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The Effects of Geopolitical Risk on Investor Attention towards Renewable Energy: Evidence from Türkiye

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Jeopolitik Risklerin Yenilenebilir Enerjiye Yönelik Yatırımcı Dikkati Üzerindeki Etkileri: Türkiye Örneği

Abstract

This study is the first to explore how geopolitical risks affect investor attention to renewable energy, with a specific focus on Türkiye. We construct an investor attention index using Google Search Volume Index (GSVI) data for the keyword "renewable energy." By incorporating the Geopolitical Risk Index (GPR) and World Uncertainty Index (WUI), we examine the impact of major events such as the COVID-19 pandemic, the Russia-Ukraine war, and the war after October 7, 2023, on investor attention since 2008. Given Türkiye's heavy reliance on foreign energy and its strategic role as an energy bridge between Europe and the Middle East, it offers a critical case for understanding how geopolitical uncertainties shape renewable energy investment behaviour.

Keywords : Geopolitical Risk, Uncertainty, Investor Attention, Türkiye.

JEL Classification Codes : Q42, Q43, D81.

Öz

Bu çalışma, jeopolitik risklerin yatırımcıların yenilenebilir enerjiye olan dikkatini nasıl etkilediğini Türkiye'ye odaklanarak inceleyen ilk çalışmadır. "Renewable energy" anahtar kelimesi için Google Arama Hacmi Endeksi (GSVI) verileri kullanılarak bir yatırımcı dikkati endeksi oluşturulmuştur. Jeopolitik Risk Endeksi (GPR) ve Dünya Belirsizlik Endeksi (WUI) verileri kullanılarak, COVID-19 pandemisi, Rusya-Ukrayna savaşı ve 7 Ekim 2023'ten sonra yaşanan savaş gibi önemli olayların 2008'den bu yana yatırımcıların dikkati üzerindeki etkisi incelenmiştir. Türkiye'nin yabancı enerjiye olan yoğun bağımlılığı ve Avrupa ile Orta Doğu arasında bir enerji köprüsü olarak stratejik rolü, jeopolitik belirsizliklerin yenilenebilir enerji yatırım davranışlarını nasıl şekillendirdiğini anlamak için kritik bir örnek teşkil etmektedir.

Anahtar Sözcükler : Jeopolitik Risk, Belirsizlik, Yatırımcı Dikkati, Türkiye.

1. Introduction

Global energy markets have seen substantial changes in the last ten years due to major geopolitical events, including the COVID-19 pandemic (March 2020), the Russia-Ukraine war (February 2022), and the Israeli-Palestinian war (October 2023), among others. Particularly during the Russia-Ukraine war, these occurrences fueled rising oil prices and increased worries about energy security (Zhao et al., 2024a: 1). As a result, there is now more discussion about renewable energy sources as potential alternatives to fossil fuels (Chen et al., 2019; Michaelides, 2020; Raza & Lin, 2022). Climate concerns, sustainability, and energy security have fueled global interest in renewable energy, and investment in this sector increased significantly between 2022 and 2023 (IEA, 2023: 27). More specifically, investment rose by approximately 7.6%, from 1617 billion USD to 1740 billion USD[1]. This raises the question of whether investor attention to renewable energy, at both the global and Turkish levels, has been affected by current geopolitical tensions and economic uncertainties.

In this paper, we contribute to answering this question by investigating the impact of global geopolitical risks and economic uncertainties since 2008 on investor attention to renewable energy at the global and Turkish levels. The reasons for the particular interest in Türkiye are primarily threefold. The first is based on Türkiye's geopolitical positions. The Eurasian and African continents make up the "World Island", according to Mackinder, which is the richest continental combination in all respects. Türkiye is in the middle of this area (Şimşek, 2014: 4). Türkiye is a strategic bridge between Europe and Asia. Given that the last two geopolitical risks (the Russia-Ukraine war and the Israeli-Palestinian war) are in Türkiye's bordering countries, it is particularly vulnerable to these conflicts. Second is based on Türkiye's role in global energy trade. Türkiye is one of the most important routes for the transportation of energy resources. For instance, Europe's fourth natural gas artery, the Southern Gas Corridor, was established through the Trans Adriatic Pipeline (TAP). The Trans Anatolian Natural Gas Pipeline (TANAP), which traverses Türkiye, serves as the backbone of the Southern Gas Corridor. Additionally, the TurkStream Natural Gas Project, which consists of two pipelines with a capacity of 15.75 billion cubic meters each and was built beneath the Black Sea, transports natural gas to Türkiye first, then to European countries (Republic of Türkiye Ministry of Foreign Affairs, 2022). Since the first phase of gas flow in 2020 (Botaş, 2025), Türkiye has received a total of 44.3 billion cubic meters of gas, while European countries have received 59.8 billion cubic meters between 2020 and 2024 (Kılıç, 2025). Energy crises, such as the Russia-Ukraine war, threaten Türkiye's energy security and affect the formation of its energy policy. Third is based on the fact that Türkiye has economic relations with many countries. The COVID-19 pandemic has caused an economic recession worldwide (World Bank, 2022: 50). As Türkiye has trade relations with

[1] *In 2015, investments in fossil fuels surpassed those in renewable energy; however, since that year, investment in renewable energy has exceeded that in fossil fuels. In 2023, there was the biggest disparity in the amounts invested. Specifically, in 2023, the global investment in renewable energy reached 1.74 trillion USD, whereas investment in fossil fuels was 1.05 trillion USD (IEA, 2023).*

many countries, geopolitical risks directly affect Türkiye's economy. Besides, the US and EU countries experienced higher inflation following the COVID-19 pandemic. There was also a rise in inflation in Türkiye. To fight inflation, the US and EU countries raised interest rates, while Türkiye kept rates low. Subsequently, the USD/TR exchange rate increased (from 6.61 at the beginning of the pandemic to 34.18 in September 2024 (Investing, 2024)). Besides, inflation reached significant levels, increasing from 11.84% in 2019:12 to 64.77% in 2023:12 (TurkStat, 2024). In an economy that is 74% dependent on foreign energy imports (Republic of Türkiye Ministry of Foreign Affairs, 2022), and whose main goal is economic growth, and which needs to increase its production in this direction, it is very sensitive to increases in the price of a basic fuel such as oil. Therefore, one of the most important steps is the transition to renewable energy. Given this, it's critical to ascertain whether geopolitical risks affect investors' attention to renewable energy in Türkiye. Due to its around 70% reliance on imported energy, particularly natural gas, which accounts for 39.5% of its imports from Russia and only 0.7% of its domestic production, Türkiye is a significant case. Thus, the goal is to ascertain whether investors are affected by the current geopolitical uncertainty in Türkiye, particularly the growing utilisation of renewable energy sources in line with the 2017 National Energy Policy. A study in this area will contribute to the body of literature, as few studies have examined how geopolitical risks affect Türkiye (see Mansour-Ichrakieh & Zeaiter, 2019; Tan et al., 2022; Kasal, 2024, among others).

