The Asymmetric Impact of Geopolitical Risks on Green and Conventional Real Estate Markets

Jeopolitik Risklerin Yeşil ve Geleneksel Gayrimenkul Piyasaları Üzerindeki Asimetrik Etkisi

Mesut Doğan[1]

1 Bilecik Şeyh Edebali Üniversitesi, Bilecik, Türkiye

ABSTRACT

This study aims to analyze the dynamic impact of global geopolitical risks (GPR) on both green and conventional real estate markets through a comparative perspective. Utilizing daily data spanning from December 19, 2016, to December 9, 2025, the green real estate market is represented by the Dow Jones Developed Green Real Estate Index, while the conventional market is proxied by the S&P Global REIT Index. Geopolitical risk is measured using the widely recognized index developed by Caldara and Iacoviello (2022). The methodological framework of the study employs the "Quantile-on-Quantile (QQ) Connectedness" approach developed by Gabauer and Stenfors (2024), which captures asymmetric interactions between markets. The empirical findings reveal that both real estate indices exhibit a pronounced quantile dependent response to geopolitical risk. Specifically, connectedness intensifies during high geopolitical risk regimes, indicating that shock transmission strengthens, and market co-movement increases during periods of stress. Furthermore, it is observed that green real estate assets exhibit higher sensitivity to geopolitical stress. This suggests that sustainability-oriented assets may become more vulnerable during periods of elevated uncertainty. In conclusion, geopolitical shocks induce asymmetric and regime dependent spillovers in real estate markets. These results provide critical implications for effective risk management, strategic portfolio diversification, and the design of macro-prudential policies.

Keywords: Real estate markets, Geopolitical risk, Sustainable real estate indices, Quantile-on-quantile connectedness

ÖZET

Bu çalışma, küresel jeopolitik risklerin (GPR) hem yeşil hem de geleneksel gayrimenkul piyasaları üzerindeki dinamik etkilerini karşılaştırmalı bir perspektifle analiz etmeyi amaçlamaktadır. 19 Aralık 2016 ile 9 Aralık 2025 tarihlerini kapsayan günlük verilerin kullanıldığı araştırmada; yeşil gayrimenkul piyasası Dow Jones Developed Green Real Estate Index, geleneksel piyasa ise S&P Global REIT endeksi ile temsil edilmiştir. Jeopolitik risk değişkeni için ise literatürde geniş kabul gören Caldara ve Iacoviello (2022) endeksi temel alınmıştır. Çalışmada, Gabauer ve Stenfors (2024) tarafından geliştirilen ve piyasalar arasındaki asimetrik etkileşimleri ölçen "Kantil-Kantil Bağlantılılık" yöntemi kullanılmıştır. Ampirik bulgular, her iki gayrimenkul endeksinin de jeopolitik riske karşı belirgin bir kantile bağımlı tepki verdiğini ortaya koymaktadır. Özellikle jeopolitik riskin yüksek olduğu rejimlerde bağlantılılık şiddetlenmekte; bu durum, stres dönemlerinde şok iletiminin güçlendiğini ve piyasaların birlikte hareket etme eğiliminin arttığını göstermektedir. Bunun yanı sıra, yeşil gayrimenkul varlıklarının jeopolitik strese karşı daha yüksek duyarlılık sergilediği gözlemlenmiştir. Bu durum, sürdürülebilirlik odaklı varlıkların yüksek belirsizlik dönemlerinde daha kırılgan hale gelebileceğine işaret etmektedir. Sonuç olarak jeopolitik şoklar, gayrimenkul piyasalarında asimetrik ve rejime bağlı yayılımlara yol açmaktadır. Elde edilen bu sonuçlar; etkin risk yönetimi, stratejik portföy çeşitlendirmesi ve makro ihtiyati politika tasarımı açısından kritik çıkarımlar sunmaktadır.

Anahtar kelimeler: Gayrimenkul piyasaları, Jeopolitik risk; Sürdürülebilir gayrimenkul endeksleri; Kantil-kantil bağlantılılık

Introduction

Geopolitical risks (GPR) constitute a major unpredictable external shock for the global financial system and the real economy. Diplomatic crises, trade sanctions, and regional conflicts have recently introduced uncertainty into asset valuations, transcending conventional economic indicators. Within this context, real estate markets, which are defined by high capital intensity, low liquidity, and long-term investment horizons, occupy an exceptionally sensitive position regarding changes in the geopolitical climate. Real estate, as an investment vehicle, is directly affected by local economic conditions as well as global security perceptions and the movement of international capital toward 'safe havens.

Theoretically, geopolitical risk impacts real estate markets through the "uncertainty channel," leading to the deferral of investment decisions or the re-pricing of risk premiums. Abakah et al. (2025) draw attention to the potential of this risk to trigger systemic crashes in real estate markets, emphasizing the destructive capacity of GPR on financial stability. Financialized assets, such as Real Estate Investment Trusts (REITs), react more instantaneously to these shocks compared to physical assets. Coën and Desfleurs (2024a), in their study of the US REIT market, demonstrate that geopolitical risk interacts with economic policy uncertainty to fundamentally alter return dynamics, thereby creating additional risk costs for investors.

Geopolitical shocks also induce "financial fragmentation," disrupting the flow of capital across different asset classes. Alsadan et al. (2025) argue that such fragmentation weakens credit mechanisms in core sectors like the housing market and leads to excessive volatility in asset prices. Global crises further highlight the dependence of the real estate market on international capital mobility. Empirical analyses by Newell and Marzuki (2023) and Yuni, Enwo-Irem, and Urom (2024) confirm how geopolitical tensions and global shocks, such as health crises, dramatically redirect real estate capital flows and leave lasting structural impacts on housing markets.

