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## Article

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## Article

# The Effects of Geopolitical Uncertainties on Growth: Econometric Analysis on Selected Turkic Republican Countries and Neighboring States

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**Abstract:** The paper aims to analyze the effect of geopolitical uncertainties on growth in the countries of selected Turkic republics and neighboring states which are experiencing geopolitical uncertainty, especially regarding their position in the global economy. This study investigates how uncertainties quantified by geopolitical risk indices for the global economy (GE), the United States (US), and the Russian Federation (RS) influence the economic growth of the Turkic republics and neighboring states which implement open macroeconomic policies. This analysis employs panel data techniques that consider the interdependence between cross-sectional units. The selected countries included in the study are Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan, Mongolia, and Uzbekistan. The results show the existence of constricting effects on the economic growth performance of selected countries.

**Keywords:** geopolitical uncertainties; economic growth; panel NARDL; Turkic republics and neighboring states



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## 1. Introduction

In recent decades, geopolitical uncertainties driven by major powers have significantly influenced the global economy. Countries with open macroeconomic policies, especially the Turkic republics and their neighboring states, are particularly vulnerable to these external shocks due to their reliance on foreign trade and investment. Thus, it is crucial to understand the extent to which geopolitical risks impact economic growth in these regions.

This study aims to answer the following question: How have global, American, and Russian geopolitical risks affected the economic growth of selected Turkic republics and neighboring states with open macroeconomic policies between 1995 and 2022? The study has two main objectives: (1) to analyze the evolution of geopolitical risk indices and their relationship with the economies in question, and (2) to assess the impact of these risks on economic growth using panel data econometric methods.

A key contribution of our study is its unique regional focus, distinguishing it from the existing literature that examines geopolitical risks in a broader context. We address a critical gap in the field by analyzing the effects of geopolitical uncertainties on Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan, Mongolia, and Uzbekistan. Additionally, we use advanced econometric techniques, including linear and nonlinear autoregressive distributed lag (L-ARDL and NL-ARDL) models, to rigorously evaluate the

dynamic relationship between geopolitical risks and economic performance while accounting for cross-sectional dependencies.

The study is structured as follows: After reviewing the relevant literature, we outline the research scope and dataset. A detailed discussion of the econometric methodology and findings follows this. The paper concludes with a summary of key insights and implications.

## 2. Literature Review

Economic growth is commonly defined as a sustained increase in real per capita income (Ünsal, 2007, p. 11). This process is influenced by numerous factors, among which the country's level of geopolitical risk plays a significant role. Thus, an increase in geopolitical risk creates uncertainties in the investment environment, which in turn has a negative impact on economic growth (Doğan & Doğan Özarıslan, 2021, p. 979).

Uncertainty is a broad phenomenon that includes the possibilities for the coming years in the minds of market participants, management, households, and policymakers. It can be explained from a wide perspective, ranging from micro- and macro-developments to non-economic events. Since the 2008–2009 global financial crisis, economic uncertainty has gained renewed attention, prompting increased interest in understanding its impact on economic performance. The recognition of uncertainty as a key factor contributing to the global crisis and the subsequent slow recovery has further reinforced this focus (Görgün, 2020, p. 23). Economic uncertainty plays a critical role in shaping economic activity, influencing the behavior of households and firms alike. In recent years, the role of economic policy in steering macroeconomic fluctuations has become one of the most debated topics (Abakah et al., 2020, p. 2). Discussions surrounding the effects of uncertainty on the economy date back at least to Keynes's (1936) General Theory. According to John Maynard Keynes' world of thought, the future of the economic structure is determined by the decisions people make based on their animalistic instincts in an environment of uncertainty. In other words, whether macroeconomic activity is fast, slow, or stable may change based on the optimistic or pessimistic attitudes of the decision-making units when it comes to uncertainty (Dařtan & Karabulut, 2022, p. 134).

In recent years, a key concern in discussions about the global economic outlook has been the prolonged economic stagnation that originated in the 2008 crisis and has deepened over time (Yalçınkaya & Aydın, 2017, p. 419). Following the global economic downturn and the subsequent Great Recession, economic growth has remained sluggish, failing to reach its potential. However, a period of recovery began in 2017 (Yalçınkaya, 2019, p. 56), only to be disrupted by the COVID-19 pandemic that commenced in 2019.

One of the pioneering efforts in a quantifying uncertainty and its economic impact is the Economic Policy Uncertainty (EPU) Index developed by Baker et al. (2012) for the United States (USA) (Gemici, 2020, p. 355). Subsequently, Davis (2016) expanded upon this methodology to develop the Global Economic Policy Uncertainty (GEPU) Index (Gürsoy, 2021, p. 121). The EPU Index serves as a comprehensive measure of economic and political uncertainties, enabling an analysis of their simultaneous effects on macroeconomic variables. Following the contributions of Baker et al. (2012), the literature on this subject is expanding rapidly. Reflecting this trend, research has increasingly focused on how geopolitical uncertainties, similar to those observed in recent global economic developments, can be measured and analyzed using similar methodologies (Yalçınkaya, 2019, p. 59).

The current global economic landscape is characterized by a multitude of risks and uncertainties, ranging from trade and financial instabilities to geopolitical and environmental challenges (Eriçok, 2020, p. 35). These risks and uncertainties have affected the

global economy with developments in different time periods. Since the beginning of the 2000s, the global economy has been shaped by significant events, including the September 11 assaults, the US–Iraq war, and the Global Financial Crisis. Subsequent years have also seen crucial economic, political, and geopolitical events, such as the Arab Spring, the European Debt Crisis, the Migrant Crisis, trade wars between the US and China, Brexit negotiations, and the most recent US elections (Daştan & Karabulut, 2022, p. 134). More recently, the COVID-19 pandemic deeply affected the world economy, and the ongoing Russia–Ukraine war and Israel’s attacks on Gaza are also contributing to uncertainty. Additionally, long-term challenges such as climate change and food security continue to exacerbate economic instability.

