POLITIK EKONOMIK KURAM

Research Article

Does Geopolitical Risk Affect Inflation? Empirical Analysis of the Impact of Russia-Ukraine and Israel-Palestine Events on Türkiye

Esra SOYU YILDIRIM[1], Cuma DEMİRTAŞ[2]

[1] Dr., Aksaray University, Aksaray Vocational School of Social Sciences, esrasoyu@aksaray.edu.tr, ORCID: 0000-0003-1614-0967
[2] Assist. Prof. Dr. Aksaray University, Aksaray Vocational School of Social Sciences, cumademirtas@aksaray.edu.tr, ORCID: 0000-0002-1475-5530

Abstract: Geopolitical risk stemming from negative events such as war, terrorist acts and tensions, together with economic and political uncertainty, has a negative impact on economic activity. Therefore, this study aims to examine the impact of geopolitical concerns originating from Russia and Israel on the inflation level in Türkiye in the time period from January 2003 to January 2024. To achieve this objective, the series undergoes wavelet transformation and an analysis is conducted to determine if there are variations in the short-term, medium-term, and long-term effects. To account for structural discontinuities in the series, the Fourier quantile causality test was initially conducted. However, as the Fourier function did not yield significant results, the quantile causality test was then done. The data indicate that in the original series, unidirectional causation occurs only at the 0.1 quantile. However, in the converted series, causality is detected at the 0.8 quantile in the short run and at the 0.1 and 0.6 quantiles in the long run. This indicates that the long-term effect of geopolitical risk and other factors on inflation has become more significant in Türkiye. In line with the findings, recommendations were presented to policy makers and researchers.

Keywords: Geopolitical risk, Inflation, Quantile causality, Russia, Türkiye
Jel Codes: E31, C33, F50

Jeopolitik Risk Enflasyonu Etkiler mi? Rusya-Ukrayna ve İsrail-Filistin Olaylarının Türkiye Üzerindeki Etkisinin Ampirik Analizi

Öz: Savaş, terör eylemleri ve gerginlikler gibi olumsuz olaylardan kaynaklanan jeopolitik risk ekonomik ve politik belirsizlikle birlikte, ekonomik aktivite üzerinde olumsuz bir etkiye sahip olmaktadır. Dolayısıyla bu çalışmada, Ocak 2003'ten Ocak 2024'e kadar olan zaman diliminde Rusya ve İsrail kaynaklı jeopolitik endişelerin Türkiye'deki enflasyon düzeyi üzerindeki etkisini incelemek amaçlanmıştır. Bu amaca ulaşmak için seriler dalgacık dönüşümüne tabi tutulmuş ve kısa vadeli, orta vadeli ve uzun vadeli etkilerde farklılıklar olup olmadığını belirlemek için bir analiz yapılmıştır. Serideki yapısal kesintileri hesaba katmak için öncelikle Fourier kantil nedensellik testi yapılmıştır. Ancak Fourier fonksiyonu anlamlı sonuçlar vermediğinden daha sonra kantil nedensellik testi yapılmıştır. Veriler, orijinal seride tek yönlü nedenselliğin yalnızca 0,1 kantilinde meydana geldiğini göstermektedir. Ancak dönüştürülen seride kısa vadede 0,8 kantilinde, uzun vadede ise 0,1 ve 0,6 kantillerinde nedensellik tespit edilmiştir. Bu durum, jeopolitik riskin ve diğer faktörlerin enflasyon üzerindeki uzun vadeli etkisinin Türkiye'de daha anlamlı hale geldiğini göstermektedir. Elde edilen bulgular doğrultusunda politika yapıcılara ve araştırmacılara öneriler sunulmuştur.

Anahtar Kelimeler: Jeopolitik risk, Enflasyon, Kantil nedensellik, Rusya, Türkiye
Jel Kodları: E31, C33, F50

Cite: Yıldırım, Soyu, E. & Demirtaş C. (2025). Does Geopolitical Risk Affect Inflation? Empirical Analysis of the Impact of Russia-Ukraine and Israel-Palestine Events on Türkiye, *Politik Ekonomik Kuram, 9*(1), 17-29. https://doi.org/10.30586/pek.1571215

Submitted: 21.10.2024
Accepted: 23.12.2024

1. Introduction

Geopolitical risk (GPR) refers to the vulnerability of a country or region's political activities to the influence of other countries (Engle & Campos-Martins, 2020). The complexity of GPR has significantly increased since the 2000s. The primary factor contributing to this intricacy is the swift and interconnected nature of the geopolitical scene on a global scale. The Gulf War, the invasion of Iraq, September 11 attacks, the Ukraine/Russia crisis, the terrorist attacks in Paris, the conflicts in Syria, US-North Korea tensions, the US recognition of Jerusalem as the capital of Israel, US-Iran tensions, the Russian-Ukrainian war, the Israeli-Palestinian conflict, and various other events have contributed to the emergence of geopolitical risks (Balli et al., 2022).

Following the 1991 dissolution of Soviet Russia, a major conflict broke out between Russia and Ukraine in 2014 when Russia annexed Crimea. In recent years, the diplomatic relations between the two nations have been strained. However, in early 2020, a conflict supported by Russia erupted between the Donetsk and Luhansk areas, leading to the imposition of many sanctions against Russia. Ukraine's aspiration to become a member of the North Atlantic Treaty Organization (NATO) intensified this struggle (Chortane & Pandey, 2022). The Russia-Ukraine conflict, which commenced on February 24, 2022, remains ongoing and exhibits no indications of cessation. The ongoing conflict between Russia and Ukraine is expected to have a lasting and intensifying effect on both countries, as well as on the global stage (Shen & Hong, 2023). The transmission of GPR shocks from one country to another is attributed to their infectious nature (Balli et al., 2022).

