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International Crises, Geopolitical Risks and the Hungarian Stock Market*

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The authors examined the impacts of 108 international crises since 1991 on the share price index of the Budapest Stock Exchange with the event window and cross-sectional regression techniques, using the MSCI Emerging Markets Index as a basis of comparison. The results show that the average cumulative abnormal returns are, for the most part, negative, and statistically significant impacts can be observed primarily during a brief (0–10-trading day) period following the event. Market responses grew stronger after the 2000s, and the Hungarian stock market responds more sensitively to crises than developing markets do. Over the longer run, peaceful crises trigger more marked negative responses but these are temporary, while more severe crises have longer negative effects. In a regional breakdown, European events have proven to be the most sensitive. Cross-sectional regression analyses show that abnormal returns in the stock market are predominantly related to global volatility (VIX) and the BUX index's return environment preceding the event, while domestic macroeconomic fundamentals and confidence indicators only show a weaker and less certain relationship.

Journal of Economic Literature (JEL) codes: G14, F52, C58

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1. Introduction

Capital market dynamics are driven primarily by geopolitical risks. It is consistently pointed out in the literature that increased geopolitical uncertainty is accompanied by lower stock returns and higher volatility (*Smales 2021; Lamine – Zribi 2024*). These are not homogeneous impacts: they differ by country, region, time period and sector. Emerging markets are profoundly affected, while developed markets

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respond less dramatically (*Nasouri 2025; Salisu et al. 2022*). Sectoral studies have found that the financial, the energy and the defence sectors are the most exposed, while other industries tend to show asymmetric reactions (*Chatziantoniou et al. 2025; Choudhury 2024*). Geographical proximity is another profound determinant, i.e. markets closer to a crisis respond significantly more remarkably than those at larger distances (*Nygaard – Sørensen 2024; Grinius – Baležentis 2025*).

The above studies reveal that international crises not only cause short-term shocks, they also structurally influence risk management, investment strategies and portfolio diversification. Accordingly, we found it important to explore how the Hungarian stock market responds to geopolitical events. We are looking for an answer to the question of whether significant abnormal returns can be identified on the BUX index, relative to the MSCI Emerging Markets Index, along with how the types, severity and geographical locations of crises affect market reactions. Finally, we also examine whether the abnormal returns associated with crises are explained by global uncertainty indicators, domestic macroeconomic fundamentals or investors' confidence indicators.

In our study, we analyse 108 international crises in the International Crisis Behaviour (ICB) database and sort the events on the basis of five dimensions (degree of violence, severity of the crisis, involvement of superpowers, level of tension and geographical location), for the periods 1991–2021, 2000–2021 and 2010–2021. Our study relies on the event window methodology, with the help of which we identify abnormal returns and then also analyse the strongest market responses with the technique of cross-sectional regression (using 22 explanatory variables).

2. Literature review

Earlier studies show that that asset returns and volatility are strongly influenced by macroeconomic announcements (*Elder et al. 2012*), global economic events (*Berkman et al. 2011*) and the tone of news appearing in the media (*Manela – Moreira 2017*). *Caldara and Iacoviello* (*2022*) were the first to create a geopolitical risk index (GPR), interpreting geopolitical risks regarding wars, terrorist attacks and tensions between states, for studying geopolitical events. Most studies in the literature use this index, along with econometric methods (such as OLS, VAR, quantile regression) to identify relationships. Another major approach in the literature studies actual events with the help of the event window technique.

The GPR index is based on a study by *Lamine and Zribi* (*2024*), in which they examined the impacts of geopolitical risks with a focus on the G7 and the BRICS stock markets and found that while the impact on returns diminishes over time, volatility displays a persistently rising trend. *Demiralay et al.* (*2024*) analysed the impacts of threats and actions besides those of geopolitical risks, to find that returns exhibit a positive response to the GPR in a rising stock market environment and a negative response in a declining environment, while volatility tends to respond positively, especially in the case of geopolitical actions.

Based on data from 40 countries, *Rafi and Ali* (*2025*) developed a new framework to measure geopolitical risk exposure (GRE), in the form of three factors (geopolitical risk, action and threat), using the index introduced by *Caldara and Iacoviello* (*2022*). Their results indicate that the geopolitical threat factor has the strongest predictive capability. Based on daily data, *Smales* (*2021*) demonstrated that an increase in geopolitical risk drives oil prices up, but depresses returns on stocks, while keeping volatility persistently high. *Denie et al.* (*2024*) made similar observations from their studies of the relationships between oil, gold and US dollar indices, as well as stock markets.

Studies based on GPR indices were also conducted to analyse the impacts of geopolitical risk in developing countries. *Nasouri* (*2025*) argues that volatility on developing countries' stock markets and financial stress respond much more vigorously to an increase in GPR, while in developed economies the corresponding impacts are observed more in the stock markets. *Salisu et al.* (*2022*) focused only on emerging markets and concluded that the index of geopolitical events is a better predictive factor than threats. The conclusions of *Wijaya et al.* (*2024*) supplement the above: they found that the GPR has different impacts on different countries.

Geopolitical risks have asymmetric impacts not only in different countries, but also at a sectoral level within the stock market. *Chatziantoniou et al.* (*2025*) found that geopolitical risks have significant, heavily sector-dependent impacts and that sectors respond more markedly to threats of terrorist attacks than to actual attacks themselves, while the escalation of war triggers more extreme volatility than threats or outbreaks of wars. *Choudhury* (*2024*) concluded the US financial sector is the most hard-hit by geopolitical risks, with the raw material and energy sectors also showing significant exposure. In line with the above, *Boungou and Urom* (*2025*) noted that the degree to which geopolitical risk affects returns in the G20 countries' banking sectors depends on market performance, the period in which the conflict occurs and the geographical locations of the banking systems.

Another avenue of research explores actually occurring events instead of geopolitical risk indices, using the event study method in most cases. Analysing the impacts on twelve stock markets of the war that broke out between Russia and Ukraine in 2022, *Grinius and Baležentis* (*2025*) identified the proximity effect as the key factor, with Poland showing the strongest price response, while markets outside Europe remained, for the most part, unresponsive. Using the event study method, *Goyal and Soni* (*2024*) described the impacts of the Israeli-Palestinian conflict that erupted in October 2023 on the stock markets of 47 countries. Emerging markets and the global stock markets were found to have responded negatively, while the developed markets proved to be more resilient. Other studies have highlighted how armed conflicts in the Middle East affect oil companies' stock returns (*Khalifa et al. 2017*), how closely the 1973 Arab–Israeli war (Yom Kippur War) was related to changes in oil prices (*Nygaard – Sørensen 2024*) and how changes in the relationship between North and South Korea affected the stock returns of companies involved in the economic cooperation concerned (*Pyo 2021*). Moreover, the 1997 Asian financial crisis, the 2008 global financial crisis and the Covid–19 pandemic enhanced the US stock market's global return transmission function, which was also affected by geopolitical risks (*Tran – Vo 2023*).