All these developments create uncertainty in the global economic circumstances, functioning as risk factors that can destabilize financial markets. Rising global uncertainty often leads to increased financial markets volatility, capital outflows, and higher investment opportunity costs due to restricted access to financing. It also discourages risk-taking among investors, thereby affecting consumption, savings, and investment decisions (Rice et al., 2018, p. 3). Beyond economic uncertainty, another key factor affecting investment decisions—particularly for international businesses—is political risk, which arises from government actions that create instability. A closely related phenomenon, geopolitical risk (GPR), refers to risks stemming from political conflicts, institutional struggles, and anti-democratic processes within or between nations (Doğan & Doğan Özarslan, 2021, p. 980). Countries experiencing high geopolitical risk often face weakened real economic activity, as heightened uncertainty deters investments and disrupt financial markets (Doğan & Afşar, 2021, p. 690).

Caldara and Iacoviello (2018) introduced the Geopolitical Uncertainty (GPU) Index, which was developed to measure the impact of events causing geopolitical uncertainty in the global economy, using the methodology of the EPU Index. The GPU Index is designed to gauge the effects of geopolitical developments that generate uncertainty, such as wars, terrorist acts, and interstate conflicts by considering the power struggles of countries in regions where conflicts remain unresolved through peaceful and democratic processes (Caldara & Iacoviello, 2018, pp. 2–3).

A review of the literature reveals a vast number of studies on the factors influencing economic growth. However, research specifically addressing the impact of geopolitical risk on economic growth is notably sparse (see Cheng & Chiu, 2018; Das et al., 2019; Akadiri et al., 2020; Doğan & Doğan Özarslan, 2021). This study is expected to make a significant contribution to this area of research. While existing studies typically explore the effects of economic and political uncertainties on macroeconomic variables, those examining the impact of geopolitical uncertainties are exceedingly limited. Moreover, there is a growing body of research on the geopolitical risk index (see Akadiri et al., 2020; Sharif et al., 2020; Bouri et al., 2020; Alptürk et al., 2021). Numerous studies have specifically investigated the impact of geopolitical risk on stock markets (Rawat & Arif, 2018; Enamul Hoque et al., 2019; Bezgin, 2019; Das et al., 2019; Hoque & Zaidi, 2020; Doğan & Afşar, 2021).

Soybilgen et al. (2019) examined the direct relationship between geopolitical risk and economic growth, concluding that a 10-point increase in the geopolitical risk index led to a 0.2–0.4% decrease in the real Gross Domestic Product (GDP) growth rate. Caldara and Iacoviello (2018), in their study on the US economy for the period 1985–2016, using the EPU and GPU indices, found that geopolitical uncertainties impact various macroeconomic variables, including the industrial production index, employment, interest rates, foreign trade, and the economic confidence index. Their analysis revealed that these uncertainties have significant short- and long-term effects on macroeconomic variables, generally with negative implications. In the study by Doğan and Doğan Özarslan (2021), the focus was on

the so-called “fragile five” countries between 1985 and 2017. They employed the Extended Average Group Estimator methodology with panel data. The study estimated the relationship between real GDP per capita, the geopolitical risk index, fixed capital investments, and the labor force to determine the impact of geopolitical risk on economic growth. The empirical results indicated that geopolitical risk negatively and statistically significantly affects economic growth in the “fragile five” countries. Additionally, the study revealed that both the labor force and fixed capital investments have a positive and statistically important effect on economic growth.

Previous studies have shown that geopolitical risks significantly influence economic growth, and a summary of the main papers relevant to this subject is presented in Table 1.

**Table 1.** Empirical studies on geopolitical risks and their impact on the economy.

Reference	Objective	Type of Analysis
Jawadi et al. (2024)	Analysis of the impact of geopolitical risks on euro-area economies for the period 2003–2024.	ARDL—autoregressive distributed lag stationarity model
Pal et al. (2024)	Geopolitical risk assessment as an inhibitor on productive capacity in 20 OECD countries in the period 2000–2021.	Panel threshold regression
Jha et al. (2024)	Measuring the impact of geopolitical risk for 41 countries in Central and Eastern Europe between 2000 and 2020.	FGLS (feasible generalized least square)
Bossmann et al. (2023)	Investigating the asymmetric effects of political uncertainties, geopolitical risk, and market sentiment on different economic sectors for the period 2013–2022.	Causality-in-quantile test quantile regression
Khan et al. (2023)	Testing the causal relationship between geopolitical risks and economic security in several Central and Eastern European countries between 2000 and 2022.	Panel bootstrap Granger causality
Doğan and Doğan Özarıslan (2021)	Analysis of the impact of geopolitical risk on economic growth in the countries known as the “fragile five”: Turkey, Brazil, India, South Africa, and Indonesia between 1985 and 2017.	Panel data model
Yalçınkaya and Çelik (2021)	Analysis of the impact of uncertainties created by economic, political, and geopolitical (EPG) events on the global economy on US economic growth.	The extension of Cobb–Douglas production function
Alptürk et al. (2021)	The investigation of the relationship among geopolitical risk index and CDS for Turkey between March 2010 and October 2020.	The Lee–Strazicich unit root test; the Hatemi-J causality test
Sharif et al. (2020)	Analyzing the impact of geopolitical risk on economic growth in fragile emerging economies, compared to G7 countries.	Panel estimates
Akadiri et al. (2020)	The effects of geopolitical risk on economic growth and tourism sector in Turkey.	The Granger causality test
Soybilgen et al. (2019)	Investigating the impact of geopolitical risks on the real GDP growth rate for 18 emerging economies between 1986 and 2016.	Panel regression
Cheng and Chiu (2018)	Analysis of the impact of geopolitical shocks on economic cycles in emerging economies for 38 countries.	Vector autoregressive (VAR) models
Caldara and Iacoviello (2018)	Analysis of the simultaneous effects of EPJ uncertainties on macroeconomic variables such as industrial production index, employment, interest rates, foreign trade, and economic confidence index.	Structural vector autoregressive (VAR) models

As can be seen from Table 1, although numerous studies have analyzed the impact of geopolitical risks on emerging economies, research specifically targeting the Turkic republics and neighboring states is limited. In addition, most existing analyses focus on large economies or global aggregate effects, without exploring regional differences. The most important contribution and original value of this study to the literature is its scope (sample) and regional focus. This research covers selected Turkic republics and related/neighborhood countries such as Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan, Mongolia, and Uzbekistan. The regional focus provides an original contribution to the literature. In addition to this, the econometric analyses (L-ARDL and NL-ARDL) used in this study are also considered contributions to the literature.

