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The Effects of Uncertainties on Exchange Rates in Türkiye: Markov Regime Switching Models

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Türkiye'de Belirsizliklerin Döviz Kuru Üzerindeki Etkileri: Markov Rejim Değişim Modelleri

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Abstract

This study examines the effects of economic policy uncertainty (EPU) and the world uncertainty index (WUI) on the exchange rate in Türkiye. Using quarterly data for 2008Q1-2024Q3, the Markov regime-switching model is applied to explain exchange rate dynamics. The study evaluates the effects of EPU and WUI on exchange rates in different periods, and control variables such as interest rates and lagged exchange rate values are added. The analysis reveals that exchange rate fluctuations are significantly related to EPU and WUI. The findings show that both EPU and WUI positively and strongly affect the exchange rates when the exchange rate shows an increasing trend (Regime 0). In particular, WUI creates volatility in exchange rates by making the effects of global uncertainties more apparent. On the other hand, in more stable periods (Regime 1), the effect of these uncertainty indicators weakens, and market conditions exhibit a more resilient structure. As a result, the effects of uncertainties on exchange rates are associated with local and global economic vulnerabilities, and significant findings that can guide policymakers in managing the effects of economic uncertainties are presented.

Keywords: *Economic policy uncertainty, World uncertainty index, exchange rate, Markov regime-switching model.*

Makale Bilgileri

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Öz

Bu çalışma, ekonomik politika belirsizliği (EPU) ve dünya belirsizlik endeksinin (WUI) Türkiye'de döviz kuru üzerindeki etkilerini incelemektedir. 2008Q1-2024Q3 dönemine ait çeyreklik veriler kullanılarak, döviz kuru dinamiklerini açıklamak amacıyla Markov rejim değişim modeli uygulanmıştır. Çalışmada, EPU ve WUI'nin döviz kuru üzerindeki farklı dönemlerdeki etkileri değerlendirilmiş, faiz oranları ve döviz kurunun gecikmeli değerleri gibi kontrol değişkenleri eklenmiştir. Analizler, döviz kurundaki dalgalanmaların EPU ve WUI ile anlamlı bir ilişkiye sahip olduğunu ortaya koymuştur. Bulgular, döviz kurunun artış eğilimi gösterdiği dönemlerde (Rejim 0) hem EPU hem de WUI'nin döviz kuru üzerinde pozitif ve güçlü bir etkiye sahip olduğunu göstermektedir. Özellikle WUI, küresel belirsizliklerin etkilerini daha belirgin hale getirerek döviz kurunda volatilite yaratmaktadır. Öte yandan, daha stabil dönemlerde (Rejim 1) bu belirsizlik göstergelerinin etkisi zayıflamakta, piyasa koşulları daha dirençli bir yapı sergilemektedir. Sonuç olarak, belirsizliklerin döviz kuru üzerindeki etkileri, yerel ve küresel ekonomik kırılganlıklarla ilişkilendirilmiş ve politika yapıcılara ekonomik belirsizliklerin etkilerini yönetmede rehberlik edebilecek önemli bulgular sunulmuştur.

Anahtar Kelimeler: *Ekonomik politika belirsizliği, Dünya belirsizlik endeksi, döviz kuru, Markov rejim değişim modeli.*

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1. Introduction

Today's global economy has become increasingly complex due to the constantly changing economic and political dynamics. Uncertainty, an important indicator of this complexity, deeply affects economic decision-making processes and creates far-reaching consequences on markets. While uncertainty generally causes fluctuations in basic economic indicators such as economic growth, investment, consumption, and trade, one of the strongest effects is in foreign exchange markets. Exchange rates are affected by both internal (national policy uncertainties) and external (global risks and uncertainties) factors, which constitutes a critical area in understanding the effects of uncertainties on financial markets (Bloom, 2009; Baker et al., 2016).

Economic policy uncertainty (EPU) refers to the unpredictability of a country's economic policy decisions and their impact on economic actors. EPU increases when policymakers' decisions are uncertain or the possible outcomes of policy changes cannot be predicted. For example, sudden changes in tax regulations, monetary policy decisions, or trade policies can increase economic uncertainty. The EPU index, developed by Baker et al. (2016), is measured based on the frequency of phrases such as “uncertainty” and “economic policy” in newspaper news and provides an essential tool for analyzing the impact of policy uncertainty on markets. Increasing EPU may increase the risk perception of economic actors, leading to the postponement of investment and consumption decisions and increased volatility in financial indicators such as exchange rates (Bloom, 2009; Caldara and Iacoviello, 2022).

On the other hand, the World Uncertainty Index (WUI) is an important indicator developed by Ahir et al. (2018) that measures the level of economic and political uncertainty worldwide. This index is calculated based on the frequency of the word “uncertainty” in reports prepared on a global scale. It is a valuable tool in understanding the effects of economic uncertainty worldwide. The increase in WUI has been associated with global crises, trade wars, geopolitical conflicts, and pandemics. For example, events such as the 2008 Global Financial Crisis, the 2016 Brexit process, the COVID-19 pandemic, and the 2022 Russia-Ukraine war caused a sudden increase in WUI and created fluctuations in global financial markets. Such events increased the volatility of exchange rates, especially in developing economies, and led to the devaluation of local currencies (Ahir et al., 2018).