Studies on the impacts of geopolitical risks on the domestic economy, particularly in terms of capital market correlations, are limited at present. However, country-specific and sectoral asymmetries that have also been identified in international results may also warrant empirical analyses of the Hungarian market. A number of studies on the Hungarian capital markets yielded results in relation to matters of asset pricing that are in line with the findings of international studies. For example, *Lakatos* (*2016*), analysing the phenomenon of overreaction, and *Rádóczy – Tóth-Pajor* (*2021*), studying responses to extreme market events, obtained results comparable to those to be found in the international literature. Additional similar results come from studies of seasonality (*Kégl – Petróczy 2024; Neszveda – Simon 2021*), the momentum effect (*Csillag – Neszveda 2020*), price drifting (*Csillag – Neszveda 2022; Nagy – Ulbert 2007*), stock market anomalies (*Bidló – Szabó 2024*) and the trading strategy of liquidity provision (*Neszveda – Vágó 2021*). Results that are different from the trends observed in international markets have also been produced; for instance, in the applicability of company valuation methods (*Takács 2007*), in financial behaviour phenomena (*Molnár 2005*) and in capital market performance indicators (*Koszorús 2019*).

Grébel and Pesuth (*2023, 2024*) noted in relation to the domestic capital market that the role of geopolitical risks has grown in importance in both theory and practice. Our analysis shows that geopolitical tensions generally exert a negative influence on stock market returns, particularly in emerging markets and in the Central and Eastern European region. Moreover, geopolitical risks were found to play a remarkable role in the stock markets and also in the trends appearing in domestic economic outlooks. For instance, *Horváth and Molnár* (*2025*) noted that the persistently subdued external environment (the Russian–Ukrainian war, the US customs tariff threats) has caused profound uncertainty in the Hungarian economy, thwarting economic growth, and future perspectives also carry substantial risks.

Overall, the literature highlights that geopolitical risks impact stock market returns and volatility asymmetrically – globally, across regions and across sectors.

3. Data and methodology

In our event study analysis, we use the daily closing prices of the Budapest Stock Exchange index for the period from 2 January 1991 to 31 December 2021. Although BUX index data are available for the subsequent period as well, the last event in the ICB database[1] of crisis data was recorded for 20 September 2021; therefore, we processed the BUX index data accordingly.

The MSCI Emerging Markets (MSCI EM) Index – representing a wide range of developing market shares and evolving in closer coordination with the BUX index than other alternative indices – was used as the benchmark in calculating the abnormal return in the event window analysis. Daily log return data of the BUX and MSCI EM indices were used, which were calculated in the estimation window as detailed below:

$$R_t = 100 * (lnP_t - lnP_{t-1}). \tag{1}$$

Based on the Augmented Dickey–Fuller-test, the series were found to be stationary. The expected return was calculated with the linear regression model, in the following form:

$$R_{i,t} = \propto_i + \beta_i R_{m,t} + \varepsilon_{i,t}, \tag{2}$$

where:

- $R_{i,t}$: the daily log return of the BUX index as at t time,
- $R_{m,t}$: the daily log return of the MSCI EM index as at t time,
- β_i: the coefficient describing sensitiveness to market returns.

The model was aligned to the period between days 130 and 10 before the event (estimation window); thereafter, the abnormal returns were calculated for the period around the actual event. The abnormal return is defined as the difference between the actual return and the expected return:

$$AR_{i,t} = R_{i,t} - E(R_{i,t}), \tag{3}$$

[1] https://sites.duke.edu/icbdata/

where:

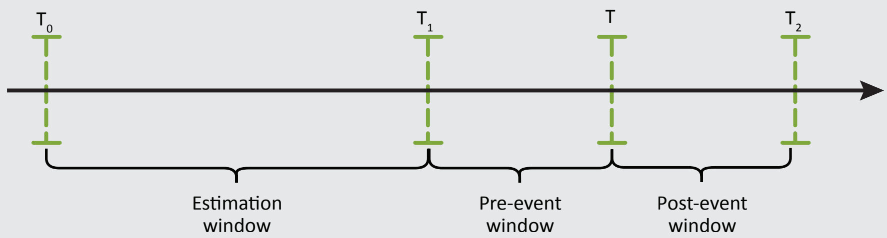
- $R_{i,t}$: is the BUX index's log return on day *t* around event *i*,
- $E(R_{i,t})$: the expected log return estimated on the basis of the estimation period's regression coefficient.

The abnormal returns calculated as described above were aggregated for the period of the event concerned, on the basis of the following formula:

$$CAR_i(T_1, T_2) = \sum_{t=T_1}^{T_2} AR_{i,t}. \quad (4)$$

Understanding the event window analysis is facilitated by *Figure 1*, where the T_0–T_1 period is the estimating period between the 10th and the 130th day preceding the event, and the T_1–T_2 period constitutes the event window.

Figure 1
Illustration of the event study's time window



Note: The figure shows the event window where T_0 and T_1 are the starting and ending days of the estimation period, T is the day of the event and T_2 is the last day of the event window.

In the event window analysis, we used both a symmetric window (–30/+30, –15/+15, –2/+2, –1/+1 days) and an asymmetric window (0–2, 0–3, 0–5, 0–10, 0–20 and 0–30 days), with the latter exclusively covering the post-event period. The length of each window was determined in view of recommendations found in the literature (*MacKinlay 1997; Azzimonti 2018; Kiss et al. 2024; Rappai 2011)*.

The robustness of the results was tested with an alternative estimation method, the so-called average return technique, in which the expected return was replaced with the average return calculated in the estimation window. Moreover, the results were compared to the S&P 500 global share price index and, to enable regional comparison, to the WIG20 (Polish) and the PX (Czech) indices. Both t-tests and z-tests were used for significance testing, in observance of methodology guidelines on event study, commonly found in the literature (*MacKinlay 1997; Fűrész – Rappai 2022; Rádóczy – Tóth-Pajor 2021*).

In the event studies, the starting points of geopolitical crises were determined on the basis of the event dates (Trigger Dates) found in the ICB database. A trigger date marks the officially recognised date of the outbreak of a crisis. In 33 of the 108 events studied, the event date fell on a non-trading date (weekends, in most cases). Those were replaced with the nearest available trading dates (typically Mondays).

In addition to the event window analysis, our research also aimed to examine the extent to which global uncertainty indicators, domestic macroeconomic factors, and investor and business confidence indicators can explain the cumulative abnormal returns associated with geopolitical events. To do so, we collected 22 variables from the categories of global and domestic economic policy uncertainty, geopolitical risks, investor sentiment, global capital market volatility, consumer and business confidence, domestic macroeconomic indicators and the technical indicators of the BUX index (*Annex, Table 4*), on the basis of our review of the relevant literature and our intuitive and empirical considerations. In the first step of our analysis, with the help of the event window analysis method, as well as z-tests and t-tests, we identified the period in which the cumulative abnormal returns (*CAR*) gave the most salient response to the events. The most pronounced time window (the [0,10] window, which proved to be the most significant) was selected for further analyses. A 5-per cent winsorisation was performed on the *CAR* value associated with the various events. In the cross-sectional regression analysis, the macroeconomic and uncertainty variables of the month preceding, the month of and the month following each event were assigned to its *CAR* value. To pre-screen the variables, each explanatory variable was examined in a separate regression analysis with the cumulative abnormal return being used as dependent variable, making it possible to identify the factors which were, even in themselves, related to the stock market reaction.

