Economics and Business Letters
15(1), 56-69, 2026

Risk without borders: a transfer entropy analysis of geopolitical spillovers in low- and lower-middle-income markets

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Received: 7 June 2025
Revised: 21 November 2025
Accepted: 2 December 2025

Abstract
How geopolitical risk affects stock markets in low and lower-middle-income countries remains an area often overlooked. This study analyzes daily data from 2014 to 2025 for 16 stock markets and two geopolitical risk subindices, acts and threats. The transfer entropy is applied in a dynamic framework to measure asymmetric and time-varying information flows. The findings reveal a heterogeneous influence of acts and threats, varying by country-income level, geographic region, and over time, and suggest an increased sensitivity of financial markets after 2020, particularly in response to acts rather than threats. This highlights distinct geopolitical risk transmission, requiring tailored investment strategies and policy responses

Keywords: geopolitical risk, low-income countries, lower-middle-income countries, information spillovers, transfer entropy
JEL Classification Codes: G11, G12, G15, G17, G18

1. Introduction

Low- and Lower-middle-income countries (LLMICs), as classified by the World Bank based on gross national income per capita, represent a substantial share of the global economic landscape, with a significant portion of the world's population living within them (Moreira,

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Citation: D. Almeida, P.J. Ferreira and F. Aslam (2026) Risk without borders: a transfer entropy analysis of geopolitical spillovers in low- and lower-middle-income markets, *Economics and Business Letters*, 15(1), 56-69. DOI: 10.17811/ebl.15.1.2026.56-69.

2024). As such, the economic development of these countries is critical for global poverty reduction and economic stability, with their policies and growth trajectories exerting a meaningful influence on global economic trends (Koch, 2015).

Some of these countries have underdeveloped financial markets and institutions, increasing their susceptibility to economic disruptions, making financial development crucial to reduce economic vulnerability, once financial systems can significantly mitigate those vulnerabilities (Nguyen & Su, 2021).

Climate change and geopolitical risks worsen existing vulnerabilities, deepening inequality, stalling growth, and increasing disruptions (Abdel-Latif & El-Gamal, 2022; Filipava, 2024; Kaya et al., 2025), with emerging markets like LLMICs being particularly exposed to geopolitical risks (Cao & Vo, 2025; Hallam, 2022; Wu & Pan, 2021; Wu et al., 2022). Regional conflicts, terrorism, and tensions destabilize these markets, hindering long-term economic growth development (Abdel-Latif & El-Gamal, 2022; Ali et al., 2025). Geopolitical risks impact stock returns and volatility (Agoraki et al., 2022) and often lead to negative financial shifts (Huang et al., 2023; Zheng et al., 2023). They also predict financial stress and instability (Zhu et al., 2025). In this context, comprehending the dynamic impact of geopolitical risks on these countries' financial stability is paramount.

Recognizing the time-varying nature of these impacts is essential for policymakers and financial stakeholders in these countries to develop effective risk management and mitigation strategies (Shaik et al., 2023). Notably, geopolitical threats can often have a greater influence on financial markets than the actual occurrence of such events, highlighting the pivotal role of uncertainty in the transmission of geopolitical risk (Caldara & Iacoviello, 2018).

This study employs transfer entropy (TE) with sliding windows (SW) to analyze complex, time-varying, and potentially nonlinear dynamic relationships. This nonparametric approach is well-suited for uncovering causal linkages within intricate systems such as financial markets and geopolitical events.

To quantify adverse geopolitical events, the analysis draws on the Geopolitical Threats (GPRT) and Geopolitical Acts (GPRA) indices developed by Caldara and Iacoviello (2018), which provide a quantitative distinction between perceived threats and the actual realization of geopolitical risks. They have been applied in different contexts [see, for example, Ali et al. (2023), Almeida et al. (2025), Bouoiyour et al. (2019), Coën and Desfleurs (2024), Gabriel et al. (2024), Wang and Dong (2024)], underscoring their relevance in both academic research and risk management. By separating threats from acts, these indices offer deeper insight into how geopolitical events influence financial markets and international stability.

