting downward pressure on the currency. These changes affect international capital movements and may lead to exchange rate volatility. In addition, real interest rates play a key role in saving and investment behavior (Gül & Açıkalın, 2007; Yılancı, 2009). Higher real interest rates usually encourage people to save more, while lower rates may lead to more consumption and borrowing. These shifts can influence economic growth and employment over time, often in indirect but important ways.

Under the assumption of rational expectations in an efficient market, the expected inflation rate can be expressed as the sum of actual inflation π_t and the inflation forecast error ε_t:

$$\pi_t^e = \pi_t + \varepsilon_t \quad (3)$$

By substituting the expected inflation term from Equation (3) into Equation (1), the following regression equation can be derived:

$$i_t = \alpha_0 + \alpha_1 \pi_t + \varepsilon_t \quad (4)$$

In this context, the parameter α_0, represents the average impact of exchange rate movements in the economy, reflecting the effects of changes in international trade and capital flows (Granville & Mallick, 2004). On the other hand, examining the condition α_1=1 is a critical step in evaluating whether changes in inflation are fully transmitted to nominal interest rates. If the estimated value of α_1 equals one, it indicates a complete pass-through of inflation to nominal interest rates, thereby supporting the validity of the Fisher Hypothesis. Thus, this analysis is important for assessing the validity of the Fisher hypothesis and understanding the implications of economic policy.

The Neo-Fisherian hypothesis is a modern macroeconomic theory that offers a different view on the relationship between interest rates and inflation. Unlike the classical Fisher hypothesis, which suggests that interest rates respond to inflation, the Neo-Fisherian view reverses this direction. It argues that raising interest rates may actually lead to higher inflation expectations, and over time, to higher actual inflation (Cochrane, 2016; Bullard, 2015; Williamson, 2016; Uribe, 2017).

In the traditional approach, central banks raise interest rates to fight inflation. But according to the Neo-Fisherian perspective, this action may instead signal higher future inflation, especially if supported by consistent monetary and fiscal policies. A conceptual figure illustrating this mechanism is presented below.

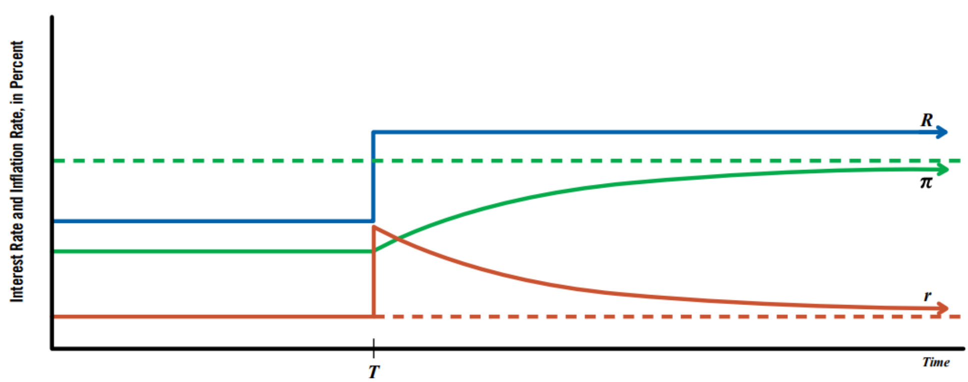

Figure 1: Response to a Permanent Increase in the Nominal Interest Rate at Time T

Source: Williamson, S. (2016), p. 8.

In Figure 1, R represents the nominal interest rate, r the real interest rate, and π the inflation rate. When the nominal interest rate increases, the real interest rate initially rises by the same amount. However, over time, the real interest rate gradually returns to its long-run equilibrium level.

Meanwhile, the inflation rate begins to rise. In the long run, the real interest rate stabilizes at its original equilibrium, and the inflation rate increases proportionally, fully absorbing the initial rise in the nominal interest rate.

To examine these dynamics, a well-structured macroeconomic model is necessary. Interestingly, most mainstream macroeconomic models—including New Keynesian frameworks—predict a response to a rise in the nominal interest rate that is consistent with what is shown in Figure 1. In this figure, the horizontal axis represents time, and it is assumed that the central bank permanently and unexpectedly increases the nominal interest rate at time T. This policy move causes an immediate rise in the real interest rate (r). Over time, however, the inflation rate (π) starts to increase gradually, and the real interest rate declines. Eventually, the real interest rate returns to its long-run equilibrium, while the inflation rate adjusts one-to-one with the initial rise in the nominal interest rate (R). Contrary to common belief, some models do not require central banks to lower nominal interest rates to generate inflation. In fact, as John Cochrane shows, even within the New Keynesian model, a permanent 1% increase in the nominal interest rate target can result in higher inflation, even in the short term (Williamson, 2016; Cochrane, 2016).

Empirical studies that provide evidence for the Fisher Hypothesis or the Neo-Fisherian hypothesis are listed in the table below.