Through the literature review analysis, it can be seen that advanced and emerging economies react differently to geopolitical risks. While in advanced economies there may be a positive impact of geopolitical risk on economic growth, in the case of emerging economies, the impact is negative. In this context, the main hypotheses are formulated ( $H_0$  and  $H_1$ ):

**$H_0$  (null hypothesis).** *Geopolitical risks do not have a significant impact on the economic growth of the Turkic republics and neighboring states that implement open macroeconomic policies.*

**$H_1$  (alternative hypothesis).** *Geopolitical risks have a significant and negative impact on the economic growth of the Turkic republics and neighboring states.*

From the main alternative hypothesis, two specific secondary hypotheses emerge, namely:

**$H_{1a}$ .** *Increased global geopolitical risk has a more pronounced negative effect on economic growth in small and open economies compared to those more integrated into global economic chains.*

**$H_{1b}$ .** *Countries with a higher degree of economic openness (outward openness) are more sensitive to geopolitical uncertainty shocks than more closed economies.*

### 3. Methodology

This section empirically examines the impact of uncertainties, as measured by geopolitical risk (GPR) indices for the global economy (GE), the United States (US), and the Russian Federation (RS), on the economic growth performance of selected Turkic republics and neighboring states during the period from 1995 to 2022. The analysis employs panel data techniques that consider the interdependence between cross-sectional units. The selected countries included in the study are Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan, Mongolia, and Uzbekistan. The remaining countries are not included in the analysis due to data limitations.

The table below presents the definition, abbreviation, and data source for the variables used in the study.

Of the variables in Table 2, the CI variable is constructed by the author using nominal fixed capital investments, the GDP deflator (2015), and mid-year total population series with USD prices from the WDI database. The EL variable is created by dividing the total labor force series from the WDI database by the mid-year total population series from the same source. The XM variable is derived by dividing the sum of the values of nominal goods and services exports and imports, calculated in USD prices from the WDI database, by the nominal GDP series values, also in USD prices, obtained from the same data source.

**Table 2.** Description of indicators used in the model.

Abbreviating Indicators	Definition of Indicators	Data Source of Indicators
GDP	Real GDP per Capita (2015-USD)	The World Bank (WB) World Development Indicators (WDI)
CI	Real Fixed Capital Investments Per Capita (2015-USD)	
EL	Total Workforce	
XM	Outward Openness	
GPR-GE	Global Geopolitical Risk Index	Economic Policy Uncertainty-2023 ( <a href="http://www.PolicyUncertainty.com">www.PolicyUncertainty.com</a> ) (accessed on 12 January 2025)
GPR-US	Geopolitical Risk Index of the United States	
GPR-RS	Geopolitical Risk Index of the Russian Federation	

The four economic variables in Table 2 (GDP, CI, EL, XM) provide a comprehensive understanding of how geopolitical risks may influence economic growth, and below is a brief justification:

- GDP is the main indicator of economic growth and the well-being of the population. The impact of geopolitical uncertainties on this indicator reflects how a country's economy withstands or reacts to external shocks.
- CI allows the assessment of how external shocks influence investment decisions and, implicitly, the potential for economic growth.
- EL reflects the size of the active population, having a direct impact on the potential for economic growth. Declining investment and trade due to uncertainty can lead to reduced demand for labor and slowed economic growth.
- XM measures the integration of the analyzed economies in international trade. Previous studies show that geopolitical uncertainties can lead to increased protectionism and decreased trade flows, affecting economic growth.

Upon analyzing the results in the Table 3, it is obvious that none of the series in the defined models exhibit a normal distribution within the research date range. While the CI variable is not normally distributed at 10% and XM variable is not normally distributed at a 5% significance level, all other variables are at the 1% significance level. Furthermore, the minimum, maximum, and standard deviation values are clearly presented in the Table 3. This study followed the methodology steps outlined below to analyze the effect of geopolitical uncertainties on economic growth.

**Table 3.** Descriptive statistics of indicators.

Statistics	Average	Median	Minimum	Maximum	Std. Dev.	Skewness	Kurtosis	JB
GDP	7.8630	7.8562	5.9496	9.3955	0.9352	−0.0818	1.8830	11.460
CI	8.1870	8.4012	1.7066	13.031	2.1056	−0.3804	3.1413	5.3922
EL	3.7055	3.7328	3.1954	3.9795	0.2027	−0.8518	3.1247	26.238
XM	84.089	80.152	5.3837	181.59	31.522	0.4493	2.9469	7.2927
GPR	96.540	90.082	50.914	176.30	29.690	1.3034	4.3340	77.157
GPR-US	2.2245	1.8914	1.0539	4.3497	0.8060	1.3272	4.2635	77.781
GPR-RS	0.7020	0.5470	0.3411	1.1407	0.2170	0.6629	2.4126	18.933
Observation	217	217	217	217	217	217	217	217