After estimating the individual regressions, we grouped the explanatory variables into thematic blocks and employed four different model specifications to identify which sets of variables best explain the patterns in abnormal returns. The final specifications included factors that showed stable and relatively strong relationships with the cumulative abnormal returns in the individual regressions. The model (5) based on global uncertainty indicators comprised the VIX (capital market volatility), the *GEPU_current* (global economic policy uncertainty), the *GPR* (geopolitical risk) and the *WUI* (world uncertainty) indicators. The model focusing on domestic macroeconomic factors (6) comprised the inflation rate, unemployment rate, retail sales and industrial production, supplemented with the domestic uncertainty indicator (*WUI_HUN*) and the domestic geopolitical risk index (*GPRC_HUN*). The model based on confidence indicators (7) comprised domestic consumer and business confidence indices as well as the Baker–Wurgler investor sentiment index. Finally, the model combining global volatility with the market performance of the BUX (8) comprised the effects of the VIX and the monthly BUX return.

$$CAR_i^w = \alpha + \beta_1 VIX_i^{-1m} + \beta_2 GEPU\_current_i^{-1m} + \beta_3 GPR_i^{-1m} + \beta_4 WUI\_global_i^{-1m} + \epsilon \quad (5)$$

$$CAR_i^w = \alpha + \beta_1 CPI\_HUNyy_i^{-1m} + \beta_2 Unemp\_HUN_i^{-1m} + \beta_3 Retail\_HUNyy_i^{-1m} + \beta_4 Prod\_HUNyy_i^{-1m} + \beta_4 WUI\_HUN_i^{-1m} + \beta_5 GPRC\_HUN_i^{-1m} + \epsilon \quad (6)$$

$$CAR_i^w = \alpha + \beta_1 CCI\_HUN_i^{-1m} + \beta_2 BCI\_HUN_i^{-1m} + \beta_3 BWSENT_i^{-1m} + \epsilon \quad (7)$$

$$CAR_i^w = \alpha + \beta_1 VIX_i^{-1m} + \beta_2 BUXreturn_i^{-1m} + \epsilon \quad (8)$$

The dependent variable is the winsorised cumulative abnormal return (CAR_i^w), while the explanatory variables marked with "–1m" refer to their values in the month preceding the event. In all inference calculations, we rely on heteroskedasticity-robust (HC1) standard errors.

4. Description of international crises

Our study relied on the International Crisis Behaviour (ICB) database (*Brecher – Wilkenfeld 1997; Brecher et al. 2025*), documenting 512 international crises that occurred between 1918 and 2021, which enables structured comparisons between crises in terms of 81 pre-defined quantitative and qualitative dimensions. Our analysis focused on 108 events that occurred in the 1991–2021 period, taking into account that this is the period in which the Hungarian stock market and the ICB database overlap. Although the database also contains information on the Russian–Ukrainian war, the event date has not been determined yet; therefore, that particular event is not covered by this analysis.

To develop a more profound understanding of the characteristics of the events, a number of different variables were used in our study. The degree of violence of the various crises was assessed with the help of the *VIOL* (violence) variable, which encodes the degree of violence occurring in the course of the various events. The values of the variable range from 1 to 4, where 1 represents a completely peaceful event, while 4 represents a full-scale war. Events were *VIOL* < 2 were considered as "peaceful", whole those with VIOL ≥ 2 were regarded as "armed". The severity of a crisis was defined in terms of the *GRAVCR* (Gravity of Value Threatened) variable, showing the weight of the value (e.g. economic interest, political regime, existence of a state) threatened during the crisis. The higher values on a scale of 0 to 6 indicate more severe threats; in our analysis, we separated severe (*GRAVCR* > 3) crises. Superpower involvement is measured by the *POWINV* (Superpower Involvement in Crisis) variable, which indicates the degree of the involvement of the United States of America and/or of the Soviet Union (now Russia). The scale extends from 1 to 7, and where the *POWINV* > 0, at least one of the two played some role in the conflict. The change in international tension as a consequence of a crisis is expressed by the *OUTESR* (Outcome of Escalation or Reduction of Tension) variable, arranging events into three categories: 1=tension eased, 2=status quo remained unchanged, 3=tension grew. (*OUTESR*=1) events where tensions eased and (*OUTESR*=2) events with no change were analysed separately in our study. *OUTESR*=3 (escalation) events were not analysed because of their small number. The geographical location of a crisis is indicated by its *GEOG* (Geographic Location of Crisis) variable, on the basis of which analyses were also carried out in regional breakdowns.

5. Empirical results of the event effects

The complete sample – i.e. the results for the period between 1991 and 2021 – shows that the average cumulative abnormal return (average *CAR*) was negative in most of the time windows used (in 8 out of 10 event windows), but it also shows that it is only the 5-trading-day window following the event in which a statistically significant effect can be identified with the help of t-testing. Z-test-based significance was identified in the case of the [–15,15], [0,2] and [0,10] day windows (*Table 1*).

Table 1
Average cumulative abnormal returns of the event windows between 1991 and 2021

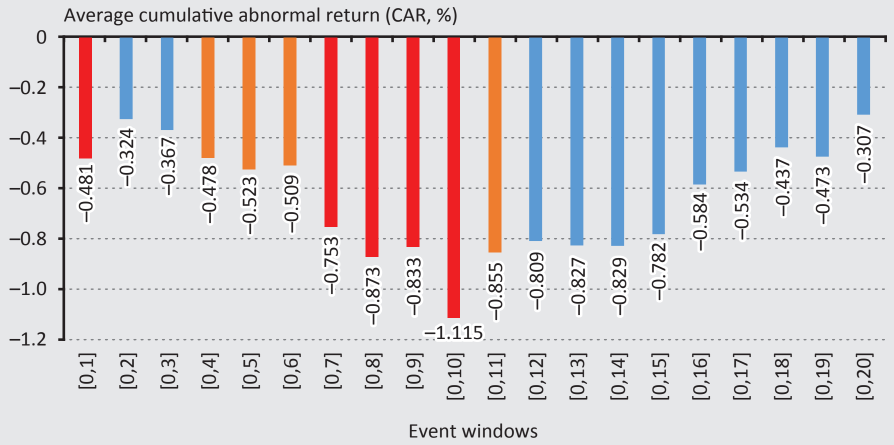
Event window	Number of cases	Average CAR	t-statistics	Positive ratio	z-statistics
[–30,30]	108	0.464	0.309	0.48	–0.385
[–15,15]	108	–0.409	–0.385	0.42	–1.732*
[–1,1]	108	–0.351	–1.348	0.49	–0.192
[–2,2]	108	0.009	0.032	0.49	–0.192
[0,2]	108	–0.337	–1.589	0.38	–2.502**
[0,3]	108	–0.422	–1.641	0.46	–0.77
[0,5]	108	–0.671	–2.205**	0.44	–1.347
[0,10]	108	–0.341	–0.462	0.41	–1.925*
[0,20]	108	–0.042	–0.042	0.47	–0.577
[0,30]	108	–0.282	–0.217	0.45	–0.962

