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### The Impact of Geopolitical Risks and Uncertainties on Equity Financing Costs: Evidence from Türkiye



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#### Abstract

This study analyses the impact of geopolitical risk (GPR) on the cost of capital in the Turkish banking sector by using autoregressive distributed lag (ARDL), dynamic conditional correlation (DCC), and generalised autoregressive conditional variance (GARCH) models. Using monthly data for the period 2005M01- 2025M03, in the paper, the long- and short-term relationships between GPR and equity financing and analyses the dynamic evolution of these relationships are examined over time. The ARDL model results demonstrate that GPR has a borderline significant impact on the cost of capital in the long run, while macroeconomic indicators such as the exchange rate and the policy rate have much stronger and statistically significant effects. In particular, the exchange rate is strongly positively correlated with the cost of capital, reflecting the dependence on foreign currency borrowing in the Turkish banking sector. Meanwhile, the policy rate is observed to have a stabilising effect. Short-term forecasts also emphasise the sensitivity of the cost of capital to geopolitical shocks, especially during periods of heightened regional tensions. The DCC-GARCH model confirms that the correlation between the GPR and the cost of capital is positive and increases over time. This tendency is predominantly evident in the post-2018 period, coinciding with increasing regional conflicts and domestic political instability. Moreover, inflation is found to be significantly associated with the cost of capital, while its link with exchange rate volatility reveals the interconnectedness of macroeconomic variables in emerging economies.

#### Keywords

Geopolitical risks • Equity financing • Banking sector • Uncertainty in economy

#### JEL Classification

F65 • F34 • F51

#### Author Note

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## The Impact of Geopolitical Risks and Uncertainties on Equity Financing Costs: Evidence from Türkiye

Geopolitical risk (GPR) significantly impacts economic and financial outcomes. Caldara and Iacoviello (2018) developed a news-based GPR index that spikes during major geopolitical events and predicts lower investment and employment. Their research shows that industries and firms more exposed to GPR experience greater investment declines. Papastamou (2023) examined the effects of geopolitical shocks on stock markets across various country groups, including the BRICS, MENA, SAHEL, and G7 nations, highlighting the importance of understanding these risks for economic diplomacy and investment decisions. Klement (2021) emphasises the growing influence of geopolitical factors on markets and argues that political risks, often considered unquantifiable, can be measured and incorporated into risk management strategies. These studies collectively demonstrate the significant role of geopolitical risk in shaping economic outcomes and investment strategies across different regions and industries.

Türkiye's geopolitical risks are as complex as the strategic importance created by its geographic positioning. As emphasised in the studies of Pehlivanlı (2025) and Tütüncü (2024), being at the intersection of Europe, Asia and the Middle East places the country positions at the centre of the global power struggle. The location has historically been both a great advantage and a source of serious security problems. In particular, regional dynamics such as recent conflicts in the Middle East, such as Iran-Israel tensions, the refugee crisis related to the Syrian civil war, and the long-lasting conflict between Palestine and Israel, directly threaten Türkiye's political and economic stability. The analysis conducted by Kyriazis and Economou (2022) reveals how border security issues and international sanctions deeply affect Türkiye's foreign policy, economy, and international trade.

Uncertainties in the economic sphere constitute one of Türkiye's most critical risk factors. As detailed in Hassan Khan's (2018) study, the 2018 Turkish Lira crisis clearly demonstrated the devastating effects of geopolitical tensions on financial stability. Mansour-Ichraikie and Zeaiter (2019) analysed how instability in monetary policies makes long-term economic planning difficult. High inflation expectations and the depreciation of the Turkish Lira create an unsustainable economic environment, as emphasised in the studies of Altiner and Bozkurt (2023). From the perspective of companies, increasing receivable risks and bankruptcy filings seriously strains the financial structure of the business world. To understand this, one can look at the research conducted by Yu and Wang (2023), which reveals how fluctuations in trade and financial markets are directly affected by the global economic conjuncture.

The migration movements in the last couple of decades are one of the most important socio-economic risks that Türkiye faces. As Aaron and Cagaptay (2025) stated in their recent study, the intense wave of migration from Syria has deeply affected the demographic structure and social fabric of the country. Perles-Ribes et al. (2018) studies on the Arab Spring predict that the problems created by forced migration will continue. As Ozkahraman (2017) and Park (2012) point out in their studies, brain drain, which means the outflow of qualified labour abroad, also remains an important threat.

Besides all these, Türkiye's geopolitical risks have manifested themselves in different ways throughout history. Afonso-Rodríguez (2017) elaborated on the NATO-Türkiye relations document how the activities of the PKK terrorist organisation have threatened the country's security since the 1980s. In addition, according to Kilic's (2025) analyses, the 2010 Mavi Marmara crisis led to serious tensions in diplomatic relations with Israel. The studies by Kyriazis and Economou (2022) show how the Syrian civil war, which began in 2011, led to the arrival of millions of migrants to Türkiye and seriously weakened border security. Additionally,

Demir et al.'s (2020) studies noted how the Gezi Park protests in 2013 and the July 15 coup attempt in 2016 deeply shook the country's domestic political stability. All these risks affect the economy, but the economic effects of the geopolitical risks are particularly evident on foreign investments. Altiner and Bozkurt's (2023) studies show how FDIs to Türkiye decrease as uncertainties increase, based on Geopolitical Risk Index data. Tütüncü's (2024) research on the tourism sector, furthermore, reveals how sensitive this sector, which constitutes a significant portion of GDP in Türkiye, is to geopolitical tensions. Mansour-Ichraikieh and Zeaiter (2019) analyse how the US's protectionist policies affect Türkiye's position in global supply chains. All these risks result from the geopolitical position of the county, directly or indirectly, yet have a grave impact on the country's almost all economic activities, including equity financing.

The main research question that led to the emergence of this study is as follows: To what extent do geopolitical risks affect the cost of equity in the Turkish banking sector, and how does this interrelationship change over time? In this paper, both short-term dynamics and long-term balances are examined, and the aim is to provide a comprehensive understanding of how financial systems in emerging markets, especially in Türkiye, respond to increasing geopolitical uncertainties. To do that, the literature around geopolitical risk indices (e.g., Caldara and Iacoviello, 2018) and time-frequency financial models (e.g., Sharif et al., 2020) have provided reliable tools to analyse these relationships. However, the number of empirical studies that apply these tools directly to Türkiye's unique context is limited. This paper aims to fill this gap by applying both the ARDL and DCC-GARCH models to investigate how fluctuations in macroeconomic variables, especially geopolitical risk, affect the costs of banks' capital.