At the corporate and commercial levels, geopolitical risk acts as a decisive force not only on pricing but also on operational strategies. Barkham and Holberton (2017) state that geopolitical security has become a criterion at least as vital as economic efficiency in the strategic location decisions of commercial real estate occupiers. This indicates that geopolitical risk is not merely a market variable but a fundamental factor shaping the use value of real estate and the portfolio resilience of institutional investors. In summary, understanding the impact of geopolitical risk on real estate markets is of critical importance for both the development of macro prudential policies and the formulation of hedging strategies for investors.

The primary objective of this study is to investigate the dynamic impact of global geopolitical risks (GPR) on green and conventional real estate markets through a dynamic perspective that encompasses varying market conditions and extreme periods. The analysis is conducted using daily data spanning from December 19, 2016, to December 9, 2025, utilizing the Dow Jones Developed Green Real Estate Index to represent the green real estate market and the S&P Global REIT Index for the conventional market, while geopolitical risk is proxied by the index developed by Caldara and Iacoviello (2022). The methodological framework of the study is based on the Quantile-on-Quantile Connectedness (QQCON) approach developed by Gabauer and Stenfors (2024). This advanced method allows for a profound analysis of how different intensity levels of geopolitical risk affect various quantiles of real estate returns across both the time dimension and diverse quantile combinations, thereby unveiling the complex and asymmetric connectedness structure between these markets.

The primary motivation of this study arises from the fact that, although the effects of geopolitical risks (GPR) on financial markets have been extensively examined in the literature, their implications for real estate markets remain relatively underexplored and fragmented. In recent years, escalating geopolitical tensions,

armed conflicts, energy supply disruptions, and global uncertainty have affected real estate markets not only through macroeconomic channels but also via investor sentiment, capital flows, and sustainability expectations. Despite this growing relevance, existing studies predominantly focus on stock markets, while real estate markets are often treated as a secondary or indirect area of analysis. Within this context, the present study aims to fill an important gap in the literature by examining the asymmetric and regime dependent effects of geopolitical risks on green and conventional real estate markets from a comparative perspective. In particular, whether sustainability-oriented assets exhibit greater resilience or heightened vulnerability during periods of heightened uncertainty remains an open empirical question. By employing the QQCON approach, this study goes beyond average effects and provides a granular assessment of dynamic connectedness across extreme market conditions and varying intensities of geopolitical risk. This methodological framework allows the analysis to capture asymmetric interactions and tail dependencies that are typically overlooked by conventional approaches.

The findings expected from this study are anticipated to offer valuable insights for investors in designing more effective portfolio diversification and risk management strategies during periods of geopolitical uncertainty. For fund managers, the results provide a framework for assessing the resilience of green real estate assets under stress conditions, while for policymakers, they offer an analytical basis for developing macroprudential policy measures aimed at mitigating the potentially destabilizing effects of geopolitical shocks on real estate market stability. In this regard, the study contributes not only to the theoretical literature but also provides practical guidance for decision making processes in the domains of sustainable finance and real estate markets.

1. Literature

In the literature, the examination of the impact of geopolitical risks (GPR) on financial markets focuses on two primary axes: real estate markets and stock markets. Real estate markets, encompassing both residential and commercial assets, exhibit significant sensitivity to geopolitical shocks.

Contemporary studies exploring the nexus between geopolitical risks and real estate markets reveal that heightened risk levels adversely affect market dynamics. Yuni, Enwo-Irem, and Urom (2024) emphasize the dynamic effects of geopolitical risks and infectious diseases on housing markets, while Abakah et al. (2025) determine that geopolitical risk can trigger crashes in real estate stocks. In studies specifically targeting Real Estate Investment Trust (REIT) returns, Coën and Desfleurs (2024a) report that both geopolitical risk and economic policy uncertainty are decisive factors for US REIT returns. In another study by the same authors (Coën and Desfleurs, 2024b), the role of geopolitical risk in shaping the dynamics of REIT returns is further detailed. From a broader perspective, Barkham and Holberton (2017) discuss how economics and geopolitics affect commercial real estate occupiers, while Alsadan et al. (2025) find that geopolitical shocks lead to financial fragmentation, impacting housing, bond, and stock markets. Additionally, Newell and Marzuki (2023) examine global real estate capital flows during the COVID-19 crisis, highlighting the pressure exerted by crisis periods on the market.

While this connection between real estate markets and geopolitical risk holds a significant place in the literature, the number of such studies remains limited compared to those focusing on stock markets. The vast majority of the literature consists of studies investigating the effects of geopolitical risks on global stock exchanges, emerging markets, commodity markets, and sectoral indices.

When examining the literature on stock markets, it is evident that geopolitical risk has a profound impact on global market volatility, development, and performance. Zhang et al. (2023) and Agoraki, Kouretas, and Laopodis (2022) state that geopolitical risks negatively affect global stock market volatility and

performance. Furthermore, Lee (2019) analyzes the dependence structure of world stock markets under risk, while Sohag et al. (2022) investigate market synchronization. Regarding market development and capital movements, Khraiche, Boudreau, and Chowdhury (2023) discuss how geopolitical risk influences stock market development, and Ji (2025) focuses on its impact on capital allocation. In the context of advanced economies, Salisu, Lasisi, and Tchankam (2022) examine the behavior of stock returns under historical risks. Additionally, Elsayed and Helmi (2021) emphasize the role of geopolitical risk in volatility transmission across financial markets.