Russia is a prominent global power, mostly because of its large economy and dominant position in energy markets. The intensification of economic integration and globalization has resulted in conflicts inside this prominent nation, which in turn have had a significant impact on commodity and financial markets worldwide. Hence, the Russia-Ukraine conflict has amplified the risks to global financial stability by impacting all facets of economic activity and financing circumstances, including energy prices, inflation, and economic growth (ECB, 2022). It has also impacted businesses, consumers, governments, and communities in many ways. Energy markets have experienced a rapid and profound influence. The reason for this is that Russia plays a significant role in exporting oil and natural gas, while Ukraine acts as a crucial pathway for transporting Russian gas to Europe (Hossain et al., 2024). Oil and its derivatives, namely, are crucial elements of economic production. Energy resources play a vital role in various areas of the economy, such as transportation, agriculture, industry, and housing. Furthermore, petroleum serves as a primary ingredient for producing petrochemical products, hence enhancing its significance and influencing the prices of other commodities (Bhardwaj et al., 2022; Sohag et al., 2023). Following the confrontation between the two nations, there was a significant increase in commodity prices, namely crude oil. In February 2022, the price per barrel was $97.13, which jumped to $117.25 in March and even reached a peak of $130 per barrel at one stage. These incidents show how vulnerable the market for natural resources is to political unrest and instability, which affects supply and demand and causes price fluctuations and spikes (Vidya & Prabheesh, 2020; Khurshid et al., 2024). This had a dual impact, not only increasing the cost of energy for consumers but also adding to the general inflationary pressures. In addition to energy, the crisis also had an impact on other commodities (Hossain et al., 2024). Russia is the primary provider of commodities including wheat, gas, oil, corn, and metals. Ukraine, on the other hand, primarily supplies commodities such as wheat and corn (Khurshid et al., 2024). Consequently, this circumstance has interrupted agricultural output and transit routes, generated apprehensions regarding food security, and resulted in an increase in the prices of these vital commodities. In addition, the possibility of sanctions and trade disruption has heightened the level of uncertainty in commodity markets (Hossain et al., 2024).

Multiple research, including Shahzad et al. (2023), Hossain & Masum (2022), and Ohikhuare (2023), have established that the escalation of geopolitical risks resulting from the Russia-Ukraine conflict might have detrimental effects on economic and financial systems in various ways (Chortane & Pandey, 2022). In recent times, there has been a rise in geopolitical tensions, which reached a peak with Russia's invasion of Ukraine. These tensions have been suggested as the cause of sudden increases and fluctuations in oil prices, as well as high commodity prices that have resulted in a global rise in inflation. The volatility of oil prices has been observed to impact consumer inflation through both non-energy and energy pathways (Lee et al., 2023).

Furthermore, there exists a significant correlation between energy and inflation within this particular setting. Access to cost-effective energy supplies and ensuring energy stability will have an impact on the cost of food, thereby affecting food security. Similarly, in other regions across the globe, European nations depend on Russia for its energy resources, particularly oil. Hence, the price of oil is a major factor in the substantial increase in food inflation (Sohag et al., 2023). The COVID-19 lockdowns and the Russia-Ukraine war have heightened prospects of sustained inflation in the long run. The war caused disruptions in oil, fertilizer, and food supplies, while the sanctions placed on Russia had a detrimental impact on trade and production, leading to an increase in prices (Bouri et al., 2023).

This study aims to analyze the effect of the geopolitical risk index of Russia and Israel on Türkiye's inflation rate. First of all, the reason for using Türkiye as a sample is that Türkiye is one of the countries in the world where inflation has increased the most recently. In this context, the annual inflation rate (% change compared to the same month of the previous year) in Türkiye is 15.85 in July 2018, 79.60 in 2022 and 61.78 in 2024 (TÜİK, 2024). Among the reasons for this increase, the significant fluctuation in the exchange rate in 2018 caused demand inflation. In 2019, the impact of COVID-19 led to a global supply shortage, which in turn caused both demand inflation and cost inflation in Türkiye. During the specified time frame, the country's economy was significantly impacted by both local factors, such as a decrease in interest rates that went against the trend of global central banks, and external factors, including negative developments resulting from geopolitical dangers. The reason for this is that Türkiye relies heavily on energy supplies from Russia. In 2021, Türkiye imported a total of 9.8 million tons of wheat from various countries. The majority, 64.6%, came from Russia, while 13.4% came from Ukraine. Additionally, Türkiye imported 668 thousand tons of sunflower, with 50.6% coming from Russia and 14.6% from Ukraine. In 2021, Russia accounted for 65.5% of the total 820,000 tons of crude sunflower oil imported. The aforementioned factors unequivocally demonstrate that Russia's incursion into Ukraine will provide challenges for Türkiye and other nations in terms of getting these goods (BBC, 2022; Özçelik, 2023).

Moreover, from Türkiye's perspective, Israel's policies towards Palestine are wrong and unjust (Özer, 2023). In this context, it is possible for Türkiye to suspend economic relations with Israel and restrict imports and exports, and for Israel to impose sanctions against Türkiye. Therefore, increasing risks directly and indirectly affect Türkiye.

Given this information, an analysis is conducted on the geopolitical risk indices of Russia and Israel to assess their influence on Türkiye's inflation. Do these geopolitical risk occurrences exert a substantial adverse influence on the escalation of inflation? This research question aims to assess the influence of the fluctuations resulting from the Russian-Ukrainian war, a significant global geopolitical tension, and the Israeli-Palestinian conflict, which has garnered widespread attention, on inflation. The objective is to identify suitable strategies in response. Additionally, our discoveries could assist Turkish policymakers in developing more pragmatic strategies to mitigate the detrimental impact of geopolitical concerns on inflation. This work contributes significantly to the existing body of knowledge on the intersection of geopolitics and macroeconomics. This study does an empirical analysis of the transmission of geopolitical risk from Russia and Israel to Turkish inflation. Additionally, we analyze whether the impact of geopolitical threats on inflation varies over time. To achieve this objective, we employ wavelet transformation on the series and examine whether the influence of geopolitical threats on inflation varies across the short-term, medium-term, and long-term. Ultimately, we do the quantile causality test, which produces reliable outcomes for series that are not regularly distributed.

The paper is structured as follows: Section 2 reviews the theoretical framework and the existing literature. The data and methodology are presented in Section 3 and the empirical results are discussed in Section 4. Finally, Section 5 concludes the paper by proposing policy solutions to the current issue.