Table 1: Selected Literature

Author(s)	Country/ Sample	Method	Data Set	Findings
Uribe, (2017)	USA, Japan 1955-2016	SVAR	Per Capita Output, Federal Funds Rate, CPI	The Neo-Fisherian hypothesis is valid.
Crowder, (2018)	USA 1951:M1 – 2015:M12	VAR	Federal Funds Rate, 3-Month, 1-Year, and 5-Year Treasury Bill Rates, CPI	The Neo-Fisherian hypothesis is valid.
Telçeken & Değirmen (2019)	Türkiye 2002:M1 – 2018:M6	ARDL	Consumer Loan Rate, Commercial Loan Rate, CPI, PPI	Weak evidence in support of the Fisher hypothesis.
Uğur, (2019)	G-7 Countries 2002:M2 – 2017:M12	Durbin Hausman Cointegration Test	Long-Term Interest Rate, Inflation Rate (OECD)	The Fisher hypothesis is not valid.
Tayyar, (2019)	Türkiye 2002:01 – 2014:05	Toda-Yamamoto Causality Test	Interbank Overnight Interest Rate, Weighted Average Deposit Rates with 1, 3, 6-Month and 1-Year Maturities, Long-Term Interest Rate, CPI	The Neo-Fisherian hypothesis is valid.
Uribe, (2020)	USA 1954:Q3 – 2018:Q2	VARs	Federal Funds Effective rate, Deflator, GDP	The Neo-Fisherian hypothesis is valid.
Crowder, (2020)	USA 1951:M1 – 2015:M12	VAR	Nominal Interest Rate, Realized Inflation	The Neo-Fisherian hypothesis is not valid; the Fisher hypothesis is supported.

Altunöz, (2020)	Türkiye 1995 – 2009	ARDL	Nominal Interest Rate, CPI	The Fisher hypothesis is valid.
Koç, (2020)	Türkiye 1985-2017	Fourier Cointegration Test	Deposit Interest Rate, CPI	The Fisher hypothesis is (weakly) supported.
Baylan & Pazarcı (2020)	Türkiye 2005:M1 – 2018:3	VAR	Deposit Interest Rate, USD/TRY Exchange Rate, CPI	The Fisher hypothesis is valid.
Sugözü & Yaşar (2020)	32 OECD Countries 2001:Q1 – 2019:Q4	Panel Regression, Panel Causality	Policy Interest Rate, CPI	Both the Fisher and Neo-Fisherian hypotheses are supported.
Sümer, (2020)	Türkiye 2010:M5 – 2019:M12	EG-FMOLS-DOLS-CCR	CBRT Overnight Lending Rate, Policy Interest Rate, CPI	The Neo-Fisherian hypothesis is supported.
Ongan & Gocer (2020)	USA 1985:M1 – 2017:M10	NARDL	10-year Government bond and CPI inflation	The Fisher hypothesis is partially supported.
Felek & Ceylan (2021)	Türkiye 2012:M1 – 2019:M6	Causality, SVAR	CBRT Overnight Borrowing Rate, CBRT Overnight Lending Rate, Policy Rate, Takasbank Money Market Weighted Average Overnight Interest Rate, Government Bond Interest Rate, Late Liquidity Window Lending Rate, 1-Month, 3-Month, and 1-Year Deposit Interest Rates, CPI	The Neo-Fisherian hypothesis is supported; the Fisher hypothesis is not supported.
Yapraklı, (2022)	Türkiye 2006:01 – 2021:08	Cointegration, Dynamic OLS Regression, VECM Causality	Government Bond Interest Rate, CPI	The Neo-Fisherian hypothesis is not supported.
Şeker & Demirel (2022)	Türkiye 2002:Q1 – 2017:Q4	ARDL	Policy Interest Rate, 5-Year Government Bond Interest Rate, CPI	Both the Fisher and Neo-Fisherian hypotheses are supported.
Bulut, (2022)	Türkiye 2004:M1 – 2020:M12	Granger Causality Test, Rolling Window Regression Estimation	Deposit Interest Rate, Growth, Real Exchange Rate, CPI	The Neo-Fisherian hypothesis is not supported.
Serel & Akşehirli (2023)	Türkiye, India, Brazil, Russia, Poland, Thailand, Indonesia, and South Africa 2015: 01 – 2022: 06	VECM – Granger Causality Test	Deposit Rate, Commercial Loan Rate, Expected Inflation Rate (CPI)	The Fisher hypothesis is valid for Türkiye. The Neo-Fisherian hypothesis is valid for India, Brazil, Russia, Poland, Thailand, Indonesia, and South Africa.

Özbek & Taş (2023)	Selected Developed and Developing Countries 2002:Q1 – 2019:Q2	Panel Cointegration	Interest Rate, CPI	The Fisher hypothesis is partially valid.
Akça, (2023)	Türkiye 2003:M1 – 2021:M9	ARDL	3-Month Term TL Deposit Interest Rate, Exchange Rate, Imports, Exports, CPI	Both the Fisher and Neo-Fisherian hypotheses are valid.
Krogsveen, (2023)	Norway 2003:M12 – 2020:M2	Toda Yamamoto Granger Causality	Nominal Interest Rates, Inflation Rates	Fisher and Neo-Fisherian Hypothesis arent valid.
Cushman et al. (2023)	USA 1953:Q1–2019:Q1 Subperiods: 1953–1980, 1980–2008, 2008–2018	NARDL	Nominal interest rate and inflation (Livingston expectations)	The Fisher hypothesis is not valid.
Koru & Gökçe (2024)	Türkiye 2010:M1–2024:M2	Johansen Cointegration, VECM	Policy Interest Rate, CPI	The Fisher hypothesis is strongly supported.
Karagöz & Özkubat (2024)	Türkiye 2013:M3–2024:M8	VAR, BVAR	Inflation Rate, Personal, Housing, Vehicle, Commercial, and Consumer Loan Interest Rates	Neither the Fisher nor the Neo-Fisherian hypothesis is valid in the short run.
Phiri, (2025)	USA 2007:M1– 2023:M4	EG, DOLS, FMOLS, ARDL, Wavelet Analysis	Five Nominal Interest Rate Measures, CPI Inflation (INF), and Michigan Inflation Expectations Survey Data	Both the Fisher and Neo-Fisherian hypotheses are valid.

Note: Table compiled by the author.

