Finance Research Letters 64 (2024) 105489

Contents lists available at ScienceDirect

Finance Research Letters

journal homepage: www.elsevier.com/locate/frl

Firm systematic risk after the Russia–Ukraine invasion

Stefano Piserà [a,b], Laura Chiaramonte [c], Andrea Paltrinieri [d,*], Flavio Pichler [d]

[a] University of Genova, Italy
[b] University of Essex, United Kingdom
[c] University of Verona, Italy
[d] Catholic University of Sacred Heart, Italy

ARTICLE INFO

JEL classification:
G32
G12

Keywords:
Russia–Ukraine invasion
Systematic risk
Geopolitical risk
Foreign sales
EU STOXX 600

ABSTRACT

We explore the systematic risk effects of the Russia–Ukraine war on European non-financial firms during the period 2021Q1–2022Q4. Using quarterly firm-level data, we find that, after the Russia–Ukraine conflict, European non-financial firms experienced a statistically significant increase of systematic risk (Beta). Moreover, we also find that firms with higher foreign sales reduced their exposure to such unprecedented geopolitical event, showing a statistically significant lower Beta in the aftermath of the announcement of the Russian invasion of Ukraine. Results are robust also using alternative measures of firm risk as well as after running alternative econometric approaches.

1. Introduction

The Russia–Ukraine war of 24th February 2022 should be considered as one of the most recent relevant demonstrations about the far-reaching effects of armed conflicts on global economies and financial markets (Ahmed et al., 2023). This is because the unique hit of local and global political interests in the Russian region has not only modified the European landscape but has also spread and been amplified by energy markets (Candila et al., 2021; Goodell et al., 2023), financial markets interconnectedness (Wu et al. 2023; Ahmed et al., 2023; Boubaker et al., 2022; Gaio et al., 2022), foreign exchange rate markets (Hossaine et al., 2023), and economic stability (Kayani et al., 2023). Specifically, Goodell et al. (2023), as a mean of bootstrapped quantile regressions and Newey-west estimator, find that the Russia–Ukraine war affected the levels of natural gas futures price and volatility having disrupting effects on commodity markets uncertainty. Therefore, higher energy prices may be considered as a structural channel affecting inflation expectations, finally leading to higher expected equity returns from investors (Alomran and Alsubaiei, 2022). Ahmed et al. (2023) explore how the Russia–Ukraine war hit the European financial markets by means of an event-study approach. The authors provide suggestive evidence about the abnormally negative return of EU STOXX listed firms immediately after the Russian invasion of Ukraine, especially for smaller firms. These initial results are corroborated by Bouabaker et al. (2022), which using a global sample of stock market indexes find that the invasion is strongly associated to remarkable negative cumulative abnormal returns (CARs) in the immediate days after the event. Interestingly, the authors highlight a different effect of the Russia–Ukraine war according to NATO allied indexes or not, as well as a higher negative effect of such event for more globalized economies. Similarly, Gaio et al. (2022) using the Multifractal Detrended Fluctuation Analysis (MF-DFA) method analyses stock markets efficiency of United States (US), United Kingdom, Germany, France, Italy, and Spain indexes, finding that during periods of high volatility such indexes seem to have multifractality properties.

* Corresponding author.
E-mail address: andrea.paltrinieri@unicatt.it (A. Paltrinieri).

https://doi.org/10.1016/j.frl.2024.105489
Received 30 January 2024; Received in revised form 1 May 2024; Accepted 1 May 2024
Available online 3 May 2024
1544-6123/© 2024 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Moreover, considering the period of Covid-19 pandemic, the paper supports the existence of a herding behavior during both geopolitical and systemic shocks among investors, warning about the violation of the market efficiency theory. From a firm specific perspective, Bougias et al. (2022) as a mean of high-frequency stock price data, observe a decrease of corporate security prices and an increase of asset volatility in the aftermath of the Russia–Ukraine invasion, especially for firms geographically closer to the default region. These results are confirmed by Abbasi et al. (2022), which find that risk exposure and trade dependence trigger invasion-generated negative abnormal returns.

Nevertheless, beside the bulk of the literature that focuses on stock market reactions, there are few firm-level analyses on the consequences of the Russia–Ukraine war on systematic risk in Europe. To the best of our knowledge, there is also a remarkable gap about how firms' foreign diversification may be used by firms to hedge possible detrimental consequences of such risk.