Geopolitical risks and economic uncertainties exert both direct and indirect effects on investor attention. Investors view the rise in geopolitical events and economic uncertainties as external risks, prompting a more cautious approach, particularly amid heightened geopolitical threats. This is a direct consequence of uncertainty-aversion behaviour. The indirect effects can be explained through three channels: The real economic activity channel, which outlines how heightened geopolitical risks precipitate a contraction in economic activity and growth rates; the firm investment channel, which elucidates how uncertainty compels companies postpone or diminish their investment decisions; and third channel is related to the influence of geopolitical risks on financial markets, resulting in a decrease in stock prices and an escalation in volatility, thereby impacting investor behavior and expectations (He, 2023: 2). In the study, four different models are constructed both at the global level and for Türkiye. Our findings indicate that the model examining the interaction among global GPR, Türkiye-specific GPR, and investor attention in both the global and Türkiye-specific cases has greater connectedness than the other models. In contrast, Model 4, which uses the WUI, exhibits lower connectedness because it focuses more on economic uncertainty than on geopolitical risks. In our sample period, there are three main shocks (March 11, 2020: COVID-19 declared as a pandemic, February 24, 2022: Russia-Ukraine War, October 7, 2023: the Israeli-Palestinian war), and except for COVID-19, the other two shocks are more related to increased geopolitical risk rather than economic uncertainty. Besides, globally, connectedness among investor attention, GPR, and WUI increases during the three shocks, whereas in Türkiye, the highest connectedness occurs post-2016, as the country is more responsive to local geopolitical risks, such as the 2016 military coup, than to global ones. While the global GSVI is a net shock receiver across all

models, the Türkiye-specific GSVI is a net shock transmitter (except in Model 2). Last but not least, global investor attention is significantly affected by both economic and geopolitical uncertainties in the short and long term, whereas shocks within its own system more directly influence Türkiye-specific investor attention than uncertainties do.

The remaining sections of this paper are organised as follows. In Section 2, related literature is given. The datasets are described in Section 3. Section 4 presents the empirical methodology, and Section 5 gives the empirical results. Conclusions and policy implications are included in Section 6.

2. Literature Review

We summarise the diverse applications of the Geopolitical Risk Index (GPR) in recent empirical research across macroeconomic, financial, commodity, and environmental domains in Table 1. For instance, Sweidan (2023) examines the impact of GPR on key U.S. macroeconomic indicators, including real income per capita growth, unemployment, and oil prices, while Asomaning et al. (2024) focus on Ghana, analysing how GPR influences foreign exchange reserves, FDI, and inflation. In financial markets, Elsayed & Helmi (2021) investigate how geopolitical risks affect stock returns in MENA countries, and Singh & Roca (2022) study the influence of GPR on China's market index across various valuation ratios. In the context of commodities, Gong & Xu (2022) assess how GPR affects returns across energy, metals, and agriculture, using the S&P Goldman Sachs Commodity Index, while Banerjee (2024) incorporates GPR and global carbon risk to study commodity market responses. Climate-related studies, such as Cengiz & Manda (2022), explore how GPR interacts with CO_2 emissions and renewable energy consumption in Latin America and Asia, and Acheampong et al. (2023) expand this to a 42-country analysis linking GPR to trade openness, emissions, and FDI. These studies collectively underscore the broad relevance of geopolitical risk in shaping global economic and environmental dynamics.

Table: 1
Literature on the Effects of Geopolitical Risks

Scope	Researchers	Variables	Region
The relationship between GPR and macroeconomic indicators	Sweidan, 2023	GPR, growth rate of real income per capita, the unemployment rate, WTI crude oil prices and the trade-weighted US dollar index	US
	Asomaning et al., 2024	GPR, foreign exchange reserves, FDI, external debt, treasury bill rate, CPI, export and import as a percentage of GDP	Ghana
	Jha et al., 2024	Real GDP per capita, investment as a percentage of GDP, human capital, population growth, trade openness, GPR, inflation rate, government expenditure, index of economic freedom, democracy index	41 countries (including Türkiye)
	Hou et al., 2024	GPR, EPU, WUI, WTU, geographical distance, total trade costs, trade costs of agricultural goods, trade costs of manufactured goods, and common language, land border, colonial relationship, and regional trade agreement	43 countries (including Türkiye)
The relationship between GPR and financial markets	Elsayed & Helmi, 2021	GPR, stock returns of each MENA country	MENA Countries
	Singh & Roca, 2022	GPR for China, market index, US stock market index, book-to-market ratio, cash earnings to price ratio, earnings to price ratio, dividend yield ratio	China, Canada
	Zheng et al., 2023	GPR and global stock markets, foreign exchange markets, bond markets, WTI and gold markets	Global

The relationship between GPR and commodity markets	Gong & Xu, 2022	The S&P Goldman Sachs Commodity Index, total return of energy, precious metal, industrial metal, agriculture, and livestock market, GPR	Global
	Cheng et al., 2023	GPR, excess return of a long position in all available commodities futures contracts, commodity carry factor, commodity momentum factor, total return of energy, metal, agriculture, and livestock markets	Global
	Banerjee, 2024	GPR, a commodity index comprising energy, agriculture, and İndustrial metals, precious metals and livestock, global carbon as a Proxy for climate and geopolitical risk	Global
The relationship between GPR and climate change	Cengiz & Manda, 2022	GPR, CO_2 emissions, GDP per capita, total population, fossil energy consumption and renewable energy consumption	12 Latin American and Asian countries
	Dhifaoui et al., 2023	GPR, total precipitation, relative humidity, temperature, wind direction, wind speed	Saudi Arabia
	Acheampong et al., 2023	GPR, real GDP per capita, population, trade openness, emission variables, renewable energy consumption, FDI	42 countries (including Türkiye)
	Lorente et al., 2023	Climate change index, green financial assets, renewable energy markets, GPR	Global

The literature reveals a growing interest in understanding how geopolitical risks influence various aspects of renewable energy (see Table 2). Several studies examine the link between GPR and renewable energy consumption (e.g., Su et al., 2021; Sweidan, 2021; Cai & Wu, 2021), with some incorporating financial development into their analyses (Alsagr & von Hemmen, 2021; Abdallah et al., 2024). Others focus on renewable energy production, such as Hille (2023) for fossil fuel-importing countries and Lee & Lee (2024) for China. Broader environmental studies like those by Chu et al. (2023) and Jlatong et al. (2023) analyse the joint effects of GPR and environmental policies or economic uncertainty on RE, while Acheampong et al. (2023) and Kızılkaya et al. (2024) incorporate emissions and economic growth in cross-country and Türkiye-specific studies, respectively. Additionally, GPR's impact on renewable energy stock returns has been addressed by Yang et al. (2021), Dutta & Dutta (2022), and others, while research on renewable energy investments under geopolitical tensions includes contributions from Flouros et al. (2022) and Zhao et al. (2024b). Collectively, these studies underline the multifaceted influence of geopolitical risk on renewable energy dynamics across different contexts. Despite the growing interest in renewable energy, relatively few studies have specifically examined investor attention in this context. Song et al. (2019: 4) use the Google Search Volume Index (GSVI) with the keyword "renewable energy" to construct an investor attention variable, analysing its relationship with fossil energy prices and renewable energy stock prices.