Baker et al. (2020) revealed that uncertainty levels were lower during the 2008 financial crisis compared to recent years. In this context, it is stated that a sudden increase in uncertainty can threaten economic growth and financial stability. Therefore, it is of great importance that monetary policies, as well as the economic and financial policies implemented, are designed to provide stability in a way that supports the global economy. Uncertainty directly affects basic economic activities such as investment, consumption, and foreign trade. Fixed capital investments, one of the first channels of influence, tend to decrease during periods of uncertainty; this has important consequences at the macroeconomic level. D’Mello and Toscano (2020) state that when economic policy uncertainty increases, firms adopt a wait-and-see approach and postpone investment and employment decisions, which causes a decrease in total investment and production. The second important effect is the reducing effect of uncertainty on consumption (Basu and Bundick, 2017). Third, foreign trade is also negatively affected by uncertainty. Recent theoretical studies have shown that trade policy uncertainty, in particular, can reduce the volume of international trade and weaken the effectiveness of economic policies. In the context of macroeconomic volatility, uncertainty is generally related to the severity of the economic recession and the speed of the recovery process. Macroeconomic uncertainty has a countercyclical nature, meaning that it increases in recession periods and decreases in expansion periods. For example, it is argued that one of the main reasons for the economic slowdown observed after 2019 is the increase in EPU caused by the COVID-19 pandemic (Al-Thaqeb et al., 2020).

Emerging economies like Türkiye are more vulnerable to the effects of both EPU and WUI. The main reason is that these economies generally have high external debt burdens, current account deficits, and dependence on global capital flows. Economic uncertainties increase the demand for foreign exchange in these countries, causing local currencies to lose value. In Türkiye, events such as the 2018 foreign exchange crisis, the COVID-19 pandemic, and the increase in energy prices in 2022 have clearly revealed the effects of both domestic and external uncertainties on the exchange rate. For example, during periods when EPU increased, the depreciation of the TL accelerated, while the increase in WUI triggered capital outflows from emerging markets like Türkiye.

This study examines the relationship between economic policy uncertainty, the world uncertainty index (WUI), and Türkiye's exchange rate dynamics. The study's main objective is to analyze the relative effects of uncertainty indicators on the exchange rate and evaluate the role of EPU and WUI in different periods. In particular, the Markov Regime Switching Model analyzes how Türkiye's exchange rate fluctuations from the 2008 Global Financial Crisis to 2024 are associated with changes in these uncertainty indicators. The study aims to provide important implications for policymakers and investors by presenting theoretical and empirical findings.

When the literature is examined, it is seen that the studies examining the relationship between economic policy uncertainty and exchange rate volatility are limited (Balcilar et al., 2016; Beckmann and Czudaj, 2017; Liming et al., 2020). Studies on the effects of economic policy uncertainty have generally focused on issues such as stock markets, asset, and commodity prices (Shahzad et al., 2017; Gupta et al., 2019; Fang et al., 2018; Li et al., 2018; Nilavongse et al., 2020). In addition, some studies have discussed the effects of increases in uncertainty on investment, interest rates, employment, and prices (Bloom, 2009; Jurada et al., 2015; Leduc and Liu, 2016).

Theoretically, uncertainties have effects on exchange rates. High economic policy uncertainty can also be the main reason for exchange rate volatility (Liming et al., 2020). Nilavongse et al. (2020), in their study examining the effects of economic policy uncertainty on the UK economy, proved that domestic industrial production and real exchange rate are affected by the EPU shock. In their study examining the effects of uncertainties in the US economy on the dollar exchange rate in developed and developing economies, Krol (2014) proved that economic policy uncertainty increases exchange rate volatility during recession periods in both developed and developing economies. Similarly, Balcilar et al. (2016) found that EPU significantly affects exchange rates in developed and developing economies. Abid and Rault (2020) stated that economic policy uncertainty shocks are an important reason for exchange rate volatility in developing economies. Aimer (2021) examines the effects of both economic policy uncertainty and volatility index (VIX) on exchange rates for the four countries that recorded the most deaths due to the COVID-19 pandemic. While economic policy uncertainty had no significant impact on the currencies of Brazil, India, Mexico, and Sweden before the pandemic, a positive and significant relationship with the Brazilian real was found during the pandemic period. Zhou and Zhang (2023) measured the effect of EPU uncertainty on exchange rate volatility and concluded that non-policy uncertainty is more dominant than EPU. Hong et al. (2024) found a causal relationship between global and national EPU on stock markets in developed and developing countries. However, global EPU has a relatively more significant impact on developed market stock markets compared to national EPU. Gürsoy (2021) examined the effect of global economic policy uncertainty on the exchange rate, inflation, and the stock market in his study of the Turkish economy. As a result of the study, it was found that the index had a positive effect on exchange rates, while there was no causal relationship with other variables. Güney (2020) tested whether economic policy uncertainty affected exchange rate volatility in Türkiye through a bounds test. The author stated that the dollar exchange rate was affected by economic policy uncertainty, but the euro exchange rate was not.

The world uncertainty index is another variable to use in the study. However, the number of studies using the World Uncertainty Index is relatively low. Studies have focused on economic

growth, stock market, trade balance, and financial markets (Liu and Gao, 2022; Yu, 2023; Chatterjee, 2023; Tombak, 2024). Şit (2024) examined the effect of the world uncertainty index on CPI, exchange rate, and CDS premiums in the Turkish economy. The analysis results prove that the uncertainty index affects the exchange rate and inflation.

The rest of the paper is organized as follows: Section 2 explains the data and methodology. Section 3 summarizes the findings. Section 4 is finalized with a conclusion.

2. Data and Methodology

This study investigates the effects of economic policy uncertainty and the world uncertainty index on the exchange rate in Türkiye using quarterly data for the period 2008Q1-2024Q3. For this purpose, the average of the dollar and euro exchange rate, economic policy uncertainty, the World Uncertainty Index, and interest rate variables were used as exchange rate variables. The sources of the variables included in the study are given in Table 1.

