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ECONOMIC TREMORS FROM A PERFECT STORM: THE UKRAINIAN CRISIS AND ITS IMPACT ON REGIONAL STOCK MARKET VOLATILITY

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ABSTRACT. This study investigates the impact of the Russia-Ukraine war on stock market volatility in neighboring countries, analyzing five stock market indices (BET, BUX, WIG, SAX, and MOEX) over a three-year period encompassing one year before and two years after the conflict's outbreak. Employing four volatility estimators (Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell), this research examines the evolution of market volatility and inter-market correlations. Findings reveal a general increase in volatility across most indices following the war's commencement, with the MOEX index experiencing the highest turbulence. The concept of a "proximity penalty" is partially supported, as geographical closeness to the conflict zone does not uniformly correspond to increased volatility. Also, findings show an initial strengthening of correlations between markets in the first year of the war, suggesting a "contagion effect." However, this is followed by a weakening of correlations in the second year, indicating a potential "decoupling effect" as markets begin to respond more to local economic conditions. These results have significant implications for investors, policymakers, and risk managers, highlighting the

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need for dynamic portfolio management strategies, tailored policy responses, and flexible risk models that can adapt to changing market conditions during prolonged geopolitical crises. This study contributes to the existing literature by extending the temporal scope of analysis beyond the immediate aftermath of the war's outbreak and providing insights into the "proximity effect" in the context of a major European conflict. The observed patterns of initial volatility spikes followed by varying degrees of persistence and changing correlation structures offer a nuanced picture of how geopolitical events impact financial markets over time, emphasizing the complex interplay between political events and financial market dynamics.

Keywords: Stock market volatility; geopolitical risk; Russia-Ukraine war; range-based volatility estimators; proximity effect.

JEL classification: **G15, F51**

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Introduction and brief review of the relevant literature

The outbreak of war between Russia and Ukraine on February 24, 2022 sent shockwaves through global financial markets, particularly impacting neighboring countries in Eastern Europe. This major geopolitical event has heightened uncertainty and risk perceptions among investors, leading to increased volatility in stock markets across the region. The conflict's far-reaching economic and political implications have made it a critical case study for examining how geopolitical crises affect financial market dynamics, especially in proximate nations.

Geopolitical events like wars, terrorist attacks, and political tensions have long been recognized as significant drivers of stock market volatility (Caldara & Iacoviello, 2022). These events introduce uncertainty into the economic landscape, affecting investor sentiment and decision-making processes. The unpredictable nature of geopolitical crises often leads to rapid shifts in market behavior as investors reassess risks and adjust their portfolios accordingly (Antonakakis et al., 2017). In the case of armed conflicts, the potential for economic disruption, sanctions, and shifts in international relations can have profound effects on market stability and investor confidence.

The relationship between geopolitical events and stock market volatility has been well-documented in financial literature. Studies have shown that heightened geopolitical risks can lead to increased market volatility, decreased returns, and changes in correlation patterns between different markets (Boubaker et al., 2022). For instance, research on the impacts of terrorist attacks has demonstrated significant short-term increases in volatility following such events (Corbet et al., 2018). Similarly, studies on the effects of political tensions and military conflicts have revealed their substantial influence on stock market dynamics (Omar et al., 2017; Hudson & Urquhart, 2015).

The Russia-Ukraine conflict presents a unique opportunity to examine these dynamics in the context of a major European war – the first of its kind since World War II. The conflict's geographic location and the economic significance of both countries have amplified its impact on neighboring nations and global markets. Russia's role as a major energy supplier to Europe and both countries' importance in global commodity markets have created complex economic ripple effects that extend far beyond their borders (Liadze et al., 2022).

Recent studies have begun to explore the specific impacts of the Russia-Ukraine war on financial markets. Yousaf et al. (2022) found significant negative abnormal returns in G20 stock markets following the outbreak of the conflict. Similarly, Boubaker et al. (2022) documented negative abnormal returns for MSCI indices in response to the invasion. These findings underscore the war's broad impact on global markets, but they also highlight the need for more focused research on its effects in neighboring countries.

The concept of proximity plays a crucial role in understanding the differential impacts of geopolitical events on various markets. Federle et al. (2022) introduced the idea of a "proximity penalty," suggesting that markets closer to conflict zones may experience more severe effects. This concept was further supported by Martins et al. (2023a,b), who found evidence of heightened market reactions in countries geographically closer to the Russia-Ukraine conflict. These findings suggest that neighboring countries may be particularly vulnerable to increased volatility and market disruptions due to their physical proximity to the war zone and potential economic ties to the conflicting nations.