2. Theoretical Framework and Literature

The global food production and supply chains are very vulnerable to the impacts of natural disasters and geopolitical tensions. The significance of geopolitical risk as a factor in risk analysis has been heightened by numerous global occurrences. Geopolitical tensions escalate when a country or multiple nations are subjected to political actions originating from other countries (Caldara & Iacoviello, 2022; Sohag et al., 2023).

The impact of increased geopolitical tensions on inflation is uncertain from a theoretical standpoint. These shocks are a mix of negative changes in both demand and supply, which have the ability to affect inflation in either a positive or negative way. Wars and their attendant risks have the capacity to destroy material and human capital, reroute resources to less productive uses, reroute international trade and money flows, and upend worldwide supply chains. Uncertainty over the results of unfavorable geopolitical events can have a detrimental effect on economic activity by tightening financial conditions, delaying employment and investment decisions, and lowering consumer confidence. Government spending, particularly in the form of debt-financed military expenditures, has the potential to counterbalance certain negative effects on demand. The overall impact on inflation is contingent upon the prevailing dominance of these dynamics (Caldara et al., 2022). Several studies have examined the correlation between geopolitical risk and inflation in food costs. The findings are summarized below:

Bouri et al. (2023) examine the divergence in monthly inflation rates among advanced economies in North America and Europe using the TVP-VAR technique. The data utilized encompasses the timeframe spanning from May 1963 to November 2022. During the Russian-Ukrainian war, the aggregate diffusion index of inflation rates significantly increased and surpassed the previous highest point recorded during the oil crisis in the 1970s. Lee et al. (2023) employ Non-parametric quantile causality and Rolling Windows methodology to examine the interaction between geopolitical oil price uncertainty and core inflation in the United States and China. It has been seen that during major geopolitical events like the Euro crisis, Brexit, presidential elections, trade wars, and COVID-19, the danger of geopolitical oil prices has an increasing impact on core inflation. In their study, Caldara et al. (2022) discovered that in 44 nations over the period of 1900 to present, geopolitical concerns have consistently preceded an increase in inflation. This rise in inflation is accompanied by a decrease in economic activity, a rise in military expenditures and public debt, and a fall in international commerce. Through the application of a VAR model, the researchers discover a positive correlation between global geopolitical threats and inflation. In their study, Sohag et al. (2023) discovered that overall indicators of geopolitical risk have a short-term impact of decreasing food costs in Eastern Europe, while simultaneously increasing food prices in Western Europe. Significantly, geopolitical risk events in Russia and global energy costs have consistently been the main factors behind food inflation.

Saâdaoui et al. (2022) employ the Multiresolution causality approach to examine the correlation between geopolitical risk and the pricing of essential food crops (wheat, maize, rice), given that Ukraine's extensive wheat output has been hindered by the Russian-Ukrainian conflict. The findings demonstrate a one-way causal connection, whereby geopolitical factors have a substantial impact on food prices. Sun & Su (2024) analyze the relationship between geopolitical risk and food price using monthly data from April 1998 to July 2022. To do this, they employed the bootstrap full- and sub-sample rolling-window Granger causality test. The empirical findings demonstrate that there is a fluctuating reciprocal connection between GPR and food price. A higher GPR results in a rise in food price, indicating that geopolitical events have the potential to disturb supply and demand dynamics in food markets, potentially leading to global food crises.

Within the existing body of literature, only one study (Sohag et al. (2023)) incorporates a comprehensive geopolitical risk index, encompassing factors such as Russia geopolitical risk, Israel geopolitical risk, a geopolitical risk "threats" index, and a geopolitical risk "acts" index. This study was carried out on a sample of European nations. Nevertheless, the present investigation was carried out on a sample from Türkiye. What is the reason for selecting a sample from Türkiye? Due to its geographical proximity and political involvement, Türkiye has been significantly impacted by both the conflicts between Russia and Ukraine, as well as the ongoing tensions between Israel and Palestine. Türkiye is poised to see the greatest impact from the ongoing Russian-Ukrainian conflict, primarily due to its close proximity to the region and its significant economic ties with both nations. The Israel-Palestine conflict, however, originates from religious, political, and cultural connections that trace back to the time of the Ottoman Empire. Do the threats arising from the Russian-Ukrainian and Israeli-Palestinian conflicts affect inflation in Türkiye? Does the presence of an effect exhibit temporal variation?
The present study aims to address this inquiry and adds to the existing body of literature with its obtained findings.

3. Methodology

3.1. Data Source

The significance of geopolitical concerns in influencing economic and financial markets has been widely acknowledged for a considerable period of time. The primary aim of the study is to ascertain the impact of geopolitical risk events on inflation. The study will analyze monthly data from January 2003 to January 2024. The variables utilized to investigate this correlation, together with its explanations and sources, are displayed in Table 1.

Table 1. Variables, definitions, measurements and sources

Variables	Measurements	Sources
INF	Consumer price index, CPI	TCMB
ACT	Geopolitical risk “acts” index (GPRHA)	Caldara and Iacoviello (2022)
ER	Exchange rates-US Dollar	TCMB
GEPI	Global energy price index	FRED Economic Data (2022
RUS	Russia geopolitical risk	Caldara and Iacoviello (2022)
ISR	Israel geopolitical risk	Caldara and Iacoviello (2022)
TH	Geopolitical risk “threats” index (GPRHT)	Caldara and Iacoviello (2022)

Note: In order to obtain more robust and robust results, the variables (except ınf) are transformed in natural logarithmic form.

We use monthly series of GPR indices for Russia and Israel. The data are obtained from the economic policy uncertainty website (http://www.policyuncertainty.com).

Table 2. Measurement: The Search Category

	Search Category
GPRHT	1. Geopolitical Threats
	2. Nuclear Threats
	3. War Threats
	4. Terrorist Threats
GPRHA	5. War Acts
	6. Terrorist Acts

Source: Caldara et al. (2022)

We construct two components of the GPR index, the indices of geopolitical threats (GPRHT) and geopolitical actions (GPRHA). The GPRHT index looks for articles containing statements about threats and military buildups (categories 1 to 5 in Table 2), while the GPRHA index looks for statements referring to the occurrence or escalation of negative events (categories 5 and 6 in Table 2).