Table 1. Data Set

Symbol	Variable	Data Source
EXR	Exchange rate	CBRT
EPU	Economic Policy Uncertainty	https://www.policyuncertainty.com/
WUI	World Uncertainty Index	https://worlduncertaintyindex.com/data/
INT	Interest Rate	CBRT

The World Uncertainty Index (*WUI*) is an indicator created to measure global economic uncertainties. This index was calculated by Ahir et al. (2018) by analyzing the frequency of the word "uncertainty" and its derivatives in country reports prepared by the Economist Intelligence Unit (EIU). The frequent use of the word uncertainty in reports indicates an increase in the index value (www.policyuncertainty.com). The economic policy uncertainty (*EPU*) data developed by Baker et al. (2016) measures the uncertainty created by economic policy decisions and policy actions. In particular, the EPU index increases during periods of increased uncertainty about policymakers' decisions, legal regulations, and the future direction of economic policies. This index plays an essential role in the decision-making processes of investors and businesses because when economic policy uncertainty increases, investment and consumption decisions may be postponed or re-evaluated (Baker et al., 2016; Saka Ilgin, 2022).

Two separate models will be used to consider the variables used in the study. The aim is to compare and analyze two different uncertainty indicators. Figure 1 shows the time series graphs of the variables used in the analysis.

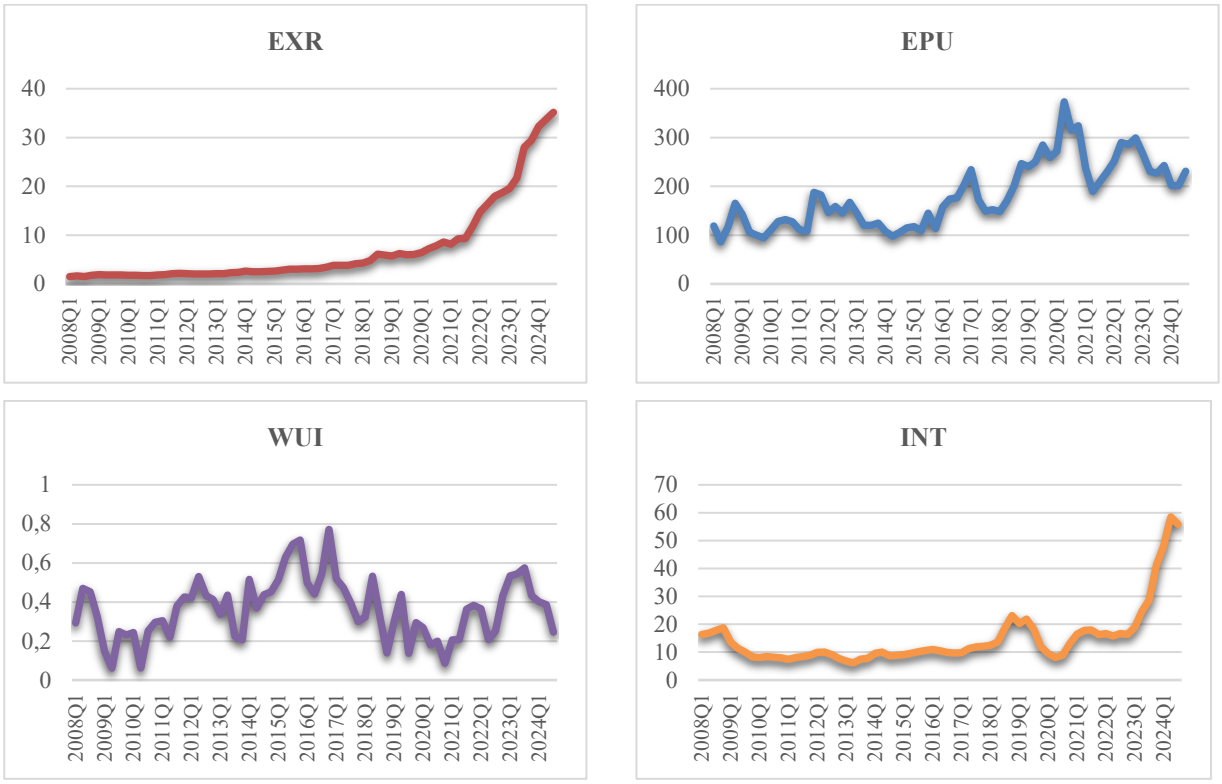

Figure 1. The Trend of The Series

When the exchange rate data graph, the primary variable to be used in the analysis, is examined, it shows that the exchange rate followed a relatively horizontal and stable course between 2008 and 2013. There was no significant upward trend in the exchange rate during this period. In 2013, the US Federal Reserve (FED) began to reduce monetary expansion (tapering), which caused capital outflows from developing countries. Türkiye 's increasing current account deficit and external debt burden increased the demand for foreign exchange, leading to a depreciation of the TL. The 2018 foreign exchange crisis was triggered by the tension in US-Türkiye relations (especially the Pastor Brunson incident) and the TL's exposure to speculative attacks. The failure of the Central Bank's policy interventions to provide market confidence and inflation pressure caused the TL to lose value significantly. Subsequently, the COVID-19 pandemic increased global uncertainty and made Türkiye's economic vulnerabilities more apparent. The Central Bank's interest rate policies, increasing inflation, and declining foreign exchange reserves put pressure on the TL. The implementation of interest rate cut policies at the end of 2021 accelerated the depreciation of the TL. High inflation and current account deficit problems supported the increase in the exchange rate. The exchange rate seems to have reached its highest levels in the third quarter of 2024. This situation shows that the TL has suffered a significant depreciation on nominal and real terms. The graph shows that there has been a general increasing trend in economic policy uncertainty from 2008 to 2024. This situation reflects the unpredictability of economic policies and the increasing economic effects of political uncertainties worldwide. The 2020 pandemic period was when economic policy uncertainty was at its highest. When the course of the World Uncertainty Index (*WUI*) is examined, it is seen that it fluctuates sensitively to global economic and political events. Major global events such as the 2008 crisis, Brexit, trade wars, and COVID-19 represent the periods when uncertainties peak. The last graph belongs to the TL interest rate (*INT*) data. The graph shows that TL interest rates have experienced significant fluctuations since 2008, with rapid increases significantly in the period after 2018 and 2022. The 2018 foreign exchange crisis and the 2022 high inflation period stand out when TL interest rates increased sharply. These increases were generally made to limit the depreciation of the TL and control inflation.