Table: 2
Studies on the Relationship between Geopolitical Risk and Renewable Energy

The relationship between GPR and renewable energy consumption	• Su et al. (2021), Sweidan (2021), Cai & Wu (2021), Cheikh & Zaied (2024), Ren et al. (2024) • Alsagr & von Hemmen (2021), Abdallah et al. (2024) focus on the relationship between GPR and RE by including financial development.
The relationship between GPR and renewable energy production	• Hille (2023) focuses on fossil fuel-importing countries, including Türkiye. • Lee & Lee (2024) focus on China.
Studies addressing climate change	• Jlatong et al. (2023) examined the effects of GPR and EPU on RE production, including environmental pollution. • Chu et al. (2023) focus on high- and middle-income countries (including Türkiye) and investigate the impact of the informal economy, environmental policies and geopolitical risks on renewable energy production. • Acheampong et al. (2023) investigated the impact of geopolitical risks on renewable energy consumption by including emission variables and focusing on 42 countries, including Türkiye. • Kızılkaya et al. (2024) examined the relationship between CO_2 emissions and GPR, economic growth, renewable energy consumption and population size for Türkiye.
The relationship between GPR and RE stock returns	• Yang et al. (2021); Dutta and Dutta (2022); Lorente et al. (2023); Zhao et al. (2024a); Ha (2024)
Relationship between GPR and RE investments	• Flouros et al. (2022); Abbas et al. (2023); Dong et al. (2023); Pata et al. (2023); Zhao et al. (2024b); Zheng et al. (2024)

In Türkiye, several studies have investigated the impact of geopolitical risk across various sectors. For instance, Demir et al. (2020), Akadiri et al. (2020), Bayraktaroğlu et al. (2021), Polat et al. (2021) and Tütüncü (2024) analyse the effects of GPR on the tourism industry. Broader economic impacts are examined by Mansour-Ichrakieh & Zeaiter (2019) and Kasal (2024), while Yıldırım et al. (2025) focus on financial markets, and Tan et al. (2022) investigate corporate investment. However, none of these studies has addressed the issue from the joint perspective of geopolitical risk and investor attention[2].

3. Data & Methodology

3.1. Data

In this study, investor attention is measured using the Google Search Volume Index (GSVI)[3], which is frequently utilised in behavioural finance literature. In accordance with Song et al. (2019: 4), a monthly investor attention variable is generated using Google Trends and the keyword "renewable energy"[4]. For a keyword with an indexed value between 0 and 100, GSVI determines the relative search volume. The lowest relative search interest for a given keyword is zero, and the highest relative search interest is one hundred. To generate an index of investor attention to renewable energy, we add 1 to the GSVI index, which has a minimum value of 0 before the logarithmic transformation, in accordance with Pham & Cepni (2022: 200).

This study employs the Geopolitical Risk Index (GPR)[5] developed by Caldara & Iacoviello (2022), which is constructed from newspaper articles across 10 major publications covering geopolitical tensions. The index offers a quantitative measure of adverse geopolitical events and their associated risks. In addition to a global GPR index, country-specific indices have also been developed for 44 individual countries. In addition to the geopolitical risk index, the world uncertainty index, which tracks global uncertainty, is also included in the model. The world uncertainty index (WUI) is a measure that tracks global

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[2] *Nazlıoğlu & Aydoğdu (2025) have developed a model examining the interaction among policy uncertainty, GPR, investor sentiment, and risk aversion. They employed the investor sentiment metric established by Baker and Wurgler (2006) instead of the GSVI to assess investor sentiment and did not focus on Türkiye.*

[3] *Before the work of Da et al. (2011), investor attention was not directly observable, and early studies often relied on indirect measures such as excess returns, trading volume, and turnover variables that primarily reflected trading activity in financial markets. The introduction of more direct proxies for investor attention, such as the Search Volume Index (SVI), social media content (including Twitter, blogs, forums, and Wikipedia), and news data, marked a significant shift in the literature (Yang et al., 2017: 1). Da et al. (2011) were the first to utilize Google Search Volume Index (GSVI) to capture investor attention systematically.*

[4] *An investor attention index was also created for Türkiye with the keyword "yenilenebilir enerji", but the results were meaningless, so the model was constructed with the keyword "renewable energy" to ensure consistency with the index created at the global level.*

[5] *The index takes values between 0 and 100.*

uncertainty by text-mining[6] the Economist Intelligence Unit (EIU)'s country reports[7]. Put differently, the WUI serves as a metric for assessing both immediate and long-term uncertainties associated with global economic and political events. WUI indicates the frequency of the word "uncertainty" in EIU country reports. For instance, the continuous hostilities between North and South Korea represent long-term uncertainty, whereas the uncertainty that would result from a UK referendum in favour of Brexit is short-term (Ahir et al., 2018: 3). Since both the world uncertainty index and the geopolitical risk index provide monthly data at the country level, the dataset for Türkiye was compiled every month. To facilitate precise comparison, the dataset has been generated monthly at a global scale. Additionally, since the world uncertainty index is constructed beginning from 2008:01, this time frame spans from 2008:01 to 2024:05.

In this study, four different models are constructed at both the global and Türkiye-specific levels; therefore, the relevant variables are determined at both levels. It is found that the variables are stationary at first order. Following Flouros et al. (2022), the relevant variables are included in the model in logarithmic terms. Figures 1, 2 and 3 present the changes in the logarithmic versions of the variables over time[8]. Figure 1 shows the change in investor attention over time and shows that following the February 2022 Russia-Ukraine war, investor attention in renewable energy increased both in Türkiye and globally. The reason for this is that energy security has taken an important place on the agenda of countries with the war, and, accordingly, investors have prioritised the energy transition towards renewable energy to minimise the effects of the war. When the war was first declared, countries, especially in the EU, began seeking alternatives to Russian gas and prioritising energy security; as a result, coal-fired power plants were prioritised during this period, followed by an accelerated transition to clean energy (Tollefson, 2022).

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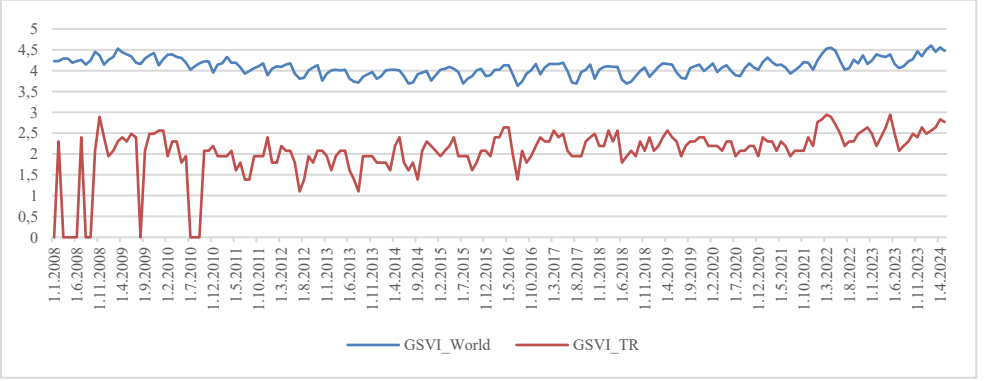
[6] *It involves finding the proportion of words (or their equivalents) with the meaning "uncertain" in the text compiled from world and country reports.*

[7] *It involves finding the proportion of words (or their equivalents) with the meaning "uncertain" in the text compiled from world and country reports.*

[8] *Series are transformed into natural logarithm as ln* (P_t / P_{t-1}).