Emerging markets and BRICS countries are extensively covered in the literature. Researchers such as Balcilar et al. (2018), Salisu, Ogbonna, Lasisi, and Olaniran (2022), Bouras et al. (2019), Yang et al. (2021), and Li et al. (2024) have demonstrated, using GARCH and similar models, that geopolitical risks increase volatility and alter return dynamics in these markets. Feng, Liu, and Yao (2023) draw attention to volatility spillovers between G7 and BRICS markets.

In country and region-specific studies, geopolitical risk exposure and sectoral connectedness in Chinese markets have been addressed by Su et al. (2025), Zhang, Zhang, Ren, and Jin (2024), and Pan, Zhang, and Wang (2023). While Saâdaoui et al. (2023) and Ayadi and Ben Mbarek (2025) conduct research on the Saudi stock market, African stock markets are examined by Korsah and Mensah (2024). Investor trends in Turkey are analyzed by Yıldırım, Eren, and Dogan (2025). Specific to Asian markets, Kannadhasan and Das (2020) compare international economic policy uncertainty and geopolitical risk, while Hoque and Zaidi (2020) address fragile emerging economies. Furthermore, Truong, Friday, and Nguyen (2025) analyze frontier markets in the case of Vietnam, and Fianto et al. (2025) examine Islamic stock market dynamics in Indonesia.

Sectoral and thematic studies also show great diversity. Chatziantoniou, Gabauer, and Stenfors (2025) investigate US sectoral stock market volatility, while the positive impact of geopolitical risks on defense company stocks is identified by Gheorghe and Panazan (2024) and Panazan and Gheorghe (2025). The relationship between energy/commodity markets and stock exchanges is explored by Smales (2021) and Li, Tu, Zeng, Gong, and Yuan (2022). Dogan (2025) examines clean energy markets, and Korsah (2025) addresses climate, energy, and geopolitical risks in African markets. Marangoz et al. (2025) analyze the impacts of disentangled geopolitical risk indices on stock markets, while Fiorillo et al. (2023) focus on stock liquidity, and He (2023) along with Le et al. (2025) focus on investor sentiment. In conclusion, the literature demonstrates that geopolitical risks create complex effects not only on general indices but also on a sectoral basis, across different market types (Islamic, conventional), and at various levels of economic development.

2. Data and Methodology

2.1. Data

The primary motivation of this study is to empirically examine the dynamic effects of global geopolitical risks (GPR) on real estate markets and to assess the structure of interdependence among these markets. Owing to its high capital intensity, illiquidity, and physical asset characteristics, the real estate sector is inherently sensitive to external shocks. To capture the performance divergence between sustainability-oriented investments and conventional markets during periods of geopolitical instability, this study incorporates both green real estate and traditional real estate indices into a comparative analytical framework.

The core variables selected for the analysis represent two distinct segments of the global real estate landscape. The Dow Jones Developed Green Real Estate Index (GJ_GREEN) is utilized to proxy the performance of the green real estate market, while the S&P Global REIT Index (SP_REIT) reflects the performance of the broader real estate investment trust (REIT) universe. Daily data for both indices were

retrieved from the S&P Global (spglobal.com) database, a widely recognized and authoritative source of financial market information. Geopolitical risk is proxied using the global geopolitical risk index developed by Caldara and Iacoviello (2022), which has become a standard measure in the literature and is constructed via text mining techniques applied to international newspaper archives.

The dataset consists of daily observations spanning the period from December 19, 2016, to December 9, 2025. This time window enables the analysis to capture market reactions across major geopolitical and economic turning points, including global trade tensions, regional military conflicts, the COVID-19 pandemic, and subsequent macroeconomic fluctuations. The use of daily data enhances the ability to measure the speed at which geopolitical shocks are transmitted to real estate markets and to identify the resulting volatility spillovers with greater precision.
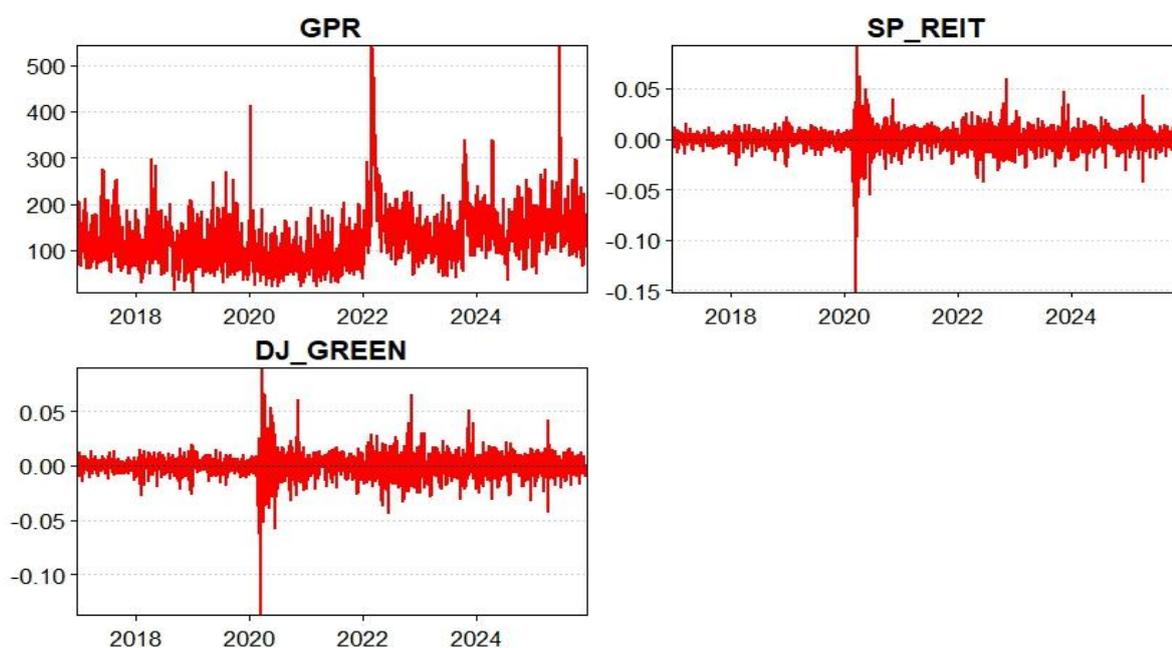