Mitchell (1985) pointed out that the relationship between expected inflation and nominal interest rates may not always be perfectly proportional. In other words, an increase in expected inflation does not necessarily lead to an equal increase in nominal interest rates. Similarly, Day (1985) argued that new macroeconomic information could affect both real interest rates and inflation expectations at the same time. As investors receive updates about the economy, both sets of expectations may shift together.

As shown in Table 1, the findings on the validity of the Fisher and Neo-Fisherian hypotheses vary across developed countries. For example, Uribe (2020) and Crowder (2020) provide evidence supporting the Neo-Fisherian hypothesis using U.S. data. In contrast, Cushman et al. (2023) and Krogsveen (2023) found that neither hypothesis holds in countries like the U.S. and Norway. Additionally, Özbek and Taş (2023) reported partial support for the Fisher hypothesis across both developed and developing countries, highlighting cross-country differences in results.

In the case of Türkiye, research results are also mixed. While Tayyar (2019) found support for the Neo-Fisherian hypothesis, Telçeken and Değirmen (2019) reported weak evidence for the Fisher hypothesis. Other studies, such as Altunöz (2020) and Şeker and Demirel (2022), also support the

Neo-Fisherian view based on Turkish data. In contrast, Yapraklı (2022) and Bulut (2022) concluded that the Neo-Fisherian hypothesis is not valid in Türkiye. On the other hand, Serel and Akşehirli (2023) found that the Fisher hypothesis holds in the Turkish case.

Furthermore, the methodological approaches used in studies on Türkiye vary significantly. Researchers commonly apply models such as ARDL, VAR, and VECM to test these hypotheses, contributing to the diversity of findings in the literature.

3. Methodology and Data

In econometrics, the Markov-Switching Autoregressive (MS-AR(p)) model was introduced by Hamilton (1989) to study how economic variables behave under changing regimes. Since then, this model has become a key tool in macroeconomics and finance due to its ability to detect structural shifts in time series data. Important contributions by Engel (1994), Diebold, et al., (1994), Hamilton (1996), Kim and Nelson (1998), and Chen (2006) have further developed the model's applications and confirmed its analytical strength. Research by Damos et al. (2011) also shows that the MS-AR(p) model is especially useful in identifying regime changes in financial data.

The basic Markov Regime Switching (MRS) model equation can be written as follows:

$$Y_t = \sum_{i=1}^{p} \emptyset\, S_t, iY_{t-i} + \epsilon_t \tag{5}$$

In this model, Y_t denotes the dependent variable observed at time t, while p refers to the number of autoregressive lags included in the specification. The coefficient $\emptyset S_t$, i captures the regime-dependent autoregressive effect for the iii-th lag. The regime variable S_t can take on two values—typically 1 or 2—corresponding to distinct structural states. The term ϵ_t represents the stochastic disturbance, assumed to be normally distributed and independent across time.

Accordingly, the general form of a two-state Markov-switching autoregressive model can be expressed as follows:

$$Y_t = \begin{cases} c_1 + \sum_{i=1}^{p} \emptyset_{1,i} y_{t-i} + \varepsilon_{1t} & if S_t = 1, \\ c_2 + \sum_{i=2}^{p} \emptyset_{1,i} + \varepsilon_{2t} & if S_t = 2, \end{cases} \tag{6}$$

In Equation (2), C_1 and C_2 represent the intercept terms corresponding to Regime 1 and Regime 2, respectively, highlighting the structural shifts between the two states. The summation $\sum_{i=1}^{p} \emptyset_{1,i} y_{t-i}$ captures the autoregressive dynamics through lagged observations, reflecting how past values impact current outcomes within each regime. The error terms ε_{1t} and ε_{2t} denote the random shocks associated with Regime 1 and Regime 2 and are assumed to be normally distributed and serially uncorrelated. Depending on the prevailing regime at time ttt, the system operates under S_t=1 or S_t=2. The transition between these regimes is governed by a probability matrix, which defines the likelihood of switching from one state to another in a two-regime framework.

$$P_{ij} = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix} \tag{7}$$

Each value in the matrix P_{ij},

$$P\left(\frac{S_{t=j}}{S_{t-1=i}}\right) = P_{ij} \qquad (i,j = 1,2) \tag{8}$$

According to Equation (8), p_{11} represents the probability that the process remains in Regime 1, given that it is already in Regime 1.

Likewise, p_{12} shows the probability of transitioning from Regime 1 to Regime 2. In contrast, p_{21} indicates the probability of moving from Regime 2 to Regime 1.

Finally, p_{22} reflects the likelihood of remaining in Regime 2. Each row of transition probabilities must sum to one. This condition ensures that the process will move to one of the regimes with certainty. In addition, all transition probabilities must be non-negative.

To assess how long the system tends to remain in each regime, specific mathematical expressions are utilized. These expressions serve to capture one of the core dynamics of theMRS framework—namely, the persistence of states. Estimating the expected duration in each regime provides valuable insights into how long the observed variable typically remains under a particular set of conditions. As described by Hamilton (1989: 360), the expected duration in Regime 1 and Regime 2 can be computed using the following equations:

$$\frac{1}{1-P_{11}};\ \frac{1}{1-P_{22}} \tag{9}$$

This study also aims to estimate how long financial variables remain in the first and second regimes, emphasizing the key features and practical importance of the Markov Regime Switching (MRS) model. Understanding the duration of each regime is important for analyzing how long certain market conditions persist and how they influence financial behavior.

The formulas developed by Hamilton (1989) help evaluate the impact of regime changes within the MRS framework and support more informed financial decision-making. By calculating both regime durations and transition probabilities, researchers can better understand how markets evolve and assess potential risks. These tools provide a strong foundation for measuring the model's ability to capture regime-dependent patterns and improve forecasting performance in financial settings.