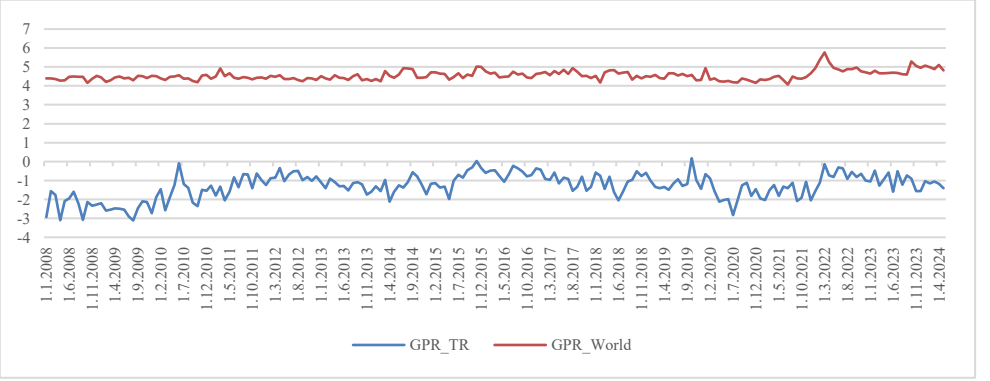
Figure: 1
Change in Investor Attention Index Over Time



Source: Google Trends (2024).
Note: GSVI_World and GSVI_TR represent global and Türkiye-specific investor attention, respectively.

Figure 2 shows the change in the geopolitical risk index over time and shows that the Türkiye-specific geopolitical risk index has a lower value than the global geopolitical risk index. The reason is that the Türkiye-specific geopolitical risk index accounts for Türkiye's geopolitical situation, domestic and foreign policies, economic conditions, and regional conflicts, whereas the global geopolitical risk index evaluates risks across many countries collectively, and high risks in some countries may raise the global average. The largest response of the Türkiye-specific geopolitical risk index is observed at the end of 2019, when COVID-19 first emerged. After the Russia-Ukraine war, it has started to rise again. The global geopolitical risk index, on the other hand, reaches its highest value following the Russia-Ukraine war. This finding aligns with Hodula et al. (2024: 1), who observe that GPR periodically amplifies economic and financial concerns, particularly during significant geopolitical events. Authors clarify this via two mechanisms: The financial channel, where uncertainty and heightened risk aversion prompt changes in investment portfolios and capital flows, and the real economy channel, which influences global trade, supply chains, and commodities.

Figure: 2
Change in the Geopolitical Risk Index Over Time

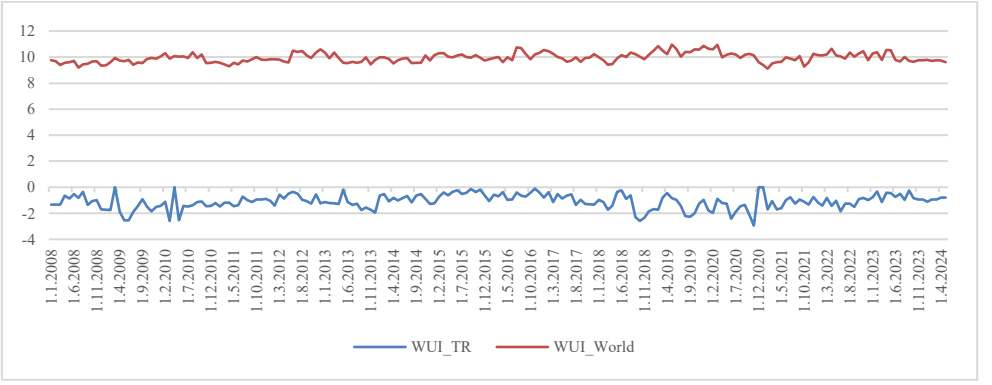


Source: Caldara & Iacoviello, 2022.
Note: GPR_World and GPR_TR represent the global and Türkiye-specific geopolitical risk index, respectively.

Figure 3 shows the change in the world uncertainty index over time and indicates that it has higher values than the Türkiye-specific uncertainty index due to large-scale risks and uncertainties, such as international trade wars, major economic crises, pandemics, and financial volatility. The world uncertainty index reaches its highest level with the declaration of COVID-19 as a pandemic. The Türkiye-specific uncertainty index, on the other hand, reaches its highest value approximately nine months after COVID-19 is declared a pandemic.

All things considered, Figures 1-3 demonstrate that all variables exhibit non-linear patterns over time, with significant shifts aligned with key global events such as the COVID-19 pandemic and the Russia-Ukraine war. These findings align with the literature, which highlights that during times of increased global tensions, variables associated with geopolitical risk, uncertainty, and investor attention are especially vulnerable to abrupt regime changes (He, 2023; Hodula et al., 2024: 1).

Figure: 3
Change in the World Uncertainty Index Over Time



Source: World Uncertainty Index, 2024.
Note: WUI_World and WUI_TR stand for the global and Türkiye-specific world uncertainty index, respectively.

3.2. Methodology

The interaction between the Geopolitical Risk Index and investor attention is analysed using the connectedness framework proposed by Diebold & Yılmaz (2012). This methodology enables the assessment of both the individual influence of a specific variable and the overall dynamics within the system. The analysis is based on a covariance-stationary N-variable VAR(p) model, which is formulated as follows:

$$x_i = \sum_{i=1}^{p} Q_i x_{t-1} + \varepsilon_t \quad (1)$$

Where x_t is a vector of n endogenous variables, including investor attention, geopolitical risk index and other control variables, the time index, t, ranges from 1 to T. p denotes the number of lags. Q_i, is the NxN parameter matrix with i=1,...,p and, is the normally distributed error term matrix. The moving average form, $x_t = \sum_{i=1}^{\infty} A_i \varepsilon_{t-i}$, is used to obtain the dynamic structure in the VAR system. The NxN coefficient matrix A_i is consistent with the recursion $A_i = \sum Q_j A_{i-j}$, j=1,2,.., p where A_0 is an NxN identity matrix and $A_i = 0$ for i < 0. Moving-average coefficients represent the dynamic process required to determine the study's diffusion indices.

In the VAR model, x_t is a vector of n endogenous variables, including investor attention, the geopolitical risk index, and control variables, observed over t=1,...,T. The model includes p lags, with Q_i denoting the N×N parameter matrices and ε_t representing normally distributed error terms. The moving average form, $x_t = \sum_{i=1}^{\infty} A_i \varepsilon_{t-i}$ captures the system's dynamics, where A_i matrices follow the recursion $A_i = \sum Q_j A_{i-j}$ with A_0 as the identity matrix and $A_i = 0$ for i<0. These coefficients define the dynamic structure used to compute connectedness measures.