The paper is organized as follows. After the introduction, section two is a detailed literature review of how geopolitical risk has been defined and measured in recent studies, with particular reference to how it applies to equity financing. Section 3 is a description of the methodology, data sources, variables, and empirical models employed (ARDL and DCC-GARCH).

The fourth section reports the empirical findings, such as unit root tests, long- and short-run ARDL estimates, and time-varying correlations of the DCC-GARCH model. The section also explains how these findings indicate the financial sensitivities of the Turkish banking industry. The conclusion summarises the main findings, explains their policy and investment implications, and provides recommendations for future research avenues. This research closes a methodological and situational gap by applying dynamic and equilibrium models to measure the effect of geopolitical risk on the cost of equity in a very exposed emerging market—providing deep insight into both macro-financial dynamics and sectoral risks that global or regional studies hitherto have not addressed.

This paper adds to the general literature on political risk, emerging markets, and financial stability in general by presenting novel evidence on macroeconomic instability, policy rates, exchange rate volatility, and geopolitical shocks collectively affecting the cost of equity. By integrating both time-invariant (ARDL) and time-varying (DCC-GARCH) econometric frameworks, it gives a refined appreciation of dynamic interdependencies that is especially useful for policy makers, financial analysts, and institutional investors who deal with the volatility of emerging economies.

## Literature Review

Geopolitical Risk (GPR) has become a key factor affecting global economic stability, financial markets, and policy frameworks. Recent empirical studies have used various methodologies to measure its impact, from news-based indices to advanced econometric models. Caldara and Iacoviello (2018) developed a news-based GPR index that analyses the frequency of specific keywords in international media, revealing significant relationships between geopolitical shocks and declines in investment, employment, and eco-

conomic output. This methodology has been adopted in many studies, including Smales' (2019) study of oil and stock market volatility. Using a dynamic conditional correlation (DCC) model, Smales showed that geopolitical risk disproportionately affects oil prices due to supply chain vulnerabilities, but oil futures can be a hedge for stock investors (Smales, 2019).

The economic implications of GPR extend beyond market volatility. Flouros et al. (2022) found that renewable energy investments experience long-term losses under increasing geopolitical tensions using panel data and an autoregressive distributed lag (ARDL) model from 171 economies. Similarly, Carney et al. (2024) emphasised that GPR increases the cost of equity in emerging markets and that this relationship can be moderated by firm-level strategies such as institutional strength and cross-listing. These findings contrast with those of developed economies, where Sweidan (2023) identified US macroeconomic indicators as an important driver of global GPR using ARDL analysis over 1973–2020 data. Regional heterogeneity is further highlighted by Arif et al. (2020), who demonstrated that BRIC countries react differently to US economic policy uncertainty using quantile-quantile regression, while China and Russia exhibited opposite reactions compared to Brazil and India.

Financial market dynamics, moreover, under geopolitical stress are increasingly analysed in time-frequency frameworks. Sharif et al. (2020) used wavelet coherence analysis to unravel the intertwined relationships between COVID-19, oil prices, and GPR and showed that pandemic-induced shocks increased short-term volatility while reshaping long-term risk perceptions. Foglia et al. (2023) expanded this perspective with a time-varying parameter VAR (TVP-VAR) model, showing that geopolitical shocks from the US and Russia had extreme effects on commodity markets, especially energy and metals. Bondarenko et al. (2023) emphasised the role of media narratives, and using local GPR indices developed from Russian newspapers, they showed that even in environments with limited press freedom, local risk perceptions produced more pronounced economic effects compared to global indices.

To respond and reduce the geopolitical risks, strategies could vary and be multidimensional. Su et al. (2021) argued that there is a two-way relationship between renewable energy transitions and geopolitical risk reduction and that energy transitions can weaken traditional resource-based conflicts. Shabir et al. (2023) analysed 574 banks from 19 countries and found that CEO authority and board resilience mitigated the destabilising effects of economic and geopolitical uncertainty on financial institutions. On the other hand, bibliometric analyses by Aiswarya and Muthumeenakshi (2024) highlighted the increasing integration of machine learning and artificial intelligence into GPR estimates, indicating the potential for innovation in this area.

In terms of methodology, it has evolved from static indices to dynamic and context-sensitive models. While the news-based approach of Caldara and Iacoviello (2018) remains a fundamental reference, developments such as TVP-VAR and wavelet coherence allow researchers to capture nonlinear and time-dependent interactions. Bondarenko et al. (2023) developed localised indices that overcome the limitations of global data and provide detailed insights into regional vulnerabilities. However, the difficulties in distinguishing GPR from overlapping crises such as pandemics or climate events highlight the need for frameworks that account for multi-causal interactions. Outstanding research on the subject is summarised in the table below.

**Table 1**

*Summary of the Selected Literature on Geopolitical Risks and Equity Financing*

Study	Variables	Methodology	Results
Caldara and Iacoviello (2018)	Geopolitical risk index, investment, employment, probability of disaster	News-based GPR index and econometric analysis	High GPR is associated with low investment/employment and high disaster risk

Study	Variables	Methodology	Results
Yılmazkuday (2024)	Geopolitical risk and stock prices	Unspecified	GPR affects stock prices
Papastamou (2023)	Russia-Ukraine war, COVID-19, stock market fluctuations, economic diplomacy	VAR, GARCH models, alternative investment analysis	GPR increases stock market fluctuations; risk management strategies are recommended
Klement (2021)	Geopolitical factors and investment risks	Unspecified	Geopolitical risks can be quantified and managed
Smales (2019)	GPR index, oil prices, stock volatility	The dynamic conditional correlation (DCC) model	GPR affects oil prices more than stocks; oil futures provide a hedge
Flourous et al. (2022)	Renewable energy investments, GPR, control variables	Panel ARDL model (171 countries)	GPR negatively affects renewable energy investments in the short and long term
Sweidan (2022)	U.S. macroeconomic indicators, international GPR	ARDL model (1973-2020 data)	U.S. indicators significantly affect global GPR
Sharif et al. (2020)	COVID-19, oil prices, stock market, GPR, political uncertainty	Wavelet compatibility analysis and Granger causality tests	COVID-19 and oil shocks increase the GPR and uncertainty
Aiswarya Muthumeenakshi (2024)	Bibliometric data and GPR research trends	PRISMA-guided systematic review, TVP-VAR models	GPR is associated with economic influences and financial markets
Ó Tuathail (1999)	Geopolitical theory, risk society	Unspecified	Theoretical link between geopolitics and risk society
Arif et al. (2020)	U.S. political uncertainty and GPR in BRIC countries	quantile-quantile (QQ) regression	U.S. uncertainty has heterogeneous effects on BRIC (China/Russia ↔, Brazil/India)
Foglia et al. (2023)	Country-specific GPR indices and commodity prices (energy, metals, food)	Time-Varying Parameter VAR (TVP-VAR)	GPR shocks from the US and Russia have a weighted impact on the commodity markets
Bondarenko et al. (2023)	GPR indices from Russian media, sanctions, Russian economy	Local/international media analysis and sanctions index	Local GPR shocks are more effective than global ones
Su et al. (2021)	Global GPR, renewable energy investments	Sliding window method and causality analysis	Two-way causality between GPR and renewable energy: Energy conversion reduces risk
Carney et al. (2024)	GPR, cost of equity, corporate factors, firm-level features	Panel data analysis (55,900 observations, 19 economies)	GPR increases the cost of equity; corporate/firm factors mitigate the impact
Shabir et al. (2023)	Economic/geopolitical uncertainty, bank risk, CEO power, and board structure	Panel analysis (574 banks, 19 countries)	Uncertainty increases bank risk and reduces the influence of the CEO and the board of directors