The method should be explained after explaining the data to be used in the study. The behavior of economic time series can change over time because these series are affected by many important events, such as business cycle fluctuations, policy changes, crises, and wars (Karagöl, 2023). In the Markov regime model, also called the Hamilton (1989) model, regime transitions between periods of stagnation and economic expansion are expressed as probabilities.

Markov chain consists of random variables that are independent of each other. In the Markov regime change model, the stochastic process that determines the change from one state or regime to another through a Markov chain is explained. Markov chain is used to model the behavior of a state variable that determines which regime is present and cannot be directly observed (Bildirici et al., 2010). The first-order Markov chain for the stochastic process in which the prior probabilities affect the probabilities in a time series is expressed as follows (Bildirici et al., 2010):

$$\mathrm{P}(s_0, s_1, \dots, s_t) = \mathrm{P}(s_0) \prod_{i=1}^{t} \Pr(s_t|s_{t-1}), \forall_t \quad (1)$$

In Equation 1, $P(s_0)$ indicates the unconditional probability, $P(s_t|s_{t-1})$ indicates the conditional (transition) probability. In this case, an M-state Markov chain has $A * A$ transition probabilities for consecutive times t and $t-1$. s_t, follows an ergodic M-state Markov process with an irreducible transition matrix and is represented as in Equation 2 (Krolzig, 2000):

$$P = \begin{bmatrix} p_{11} & \cdots & p_{1A} \\ \vdots & \ddots & \vdots \\ p_{A1} & \cdots & p_{AA} \end{bmatrix} \quad (2)$$

Based on Equation 2, the Markov regime-switching model can be written as follows, taking into account the dynamic nature of the regimes:

$$y_t = \begin{cases} f_1(y_t; x_t; \delta_1) & - \ Regime\ 0 \\ f_2(y_t; x_t; \delta_2) & - \ Regime\ 1 \end{cases} \quad (3)$$

In Equation 3, f_1 and f_2 represent the sub-regimes in the model, and δ_1 and $\delta_2$represent the dynamic model parameters. In Markov regime change models, the likelihood ratio statistic is often used to determine the number of regimes. However, there are other methods in the literature. Some of these methods examine the graph of the existing data (a priori) and argue that a second regime is based on an economic view (Bildirici et al., 2010). The representation and hypotheses of the likelihood ratio are as follows (Tesfamichael and Shiferaw, 2019):

$$LR = 2\left[\mathcal{L}\left(\hat{\theta}\right) - \mathcal{L}(\hat{\theta}_0)\right] \quad (4)$$

In Equation 4, $\hat{\theta}$ and $\hat{\theta}_0$ represent the maximum likelihood estimators for $\hat{\theta}$ and $\hat{\theta}_0$under the hypotheses H_1 that the model includes regime change and H_0 that the model does not include regime change, respectively. LR has an asymptotic χ_k^2 distribution, where k is the number of parameters. If the probability value of LR is less than the significance levels of 0.10, 0.05, and 0.01, the H_0 hypothesis is rejected, and the conclusion that the model includes regime change is reached.

For this study, the following models will be estimated:

Model 1: $EXR_t = f(EPU_{S_t}, INT_{S_t}, EXR(-1)_{S_t}$ (5)

Model 2: $EXR_t = f(WUI_{S_t}, INT_{S_t}, EXR(-1)_{S_t}$ (6)

3. Empirical Findings

In the study, two different models were estimated through the Markov regime change regression model. The first model used Economic Policy Uncertainty, while the second used the World Uncertainty Index. Thus, it will be possible to compare the effects of different uncertainty indicators on the exchange rate. For this purpose, first of all, the stationarity of the variables and the existence of structural breaks should be tested.

Table 2. Unitroot Test with Structural Break

Variables	T-stat	Prob.	Breakpoint	Outcome
EXR	-1.0764	>0.99	2020Q3	
ΔEXR	-4.5275**	0.04	2011Q1	I(1)
EPU	-4.0259	0.14	2018Q2	
ΔEPU	-9.3516***	<0.01	2020Q2	I(1)
WUI	-4.2350*	0.08	2016Q4	I(0)
INT	-4.5680**	0.03	2023Q1	I(0)

Note: *, **, and *** indicates the statistical significance at the 10%, 5% and 1% significance level, respectively.

The findings related to the single-break unit root test, which was applied to test the presence of stationarity and structural breaks in variables and based on the studies of Perron (1989) and Perron and Vogelsang (1992), are given in Table 2. The test findings show that the *EXR* and *EPU* variables are not stationary at the level and contain a unit root. These variables, which become stationary at the first difference, i.e. integrated of the first degree, also contain structural breaks in different periods. The *WUI* and *INT* variables are stationary at the level values.

The results of the priori tests applied are in line with the requirements of the methodology applied in the study and support the suitability of a non-linear econometric model. In this context, the findings related to the Markov regime change regressions, which are preferred in accordance with the purpose of the study, are expressed in Table 3.