Figure 1. Return Series

Upon examining the return series in Figure 1, distinct volatility structures are observed across the Dow Jones Green Real Estate (DJ_GREEN), S&P Global REIT (SP_REIT), and Geopolitical Risk (GPR) variables over time. All three series exhibit prominent volatility clustering, particularly during the global pandemic shock in 2020 and subsequent geopolitical tensions, where the amplitude of fluctuations in the return series significantly increased. While the green real estate (DJ_GREEN) and general real estate series follow a highly synchronized path, reacting similarly to market shocks, the GPR series is characterized by abrupt and sharp spikes, reflecting the discontinuous and unpredictable nature of geopolitical events. This suggests that real estate returns are more susceptible to negative extreme tails during periods of peak geopolitical risk, and the series demonstrate typical financial time series characteristics prior to formal stationarity testing

Table 1. Descriptive Statistic

	GPR	SP_REIT	DJ_GREEN
Mean	124.77710	0.00008	0.00005
Median	116.54500	0.00052	0.00045
Maximum	542.29410	0.09241	0.08954
Minimum	9.49160	-0.15155	-0.13671
Std. Dev.	57.23974	0.01096	0.01109

Observations	2305	2305	2305

The descriptive statistics in Table 1 indicate that the variables exhibit fundamental financial time series characteristics. The Geopolitical Risk Index (GPR) displays significant volatility with a high standard deviation, while the substantial gap between its maximum and minimum values points to a structure susceptible to sharp shocks. The average returns for the real estate indices, SP_REIT and DJ_GREEN, are notably similar and hover near zero. The standard deviation values of both real estate series suggest a comparable level of market risk. Furthermore, the fact that minimum values are greater in absolute terms than maximum values reveal that negative shocks (left tail risk) are more pronounced in real estate markets.

2.2. Methodology

To analyze the intricate linkages between geopolitical risk and real estate indices, this study adopts the Quantile-on-Quantile connectedness (QQCON) framework of Gabauer and Stenfors (2024). This methodology refines the quantile approaches established by Chatziantoniou et al. (2021) and Ando et al. (2022) by integrating cross quantile interdependencies into the analysis. The estimation process commences with a Quantile Vector Autoregressive (QVAR) model, which serves as the foundational step for capturing distributional dependencies across various market states (Equation 1).

$$x_t = \mu(\tau) + \sum_{j=1}^{p} B_j(\tau)\, x_{t-j} + u_t(\tau) \qquad \text{Equation (1)}$$

In this specification, x_t and $x_{(t-j)}$ represent K-dimensional vectors of endogenous variables, with τ capturing the quantile range [0, 1] and p denoting the order of lags used in the QVAR framework. The QVAR process can be re-expressed as a moving average representation comprising a series of historical shocks:

$$x_t = \mu(\tau) + \sum_{j=1}^{p} B_j(\tau)x_{t-j} + u_t(\tau) = \mu(\tau) + \sum_{i=0}^{\infty} A_j(\tau)\, u_{t-1}(\tau) \qquad \text{Equation (2)}$$

The formulation in Equation 2 demonstrates the effect of shocks originating from j on the dynamics of i across an F-step horizon. In this context, the transmission of a disturbance originating in series j to series i is assessed using the F-step-ahead GFEVD, as formalized in Equation (3).

$$\varphi_{i \leftarrow j, \tau}^{g}(F) = \frac{\sum_{f=0}^{F-1}\left(e_i' A_f(\tau) H(\tau) e_j\right)^2}{H_{ii}(\tau) \sum_{f=0}^{F-1}\left(e_i' A_f(\tau) H(\tau) A_f(\tau)' e_i\right)}, \qquad gSOT_{i \leftarrow j, \tau}(F) = \frac{\varphi_{i \leftarrow j, \tau}^{g}(F)}{\sum_{j=1}^{k} \varphi_{i \leftarrow j, \tau}^{g}(F)} \qquad \text{Equation (3)}$$

The net aggregate directional connectedness, as expressed in Equation (4), is obtained by subtracting the FROM measure from the TO measure for a given series.

$$S_{i,\tau}^{gen,net} = S_{i \to \bullet, \tau}^{gen,to} - S_{i \leftarrow \bullet, \tau}^{gen,from} \qquad \text{Equation (4)}$$

The condition $S_{i,\tau}^{gen,net} > 0$ designates series i as a net shock transmitter, while $S_{i,\tau}^{gen,net} < 0$ categorizes it as a net shock receiver. Lastly, the adjusted Total Connectedness Index (TCI), which is constrained within the [0, 1] interval as proposed by Chatziantoniou et al. (2021), is derived using the formulation presented in Equation (5).