## Methodology, data, and empirical evidence

This study examines the impact of geopolitical risk on the cost of equity in the banking sector. In the analysis, the relationship between geopolitical risk and the cost of equity of banks is examined by using the sectoral balance sheet data of deposit banks operating in Türkiye.

**Table 2**

*Definitions of the Variables*

Variables	Symbol	Sources
Inflation	INF	Fred
Growth	GROWTH	Fred
The geopolitical risk index	GPR	<a href="https://www.matteoiacoviello.com/gpr.htm">https://www.matteoiacoviello.com/gpr.htm</a>
Cost of equity capital [Equity: Deposit Bank Sectoral Balance Sheet (Thousand TRY)]	COEC	TCMB
Policy interest rate	I	Fred
USD/TRY	EXCH	TCMB

**Note:** Growth transmitted to monthly by the Litterman methodology.

To empirically examine the link between geopolitical risk and the equity cost of the Turkish banking sector, a meticulously chosen group of macroeconomic and financial variables has been employed. These variables, their notation, and data sources are presented in the variable definition table. The inflation rate (INF) and the GDP growth rate (GROWTH) are obtained from the Federal Reserve Economic Data (FRED) and represent important domestic macroeconomic measures of price change and general economic activity, respectively. The Geopolitical Risk Index (GPR), constructed by Caldara and Iacoviello (2018), retrieved on their official website<sup>1</sup>, measures global geopolitical tension based on news media keyword frequency and serves as the primary explanatory variable in this study.

The cost of equity capital (COEC) is the dependent variable and is estimated on the basis of the Central Bank of the Republic of Türkiye (TCMC) sectoral balance sheets of deposit banks and expressed in thousand Turkish Lira (TRY). The second macro-financial variable drawn from FRED is the policy interest rate (I) and represents the monetary policy stance, whereas the USD/TRY exchange rate (EXCH), drawn from TCMB, captures external vulnerability and currency–risk exposure, which is especially important for Türkiye’s highly dollarized financial system.

Each of the variables serves a specific function in the econometric models employed and, together, accounts for the overall information on the financial effect of geopolitical risks in the case of Türkiye. All the variables were obtained on a monthly basis for the period 2005M01–2025M03.

The basic model used in the study can be expressed as follows:

$$COE_{i,t} = \alpha + \beta_1 GPR_t + \beta_2 X_{i,t} + \varepsilon_{i,t}$$

Where  $COE_{i,t}$  is the cost of equity,  $GPR_t$  is the geopolitical risk index,  $X_{i,t}$  is a vector consisting of control variables, and lastly  $\varepsilon_{i,t}$  is the error term.

As control variables, variables determined at the bank and macroeconomic levels are included in the model. At the bank level, financial indicators such as the cost of equity and the long-term growth rate (long-

<sup>1</sup>See: <https://www.matteoiacoviello.com/gpr.htm>

term growth) are considered. At the macroeconomic level, inflation and the GDP growth rate (GDP growth) and the exchange rate (USD/TRY) are added as control variables.

**Table 3***Unit Root Test Results*

Variable	Test Type	Level t-statistic	1. Difference t-statistic	Results (Stationary Level)
<b>INF</b>	ADF	-2.655** (0.047)	-11.99*** (0.00)	Stationary at I(0)
	PP	-6.94*** (0.000)-	-56.09*** (0.0001)	Stationary at I(0)
<b>GROWTH</b>	ADF	-4.39 *** (0.000)	-4.76 *** (0.0001)	Stationary at I(0)
	PP	-3.02 ** (0.034)	-6.58 *** (0.000)	Stationary at I(0)
<b>GPR</b>	ADF	-6.86 *** (0.000)	-12.30*** (0.000)	Stationary at I(0)
	PP	-6.78*** (0.000)	-41.73*** (0.0001)	Stationary at I(0)
<b>COEC</b>	ADF	2.85 (1.00)	-3.144 (0.08)	Stationary at I(1)
	PP	10.81 (1.00)	-8.565*** (0.00)	Stationary at I(1)
<b>I</b>	ADF	-0.056 (0.95)	-14.66*** (0.00)	Stationary at I(1)
	PP	-0.945 (0.77)	-15.40*** (0.000)	Stationary at I(1)
<b>EXCH</b>	ADF	5.192 (1.00)	-5.85 *** (0.00)	Stationary at I(1)
	PP	7.75 (1.00)	-8.367*** (0.000)	Stationary at I(1)

**Note:** \*\*\* = significant at 1% level (critical value:  $\approx -3.50$ ), \*\* = significant at 5% level (critical value:  $\approx -2.89$ ), \* = significant at 10% level (critical value:  $\approx -2.58$ )

Based on Table 3, the inflation variable gave a value very close to the limit at the 10% significance level for level stationarity in the ADF test ( $p = 0.047$ ), and it was found to be very strongly significant at the 1% level in the PP test ( $p = 0.0000$ ). In the first difference in both tests, it was clearly found to be stationary at the 1% level. This shows that the inflation is stationary [ $I(0)$ ]. In both the ADF and PP tests, the growth rate variable (GROWTH) was found to be stationary at the 1% and 5% significance levels at the level. This shows that the series has a constant mean and variance over time, that is, it is stationary [ $I(0)$ ]. Therefore, this variable can be used directly in regression analyses and there is no need for any difference taking process. The geopolitical risk index (GPR) was found to be level stationary at 1% level with very low p-values in both ADF and PP tests. This demonstrates that the GPR variable is stable over time and can be used directly in economic analyses. The GPR variable is clearly in the form of  $I(0)$  and no difference taking is necessary.