The explicit and implicit definitions of the variables used in the analysis are summarized in Table 2.

Table 2: Data Set

Variable	Description
TICKREDI	Commercial Loans (Issued in TL) (Flow Data, (% Change)) – (Interest Rate)
TUKREDI	Consumer Loans (Issued in TL) (Personal + Auto + Housing) (Flow Data, (% Change)) – (Interest Rate)
ETUFE	12-Month Ahead Annual CPI Expectation (% Change)

Notes: Monthly data spanning the period from February 2013 to December 2024. All data are obtained from the Electronic Data Delivery System of the Central Bank of the Republic of Türkiye.

The sample period from February 2013 to December 2024 was chosen based on data availability and its economic relevance. The starting point aligns with the post-global financial crisis recovery and the introduction of a new monetary policy framework in Türkiye, which involved a greater use of credit-based policy tools. This period also includes several important developments, such as major policy changes, exchange rate shocks, and increased economic uncertainty, especially after 2018. These features make the period well-suited for a regime-switching analysis.

4. Findings

The correlation matrix and descriptive statistics of the variables are presented in Table 3. These tables illustrate the relationships among the variables, as well as the central tendency and dispersion characteristics of each variable.

Table 3: Correlation Analysis and Descriptive Statistics

	TICKREDI	TUKREDI	ETUFE
Mean	0.015552	0.014751	0.012241
Median	0.008036	-0.001250	0.006500
Maximum	0.568080	0.307696	0.370275
Minimum	-0.178425	-0.213744	-0.128293
Std. Dev.	0.097186	0.078222	0.062231
Skewness	1.813917	0.958000	2.155883
Kurtosis	10.24582	5.138455	12.00498
Jarque-Bera	391.2423	49.12078	593.9323
Probability	0.000000	0.000000	0.000000
Sum	2.223979	2.109421	1.750454
Sum Sq. Dev.	1.341213	0.868855	0.549925
Observations	143	143	143
Corelation Analysis			
	TICKREDI		**TUKREDI**
TICKREDI	1	**TUKREDI**	1
ETUFE	0.485.872.9053135011	**ETUFE**	0.403.479.4686903421

As shown in Table 3, all three series exhibit noticeable asymmetry and excess kurtosis, with means of 0.0156 (TICKREDI), 0.0148 (TUKREDI), and 0.0122 (ETUFE) that exceed their medians of 0.0080, –0.0013, and 0.0065, respectively. Extreme values—such as ETUFE's range from –0.1283 to +0.3703—underscore significant volatility, while standard deviations of 0.0972, 0.0782, and 0.0622 further illustrate differing dispersion levels across the series. Jarque–Bera statistics reject normality at the 1% level for all variables, confirming their heavy-tailed, non-Gaussian behavior. Finally, correlation coefficients of 0.486 between ETUFE and TICKREDI and 0.403 between ETUFE and TUKREDI indicate a moderate positive relationship between inflation expectations and both commercial and consumer loan rates.

Table 4: Linearity Test – BDS Test

Dimension	TUKREDI	TICKREDI	ETUFE
2	0.054197*** (0.009398) [5.767130]	0.050616*** (0.008012) [6.317807]	0.072399*** (0.008959) [8.080890]
3	0.090273*** (0.015038) [6.002928]	0.089236*** (0.012824) [6.958540]	0.118157*** (0.014304) [8.260302]
4	0.112891*** (0.018040) [6.257898]	0.110546*** (0.015384) [7.185974]	0.149845*** (0.017119) [8.753286]
5	0.119195*** (0.018946) [6.291459]	0.117184*** (0.016154) [7.254237]	0.165763*** (0.017935) [9.242281]
6	0.118133*** (0.018413) [6.415816]	0.115774*** (0.015696) [7.375942]	0.165920*** (0.017389) [9.541827]

Notes: ***,**,* indicate significances at the levels of the 1%, 5%, and 10%, respectivelly. (…) Shows standard errors. […] shows z-Statistic.

Table 4. The BDS test assesses whether a time series is independently and identically distributed (i.i.d.), a necessary condition for linear models such as ARMA. In this study, embedding dimensions m = 2–6 all yield large z-statistics and p-values below 1%, leading to rejection of the i.i.d. null hypothesis at the 1% level. These results provide clear evidence of nonlinearity in the TICKREDI, TUKREDI, and ETUFE series and justify the use of nonlinear models—such as Markov-switching or MS-ARCH—in the subsequent analysis.

Table 5: Unit Root Tests

ADF				
	At Level			
		TICKREDI	TUKREDI	ETUFE
With Constant	t-Statistic	-6.641460	-6.999557	-6.090613
	Prob.	***	***	***
With Constant & Trend	t-Statistic	-6.664486	-7.009085	-6.068988
	Prob.	***	***	***
PP				
With Constant	t-Statistic	-6.664109	-6.661015	-6.061414
	Prob.	***	***	***
With Constant & Trend	t-Statistic	-6.693317	-6.637436	-6.039590
	Prob.	***	***	***

Note: ***, indicate significances at the levels of the 1%.

Table 5. Unit root tests were conducted using both the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) methods under two specifications—one with a constant term and one with a constant and trend. In every case, the observed t-statistics (around −6 to −7) far exceeded critical thresholds, and p-values were below 1%. These results firmly reject the null hypothesis of a unit root, indicating that TICKREDI, TUKREDI, and ETUFE are stationary at levels (integrated of order zero, I(0)).

Log-likelihood and information criteria provided consistent results across all models. Model selection was conducted accordingly, based on these criteria.