To theoretically ground the analysis of these market dynamics, it is essential to consider the historical continuity provided by foundational studies on contagion and entropy. For example, Forbes and Rigobon (2002) assessed the empirical evidence of contagion and proposed a framework that allows the distinction between contagion and interdependence. Regarding the theoretical foundation for information theory, which has been crucial for the development of entropy-based measures in finance, it was laid by Kullback and Leibler (1951), whose work on relative entropy is widely cited in studies exploring the informational aspects of financial contagion. In the context of entropy-based measures, the work of Mantegna and Stanley (1999) introduced the application of statistical physics to financial markets, demonstrating how entropy can be used to measure the complexity and correlations among asset returns, providing

by this way a new perspective on market dynamics and contagion, illustrating the utility of entropy as a tool for understanding financial interconnections.

While existing research often examines geopolitical risk in global and emerging markets, few studies assess its dynamic and heterogeneous effects on LLMICs using disaggregated GPRT and GPRA indices. The use of TE with SW to capture non-linear, time-varying impacts, especially distinguishing between threats and acts, also remains limited. This paper fills that gap by offering a comprehensive analysis of geopolitical risk on LLMICs' financial stability, providing insights that can support policymakers and international efforts to enhance economic resilience.

The remainder of the letter is structured as follows: Section 2 presents the methods, Section 3 outlines the data, Section 4 presents and discusses the results, and Section 5 provides the conclusions.

2. Methods

Parametric volatility-based models, such as the Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH), are commonly used to characterize time-varying relationships, modelling conditional correlations through the joint evolution of variances and covariances (Jizba et al., 2021). While the DCC-GARCH model is effective in modeling volatility clustering and time-varying correlations, due to specific data-model assumptions, it may not capture nonlinear dependencies, thereby reducing its ability to handle more complex causal relationships (Jizba et al., 2021; Restrepo et al., 2020). By contrast, TE does not rely on distributional assumptions and is therefore better positioned to detect asymmetric and time-varying spillovers between geopolitical risk indices and LLMIC stock markets. TE is an information-based approach that allows measuring the information flow from one time series to another, capturing both linear and nonlinear dependencies without assuming a specific model (Nichols et al., 2005; Schreiber, 2000). Alternative nonlinear approaches offer complementary perspectives but rely on different assumptions. Rényi transfer entropy (RTE), for instance, extends the concept of TE by incorporating Rényi entropy, which allows for the adjustment of a parameter α to emphasize or suppress specific parts of the probability distributions, such as the tails. This makes RTE particularly useful in scenarios where rare events or "black swan" events are of interest (Jizba et al., 2021, 2022), which is not the particular case of this study, that aims to evaluate the bidirectional and asymmetric information flow between each country's stock index and each of the GPR subindices. Thus, the TE proposed by Schreiber (2000) was applied to the log return series. This approach enables the analysis of market dynamics, risk transmission, and interdependencies among variables (Dimpfl & Peter, 2013; Marschinski & Kantz, 2002).

Assuming a Markovian process of order k for X and l for Y, TE is defined in Eq. 1.

$$TE_{Y\to X}(k,l) = \sum_{x,y} p\left(x_{t+1}, x_t^{(k)}, y_t^{(l)}\right) log \frac{p\left(x_{t+1}\middle| x_t^{(k)}, y_t^{(l)}\right)}{p\left(x_{t+1}\middle| x_t^{(k)}\right)} \quad (1)$$

To identify the dominant direction of information flow, the NET TE, defined in Eq. 2, was estimated:

$$NET\ TE_{YX} = TE_{Y \to X} - TE_{X \to Y} \quad (2)$$

Where Y represents each geopolitical risk index and X represents each country's stock index. If $NET\ TE_{YX} > 0$, then $TE_{Y \to X}(k,l) > TE_{X \to Y}(k,l)$, indicating that the dominant direction of information flow is from Y to X. Conversely, if $NET\ TE_{YX} < 0$, then $TE_{Y \to X}(k,l) < TE_{X \to Y}(k,l)$), meaning the dominant direction of information flow is from X to Y. If $TE_{Y \to X}(k,l) = TE_{X \to Y}(k,l)$, then $NET\ TE_{YX} = 0$, indicating that the information flow is equal in both directions.