To evaluate how much each variable contributes to the forecast error variance of the others, we employ the H-step Generalised Forecast Error Variance Decomposition (GFEVD), an order-invariant approach introduced by Diebold & Yılmaz (2012: 58-59).

$$q_{ij}^{g}(H) = \frac{\sigma_{jj}^{-1}\sum_{h=0}^{H-1}(e_i' A_h \sum e_j)^2}{\sum_{h=0}^{H-1}(e_i' A_h \sum A_h' e_j)} \quad (2)$$

Here, σ_{jj} is the standard deviation of the i'th error term, Σ is the error variance-covariance matrix, and e_i is a selection vector with 1 in the i-th position. The term $q_{ij}^{g}(H)$ quantifies the contribution of variable j to the forecast error variance of variable i, capturing the directional impact from j to i. These contributions are normalised in each estimation to ensure comparability.

$$\tilde{\theta}_{ij}^{g}(H) = \frac{\theta_{ij}^{g}(H)}{\sum_{j=1}^{N}\theta_{ij}^{g}(H)} \quad (3)$$

The analysis begins by estimating the VAR model with an optimal lag length. Based on this model, the forecast error variance decomposition is computed, forming the foundation for the connectedness measures. From this, total, directional, and net connectedness indices are derived. Identifying whether a variable acts as a net transmitter or receiver of shocks provides insight into the system's dynamics and supports the development of relevant policy implications.

4. Empirical Findings

In this study, Diebold & Yılmaz's (2012) connectedness approach is used to assess connectedness between variables. This approach provides a framework for examining the impact of a single variable and of the entire network. In the study, four models are constructed at both the global and Türkiye levels. First, the impact of global geopolitical risks on the global investor attention is analysed (Hereafter referred to as Model 1). Second, the impact of Türkiye-specific geopolitical risk and uncertainty index on investor attention to renewable energy is examined (hereafter referred to as Model 2). Third, the impact of GPR on investor attention in Türkiye and globally is analysed (hereafter, Model 3). Finally, the impact of WUI on investor attention in Türkiye and globally is analysed (hereafter, Model 4).

4.1. Empirical Results for the Long-Run Dynamics between Variables

We begin by presenting the results of the static model, which captures long-term relations over the full sample period, followed by the dynamic model results, which highlight short-term interactions among the variables. The "TO" row reflects the total influence each variable exerts on the others, whereas the "FROM" column captures the total impact received by each variable from all others. The Total Spillover Index (TSI) represents the average proportion of the variance of forecast errors across all variables that arises from cross-variable spillovers over the entire sample period. Accordingly, the TSI is 14.18% in

Model 1. This implies that 14.18% of the variation in the variances of the geopolitical risk index, uncertainty index, and investor attention globally can be explained by spillover effects. However, the long-run connectedness is 5.48% in Model 2. This rate in the Türkiye-specific model is lower than in the global model. Comparing Model 1 and Model 2, global GPR affects global GSVI by 23.11%, while Türkiye-specific GPR affects Türkiye-specific GSVI by only 2.02%. Besides, in the long run, while the global GSVI is highly affected by global WUI and global GPR at 27.32%, the rate of Türkiye-specific GSVI affected by Türkiye-specific GPR and Türkiye-specific WUI is very low at 2.08%. In Model 2, Türkiye-specific GPR affects other variables the most (7.48%) and is affected by them the most (8.40%). However, global GPR affects the other variables the most (27.19%), and global GSVI is affected by the others the most (27.32%).

Table: 3
Static Connectedness for Model 1 and Model 2

Model 1: Static Model for GPR, WUI, GSVI (on A Global Scale)				
	GSVI_World	WUI_World	GPR_World	FROM
GSVI_World	72.68	4.21	23.11	27.32
WUI_World	1.39	94.52	4.08	5.48
GPR_World	6.43	3.32	90.25	9.75
TO	7.82	7.53	27.19	42.54
Inc. own	80.51	102.05	117.44	TSI: 14.18%
NET	-19.49	2.05	17.44	
Model 2: Static Model for GPR, WUI, GSVI (Türkiye-Specific)				
	GSVI	GPR	WUI	FROM
GSVI	97.62	2.02	0.05	2.08
GPR	4.48	91.60	3.92	8.40
WUI	0.51	5.46	94.03	5.97
TO	4.99	7.48	3.98	16.44
Inc. Own	102.91	99.08	98.01	TSI: 5.48%
NET	2.91	-0.92	-1.99	

Note: GSVI, GSVI_World, WUI, WUI_World, GPR, GPR_World stand for Türkiye-specific investor attention, global investor attention, Türkiye-specific uncertainty index, global uncertainty index, Türkiye-specific geopolitical risk index and global geopolitical risk index, respectively.

The highest connectedness among the variables is observed in Model 3 (compared to the other models), where we use GPR and GSVI for both global and Türkiye-specific cases, at 29%. According to Model 3, Türkiye-specific GSVI is most affected by global GSVI (13.78%); globally, global GPR is the most influential factor on global GSVI (14.63%). Based on both Model 3 and Model 4, the global GSVI is the most significantly influenced by other variables. In particular, in Models 3 and 4, the global GSVI is predominantly influenced by Türkiye-specific GSVI, Türkiye-specific GPR, and global GPR (42.33% in Model 3), as well as Türkiye-specific GSVI, Türkiye-specific WUI, and global WUI (33.33% in Model 4). In the Model 3, global GPR has the greatest impact on the network, at 42.75%. Both the Türkiye-specific WUI and the global WUI have less influence on the network than GSVI, both globally and in Türkiye. Another important point is that the Türkiye-specific GPR has a bigger effect on the Türkiye-specific GSVI than on the global GPR. Moreover, the Türkiye-specific GSVI is affected by other variables by 30.30%, whereas the global GSVI is affected by other variables by 42.33%. The model with WUI (Model 4) has a lower TSI (19.49%) compared to the model with GPR (Model 3).

Table: 4
Static Connectedness for Model 3 and Model 4

Model 3: Static Model for GPR, GSVI for both Global and Türkiye-Specific					
	GSVI	GSVI_World	GPR	GPR_World	FROM
GSVI	69.70	13.78	9.33	7.20	30.30
GSVI_World	6.17	57.67	4.50	14.63	42.33
GPR	2.12	2.39	74.56	20.92	25.44
GPR_World	6.17	3.64	8.14	82.06	17.94
TO	31.48	19.80	21.97	42.75	116.01
Inc. own	101.18	77.48	96.53	124.81	TSI: 29%
NET	1.18	-22.52	-3.47	24.81	
Model 4: Static Model for WUI, GSVI for both Global and Türkiye-Specific					
	GSVI	GSVI_World	WUI	WUI_World	FROM
GSVI	77.53	15.91	4.14	2.41	22.47
GSVI_World	26.35	66.67	2.52	4.46	33.33
WUI	4.14	2.32	90.34	3.20	9.66
WUI_World	7.66	2.58	2.25	87.51	12.49
TO	38.16	20.81	8.91	10.08	77.95
Inc. Own	115.69	87.47	99.25	97.58	TSI: 19.49%
NET	15.69	-12.53	-0.75	-2.42	