Table 6: Fisher Hypothesis Analysis: Model 1

Dependent Variable: TICKREDI				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
Regime 1:				
ETUFE	1.084967	0.243140	4.462312	0.0000
LOG(SIGMA)	-2.237633	0.089306	-25.05586	0.0000
Regime 2:				
ETUFE	0.252978	0.082604	3.062524	0.0022
LOG(SIGMA)	-3.462774	0.119010	-29.09653	0.0000
Transition Matrix Parameters				
P11-C	2.766850	0.743998	3.718892	0.0002
P21-C	-2.681048	0.667809	-4.014695	0.0001
Mean dependent var	0.015552	S.D. dependent var		0.097186
S.E. of regression	0.085364	Sum squared resid		1.012885
Durbin-Watson stat	1.468189	Log likelihood		180.2858
Akaike info criterion	-2.437563	Schwarz criterion		-2.313248
Hannan-Quinn criter.	-2.387048			
Constant transition probabilities:				
P(i, k) = P(s(t) = k | s(t-1) = i)				
(row = i / column = j)				
		1	2	
	1	0.940858	0.059142	
	2	0.064101	0.935899	
Constant expected durations:				
		1	2	
		16.90844	15.60039	

Note: Regime 1: High Uncertainty, Regime 2: Low Uncertainty

Table 6 presents the results of a two-regime Markov-switching regression model, where TICKREDI is the dependent variable and ETUFE is the independent variable. In Regime 1, the coefficient of ETUFE is estimated as 1.08497, which is strongly significant ($p = 0.0000$). The value of LOG(SIGMA) = –2.23763 implies a volatility of approximately 10.6%, indicating that inflation shocks have a strong and volatile effect on credit interest rates under high uncertainty conditions.

In Regime 2, the coefficient of ETUFE is 0.25298 ($p = 0.0022$), also statistically significant, while LOG(SIGMA) = –3.46277 corresponds to a lower volatility level of around 3.1%. During this regime, the relationship between inflation expectations and credit rates remains positive but is weaker and more stable. The transition probabilities $P_{11} \approx 0.94$ and $P_{22} \approx 0.94$ suggest high persistence in both regimes. The log-likelihood value of 180.29 and the negative information criteria (AIC = –2.438; SC = –2.313; HQ = –2.387) indicate that incorporating regime shifts significantly improves the model's performance.

The table presents the fixed Markov transition probabilities and the expected durations of regimes. The probability of remaining in Regime 1 is calculated as $P_{11} = 0.9409$, while the probability of remaining in Regime 2 is $P_{22} = 0.9359$.

Based on these values, the expected duration in the high uncertainty regime is approximately 16.9 months, and in the low uncertainty regime, about 15.6 months. These findings indicate a high degree of persistence in both regimes, suggesting that each regime typically lasts for nearly one and a half years on average.

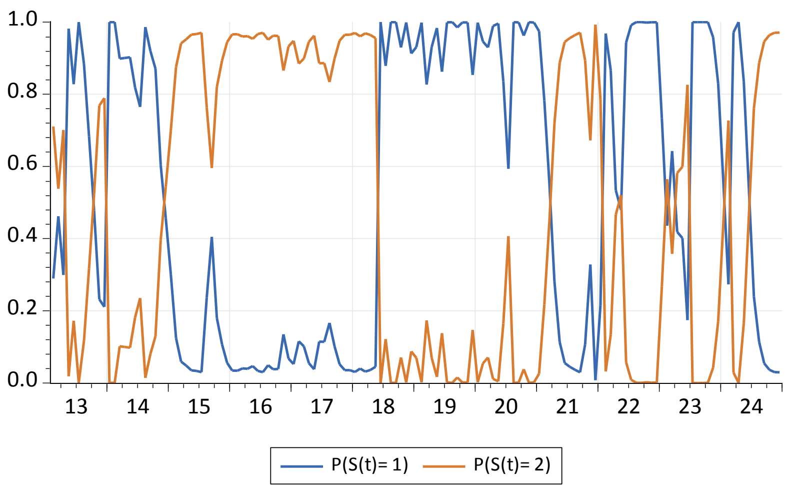

Figure 2: Fisher Hypothesis Regime Probabilities: Model 1

Figure 2, illustrates the probabilities of two distinct regimes. The blue line represents the probability of the "High Uncertainty" regime, which notably increases during the early 2018, 2021–2022, and 2023 periods. The orange line, on the other hand, remains close to a unit value during 2013–2017, 2019–2020, and early 2024, indicating periods of low volatility in which commercial loan interest rates were shaped more directly by inflation expectations. The sharp transitions between the blue and orange lines suggest that shocks in economic policy and credit conditions rapidly shift the commercial loan interest rate between uncertainty regimes. Moreover, the prolonged dominance of the orange line points to the persistence of the low-uncertainty regime.

Table 7: Neo-Fisherian Analysis: Model 2

Dependent Variable: ETUFE				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
Regime 1				
TICKREDI	0.656897	0.221309	2.968238	0.0030
LOG(SIGMA)	-2.283974	0.164704	-13.86718	0.0000
Regime 2				
TICKREDI	0.182902	0.030824	5.933714	0.0000
LOG(SIGMA)	-3.599166	0.091448	-39.35752	0.0000

Transition Matrix Parameters				
P11-C	1.627282	0.714485	2.277560	0.0228
P21-C	-3.307042	0.659944	-5.011097	0.0000
Mean dependent var	0.012241	S.D. dependent var		0.062231
S.E. of regression	0.054701	Sum squared resid		0.415915
Durbin-Watson stat	1.258002	Log likelihood		260.0648
Akaike info criterion	-3.553354	Schwarz criterion		-3.429039
Hannan-Quinn criter.	-3.502838			
Constant transition probabilities:				
P(i, k) = P(s(t) = k | s(t-1) = i)				
(row = i / column = j)				
		1	2	
	1	0.835797	0.164203	
	2	0.035330	0.964670	
Constant expected durations:				
		1	2	
		6.090020	28.30424	