Table 3. Markov Regime Switching Regression Results

	Model 1	Model 2
Regime (0)		
C	3.61178** (0.036)	0.6398** (0.037)
EPU	0.00209*** (0.000)	-
WUI	-	4.55152** (0.012)
INT	0.09632*** (0.000)	0.0746 * (0.068)
EXR(-1)	1.21302*** (0.000)	1.16994*** (0.000)
Regime (1)		
C	-0.36317*** (0.000)	0.11599** (0.041)
EPU	-0.01266 (0.217)	-
WUI	-	1.37719* (0.056)
INT	0.00846* (0.096)	0.03250* (0.078)
EXR(-1)	1.02650*** (0.000)	1.04110*** (0.000)
Diagnostic Tests		
LR Test (χ^2)	131.63*** (0.000)	128.29*** (0.000)
AIC	0.6233	0.6490
Log-likelihood	-8.8720	-9.4194
ARCH Test (*F*)	0.0964(0.7573)	4.1963 (0.1320)
Portmanteau Test (χ^2)	4.0931 (0.9817)	8.2856 (0.7624)

Note: *, **, and *** indicates the statistical significance at the 10%, 5% and 1% significance level, respectively.

The coefficient findings and model fit tests for the two-regime Markov regime change models, Model 1 and Model 2, are presented in Table 3. Both models separate the regime change periods into periods when the exchange rate increases and remains stable. While Regime 0 is when the exchange rate increases significantly, Regime 1 represents more stable periods. The *EXR(-1)* variable eliminates the autocorrelation problem in the model. It gives a clue that the exchange rate is significantly and positively affected by the exchange rate levels of the previous period. According to the results of Model 1, the effect of *EPU* on the exchange rate in Regime (0) is positive and significant. This shows that during periods of increase, economic uncertainty creates a tendency towards foreign exchange in the markets and causes the local currency to lose value. Uncertainties generally reduce investor confidence and increase foreign exchange demand by triggering speculative movements. The effect of interest rates on the exchange rate is quite strong and significant. The cost increase can generally explain the increase in interest rates during the periods of increase, the change in investors' risk perception, and the effect of capital movements. This shows that the impact of interest policy on the exchange rate is more complex and intense in uncertain periods. The dependence of the exchange rate on its past values is relatively high. This shows that the exchange rate is affected by past shocks during the periods of increase. Such dependence supports the expectation of a continuous increase in the market in the short term, which can create a "self-reinforcing cycle". When the results in Regime (1) are examined, the effect of *EPU* on the exchange rate is negative but insignificant. This shows that uncertainty does not pressure the exchange rate in stable periods, and the market is more resilient. It can be considered that there is an economic structure where the markets can tolerate political uncertainties. The effect of interest rates on the exchange rate is weak and significant. This shows that changes in interest rates do not affect the exchange rate much in stable periods. The lagged exchange rate coefficient is high and significant. This indicates that the exchange rate is significantly affected by its past values, but this effect is slightly weaker than in the periods of increase. The findings are similar to the results of Nilavongse et al. (2020), Balcilar et al. (2016); Abid and Rault (2020).

When the results of Model 2 are examined, a one-unit increase in the World Uncertainty Index (*WUI*) in Regime (0) is associated with a significant increase in the exchange rate. This shows that global uncertainties create intense pressure on the Turkish Lira during periods of increase. In particular, dependence on external financing may cause such effects to be more pronounced. The increase in interest rates has a positive impact on the exchange rate. This may imply that interest rate policies are ineffective in controlling the exchange rate during periods of increase and may even affect the exchange rate upwards. This situation can be explained by the fact that interest rate increases increase the pressure on the local currency by increasing investment costs. In addition, the dependence of the exchange rate on its past values is strong, and this dependence increases with the acceleration effect during periods of increase. When the results of Regime (1) are examined, the impact of global uncertainties is weaker in periods when the exchange rate remains more stable compared to periods of increase. This shows that the market is more resilient, and global risks have a limited effect on the exchange rate. The impact of interest rate policies on the exchange rate is quite limited. This shows that the markets are less sensitive to interest rate changes in such periods. The findings are similar to the results of Şit (2024).

However, although the negative effects of uncertainties on exchange rates are at the forefront in the study, it should also be considered that such uncertain environments can create opportunities for some market actors. Investors operating in financial markets, in particular, can develop arbitrage and short-term profit strategies by taking advantage of the volatility caused by uncertainty. Exporters and importers trading in the foreign exchange market can provide risk management by implementing hedge strategies against uncertainty through derivative products (forward, option, etc.) and gain a position advantage. In addition, according to real option theory, uncertainty gives firms timing flexibility by postponing investment decisions and can create option value in long-term strategic

planning. In this context, economic policy and global uncertainties are not only threats, but also can turn into opportunities for certain economic actors when evaluated with the right strategies.

When the results of Model 1 and Model 2 are compared, the effect of the world uncertainty index is greater than the economic policy uncertainty in periods when there are increases in the exchange rate. Since the World Uncertainty Index covers economic and political risks at the global level, it provides a broader risk indicator for developing countries. An increase in global risk perception in countries like Türkiye may lead to capital outflows and, thus, an increase in foreign exchange demand. In particular, the rapid effects of global uncertainties, such as the US Federal Reserve (FED) interest rate decisions and global trade wars on the exchange rate, may cause the world uncertainty index more effective than the EPU. While economic policy uncertainty generally focuses on domestic economic factors, external financing problems such as foreign exchange reserves are more affected by global uncertainties. In addition, the LR linearity test for both models indicates that the models are nonlinear and that using two regimes is appropriate. The AIC and log-likelihood statistics, which are very close to each other, may indicate that the models do not have any superiority over each other. Additionally, the ARCH and Portmanteau tests in the models show that there are no heteroscedasticity and autocorrelation problems in the model, respectively.