Table 3. Descriptive statistics

		LNINF	LNACT	LNER	LNGEPI	LNRUS	LNISR	LNTH
Orginal	**Mean**	7.247416	1.852490	0.460720	2.189684	-0.141448	-0.432372	1.973150
	Median	7.270545	1.855080	0.286449	2.189961	-0.181445	-0.452122	1.954753
	Max.	7.997242	2.468099	1.477899	2.575664	0.746950	0.561166	2.422347
	Min.	5.338632	1.324875	0.070439	1.747338	-0.643551	-1.061704	1.673398
	S-D	0.413473	0.178337	0.374733	0.161994	0.258396	0.246849	0.119450
	Skew.	-1.448703	0.035705	1.114562	-0.180690	0.673716	0.817433	0.819447
	Kurto.	6.569137	3.709020	3.188353	2.462053	3.333039	5.281653	4.045250
	J-B	221.9038	5.353147	52.75550	4.427316	20.30840	83.05491	39.83187
	Prob.	0.0000***	0.068798*	0.0000***	0.109300	0.0000***	0.0000***	0.000***
	Sum	1826.349	468.6801	116.5621	553.9901	-35.78637	-109.3902	499.2071
	Obs.	253	253	253	253	253	253	253
Short term	**Mean**	2.44E+14	1.38E-15	43873518	1.65E-15	-1.24E-16	-3.13E-16	-1.29E-12
	Median	2.56E+14	-0.000256	-0.000234	0.000105	-0.002806	-0.001967	0.001193
	Max.	9.90E+15	0.144880	8.95E+10	0.080888	0.255390	0.388426	0.196384
	Min.	-9.64E+15	-0.163605	-4.14E+10	-0.120458	-0.201681	-0.286275	-0.128077
	S-D	4.58E+15	0.050315	6.63E+09	0.015024	0.078552	0.110762	0.045811
	Skew.	0.054595	0.113256	8.084946	-1.353166	0.165144	0.196264	0.136550
	Kurto.	2.400040	3.679380	141.6068	21.96087	2.921656	3.549221	3.695882
	J-B	3.920176	5.406450	205281.3	3867.091	1.214690	4.804067	5.891053
	Prob.	0.140846	0.066989*	0.000***	0.000***	0.544795	0.09053*	0.05257*
	Sum	6.17E+16	3.49E-13	1.11E+10	4.17E-13	-3.11E-14	-7.87E-14	-3.27E-10
	Obs.	253	253	253	253	253	253	253
Medium term	**Mean**	-1.22E+19	3.56E+08	6.78E-16	59683794	-2.26E-16	-6.36E-16	2.95E-15
	Median	5.01E+18	-0.001793	-0.001689	0.002205	0.000981	-0.004490	-0.000898
	Max.	9.59E+20	9.00E+10	0.348807	1.51E+10	0.280917	0.475263	0.157721
	Min.	-9.73E+20	-0.204179	-0.390562	-0.124628	-0.248847	-0.514118	-0.156618
	S-D	3.96E+20	5.66E+09	0.069168	9.49E+08	0.092361	0.151239	0.056540
	Skew.	-0.175269	15.81151	-1.011961	15.81151	0.222441	0.075063	0.048330
	Kurto.	2.880638	251.0040	20.07937	251.0040	3.156929	3.671919	2.888107
	J-B	1.445519	658917.2	3118.238	658917.2	2.346021	4.996893	0.230476
	Prob.	0.485411	0.000***	0.000***	0.000***	0.309434	0.08221*	0.891154
	Sum	-3.08E+21	9.00E+10	1.71E-13	1.51E+10	-5.71E-14	-1.62E-13	7.47E-13
	Obs.	253	253	253	253	253	253	253
Long term	**Mean**	7.87E+17	5.59E-15	1.28E-15	6.50E-15	-4.20E-16	-1.32E-15	5.89E-15
	Median	-1.79E+15	-0.027405	-0.009985	0.008399	-0.000131	-0.011548	0.003497
	Max.	9.92E+20	0.413000	0.431275	0.300024	0.505538	0.444964	0.175728
	Min.	-9.96E+20	-0.234118	-0.701905	-0.361184	-0.371790	-0.352499	-0.175096
	S-D	3.28E+20	0.150670	0.323792	0.156206	0.210457	0.154107	0.089710
	Skew.	0.117397	0.902394	-0.542383	-0.212308	0.150458	0.187671	-0.063042
	Kurto.	5.395987	3.318668	2.250002	2.614348	2.444777	3.190273	2.064228
	J-B	61.09828	35.40748	18.33420	3.468477	4.204256	1.866782	9.398598
	Prob.	0.000***	0.000***	0.0001***	0.176535	0.122196	0.393218	0.00910*
	Sum	1.99E+20	1.42E-12	3.56E-13	1.65E-12	-1.07E-13	-3.32E-13	1.49E-12
	Obs.	253	253	253	253	253	253	253

Note: J-B *, **, and *** represent respectively the rejection of the null of normality at 1%, 5%, and 10% significance levels.

As seen in Table 3, according to the Jarque-Bera test statistics, except for lngepi in the original series; lnenf and lnrus in the short run; lninf, lnrus and lnth in the medium run; and lngepi, lnrus and lnisr in the long run, the other variables do not have a normal distribution. Previous evidence supports the application of quantile causality test in empirical analysis in the presence of non-normality (Balcılar et al. 2021). This is because quantile causality tests, which can capture correlations between variables in both the center and the tail, are robust to non-normal distributions (Balcılar et al. 2018).

3.2. Method

Disregarding structural changes while examining the relationship between series can lead to biased findings. Cointegration tests are used to analyze long-term relationships while considering structural changes. However, prior to the research conducted by Enders & Jones in 2016, various causality tests were conducted to study the impacts of these changes. In order to examine Granger causality, Enders & Jones (2016) suggest integrating the Fourier function into the VAR model (Pata et al. 2022).