To account for the evolving nature of financial markets, a sliding window (SW) approach was used to capture time-varying relationships. This method helps identify transient interactions and their directionality (Martini et al., 2011) and supports dynamic analysis and trend prediction (Peng et al., 2022). A window size of 250 observations was chosen to balance estimation accuracy and temporal sensitivity. A robustness check with a 500-observation window yielded similar qualitative results (available upon request).

All the TE estimates were made using the R package RTransferEntropy.

3. Data

Daily closing prices of 16 stock indices and the two subindices of the Geopolitical Risk Index (GPR), GPRA and GPRT, were used, as detailed in Table 1. Stock market data was obtained from LSEG Refinitiv, while the GPRA and GPRT data were extracted from the Geopolitical Risk website (https://www.matteoiacoviello.com/gpr.htm), with both accessed on March 7, 2025. The dataset spans from March 6, 2014 (based on the earliest date with available data for all country stock indices) to March 6, 2025, totaling 1,227 observations. The database was cleaned to ensure the same number of observations and identical dates across all countries.

4. Results and discussion

The descriptive statistics (Table 2) reveal: (i) near-zero but positive mean returns, indicating gains across most stock markets (except UGA, JOR, PHL, and WBG); (ii) high kurtosis (>4.39), especially in RWA, JOR, and LBN, suggesting fat-tailed distributions and frequent extreme events likely tied to political or liquidity shocks, while GPRA and GPRT present low kurtosis, consistent with indices constructed from aggregations or moving averages of events; (iii) predominantly negative skewness, reflecting vulnerability to downside shocks, while GPRA and GPRT show smoother variations (low kurtosis) and more frequent sharp increases (positive skewness), consistent with the abrupt nature of risk events. Augmented Dickey–Fuller and Kolmogorov–Smirnov tests reject the null hypotheses, reinforcing the use of TE to handle non-stationary, non-Gaussian, and non-linear data.

Figure 1 depicts the evolution of NET TE between each geopolitical risk subindex and each country's stock index, considering SWs of 250 observations.

Geopolitical risks affect low-income countries' stock markets in diverse ways. In Rwanda (RWA), the GPRA mainly acts as a net receiver of information (NET TE < 0), suggesting limited market integration and vulnerability to external shocks and information flows from more dominant economies (Hegerty, 2014), but also some capacity to anticipate events

(Fiorillo et al., 2023). In UGA, the GPRA shows a mixed pattern, though it often functions as a net transmitter, especially post-2020, possibly reflecting FinTech adoption and strengthened trade ties (Ecel et al., 2025). Both markets were relatively insensitive to geopolitical events until mid-2020, after which responsiveness increased, likely due to greater regional integration and the effects of COVID-19 (Bossman et al., 2025; Korsah & Mensah, 2024). For the GPRT, 2021 marks a shift to a consistent role as a net transmitter, particularly in RWA following the Russian invasion of Ukraine.

Globally, these countries' stock markets exhibit increasing sensitivity to the GPRT from 2021 onward. The UGA market is generally more reactive to consummated geopolitical acts, whereas the RWA market is more responsive to geopolitical threats.

Among lower-middle-income countries in the South Asia region, distinct behavior patterns emerge. The GPRA strongly influenced the Bangladeshi stock market between 2019 and 2022 (inclusive) and the Pakistani stock market between mid-2021 and mid-2022. This may be attributed to proximity to conflict zones and political instability in neighboring regions, including the ongoing Rohingya crisis, political unrest in Myanmar, and the Afghanistan conflict (Lee, 2024; Panazan et al., 2024). In contrast, the GPRA's influence on the Indian stock market does not follow a consistent pattern, with several changes between acting as a net information transmitter and receiver over time.

Regarding the GPRT, the Bangladeshi stock market shows strong sensitivity to geopolitical threats, with significant peaks between 2019 and 2020. This aligns with Borman et al. (2025), who documented significant volatility and co-movements between the Dhaka Stock Exchange and global markets during major geopolitical crises, such as the COVID-19 pandemic and the Russia–Ukraine conflict. The GPRT lost informational traction in Pakistan after 2022, when the GPRA became more influential. As with the GPRA, the GPRT's influence on the Indian stock market lacks a defined pattern. Nevertheless, the GPRT strongly influenced the Indian stock market, albeit in short-lived peaks, during the second and third quarters of 2024.