$$TCI_\tau(F) = \frac{K}{K-1}\sum_{k=1}^{K} S_{i\leftarrow\bullet,\tau}^{gen,from} \equiv \sum_{k=1}^{K} S_{i\rightarrow\bullet,\tau}^{gen,to} \qquad\qquad \text{Equation (5)}$$

3. Empirical Results

This section of the study presents the empirical findings on the dynamic connectedness between geopolitical risk (GPR) and both conventional and sustainable real estate markets, utilizing the QQCON approach.
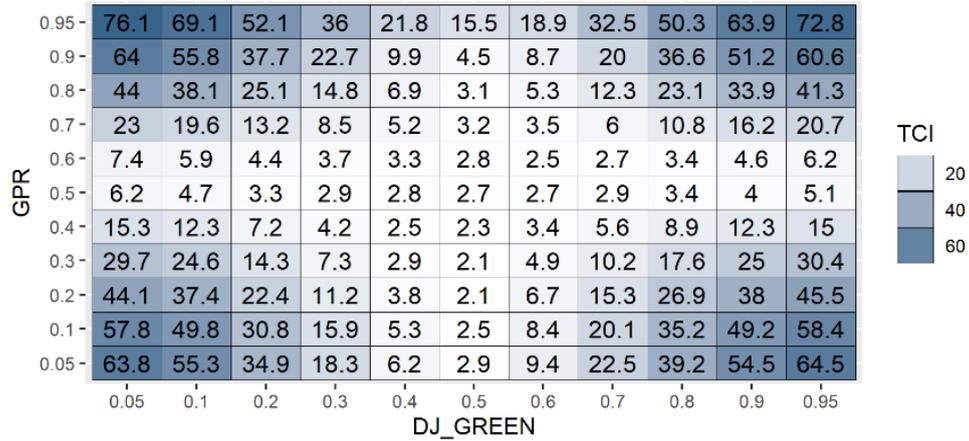

Figure 2. Quantile Total Connectedness Indices between DJ_GREEN and GPR

The quantile based TCI results presented in Figure 2 show that the connectedness between DJ_GREEN and GPR varies markedly depending on the level of geopolitical risk. In particular, the fact that the connectedness index exceeds 60 in the areas where high GPR quantiles intersect with high DJ_GREEN quantiles reveals that geopolitical risk shocks are strongly transmitted to the green real estate market and that market interactions intensify during stress periods. This indicates that investor behavior becomes more synchronized under high uncertainty regimes, and that inter-market dependence strengthens as risk premia increase and liquidity conditions tighten.

In contrast, the weak connectedness between low GPR and low DJ_GREEN quantiles indicates that, under normal market conditions, the green real estate market is only marginally affected by geopolitical risks. This structure suggests that, in low stress regimes, market movements are primarily determined by sectoral fundamentals and long term investment dynamics. Overall, the TCI matrix shows that the relationship between DJ_GREEN and GPR is both asymmetric and regime-dependent; it reveals that shock transmission mechanisms strengthen particularly in high risk environments, while connectedness weakens significantly in low risk environments.
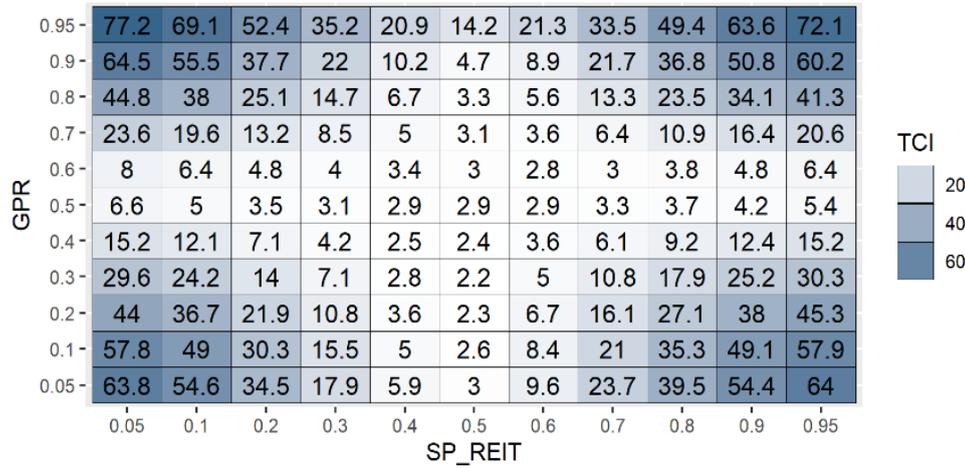
GPR	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.95
0.95	77.2	69.1	52.4	35.2	20.9	14.2	21.3	33.5	49.4	63.6	72.1
0.9	64.5	55.5	37.7	22	10.2	4.7	8.9	21.7	36.8	50.8	60.2
0.8	44.8	38	25.1	14.7	6.7	3.3	5.6	13.3	23.5	34.1	41.3
0.7	23.6	19.6	13.2	8.5	5	3.1	3.6	6.4	10.9	16.4	20.6
0.6	8	6.4	4.8	4	3.4	3	2.8	3	3.8	4.8	6.4
0.5	6.6	5	3.5	3.1	2.9	2.9	2.9	3.3	3.7	4.2	5.4
0.4	15.2	12.1	7.1	4.2	2.5	2.4	3.6	6.1	9.2	12.4	15.2
0.3	29.6	24.2	14	7.1	2.8	2.2	5	10.8	17.9	25.2	30.3
0.2	44	36.7	21.9	10.8	3.6	2.3	6.7	16.1	27.1	38	45.3
0.1	57.8	49	30.3	15.5	5	2.6	8.4	21	35.3	49.1	57.9
0.05	63.8	54.6	34.5	17.9	5.9	3	9.6	23.7	39.5	54.4	64