The COEC variable is not found to be significant at the level in both ADF and PP tests; p-values are close to 2.85. This shows that the variable is not level stationary and contains a unit root. However, after the first difference was taken, significant results were obtained at the 1% level in both tests. Therefore, the COEC variable shows  $I(1)$  property, that is, it should be included in the model by taking its first difference.

The policy rate variable is not stationary according to both ADF and PP tests at the level; p-values are quite high. Nevertheless, when the first difference is taken, both ADF and PP tests give significant results at the 1% level. This means that the interest rate variable is  $I(1)$ , that is, it can be used in econometric analyses only after the first difference is taken. The EXCH variable [exchange rate (USD/TRY)] was not found significant according to ADF and PP tests at the level. In both tests, the p-values are very close to 1 and the test statistics are far from the critical values. When the first difference is taken, however, significant results at the 1% level are obtained in both tests. Therefore, the exchange rate variable should be evaluated as  $I(1)$ ; its difference should be taken before using it in the analyses.

### Long-run Relationship (Cointegration Analysis)

Based on the unit root test results, the autoregressive distributed lag (ARDL) method is a suitable model where both  $I(0)$  and  $I(1)$  variables are present. The ARDL model developed by Pesaran et al. (2001a) is a flexible econometric method widely used in time series analysis. One of its main advantages is that it allows variables to have different degrees of stationarity—levels of integration. For instance, both the  $I(0)$  and  $I(1)$  variables can be used together in the model. This feature provides great convenience when working with non-stationary series, which are frequently encountered in real-world data. In addition, ARDL can estimate both short-term dynamic relationships and long-term equilibrium relationships in a single equation. The existence of long-term relationships can be verified by a method called bound testing, and this process requires less data than traditional co-integration tests. Another advantage of the model is that it can produce reliable results even with small sample sizes. Unlike system-based methods such as Johansen, ARDL provides consistent estimates even with limited data sets (e.g. 30-40 observations). In addition, the ability to specify different lag lengths for variables increases the flexibility of the model. In this way, the lag structure that best reflects the effect of each variable can be selected and the risk of over-parameterisation is minimised. The ARDL model is especially preferred in cases where the integration degrees of the variables are not certain. For example, it is useful when analysing the relationship between indicators that exhibit different behaviours such as economic growth, inflation and interest rates. It is also frequently used in political evaluations; it is possible to examine the instantaneous effects and long-term results of a policy change in the same model. It can also be applied in cases where causality relationships are investigated or structural breaks are present. However, if any variable is an  $I(2)$  (second difference taken) series, the model becomes invalid. In our case, ARDL ( $p, q_1, q_2, q_3$ ) can be written as follows:

$$\Delta\text{COEC}_t = \alpha + \lambda\text{COEC}_{t-1} + \delta_1\text{GPR}_{t-1} + \delta_2\text{GROWTH}_{t-1} + \delta_3\text{INF}_{t-1} + \sum_{i=1}^{p-1} \phi_i \Delta\text{COEC}_{t-i} + \sum_{j=0}^{q_1-1} \beta_j \Delta\text{GPR}_{t-j} + \sum_{k=0}^{q_2-1} \gamma_k \Delta\text{GROWTH}_{t-k} + \sum_{l=0}^{q_3-1} \theta_l \Delta\text{INF}_{t-l} + \varepsilon_t$$

Where  $\lambda, \delta_1, \delta_2, \delta_3$  refer long-term coefficients while  $\phi_i, \beta_j, \gamma_k, \theta_l$  refer short-term dynamics, and  $\varepsilon_t$  is error term.

The bounds test hypotheses for the long-term relationship are as follows:

$H_0$  (Null Hypothesis) :  $\lambda = \delta_1 = \delta_2 = \delta_3 = 0$

$H_1$  (Alternative Hypothesis) : At least one  $\delta_i \neq 0$  (i.e., there is a long-run relationship)

The F-statistic value is compared with the critical table values presented by Pesaran et al. (2001b):

- If the F-statistic exceeds the upper limit [ $I(1)$ ]: There is a long-run relationship.
- If the F-statistic is below the lower limit [ $I(0)$ ]: There is no long-run relationship.
- If the F-statistic is between the limits: uncertainty area.

The applied ARDL model is estimated to analyse the relationship between the COEC and geopolitical risk (GPR), economic growth (GROWTH), inflation (INF), policy rate (I) and exchange rate (EXCH) variables. The model structure is ARDL (4, 3, 0, 0, 4, 6), which indicates that the past values of the dependent and independent variables are also considered. The main purpose of the model is to determine whether there is a long-term co-integration relationship between these variables. The short run coefficient and **the conditional error correction regression are** summarised in Table 4.

**Table 4**  
ARDL bound test results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	43527429	9414220.	0.000000	0.0000
$COEC_{t-1}(ECT)$	-0.221187	0.036068	-6.132545	0.0000
$GPR_{t-1}$	-109694.8	72900.14	-1.504727	0.1339
GROWTH	-475079.9	255291.8	-1.860929	0.0642
INF	-860834.3	1180220.	0.000000	0.0000
$I_{t-1}$	-1854219.	298093.4	-6.220263	0.0000
$EXCH_{t-1}$	21578350	3421945.	0.000000	0.0000
$\Delta COEC_{t-1}$	0.206392	0.066126	3.121194	0.0021
$\Delta COEC_{t-2}$	0.020043	0.062741	0.319455	0.7497
$\Delta COEC_{t-3}$	0.122616	0.061467	1.994830	0.0474
$\Delta GPR$	79174.94	59368.90	1.333610	0.1838
$\Delta GPR_{t-1}$	207668.3	65458.44	3.172522	0.0017
$\Delta GPR_{t-2}$	211501.1	58699.31	3.603127	0.0004
$\Delta I$	-2042537.	727976.3	-2.805774	0.0055
$\Delta I_{t-1}$	1081724.	747256.5	1.447594	0.1492
$\Delta I_{t-2}$	-577476.2	730231.8	-0.790812	0.4300
$\Delta I_{t-3}$	2263214.	686671.3	3.295920	0.0012
$\Delta EXCH$	15852808	4048141.	0.000000	0.0000
$\Delta EXCH_{t-1}$	-6565344.	5366222.	0.000000	0.0000
$\Delta EXCH_{t-2}$	-15949940	4788656.	0.000000	0.0000
$\Delta EXCH_{t-3}$	8879218.	5155262.	0.000000	0.0000
$\Delta EXCH_{t-4}$	-24004649	4364953.	0.000000	0.0000
$\Delta EXCH_{t-5}$	11617087	4464686.	0.000000	0.0000

Based on Table 4, the EC term ( $COEC_{t-1}$  coefficient) is  $-0.221$  and this coefficient is highly significant at the 1% significance level ( $p = 0.0000$ ). The fact that this coefficient is negative and significant indicates that short-term imbalances are corrected in the long term, that is, the system tends to return to long-term equilibrium. In addition, the value of this coefficient indicates that approximately 22% of the deviation in the system is corrected in each period. This indicates a medium-speed equilibrium return process.