*Note: The table shows the average cumulative abnormal returns (CAR) calculated for the whole period and for all events, along with the corresponding t-statistics and z-statistics for various event windows. The "Positive ratio" column indicates the percentage rates of the events with positive CAR values. The figures marked * and ** indicate 10-per cent and 5-per cent significance levels, respectively (p < 0.10; p < 0.05).*

The following partial periods were analysed: 1991–2000 (32 events), 2000–2021 (76 events) and 2010–2021 (48 events). The analysis of the 2000–2021 partial period instead of the 2000–2010 period is justified by the fact that the Hungarian capital market was more advanced and more liquid in those years and that a larger number (n=76) of events were available, resulting in more robust significance estimates. Our analysis of the partial periods shows that during the 1991–2000 period the average *CAR* was positive in several time windows, without being statistically significant in any of the cases (*Annex, Tale 5*). By contrast, the average CAR was persistently negative in each reviewed event window during the 2000–2021 period, apart from the [–30,30] day interval. The t-test identified significant negative effects in the [0,5] and [0,10] day windows, while the z-test found statistically significant differences in the [0,1] and [0,2] day windows. Similar results were obtained for the 2010–2021 period (48 cases). Negative average cumulative abnormal returns were measured in each of the time windows, barring the [–30,30] day slot. Significant effects were found in the [0,10] and [0,2] day windows even by t-testing, while significant differences were also found by z-testing in additional shorter windows (*Annex, Table 5*).

No capital market effect on the BUX index could be statistically found to have been caused by the crises between 1991 and 2000. By contrast, significant effects were identified in several event windows after 2000; therefore, we examined the average cumulative abnormal return in 1-day steps for that period (76 events). As illustrated in *Figure 2*, the results show that the strongest significant effect was identified in the [0,10] trading day event window (*CAR*=–1.12; $p < 0.05$). Statistically significant negative effect can also be identified on the basis of the test results, in the 4th to 11th day post-event period. Each of the windows between [0,4] and [0,11] is significant at least at the 10-per cent level, while some of them are significant even at 5 per cent. These results indicate that a steady negative market reaction follows the events during the first two weeks, during which the BUX index underperforms the MSCI Emerging Markets Index. Thereafter, this effect gradually wanes and starting from the [0,12] day period no statistically significant difference can be detected. The analyses of the partial periods have shown that the effects are not homogeneously distributed over time. While in the period between 1991 and 2000, no statistically significant average *CAR* could be identified, in the 2000s, it was possible to find negative reactions in several event windows, and this trend gained momentum after 2010.

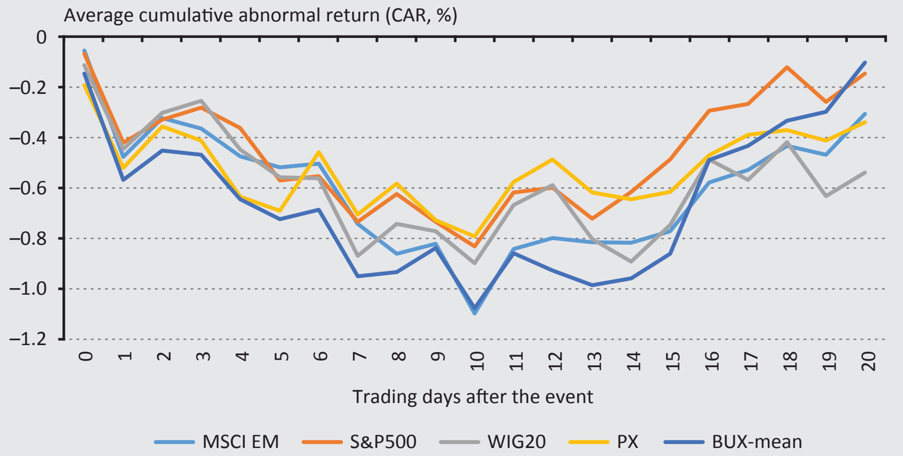
Figure 2
Changes in the average CAR in different event windows



Note: The chart shows the post-event average abnormal returns in event windows formed with a 1-trading-day step span. The red bars and the orange bars indicate significant negative effect at 5 per cent ($p < 0.05$) and at 10 per cent ($p < 0.10$), respectively, while in the case of the blue bars the effect is not statistically significant according to t-testing.

The results for the 1991–2000 period may also be caused by reasons of methodology, because in the 1991–1996 period, the explanatory power of the market model (R^2) was extremely small (below 5 per cent in all cases) during the estimation period, making the reliability of the expected returns estimated by regression questionable. An alternative approach was also applied to correct these, and the expected return was substituted with the estimation period's average return, but even this method failed to show a significant abnormal return for the 1991–2000 period. However, in the 2000–2021 period, a statistically significant negative abnormal return was observed for the [0,2] and [0,5] event windows; i.e. the BUX index underperformed relative to both its own pre-event average return and the benchmarks (MSCI EM, S&P 500, WIG20, PX). The results of the basic model are also confirmed by the robustness tests: the negative abnormal return persists, only to return to its highest absolute value by the 10th trading day after the event (*Figure 3*).

Figure 3
Changes in the average CAR with different benchmarks



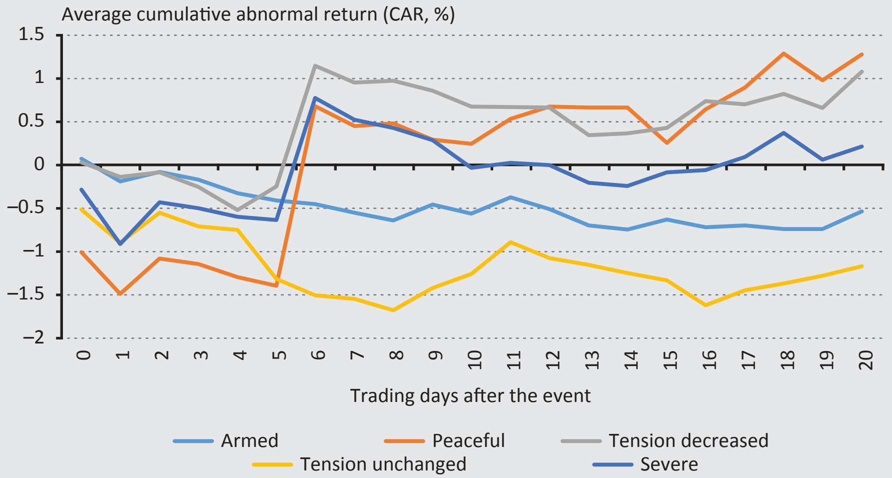
Note: The figure illustrates the cumulative abnormal returns calculated on the basis of a variety benchmarks (MSCI EM, S&P 500, WIG20, PX) and the previous average return of the BUX (BUX-mean).