Thus, this region's stock markets are generally more sensitive to geopolitical events in the post-2020 period, while the GPRT has lost informational influence, especially in IND and PAK. Among them, the Indian stock market displays the most ambiguous and unstable relationship with geopolitical risk.

Although Sub-Saharan African countries exhibit mixed behavior patterns, their stock markets are generally more strongly influenced by the GPRA than the GPRT, though all are influenced by geopolitical risks, supporting findings by Truong et al. (2025). Only from 2024 onward, particularly in the case of CIV, did the GPRT begin to show a stronger influence. While the GPRA has had an impact across the region's stock markets, its influence was particularly pronounced during the pandemic and following the onset of the Russia–Ukraine war, indicating that these markets are highly reactive to consummated geopolitical events, in line with Del Lo et al. (2022), Jreisat (2023), and Ncube et al. (2023). CIV appears to be the least affected by geopolitical events among these three stock markets. The weak interdependence among West African stock markets, including CIV, may explain its relative insulation from external shocks (Emenike, 2021).

As for the GPRT, the ZMB and CIV stock markets show limited sensitivity to geopolitical threats, whereas the TZA stock market is more responsive to this type of risk. These findings are consistent with Adam (2020) and Oyadeyi et al. (2024). The former notes that ZMB's stock

market receives insignificant information from international economic policy uncertainty, and the latter shows that the TZA All Share Index was significantly affected by the Russia–Ukraine crisis, indicating heightened sensitivity to geopolitical events.

Table 1. Description of the data and codes used

Country	Country classification	Region	Code
Rwanda	Low-income	Sub-Saharan Africa	RWA
Uganda			UGA
Bangladesh	Lower-middle-income	South Asia	BGD
India			IND
Pakistan			PAK
Côte d'Ivoire		Sub-Saharan Africa	CIV
Tanzania			TZA
Zambia			ZMB
Egypt, Arab Rep.		Middle East and North Africa (MENA)	EGY
Jordan			JOR
Lebanon			LBN
Morocco			MAR
Tunisia			TUN
West Bank and Gaza			WBG
Philippines		East Asia and Pacific	PHL
Vietnam			VNM
Geopolitical risk index			**Symbol**
Geopolitical acts index			GPRA
Geopolitical threats index			GPRT

Notes: (i) Countries were classified by income level according to the World Bank's country classification for the fiscal year of 2025; (ii) The GPRA is a subindex of the GPR index. It includes terms related to "beginning of the war," "escalation of the war," and "terror acts," as identified across 10 newspapers (six from the U.S., three from the U.K., and one from Canada); (iii) The GPRT is also a subindex of the GPR index. It includes terms related to "war threats," "peace threats," "military buildups," "nuclear threats," and "terror threats", extracted from the same newspapers used for the GPRA.

Table 2. Descriptive statistics

Country	Mean	Std. Dev.	Skewness	Kurtosis	K-S	ADF
RWA	0.00002	0.00489	10.59580	240.75843	0.33265 ***	-10.13944 **
UGA	-0.00008	0.02277	-0.22862	30.53447	0.18605 ***	-10.63443 **
BGD	0.00008	0.01248	-0.57482	11.62444	0.11478 ***	-10.19675 **
IND	0.00115	0.01454	-0.72697	9.92907	0.08591 ***	-10.58438 **
PAK	0.00103	0.01438	-0.14801	4.39745	0.08179 ***	-9.85184 **
CIV	0.00015	0.01052	-0.01299	7.89250	0.08929 ***	-8.58134 **
TAZ	0.00012	0.01859	0.57857	31.34130	0.16730 ***	-10.88000 **
ZMB	0.00090	0.01166	0.17843	40.27278	0.23425 ***	-9.36304 **
EGY	0.00111	0.02086	-0.55145	7.92064	0.08309 ***	-9.61587 **
JOR	-0.00046	0.02055	-26.03555	827.25758	0.26198 ***	-10.09212 **
LBN	0.00056	0.01881	3.82725	79.22775	0.20227 ***	-9.90550 **
MAR	0.00045	0.01074	-2.71223	51.40056	0.11907 ***	-10.12985 **
TUN	0.00068	0.00741	-0.68031	19.83831	0.11296 ***	-9.08235 **
WBG	-0.00015	0.00797	-0.78107	11.31437	0.13234 ***	-10.35610 **
PHL	-0.00005	0.01411	-1.45533	22.19929	0.09400 ***	-10.35530 **
VNM	0.00051	0.01859	-0.20663	7.24744	0.10973 ***	-11.14550 **
Geopolitical risk index						
GPRA	0.00099	0.71481	0.06929	0.73790	0.03828 *	-14.63243 **
GPRT	0.00032	0.53227	0.01710	1.11969	0.02630	-16.95614 **