In this study, the basic form of the econometric model, estimated using panel data analysis methodology which accounts for the cross-sectional dependence of the panel units, along with the control variables CI, EL, XM, GPR-GE, GPR-US, and GPR-RS, to

measure the effect of geopolitical uncertainties on economic growth, is expressed in Equation (1) below:

$$\text{Model : } \text{GDP}_{it} = \alpha + \beta_1 \text{CI}_{it} + \beta_2 \text{EL}_{it} + \beta_3 \text{XM}_{it} + \beta_4 \text{GPR}_{it} + \mu_{it} \quad (1)$$

Since the study utilizes three different geopolitical uncertainty indices—GPR-GE, GPR-US, and GPR-RS—three distinct variations in the basic model defined in Equation (1) are estimated to address multicollinearity issues. The terms  $(\alpha)$ ,  $(\beta)$ , represent the constant and slope parameters and  $(u)$  represents error term, while  $(i)$  and  $(t)$  denote the cross-section and time dimensions of the panel. In this study, the basic model in Equation (1) is estimated using both linear (L) and nonlinear (NL) panel ARDL (autoregressive distributed lag) methodologies to assess the impact of geopolitical uncertainties on economic growth.

In this context, the panel L-ARDL and NL-ARDL models are applicable, assuming that the model indicators are stationary at different degrees  $[I(0)]$ - $[I(1)]$  and at most  $[I(1)]$ . These models allow for the examination of both symmetric and asymmetric relationships between indicators, considering the inherent heterogeneous effects (Salisu & Isah, 2017, p. 261).

Drawing on the studies by Pesaran et al. (1999) and Shin et al. (2014), the panel L-ARDL and NL-ARDL models investigate the short- and long-run symmetric and asymmetric relationships between model indicators, which are stationary at the maximum  $[I(1)]$  level, using the Unrestricted Error Correction Model (UECM). These models, which incorporate the lagged values of the indicators to address potential issues of autocorrelation and endogeneity, are also referred to as lagged autoregressive models (Pesaran et al., 1999, pp. 621–634; Shin et al., 2014, pp. 285–290). In the panel L-ARDL model developed by Pesaran et al. (1999), the short- and long-run symmetric relationships between two variables, such as  $(Y)$  and  $(X)$ , can be analyzed using the regression equation below:

$$\Delta Y_{it} = \beta_{0i} + \beta_{1i} Y_{i,t-1} + \beta_{2i} X_{t-1} + \sum_{j=1}^{N1} \lambda_{ij} \Delta Y_{i,t-j} + \sum_{j=0}^{N2} \gamma_{ij} \Delta X_{t-j} + \mu_i + \varepsilon_{it} \quad (2)$$

Here, the terms  $(i)$  and  $(t)$  refer to the horizontal cross-sectional units and the time dimension of the panel, respectively. The term  $(\mu_i)$  in the equation accounts for the group-specific effects in the horizontal cross-sectional units of the panel, while  $(\varepsilon_{it})$  denotes the error term, which has a mean of zero and a finite variance. Given that the equation assumes  $(\Delta Y_{i,t-j} = 0)$  and  $(\Delta X_{t-j} = 0)$ , the long-run coefficients are computed as  $(-\frac{\beta_{2i}}{\beta_{1i}})$ , and the short-run coefficients are determined as  $(\gamma_{ij})$ . The panel L-ARDL model in Equation (2) can be rewritten in UECM format as the following equation:

$$\Delta Y_{it} = \delta_i v_{i,t-1} + \sum_{j=1}^{N1} \lambda_{ij} \Delta Y_{i,t-j} + \sum_{j=0}^{N2} \gamma_{ij} \Delta X_{t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

Here, the parameters  $(\varnothing_{0i})$  and  $(\varnothing_{1i})$ , calculated as  $(-\frac{\beta_{0i}}{\beta_{1i}})$  and  $(-\frac{\beta_{2i}}{\beta_{1i}})$ , respectively  $(v_{i,t-1} = Y_{i,t-1} - \varnothing_{0i} - \varnothing_{1i} X_{t-1})$ , denote the symmetric error correction term calculated for the long-run equilibrium relationships between the variables in the horizontal cross-sectional units of the panel. The term  $(\delta_i)$  in the equation refers to the symmetric error correction coefficient, which indicates the speed of convergence to equilibrium in the long-run relationship between indicators and always takes negative values (Pesaran et al., 1999, pp. 621–634).

Adapted from the NL-ARDL model developed by Shin et al. (2014) for time series, which facilitates the investigation of symmetric and asymmetric relationships between model variables, the panel NL-ARDL model can analyze the short- and long-term asym-

metric relationships between ( $Y$ ) and ( $X$ ) variables using the following regression equation (Salisu & Isah, 2017, pp. 259–264):

$$\Delta Y_{it} = \beta_{0i} + \beta_{1i} Y_{i,t-1} + \beta_{2i}^+ X_{t-1}^+ + \beta_{2i}^- X_{t-1}^- + \sum_{j=1}^{N1} \lambda_{ij} \Delta Y_{i,t-j} + \sum_{j=0}^{N2} \left( \gamma_{ij}^+ \Delta X_{t-j}^+ + \gamma_{ij}^- \Delta X_{t-j}^- \right) + \mu_i + \varepsilon_{it} \quad (4)$$

Here, the long-run asymmetric coefficients represent the positive and negative changes in ( $X_t^+$ ) and ( $X_t^-$ ), calculated as  $(-\frac{\beta_{2i}^+}{\beta_{1i}})$  and  $(-\frac{\beta_{2i}^-}{\beta_{1i}})$ , respectively. The positive and negative changes in ( $X_t^+$ ) and ( $X_t^-$ ) can be decomposed to show partial sum processes and can be expressed iteratively as follows:

$$X_t^+ = \sum_{k=1}^t \Delta X_{ik}^+ = \sum_{k=1}^t \text{Max}(\Delta X_{ik}, 0) \quad (5)$$

$$X_t^- = \sum_{k=1}^t \Delta X_{ik}^- = \sum_{k=1}^t \text{Min}(\Delta X_{ik}, 0) \quad (6)$$