Having completed the analysis of the various periods, the results were also separated on the basis of the dimensions discussed in *Section 4*. Sorting the events into categories of "armed" and "peaceful" (*VIOL* variable), we found regarding the entire period that although in the case of the events associated with armed conflicts (n=80) the average *CAR* was negative for the most time, none of the applied statistical tests produced significant results (*Annex, Table 6*). By contrast, in the case of peaceful conflicts (n=28) the average CAR is statistically significantly negative in the short run, in the [0,5] event window, and thereafter, it turns positive, but the effect is not significant (*Figure 4*).

A breakdown by GRAVCR – the variable indicating the severity of the crisis – shows a pattern consistent with peaceful conflicts. Over the entire period (n=41), events associated with more severe crises (*GRAVCR* > 3) showed a statistically significant negative average CAR in the short term, in the [–1,1] and [0,2] day windows. However, thereafter, the abnormal return turns positive, but the effect is no longer significant. This negative and significant market reaction was confirmed – also in several event windows ([–1,1], [0,2], [0,20]) during the 2000–2021 partial period (n=27). On the other hand, no material difference could be identified on the basis of the *POWINV* variable – reflecting the involvement of the superpowers – in the effects of events on the stock exchange, because no event occurred during the examined period without the involvement of at least one of the superpowers.

In 51 of the 108 events covered by the study, the tension was found to have eased, when examined on the basis of the *OUTESR* variable, after the outbreak of the crisis, no change took place in the external participants' crisis perception in 47 cases, and the tension grew in 10 cases. The results of the analysis showed that no statistically significant abnormal return could be established in the cases when the tensions eased (*OUTESR*=1), and the events unfolded similarly to peaceful conflicts (*Figure 4*). By contrast, during events when the status quo remained unchanged (*OUTESR*=2), negative and significant *CAR* values could be observed in several time windows. Significant results were found, for instance, regarding the [–1,1], [0,2], [0,3] and [0,5] windows. The market reactions to the events are summarised in *Figure 4.* The results are consistent with intuitive expectations, in that persistent underperformance can be observed in the case of armed conflicts and crises with unchanged tensions, while the effects of severe, peaceful or declining tensions proved to be short-lived.

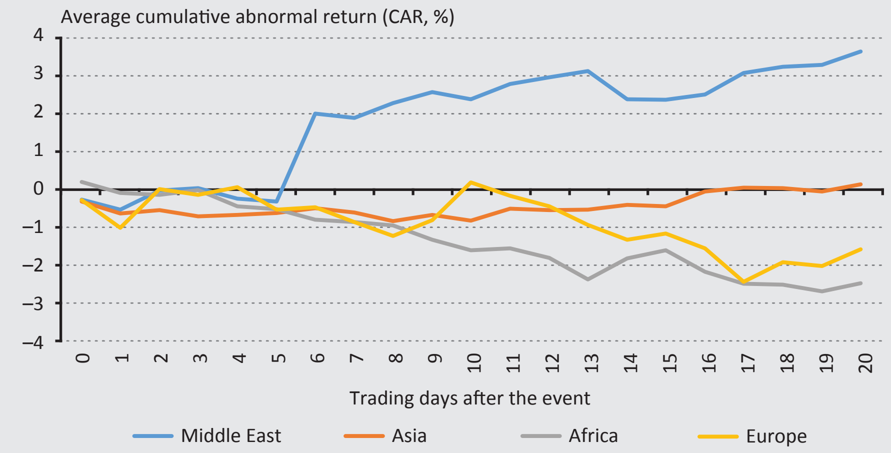
Figure 4
Abnormal returns by type of event



Note: The figure presents the average cumulative abnormal returns associated with armed (VIOL ≥ 2) and peaceful (VIOL < 2) crises, as well as events characterised by decreasing tension (OUTESR=1), unchanged tension (OUTESR=2), and high crisis severity (GRAVCR > 3), over the 20 trading days following the event.

From a breakdown of the sample by region, it can be seen that the events relate to Africa (23 cases), Asia (50 cases), Europe (7 cases) and the Middle East (26 cases). However, in most of the regions, no statistically significant correlation can be found between the events and abnormal stock market returns (*Annex, Table 7*). Some cases are exceptions to the above. In the case of the events in Africa, the average *CAR* is –1.6 in the [0,10] window, with a t=–1.975 statistical value, which is regarded as nearly significant. In the case of the events that took place in Asia, negative and significant cumulative abnormal returns were found in the [–1,1], [0,2] and [0,3] windows (*Figure 5*). Negative average *CAR* figures were identified in 23 of a total of 40 region and time window combinations during the entire time period, in 5 of which we found statistically significant results. Most non-negative average *CAR* values were associated with events relating to the Middle East, where the average *CAR* was positive in 7 of the 10 event windows reviewed. From *Figure 5*, it can be concluded that while the events that took place in the Middle East were accompanied by positive price reactions, the crises in Africa and Europe consistently resulted in negative abnormal returns. The effects of events in Asia are modest and show no clear direction. The generalisability of the results, however, is limited by the fact that in most of the time windows the abnormal returns are not significant.

Figure 5
Cumulative abnormal returns by region



Note: The figure shows the average cumulative abnormal returns associated with events in different regions (Middle East, Asia, Africa, Europe) over the first 20 trading days following the event, on the entire sample.

The number of events in which statistically significant negative abnormal returns could be identified increased after the 2000s. Having analysed as many as 40 region and time window combinations, we found 28 cases with negative average *CAR* figures, in 8 of which we found statistically significant results. In the 2000–2021 period, the positive average *CAR* is no longer associated with the Middle East but with Africa, where a positive average *CAR* can be observed in 7 cases. Mention should be made in particular of the crises relating to the European region, in the case of which significant negative effects were observed even in the case of the lowest average *CAR*, bearing out the hypothesis that geographical proximity enhances the market's reaction to geopolitical events. Nevertheless, the small number of cases (4 events) should also be taken into account in the interpretation of the results, as it limits the generalisability of the conclusions. It should also be noted that although the ICB database distinguishes between 21 sub-regions under the *GEOG* variable within the four regions examined (Africa, Asia, Europe, Middle East), a detailed analysis of these failed to provide any additional information to the above results, i.e. no subregion can be identified where significant effects are more observable, and the interpretability of the results is limited the small number of cases in the case of a number of subregions.

6. The effects of global, domestic and other uncertainty factors on the CAR values

On the basis of the above analysis, the *CAR* values belonging to the event window [0,10] were used as the dependent variable of the cross-sectional regression for the entire period, because that particular period was found to have the strongest statistical power. The distribution of winsorised cumulative abnormal returns (*CAR*) does not deviate significantly from normality according to the Shapiro–Wilk test (W=0.982, p=0.44).