Notes: (i) "Std. Dev" represents the standard deviation; (ii) "***", "**" and "*" represent the significance levels of 1%, 5% and 10%, respectively.

In MENA region stock markets, the GPRA emerged as a strong driver of market behavior, particularly between 2020 and 2022, a period marked by extreme events such as the pandemic and intensified regional conflicts. During this time, its influence was especially pronounced in the EGY, LBN, MAR, and TUN stock markets. These results align with those of Eissa et al.

(2024), Gharaibeh (2023), and Medhioub (2025). In the WBG stock market, the GPRA was a strong influencer from 2021 through mid-2023. For Jordan, the GPRA acted as a strong net information transmitter in 2020, consistent with Medhioub (2025), who found that geopolitical risk significantly impacts herding behavior in the Jordanian stock market, particularly during downturns.

The GPRT, by contrast, exhibits a less defined influence pattern. The LBN, TUN, and MAR stock markets appear more sensitive to geopolitical threats, especially in political instability and regional conflict contexts. This is broadly consistent with Gharaibeh (2023), who found that geopolitical risks significantly affect the volatility of the Tunisian and Moroccan stock markets during conflict periods such as the Arab Spring and the Russia–Ukraine war. In other MENA stock markets, however, the GPRT alternates between acting as a net information transmitter and receiver, highlighting that market responses to geopolitical risks are highly context-dependent and vary considerably across countries, as also noted by Eissa and Al Refai (2024).

Overall, stock markets in this region exhibit greater sensitivity to geopolitical acts, frequently acting as net information receivers. This likely reflects the region's high levels of political and geostrategic instability. In contrast, the GPRT displays a more volatile pattern, characterized by frequent and pronounced reversals over time.

In the East Asia and Pacific region, stock markets display high sensitivity to the GPRA and GPRT, reflecting a strong geostrategic profile and deep integration into global risk flows. Since 2019, the GPRA has consistently acted as a net transmitter of information to the Philippine stock market, while its influence on the Vietnamese market emerged only in the fourth quarter of 2022. This pattern aligns with the general trend of increasing sensitivity to geopolitical risks in the Asia-Pacific region, particularly during periods of heightened tensions, as documented by Tran and Vo (2023a, 2023b). The Philippine stock market was especially affected by the GPRA in the first half of 2022, coinciding with the country's presidential elections (May 2022) and an escalation of the territorial dispute with China over the Spratly Islands, factors that likely contributed to the GPRA's pronounced influence during this time.

As for the GPRT, despite some fluctuations, the PHL and VNM stock markets are overall net receivers of information, indicating that geopolitical threats strongly influence these markets. This behavior likely reflects sensitivity to regional tensions in the Indo-Pacific, including maritime disputes and military redeployments.

Despite exhibiting distinct and temporally dynamic informational patterns, both stock markets are highly sensitive to and influenced by geopolitical threats and acts. This result corroborates Tran and Vo (2023b), who observed that Asia-Pacific stock markets are influenced by geopolitical risks, albeit with varying degrees of sensitivity.

5. Concluding remarks

The findings lead to the conclusion that geopolitical risk influences stock market behavior in LLMICs. However, this influence is not homogeneous, geopolitical acts and threats affect stock markets in distinct ways. Moreover, the nature and intensity of these effects vary according to countries' income levels and geographical regions.