To fill this gap, our paper delves into the intricate consequences coming from the growing conflict between Russia and Ukraine, unravelling the systematic risk consequences of such event, proxied by the capital asset pricing model (CAPM) Beta.[1] Moreover, we aim at showing the importance of firms' foreign diversification to hedge the financial systematic impact of such geopolitical shock, providing useful suggestions for investors and asset-managers.

Focusing on a sample of 475 non-financial firms listed on the European Union (EU) STOXX 600, we find that the Russia–Ukraine war led to a positively and statistically significant increase of firms' systematic risk which, by being the non-diversifiable risk, poses several threats to the financial system, firm asset pricing and cost of capital. However, we also find that firms may reduce the detrimental effect of Russia–Ukraine conflict by increasing their foreign sales activity which statistically significantly reduces their systematic exposure.

Against the backdrop of escalating tensions and cascades effects for financial markets, our paper aims to provide a comprehensive firm-level analysis of non-diversifiable risk consequences of geopolitical shock, providing suggestive policy recommendation for asset managers and institutions.

The rest of the paper is organized as follows. In Section 2 we explain the data and variables and the econometric methodology. In Sections 3 and 4 we discuss the main results and the additional and robustness tests, respectively. Finally, Section 5 concludes the paper.

2. Data and variables

2.1. Data

Our paper explores the impact of the Russia–Ukraine war on firms' systematic risk (Beta). We focus our sample on all European STOXX 600 listed non-financial firms to capture the short-term effect of the Russia–Ukraine conflict on companies operating in the closest geographical area where the shock happened. To capture the market risk effect of the Russian invasion of Ukraine, we build our sample to quarterly frequency observations spanning from January 2021 to December 2022, on a sample of 475 non-financial firms collected through DataStream.

2.2. Dependent and target variables definition

We follow the literature (see i.e. Cheung 2016; Sila et al., 2016; Piserà, 2024), using the systematic risk (Beta) obtained by the correlation of firm-specific weekly stock returns of the previous month with the stock market index (EU STOXX 600), to capture the systematic risk reaction of non-financial firms to the Russia–Ukraine war.[2] Fig. 1 shows the average trend of firms' Beta during the period of interest (2021Q1–2022Q4).

As our target variable, we follow the recent paper of Godell et al. (2023) and we use the dummy variable Russia–Ukraine (*Russia–Ukraine*), which takes the value of 1 for the period 2022Q2–2022Q4, and 0 otherwise.

2.3. Empirical model

We empirically test firms' Beta change after the outbreak of the Russia–Ukraine conflict, applying the following regression model:

$$Beta_{i,t} = c + \beta_1 Russia - Ukraine_{i,t} + \beta_2 X_{i,t} + Firm_i + Quarter_t + \varepsilon_{i,t} \quad (1)$$

*w*here:

- $Beta_{i,t}$ is the firm systematic risk of the i th firm ($i = 1, \ldots, 475$) at time t ($t =$ 2021Q1–2022Q4) ;[3]
- $Russia - Ukraine_{i,t}$is equal to 1 if t belongs to the period 2022Q2–2022Q4, and 0 otherwise;

[1] From here to after, we use the term Systematic risk and Beta as interchangeable.

[2] Additionally, in the robustness tests we also repeated our analysis using the total market risk to stress the validity of baseline assumptions.

[3] We perform the baseline estimation also using as dependent variable the Fama-French-factor model (more specifically the 4-factor model) in place of the one factor beta. We obtained very similar results for our target variable "Russia-Ukraine". The results are not reported in the text, but they are available upon request.