Some short-term coefficients were found to be significant  $\Delta GPR_{t-1}$  and  $\Delta GPR_{t-2}$  are both significant and positive. This shows that increases in geopolitical risk increase the cost of equity capital in the short term.  $D(I)$  and  $\Delta I_{t-3}$  reveal that the interest rate effect is complex but generally effective in the short term. Lagged differences such as  $\Delta COEC_{t-1}$  and  $\Delta COEC_{t-3}$  are also significant, indicating that  $COEC$  is sensitive to its own history. The long run coefficient and bound test are summarised in Table 5.

**Table 5***Long-run coefficient and bound test*

Variable	Coefficient	Std. Error	t-Statistic (Prob.)
GPR	-495937.9	309178.0	-1.8540 (0.0702)
GROWTH	-2147870.	1162190.	-1.8481 (0.066)
INF	-3891893.	5352591.	-0.7271 (0.468)
I	-8383057.	782107.9	-10.7185 (0.000)
EXCH	97557248	1605442.	60.766 (0.000)
C	1.97E+08	29507381	6.6691 (0.000)

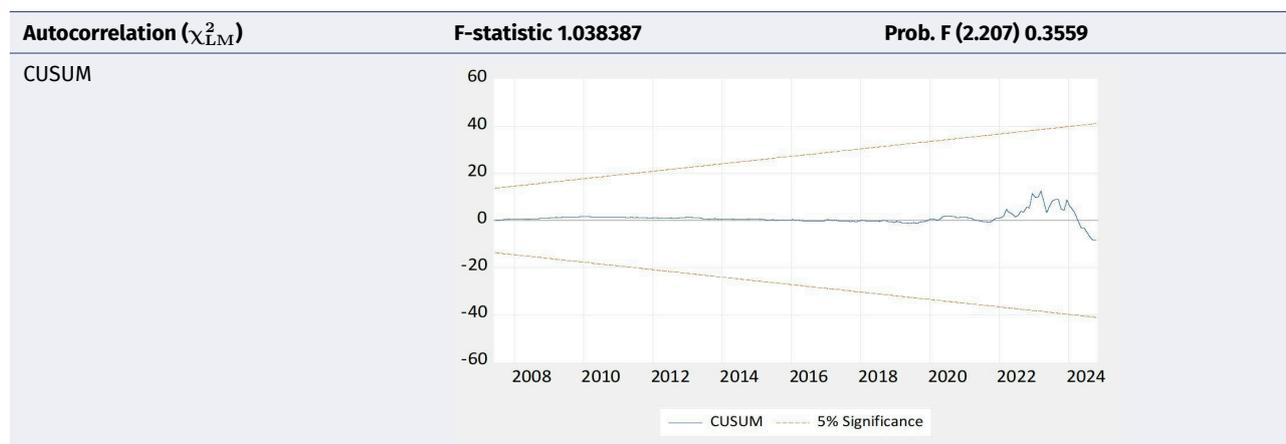
According to Table 5, the long-run equation results show the effects of the variables at the level. In this context, the most striking finding is related to the exchange rate variable (EXCH). The coefficient of the exchange rate is quite large, and the p-value is 0.000, meaning that its effect is both economically significant and statistically extremely strong. This shows that increases in the exchange rate significantly increase the cost of equity. Moreover, the coefficient of the policy rate (I) is  $-8.38$  million, which is again very significant ( $p = 0.000$ ). This shows that increases in interest rates have a negative but strong effect on the cost of equity. In the case of other variables, geopolitical risk (GPR) and economic growth are found statistically in the 10% level. This shows that GPR and GROWTH have a negative effect on the cost of equity capital of the banking system. Inflation (INF) is not found to be statistically significant in the long-term equation.

According to the Bounds test, the F-statistic value is 6.5110. This value exceeds the upper limit value  $I(1)$  even at the 1% significance level for both asymptotic and finite samples. The critical value range for 5% is (2.39 ; 3.38) and for the critical value range for 1% is (3.06 ; 4.15) and our model  $F = 6.511 > 4.15$ . the bound test is summarised in Table 6:

**Table 6***F-Bounds Test (Null Hypothesis: No level relationship)*

Test Statistic	Value	Significance Level	I(0)	I(1)
<b>F-statistic</b>	6.511028	10%	2.08	3
		5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

This result shows that the  $H_0$  hypothesis (there is no long-term relationship) is rejected. In other words, there is a long-term co-integration relationship between COEC and the GPR, GROWTH, INF, I, and EXCH variables. According to the **Breusch-Godfrey Autocorrelation Test** results, since the p-values are above the 5% significance level, the null hypothesis that there is no autocorrelation in the model up to two consecutive lags cannot be rejected; that is, there is no autocorrelation problem in the model and based on the CUSUM test the model is structurally stable. The results are summarised in Table 7.

**Table 7***Autocorrelation and the CUSUM test results*

Based on Tables 5 and 7, the exchange rate variable has a large coefficient in economic terms in the model and is found to be statistically significant at the 1% level. The reason for this result is that the banking sector borrows largely in foreign currency and its asset-liability structure is sensitive to foreign exchange. An increase in the exchange rate increases the cost of borrowing in foreign currency for banks, increasing their capital costs. This effect becomes even more pronounced in economies with a high exchange rate pass-through, such as Türkiye. Therefore, both the economic and statistical significance of the variable is extremely strong.

The policy rate coefficient is found to be negative in the model and found to be highly significant. This result can be interpreted as the increase in interest rates increasing the general financing costs and reducing the equity capital costs of banks. The main reason for this may be that increases in policy rates generally indicate a tight monetary policy and investors turn to higher interest-yielding alternatives. This situation suppresses banks' need to provide funds with equity and may decrease their capital costs. In addition, interest rate hikes generally reduce the exchange rate pressure and may indirectly reduce capital costs coming through exchange rates.