Figure 1. Time evolution of the NET TE between GPRA, GPRT, and each country's stock index returns

Figure 1 (Cont.). Time evolution of the NET TE between GPRA, GPRT, and each country's stock index returns

Since 2020, these stock markets have shown increasing sensitivity to specific geopolitical events, with the GPRA exerting a more pronounced influence. In contrast, the GPRT, while still relevant, exhibits less consistent and more varied patterns across countries. This informational asymmetry suggests that stock markets tend to respond more strongly to realized geopolitical acts than to threats, potentially reflecting limitations in investors' ability to forecast geopolitical developments, as well as disparities in the availability and quality of information. Low-income countries display similar patterns of increasing net threat reception, whereas lower-middle-income countries exhibit less defined responses, shaped by regional dynamics, levels of international integration, and geostrategic relevance.

The identified patterns carry important implications for various stakeholders. Investors must account for the specific geopolitical context when assessing risk, especially in emerging markets that are more susceptible to external shocks. For policymakers and regulators, the results highlight the need to strengthen transparency mechanisms and the resilience of financial markets, especially in economies with weaker institutional frameworks. Beyond transparency and resilience, the results emphasize the need for regulatory frameworks that explicitly account for asymmetric and time-varying geopolitical spillovers. As LLMICs often have limited supervisory capacity and market depth, to reduce their systemic volatility, geopolitical risk indicators should be incorporated into macroprudential stress testing, real-time monitoring of cross-border shocks should be enhanced, and crisis management protocols strengthened. Furthermore, to enhance institutional robustness in markets that primarily act as information receivers, rules that promote timely disclosure, strengthen liquidity buffers, and support the adoption of digital reporting infrastructures should be implemented. For multilateral actors and development organizations, recognizing regional patterns of geopolitical sensitivity can support the design of systemic risk mitigation strategies and guide financing instruments with each country's information profile.

Although the newspaper-based GPR indices are widely used in financial studies, they primarily capture geopolitical news from major Western outlets, potentially leaving them only partially representative of local information structures in low-information or thin-media environments. As a result, some region-specific shocks or informal channels of political uncertainty may be underrepresented, especially in LLMICs where domestic news coverage and information diffusion are more limited. This is a limitation, and we acknowledge it.

Incorporating institutional and market variables to account for the observed heterogeneity would be a valuable extension of this analysis. Likewise, integrating press freedom metrics could provide deeper insight into how geopolitical risks are internalized in developing countries' financial markets.

Acknowledgements. Dora Almeida and Paulo Ferreira acknowledge the financial support of Fundação para a Ciência e a Tecnologia (grant UID/05064/2025 - https://doi.org/10.54499/UID/05064/2025 and grant UID/04007/2025).

References

Abdel-Latif, H. and El-Gamal, M. (2022) White elephants on quicksand: low oil prices and high geopolitical risk, *Scottish Journal of Political Economy*, 69(1), 60–107.

Adam, A.M. (2020) Susceptibility of stock market returns to international economic policy:

evidence from effective transfer entropy of Africa with the implication for open innovation, *Journal of Open Innovation: Technology, Market, and Complexity*, 6(3), 71.

Agoraki, M.-E.K., Kouretas, G.P. and Laopodis, N.T. (2022) Geopolitical risks, uncertainty, and stock market performance, *Economic and Political Studies*, 10(3), 253–265.

Ali, Md.I., Rahaman, Md.A., Ali, M.J. and Rahman, Md.F. (2025) The growth–environment nexus amid geopolitical risks: cointegration and machine learning algorithm approaches, *Discover Sustainability*, 6(1), 78.

Ali, S.R.M., Anik, K.I., Hasan, M.N. and Kamal, M.R. (2023) Geopolitical threats, equity returns, and optimal hedging, *International Review of Financial Analysis*, 90, 102835.

Almeida, D., Ferreira, P., Dionísio, A. and Aslam, F. (2025) Exploring the connection between geopolitical risks and energy markets, *Energy Economics*, 141, 108113.

Borman, T., Nahiduzzaman, Md., Kuri, B.C., Dhar, B.K. and Sarker, S.K. (2025) Global financial market spillovers to the Dhaka Stock Exchange: Strategic insights from trade-friendly nations, *Thunderbird International Business Review*, 67(2), 225–246.