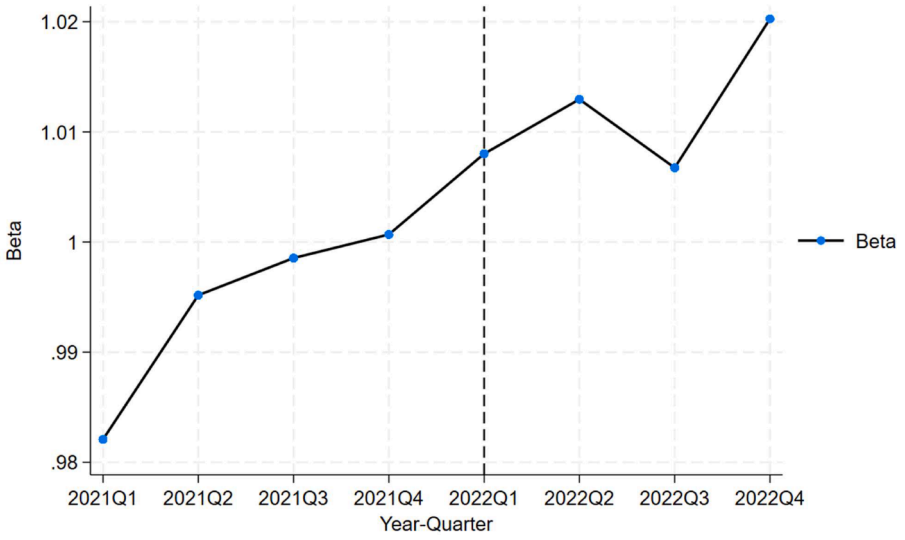

Fig. 1. Trend of EU firms' beta.

- X is the vector of control variables for the i th firm in quarter t;
- $Firm_i$,$Quarter_t$ and $\varepsilon_{i,t}$ represent firm, time (8 quarters) and the clustered standard error terms, respectively. However, we test the model with and without fixed effects.

The coefficient of interest of model (1) is β_1 and captures the firms' Beta changes in the aftermath of the Russia–Ukraine war. Therefore, if EU non-financial firms' Beta increased after the Russian invasion of Ukraine, we should observe a positive and statistically significant coefficient of the Russia–Ukraine variable. In contrast, if the Russia–Ukraine conflict did not affect firms' Beta, we would observe non statistically significant coefficients of the response variable.

The vector X represents a set of variables usually employed to control for firms' Beta (Cheung, 2016), namely: the natural logarithm of a firm's total assets as a proxy for size (Size); the return on assets (Roa) as a proxy for profitability; the ratio of long term debt to total assets (Lev) as a proxy for firm leverage; the operating expenses to total assets ratio as a proxy of firms' operating costs (Opexp); the sales growth to total assets ratio (Sales_grwth) to proxy for turnover; the research and development expenses to total sales ratio (R&D) as a measure of firms' innovation; a dummy variable equal to 1 for the period 2020Q1–2021Q4, and 0 otherwise (Chan et al., 2022), to capture the acute phase of the Covid-19 crisis (D_Covid)[4]; and the country level measure of gross-domestic product (GDP) to account for different macroeconomic conditions across Europe.[5] Table 1 shows the definition and source of all variables used in the paper.[6]

3. Results

The multivariate descriptive analysis of the sample seems to support the hypothesis of an increase of firms' Beta after the outbreak of the Russia–Ukraine war (Table 2). Specifically, the average Beta in Table 2 changes from 0.99 (for the period before the shock) to 1 (for the period after), with higher percentile values reaching the level of 1.3. However, Table 2 exclusively presents multivariate descriptive statistics, showing the lack of a statistically significant distinction in the firm's covariates between the two periods (*Pre Russia–Ukraine versus Post Russia–Ukraine*). The only exceptions to this observation are firm size, operating expenses, the leverage and country-level GDP.

Table 3 shows the result for the panel regression with and without firm and time fixed effects (FE). We always observe a positively and statistically significant coefficient of the variable Russia–Ukraine (target variable) on firms' Beta. Specifically, the coefficient of Russia–Ukraine takes value spanning from 0.011 to 0.018 with a statistically significant correlation always above the 99 % level.

[4] We run the baseline model also replacing the dummy variable D_Covid with a continuous firm-level variable for Covid-19, collected by Thomson Refinitiv database, and computed as unexpected and unplanned write-down of long-term assets due to the impact of Covid-19. We obtained very similar results of those showed in Table 3 for our target variable "Russia-Ukraine". The results are not reported in the text, but they are available upon request.

[5] We run the baseline model also adding a liquidity variable (cash to total assets ratio) and a measure for proximity (a dummy variable for proximity equal to 1 for firms headquartered in Finland, Denmark and Poland – the closest countries to Ukraine and Russia in our sample, and 0 otherwise). We obtained very similar results of those showed in Table 3 for our target variable "Russia–Ukraine". The variable "proximity" is statistically significant in two out of three models, while the variable "liquidity" is not statistically significant on beta, showing a consistent behaviour with the recent literature (see i.e. Piserà, 2024). The results are not reported in the text, but they are available upon request.

[6] Table A1 in appendix shows the correlation matrix of all variables in the sample.

Table 1
Variable description and source.