Following the publication of Enders & Jones (2016), several tests have been developed to analyze various structural modifications in causal relationships. It is recommended to employ a novel Fourier causality test to analyze the causality relationships across different quantiles. This is necessary as the current tests lack reliability when outliers are present and are impractical when the residuals do not follow a normal distribution. In this paper, we propose an expansion of the Fourier quantile causality test and recommend its application across various frequencies. To achieve this, we first partition the original series into different scales and then examine the decomposed series for causality at different frequencies using the Fourier quantile causality test. The approach for the two-step Fourier Quantile Toda-Yamamoto (FQTY) causality test is explained in detail in a publication by Pata et al. (2022). The first stage involves estimating the following equation as in Eq. (1):

$$Y_t = \beta_0 + \beta_1 \sin\left(\frac{2\pi kt}{T}\right) + \beta_2 \cos\left(\frac{2\pi kt}{T}\right) + \sum_{i=1}^{p+dmax} \alpha_{1i} Y_{t-i} + \sum_{i=1}^{p+dmax} \alpha_{2i} X_{t-i} + e_t \quad (1)$$

Here, the optimal lag duration is determined using informational criteria, and dmax displays the highest level of integration of the variables under consideration. As with the FADF unit root test, the ideal lag length (p) and frequency (k) are established. The quantile regression approach uses the following model in Eq. (2) after p and k have been determined:

$$Q_{Y_t}(\tau|Z) = \beta_0(\tau) + \beta_1(\tau)sin\left(\frac{2\pi k^* t}{T}\right) + \beta_2(\tau)cos\left(\frac{2\pi k^* t}{T}\right) + \sum_{i=1}^{p^*+dmax} \alpha_{1i}(\tau)Y_{t-1} + \sum_{i=1}^{p^*+dmax} \alpha_{2i}(\tau)X_{t-1} + e_t \quad (2)$$

In Eq. (2) τ and Z denote, respectively, a particular quantile and covariate matrix. To test the null hypothesis that Xt does not cause Yt at the τ th quantile, we utilize the test statistic shown below:

$$H_0: \alpha_{2,1}(\tau) = \alpha_{2,2}(\tau) = \cdots = \alpha_{2,p^*}(\tau) = 0, \forall\, \tau \in (0,1)$$

$$W = \frac{\left[T\left(\hat{\alpha}_2(\tau)'\left(\left(\widehat{\Omega}(\tau)\right)^{-1}\right)\hat{\alpha}_2(\tau)\right)\right]}{\tau(1-\tau)}$$

Where $\widehat{\Omega}(\tau)$ is the matrix that it represents a consistent estimate of variance and covariance of $\hat{\alpha}_2(\tau)$. A time series causality test can be used to determine whether there have been any causal relationships during the study period. But accounting for different time periods will enable a more comprehensive analysis. In this work, I used wavelet decomposition to verify the causality between the series for this reason.

Wavelet analysis has frequently been utilized in recent years in economic research because to its attractive features (e.g., Pata et al. 2022, Pata et al. 2023, Gorus et al. 2023, Demirtaş, 2023). Wavelets incorporate data from both the time and frequency domains, enabling wavelet analysis to examine the dynamic relationship between series at different time scales.

In this study, we use the discrete wavelet transform to divide the time series into different frequencies. (DWT). The following is a representation of the DWT orthogonal approximation:

$$Y(t) = S_j(t) + D_j(t) + D_{j-1}(t) + \cdots + D_1(t) \quad (3)$$

$S_j(t)$ and $D_j(t)$ can be written in detail below.

$$S_j(t) = \sum_k s_{j,k}\, \varphi_{j,k}(t) \quad (4)$$

Where the scaling function $\varphi_{j,k}$ represents a series' low frequency component and captures long-term behavior.

Also $s_{j,k}$ shows smoothing coefficients that capture information about trend components.

$D_j(t) = \sum_k d_{j,k}\, \theta_{j,k}(t)$

For

$$j = 1, 2, \ldots, log2(N) \quad (5)$$

The wavelet function represented by the notation $\theta_{j,k}$ denotes the high frequency components of a series and captures short run behavior. Also $d_{j,k}$ shows detail coefficients that capture information about short run components.

As proposed by Walden (2001), The series under investigation is split into orthogonal components using the maximal overlapping discrete wavelet transform (MODWT), and causality is evaluated at various frequencies. Because DWT loses its ability to perform statistical analysis as the wavelet number and scaling coefficients decrease. The MODWT representation of the original time series is subject to the following definitions:

$$w_{j,k}(t) = \sum_{l=0}^{L-1} \frac{2^{-j/2}\varphi[(t-2^j l)/2^j]}{2^{j/2}} Y_{t-L} modN \quad (6)$$

And

$$v_{j,k}(t) = \sum_{l=0}^{L-1} \frac{2^{-j/2}\theta[(t-2^j l)/2^j]}{2^{j/2}} Y_{t-L} modN \quad (7)$$

In equation, wavelet ($w_{j,k}$) and scaling ($v_{j,k}$) show coefficients of the MODWT. Also Y_t (t=0,1,2,…, L-1) shows the time series. By following the suggestion of Gençay et al. (2010), we use Daubechies Least Asymmetrical as a wavelet filter and eight as a wavelet length (LA8). We combined the orthogonal components of Y_t considering three different time frequencies: short-term (<2 mounths), mid-term (4-8 mounths), and long-term (over 16 mounths) (Andersson, 2016; Ha et al., 2018).

4.Empirical Findings

The first step of the quantile causality test used in this study is to find the maximum degree of integration (dmax) of the variables. Therefore, the stationarity of the variables is checked and dmax is determined before the tests are conducted. For this purpose, Fourier ADF and ADF unit root tests are used and the results are shown in Table 4. Before interpreting the results of the FADF test, the F test was used to determine the appropriateness of the trigonometric terms. According to the F test, the Fourier function is significant only for lnrus and lnthreats variables in the original series. The FADF unit root test can be used for these series and the ADF unit root test for the remaining series.