Furthermore, the Russia-Ukraine conflict has had significant implications for energy and commodity markets, which in turn affect stock market dynamics. Adekoya et al. (2022) and Wang et al. (2022) have explored the complex relationships between energy markets and other financial markets in the context of this conflict. Their findings suggest that countries with strong ties to Russian energy markets or those competing with Russia in energy production may experience unique patterns of stock market volatility in response to the war.

Given the ongoing nature of the conflict and its continued impact on global markets, there is a pressing need for comprehensive research that examines its long-term effects on stock market volatility, particularly in neighboring countries. While existing studies have provided valuable insights into the immediate market reactions to the war's outbreak, there is a gap in the understanding of how these effects evolve over time and how they specifically impact the markets of countries in close proximity to the conflict zone.

Considering this context, the main objective of this research is to analyze the impact of the Russia-Ukraine war on stock market index volatility in neighboring countries over an extended period, comparing pre-war and post-war market behavior. By examining a sample of index quotations from neighboring countries for one year before the war and two years after its commencement, this study aims to provide a comprehensive assessment of how proximity to the conflict zone influences stock market volatility patterns.

This research contributes to the existing literature in several important ways. First, it extends the temporal scope of analysis beyond the immediate aftermath of the war's outbreak, allowing for a more nuanced understanding of how market volatility evolves over time in response to ongoing geopolitical tensions. Second, by focusing specifically on neighboring countries, the study provides insights into the "proximity effect" in the context of a major European conflict, building on the work of Federle et al. (2022) and Martins et al. (2023a,b). Finally, the research offers practical implications for investors, policymakers, and financial institutions operating in or connected to markets in close proximity to geopolitical hotspots.

Understanding the long-term impacts of the Russia-Ukraine war on stock market volatility in neighboring countries is crucial for developing effective risk management strategies, informing policy decisions, and guiding investment practices in an increasingly uncertain global environment. As geopolitical tensions continue to shape the international landscape, this research provides valuable insights into the complex interplay between political events and financial market dynamics.

Research methodology

This study employs a comprehensive approach to assess the impact of the Russia-Ukraine war on stock market volatility in neighboring countries, using four well-established range-based volatility estimators: Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell. These methods are chosen for their ability to capture intraday price fluctuations and provide more efficient estimates of volatility compared to traditional close-to-close estimators (Floros, 2009).

The collected dataset comprises daily stock index quotations for five markets in close proximity to the conflict zone: BET (Romania), BUX (Hungary), WIG (Poland), SAX (Slovakia), and MOEX (Russia). These markets represent countries that share direct borders with Ukraine, making them particularly relevant for studying the proximity effect of the conflict. The selected countries form a geographical corridor along the frontier of the conflict zone, providing a comprehensive view of the war's financial impact on neighboring markets.

Also, the selected markets share similar characteristics as emerging European economies, with comparable market structures and development levels. This homogeneity allows for more meaningful comparisons and reduces the potential bias from differing market maturity levels. The collected data from the selected markets is rendered consistent, reliable, and complete daily trading data throughout the study period, ensuring robust analysis.

The study excludes the Ukrainian stock market (PFTS) from the dataset due to: a direct effect of the conflict on their grounds (as opposed to Russia, where the conflict is outside their border), trading suspensions following the war's outbreak (rendering incomplete price data series), a lack of reliability for high and low prices needed for range-based volatility estimation, as well as significant market disruptions.

The sample period spans from February 24, 2021, to February 23, 2024, encompassing one year before the outbreak of the Russia-Ukraine war and two years following its commencement. This timeframe allows us to analyze the pre-war volatility patterns and compare them to the post-war dynamics, providing insights into the conflict's immediate and prolonged effects on market volatility.

Daily opening, closing, high, and low prices for each index were collected from reliable financial data providers. The use of these four price points enables the application of range-based volatility estimators, which have been shown to be more efficient than traditional methods that rely solely on closing prices (Garman & Klass, 1980; Rogers & Satchell, 1991).