Table 4. Transition Probabilities Matrix

	Model 1		**Model 2**	
	Regime 0, t	*Regime 1, t*	*Regime 0, t*	*Regime 1, t*
Regime 0, t+1	0.82303	0.066790	0.89207	0.052920
Regime 1, t+1	0.17697	0.93321	0.10793	0.94708

Table 4 shows the regime transition probability matrices for Markov regime models. The probability of staying in Regime 0 in Model 1 is 0.82303 and 0.89207 in Model 2. The probability of staying in Regime 1 is 0.93321 in Model 1 and 0.94708 in Model 2. These high probability values indicate high persistence in the regimes for both Model 1 and Model 2.

In addition, the structural properties of the estimated Markov Regime Switching Models are also evaluated. First of all, when the transition probability matrices are examined, it is seen that the transition probabilities between regimes are greater than zero in both models (for example, the probability of transition from Regime 0 to Regime 1 in Model 1 is 0.177, and the reverse transition probability is 0.067). This situation shows that the system can switch between all regimes and reveals that the models are irreducible. In addition, since the diagonal elements of the transition probability matrix are in the range of $0<P_{ii}<1$, it can be said that the system is not periodic and can reach a constant probability distribution over time. This shows that the models are ergodic. Additionally, the Markov process used in the model is time-homogeneous, meaning that the transition probabilities remain constant over time. In this case, it is possible to transition to any regime from another with positive probability, not only in one step but also in multiple steps. Therefore, the system exhibits a structure that enables transition between all regimes in a finite number of steps in the classical sense. In this respect, it satisfies the conditions of irreducibility and ergodicity. These structural features support the long-term equilibrium reachability and statistical validity of the model. On the other hand, the stability property is evaluated by examining the autoregressive coefficients (EXR(-1)) in each regime. In both models, the fact that these coefficients are above 1 (for example, 1.213 in Regime 0 and 1.026 in Regime 1 for Model 1) reveals that the series are not stationary within the regime and the system exhibits technical instability. However, this situation aligns with the nature of the Markov Regime Change Model. Because these models can reflect short-term instabilities, especially in explaining structures such as the economy, which experience transitions between periods of crisis and stability (Hamilton, 1989; Krolzig, 2000). In this context, the non-linear structure offered by the model contributes to the meaningful interpretation of economic variables together with time-dependent regime transitions.

Table 5. Regime Classifications

Model 1			**Model 2**		
Period	**Quarters**	**Avg. Prob**	**Period**	**Quarters**	**Avg. Prob**
Regime (0)					
2018(2)- 2019(4)	7	0.953	2018(2)- 2022(3)	18	0.981
2021(1)- 2022(3)	7	0.998	2023(2)- 2024(1)	4	0.980
2023(2)- 2024(1)	4	0.966			
Average duration	18 quarters (27.27%)		Average duration	22 quarters (33.33%)	
Regime (1)					
2008(2)- 2018(1)	40	0.997	2008(2)- 2018(1)	40	0.994
2020(1)-2020(4)	4	0.926	2022(4)- 2023(1)	2	0.994
2022(4) -2023(1)	2	0.723	2024(2)-2024(3)	2	0.909
2024(2)- 2024(3)	2	0.964			
Average duration	48 quarters (72.73%)		Average duration	44 quarters (66.67%)	

The last significant output of Markov regime-switching models is related to regime classification. The duration matrices containing the historical classification of regimes are presented in Table 5. The durations in different regimes in both models appear to be close. The average duration in Regime 0, which represents the phases of exchange rate increase, is 18 quarters in Model 1, while it is 22 quarters in Model 2. The average duration for Regime 1 is 48 quarters in Model 1, while it is 44 quarters in Model 2.

The timing of the regimes in Table 5 largely coincides with significant economic and political developments in the Turkish economy. When the periods represented by Regime 0, during which increases in the exchange rate were observed, the 2018 foreign exchange crisis, the global uncertainties created by the COVID-19 pandemic, and the heterodox monetary policies implemented after 2021 are noteworthy. During these periods, increasing EPU and WUI values increased the pressure of domestic and external risks on the exchange rate, causing rapid depreciation in the TL. On the other hand, Regime 1 periods exhibit a more stable outlook; for example, between 2008 and 2018, relatively more predictable monetary policies were implemented and favorable global liquidity conditions. Therefore, not only statistical but also policy-based interpretation of regime transitions contributes to interpreting the findings in the economic context.

4. Conclusion

This study examines the effects of economic policy uncertainty and the world uncertainty index on the exchange rate in the Turkish economy during the period 2008Q1-2024Q3. For this purpose, two different models were estimated using the Markov regime-switching regression model. Economic Policy Uncertainty was used in the first model, while the World Uncertainty Index was used in the second model. In addition, the TL deposit interest rate was used as an exogenous variable to represent interest rates.

The analyses conducted using the Markov regime change model were examined with two periods and two separate models, Regime 0 and Regime 1. Regime 0 is when there are significant increases in the exchange rate, while Regime 1 represents more stable periods. In Model 1, where economic policy uncertainty is used in Regime 0, the positive and significant effect of *EPU* on the exchange rate indicates that economic uncertainty creates a tendency towards foreign exchange in the markets and causes the local currency to lose value. Since *EPU* strongly affects the exchange rate during periods of increase, a transparent and predictable economic policy should be implemented. The government and the central bank should develop structural reforms and clear communication strategies that will give confidence to the markets. For example, controlling budget deficits, diversifying external financing sources, and eliminating political uncertainties may be necessary.