Variables	Definition	Source
Beta	Firm systematic risk derived from the one factor CAPM.	DataStream
Size	Natural logarithm of total assets.	
Roa	Return on assets.	
Lev	Long term debt to total assets.	
Opexp	Operating expenses to total assets.	
R&D	Research and development expenses to total sales.	
Sale_grwt	Sales growth to total assets.	
Foreign_sales	Foreign sales to total sales.	
GDP	Natural logarithm of country level Gross Domestic Product.	World Bank database
Russia–Ukraine	Dummy variable equal to 1 for the period 2022Q2–2022Q4; and 0 otherwise.	Authors' calculation
D_Covid	Dummy variable equal to 1 for the acute pandemic period (2020Q1–2021Q4); and 0 otherwise.	

This table shows the description and data source of all variables.

Table 2
Descriptive statistics.

	Before Russia–Ukraine invasion (2021Q1–2022Q1) (1)				After Russia–Ukraine invasion (2022Q2–2022Q4) (2)				Diff (2)-(1)
Variables	Mean	Std.Dev	p25	p75	Mean	Std.Dev	p25	p75	*t*-test
Beta	0.998	0.472	0.665	1.298	1	0.502	0.640	1.300	0.002
Size	9.000	1.589	7.722	9.906	9.001	1.412	8.162	10.057	0.334*
Roa	0.033	0.057	0	0.058	0.032	0.053	0	0.059	−0.001
Lev	0.197	0.363	0	0.324	0.149	0.226	0	0.282	−0.048*
Opexp	0.134	0.343	0	0.183	0.095	0.179	0	0.155	−0.038*
R&D	0.013	0.037	0	0	0.011	0.034	0	0	−0.001
Sale_grwt	−0.123	0.401	−0.028	0.036	−0.103	0.353	−0.001	0.021	0.020
Foreign_sale	0.659	0.340	0.479	0.946	0.651	0.344	0.454	0.937	−0.007
GDP	1.000	1.068	−0.287	2.145	4	9.165	−0.115	−0.138	2.313*

This table shows the descriptive statistics before (2021Q1–2022Q1) and after (2022Q2–2022Q4) the Russia–Ukraine invasion.

Economically, it means that the Russia–Ukraine war led to an increase of EU STOXX non-financial firms systematic risk ranging from 1.1 % to 1.8 %, confirming its relevance for European financial markets.

Looking at the control variables, we only observe a positively and statistically significant correlation between Roa and firm Beta, and a weakly negative correlation of firm Beta with the dummy Covid-19 (D_Covid) and country GDP, remarking the importance of firm performances and country characteristics during geopolitical shocks.

Our results seem to confirm the existence of a global increase of financial market connectedness after the Russian invasion of Ukraine as shown by Queshi et al. (2022). However, differently from previous research, we are the first observing such effects at firms' level, and thus on the systematic risk side, which is the undiversifiable component of firms' market risk. From an investor perspective, this means that geopolitical risk has a direct effect on systematic risk of a portfolio, with an economically significant relevance spanning from the 1.1 % to 1.8 %. Thus, market participants should be aware about the firm-level financial consequences of Russia–Ukraine invasion, reducing their exposition to the increasing geopolitical pressure in the European region.

4. Additional tests and robustness checks

Further, we aim at exploring if any firms' strategy may be effective in reducing the exposition of Russia–Ukraine war to its Beta. As argued by Acharya et al. (2011), firms tend to reduce country-specific riskiness, by geographically diversifying their profits. This view has also been supported by Puhr et al. (2022), which find that foreign diversification can mitigate firms' riskiness through the access to diverse resources useful for managing supply chain disruptions. Therefore, we test if firms' foreign diversification, proxied by the foreign sales to total sales ratio (*Foreign_sales*), appears to moderate the detrimental effect of the Russia–Ukraine conflict on firm's Beta. In Table 4, we test this assumption by running the following interaction term regression:

$$Beta_{i,t} = c + \beta_1 Russia - Ukraine_{i,t} * Foreign\_sales + \beta_2 Russia - Ukraine_{i,t} + \beta_3 Foreign\_sales + \beta_4 X_{i,t} + Firm_i + Quarter_t + \varepsilon_{i,t} \quad (2)$$

Table 4 shows the result of the moderating role of firms' foreign sale diversification on the systematic effect of the Russia–Ukraine war. Specifically, our coefficient of interest (*Russia–Ukraine*Foreign_sales*) is always negatively and statistically significantly correlated with firms' Beta, while the Russia–Ukraine dummy is still positively and statistically significantly associated with Beta. Looking at the magnitude of coefficients, the *Russia–Ukraine*Foreign_sales* appears to be always smaller than the *Russia–Ukraine* confirming the existence of a moderating role of foreign diversification strategy on Beta when geopolitical shocks occur. From a policy perspective, our results shed light on the systematic impact of the Russia–Ukraine conflict on EU STOXX non-financial firms, providing strong evidence about the role of foreign sales diversification strategies to reduce such negative effect.