Three factors appear to be dominant in view of the univariate cross-sectional regression analyses. Of the global uncertainty indicators, the VIX index showed significant positive correlation with the cumulative abnormal returns, indicating that with higher prior-month market volatility, the stock market reactions may be less negative and may even be more favourable. The *BUXrec* variable, which is of a more technical nature, also indicated a positive correlation, showing that when the BUX index is below the 12-month moving average (in a trend of decrease), the market reacts less markedly to geopolitical events than when it is on the upswing. The above conclusions are also confirmed by two additional variables (*BUXmedian* and *BUXreturn*) relating to the BUX index return. Reactions to geopolitical events are dampened by prior-month stock market returns below the median and by more pronounced stock market downturns. In the case of the business confidence index (*BCI_HUN*), the negative coefficient shows that cumulative abnormal returns are higher when confidence indices are lower; in other words, the market tends to react more favourably in a pessimistic economic environment, presumably because negative outlooks have already been factored in by investors (*Table 2*). Of the variables examined simultaneously with the occurrence of the events only the ones associated with the BUX index (*BUXmedian* and *BUXreturn*) show a correlation; however, the nature of the relationship is reversed in this case, and the less dramatic price reactions identified during an event are linked to higher stock market returns and to higher-than-median performance levels. The post-event 1-month correlations of the variables reviewed in our study are also consistent with the above – they are supplemented with a negative correlation with the domestic geopolitical risk (*GPRC_HUN*) and uncertainty (*WUI_HUN*) indicators, i.e. the marked price reaction (negative *CAR*) is accompanied by increasing uncertainty (increasing indicator value) in the following month. It should be noted in particular that the uncertainty (*WUI_RUS*) and geopolitical risks relating to Russia (*GPR_RUS*) show no significant correlations with the reactions shown on the Hungarian stock market.

Table 2
Cross-sectional regression results for the CAR values

Variable	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Period	**1 month before**		**Concurrently**		**1 month after**	
GEPU_current	–0.001	0.747	–0.001	0.826	–0.002	0.661
GEPU_ppp	–0.001	0.704	0.000	0.899	–0.002	0.666
US_EPU	0.001	0.811	0.001	0.878	0.003	0.531
GPR	0.002	0.796	0.008	0.437	0.008	0.499
GPRT	0.002	0.856	–0.001	0.954	–0.001	0.942
GPRA	0.001	0.806	0.007	0.210	0.007	0.304
GPRC_HUN	9.830	0.601	3.567	0.859	–21.863*	0.048
BWSENT	0.413	0.500	0.020	0.975	–0.239	0.674
VIX	0.115**	0.007	0.046	0.305	0.030	0.496
CCI_HUN	–0.122	0.517	–0.137	0.461	–0.148	0.419
BCI_HUN	–0.254	0.090	–0.271	0.080	–0.241	0.145
BUXrec	1.511*	0.029	–0.110	0.878	–0.571	0.410
CPI_HUNyy	0.128	0.347	0.104	0.467	0.127	0.395
Unemp_HUN	0.029	0.832	0.028	0.841	0.040	0.770
Retail_HUNyy	0.013	0.859	0.026	0.728	–0.011	0.873
Prod_HUNyy	–0.045	0.207	0.038	0.223	–0.033	0.415
WUI_global	0.000	0.510	0.000	0.858	0.000	0.239
WUI_HUN	2.227	0.369	–2.094	0.374	–6.632*	0.019
BUXmedian	1.530*	0.016	–1.488*	0.020	–1.599*	0.014
BUXreturn	–12.837*	0.030	19.317**	0.000	12.504*	0.030
WUI_RUS	2.240	0.378	2.509	0.221	–2.170	0.330
GPR_RUS	–0.466	0.648	0.178	0.846	–1.101	0.234

*Note: The data in the table show the results of cross-sectional regression analyses on winsorised cumulative abnormal returns (CAR). The three columns indicate the effects of the explanatory variables during the month preceding, simultaneously with and following the event. HC1 robust (heteroskedasticity-robust) standard deviations were used for inference. The significance levels are marked: ** $p < 0.01$; * $p < 0.05$.*

In the global model presented in *Table 3*, the VIX index showed a significant positive effect for the *CAR* values (β=0.175, $p < 0.01$), while the *GEPU_current*, the *GPR* and the *WUI_global* did not prove to be significant. The model's alignment is considered low (*adjusted* R^2=0.10). Diagnostic tests show that the model is reliable because multicollinearity is low (*VIF* < 1.5), the Shapiro–Wilk test did not reject the normal distribution of residuals (p=0.996), and the Breusch–Pagan test indicated no heteroscedasticity (p=0.90).

None of the variables in the domestic macroeconomic and uncertainty models reached the significance level. Alignment is weak (negative *adjusted* R^2), showing that the domestic fundamentals do not contribute to a substantial explanation of the *CAR*. In the model of confidence indices, neither the consumer indicator, the business confidence indicator, nor the Baker–Wurgler investor sentiment index showed any significant correlation with the *CAR* values. Alignment is weak (negative *adjusted* R^2=0.00) again, i.e. these indicators do not explain the changes in returns.

In the final model, the VIX showed a significant positive impact on the *CAR* values (β=0.097, $p < 0.05$). The effect of the monthly return of the BUX was negative (β=–9.25), which proved to be weakly significant with robust errors (p=0.09). The model has weak explanatory power (*adjusted* R^2=0.11). Based on the diagnostic tests, the model's estimate may be regarded as reliable. Multicollinearity is not a problem (*VIF*=1.08 in the case of both variables). The hypothesis of normal distribution of residuals was not rejected by the Shapiro–Wilk test (p=0.81), and no significant heteroscedasticity was indicated by the Breusch–Pagan test (p=0.79).

Among the models, only the global uncertainty model, and within that, the VIX index, showed a significant correlation with *CAR* values. The domestic fundamentals and confidence indicators provided no additional information. The results provided by the final model confirm, on the whole, that the abnormal returns in the domestic stock market were related primarily to the prior month's global volatility (VIX), while the domestic market performance (*BUXreturn*) showed a weaker and more uncertain correlation. Accordingly, the results suggest that negative reactions are more moderate (higher *CAR*) after periods characterised by higher capital market risks and that reactions are similarly moderate even when the BUX index's return in the previous month is low. It is concluded from the above that the market had already partially factored in the unfavourable outlook prior to the events, and that investors view geopolitical developments as minor surprises during this period of increased uncertainty.

Table 3
Cross-sectional regression results for the CAR values

Variable	Global (5)	Domestic macros (6)	Confidence indices (7)	Final model (8)
Constant	–6.785*	–2.607	20.452	–2.647**
VIX	0.175**			0.097*
GEPU_current	–0.002			
GPR	0.033			
WUI_global	0			
CPI_HUNyy		0.087		
Unemp_HUN		0.064		
Retail_HUNyy		0.008		
Prod_HUNyy		–0.064		
WUI_HUN		1.828		
GPRC_HUN		32.54		
CCI_HUN			0.057	
BCI_HUN			–0.271	
BWSENT			0.306	
BUXreturn				–9.245
R^2	0.169	0.101	0.047	0.136
Adjusted R2	0.096	–0.024	0.003	0.11

*Note: The data in the table show the results of cross-sectional regression analyses on winsorised cumulative abnormal returns (CAR) on the basis of the equations – (5), (6), (7) and (8) – discussed in Chapter 3. HC1 robust (heteroskedasticity-robust) standard deviations were used in the estimates. The significance levels are marked: ** p < 0.01; * p < 0.05.*

7. Discussion

Our conclusions are consistent with the international literature, in that the negative short-term reactions of the BUX index primarily lead to diminishing stock returns (*Smales 2021; Lamine – Zribi 2024*). The enhanced market sensitivity observed since 2000 may be related to the fact that the market has become more developed and liquid, thereby amplifying the impact of geopolitical shocks (*Grinius – Baležentis 2025*). The significant negative abnormal returns associated with peaceful events, identified in the [0,5] day event window, may at first appear to be in contrast to the expectations, but they are in line with findings that the persistence of threats and uncertainty triggers stronger market reactions than the violent escalation itself (*Rafi – Ali 2025*). It was also in line with this that we demonstrated how we observed similar reactions in events characterised by preservation of the status quo. This indicates that the market often aligns its reactions not to the actions themselves, but rather to the persistence of lasting uncertainties and threats. The impact of geographical proximity is also borne out by the results in a regional breakdown. The European events caused greater underperformance on the part of the BUX index, which is in line with the proximity effect hypothesis (*Grinius – Baležentis 2025; Nygaard – Sørensen 2024*).