In the full extent of the computations spectrum, the methodology is grounded on four well-established estimators of volatility assessment:

A. Close-to-Close (CC)

The Close-to-Close historical volatility estimator is a standard method of calculation of historical volatility. The estimator calculated by the through of logarithmic returns over a given period of observation. CC volatility reflects the historical price movements of the underlying stock, measuring the assets' actual volatility.

$$\sigma_{CC}^2 = \frac{1}{T-1}\sum_{t=1}^{T}(r_t - \acute{r})^2 \tag{1}$$

Where:

- σ_{CC}^2 is the Close-to-Close variance estimate;
- T is the number of trading days;
- $r_t = \ln(C_t/C_{t-1})$ represents the logarithmic return between consecutive closing prices;
- $\acute{r}$ is the mean of the logarithmic returns;
- C_t and C_{t-1} are the closing prices on days t and t-1, respectively.

This estimator uses only closing prices and assumes that returns are normally distributed. While it is the most traditional approach, it has limitations as it ignores intraday price movements and can be more sensitive to market microstructure effects than range-based estimators. The CC estimator is particularly useful for long-term volatility analyses and serves as a benchmark for comparing other volatility estimation methods.

B. Parkinson estimator

The Parkinson estimator, introduced by Parkinson (1980), utilizes the daily high and low prices to estimate volatility. It is defined as:

$$\sigma_P^2 = \frac{1}{4ln(2)T}\sum_{t=1}^{T}\left(ln\frac{H_t}{L_t}\right)^2 \tag{2}$$

Where:

- σ_P^2 is the Parkinson variance estimate;
- T is the number of trading days;
- H_t and L_t are the high and low prices on day t, respectively.

The Parkinson estimator is considered more efficient than the close-to-close estimator, as it captures intraday price movements and is less affected by microstructure noise (Alizadeh et al., 2002).

C. Garman-Klass estimator

Garman and Klass (1980) proposed an improved estimator that incorporates opening and closing prices in addition to high and low prices. The Garman-Klass estimator is defined as:

$$\sigma_{GK}^2 = \frac{1}{T}\sum_{t=1}^{T}\left[0.5\left(ln\frac{H_t}{L_t}\right)^2 - (2ln2-1)\left(ln\frac{C_t}{O_t}\right)^2\right] \quad (3)$$

Where:

- σ_{GK}^2 is the Garman-Klass variance estimate;
- T is the number of trading days;
- H_t and L_t are the high and low prices on day t, respectively;
- O_t and C_t are the opening and closing prices on day t, respectively.

This estimator is theoretically more efficient than the Parkinson estimator, as it utilizes more price information (Chan and Lien, 2003).

D. Rogers-Satchell estimator

Rogers & Satchell (1991) developed an estimator that is unbiased in the presence of a non-zero drift, making it particularly suitable for longer estimation periods or markets with strong trends. The Rogers-Satchell estimator is defined as:

$$\sigma_{RS}^2 = \frac{1}{T}\sum_{t=1}^{T}\left[ln\frac{H_t}{O_t}ln\frac{H_t}{C_t} + ln\frac{L_t}{O_t}ln\frac{L_t}{C_t}\right] \quad (4)$$

Where:

- σ_{RS}^2 is the Rogers-Satchell variance estimate;
- T is the number of trading days;
- H_t and L_t are the high and low prices on day t, respectively;
- O_t and C_t are the opening and closing prices on day t, respectively.

This estimator has the advantage of being drift-independent, which is particularly relevant for the current study given the potential for significant market trends during the conflict period (Rogers et al., 1994).

For each of the five indices (BET, BUX, WIG, SAX, and MOEX), computations include daily volatility estimates using the Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell methods. The process involved the following steps:

- In the preprocessing phase, data quality is ensured by checking for and addressing any missing values or outliers in the price series.
- For each trading day, computations include daily volatility estimates using the four previously described methods.
- To facilitate comparison and interpretation, data annualizes the daily volatility estimates by multiplying by the square root of the number of trading days in a year (typically 252).

- The study inclused time series of annualized volatility estimates for each index and each estimation method.

To assess the interconnectedness of market volatilities and potential spillover effects, the study proceeds with correlation analyses between the volatility estimates of the five indices. More specifically, computations include Pearson correlation coefficients for three distinct periods:

- Pre-war period: February 24, 2021 - February 23, 2022;
- First year of war: February 24, 2022 - February 23, 2023;
- Second year of war: February 24, 2023 - February 23, 2024.

This segmentation allows us to examine how the relationships between market volatilities evolved from the pre-war period through the first and second years of the conflict.

In the subsequent sections of this study, interpretations include a detailed analysis of these results, discussing their implications for investors, policymakers, and risk managers operating in or connected to these markets. The study also explores potential explanations for the observed patterns, drawing on existing literature on geopolitical risks and financial market behavior.