SP_REIT

TCI: 20, 40, 60

Figure 3. Quantile Total Connectedness Indices between SP_REIT and GPR

The quantile-based TCI results presented in Figure 3 show that the connectedness between the global real estate investment trust market (SP_REIT) and geopolitical risk (GPR) varies significantly depending on the level of risk. In particular, the TCI values exceeding 60 in the areas where high GPR quantiles intersect with high SP_REIT quantiles reveal that geopolitical shocks are transmitted strongly and rapidly to the global REIT market. This indicates that the sensitivity of the REIT market to geopolitical uncertainty increases during stress periods, that investors' portfolio behaviours become more synchronized, and that cross-market interactions strengthen. These findings confirm that REIT markets are highly responsive to shifts in global risk perception and that volatility spillover channels become sharply activated during periods of heightened uncertainty.

The weak connectedness observed between low GPR and low SP_REIT quantiles, on the other hand, implies that the effects of geopolitical risks on the REIT market are limited under normal market conditions. In this structure, market movements appear to be driven largely by real estate sector fundamentals, interest rates, rental yields, and global liquidity conditions. Overall, the TCI matrix shows that the relationship between SP_REIT and GPR is asymmetric and regime dependent; connectedness increases markedly in high-risk regimes, while it remains quite weak in low-risk regimes. These results emphasize that the sensitivity of the REIT market to geopolitical shocks varies depending on both the level of risk and the prevailing market regime.
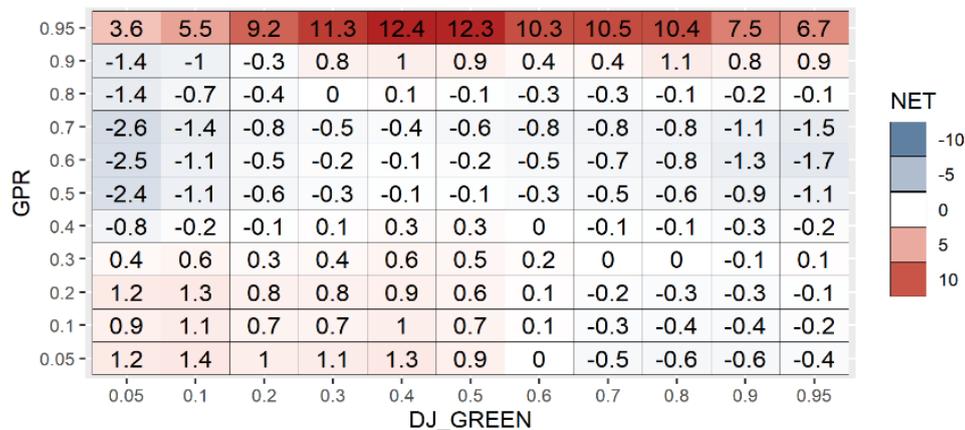
GPR	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.95
0.95	3.6	5.5	9.2	11.3	12.4	12.3	10.3	10.5	10.4	7.5	6.7
0.9	-1.4	-1	-0.3	0.8	1	0.9	0.4	0.4	1.1	0.8	0.9
0.8	-1.4	-0.7	-0.4	0	0.1	-0.1	-0.3	-0.3	-0.1	-0.2	-0.1
0.7	-2.6	-1.4	-0.8	-0.5	-0.4	-0.6	-0.8	-0.8	-0.8	-1.1	-1.5
0.6	-2.5	-1.1	-0.5	-0.2	-0.1	-0.2	-0.5	-0.7	-0.8	-1.3	-1.7
0.5	-2.4	-1.1	-0.6	-0.3	-0.1	-0.1	-0.3	-0.5	-0.6	-0.9	-1.1
0.4	-0.8	-0.2	-0.1	0.1	0.3	0.3	0	-0.1	-0.1	-0.3	-0.2
0.3	0.4	0.6	0.3	0.4	0.6	0.5	0.2	0	0	-0.1	0.1
0.2	1.2	1.3	0.8	0.8	0.9	0.6	0.1	-0.2	-0.3	-0.3	-0.1
0.1	0.9	1.1	0.7	0.7	1	0.7	0.1	-0.3	-0.4	-0.4	-0.2
0.05	1.2	1.4	1	1.1	1.3	0.9	0	-0.5	-0.6	-0.6	-0.4

DJ_GREEN

NET: -10, -5, 0, 5, 10

Figure 4. Net Quantile Connectedness between DJ_GREEN and GPR

The net quantile connectedness results presented in Figure 4 show that the direction of shock