The panel NL-ARDL model in Equation (4) can be rewritten in the UECM format as follows:

$$\Delta Y_{it} = \tau_i \zeta_{i,t-1} + \sum_{j=1}^{N1} \lambda_{ij} \Delta Y_{i,t-j} + \sum_{j=0}^{N2} \left( \gamma_{ij}^+ \Delta X_{t-j}^+ + \gamma_{ij}^- \Delta X_{t-j}^- \right) + \mu_i + \varepsilon_{it} \quad (7)$$

Here, the term ( $\zeta_{i,t-1}$ ) explains the asymmetric error correction term calculated for the long-run equilibrium relationships between indicators in the horizontal cross-sectional units of the panel. The term ( $\tau_i$ ) in the equation refers to the asymmetric error correction coefficient, which indicates the speed of convergence to equilibrium in the long-run relationship between indicators and always takes negative values (Shin et al., 2014, pp. 285–290).

Short-run and long-run coefficients in the panel L-ARDL and NL-ARDL models specified in Equations (3) and (7) are estimated using two different estimators: the pooled mean group (PMG) and the mean group (MG). The PMG assumes that cross-sectional units are homogeneous, while the MG assumes that they are heterogeneous. The Hausman ( $Chi^2$ ) test is used to determine which estimator yields consistent and robust results. If the  $p$ -value of the Hausman ( $Chi^2$ ) test statistic exceeds 0.05, the null hypothesis—“the long-run estimated coefficients in the model are homogeneous”—is accepted at the 5% significance level, implying that the PMG estimator is the most appropriate (Pesaran et al., 1999, pp. 621–634).

At its simplest, cross-sectional independence assumes that a given shock in one of the cross-sectional units affects the other units in the sample equally, whereas a shock in the other cross-sectional units does not affect these other units (Koçbulut & Altıntaş, 2016, p. 152). Two alternative perspectives on the assumptions of panel unit root tests exist. While a first-generation panel unit root test is developed under the assumption that there is no cross-sectional dependence, a second-generation unit root test assumes that there is cross-sectional dependence. At one point, Robertson and Symons (2000), Anselin (2001), and Pesaran (2004) emphasized the necessity of accounting for horizontal cross-section dependence in panel data analysis (Breusch & Pagan, 1980; Pesaran, 2004). Moreover, Phillips and Sul (2003) state that neglecting horizontal cross-section dependence leads to inefficient estimations (Keskin & Aksoy, 2019, p. 5). The stationarity of the series is very important in panel data analysis because the analysis with non-stationary series may produce inconsistent  $t$ ,  $F$ , and  $R^2$  test statistics. For this reason, examining the stationarity of series in panel data analysis is necessary in order to avoid spurious regression and to obtain unbiased

outcomes (Tatoğlu, 2013, p. 199). Before assessing the stationarity of the series, the descriptive statistics of the variables are examined, followed by stationarity tests considering cross-sectional dependence.

### 4. Results

This study, which investigates both the symmetric and asymmetric effects of geopolitical uncertainties on economic growth in the selected countries using panel L-ARDL and NL-ARDL models, begins with an analysis of the cross-sectional dependence (CSD) between the models and the cross-sectional units (countries) in the panel. Taking CSD into account in models and variables is important as it affects the choice of unit root tests and can significantly affect the reliability of estimation outcomes (Menyah et al., 2014, pp. 390–391).

In panel data analysis, the presence of CSD in the specified models and variables can be evaluated by using CD-LM (Lagrange multiplier) tests considering the time (T) and cross-section (N) dimensions of the panel. The CD-LM1 test of Breusch and Pagan (1980) is appropriate when  $T > N$ , the CD-LM2 test of Pesaran (2004) is appropriate when  $T < N$  or  $T = N$ , and the CD-LMadj test of Pesaran et al. (2008) is suitable for all alternative scenarios between T and N (Eren, 2019, p. 117). In this study, the existence of CSD in the model variables is investigated using CD-LM1 and CD-LMadj tests and the findings are detailed in Table 4.

Table 4. CSD-LM test results.

Variables	Test Statistics (CT)						
	CD-LM1	CD-LM <sub>adj</sub>	L	Model	CD-LM1	CD-LM <sub>adj</sub>	L
GDP	84.34 <sup>a</sup> [0.000]	65.24 <sup>a</sup> [0.000]	2	---	---	---	—
CI	76.37 <sup>a</sup> [0.000]	79.22 <sup>a</sup> [0.000]	1	---	---	---	—
EL	103.42 <sup>a</sup> [0.000]	53.33 <sup>a</sup> [0.000]	2	---	---	---	—
XM	75.63 <sup>a</sup> [0.000]	32.26 <sup>a</sup> [0.000]	3	---	---	---	—
GPR	689.82 <sup>a</sup> [0.000]	81.32 <sup>a</sup> [0.000]	1	Model 1	169.23 <sup>a</sup> [0.000]	12.37 <sup>a</sup> [0.000]	2
GPR-US	462.22 <sup>a</sup> [0.000]	81.32 <sup>a</sup> [0.000]	1	Model 2	168.22 <sup>a</sup> [0.000]	11.44 <sup>a</sup> [0.000]	2
GPR-RS	429.12 <sup>a</sup> [0.000]	81.32 <sup>a</sup> [0.000]	1	Model 3	174.42 <sup>a</sup> [0.003]	11.82 <sup>a</sup> [0.000]	2

Note: The superscript “<sup>a</sup>” denotes statistical significance at the 1% level, with *p*-values in brackets. L indicates the optimal lag length determined by the Schwarz information criterion.

As can be clearly seen from Table 4, the test results show that CSD is found in all indicators and models. At this point, tests that take CSD into account are used.