The geopolitical risk variable was found to be significant at the 10% level of significance, i.e., borderline. The reason why the effect of this variable is not completely strong is that risk perceptions have indirect effects on the banking system. Geopolitical risks affecting investor confidence and capital inflows may not be directly reflected in the cost of equity but through indirect and delayed channels. Therefore, its statistical significance is limited, but it is still an effect that should be considered.

The economic growth variable was also found to have a negative effect at the 10% level of significance. Increasing economic growth generally increases credit demand in the banking sector, increases profitability and reduces the pressure on capital. Therefore, growth can have a decreasing effect on the cost of equity. However, the strength of this relationship may vary depending on the quality of growth and how the sector is affected by growth. This may explain why no completely strong relationship is observed in the model. Although the inflation variable is not statistically significant in the long-term equation, the effect is negative. Rising inflation may also cause nominal interest rates to rise. However, if the nominal interest rate increases lag behind inflation, the real interest rate falls. This may also cause firms to reduce their capital costs. Since the policy rate variable ( $I$ ) is controlled separately in the model, the negative coefficient of inflation may mean a lower capital cost due to the real interest rate decline. In other words, investors may be more inclined to invest in equity capital with low real returns in a high inflation environment, thus reducing the firms' cost of equity capital.

During the period in which the model is estimated (2005M01–2025M03), the Turkish economy experienced low-interest rate policies, exchange rate shocks and credit expansions accompanied by high inflation. These periodic policies may have reversed the effect of inflation on the cost of capital. There is, for instance, a structure in which the policy rate was suppressed despite high inflation in the post-2021 period; this may have reduced investment costs.

### Time-Varying Estimation:

When the relationships between financial and macroeconomic indicators are assumed to be fixed and unchanging structures over time, important dynamics can be ignored. However, especially in developing countries, economic and political shocks can cause these relationships to fluctuate over time. Therefore, considering the time-varying structure of the relationship between variables in econometric analyses provides more accurate and policy-significant results.

For this study, the Dynamic Conditional Correlation - Generalised Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model will be used to examine how the relationship between the basic macroeconomic factors determining the cost of equity capital in the Turkish banking sector and this cost changes over time. The DCC-GARCH model is a version of the basic GARCH model developed by Bollerslev (1990) and extended by Engle (2002a) with a dynamic conditional correlation structure. This model allows the estimation of the time-varying variance-covariance structure between variables in a multivariate time series. It is an effective method especially for analysing volatility dependencies between macroeconomic variables and financial indicators in the time dimension.

The main reason for choosing this model is that, unlike classical fixed parameter models, it considers the time-varying nature of risks and macroeconomic effects in the financial system. In an economy like Türkiye, where exchange rates, interest rates and geopolitical risks fluctuate frequently, it is not expected that these relationships will remain constant. In this context, the DCC-GARCH model is one of the most appropriate model structures in terms of determining the dynamic dependence between the cost of equity and fundamental determinants such as exchange rates, interest rates, inflation, geopolitical risks and growth. In the first stage of this study, the long-term relationship between the variables is determined with the ARDL model, and then the volatility and co-movement structure of this relationship over time will be analysed with the DCC-GARCH model. In this way, both the long-term balance and the short-term co-integration and correlation structure that change over time will be evaluated together. Engle (2002b) defines  $\rho_{12,t}$  as a conditional correlation between two random variables  $r_1$  and  $r_2$  as follows:

$$\rho_{12,t} = \frac{E_{t-1}(r_{1,t}r_{2,t})}{\sqrt{E_{t-1}(r_{1,t}^2)E_{t-1}(r_{2,t}^2)}}$$

Based on probability,  $\rho_{12,t}$  must lie within the interval  $[-1, 1]$ . Hence, following Engle (2002c) and Hamilton (2008), the multivariate GARCH model allowing for time-varying correlation is as follows:

$$A(L)y_t = \epsilon_t; \epsilon_t \sim N(0, H_t), t = 1, \dots, T$$

where,

$y_t = [y_{1t}, y_{2t}]'$  and  $A(L)$  is a matrix in the lag operator  $L$ ,  $\epsilon_t = [\epsilon_{1t}, \epsilon_{2t}]'$  vector of innovation, which follows the conditional variance-covariance matrix:

$$H_t = D_t R_t D_t$$

$R_t = [\rho_{ij}]_t$  for  $i$  and  $j= 1,2$  is a symmetric positive definite matrix with  $\rho_{ij} = 1, \forall i$ , and a correlation matrix containing conditional correlation coefficients (CCC) and  $D_t = \text{diag}(\sqrt{h_{11t}}, \dots, \sqrt{h_{NNt}})$  containing the time-varying standard deviation from the univariate GARCH models. Univariate GARCH (p, q) process:

$$h_t^2 = \omega + \sum_{i=1}^q \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^p \beta_j h_{t-j}^2$$

Based on Engle (2002c),  $R_t$  is taken as follows:

$$R_t = \text{diag}(q_{11,t}^{-\frac{1}{2}} \dots q_{NN,t}^{-\frac{1}{2}}) Q_t \text{diag}(q_{11,t}^{-\frac{1}{2}} \dots q_{NN,t}^{-\frac{1}{2}})$$

where;

$$Q_t = (1 - \alpha - \beta) \bar{Q} + \alpha u_{t-1} u_{t-1}' + \beta Q_{t-1}$$

According to Engle and Sheppard (2001), if we have positive definite  $Q_t$ , it implies  $R_t$  to have positive sign and  $\bar{Q}$  is an  $N \times N$  unconditional variance matrix of  $u_t$  and  $\alpha \geq 0$  and  $\beta \geq 0$  and  $\alpha + \beta < 1$ .

$$\rho_{12t} = \frac{(1 - \alpha - \beta) \bar{q}_{12} + \alpha u_{1,t-1} u_{2,t-1} + \beta q_{12,t-1}}{\sqrt{((1 - \alpha - \beta) \bar{q}_{11} + \alpha u_{1,t-1}^2 + \beta q_{11,t-1})(1 - \alpha - \beta) \bar{q}_{22} + \alpha u_{2,t-1}^2 + \beta q_{22,t-1}}}$$

The DCC-GARCH (Dynamic Conditional Correlation-Generalised Autoregressive Conditional Heteroskedasticity) model is a multivariate volatility model frequently used in the analysis of time-varying variance and correlation structures. Due to the theoretical infrastructure of this model, all variables included in the analysis must be stationary  $I(0)$ , that is, have a constant mean and variance over time. Non-stationary series may impair the statistical validity of the model and lead to incorrect inferences. Therefore, the stationarity levels of all variables were tested with unit root tests before modelling. According to the applied ADF and PP tests, the exchange rate [EXCH (USD/TRY)], policy rate (I) and cost of equity (COEC) variables are not stationary at the level; however, when the first differences of these variables are taken, it is determined that they become stationary at the 1% significance level. According to this result, the returns or changes of these variables were used in the model. Thanks to this transformation, all series were made  $I(0)$  and made suitable for the DCC-GARCH model. The results of the DCC-GARCH model are summarised in Table 8.