Subsequently, we run the following set of robustness tests to support our results: 1) we replaced our measure of risk (systematic)

Table 3
Baseline results.

	Beta		
Variables	(1)	(2)	(3)
Russia–Ukraine	0.011***	0.013***	0.018***
	(0.003)	(0.003)	(0.006)
Size	−0.006	−0.016	−0.022*
	(0.009)	(0.012)	(0.012)
Roa	0.460***	0.496***	0.466***
	(0.107)	(0.109)	(0.107)
Lev	−0.010	−0.009	−0.010
	(0.033)	(0.033)	(0.033)
Opexp	−0.005	−0.011	−0.012
	(0.010)	(0.011)	(0.011)
R&D	0.092	0.139	0.160
	(0.108)	(0.120)	(0.122)
Sale_grwth	−0.003	−0.003	−0.001
	(0.004)	(0.004)	(0.004)
D_Covid	−0.004	−0.006	−0.021**
	(0.005)	(0.005)	(0.009)
GDP	−0.0002	−0.0002	−0.0004**
	(0.0002)	(0.0002)	(0.0002)
Firm FE	No	Yes	Yes
Quarter FE	No	No	Yes
Cluster SE Firm	Yes	Yes	Yes
N. of obs.	2606	2606	2606
R-squared	0.030	0.039	0.047

This table shows the result for the baseline model during the period 2021Q1–2022Q4 with and without firm and quarter fixed-effects (FE). The dependent variables is Beta, which measure firm systematic risk. The target variable is the dummy variable Russia–Ukraine, which takes value of 1 for the period 2022Q2–2022Q4, and 0 otherwise. Variable definitions are provided in Table 1. Firm clustered standard errors (SE) are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1 %, 5 %, and 10 % levels, respectively, in two-tailed tests.

Table 4
The moderating role of firms' foreign sales.

	Beta		
Variables	(1)	(2)	(3)
Russia–Ukraine*Foreign_sales	−0.041***	−0.040***	−0.042***
	(0.012)	(0.011)	(0.011)
Russia–Ukraine	0.037***	0.039***	0.043***
	(0.008)	(0.008)	(0.009)
Foreign_sales	0.091**	0.107**	0.105*
	(0.030)	(0.035)	(0.035)
Control variables	Yes	Yes	Yes
Firm FE	No	Yes	Yes
Quarter FE	No	No	Yes
Cluster SE Firm	Yes	Yes	Yes
N. of obs.	2528	2528	2528
R-squared	0.030	0.045	0.053

This table shows the result for the moderating role of foreign sales on Beta during the period 2021Q1–2022Q4 with and without firm and quarter fixed-effects (FE). The dependent variables is Beta, which measure firm systematic risk. The target variable are: the dummy variable Russia–Ukraine, which takes value of 1 for the period 2022Q2–2022Q4, and 0 otherwise; and the variable Foreign_sales, which measures firms' foreign sale diversification; and their interactions. Variable definitions are provided in Table 1. Firm clustered standard errors (SE) are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1 %, 5 %, and 10 % levels, respectively, in two-tailed tests.

with the firms' quarterly return volatility (total risk); 2) we run a dynamic regression including a fake shock variable (equal to 1 for the quarter before the Russian invasion of Ukraine, and 0 otherwise) to check if any anticipatory effect before the Russia–Ukraine war on firm Beta occurs; 3) we changed combination of fixed-effects, replacing firm fixed-effects with the country and industry fixed-effects; 4) we enlarged the time period of analysis to four quarters (2020Q1) before the shock. All tests confirm baseline results supporting our assumptions.[7]

[7] Results are available upon requests.