Developed by Pesaran (2007), the Cross-Sectional Augmented Dickey–Fuller (CADF) test adapts the ADF test used in time series analysis to panel data by taking into consideration cross-sectional dependence. In contrast, panel unit root test developed by Hadri and Kurozumi (2012) assumes the existence of common factors among the series. It can also detect stationarity present in some of the horizontal cross-sections. In this respect, it is considered more powerful than other contemporary panel unit root tests (Varol, 2019, pp. 31–33).

When Table 5 is analyzed, one can see that some variables are stationary at level values and some are stationary at first differences. In other words, the level of stationarity consists of different variables. In this context, co-integration tests that take into account this situation are used.

**Table 5.** CADF and HK panel unit root test results.

Test Statistics (CT)		CIPS		HK( $Z_A^{SPC}$ )		L
Variables		LV	FD	LV	FD	
GDP		−2.10	−3.41 <sup>a</sup>	−2.12 [0.000]	−1.27 <sup>a</sup> [0.099]	2
CI		−3.28 <sup>a</sup>		0.26 <sup>a</sup> [0.800]	—	1
EL		−0.92	−3.28 <sup>a</sup>	−1.07 [0.000]	−1.41 <sup>a</sup> [0.965]	2
XM		−1.96	−3.43 <sup>a</sup>	−1.69 <sup>a</sup> [0.987]	—	3
GPR		−2.19	−3.61 <sup>a</sup>	2.63 <sup>a</sup> [0.917]	—	1
GPR-US		−2.73	−4.08 <sup>a</sup>	1.71 <sup>a</sup> [0.595]	—	1
GPR-RS		−2.21	−3.16 <sup>a</sup>	1.41 <sup>a</sup> [0.976]	—	1
Critical Values	1%	−2.83				

Note: LV = level; FD = first difference; CIPS: cross-section IPS test statistic. The “<sup>a</sup>” superscript indicates that the variables are stationary at the 1% significance level. The CIPS critical table values refer to the values taken from Pesaran (2007). Please refer to Table 3 for the abbreviations used.

In this study, the Durbin–Hausman (DH) symmetric and Hatemi-J (HJ) asymmetric panel co-integration tests are employed to investigate the potential long-run co-integrated relationships between the model variables, which are determined to be integrated at the maximum [I(1)] level and dependent on horizontal cross-sectional units. The Westerlund (2008) Durbin–Hausman panel co-integration test allows for the examination of long-run relationships when the dependent indicator is [I(1)] and the independent indicators are [I(1)] or [I(0)], including the presence of common factors in the panel. The Durbin–Hausman method, capable of calculating different test statistics for hypotheses considering both panel homogeneity and panel heterogeneity, facilitates the examination of long-run cointegration relationships in panel and group dimensions (Westerlund, 2008, pp. 196–199). The HJ asymmetric panel co-integration test, developed by Hatemi-J (2020), is applicable in the presence of CSD between the units in the panel, enabling the investigation of hidden relationships in the long run when the dependent and independent variables are [I(1)]. In the HJ test, it is assumed that there are hidden dynamics in the components of the variables, and it is accepted that there is no symmetric co-integration relationship between the linear forms of the model variables. Therefore, the HJ test takes into account the hidden dynamics in the components of the variables and investigates asymmetric co-integration relations between the negative and positive components of the model variables (Hatemi-J, 2020, pp. 507–510). Table 5 details the findings of the DH and HJ symmetric and asymmetric panel co-integration tests, investigating the long-run relationships between variables in the defined models in CT form.

When Table 6 is examined, according to the DH and HJ Panel cointegration test findings, it can be seen that there is a symmetric and asymmetric cointegration relationship between the variables in all defined models at the 1% or 5% significance level. This result is obtained when the probability values of the DHp and DHg test statistics for the models defined in the DH test are less than 0.01 or 0.05, leading to the rejection of the null hypotheses. The HJ test yields similar results, confirming that the error term residuals (e), which exhibit cross-sectional dependence (CSD) for the defined models, are stationary at the level value based on the calculated CIPS panel unit root test statistics. As shown in Table 6, changes in cointegration are present according to both tests and the coefficients are estimated as presented in the table below.

According to Table 7, GPR-GE for Model 1 and GPR-RS for Model 2 were found to be significant. In other words, global geopolitical risks and US geopolitical risks affect economic growth negatively and significantly. On the other hand, GPR-RS for Model 3

was found to be meaningless. In other words, geopolitical uncertainty does not affect economic growth for Russia. In addition, physical capital, human capital, and openness affect growth positively and significantly, as expected. It was also observed that the  $ECM_{(t-1)}$  error correction mechanism worked, demonstrating that when a shock occurs in the model variables in the short term, the effects of these shocks decrease in the long term and the variables move together again.

**Table 6.** DH and HJ Panel Cointegration Test Results.

Models	Test Statistics (CT)				
	DH	HJ			
		DH <sub>g</sub>	DH <sub>p</sub>	CD-LM <sub>adj</sub> Residuals (e) (Y <sup>+</sup> , X <sup>+</sup> )	Residuals (e) (Y <sup>-</sup> , X <sup>-</sup> )
Model 1	1.96 <sup>a</sup> [0.020]	6.12 <sup>a</sup> [0.000]	4.58 <sup>a</sup> [0.000]	4.38 <sup>a</sup> [0.000]	-4.80 <sup>a</sup>
Model 2	1.69 <sup>a</sup> [0.040]	3.89 <sup>b</sup> [0.000]	4.65 <sup>a</sup> [0.000]	4.46 <sup>a</sup> [0.000]	-4.72 <sup>a</sup>
Model 3	1.90 <sup>a</sup> [0.032]	3.56 <sup>b</sup> [0.000]	3.43 <sup>a</sup> [0.000]	3.28 <sup>a</sup> [0.000]	-4.73 <sup>a</sup>

Note: The “a” and “b” superscripts labeling the DH<sub>g</sub> and DH<sub>p</sub> test statistics, whose optimal lag lengths were determined as 2, in accordance with the Schwarz Information Criterion, indicate that there is a symmetric cointegration relationship between the model variables at significance levels of 1% and 5%, respectively. The “a” and “b” superscripts in front of the CD-LM<sub>adj</sub> and CIPS test statistics, whose optimal lag lengths were determined as 2, in accordance with the Akaike Information Criterion, indicate that there is CSD in the error term of the models and that the error term is stationary at 1% and 5% significance levels, respectively. In the table, the values in parentheses “[ ]” indicate the probabilities of the tests.