**Table 8**

The DCC-GARCH test results

Parameter	Coefficient	t-value (t-prob)
$\rho_{21}$	0.169081	1.147 (0.2525)
$\rho_{31}$	261264	1.810 (0.0715)
$\rho_{41}$	0.307643	2.679 (0.0079)
$\rho_{32}$	-0.030035	-0.2549 (0.7990)
$\rho_{42}$	0.338831	5.508 (0.0000)
$\rho_{43}$	0.040633	0.3133 (0.7543)
$\alpha$	0.073357	1.349 (0.1785)
$\beta$	0.732285	5.551 (0.0000)

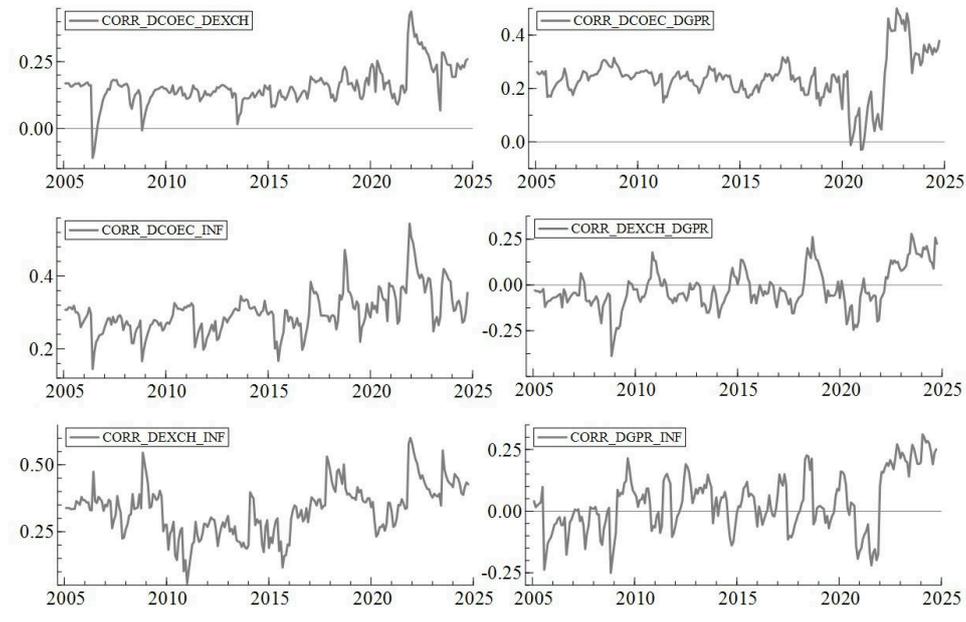
The DCC-GARCH model is estimated with four time series of DCOEC (change in cost of equity capital), DEXCH (change in exchange rate), DGPR (change in geopolitical risk) and INF (inflation rate). The model used is based on the dynamic conditional correlation structure developed by Engle (2002), and the variance structure is defined in the multivariate GARCH form. The dataset consists of 237 observations covering the period 2005(2)–2024(10).

The estimated  $\rho_{ij}$  coefficients in the model represent the initial levels of the time-varying correlation between the series. For  $\rho_{21}$  (DEXCH with DCOEC), a positive relationship with a coefficient of 0.169 is observed; however, it is not statistically significant with a p-value of 0.2525. This indicates that there is a positive but weak and unreliable relationship between the return of the exchange rate and the cost of equity.  $\rho_{31}$  (DGPR with DCOEC); a positive and nearly significant relationship ( $p = 0.0715$ ) was detected with a coefficient of 0.261. This result shows that the effect of changes in geopolitical risks on the cost of equity is borderline significant. This provides an indication that COEC may increase in periods when risk perception increases. The case of  $\rho_{41}$  (INF with DCOEC) shows that a statistically significant and positive relationship ( $p = 0.0079$ ) is found with a coefficient of 0.308. This shows that inflation increases the cost of equity and this relationship is strong. This result is quite expected, especially in high-inflation economies such as Türkiye.  $\rho_{32}$  (DGPR with DEXCH) shows that a negative but insignificant relationship was observed with a coefficient of  $-0.030$  ( $p = 0.7990$ ). In other words, geopolitical risks do not have a significant effect on the exchange rate volatility.  $\rho_{42}$  (INF with DEXCH); a very high and very significant positive relationship ( $p = 0.0000$ ) is found with a coefficient of 0.339. This result clearly shows that as inflation increases, the exchange rate volatility also increases. This is an important finding in terms of the link between the exchange rate pass-through and price stability.  $\rho_{43}$  (INF with DGPR) showed a positive but insignificant relationship with a coefficient of 0.041 ( $p = 0.7543$ ). In other words, a strong dynamic relationship could not be determined between inflation and geopolitical risk.

The parameters determining the dynamic correlation structure in the model for  $\alpha = 0.073$  ( $p = 0.1785$ ) Measures the magnitude of the response of the time-varying correlation to shocks. The lack of significance indicates that the correlations do not respond very quickly to shocks.  $\beta = 0.732$  ( $p = 0.0000$ ) indicates the dependence of the correlation on its past. Since this value is significant and high, it shows that the correlation structure of the model is quite persistent over time. In other words, the effect of past periods is preserved for a long time. The total log-likelihood value of the model is  $-4349.76$  and the statistical convergence of the model was achieved. In addition, robust standard errors (sandwich estimator) were used to increase the reliability of the coefficients.

These DCC-GARCH model results show that the DCC effect of inflation on both the cost of equity and exchange rate volatility is statistically strong and positive. In addition, geopolitical risk has a significant effect on the cost of equity, which is close to the limit. The DCC between the exchange rate and COEC is positive but not significant. This situation provides important clues in understanding how time-varying correlations respond to different economic shocks. Due to the high beta value of the model, it is understood that volatility and correlations follow a stable structure over time and are strongly affected by the past values of these structures. This shows that both the level and the persistence of risks should be considered by policy makers. [Figure 1](#) shows the DCC between the variables.