transmission between DJ_GREEN and GPR varies distinctly according to risk regimes. In particular, the positive and intense red tones observed in the high GPR quantiles reveal that geopolitical risk is in a net shock transmitting position and exerts a strong influence on the green real estate market. This indicates that as geopolitical uncertainty increases, the DJ_GREEN index is placed under greater external risk pressure and its sensitivity to GPR driven news flows rises. In contrast, the neutral or slightly negative values observed at low GPR levels show that, in normal periods, the DJ_GREEN market is only marginally affected by geopolitical risk and, in some low quantiles, even assumes a partial shock-receiving role. Overall, the results demonstrate that geopolitical risk becomes a dominant driving force over the green real estate market particularly in high uncertainty regimes, and that the structure of the relationship is clearly regime dependent.
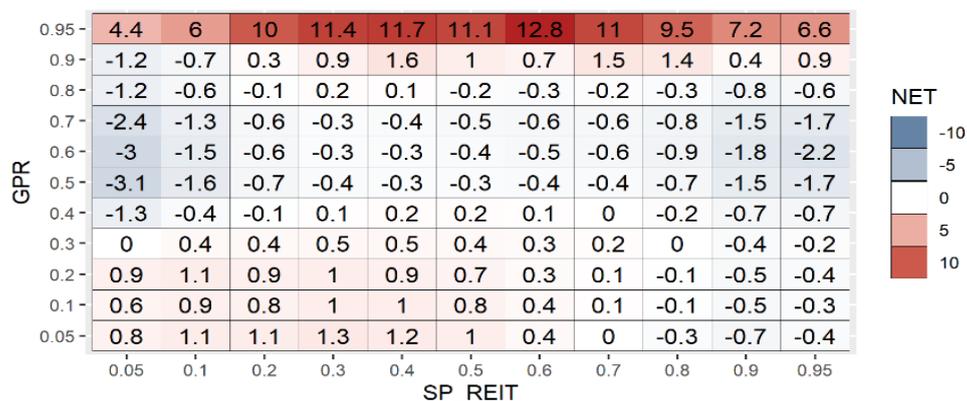

Figure 5. Net Quantile Connectedness between SP_REIT and GPR

The net quantile connectedness results presented in Figure 5 indicate that global geopolitical risk (GPR) creates a significant and regime dependent transmission effect on the traditional real estate market. The concentration of red tones in the high GPR quantiles shows that the SP_REIT index operates as a net shock receiver in the face of geopolitical uncertainty. This implies that rising geopolitical tensions generate a strong risk transmission toward the traditional real estate market, reflecting investors' tendency to reposition their portfolios and behave more cautiously during periods of heightened uncertainty. Conversely, the more neutral or slightly negative values observed at low GPR levels suggest that, under normal market conditions, the traditional real estate market is only marginally affected by geopolitical fluctuations. Overall, the findings demonstrate that geopolitical risk becomes a dominant determinant of the SP_REIT index under high uncertainty regimes, whereas connectedness weakens distinctly during low uncertainty periods.

Figure 6. Direct and Reverse Total Connectedness between DJ_GREEN and GPR

Figure 6. Direct and Reverse Total Connectedness between DJ_GREEN and GPR illustrates the dynamic connectedness between geopolitical risk and the green real estate market over time, showing how geopolitical shocks are transmitted and with what magnitude. The green line (Direct Quantiles) represents the direct effect from GPR to DJ_GREEN, and its predominantly positive trajectory indicates that increases in geopolitical risk generate a persistent and directional influence on the green real estate market. By contrast, the red line (Reverse Quantiles) reflects the effect from DJ_GREEN back to GPR, displaying substantial fluctuations particularly toward the end of 2019, during the 2020 pandemic period, and throughout the geopolitical tensions of 2022; this suggests that shocks create a bidirectional and dynamic interaction. The blue line (ΔTCI) shows changes in total connectedness, with notable intensification during the pandemic and after 2022. This pattern indicates that when geopolitical shocks escalate, integration between GPR and DJ_GREEN strengthens, and cross market shock transmission accelerates. In periods of low uncertainty, the flatter and lower ΔTCI values demonstrate that cross market interaction weakens, and DJ_GREEN mainly follows its own sector specific dynamics. Overall, the figure clearly reveals that when geopolitical risk rises, DJ_GREEN exhibits more synchronized and more sensitive behavior, whereas in calmer periods, the market returns to its underlying fundamentals.

Figure 7. Direct and Reverse Total Connectedness between SP_REIT and GPR

Figure 7. Direct and Reverse Total Connectedness between SP_REIT and GPR illustrates the time varying dynamics between the traditional real estate market (SP_REIT) and global geopolitical risk. The green line (Direct Quantiles) represents the transmission of shocks from GPR to SP_REIT, whereas the red line (Reverse Quantiles) captures the feedback effect from SP_REIT to GPR. The consistently positive and relatively stable pattern of the direct connectedness indicates that increases in geopolitical risk exert a continuous and systematic influence on the traditional real estate market. In contrast, the reverse connectedness exhibits a more volatile structure, suggesting that SP_REIT contributes only marginally and intermittently to movements in geopolitical risk, primarily during periods of heightened market stress. The blue line (ΔTCI) reflects changes in overall connectedness and shows marked increases during the pandemic period and after 2022, when geopolitical tensions intensified. This pattern demonstrates that the degree of interdependence between SP_REIT and GPR strengthens under high uncertainty regimes, with greater synchronization across markets and more rapid shock transmission. Overall, the figure indicates that while the traditional real estate market is sensitive to geopolitical risks, this sensitivity becomes substantially more pronounced during geopolitical or economic stress episodes.

The existing literature aligns closely with the findings of this study. The evidence provided by Yuni, Enwo-Irem, and Urom (2024), showing that geopolitical risks exert dynamic pressures on real estate markets, and by Abakah et al. (2025), demonstrating that geopolitical shocks can trigger real estate stock crashes, corroborates our results indicating that both the DJ_GREEN and SP_REIT markets are strongly affected by GPR during high-risk regimes. Similarly, the conclusions of Coën and Desfleurs (2024a), which highlight the sensitivity of REIT returns to geopolitical risk and policy uncertainty, are consistent with our quantile dependent connectedness results, as we also identify strong shock transmission toward the conventional real estate market at higher GPR quantiles.