Note: Regime 1: High Uncertainty, Regime 2: Low Uncertainty

Table 7 presents the results of the two-regime Markov-switching regression model, where ETUFE is the dependent variable and TICKREDI is the independent variable. In Regime 1, the coefficient of TICKREDI is estimated at 0.6569 ($z = 2.968$; $p = 0.0030$), indicating statistical significance at a high confidence level. With LOG(SIGMA) = –2.28397, the corresponding volatility is calculated as $\sigma_1 \approx$ 10.2%. This implies that in this regime, a one-point increase in commercial loan interest rates raises inflation expectations by approximately 0.66 points, and the market conditions are characterized by relatively strong and volatile uncertainty.

In Regime 2, the coefficient of TICKREDI is found to be 0.1829 ($z = 5.934$; $p < 0.0001$), again highly significant, with LOG(SIGMA) = –3.59917 yielding a volatility level of $\sigma_2 \approx 2.7\%$. In this regime, although the relationship between credit interest rates and inflation expectations remains positive, it is weaker and more stable. The regime transition probabilities of $P_{11} \approx 0.84$ and $P_{22} \approx 0.965$ indicate a high level of persistence within both regimes. The model's log-likelihood value of 260.06, along with the low and negative values of information criteria such as AIC and SC, highlight the meaningful contribution of the regime-switching structure to the model.

Table 7 presents the fixed Markov transition probabilities and the expected regime durations. The probability of remaining in the high uncertainty regime is calculated as $P_{11} = 0.8358$, while the probability of remaining in the low uncertainty regime is $P_{22} = 0.9647$.

These values indicate that the average duration in the high uncertainty regime is approximately 6.1 months, whereas the low uncertainty regime lasts around 28.3 months. Accordingly, the low uncertainty period is observed to be significantly longer and more stable compared to the high uncertainty period.

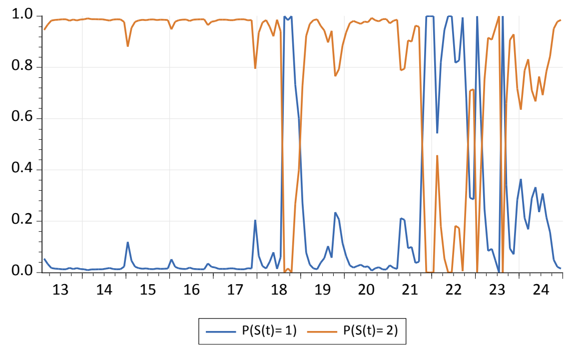

Figure 3: Neo-Fisherian Hypothesis Regime Probabilities: Model 2

Figure 3 displays the probabilities of two different regimes. The blue line represents the probability of the "High Uncertainty" regime, which is observed to rise significantly, particularly at the beginning of 2018 and during the 2021–2022 period. The orange line, on the other hand, hovers close to a unit value during the periods of 2013–2017, 2019–2020, and early 2024, indicating that commercial loan interest rates were in phases of low volatility and stable alignment with inflation expectations. Sudden transitions between the blue and orange lines suggest that economic-policy or financial shocks accelerate regime shifts in credit-interest dynamics. Additionally, the sustained elevation of the orange line underscores the persistence of the low uncertainty regime.

Table 8: Fisher Hypothesis Analysis: Model 3

Dependent Variable: TUKREDI				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
Regime 1				
ETUFE	0.894172	0.277953	3.216995	0.0013
LOG(SIGMA)	-2.284405	0.102617	-22.26156	0.0000
Regime 2				
ETUFE	0.181297	0.056348	3.217420	0.0013
LOG(SIGMA)	-3.680058	0.094110	-39.10390	0.0000
Transition Matrix Parameters				
P11-C	1.892349	0.589307	3.211141	0.0013
P21-C	-2.366798	0.526464	-4.495647	0.0000
Mean dependent var	0.014751	S.D. dependent var		0.078222
S.E. of regression	0.071954	Sum squared resid		0.719647
Durbin-Watson stat	1.493706	Log likelihood		214.1218
Akaike info criterion	-2.910795	Schwarz criterion		-2.786480
Hannan-Quinn criter.	-2.860279			
Constant transition probabilities:				
P(i, k) = P(s(t) = k | s(t-1) = i)				
(row = i / column = j)				
		1	2	
	1	0.869023	0.130977	
	2	0.085740	0.914260	
Constant expected durations:				
		1	2	
		7.634936	11.66319	

Note: Regime 1: High Uncertainty, Regime 2: Low Uncertainty

Table 8 presents the results of the two-regime Markov-switching regression model estimated using TUKREDI as the dependent variable and ETUFE as the independent variable. In Regime 1, the coefficient of ETUFE is found to be 0.8942 and statistically significant at a high confidence level ($p = 0.0013$). The error term volatility is LOG(SIGMA) = −2.2844, corresponding to $\sigma_1 \approx 10.2\%$, indicating that in periods of uncertainty, inflation shocks strongly and erratically influence consumer loan rates. In Regime 2, the ETUFE coefficient is 0.1813 (also $p = 0.0013$) and remains statistically significant, although the effect is relatively weaker. The volatility level is LOG(SIGMA) = −3.6801, which corresponds to $\sigma_2 \approx 2.5\%$, suggesting that with reduced uncertainty, the credit rate response becomes both smaller in magnitude and more stable.