Table 4. Results of unit root tests

Original series					**Result: (dmax=1)**
Variables	**k.**	**F-stat**	**p**	**FADF Test Stat**	**ADF Test Stat**
inf	1	5.378647	6	-4.501826	-5.460439*
lnrus	0.1	7.772660**	2	-4.988659*	-
lnisr	1.8	4.113879	1	-7.379665	-8.105167*
lngepi	4.1	2.963818	2	-3.161995	-2.635352***
lnth	0.1	8.635281**	2	-6.676774*	-
lnact	2.1	4.124422	4	-3.764888	-3.972321**
lner	0.1	6.231140	4	2.909797	-12.15941*
		Decomposed Series **Short Run**			**Result: (dmax=null)**
inf	0.1	0.327121	15	-9.655842	-12.34984*
lnrus	0.1	0.073285	15	-9.975180	-11.62483*
lnisr	0.1	0.045292	15	-10.31679	-10.36589*
lngepi	3.5	0.006300	15	-9.840099	-9.889399*
lnth	0.1	0.104466	15	-10.01985	-10.05166*
lnact	0.1	0.146322	15	9.910345	-9.934963*
lner	0.1	0.104466	15	-10.01985	-15.81209*
		Medium Run			**Result: (dmax=null)**
inf	0.1	0.444279	15	-7.454015	-12.23560*
lnrus	0.1	0.495308	15	-7.249288	-7.229762*
lnisr	0.1	0.107517	15	-9.079148	-9.110159*
lngepi	NA	-	-	-	-15.87451*
lnth	0.1	0.382937	15	-7.604883	-7.583579*
lnact	5	2.325416	15	-9.886715	-15.87451*
lner	NA	-	-		-9.624292*
		Long Run			**Result: (dmax=2)**
inf	1.7	3.201575	13	-2.837234	-6.301070*
lnrus	4.6	4.341982	15	-0.631641	-3.138348**
lnisr	4.5	5.911904	15	-1.511038	-3.216948**
lngepi	4.5	4.094797	15	-2.119026	-2.904675**
lnth	4.6	3.986759	15	-1.881725	-3.427855**
lnact	2.1	3.236370	15	-1.984586	-8.953642*
lner	4.5	4.134121	15	-1.137368	-2.641543***

Note: *, ** and *** shows the rejection of null of non-causality at 1%, 5% and 10% levels, respectively. F test: 1%, 5%, 10% respectively 10.02, 7.41, 6.25 and for stationarity 1%, 5%, 10% respectively −4.42136, −3.85494, −3.56574

The FADF test results show that the series are stationary at I(0) in the original lnrus and lnnthreats. Therefore, ADF test results are taken into consideration except for the series mentioned above. Accordingly, it finds that the lner variable in the original series contains a unit root and is stationary in first differences. Therefore, dmax can be calculated as "1" for all VAR model specifications in the original series. In the transformed series, all variables in the short-term and medium-term series are found to be stationary at level. Thus, dmax can be calculated as "0" for all VAR model specifications. In the long-term series, the lnacts variable becomes stationary when the second difference is taken. Therefore, dmax can be calculated as "2" for all VAR model specifications. Moreover, in light of the unit root test results, VAR models are modified with additional lags in order to assess the causal links between variables. In a multivariate setting, in the second stage, the original and decomposed series are subjected to Fourier quantile causality test. However, since the Fourier functions are not significant, a quantile causality test is performed. The results of this test are presented in Table 5.

Table 5. Quantile causality results

Model: INF=f(lnrus, lnisr, lngepi, lnth, lnact, lner)				
		Original Series (k=0.5)		
quantile	**Wald test**	**%10**	**%5**	**%1**
0.1	130.5494	47.13938	55.90255	74.65438
0.2	25.37335	38.07622	44.42952	59.59339
0.3	19.37948	39.75163	45.07942	59.02349
0.4	0.778649	37.99246	44.43715	55.58986
0.5	1.538587	35.24191	40.68843	51.63239
0.6	9.337186	32.12523	36.44590	48.89804
0.7	9.315473	28.90223	33.93491	42.30821
0.8	12.87085	29.10071	33.63599	44.78157
0.9	12.06107	36.91509	43.82817	59.05313
		Short run (k=1.9)		
0.1	11.36001	13.16561	17.10076	25.78955
0.2	7.980228	10.88396	14.13460	20.16110
0.3	9.382510	10.17192	12.58701	17.71864
0.4	5.789540	9.066774	10.87766	16.60661
0.5	6.610021	8.646129	10.65439	16.41173
0.6	5.222066	8.838597	10.78406	15.37476
0.7	6.919261	9.583900	11.77696	16.51152
0.8	15.58345	10.43895	12.97276	18.90371
0.9	10.41015	12.11998	15.47515	23.89937
		Medium run (k=1.8)		
0.1	29.87070	38.14595	50.63118	73.84773
0.2	9.073660	26.49217	33.91645	51.48065
0.3	2.724949	18.64144	25.07744	36.96010
0.4	0.867264	14.93124	20.30333	31.49187
0.5	0.542175	14.63998	19.91373	31.19800
0.6	0.897974	18.40100	25.06413	37.18232
0.7	2.882532	27.04092	36.16145	54.78933
0.8	5.065924	44.34283	56.42686	81.39673
0.9	13.77505	66.28116	85.60470	126.2240
		Long run (k=1.9)		
0.1	16.21841**	8.174425	10.94179	17.77858
0.2	5.921305	7.313294	9.050731	14.01378
0.3	3.145350	7.795861	9.757503	13.67011
0.4	2.799955	8.030653	9.688998	13.04126
0.5	3.044923	7.485355	9.156202	12.40455
0.6	8.242393***	7.425853	8.767388	12.40340
0.7	2.257762	7.389634	9.170706	14.96574
0.8	0.485360	7.675894	9.750501	14.99919
0.9	0.631228	8.046295	11.33995	18.23765

Note: *, ** and *** shows the rejection of null of non-causality at 1%, 5% and 10% levels, respectively

In the original series, unidirectional causality is realized only at the 0.1 quantile. However, when the variables are decomposed using the MODWT decomposition technique, causal links can be assessed in more detail. Wavelet decomposed series show that there is no causal relationship between geopolitical risk and other variables and inflation in the medium term. In the short run, unidirectional causality between geopolitical risk and other variables and inflation is found only at the 0.8 quantile. In the long run, the causal relationship between these variables is higher than in other periods. Thus, there is a causal relationship between geopolitical risk and other variables and inflation at the 0.1 and 0.6 quantiles. This shows that the impact of geopolitical risk and other variables on inflation has become more pronounced in the long run.