Bossman, A., Teplova, T. and Umar, Z. (2025) What do we know about COVID-19 media coverage and African stock markets? A time-varying connectedness analysis, *Applied Economics*, 57(16), 1962–1976.

Bouoiyour, J., Selmi, R., Hammoudeh, S. and Wohar, M.E. (2019) What are the categories of geopolitical risks that could drive oil prices higher? Acts or threats?, *Energy Economics*, 84, 104523.

Caldara, D. and Iacoviello, M. (2018) *Measuring geopolitical risk*, International Finance Discussion Papers, 1222. Board of Governors of the Federal Reserve System: Washington D.C.

Cao, P.T.-H. and Vo, D.H. (2025) Market responses to geopolitical risk and economic policy uncertainty: evidence from Vietnam, *Heliyon*, 11(4), e42703.

Coën, A. and Desfleurs, A. (2024) Geopolitical risk and the dynamics of REITs returns, *Finance Research Letters*, 64, 105437.

Del Lo, G., Basséne, T. and Séne, B. (2022) COVID-19 and the African financial markets: less infection, less economic impact?, *Finance Research Letters*, 45, 102148.

Dimpfl, T. and Peter, F.J. (2013) Using transfer entropy to measure information flows between financial markets, *Studies in Nonlinear Dynamics and Econometrics*, 17(1), 85–102.

Ecel, A., Ahimbisibwe, G.M., Nuwagaba, D., Nankya, M.N. and Nahurira, S. (2025) Evaluating Uganda's preferential market access; trade intensity, comparative advantage and the potential for trade, *Competitiveness Review: An International Business Journal*, 35(3), 579–600.

Eissa, M.A. and Al Refai, H. (2024) Context-dependent responses to geopolitical risk in Middle Eastern and African stock markets: an asymmetric volatility spillover study, *International Review of Economics & Finance*, 94, 103402.

Eissa, M.A., Al Refai, H. and Chortareas, G. (2024) Heterogeneous impacts of geopolitical risk factors on stock markets in the Middle East: a quantile regression analysis across four emerging economies, *The Journal of Economic Asymmetries*, 30, e00374.

Emenike, K.O. (2021) Interdependence among West African stock markets: a dimension of

regional financial integration, *African Development Review*, 33(2), 288–299.
Filipava, L. (2024) Does climate change increase global economic gap? Empirical evidence, *Journal of Poverty*, forthcoming.
Fiorillo, P., Meles, A., Pellegrino, L.R. and Verdoliva, V. (2023) Geopolitical risk and stock liquidity, *Finance Research Letters*, 54, 103687.
Gabriel, V., Dionísio, A., Almeida, D. and Ferreira, P. (2024) From wars to waves: geopolitical risks and environmental investment behaviour, *Post-Communist Economies*, 36(5), 631-658.
Gharaibeh, O. (2023) Geopolitical risks, returns, and volatility in the MENA financial markets: evidence from GARCH and EGARCH models, *Montenegrin Journal of Economics*, 19(3), 21-36.
Hegerty, S.W. (2014) Measuring exchange market pressure and its contagion in the East African Community, *South African Journal of Economics*, 82(2), 239–257.
Huang, J., Li, Y., Suleman, M.T. and Zhang, H. (2023) Effects of geopolitical risks on gold market return dynamics: evidence from a nonparametric causality-in-quantiles approach, *Defence and Peace Economics*, 34(3), 308–322.
Jreisat, A. (2023) The impact of the Ukrainian crisis and global shocks on stock market connectedness in Sub-Saharan Africa: evidence from Diebold and Yilmaz (2012) spillover analysis, *International Journal of Sustainable Development and Planning*, 18(10), 3125–3135.
Kaya, H., Küçükşahin, Y. and Çitil, M. (2025) Impact of geopolitical risk on firm financial fragility: international evidence from listed companies, *Borsa Istanbul Review*, 25(2), 286–295.
Koch, S. (2015) From poverty reduction to mutual interests? The debate on differentiation in EU development policy, *Development Policy Review*, 33(4), 479–502.
Korsah, D. and Mensah, L. (2024) Geopolitical risk, economic policy uncertainty, financial stress and stock returns nexus: evidence from African stock markets, *Journal of Capital Markets Studies*, 8(1), 25–42.
Lee, G. (2024) The impact of North Korean nuclear threat on stock market linkages in Northeast Asia: The case of South Korea, China, and Japan, *Finance Research Letters*, 66, 105727.
Marschinski, R. and Kantz, H. (2002) Analysing the information flow between financial time series, *The European Physical Journal B*, 30(2), 275–281.
Martini, M., Kranz, T.A., Wagner, T. and Lehnertz, K. (2011) Inferring directional interactions from transient signals with symbolic transfer entropy, *Physical Review E*, 83(1), 011919.
Medhioub, I. (2025) Impact of geopolitical risks on herding behavior in some MENA stock markets, *Journal of Risk and Financial Management*, 18(2), 85.
Ncube, M., Sibanda, M. and Matenda, F.R. (2023) COVID-19 pandemic and stock performance: evidence from the Sub-Saharan African stock markets, *Economies*, 11(3), 95.
Nguyen, C.P. and Su, T.D. (2021) Easing economic vulnerability: multidimensional evidence of financial development, *The Quarterly Review of Economics and Finance*, 81, 237–252.
Oyadeyi, O.O., Arogundade, S. and Biyase, M. (2024) How did African stock markets react to the Russia-Ukraine crisis "black-swan" event? Empirical insights from event study, *Humanities and Social Sciences Communications*, 11(1), 121.