The transition dynamics also indicate that both regimes exhibit high persistence. The probability of remaining in the high-uncertainty regime is $P_{11} \approx 0.87$, suggesting infrequent transitions out of this state, while $P_{22} \approx 0.91$ implies that the low-uncertainty regime is relatively more stable. The negative and low values of the AIC, SC, and HQ information criteria suggest that the regime-switching structure significantly improves the model's explanatory power.

Table 8 presents the fixed Markov transition probabilities and the expected regime durations. The probability of remaining in Regime 1 (high uncertainty) is calculated as $P_{11} = 0.8690$, while the probability of staying in Regime 2 (low uncertainty) is $P_{22} = 0.9143$.

Based on these values, the average duration in the high-uncertainty regime is estimated to be approximately 7.63 months, while the average duration in the low-uncertainty regime is about 11.66 months. This suggests that the low-uncertainty regime stands out as a more prolonged and stable period.

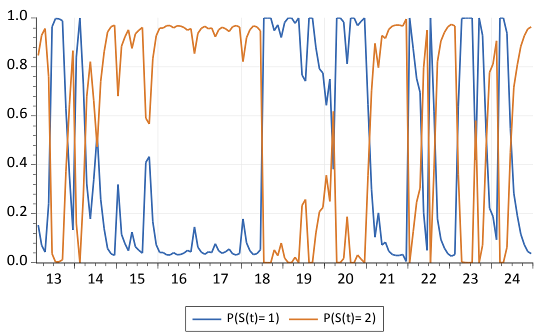

Figure 4: Fisher Hypothesis Regime Probabilities: Model 3

Figure 4 displays the smoothed probabilities of two distinct regimes. The blue line represents the probability of the "High Uncertainty" regime, which notably increases during the early 2018, 2021–2022, and 2023 periods. In contrast, the orange line hovers near unity between 2013–2017, 2019–2020, and at the beginning of 2024, marking these periods as low-volatility phases in which consumer loan interest rates were shaped more consistently by inflation expectations. Sudden transitions between the blue and orange lines indicate that economic shocks rapidly altered the uncertainty regimes of consumer credit rates, while the sustained elevation of the orange line highlights the persistence of the low-uncertainty regime.

Table 9: Neo-Fisherian Analysis: Model 4.

Dependent Variable: ETUFE				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
Regime 1				
TUKREDI	0.618527	0.329275	1.878454	0.0603
LOG(SIGMA)	-2.237199	0.193558	-11.55829	0.0000
Regime 2				
TUKREDI	0.186578	0.050865	3.668097	0.0002
LOG(SIGMA)	-3.555388	0.105025	-33.85289	0.0000
Transition Matrix Parameters				
P11-C	2.048230	1.236815	1.656052	0.0977
P21-C	-3.581495	0.862611	-4.151923	0.0000
Mean dependent var	0.012241	S.D. dependent var		0.062231
S.E. of regression	0.056154	Sum squared resid		0.438312
Durbin-Watson stat	1.272772	Log likelihood		253.5792
Akaike info criterion	-3.462646	Schwarz criterion		-3.338331
Hannan-Quinn criter.	-3.412131			

Constant transition probabilities:			
P(i, k) = P(s(t) = k | s(t-1) = i)			
(row = i / column = j)			
		1	2
	1	0.885769	0.114231
	2	0.027080	0.972920
Constant expected durations:			
		1	2
		8.754164	36.92722

Note: Regime 1: High Uncertainty, Regime 2: Low Uncertainty

Table 9 presents the results of the two-regime Markov-switching regression model estimated using ETUFE as the dependent variable and TUKREDI as the independent variable. In Regime 1, the coefficient of TUKREDI is 0.6185, with a z-statistic of 1.878 and p = 0.0603, indicating significance at the 10% confidence level. The volatility of the error term is calculated as $\sigma_1 \approx 10.6\%$ based on LOG(SIGMA) = –2.2372. This suggests that during periods of high uncertainty, a one-point increase in consumer loan interest rates raises expected inflation by approximately 0.62 points, accompanied by elevated residual volatility.

In Regime 2, the coefficient of TUKREDI is estimated at 0.1866, showing high statistical significance (z = 3.668; p = 0.0002), with $\sigma_2 \approx 2.9\%$ derived from LOG(SIGMA) = –3.5554.

This highlights that during periods of low uncertainty, the credit-interest rate pass-through remains positive but relatively weak and stable.

The regime transition probabilities $P_{11} \approx 0.88$ and $P_{22} \approx 0.97$ indicate a high degree of persistence within each regime. The model's log-likelihood value of 253.58, along with negative and low information criteria values (AIC = −3.463; SC = −3.338; HQ = −3.412), confirm the significant explanatory power contributed by the regime-switching structure.

Table 9 presents the fixed Markov transition probabilities and the expected durations of regimes. The probability of remaining in Regime 1 (high uncertainty) is calculated as $P_{11} = 0.8858$, while the probability of staying in Regime 2 (low uncertainty) is $P_{22} = 0.9729$.

Accordingly, the average duration in the high uncertainty regime is estimated to be approximately 8.75 months, while the low uncertainty regime lasts around 36.93 months on average. These findings indicate that the low uncertainty regime is considerably more persistent and stable, standing out as a longer-lasting period.