Cross-sectional regression analyses found that the global risk indicators (VIX) and the stock market's prior performance play a significant role, while the domestic macroeconomic factors and confidence indicators do not substantially explain the cumulative abnormal returns. This is consistent with the findings of international studies, which show that the extent of the effect depends on the level of stock market performance (*Demiralay et al. 2024*).

8. Conclusion

Our study explored the Hungarian capital market's short-term reactions in relation to international crises. The results for the period between 1991 and 2021 showed negative average cumulative abnormal return values in the majority of the event windows, but the t-testing found significant effects only in the [0,5] day window, while z-testing found such effects in the [–15,15], [0,2] and [0,1] windows. In the partial period between 2000 and 2021, an increase in significant effects was observed along with stronger and more persistent negative market reaction, particularly in the windows between [0,1] and [0,11], where the lowest average abnormal return was found in the [0,10] window. All of this goes to show that the BUX index not only reacts negatively to international crises compared to its own past performance, but also underperforms relative to benchmarks representing developing and developed markets – the MSCI Emerging Markets, S&P 500, the WIG20 and the PX indices – meaning that the Hungarian market reacts more sensitively and strongly to geopolitical events.

The crises were also grouped by various dimensions (e.g. by severity or by geographical location). The results show that although the average abnormal return tends to be negative during events related to armed conflicts, the effects of such events are not statistically significant. On the other hand, in the case of peaceful events, significant negative reactions can be observed in the short term, in the [0,5] day event window, which, however, is a temporary phenomenon, as returns rebound in subsequent periods, although the effect is no longer statistically significant. In the case of events accompanied by eased tensions, the market's reaction shows a pattern similar to those of peaceful conflicts: negative in the short term, then turning positive later, but the effect is only significant in the short term.

On the other hand, events indicating continuation of the status quo, i.e. prolongation of the crisis and uncertainty, result in negative and statistically significant cumulative abnormal returns in several time windows. When we categorised crisis events in terms of severity, events related to more severe crises during the period between 2000 and 2021 resulted in significantly negative abnormal returns in several of the event windows examined.

In a breakdown by geographical region, the results show that the Hungarian stock market is most sensitive to European crises, which resulted in significantly negative abnormal returns. The effects of events taking place in Africa were mostly negative but insignificant, while events in the Middle East were accompanied by moderately positive exchange rate reactions. The effects of events in Asia are moderate and short-term, suggesting in general that geographical proximity increases the intensity of the Hungarian market's response to international crises.

Cross-sectional regression analyses found that cumulative abnormal returns are primarily explained by global uncertainty factors and the past performance of the Hungarian stock market. The preceding month's VIX index showed significant positive correlation with *CAR* values, indicating that an increase in global market volatility prior to an event moderates the negative reactions (higher *CAR*) of the Hungarian stock exchange to crises. Investors tend to become more risk-averse in such situations even before the crisis; thus, when the crisis hits, the selling pressure is less intense, because some of the increased risks have already been factored in.

Similar correlations are found in the case of technical indicators related to the BUX (*BUXrec, BUXmedian, BUXreturn*): in the month preceding the event, the downward trend (*BUXrec*), monthly returns below the median (*BUXmedian*) or low monthly returns (*BUXreturn*) dampened the market reaction (higher CAR). This suggests that investors had already factored in the unfavourable outlook to some extent ahead of the event; therefore, the actual effect of the crisis was not as dramatic as it might have been. Conversely, domestic macroeconomic factors (inflation, unemployment, industrial production, consumer confidence) showed no significant correlation with cumulative abnormal returns.

The general applicability of the conclusions is limited by the fact that abnormal returns were not statistically significant in many event windows, indicating that the market impacts of crises were often temporary or relatively weak.

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Annex

Table 4
Variable descriptions

Variable	Category	Brief description / Source
GEPU_current	Global economic policy uncertainty	The Global Economic Policy Uncertainty Index is a text-based, news-based, GDP-weighted indicator, based on current price GDP (*Baker et al. 2016*).
GEPU_ppp	Global economic policy uncertainty	The Global Economic Policy Uncertainty Index is a text-based, news-based, purchasing power parity-weighted indicator (*Baker et al. 2016*).
US_EPU	US economic policy uncertainty	The Economic Policy Uncertainty Index is a text-based, news-based indicator, United States of America (*Baker et al. 2016*).
GPR	Global geopolitical uncertainty	The Geopolitical Risk Index is a global aggregated, text-based and news-based indicator (*Caldara – Iacoviello 2022*).
GPRT	Global geopolitical uncertainty	The Geopolitical Threat Index (threat) is a text-based and news-based indicator (*Caldara – Iacoviello 2022*).
GPRA	Global geopolitical uncertainty	The Geopolitical Act Index (actual acts) is a text-based and news-based indicator (*Caldara – Iacoviello 2022*).
GPRC_HUN	Hungarian geopolitical uncertainty	A Hungary-specific geopolitical risk index (*Caldara – Iacoviello 2022*)
BWSENT	Investor sentiment indicator	Baker–Wurgler investor sentiment index (*Baker – Wurgler 2006, 2007*)
VIX	Global capital market uncertainty	Volatility index (implied volatility of S&P500 options). Source: CBOE
CCI_HUN	Hungarian consumer confidence	Consumer Confidence Index (domestic consumer confidence index). Source: OECD
BCI_HUN	Hungarian business confidence	Business Confidence Index (domestic business confidence index). Source: OECD
CPI_HUNyy	Hungarian macroeconomic variable	Inflation (consumer price index, annual change). Source: HCSO
Unemp_HUN	Hungarian macroeconomic variable	Unemployment rate (%). Source: HCSO
Retail_HUNyy	Hungarian macroeconomic variable	Retail sales, annual change (%). Source: HCSO
Prod_HUNyy	Hungarian macroeconomic variable	Industrial production, annual change (%). Source: HCSO
WUI_global	Global uncertainty indicator	World Uncertainty Index (global average, GDP-weighted) (*Ahir et al. 2022*)
WUI_HUN	Hungarian uncertainty indicator	World Uncertainty Index – Hungary (*Ahir et al. 2022*)
BUXmedian	Technical market indicator	It equals 1, if the BUX index return is below the median, otherwise it equals 0.
BUXreturn	Technical market indicator	The monthly return of the BUX index
BUXrec	Technical market indicator	It equals 1, if the BUX is below the previous 12-month moving average, otherwise it equals 0.
WUI_RUS	Uncertainty indicator	World Uncertainty Index – Russia (*Ahir et al. 2022*)
GPR_RUS	Geopolitical uncertainty	Russia-specific geopolitical risk index (*Caldara – Iacoviello 2022*)