4.2. Empirical Results for the Short-Run Dynamics between Variables

The global model indicates that TSI increases from 14.18% to 26.50% over the short term. Simply put, the rate at which variables influence one another is greater in the short term. Even though the Türkiye-specific model has shown an increase in TSI, TSI remains at relatively low levels. This suggests that the mutual influence of variables in the Türkiye-specific model is significantly lower than in the global model. In both the long and short runs of Model 2, the Türkiye-specific GPR is the variable that most strongly affects and is affected by other factors. Similarly, the global GSVI is the variable most influenced by global WUI and global GPR in both the long and short term in the global model, while global GPR has the greatest impact on global GSVI and global WUI. It is possible to derive the following: Global investor attention is influenced by global geopolitical risks, whereas Türkiye-specific investor attention is more influenced by the shocks within its own system than by geopolitical risks (according to Table 5). One of the differences between the short-run and the long-run is that the impact of the WUI, both globally and for Türkiye, increases in the short-run (almost approaching that of the GPR). Another difference is that while the global GSVI is a net shock receiver in both the short-run and the long-run, the Türkiye-specific GSVI shifts from a net shock transmitter in the long-run to a net shock receiver in the short-run. In other words, in the short term, investor attention to Türkiye serves as a shock receiver responsive to global uncertainty; in the long term, it becomes a shock transmitter influenced by internal dynamics. The stability and multi-sourced nature of global investor attention accounts for this conclusion, as it does not experience a similar shift. This occurs because, globally, investors concurrently incorporate a wide array of news from various countries and sectors into their decisions, indicating that the long-term trends of an individual country are not pivotal for this variable (Mengoli et al., 2025: 752). This framework constrains the influence of country-specific changes on global investor attention, while leading to pronounced and uneven repercussions in other economies, such as Türkiye, amid significant global uncertainty. Consequently, the global attention indicator functions as a receiver of shocks rather than a transmitter of information. Conversely, Türkiye's

investor attention in renewable energy serves as a net shock receiver, responsive to global swings in the short term. In the long term, the sector's structural growth dynamics, policy direction, and the consolidation of local expectations render it a net shock transmitter, generating information flow towards the global attention indicator.

Table: 5
Dynamic Connectedness for Model 1 and Model 2

Model 1: Dynamic Model for GPR, WUI, GSVI (on A Global Scale)				
	GSVI_World	WUI_World	GPR_World	FROM
GSVI_World	61.50	18.59	19.91	38.50
WUI_World	6.38	77.67	15.95	22.33
GPR_World	6.49	12.19	81.32	18.68
TO	12.87	30.78	35.86	79.50
Inc. own	74.37	108.45	117.18	TSI: 26.50%
NET	-25.63	8.45	17.18	
Model 2: Dynamic Model for GPR, WUI, GSVI (Türkiye-Specific)				
	GSVI	GPR	WUI	FROM
GSVI	94.46	3.59	1.96	5.54
GPR	2.80	91.13	6.06	8.87
WUI	1.37	7.00	91.62	8.38
TO	4.18	10.59	8.02	22.79
Inc. Own	98.63	101.73	99.64	TSI: 7.60%
NET	-1.37	1.73	-0.36	

Connectedness increased in both the WUI model (Model 4) and the GPR model (Model 3). The model with WUI has low connectedness in the long run, while it is almost the same connectedness (with a TSI of 42.72%) as the model with GPR in the short run. In the long term, the global GSVI has the most significant impact on Türkiye-specific GSVI, whereas the global GPR has the most significant impact on it in the short term. In contrast, the global GPR has the greatest impact on the global GSVI over the long term, whereas the Türkiye-specific GSVI has the greatest impact over the short term. However, in the model with WUI, both in the short and long run, Türkiye-specific GSVI is most affected by global GSVI, whereas global GSVI is most affected by Türkiye-specific GSVI. The findings show that shock transmission in the renewable energy market occurs through the mutual interaction of investor attention rather than economic uncertainty indicators. The structure in which Türkiye-specific and global investor attention mutually reinforce each other may arise from factors that respond quickly to internal market information flows. Nevertheless, when geopolitical threats arise, investors in Türkiye exhibit heightened sensitivity to global risk indicators, while global investor attention remains influenced by local dynamics. In the long run, the Türkiye-specific GPR has a greater impact on the Türkiye-specific GSVI than the global GPR does. However, in the short run, the global GPR has a greater impact than the Türkiye-specific GPR. Based on Models 3 and 4, Türkiye-specific GSVI is a net shock transmitter, while global GSVI is a net shock receiver.

Table: 6
Dynamic Connectedness for Model 3 and Model 4

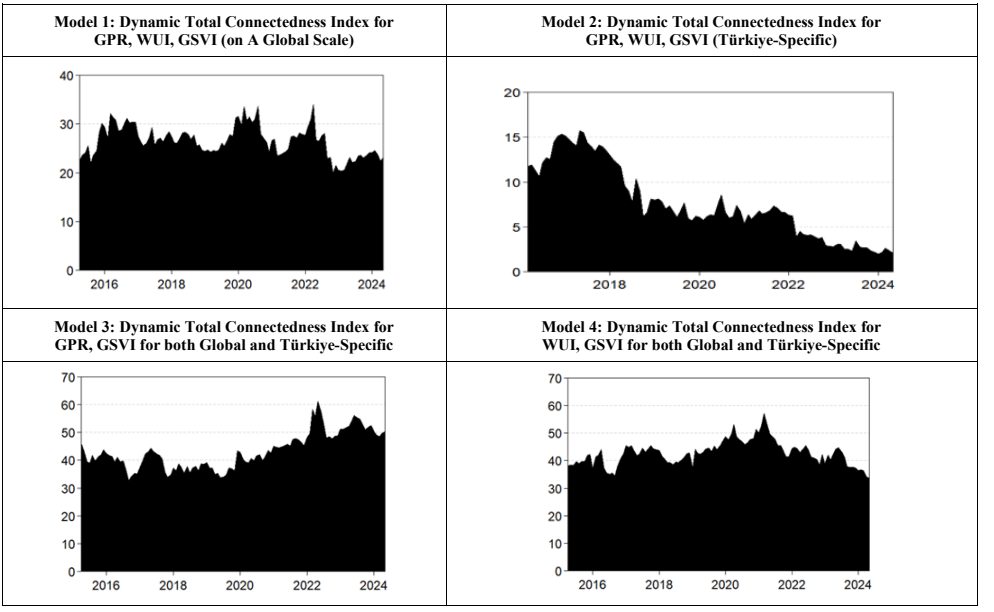
Model 3: Dynamic Model for GPR, GSVI for both Global and Türkiye-Specific					
	GSVI	GSVI_World	GPR	GPR_World	FROM
GSVI	55.03	15.63	11.06	18.39	44.97
GSVI_World	21.38	53.15	10.39	15.08	46.85
GPR	13.15	8.66	62.64	15.55	37.36
GPR_World	15.14	53.15	20.74	56.32	43.68
TO	49.66	31.99	42.19	49.02	172.86
Inc. own	104.69	85.14	104.84	105.34	TSI: 43.22%
NET	4.69	-14.86	4.84	5.34	
Model 4: Dynamic Model for WUI, GSVI for both Global and Türkiye-Specific					
	GSVI	GSVI_World	WUI	WUI_World	FROM
GSVI	56.37	18.49	13.63	11.51	43.63
GSVI_World	22.57	50.02	11.11	16.30	49.98
WUI	15.37	7.94	65.92	10.77	34.08
WUI_World	16.58	10.29	16.32	56.80	43.20
TO	54.52	36.72	41.07	38.58	170.88
Inc. own	110.88	86.74	106.99	95.38	TSI: 42.72%
NET	10.88	-13.26	6.99	-4.62	