Results and discussion

The volatility estimates obtained using the four methods (Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell) show varying levels of market turbulence across the five indices over the study period. Generally, as findings show in *Table 1*, an increase in volatility is noted, following the outbreak of the Russia-Ukraine war, with the magnitude and persistence of this increase varying across markets.

A notable finding from the volatility estimates presented in *Table 1* is the consistency across all four estimation methods (Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell) for each market index. For instance, in the pre-war period (2021-2022), the BET index shows minimal variation between estimators, ranging from 0.74% (Garman-Klass) to 0.83% (Close-to-Close). Similarly, the MOEX index demonstrates consistent values across all estimators, ranging from 2.27% to 2.56%.

This consistency in volatility estimates across different methodologies strengthens the robustness of the findings and suggests that the observed market dynamics are not artifacts of the estimation method chosen. Similar values obtained through different approaches, each with its theoretical advantages, provide strong validation of the measured volatility levels and their changes across the three distinct periods. This convergence is particularly important given that each estimator captures different aspects of price movements - from simple close-to-close returns to more sophisticated measures incorporating intraday price ranges.

Table 1. Volatility estimators of analyzed stock market indices before and after the start of the conflict in Ukraine

Timeframe	Estimator	BET	BUX	WIG	SAX	MOEX
2021-2022	Close to close	0.8300%	1.2200%	1.2300%	0.7200%	2.5600%
	Parkinson	0.7700%	1.1500%	0.8800%	0.2400%	2.2800%
	Garman and Klauss	0.7400%	1.1100%	0.8300%	0.1600%	2.2700%
	Roger Satchell	0.7800%	1.1400%	0.8100%	0.1300%	2.3600%
2022-2023	Close to close	1.1700%	1.8700%	1.6700%	0.8500%	3.1700%
	Parkinson	1.0000%	1.6500%	1.1900%	0.2700%	2.6600%
	Garman and Klauss	0.9300%	1.5600%	1.1100%	0.1900%	2.6400%
	Roger Satchell	0.9500%	1.5600%	1.0800%	0.1600%	2.7400%
2023-2024	Close to close	0.6900%	0.9000%	1.0800%	0.7600%	0.8100%
	Parkinson	0.6200%	0.9200%	0.8700%	0.1100%	0.8100%
	Garman and Klauss	0.5900%	0.9200%	0.8400%	0.0900%	0.8200%
	Roger Satchell	0.6000%	0.9400%	0.8300%	0.0800%	0.8400%

Source: authors' computation based on data collected from investing.com (with validation from stock markets' official websites) between February 24, 2021 and February 23, 2024

For the MOEX index, findings show the highest volatility levels, particularly in the immediate aftermath of the war's outbreak. Specifically, the Parkinson estimator showed a volatility of 2.66%, the Garman-Klass estimator 2.64%, and the Rogers-Satchell estimator 2.74% for MOEX in the year following the war's start. In contrast, the SAX index exhibited relatively low volatility, with estimates typically below 1% throughout the study period. For instance, in the year following the war's outbreak, the SAX index showed volatility estimates of 0.27% (Parkinson), 0.19% (Garman-Klass), and 0.16% (Rogers-Satchell).

The BET, BUX, and WIG indices showed intermediate levels of volatility. In the year following the war's start, the BET index exhibited volatility estimates of 1.00% (Parkinson), 0.93% (Garman-Klass), and 0.95% (Rogers-Satchell). The BUX index showed slightly higher volatility with 1.65% (Parkinson), 1.56%

(Garman-Klass), and 1.56% (Rogers-Satchell). The WIG index demonstrated volatility levels of 1.19% (Parkinson), 1.11% (Garman-Klass), and 1.08% (Rogers-Satchell).

Comparing the pre-war period to the first year of the war, findings show significant increases in volatility across all indices except SAX. For instance, the BET index saw its Parkinson volatility rise from 0.77% to 1.00%, while the BUX index experienced an increase from 1.15% to 1.65%.

For the correlation analysis between market indices, the study employed the close-to-close volatility estimator, which is calculated using logarithmic returns over the observation period. While the volatility data was computed using multiple estimators (Parkinson, Garman-Klass, and Rogers-Satchell), the close-to-close method was selected for correlation calculations due to its widespread use in financial literature and its established reliability in capturing market co-movements.