**Figure 1**  
DCC results



This graph shows the results of the time-varying conditional correlation—Dynamic Conditional Correlation—obtained from the DCC-GARCH model. The graphs show the periodic course of the correlation between each pair of variables between 2005 and 2025. The graph illustrates that the conditional correlation between DCOEC and DEXCH is generally positive and tends to increase over time. While the correlation between 2005 and 2015 is lower and fluctuating, the correlation after 2018 increases significantly and reaches its peak in the 2021-2022 period. This shows that changes in the exchange rate have had a stronger effect on the cost of equity in recent years, meaning that foreign exchange risk is increasingly associated with banking sector costs. In this panel, the correlation is almost positive between 2005 and 2020; however, it shows a rapid and significant increase after 2021. This relationship, which reached 0.5% in the last period (2023–2025), shows that the effect of the increase in geopolitical risks on banks' capital costs has strengthened over time. This situation indicates that regional conflicts or political uncertainties are reflected in the economic costs. The correlation is generally positive and shows a fluctuating but upward trend over time. It reached peak levels especially in the period after 2018 and 2020. This situation reveals that banks' cost of equity tends to increase in high inflation environments, and this relationship becomes more pronounced in crisis periods.

The relationship between the variables is not stable and shows significant structural changes over time. While the correlation occasionally drops to negative levels, it shows a slight increase after 2015. However, it is a generally fluctuating and weak correlation without a clear direction. In other words, the effect of geopolitical risks on the exchange rate is unstable and context-dependent over time. This graph shows that the strongest and most consistently positive correlation is between these two variables, namely the exchange rate and inflation. The correlation level generally ranges between 0.3 – 0.5, which reveals that exchange rate changes are very closely linked to inflation and that this relationship continues in a stable structure in economies with high exchange rate pass-through, such as the Türkiye. The correlation between geopolitical risk and inflation is generally weak but shows an increasing positive trend over time. The upward trend after 2015 became evident and exceeded 0.2 in the 2023–2025 period. This indicates that the impact of political risks on inflation expectations and pricing behaviour has become more visible in the recent period.

The lack of statistical significance in the model for the correlation between GPR and exchange rate changes ( $p > 0.7$ ) indicates that this relationship remains weak due to contextual and seasonal factors. However, the increase in correlation seen in Graph 1 indicates that geopolitical events, especially in the post-2018 period, are more directly reflected in exchange rate expectations. This contradiction can be explained by the model reflecting the average correlation relationship and the difference in the trend over time. In other words, although statistical significance was not achieved in the model, graphical analysis showed that this relationship strengthened over time and was sensitive to seasonal shocks.

## Concluding Remarks

This paper analysed the dynamic impacts of geopolitical risk on the costs of equity capital in the Turkish banking industry, based on a sound empirical paradigm of the ARDL and DCC-GARCH models. The results validate considerable long- and short-run relationships between geopolitical uncertainty and the cost of capital, which make important contributions to the literature on financial volatility in emerging economies subject to regional conflict, macroeconomic instability, and policy uncertainty.

In the long run, the ARDL estimates also indicate that geopolitical risk (GPR), albeit weakly significant at the 10% level, has a negative impact on the cost of equity. In the long-term model, the GPR coefficient is  $-495,937.9$ , which shows that a one-point increase in the GPR index creates an average decrease of approximately 496 thousand TL in the cost of equity. This finding shows that despite the effect of increasing geopolitical risks on reducing capital flows by distorting investor perception, it can create a negative pressure on the cost of capital with indirect effects. Here, it is able to capture the multidimensionality and at times lagged transmission channels through which geopolitical tension impacts financial markets, e.g., investor sentiment, capital flight, and perceived risk premiums. The policy interest rate and exchange rate, in contrast, are the most potent long-run determinants of equity costs. The exchange rate, indeed, has a very sizeable and statistically significant positive coefficient, highlighting Turkish banks' exposure to currency devaluation. With such high exposure of the banking sector to foreign currency liabilities, the result implies that exchange rate risk is still a key channel through which macroeconomic uncertainty raises capital costs. The large and negative policy rate has been interpreted as proof that a tighter monetary policy can reduce capital costs via stabilising exchange rate and inflation expectations, thereby improving investor confidence.

Short-run dynamics also reflect the connection between equity capital and macro-financial variables. Different lags of GPR changes were seen to have a significant effect on the cost of equity in the short term, implying that markets respond quickly to perceived shocks or threats. This highlights the need for real-time risk monitoring tools and investor sentiment measures. Likewise, the short-run impact of interest rate changes, as revealed in the significance of lagged differences, indicates that policy messages are rapidly digested by financial participants.

The DCC-GARCH (1,1) estimation introduces a dynamic component to the analysis by estimating the time-varying relations between geopolitical risk and the cost of equity in Türkiye's banking industry. The model detects a weak but positive and rising correlation, especially after 2018, which coincides with escalating regional conflicts, such as the Syrian spillover, Eastern Mediterranean tensions, and internal political instability. The implication is that the cost of capital of banks has been increasingly sensitive to geopolitical uncertainty in recent years.

Inflation and exchange rate behaviour also exhibit strong, time-varying correlations with share prices. The association between inflation and equity agrees with the argument that persistent macroeconomic uncertainty erodes investor confidence and increases risk premia. The impact of the exchange rate reflects the exposure of the Türkiye to currency risk in a dollarized economy. From a policy point of view, the

evidence underlines the significance of macro-financial stability to ensure access to cheap capital. Institutional resilience, monetary policy credibility, and transparency are essential for curbing vulnerability. The observation that there is even a small long-term geopolitical risk effect that regional diplomacy, conflict resolution, and reputation risk management are also value-generating. In either case, the answer is no.

This research is an example of the benefits of merging the ARDL-bound and DCC-GARCH models. As ARDL pinpoints long- and short-run relationships, DCC-GARCH picks up volatility dynamics, presenting a broader picture—especially during uncertain periods. Follow-up research can aim to split the GPR index into its domestic and international counterparts or utilise firm-level data to examine how banks with varying risk profiles respond to geopolitical shocks. Additionally, employing AI-based sentiment analysis and industry-level GPR indices—most notably, for technology and critical minerals—can increase predictive power and policy relevance. In general, geopolitical risk is a rising force in Türkiye’s financial landscape, and its changing role must be understood by policymakers and investors.

This study is based only on the balance sheet data of the deposit banks operating in Türkiye. Excluding participation banks and investment banks from the model may limit the reflection of the findings of the banking sector as a whole. In particular, participation banks with non-interest income structures or Islamic financial structures may respond differently to geopolitical risk perception. Therefore, it is recommended that more comprehensive analyses be conducted in future studies by considering the differences between banking sub-sectors.



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