Since the effect of interest rates on the exchange rate is strong during periods of increase, interest rate increases should be planned carefully during such periods. In particular, interest rate increases should be implemented only by supporting them with other policy tools to stabilize short-term capital movements (for example, effective use of foreign exchange reserves). Considering the dependence of the exchange rate on past movements, regulatory measures can be taken to limit speculative movements in the market during periods of increase. The results of Model 2 in the same regime show that a one-unit increase in the World Uncertainty Index (*WUI*) is associated with a significant increase in the exchange rate. Considering the strong impact of world uncertainties on the exchange rate, Türkiye needs to increase its foreign exchange reserves and reduce external borrowing to become more resilient to external shocks. Additionally, strategies to diversify trade and investment partners can be implemented to mitigate the effects of global uncertainties. The positive effect of interest rates on the exchange rate during periods of increase indicates the limited impact of traditional monetary policies. Therefore, interest policies should be supported by foreign exchange reserve management and macroprudential measures.

The results of Model 1 in the Regime 1 period show that the uncertainty effect on the exchange rate is low when the exchange rate is more stable. Since the uncertainty effect on the exchange rate is low in stable periods, these periods are suitable for long-term economic reforms. Investment incentives, infrastructure projects, and industrial policies can support economic growth. Since the effect of interest rates on the exchange rate is weak in stable periods, monetary policy may not be used as a primary tool. Instead, measures to increase market liquidity and fiscal policies can be implemented. Increasing foreign exchange reserves in such stable periods can serve as a buffer to be used in periods of increase. Although the impact of world uncertainties is weaker in stable periods, their effect on the exchange rate continues. During this period, Türkiye needs to accelerate economic reforms, increase market confidence, and strengthen its immunity against global uncertainties. Stable periods offer opportunities for implementing long-term policies to increase exchange rate stability. For example, diversification of the production structure and policies encouraging the local currency can reduce dependence on foreign exchange markets.

In this context, it is important to discuss more concrete policy tools to ensure exchange rate stability in developing countries like Türkiye. Firstly, regulations encouraging the channeling of export revenues to the Central Bank can be strengthened to increase foreign exchange reserves. Additionally, foreign exchange transactions of public institutions and state-owned enterprises can be aligned with reserve management. In addition, selective capital controls or macroprudential measures can be put on the agenda to reduce the vulnerabilities created by short-term capital movements in the economy. In periods of intense uncertainty, policy clarity and predictability can be increased, and market confidence can be strengthened. In this context, fiscal policies and central bank communication should be carried out in coordination; predefined policy responses to periods of uncertainty should be openly announced to the public. In addition, structural steps such as digital TL projects aimed at increasing the use of domestic currency and bilateral agreements encouraging trade in TL can also support exchange rate stability by limiting foreign exchange demand.

References

Abid, A., and Rault, C. (2020). On the exchange rate and economic policy uncertainty nexus: A panel VAR approach for emerging markets. *CESifo Working Papers*, No. 8189. http://dx.doi.org/10.2139/ssrn.3570291

Ahir, H., Bloom, N., and Furceri, D. (2018). The world uncertainity index. *SSRN 3275033.* http://dx.doi.org/10.2139/ssrn.3275033

Aimer, N. (2021). Economic policy uncertainty and exchange rates before and during the COVID-19 pandemic. *Journal of Ekonomi*, *3*(2), 119-127. https://tinyurl.com/rtdnvf25

Al-Thaqeb, S. A., Algharabali, B. G., and Alabdulghafour, K. T. (2022). The pandemic and economic policy uncertainty. *International Journal of Finance & Economics*, *27*(3), 2784-2794. https://doi.org/10.1002/ijfe.2298

Baker, S. R., Bloom, N., and Davis, S. J. (2016). Measuring economic policy uncertainty. *The Quarterly Journal of Economics*, *131*(4), 1593-1636. https://doi.org/10.1093/qje/qjw024

Baker, S. R., Bloom, N., Davis, S. J., and Terry, S. J. (2020). Covid-induced economic uncertainty. *National Bureau of Economic Research, Working Paper 26983.* https://doi.org/10.3386/w26983

Balcilar, M., Gupta, R., Kyei, C., and Wohar, M. E. (2016). Does economic policy uncertainty predict exchange rate returns and volatility? Evidence from a nonparametric causality-in-quantiles test. *Open Economies Review*, *27*, 229-250. https://doi.org/10.1007/s11079-016-9388-x

Basu, S., and Bundick, B. (2017). Uncertainty shocks in a model of effective demand. *Econometrica*, *85*(3), 937-958. https://doi.org/10.3982/ECTA13960

Beckmann, J., and Czudaj, R. (2017). Exchange rate expectations and economic policy uncertainty. *European Journal of Political Economy*, *47*, 148-162. https://doi.org/10.1016/j.ejpoleco.2016.06.003

Bildirici, M. E., Alp, E. A., Ersin, Ö. Ö., and Bozoklu, Ü. (2010). *İktisatta kullanılan doğrusal olmayan zaman serisi yöntemleri.* İstanbul: Türkmen Kitabevi.

Bloom, N. (2009). The impact of uncertainty shocks. *Econometrica*, *77*(3), 623-685. https://doi.org/10.3982/ECTA6248

Caldara, D., and Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review*, *112*(4), 1194-1225. https://doi.org/10.1257/aer.20191823

Chatterjee, U. (2023). World uncertainty indices, financial markets, and US GDP growth. *Journal of Accounting and Finance*, *23*(4), 20-30. https://doi.org/10.33423/jaf.v23i4.6447

D'Mello, R., and Toscano, F. (2020). Economic policy uncertainty and short-term financing: The case of trade credit. *Journal of Corporate Finance*, *64*, 101686. https://doi.org/10.1016/j.jcorpfin.2020.101686

Fang, L., Chen, B., Yu, H., and Qian, Y. (2018). The importance of global economic policy uncertainty in predicting gold futures market volatility: A GARCH-MIDAS approach. *Journal of Futures Markets*, *38*(3), 413-422. https://doi.org/10.1002/fut.21897