**Table 7.** L-ARDL models estimation results.

Long-Term Coefficients	Model 1		Model 2		Model 3	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
CI	0.08042 <sup>a</sup>	0.01359 [0.000]	0.07922 <sup>a</sup>	0.01420 [0.000]	0.09542 <sup>a</sup>	0.01520 [0.000]
EL	1.46223 <sup>a</sup>	0.20220 [0.000]	1.41944 <sup>a</sup>	0.20752 [0.000]	1.52910 <sup>a</sup>	0.21320 [0.000]
XM	0.00094 <sup>a</sup>	0.00044 [0.041]	0.00113 <sup>b</sup>	0.00041 [0.032]	0.00199 <sup>a</sup>	0.00059 [0.000]
GPR-GE	-0.00039 <sup>b</sup>	0.00016 [0.041]	—	—	—	—
GPR_US	—	—	-0.01523 <sup>b</sup>	0.00736 [0.041]	—	—
GPR_RS	—	—	—	—	0.02562	0.03812 [0.511]
ECM <sub>t-1</sub>	-0.19182 <sup>b</sup>	0.08110 [0.010]	-0.18865 <sup>a</sup>	0.07942 [0.012]	-0.21927 <sup>a</sup>	0.06737 [0.001]
C	0.37489 <sup>b</sup>	0.10543 [0.041]	0.36345 <sup>b</sup>	0.10123 [0.031]	0.31315 <sup>b</sup>	0.13446 [0.046]
Hausman_Sigamore	0.54 [0.916]		1.57 [0.8130]		2.41 [0.6534]	
Log Likelihooh	458.9242		450.6123		452.9853	
CSD	8		8		8	
Observation	209		209		209	

Note: In the table, the superscripts “a” and “b” indicate that the t-statistics of the coefficients are significant at the 1% and 5% significance levels, respectively. The values in brackets “[ ]” represent the probability of the coefficients.

Table 8 presents the estimation results of the Nonlinear Autoregressive Distributed Lag (NL-ARDL) models, which allow for asymmetric effects of geopolitical risks on economic growth.

Table 8. NL-ARDL models estimation results.

Long-Term Coefficients	Model 1		Model 2		Model 3	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
CI	0.07589 <sup>a</sup>	0.01420 [0.000]	0.27923 <sup>a</sup>	0.0121 [0.000]	0.18453 <sup>a</sup>	0.0162 [0.000]
EL	1.44641 <sup>a</sup>	0.21012 [0.000]	0.22723 <sup>b</sup>	0.1023 [0.036]	0.61292 <sup>a</sup>	0.1023 [0.000]
XM	0.00073 <sup>a</sup>	0.00031 [0.000]	0.11264 <sup>a</sup>	0.0112 [0.000]	0.09235 <sup>a</sup>	0.0151 [0.000]
GPR – GE <sup>+</sup>	–0.00048 <sup>b</sup>	0.00021 [0.029]	–	–	–	–
GPR – GE <sup>–</sup>	–0.00076 <sup>b</sup>	0.00031 [0.042]	–	–	–	–
GPR – US <sup>+</sup>	–	–	0.00762 <sup>a</sup>	0.0021 [0.001]	–	–
GPR – US <sup>–</sup>	–	–	–0.00622 <sup>a</sup>	0.0021 [0.002]	–	–
GPR – RS <sup>+</sup>	–	–	–	–	0.17491 <sup>a</sup>	0.0311 [0.000]
GPR – RS <sup>–</sup>	–	–	–	–	–0.08485 <sup>a</sup>	0.0257 [0.002]
ECM <sub>t–1</sub>	–0.18142 <sup>b</sup>	0.08139 [0.024]	–0.27232 <sup>a</sup>	0.0522 [0.000]	–0.24562 <sup>a</sup>	0.0327 [0.000]
C	0.33643 <sup>b</sup>	0.1425 [0.048]	1.53572 <sup>a</sup>	0.1587 [0.000]	0.86723 <sup>a</sup>	0.1342 [0.000]
Hausman_Sigmamore	1.22 [0.898]		1.49 [0.933]		2.29 [0.822]	
Log Likelihooh	452.3322		1480.023		1472.873	
CSD	8		8		8	
Observation	209		209		209	

Note: The “a” and “b” superscripts in front of the CD-LMadj and CIPS test statistics, whose optimal lag lengths were determined as 2, in accordance with the Akaike Information Criterion, indicate that there is CSD in the error term of the models and that the error term is stationary at 1% and 5% significance levels, respectively. For definitions of terms, symbols, abbreviations, etc., in the table, see Table 6.

Finally, it can be seen that the variables GPR-GE<sup>+</sup> and GPR-GE<sup>–</sup> for Model 1, GPR-US<sup>+</sup> and GPR-US<sup>–</sup> for Model 2, and GPR-RS<sup>+</sup> and GPR-RS<sup>–</sup> for Model 3 are significant. In other words, global geopolitical risks, US geopolitical risks, and Russian geopolitical risks affect growth negatively and significantly. On the other hand, physical capital, human capital, and openness affect growth positively and significantly, as expected.