Moreover, the findings of Barkham and Holberton (2017) and Alsadan et al. (2025) regarding the disruptive influence of geopolitical shocks on commercial real estate users and financial integration align with our evidence showing that geopolitical risk propagates asymmetrically across markets in both direction and magnitude. Overall, the literature broadly supports our conclusion that geopolitical risks heighten volatility and strengthen interdependence within real estate markets.

4. Conclusion and Policy Implications

This study examines the quantile dependent effects of global geopolitical risks (GPR) on both the green real estate market (DJ_GREEN) and the conventional real estate market (SP_REIT), demonstrating that cross market connectedness differs markedly across risk regimes. The findings reveal that both markets are exposed to strong shock transmission mechanisms during periods of elevated geopolitical risk, with market integration increasing sharply in crisis regimes. This pattern indicates that under uncertainty shocks, investor behavior becomes more synchronized; rising risk premia, tightening liquidity conditions, and increasing information asymmetries lead both green and conventional real estate markets to exhibit similar response patterns. Conversely, weak connectedness in low-risk regimes suggests that market dynamics are primarily shaped by sectoral fundamentals, the long-term nature of sustainability investments, and country specific economic conditions.

The results also show that geopolitical shocks generate not only short-term fluctuations, but also structural regime shifts that reshape pricing behavior. The relatively strong connectedness observed in the green real estate market under high-risk conditions indicates that sustainability-oriented investments become more sensitive during periods of heightened uncertainty. In contrast, the conventional REIT market exhibits increased volatility transmission due to its exposure to energy prices, trade routes, and global capital flows. The differing sensitivity levels between the two markets demonstrate that investor preferences are reorganized depending on risk regimes and that market behavior has increasingly adopted a regime dependent structure.

These findings provide an important roadmap for policymakers, as they show that geopolitical risks exert asymmetric and regime dependent effects on both green and conventional real estate markets. Given that market reactions intensify significantly in high-risk periods, strengthening information transparency mechanisms is essential for safeguarding financial stability under geopolitical uncertainty. Although real estate markets generally exhibit greater inertia than many other financial assets, they remain vulnerable to sharp price fluctuations during crisis periods due to liquidity contractions, rising information asymmetries, and sudden changes in investor sentiment. For this reason, regulatory authorities should develop market based early warning indicators, update risk monitoring systems to incorporate geopolitical developments, and ensure continuous information flow to sectoral stakeholders.

The heightened sensitivity of sustainability oriented real estate investments to geopolitical shocks highlights the importance of adopting a long term and structurally grounded perspective in policy design. Enhancing the resilience of green real estate markets requires a broader and more systematic integration of sustainable finance instruments, including green bonds, sustainability linked loans, and carbon-neutral project financing mechanisms. In parallel, strengthening the international harmonization of green building certification and disclosure standards would contribute to reducing informational uncertainty faced by investors and improve the capacity of sustainability-oriented projects to withstand periods of geopolitical stress. Such harmonization efforts can alleviate information asymmetries, enhance market transparency, and support more consistent and efficient asset pricing.

The strong connectedness observed in conventional real estate investment trust (REIT) markets suggests a higher degree of exposure to macroeconomic transmission channels that are closely intertwined with

geopolitical developments, including energy price fluctuations, disruptions in trade routes, and shifts in global capital flows. This finding underscores the necessity of coordinated policymaking across sectors that are structurally linked to real estate markets, particularly energy, transportation, and financial services. Policies aimed at strengthening energy supply security, diversifying supply chains, and reinforcing cross sectoral risk management frameworks may reduce the vulnerability of conventional real estate markets to external geopolitical shocks. Furthermore, financial institutions are encouraged to recalibrate portfolio diversification strategies by explicitly accounting for regime shifts, increasing the sensitivity of asset allocation decisions to geopolitical risk, and incorporating long horizon geopolitical scenarios into investment and stress testing models.

For global investors and fund managers, the study confirms once again that geopolitical risks reinforce cross market shock transmission mechanisms. Therefore, portfolio strategies must be updated to incorporate regime dependent risks. Although green real estate investments offer attractive long-term returns based on sustainability fundamentals, they may become more fragile under high uncertainty regimes. Hence, investors should adopt protective asset positions during stress periods, develop hedging strategies, and increase the weight of sectors with low geopolitical risk sensitivity.

At the national policy level, urban planning policies, land use strategies, and sustainable urban transformation programs should be designed within an integrated framework that acknowledges geopolitical risk perceptions. Given the central role of real estate markets in macro financial stability, establishing a resilient economic environment requires stronger coordination mechanisms between public and private sector stakeholders. As geopolitical risks continue to evolve into a persistent feature of the global system, building a robust real estate market has become not only an economic necessity but also a strategic imperative.

This study has several limitations, which provide important avenues for future research. Since the analysis is restricted to the DJ_GREEN and SP_REIT indices, different real estate subsectors or regional markets could not be incorporated into the model. Moreover, the global geopolitical risk index used in the study does not capture cross country differences, preventing a detailed examination of heterogeneity in market responses. Because macroeconomic variables and other forms of risk were not controlled for, the transmission mechanisms of geopolitical shocks could not be fully disentangled. Future studies may offer deeper contributions to the literature by employing country and sector specific datasets, alternative geopolitical risk measures, and different modeling approaches to analyze these relationships within a more comprehensive and causal analytical framework

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