5. Conclusions

Although the financial implications of systematic risk, the literature on its relationship with geopolitical shock and Russia–Ukraine conflict has not been investigated so far. Moreover, researchers have overlooked how and to what extent European firms should approach to such events to reduce its detrimental consequences. In this paper, we fill this gap showing data driven results about an increase of European firms' Beta ranging from the 1.8 % to 1.9 % in the aftermath of the Russian invasion of Ukraine. Moreover, we also provide suggestive evidence on how firm foreign diversification may help in reducing such negative effects. Future research can extend this stream exploring the cost of equity and capital effects of the Russia–Ukraine conflict in Europe, the different reaction of industrial sectors as well as testing similar assumption on a longer period of interest.

CRediT authorship contribution statement

Stefano Piserà: Methodology, Formal analysis. **Laura Chiaramonte:** Writing – original draft, Data curation. **Andrea Paltrinieri:** Writing – review & editing, Conceptualization. **Flavio Pichler:** Writing – review & editing, Supervision, Resources.

Declaration of competing interest

We confirm we do not have any conflict of interest.

Data availability

Data will be made available on request.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.frl.2024.105489.

References

Abbassi, W., Kumari, V., Pandey, D.K., 2022. What makes firms vulnerable to the Russia–Ukraine crisis? J. Risk Finance 24, 24–49.
Acharya, V.V., Amihud, Y., Litov, L., 2011. Creditor rights and corporate risk-taking. J. Financ. Econ. 102, 150–166.
Ahmed, S., Hasan, M.M., Kamal, M.R., 2023. Russia–Ukraine crisis: the effects on the European stock market. Eur. Financ. Manag. 29, 1078–1118.
Alomran, A.A., Alsubaiei, B.J., 2022. Oil price uncertainty and corporate cash holdings: global evidence. Int. Rev. Financ. Anal. 81, 102115.
Boubaker, S., Goodell, J.W., Pandey, D.K., Kumari, V., 2022. Heterogeneous impacts of wars on global equity markets: evidence from the invasion of Ukraine. Financ. Res. Lett. 48, 102934.
Bougias, A., Episcopos, A., Leledakis, G.N., 2022. Valuation of European firms during the Russia–Ukraine war. Econ. Lett. 218.
Candila, V., Maximov, V., Mikhaylov, A., Moiseev, N., Senjyu, T., Tryndina, N, 2021. On the relationship between oil and exchange rates of oil-exporting and oil-importing countries: from the great recession period to the COVID-19 era. Energies (Basel) 14, 8046.
Chan, K.F., Zhuo, C., Yuanji, W., Tong, X., 2022. COVID-19 vaccines and global stock markets. Financ. Res. Lett. 47.
Cheung, A., 2016. Corporate social responsibility and corporate cash holdings. J. Corp. Finance 37, 412–430.
Gaio, L.E., Stefanelli, N.O., Junior, T.P., Bonacim, C.A.G., Gatsios, R.C., 2022. The impact of the Russia-Ukraine conflict on market efficiency: evidence for the developed stock market. Financ. Res. Lett. 50, 103302.
Goodell, J.W., Gurdgiev, C., Paltrinieri, A., Piserà, S., 2023. Global energy supply chain risks: evidence from the reactions of European natural gas futures to Nord Stream announcements. Energy Econ. 125, 106838.
Hossain, A.T., Masum, A.A., Saadi, S., 2023. The impact of geopolitical risks on foreign exchange markets: evidence from the Russia–Ukraine war. Financ. Res. Lett. 59, 104750.
Kayani, U.N., Hassan, M.K., Moussa, F., Hossain, G.F., 2023. Oil in crisis: what can we learn. J. Economic Asymmetries 28.
Piserà, S., 2024. Hidden effects of Brexit. Res. Int. Bus. Finance 67, 102158.
Puhr, H., Müllner, J., 2022. Foreign to all but fluent in many: the effect of multinationalism on shock resilience. J. World Bus. 57, 1–12.
Qureshi, A., Rizwan, M.S., Ahmad, G., Ashraf, D., 2022. Russia-Ukraine war and systemic risk: who is taking the heat? Financ. Res. Lett. 48.
Sila, V., Gonzalez, A., Hagedorff, J., 2016. Women on board: does boardroom gender diversity affect firm risk? J. Corp. Finance 36, 26–53.
Wu, Y., Ren, W., Wan, J., Liu, X., 2023. Time-frequency volatility connectedness between fossil energy and agricultural commodities: comparing the COVID-19 pandemic with the Russia-Ukraine conflict. Financ. Res. Lett.