Panazan, O., Gheorghe, C. and Calefariu, E. (2024) Geopolitical risks and stock market volatility in the SAARC Region, *Economics*, 18(1), 20220124.

Peng, S., Han, W. and Jia, G. (2022) Pearson correlation and transfer entropy in the Chinese stock market with time delay, *Data Science and Management*, 5(3), 117–123.

Pinto Moreira, E. (2024) *Introduction and overview*, in: Avoiding the middle-income trap in Africa, *Springer Nature: Cham*, 1–6.

Schreiber, T. (2000) Measuring information transfer, *Physical Review Letters*, 85(2), 461–464.

Shaik, M., Jamil, S.A., Hawaldar, I.T., Sahabuddin, M., Rabbani, M.R. and Atif, M. (2023) Impact of geo-political risk on stocks, oil, and gold returns during GFC, COVID-19, and Russian – Ukraine War, *Cogent Economics & Finance*, 11(1), 2190213.

Sungurtekin Hallam, B. (2022) Emerging market responses to external shocks: a cross-country analysis, *Economic Modelling*, 115, 105948.

Tran, M.P.-B. and Vo, D.H. (2023a) Asia-Pacific stock market return and volatility in the uncertain world: evidence from the nonlinear autoregressive distributed lag approach, *PLOS ONE*, 18(5), e0285279.

Tran, M.P.-B. and Vo, D.H. (2023b) Market return spillover from the US to the Asia-Pacific countries: the role of geopolitical risk and the information & communication technologies, *PLOS ONE*, 18(12), e0290680.

Truong, L.D., Friday, H.S. and Nguyen, A.T.K. (2025) The effects of geopolitical risks on market returns in a frontier market: evidence from Ho Chi Minh Stock Exchange, *Asia-Pacific Financial Markets*, 32.

Wang, Z. and Dong, Z. (2024) Volatility spillover effects among geopolitical risks and international and Chinese crude oil markets. A study utilizing time-varying networks, *Resources Policy*, 96, 105225.

Wu, S. and Pan, Q. (2021) Economic growth in emerging market countries, *Global Journal of Emerging Market Economies*, 13(2), 192–215.

Wu, W., Wang, L., Erzurumlu, Y.O., Gozgor, G. and Yang, G. (2022) Effects of country and geopolitical risks on income inequality: evidence from emerging economies, *Emerging Markets Finance and Trade*, 58(15), 4218–4230.

Zheng, J., Wen, B., Jiang, Y., Wang, X. and Shen, Y. (2023) Risk spillovers across geopolitical risk and global financial markets, *Energy Economics*, 127, 107051.

Zhu, S., Xia, Y., Li, Q. and Chen, Y. (2025) Global geopolitical risk and financial stability: evidence from China, *Finance Research Letters*, 72, 106501.