Gupta, R., Lahiani, A., Lee, C. C., and Lee, C. C. (2019). Asymmetric dynamics of insurance premium: the impacts of output and economic policy uncertainty. *Empirical Economics*, *57*, 1959-1978. https://doi.org/10.1007/s00181-018-1539-z

Güney, P. Ö. (2020). Ekonomik politika belirsizliği ve döviz kuru oynaklığı. *Bankacılar Dergisi*, *114*, 3-17. https://www.tbb.org.tr/bankacilik/arastirma-ve-yayinlar/bankacilar-dergisi/pdf/827

Gürsoy, S. (2021). Küresel ekonomik politik belirsizliğin (GEPU) döviz kuru, enflasyon ve borsa etkisi: Türkiye'den kanıtlar. *Journal of Vocational and Social Sciences of Turkey*, *3*(5), 120-131. https://doi.org/10.46236/jovosst.877608

Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. *Econometrica: Journal of the Econometric Society*, *57*(2) 357-384. https://doi.org/10.2307/1912559

Hong, Y., Zhang, R., and Zhang, F. (2024). Time-varying causality impact of economic policy uncertainty on stock market returns: Global evidence from developed and emerging countries. *International Review of Financial Analysis*, *91*, 102991. https://doi.org/10.1016/j.irfa.2023.102991

Jurado, K., Ludvigson, S. C., and Ng, S. (2015). Measuring uncertainty. *American Economic Review*, *105*(3), 1177-1216. https://doi.org/10.1257/aer.20131193

Karagöl, V. (2023). Türkiye'de küresel finansal kriz sonrası nakit ikamesinin seyri: Markov rejim değişim modelleri. *İktisadi İdari ve Siyasal Araştırmalar Dergisi*, *8*(Cumhuriyet'in 100. Yılında Türkiye'nin Sosyo-Ekonomisi Özel Sayısı), 39-52. https://doi.org/10.25204/iktisad.1340538

Krol, R. (2014). Economic policy uncertainty and exchange rate volatility. *International Finance*, *17*(2), 241-256. https://doi.org/10.1111/infi.12049

Krolzig, H. M. (2000). *Predicting Markov-switching vector autoregressive processes* (pp. 1-30). Oxford: Nuffield College. https://tinyurl.com/4dztp3hd

Leduc, S., and Liu, Z. (2016). Uncertainty shocks are aggregate demand shocks. *Journal of Monetary Economics*, *82*, 20-35. https://doi.org/10.1016/j.jmoneco.2016.07.002

Li, Z., Dong, H., Huang, Z., and Failler, P. (2018). Asymmetric effects on risks of Virtual Financial Assets (VFAs) in different regimes: A Case of Bitcoin. *Quantitative Finance and Economics*, *2*(4), 860-883. https://doi.org/10.3934/QFE.2018.4.860

Liming, C., Ziqing, D., and Zhihao, H. (2020). Impact of economic policy uncertainty on exchange rate volatility of China. *Finance Research Letters*, *32*, 101266. https://doi.org/10.1016/j.frl.2019.08.014

Liu, N., and Gao, F. (2022). The world uncertainty index and GDP growth rate. *Finance Research Letters*, *49*, 103137. https://doi.org/10.1016/j.frl.2022.103137

Nilavongse, R., Michał, R., and Uddin, G. S. (2020). Economic policy uncertainty shocks, economic activity, and exchange rate adjustments. *Economics Letters*, *186*, 108765. https://doi.org/10.1016/j.econlet.2019.108765

Perron, P. (1989). The Great Crash, the oil price shock, and the unit root hypothesis. *Econometrica, 57*(6), 1361-1401. https://doi.org/10.2307/1913712

Perron, P., and Vogelsang, T. J. (1992). Nonstationarity and level shifts with an application to purchasing power parity. *Journal of Business & Economic Statistics, 10*, 301–320. https://doi.org/10.1080/07350015.1992.10509907

Saka Ilgin, K. (2022). Ulusal ekonomik politika belirsizliği ile borsa endeksleri arasındaki ilişkinin incelenmesi: Seçilmiş Avrupa ülkeleri için ampirik bir analiz. *Journal of Economic Policy Researches*, *9*(2), 455-474. https://doi.org/10.26650/JEPR1074582

Shahzad, S. J. H., Raza, N., Balcilar, M., Ali, S., and Shahbaz, M. (2017). Can economic policy uncertainty and investors sentiment predict commodities returns and volatility?. *Resources Policy*, *53*, 208-218. https://doi.org/10.1016/j.resourpol.2017.06.010

Şit, M. (2024). Türkiye ekonomisinde belirsizlik endeksi- CDS primleri- döviz kuru- TÜFE arasındaki ilişkinin amprik analizi. *Turkish Business Journal*, *9*(5), 19-32. https://doi.org/10.51727/tbj.1458957

Tesfamichael, S. G. and Shiferaw, Y. A. (2019). A Markov regime-switching regression approach to modelling NDVI from surface temperature and soil moisture. *International Journal of Remote Sensing, 40*(24), 9352-9379. https://doi.org/10.1080/01431161.2019.1630783

Tombak, F. (2024). Dünya belirsizlik indeksi altında Türkiye ticaret dengesi: Bir Markov rejim değişim analizi. *Uluslararası Yönetim İktisat ve İşletme Dergisi*, *20*(3), 687-705. https://doi.org/10.17130/ijmeb.1445457

Yu, M. (2023). Forecasting sector-level stock market volatility: The role of world uncertainty index. *Finance Research Letters*, *58*, 104568. https://doi.org/10.1016/j.frl.2023.104568

Zhou, Z., and Zhang, F. (2023). A study of the impact of economic policy uncertainty on exchange rate volatility. *SSRN 4510874*. http://dx.doi.org/10.2139/ssrn.4510874