## 5. Discussions

Upon reviewing the existing literature, it can be seen that panel data analysis is generally applied in studies examining the impact of geopolitical uncertainties on growth (Pal et al., 2024; Khan et al., 2023; Doğan & Doğan Özarıslan, 2021; Sharif et al., 2020; Soybilgen et al., 2019). In this study, panel data analysis, which is an approach similar to that commonly used in research, was utilized and contributed to the literature as a novel method. In this context, the econometric (L-ARDL and NL-ARDL) analyzes used in the study are considered to be the original contribution of the research. Panel data analysis, which takes into account the dependency between cross-sectional units, is used in the research.

Moreover, the literature highlights that countries or country groups such as Central and Eastern European countries (Jha et al., 2024; Khan et al., 2023), emerging economies (Soybilgen et al., 2019; Cheng & Chiu, 2018), Eurozone economies (Jawadi et al., 2024),

OECD countries (Pal et al., 2024), the “fragile five” (Doğan & Doğan Özarlan, 2021), and America (Yalçınkaya & Çelik, 2021) were studied. In this research, selected Turkic republics and neighboring states were studied, and the results were contributed to the literature. In addition, the scope and regional focus of the research contribute to the literature.

There are numerous studies in the literature on the relationship between geopolitical uncertainties and growth. In the study by Jha et al. (2024), the results of geopolitical shocks differed between developed and developing economies. While geopolitical risk may have a positive effect on economic growth in developed economies, the effect was negative in developing economies. On the other hand, in the study conducted by Jawadi et al. (2024), geopolitical shocks negatively affected the Eurozone GDP. In the literature, geopolitical developments generally affect economic growth negatively (Pal et al., 2024; Soybilgen et al., 2019). As a result of the analyses carried out for the period 1995–2022, considering the symmetric and asymmetric relationships between geopolitical uncertainty and economic growth, it can be concluded that geopolitical uncertainties have a contractionary effect on the growth performance of the selected Turkish Republic and neighboring countries, as predicted in the theoretical literature. However, this study concludes that the effects of geopolitical uncertainties arising from developments in the global economy on the economic growth performance of selected countries are more restrictive.

The results of our study confirm the conclusions found in the literature, highlighting the significant negative impact of geopolitical uncertainties on economic growth in the analyzed Turkic republics and neighboring countries. Our analysis makes a remarkable contribution by using the L-ARDL and NL-ARDL models, which allow the identification of relationships between variables. These econometrics methods emphasize that the effects of geopolitical uncertainties on economic growth are more pronounced in the long run, especially in economies more dependent on foreign capital and the stability of foreign markets. Compared to other countries or regions studied in the literature, the impact of geopolitical risk in the Turkic republics and neighboring countries is more pronounced due to their economic vulnerability and high interdependence with large economies, such as the Russia and United States.

Another important finding of our analysis is that while the effects of geopolitical uncertainties are mostly negative, they are also influenced by structural factors, such as the degree of economic openness, fixed capital investment, and human capital. The results confirm that these variables have a positive and significant impact on economic growth, partially mitigating the negative effects of geopolitical risks. Thus, economic policies aimed at increasing competitiveness and diversifying investment sources could represent viable solutions for reducing the vulnerability of these economies to external shocks. This paper represents a useful perspective for policymakers, emphasizing the importance of macroeconomic stability and adaptation strategies to the ever-changing geopolitical context.

## 6. Conclusions

Since the 2008 global crisis, the world economy has experienced recurrent and unresolved economic recessions. This situation creates concern and uncertainty about the future of the global economy. Although global economic growth, which had been below its full potential since the crisis and the recession that followed, started to recover after 2017, this process was interrupted by the pandemic that started in 2019.

Today, there are different risks and uncertainties that affect the global economy, from trade to finance and from climate change to geopolitical uncertainties. When the global economy is examined historically, it can be seen that critical changes affecting the global economy, such as the September 11 attacks, the war between the USA and Iraq, and the

Global Financial Crisis, occurred in the early 2000s. In the period following, significant changes in economic, political, and geopolitical landscapes, such as the Arab Spring, the European Debt Crisis, the Immigration Crisis, the trade wars between the USA and China, Brexit negotiations, and the latest election process of the USA, took place. In addition, the pandemic that deeply affected the world economy, the ongoing Russia–Ukraine war, and Israel’s attacks on Gaza also contribute to uncertainty. Finally, issues such as global warming or climate change, food security, and drought, which are making themselves felt, deepen current economic uncertainty. All these developments create uncertainty in the global economic conjuncture and are considered risk factors.

This study aims to analyze the impacts of geopolitical uncertainties on economic growth in selected countries, which are in the sphere of influence of geopolitical uncertainties regarding their position in the global economy and which operate under open macroeconomic policies. Considering the symmetric and asymmetric relationships between geopolitical uncertainty and economic growth, the analysis for the period 1995–2022 reveals that geopolitical uncertainties have a contractionary effect on the growth performance of the selected eight countries as predicted in the theoretical literature. Moreover, the findings indicate that geopolitical uncertainties stemming from global economic developments have an even stronger contractionary impact on the economic growth of these countries. Based on these findings, this study suggests that policymakers should account for geopolitical risks when designing monetary and fiscal policies. To support sustainable economic growth, it is recommended that policy measures be developed to mitigate the adverse effects of geopolitical uncertainties, ensuring greater economic resilience and stability in the affected countries.

The limitations of this study mainly refer to the following aspects: (a) the exclusion from the analysis of some determinants for economic growth, such as technological change, climate change, cultural influences, etc.; (b) the geopolitical risk indices used in the analysis provide an aggregate measure and cannot fully capture the complexity and dynamics of geopolitical uncertainty, in particular at regional or local level; and (c) although the analyzed countries share similar characteristics, the impact of geopolitical risk can vary significantly due to the differences in economic structure, dependence on foreign trade, and national economic policies.

Considering the limitations mentioned above, we propose, as the first direction of future research, the continuation of this study by integrating additional factors which influence national economies, considering technological progress as a positive factor and climate change as a threat. Furthermore, a bidirectional analysis between economic and geopolitical stability in the targeted sample of countries will be considered as a second research direction.

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