5. Discussion

This study investigates the impact of geopolitical risks from Russia and Israel on inflation in Türkiye, and elucidates the variations in these effects across the short, medium, and long term. The outcomes of wavelet transform and quantile causality tests unambiguously demonstrate the varying impact of geopolitical threats on inflation as time progresses. The results demonstrate the susceptibility of Türkiye's economic framework and geopolitical situation to external variables that influence the dynamics of inflation. The study's findings indicate that geopolitical risks exert a more substantial influence on inflation in Türkiye, particularly over an extended period. This demonstrates that geopolitical threats not only generate immediate economic disruptions, but also have the potential to cause enduring impacts on long-term macroeconomic indices. Geopolitical conflicts with nations like Russia and Israel are recognized as elements that pose a danger to price stability in Türkiye. The identified causation link, particularly in the transformed series, indicates that these risks have a more intricate and time-dependent impact on economic indices. While the results of this study align with previous studies in the literature, certain notable distinctions were also identified. In the study conducted by Bouri et al. (2023), it was shown that geopolitical risks had a more abrupt and intense impact on inflation in the North American and European economies. However, in the case of Türkiye, similar impacts were observed to occur over a longer period of time. In contrast to the study conducted by Sohag et al. (2023), which focused on the impact of geopolitical threats on food prices in Eastern and Western Europe, our current research explicitly examines a broad spectrum of inflation in Türkiye. This circumstance demonstrates that Turkey possesses a distinct economic dynamic in relation to geopolitical concerns, and that the impact of these risks on inflation exhibits unique characteristics.

6. Conclusion

The objective of the study is to analyze the influence of Russian and Israeli geopolitical concerns on inflation in Türkiye. To achieve this objective, the series underwent wavelet transformation and an analysis was conducted to determine if the impacts vary across the short, medium, and long term. To account for structural discontinuities in the series, the Fourier quantile causality test was initially conducted. However, as the Fourier function did not yield significant results, the Quantile causality test was then done. Based on the results, it was found that in the original series, there was only one-way causality in the 0.1 quantile. However, in the transformed series, it was seen that there is a causal relationship in the 0.8 quantile in the short term and in the 0.1 and 0.6 quantiles in the long term. This demonstrates that the long-term effects of geopolitical risk and other factors on inflation have become more apparent in Türkiye.

Based on the results, several recommendations can be provided to policymakers and researchers. (i) The impact of geopolitical threats on inflation appears to be more noticeable over a longer period of time. Türkiye should create long-term plans to mitigate the adverse impact of geopolitical concerns on economic indicators. It is crucial to actively pursue alternative markets and collaboration prospects, particularly in dealings with nations like Russia and Israel, in order to decrease economic reliance. (ii) Given Türkiye's significant reliance on Russia in critical sectors like energy and agriculture, it is crucial to enhance diversification and independence, especially in essential domains such as energy supply security. This would help offset the impact of geopolitical risks on Türkiye's inflation. (iii) The results indicate that geopolitical risks have a significant influence on Turkish inflation, particularly over a prolonged period. Given the circumstances, it is imperative for Türkiye's policymakers to adopt a more comprehensive approach in formulating their anti-inflation strategies. This entails not just concentrating on monetary policy instruments but also effectively managing geopolitical risks. (iv) In future research, it is possible to analyze the impact of geopolitical concerns on not just inflation but also other macroeconomic indicators such as unemployment and growth. This will enhance the creation of a more holistic risk management strategy in economic decision-making processes.

References

Andersson, F. N. (2016). Identifying and modelling cycles and long waves in economic time series. In J. Ljunberg (Eds.), *Structural analysis and the process of economic development*, 54-75, UK: Routledge.

Balcilar, M., Bathia, D., Demirer, R. & Gupta, R. (2021). Credit ratings and predictability of stock return dynamics of the BRICS and the PIIGS: Evidence from a nonparametric causality-in-quantiles approach. *The Quarterly Review of Economics and Finance*, *79*, 290-302.

Balcilar, M., Gupta, R., Nguyen, D. K. & Wohar, M. E. (2018). Causal effects of the United States and Japan on Pacific-Rim stock markets: nonparametric quantile causality approach. *Appl. Econ*. *50*(53), 5712-5727.

Balli, F., Balli, H. O., Hasan, M., & Gregory-Allen, R. (2022). Geopolitical risk spillovers and its determinants. *The Annals of Regional Science*, *68*(2), 463-500.

BBC (2022). Rusya'nın Ukrayna'yı İşgal Küresel Gıda Zincir İçin Felaket Olabilir. https://www.bbc.com/turkce/haberlerdunya-60643229, (Erişim Tarihi: 13.05.2022).

Będowska-Sójka, B., Demir, E., & Zaremba, A. (2022). Hedging geopolitical risks with different asset classes: A focus on the Russian invasion of Ukraine. *Finance Research Letters*, 50, 103192.

Bhardwaj, M., Kumar, P., Kumar, S., Dagar, V. & Kumar, A. (2022). A district-level analysis for measuring the effects of climate change on production of agricultural crops, ie, wheat and paddy: evidence from India, *Environmental Science and Pollution Research*, *29*(21), 31861-31885

Bouri, E., Gabauer, D., Gupta, R., & Kinateder, H. (2023). Global geopolitical risk and inflation spillovers across European and North American economies. *Research in International Business and Finance, 66*, 102048.

Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review*, *112*(4), 1194-1225.

Caldara, D., Conlisk, S., Iacoviello, M., & Penn, M. (2022). Do geopolitical risks raise or lower inflation. Federal Reserve Board of Governors.

Chortane, S.G., & Pandey, D.K. (2022). Does the Russia-Ukraine war lead to currency asymmetries? A US dollar tale. J. *Econ. Asymmetries*, 26, e00265.