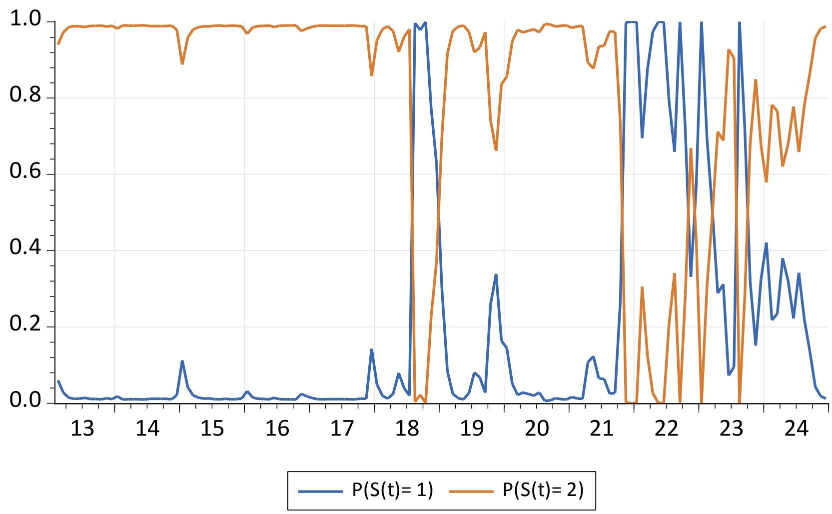

Figure 5: Neo-Fisherian Hypothesis Regime Probabilities: Model 4

Figure 5 displays the filtered probabilities of two different regimes over time. The blue line represents the probability of the high uncertainty regime, which noticeably increases during the early 2018, as well as the 2021–2022 and 2023 periods. The orange line, on the other hand, stays close to unity during 2013–2017, 2019–2020, and the beginning of 2024, indicating that these periods can be characterized as relatively stable and low-volatility phases. The sharp transitions between blue and orange lines point to rapid regime shifts triggered by internal or external shocks, while the prolonged dominance of the orange line highlights the persistence of the low uncertainty regime.

5. Discussion and Conclusion

This study examines the regime-dependent relationship between expected inflation and credit interest rates, within the frameworks of the classical Fisher and Neo-Fisherian hypotheses. Using monthly data from February 2013 to December 2024, which includes commercial and consumer loan interest rates and 12-month inflation expectations, the analysis captures key structural changes and economic uncertainty in Türkiye's macroeconomic environment.

The ADF and PP unit root tests show that all variables are stationary at levels, while the BDS test reveals evidence of nonlinear dynamics. Based on these results, four separate Markov Regime Switching (MRS) models are estimated to explore how the inflation–interest rate relationship changes under high and low uncertainty regimes. The analysis focuses on within-regime coefficients, transition probabilities, and regime durations to provide a complete picture of these dynamics.

The findings summarized in Tables 6 through 9 help explain why past studies on this topic have reached different conclusions. For example, during the high-uncertainty regime, commercial loan interest rates showed a strong (≈1.08) and long-lasting (about 17 months) response to expected inflation. This result supports the classical Fisher hypothesis and is in line with the findings of Crowder (2020) and Altunöz (2020), who also reported a one-to-one long-term relationship between nominal interest rates and expected inflation. On the other hand, in the low-uncertainty regime, the effect was weaker (≈0.25) and shorter (around 15.6 months), which is similar to what Cushman et al. (2023) and Krogsveen (2023) found—little or no support for either the Fisher or Neo-Fisherian views. In the case of consumer loans, a strong response (≈0.89) and high volatility (σ≈10.2%) under high uncertainty are consistent with Altunöz (2020) and Şeker & Demirel (2022), who also observed strong effects during uncertain periods. Meanwhile, the milder effect in low-uncertainty times agrees with Yapraklı (2022) and Bulut (2022), who found limited support for the Neo-Fisherian hypothesis. Overall, these results suggest that how inflation expectations affect credit interest rates largely depends on the level of uncertainty. This supports the idea that monetary policy should be designed with these regime shifts in mind.

The study provides clear answers to its three research questions. First, the relationship between expected inflation and credit interest rates becomes stronger and more volatile during high-uncertainty periods. Second, the validity of the Fisher and Neo-Fisherian hypotheses is regime-dependent, with stronger support during periods of economic stress. Third, the low-uncertainty regime is more stable and predictable, as indicated by lower volatility and longer average regime durations.

These findings have several practical and theoretical implications. They show that the Fisher and Neo-Fisherian effects cannot be treated as time-invariant mechanisms; instead, their strength varies with the state of the economy. From a practical policy perspective, incorporating regime-detection tools into central bank decision-making could allow interventions to be timed more effectively. From a theoretical standpoint, models of interest-rate transmission should accommodate state-contingent parameter shifts, as fixed-parameter models risk misestimating both the direction and magnitude of actual economic responses.

The results also highlight several policy considerations. Monetary policy should not remain static across all environments, as high-uncertainty regimes require stronger and more decisive responses. When the model's latent probability of being in a high-uncertainty state exceeds 0.7, policy rates may need to be raised by at least 50 basis points and reinforced with forward guidance if inflation expectations exceed 12 percent. Conversely, when uncertainty falls below 0.3, gradual normalization through 25-basis-point adjustments can be supported by coordinated macroprudential easing to preserve healthy credit conditions.

This study contributes to the literature by showing that the relationship between expected inflation and credit interest rates is conditional on the underlying uncertainty regime. While most existing studies evaluate the Fisher or Neo-Fisherian hypotheses under a single-regime structure, this paper demonstrates that their validity changes with economic conditions. It also advances the application of MRS models in macroeconomics by jointly examining inflation expectations and credit-market dynamics across different uncertainty levels.

Future research could extend this work by employing high-frequency data to capture short-term regime shifts, particularly during crises or abrupt policy changes. Cross-country comparisons may help reveal how institutional structures and central bank credibility shape these relationships. Additionally, incorporating time-varying or non-parametric models may further improve the ability to detect structural breaks and evolving policy environments.

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