4.3. Dynamic Total Connectedness Index Over Time

In Model 1, during periods of global geopolitical risk (March 2020: COVID-19 declared a pandemic; February 2022: Russia-Ukraine war; October 2023: the Israeli-Palestinian war), connectedness increases. In Model 2, the highest connectedness is observed after 2016. This may be attributed to the 2016 coup attempt in Türkiye. The coup attempt was followed by political uncertainty and regional instability, which had a negative impact on the economy as foreign direct investment (FDI) inflows fell by 30.5% in 2016 (European Commission, 2018: 54). Besides, the declaration of COVID-19 as a pandemic, the Russia-Ukraine war in 2022, and the Israeli-Palestinian war in 2023 show that the connectedness between the variables increases at first, but in general, the connectedness decreases after 2018. In the Model 3, the interaction between the global GPR, global GSVI, Türkiye-specific GPR, and Türkiye-specific GSVI is about 32% after COVID-19, rising to 60% during the Russia-Ukraine war and 55% during the Israeli-Palestinian war in 2023. In Model 4, the responses are similar to those in the GPR model (Model 3). The most significant difference is that, in the Model 3 with GPR, the largest response occurs during the Russia-Ukraine war (around 60%), whereas in the model with WUI, the largest response occurs after COVID-19. This is because the WUI measures uncertainty related to economic policy, market conditions, and global economic trends rather than specifically to geopolitical issues, and the COVID-19 pandemic has caused a worldwide economic recession (World Bank, 2022: 50).

In general, the strongest reaction occurs during the Russia-Ukraine war, with the only exception being Model 2's reaction. Türkiye reacts more to local geopolitical risks, such as the 2016 military coup, than to global risks.

Figure: 4
Dynamic Total Connectedness Index Over Time

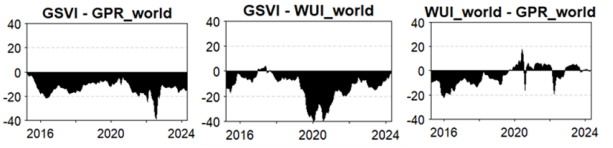


4.4. Net Pairwise Directional Connectedness

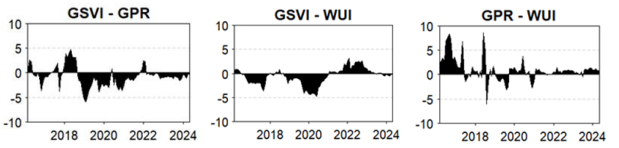
In Model 1, both global geopolitical risk and the world uncertainty index affect global investor attention. On the other hand, in Model 2, geopolitical risk affects investor attention more than investor attention affects geopolitical risk. While the uncertainty index affects investor attention more during the Russia-Ukraine war, investor attention, in turn, affects the uncertainty index during the war. This may be due to the war between Russia and Ukraine destabilising global energy markets, making Türkiye, as an energy importer, susceptible to fluctuations in natural gas and oil prices. Renewable energy has evolved as a strategic hedge against uncertainties and geopolitical threats (Zhao et al., 2024a: 10). Investor attention to renewable energy in Türkiye during wartime may influence the WUI. This is because the energy market has been disrupted, making investors more interested in renewable energy and more aware of energy prices and policy changes. These effects can be seen in the WUI. Consequently, investor attention has emerged as a channel for transmitting external geopolitical shocks to domestic economic instability. Afterwards, its effect gradually decreases (as illustrated in Figure 5).

Figure: 5
Net Pairwise Directional Connectedness for Model 1 and Model 2

Model 1: Net Pairwise Connectedness between GPR, WUI, and GSVI (on A Global Scale)

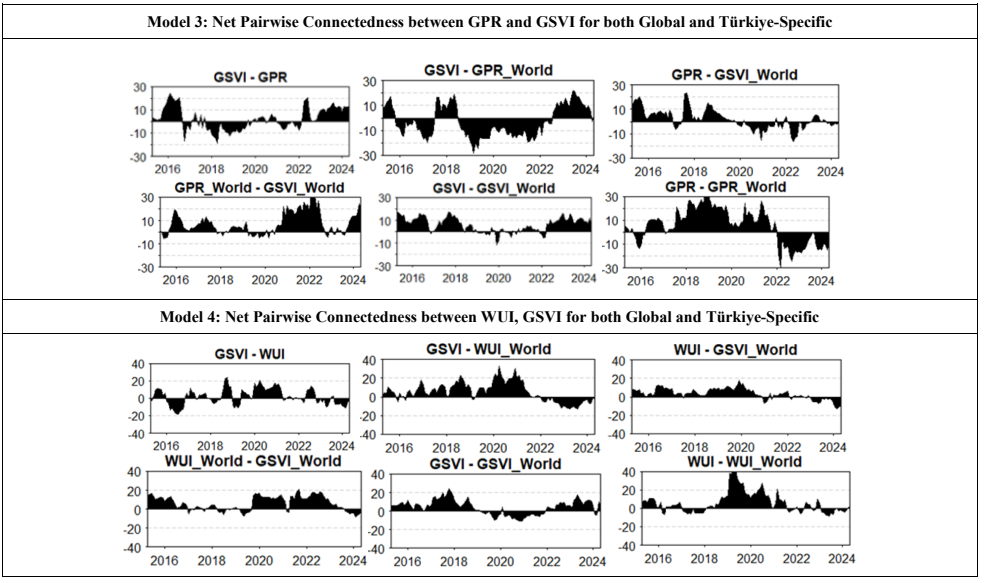


Model 2: Net Pairwise Connectedness between GPR, WUI, GSVI (Türkiye-Specific)



Looking at the GSVI-GPR and GSVI-GPR_World graphs (top 2 graphs in the Model 3), the investor attention for Türkiye is more affected by the global GPR (compared to the Türkiye-specific GPR). While Türkiye-specific GSVI do not affect global GPR during the COVID-19 period, they start to affect global GPR more after the Russia-Ukraine war. This may be due to the increased uncertainty caused by the war, which led investors (especially amid the Russia-Ukraine war) to turn to renewable energy, potentially helping ensure Türkiye's energy security and exerting downward pressure on geopolitical risk. The recent decline in renewable energy costs in Türkiye has also contributed to increased investment. In addition, according to the GSVI-GSVI_World graph, the Türkiye-specific GSVI has a larger impact on the global GSVI. According to Model 4, global WUI has a greater influence on Türkiye-specific WUI. In addition, Türkiye-specific GSVI has a greater effect on the global GSVI, except during the period between the COVID-19 pandemic and the Russia-Ukraine war. Türkiye-specific GSVI affects the WUI (both Türkiye-specific and global) more generally.