Table 5
Results of the cumulative abnormal returns of the event windows, in a breakdown by period

Period	Event window	Number of cases	Average CAR	t-statistics	Positive ratio	z-statistics
1991–2000	[–30,30]	32	0.584	0.13	0.53	0.354
1991–2000	[–15,15]	32	–0.365	–0.117	0.40	–1.061
1991–2000	[–1,1]	32	–0.253	–0.393	0.56	0.707
1991–2000	[–2,2]	32	0.394	0.554	0.56	0.707
1991–2000	[0,2]	32	–0.37	–0.717	0.38	–1.414
1991–2000	[0,3]	32	–0.555	–0.909	0.44	–0.707
1991–2000	[0,5]	32	–1.024	–1.265	0.47	–0.354
1991–2000	[0,10]	32	1.496	0.679	0.44	–0.707
1991–2000	[0,20]	32	0.588	0.195	0.59	1.061
1991–2000	[0,30]	32	0.517	0.129	0.56	0.707
2000–2021	[–30,30]	76	0.414	0.401	0.46	–0.688
2000–2021	[–15,15]	76	–0.427	–0.554	0.42	–1.376
2000–2021	[–1,1]	76	–0.392	–1.534	0.46	–0.688
2000–2021	[–2,2]	76	–0.152	–0.53	0.46	–0.688
2000–2021	[0,2]	76	–0.324	–1.523	0.38	–2.065**
2000–2021	[0,3]	76	–0.367	–1.392	0.47	–0.459
2000–2021	[0,5]	76	–0.523	–1.937*	0.42	–1.376
2000–2021	[0,10]	76	–1.115	–2.306**	0.39	–1.835*
2000–2021	[0,20]	76	–0.307	–0.493	0.42	–1.376
2000–2021	[0,30]	76	–0.619	–0.767	0.40	–1.606
2010–2021	[–30,30]	48	0.509	0.408	0.43	–0.866
2010–2021	[–15,15]	48	–0.844	–0.899	0.38	–1.732*
2010–2021	[–1,1]	48	–0.373	–1.622	0.46	–0.577
2010–2021	[–2,2]	48	–0.197	–0.588	0.48	–0.289
2010–2021	[0,2]	48	–0.422	–1.624	0.37	–1.732*
2010–2021	[0,3]	48	–0.275	–0.839	0.52	0.289
2010–2021	[0,5]	48	–0.445	–1.333	0.45	–0.577
2010–2021	[0,10]	48	–1.499	–2.511**	0.35	–2.021**
2010–2021	[0,20]	48	–1.309	–1.935*	0.37	–1.732*
2010–2021	[0,30]	48	–1.194	–1.375	0.35	–2.021**

*Note: The table shows the average cumulative abnormal returns (CAR) calculated for all events, along with the corresponding t-statistics and z-statistics for various event windows. The "Positive ratio" column indicates the percentage rates of the events with positive CAR values. The asterisks mark statistical significance: * $p < 0.10$; ** $p < 0.05$.*

Table 6
Results of event windows, in the case of peaceful and armed conflicts

Event window	Number of cases	Average CAR	t-statistics	Positive ratio	z-statistics
Peaceful crisis					
[–30,30]	28	1.399	0.454	0.5	0
[–15,15]	28	–1.06	–0.371	0.29	–2.268**
[–1,1]	28	–1.435	–2.128**	0.32	–1.89*
[–2,2]	28	–1.098	–1.632	0.36	–1.512
[0,2]	28	–1.112	–2.467**	0.32	–1.89*
[0,3]	28	–1.177	–1.962**	0.32	–1.89*
[0,5]	28	–1.441	–1.793*	0.36	–1.512
[0,10]	28	0.268	0.111	0.21	–3.024**
[0,20]	28	1.346	0.546	0.36	–1.512
[0,30]	28	1.987	0.738	0.46	–0.378
Armed crisis					
[–30,30]	80	0.137	0.079	0.48	–0.447
[–15,15]	80	–0.181	–0.174	0.46	–0.671
[–1,1]	80	0.028	0.113	0.55	0.894
[–2,2]	80	0.397	1.299	0.54	0.671
[0,2]	80	–0.066	–0.282	0.4	–1.789*
[0,3]	80	–0.158	–0.58	0.51	0.224
[0,5]	80	–0.402	–1.35	0.46	–0.671
[0,10]	80	–0.555	–1.014	0.48	–0.447
[0,20]	80	–0.527	–0.518	0.51	0.224
[0,30]	80	–1.077	–0.725	0.45	–0.894

*Note: The table shows the average cumulative abnormal returns (CAR) calculated for the whole period and for all events, along with the corresponding t-statistics and z-statistics in a breakdown by armed (VIOL ≥ 2) and peaceful (VIOL < 2) conflicts. The "Positive ratio" column indicates the percentage rates of the events with positive CAR values. The figures marked * and ** indicate 10-per cent (p < 0.10) and 5-per cent significance levels, respectively (p<0.05).*

Table 7
Results of the event windows in the case of conflicts broken down by region

Period	Event window	Number of cases	Average CAR	t-statistics	Positive ratio	z-statistics	Region
1991–2021	[0,10]	23	–1.609	–1.975**	0.35	–1.46	Africa
1991–2021	[–1,1]	50	–0.632	–1.782*	0.4	–1.414	Africa
1991–2021	[0,2]	50	–0.559	–1.998**	0.36	–1.98**	Asia
1991–2021	[0,3]	50	–0.713	–1.989**	0.42	–1.131	Asia
1991–2021	[0,10]	50	–0.832	–1.519	0.36	–1.98**	Asia
2000–2021	[–1,1]	17	0.669	2.097**	0.76	2.183**	Africa
2000–2021	[–1,1]	39	–0.787	–1.839*	0.35	–1.761*	Asia
2000–2021	[0,2]	39	–0.618	–1.985**	0.33	–2.082**	Asia
2000–2021	[0,3]	39	–0.718	–1.821*	0.41	–1.121	Asia
2000–2021	[0,10]	39	–0.67	–1.297	0.35	–1.761*	Asia
2000–2021	[0,3]	4	–1.887	–2.502**	0	–2**	Europe
2000–2021	[0,5]	4	–2.932	–3.457**	0	–2**	Europe
2000–2021	[0,10]	4	–3.615	–2.276**	0.25	–1	Europe

*Note: The table shows the cumulative abnormal returns (CAR) of the BUX index and the corresponding t-statistics and z-statistics for different event windows by region, only in cases where statistically significant results can be observed. The significance levels are marked: * p < 0.10; ** p < 0.05.*