The choice of the close-to-close estimator for correlation analysis is further supported by preliminary tests showing that all estimators (Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell) yielded similar correlation patterns. The consistency across different estimation methods suggests that the findings regarding market interconnectedness are robust and not dependent on the specific volatility estimation technique employed

The close-to-close estimator's simplicity and direct interpretation render it particularly suitable for the correlation analysis, as it captures the overall daily price movements that are most relevant for understanding market relationships. This approach allows for a clear and straightforward assessment of how different markets respond to shared external shocks, such as the geopolitical crisis under study.

The correlation analysis reveals interesting patterns in the co-movement of volatilities across markets over the three distinct periods. For instance, in the pre-war period (see *Table 2*), results reveal moderate positive correlations between most pairs of indices. The strongest correlation (0.233) is found between BET and WIG, significant at the 0.01 level. This suggests a moderate level of market integration between Romania and Poland prior to the conflict. The MOEX index shows weak to moderate positive correlations with other indices during this period, with significant correlations with BET (0.129) and WIG (0.146) at the 0.05 level.

An interesting finding is that the BUX index shows a significant negative correlation (-0.140) with MOEX, indicating a potential divergence in market behavior between Hungary and Russia before the war.

Table 2. Volatility correlation matrix between indices – timeframe: February 24, 2021 – February 23, 2022

		BET	BUX	WIG	SAX	MOEX
BET	Pearson Correlation	1	0.036	0.233**	0.015	0.129*
	Sig. (2-tailed)		0.571	0.000	0.810	0.041
BUX	Pearson Correlation		1	0.200**	-0.010	-0.140*
	Sig. (2-tailed)			0.001	0.874	0.026
WIG	Pearson Correlation			1	0.111	0.146*
	Sig. (2-tailed)				0.081	0.020
SAX	Pearson Correlation				1	0.005
	Sig. (2-tailed)					0.938
MOEX	Pearson Correlation					1
	Sig. (2-tailed)					
****. Correlation is significant at the 0.01 level (2-tailed).**						
***. Correlation is significant at the 0.05 level (2-tailed).**						

Source: authors' computation based on quotation data collected from investing.com

In the first year of the war (see *Table 3*), findings show a general strengthening of correlations between indices. The correlation between BET and WIG increased to 0.336, significant at the 0.01 level. New significant correlations emerged, such as between BUX and MOEX (0.331), and between BET and BUX (0.265), all significant at the 0.01 level.

Table 3. Volatility correlation matrix between indices – timeframe: February 24, 2022 – February 23, 2023

		BET	BUX	WIG	SAX	MOEX
BET	Pearson Correlation	1	0.265**	0.336**	-0.055	0.206**
	Sig. (2-tailed)		0.000	0.000	0.386	0.002
BUX	Pearson Correlation		1	0.281**	-0.061	0.331**
	Sig. (2-tailed)			0.000	0.338	0.000
WIG	Pearson Correlation			1	-0.152*	0.415**
	Sig. (2-tailed)				0.016	0.000
SAX	Pearson Correlation				1	0.021
	Sig. (2-tailed)					0.750
MOEX	Pearson Correlation					1
	Sig. (2-tailed)					
****. Correlation is significant at the 0.01 level (2-tailed).**						
***. Correlation is significant at the 0.05 level (2-tailed).**						

Source: authors' computation based on quotation data collected from investing.com

This strengthening of correlations suggests increased market interconnectedness during the initial phase of the conflict. The strongest correlation in this period is observed between WIG and MOEX (0.415), indicating a particularly strong co-movement between Polish and Russian market volatilities.

Another peculiar finding is that in the second year of the war (2023-2024), as shown in *Table 4*, the analysis exhibits a weakening of correlations across most index pairs. Only the correlation between BUX and WIG remains statistically significant at 0.151, while other correlations become insignificant or approach zero. This decoupling of market volatilities could indicate a normalization of market behavior or a divergence in economic responses to the prolonged conflict across different countries.