Figure: 6
Net Pairwise Directional Connectedness for Model 3 and Model 4



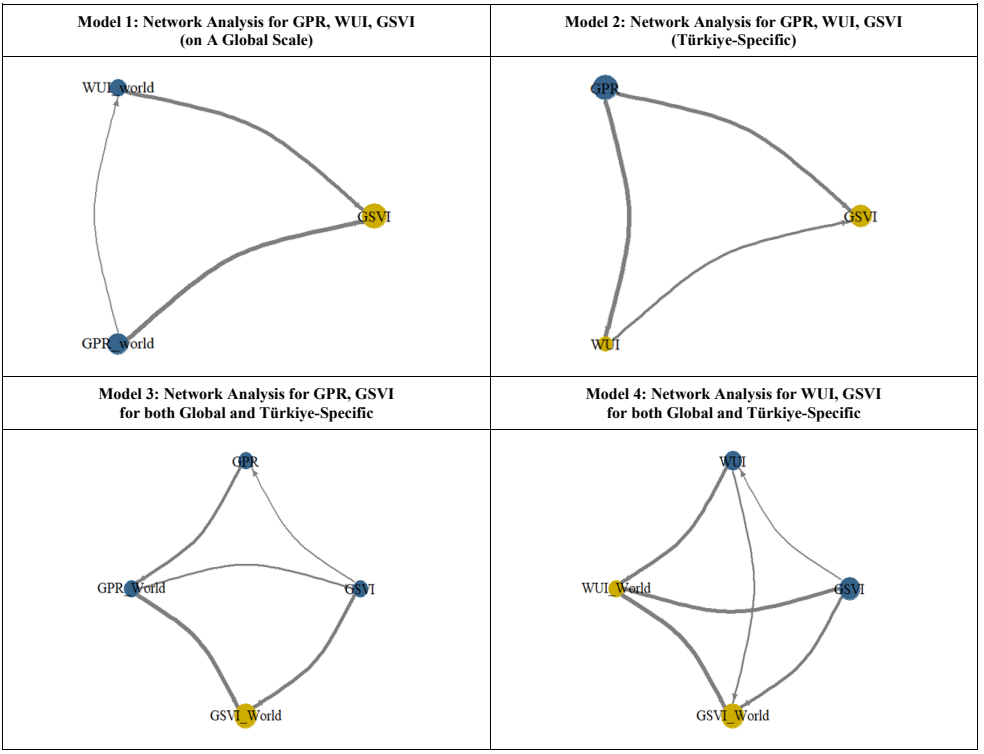
4.5. Network Analysis

Global geopolitical risk and the world uncertainty index are net shock transmitters and affect global investor attention (as shown in Model 1). In the Model 2, both Türkiye-specific GPR and Türkiye-specific WUI affect Türkiye-specific GSVI. Investor attention to renewable energy in Türkiye is more affected by the Türkiye-specific geopolitical risk index than the uncertainty index. While Türkiye-specific GPR is the only shock transmitter in the system, Türkiye-specific GSVI and Türkiye-specific WUI are shock receivers.

Based on the Model 3, global GSVI is a net shock receiver, affected by Türkiye-specific investor attention and global GPR. Global GPR affects Türkiye-specific GSVI, and Türkiye-specific GSVI affects Türkiye-specific GPR, but their connectedness is weak. The strongest connectedness is between global GPR and global GSVI. The results of Model 4 are almost identical to those of Model 3. The two most important differences are that, while Türkiye-specific GPR does not affect global GSVI in Model 3, Türkiye-specific WUI does in Model 4, and that the strongest connectedness is established between global WUI and Türkiye-specific GSVI.

The Global GSVI is a net shock receiver across all models. On the other hand, Türkiye-specific GSVI is a net shock transmitter (except for model 2). The GPR is a net shock transmitter both globally and in the Türkiye-specific case.

Figure: 7
Network Analysis



5. Conclusion

Using Diebold-Yılmaz's (2012) connectedness approach, we investigate the effects of geopolitical risks and economic uncertainties on the investor attention towards renewable energy at both the global and Turkish levels. To the best of our knowledge, this is the first study to examine the interaction between geopolitical risks and investor attention toward renewable energy.

Our main findings are as follows. First, in both the short and long run, Model 3 has the highest connectedness between variables. In other words, the model that examines the interaction between global GPR, Türkiye-specific GPR, and investor attention for both the global and Türkiye-specific cases shows greater connectedness than the other models. The main reason is the strong interaction between Türkiye-specific GPR and global GPR, as global GPR covers geopolitical risks across all countries. The lower connectedness in the model with WUI (Model 4) is due to WUI focusing more on economic uncertainty, whereas GPR specifically measures risks arising from geopolitical events such as conflicts, wars,

political instability, and diplomatic tensions. In our sample period, there are three main shocks (March 11, 2020: COVID-19 declared as a pandemic, February 24, 2022: Russia-Ukraine War, October 7, 2023: the Israeli-Palestinian war), and except for COVID-19, the other two shocks are more related to increased geopolitical risk rather than economic uncertainty. This is also supported by the fact that the dynamic connectedness index obtained from the model with WUI (Model 4) is the highest in the COVID-19 period. Second, on a global scale, the connectedness between investor attention, the GPR and WUI increases at the time of the three shocks. On the Turkish level, the highest connectedness is observed after 2016. This is because Türkiye reacts more to local geopolitical risks, such as the 2016 military coup, than to global risks. Third, the global GSVI is a net shock receiver in all models. Türkiye-specific GSVI, on the other hand, is a net shock to the transmitter. The only exception is Model 2, which includes Türkiye-specific GPR, WUI, and GSVI. In Model 2, the Türkiye-specific GSVI is a net receiver of shocks. Besides that, GPR is a net shock transmitter on a global and a Turkish scale. Fourth, we have discovered that the global WUI, which assesses uncertainty associated with economic policy, market conditions, and global economic trends, has a greater influence on global investor attention during the COVID-19 pandemic. This is corroborated by Zhao et al. (2024a: 10), who observe that economic uncertainty has a beneficial effect on renewable energy during the initial and subsequent phases of the COVID-19 pandemic. Finally, global investor attention is significantly affected by uncertainties (both economic and geopolitical) in the short and long term. However, Türkiye-specific investor attention is more directly influenced by the shocks within its own system than by uncertainties.

These findings carry several important policy implications. Given that GPR amplifies awareness of catastrophic outcomes, diminishes the appeal of investments in risky projects, and undermines consumer confidence, with 75% of investors expressing concern about GPR (Caldara & Iacoviello, 2022), it is crucial to investigate the connection between investor attention and GPR. Consequently, authorities must regulate excessive market responses by transparently and consistently controlling information dissemination during periods of uncertainty, while incorporating the GPR-attention relationship into financial stability evaluations. Given Türkiye's heavy dependence on energy imports and its vulnerability to geopolitical disruptions, there is a pressing need to strengthen domestic energy security. Policymakers should continue to support renewable energy investments in line with the 2017 National Energy Policy to reduce exposure to external risks. Second, since Türkiye-specific investor attention is more responsive to domestic than global risks, national policies should be adapted to address local concerns and maintain investor trust during periods of internal political or economic instability. Finally, measures like GSVI can serve as real-time indicators of investor attention. Integrating such data into energy policy planning and market monitoring could enhance responsiveness to emerging risks and opportunities. Future studies may investigate shock reactions more comprehensively by employing models that accommodate time-varying dynamics, such as TVP-VAR, given the constraints of the monthly data set utilised in this study, which inadequately represents high-frequency shocks. Moreover, constructing a composite index utilising Natural Language Processing (NLP)

methods with keywords segmented into categories such as wind, solar, and geothermal, rather than the broad term "renewable energy", could yield a more nuanced understanding of investor behaviour in relation to GPR.

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