Demirtaş, C. (2023). Does Inflation Instability Cause Environmental Pollution in Turkiye? Evidence from the Fourier-Wavelet Causality Test. *Ekonomi Politika ve Finans Araştırmaları Dergisi*, *8*(4), 622-642.

ECB (2022). Financial Stability Review, https://www.ecb.europa.eu/pub/financialstability/fsr/html/ecb.fsr202205~f207f46ea0.en.html#toc4

Enders, W. & Jones, P. (2016). Grain prices, oil prices, and multiple smooth breaks in a VAR. *Studies in Nonlinear Dynamics & Econometrics*, *20*(4), 399-419. https://doi.org/10.1515/snde-2014-0101

Engle, R.F. & Campos-Martins, S. (2020). Measuring and hedging geopolitical risk", NYU Stern School of Business Forthcoming, SSRN, available at: https://ssrn.com/abstract53685213 or doi: 10.2139/ssrn.3685213.

Gençay, R., Gradojevic, N., Selçuk, F. & Whitcher, B. (2010). Asymmetry of information flow between volatilities across time scales. *Quantitative Finance*, *10*(8), 895-915. https://doi.org/10.1080/14697680903460143

Gorus, M. S., Yilanci, V. & Kongkuah, M. (2023). FDI inflows-economic globalization nexus in ASEAN countries: The panel bootstrap causality test based on wavelet decomposition. *AsiaPacific Financial Markets*, *30*(2), 339-362. https://doi.org/10.1007/s10690-022-09377-5

Ha, J., Tan, P. P. & Goh, K. L. (2018). Linear and nonlinear causal relationship between energy consumption and economic growth in China: New evidence based on wavelet analysis. *PLoS One*, *13*(5), e0197785. https://doi.org/10.1371/journal.pone.0197785

Hossain, A. T., & Masum, A. A. (2022). Russian invasion of Ukraine, geopolitical risk, and global financial markets. Available at SSRN.

Hossain, A. T., Masum, A. A., & Saadi, S. (2024). The impact of geopolitical risks on foreign exchange markets: Evidence from the Russia–Ukraine war. *Finance Research Letters*, *59*, 104750.

Khurshid, A., Khan, K., Rauf, A., & Cifuentes-Faura, J. (2024). Effect of geopolitical risk on resources prices in the global and Russian-Ukrainian context: A novel Bayesian structural model. Resources Policy, *88*, 104536.

Lee, C. C., Olasehinde-Williams, G., & Özkan, O. (2023). Geopolitical oil price uncertainty transmission into core inflation: evidence from two of the biggest global players. *Energy Economics*, *126*, 106983.

Ohikhuare, O. M. (2023). How geopolitical risk drives spillover interconnectedness between crude oil and exchange rate markets: Evidence from the Russia-Ukraine war. *Resources Policy*, *86*, 104282.

Özçelik, O. (2023). Rusya-Ukrayna Savaşı Gölgesinde Dünyadaki Gıda Fiyatlarının Belirleyicileri: Fourier Bootstrap Ardl ve Fourier Bootstrap Toda-Yamamoto Yaklaşımlarından Kanıtlar. *Tarım Ekonomisi Dergisi*, *29*(1), 29-47.

Özer, Ç. (2023). Uluslararası politika açısından Filistin sorunu. Külliye, [Türkiye Cumhuriyeti'nin 100. Yılı Özel Sayısı], 582-605. https://doi.org/10.48139/aybukulliye.1360984

Pata, U. K., Kartal, M. T., Erdogan, S. & Sarkodie, S. A. (2023). The role of renewable and nuclear energy R&D expenditures and income on environmental quality in Germany: Scrutinizing the EKC and LCC hypotheses with smooth structural changes. *Applied Energy*, *342*, 121138. https://doi.org/10.1016/j.apenergy.2023.121138

Pata, U. K., Yilanci, V., Zhang, Q. & Shah, S. A. R. (2022). Does financial development promote renewable energy consumption in the USA? Evidence from the Fourier-wavelet quantile causality test. *Renewable Energy*, *196*, 432-443. https://doi.org/10.1016/j.renene.2022.07.008

Saâdaoui, F., Jabeur, S. B., & Goodell, J. W. (2022). Causality of geopolitical risk on food prices: Considering the Russo–Ukrainian conflict. *Finance Research Letters*, *49*, 103103.

Shahzad, U., Mohammed, K. S., Tiwari, S., Nakonieczny, J., & Nesterowicz, R. (2023). Connectedness between geopolitical risk, financial instability indices and precious metals markets: Novel findings from Russia Ukraine conflict perspective. *Resources Policy*, *80*, 103190.

Shen, L., & Hong, Y. (2023). Can geopolitical risks excite Germany economic policy uncertainty: Rethinking in the context of the Russia-Ukraine conflict. *Finance Research Letters*, *51*, 103420.

Sohag, K., Islam, M.M., Tomas Žiković, I., & Mansour, H. (2023). Food inflation and geopolitical risks: Analyzing European regions amid the Russia-Ukraine war. *British Food Journal*, *125*(7), 2368-2391.

Sun, T.T. & Su, C.W. (2024). How is geopolitical risk associated with food prices?. *International Journal of Emerging Markets*.

Vidya, C.T. & Prabheesh, K.P. (2020). Implications of COVID-19 pandemic on the global trade networks. *Emerg. Mark. Finance Trade*, *56*(10), 2408–2421.

Walden, A.T. (2001). Wavelet analysis of discrete time series. In C. Casacuberta, R.M. Miró-Roig, J. Verdera and S. Xambó-Descamps (Eds.), Progress in mathematics (627-641). Papers presented at the European Congress of Mathematics, Basel: Springer. https://doi.org/10.1007/978- 3-0348-8266-8_56

Conflict of Interest: None.
Funding: None.
Etik Onay: Yoktur.
Author Contributions: Esra SOYU YILDIRIM (50%), Cuma DEMİRTAŞ (50%)

Çıkar Çatışması: Yoktur.
Finansal Destek: Yoktur.
Etik Onay: Yoktur.
Yazar Katkısı: Esra SOYU YILDIRIM (%50), Cuma DEMİRTAŞ (%50)