Table 4. Volatility correlation matrix between indices – timeframe: February 24, 2023 – February 23, 2024

		BET	BUX	WIG	SAX	MOEX
BET	Pearson Correlation	1	0.041	0.102	-0.002	0.051
	Sig. (2-tailed)		0.516	0.111	0.970	0.420
BUX	Pearson Correlation		1	0.151*	0.043	-0.049
	Sig. (2-tailed)			0.017	0.504	0.444
WIG	Pearson Correlation			1	-0.024	-0.008
	Sig. (2-tailed)				0.706	0.905
SAX	Pearson Correlation				1	-0.055
	Sig. (2-tailed)					0.389
MOEX	Pearson Correlation					1
	Sig. (2-tailed)					

***. Correlation is significant at the 0.05 level (2-tailed).**

Source: authors' computation based on quotation data collected from investing.com

These findings provide valuable insights into the evolving dynamics of stock market volatilities in countries neighboring the conflict zone. The observed patterns of initial volatility spikes followed by varying degrees of persistence and changing correlation structures offer a nuanced picture of how geopolitical events impact financial markets over time.

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The immediate increase in volatility across most indices following the war's outbreak aligns with findings from previous studies on the impact of geopolitical events on financial markets. For instance, Yousaf et al. (2022) found significant negative abnormal returns in G20 stock markets following the outbreak of the conflict, which is consistent with the observations of increased volatility.

The concept of a "proximity penalty" introduced by Federle et al. (2022) is partially supported by the study's findings. While the MOEX index, representing the Russian market, indeed showed the highest volatility, the SAX index, representing Slovakia, which is also geographically close to the conflict, showed the lowest volatility. This suggests that factors beyond mere geographical proximity, such as economic ties and policy responses, play crucial roles in determining market reactions.

The evolution of correlations over the three periods provides insights into the changing dynamics of market integration in response to the conflict. The initial strengthening of correlations in the first year of the war suggests a "contagion effect," where the shock of the conflict led to more synchronized market movements. This is consistent with findings from Martins et al. (2023a,b), who observed heightened market reactions in countries geographically closer to the Russia-Ukraine conflict.

However, the subsequent weakening of correlations in the second year of the war presents an interesting phenomenon. This could indicate a "decoupling effect," where markets begin to respond more to local economic conditions and policy measures rather than the ongoing conflict. This finding contributes new insights to the existing literature on long-term impacts of geopolitical events on market integration.

These results have several implications for investors, policymakers, and risk managers. For instance, the changing correlation structures highlight the importance of dynamic portfolio management for investors in times of geopolitical crisis. The initial increase in correlations suggests reduced diversification benefits in the short term, while the subsequent decrease may present new opportunities for portfolio diversification.

Policymakers should be aware of the potential for prolonged market volatility, particularly in countries closely tied to the conflict economically. The varying responses of different markets (e.g., MOEX vs. SAX) underscore the need for tailored policy responses that consider each country's unique economic situation and ties to the conflicting nations.

Risk managers need to adapt their models to account for the changing nature of market correlations during extended geopolitical crises. The observed pattern of initial correlation increase followed by a decrease suggests that risk models should be flexible and regularly updated to reflect these dynamic market conditions.

Conclusions, limitations and research perspectives

In essence, this study provides valuable insights into the impact of the Russia-Ukraine war on stock market volatility in neighboring countries. The analysis of five stock market indices (BET, BUX, WIG, SAX, and MOEX) over a three-year period reveals significant changes in volatility patterns and market correlations following the outbreak of the conflict.

The results from the current study demonstrate a general increase in volatility across most indices after the war's commencement, with the MOEX index experiencing the highest levels of turbulence. This aligns with the concept of a "proximity penalty" but also highlights the complexity of market reactions, as evidenced by the SAX index's relatively low volatility despite its geographical proximity to the conflict. The evolution of market correlations over time provides further insights into the changing dynamics of market integration. Findings show an initial strengthening of correlations in the first year of the war, suggesting a "contagion effect," followed by a weakening of correlations in the second year, indicating a potential "decoupling effect."

These findings have important implications for investors, policymakers, and risk managers. They underscore the need for dynamic portfolio management strategies, tailored policy responses considering each country's unique economic situation, and flexible risk models that can adapt to changing market conditions during prolonged geopolitical crises.

The study's limitations include its focus on a specific set of neighboring countries, which may not fully represent the broader impact of the conflict on global markets. Additionally, the use of daily data may not capture intraday volatility spikes, potentially underestimating the full extent of market reactions to specific war-related events.

Future research endeavors will aim to expand on this study by incorporating a wider range of countries, including those indirectly affected by the conflict. Investigating the specific economic and policy factors contributing to the observed volatility patterns and correlation changes will provide deeper insights into market behavior during geopolitical crises. Furthermore, exploring the long-term implications of these market dynamics on economic growth and financial stability in the region could offer valuable perspectives for policymakers and investors alike.

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