A Russian carol: impact and dependence on global equity markets during the Ukraine invasion

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Abstract

Purpose – The authors present a study of the short-term impact of the Russian–Ukrainian war on global equity returns. The study aims to show that the conflict was priced into markets and whether the intensity of the impact depends on economic factors, such as dependence on gas, or/and political factors, such as belonging to the former Soviet power circle.

Design/methodology/approach – Using the event study and a sample of 77 capital markets, accounting for over 99% of global capitalisation, the authors apply a system of seemingly unrelated regressions to the daily returns of the indices, isolating the short-term effect on the markets and finally apply cross-sectional methods to help determine the size and variability of the impact.

Findings – The authors show that the impact is concentrated around day zero but is relevant in the days before and after. In addition, the authors show that being in the Soviet orbit and NATO simultaneously, as well as having high gas consumption and importing gas from Russia were key factors for investors.

Originality/value – This study is the first to try to discern whether the impact on stock markets caused by the war in Ukraine is due to purely economic factors, especially energy, or whether there is also a geopolitical component. Specifically, whether the countries closest to Russia are being more threatened by the fact that they are closer to Russia.

Keywords Event study, Stock markets, War, Abnormal returns, NATO, Gas

Paper type Research paper

1. Introduction

February 24, 2022, Russia invades Ukraine. In 2014, two regions of Ukraine self-proclaimed their independence; Russia supported them and annexed Crimea. Tension over a possible major conflict has existed ever since, culminating in the USA hinting that an invasion of Ukraine was imminent in December 2021. Putin finally responded with weapons.

Of late, the news about the war has been relentless, not just on unfortunate human loss, but also on the economic consequences: sanctions, blockade and all kinds of restrictions, which, amongst other things, caused the Russian stock markets to close on February 26.

The first part of this paper looks at the impact of political and economic uncertainty on capital markets. In this regard, many papers have shown that there is a negative relationship between uncertainty and short-term returns (Angosto-Fernández and Ferrández-Serrano, 2020; He *et al.*, 2017 or Liu *et al.*, 2017), with similar results after the COVID-19 pandemic (Ashraf, 2020; Fernandez-Perez *et al.*, 2021 or Liu *et al.*, 2020), as investors decide to minimise financial exposure until the contingency is resolved (Brown *et al.*, 1988).

We further try to show that global reaction depends on quantifiable and objective factors, contributing to the literature that attempts to explain the cross-sectional dispersion that usually follows political risk events (Heyden and Heyden, 2021; Hill *et al.*, 2019; Oehler *et al.*, 2017 or Wagner *et al.*, 2018).

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Our article is eminently empirical, and our objective is twofold: to demonstrate that there is a significant negative reaction in global capital markets to the threat of war and to show how this is due to political and/or economic factors.

To this end, we rely on a sample of indices from 77 countries, in which we analyse the magnitude and persistence of abnormal returns preceding and following the invasion, using a seemingly unrelated regressions (SUR) model (Zellner, 1962; Binder, 1985). Subsequently, we use cross-sectional regressions, showing that a significant part of the short-term impact is due to economic and political dependence on Russia.

2. Data and methodology

2.1 Conceptual framework

The first objective is to show that the event significantly affected capital markets. Specifically, that the outbreak of war in Ukraine generated political and economic instability that was immediately transferred to global stock markets.

It is important to consider that several weeks before the invasion of Ukraine numerous media claimed that such an invasion was imminent. Thus, the significance of previous days and the zero day itself on returns will be an estimator of market efficiency.

Having analysed the magnitude of the event, we are particularly interested in demonstrating that the variability of the impact on markets depends on rational factors: either economic factors, such as Russia's energy dependence (especially in Europe), or geopolitical factors, such as the fear of possible Russian retaliation with other countries.

Figure 1 presents a diagram of the hypotheses and tests we carried out.

2.2 Data

We based this study on the analysis of stock market indices. Therefore, we took daily data from as many indices as possible on a global scale, and from the point data we calculated their logarithmic daily returns. Most of the data were collected thanks to *Investing.com*, but also thanks to some of the respective stock exchanges. In addition, we also collected data from a global index: the MSCI World, representing our market performance.

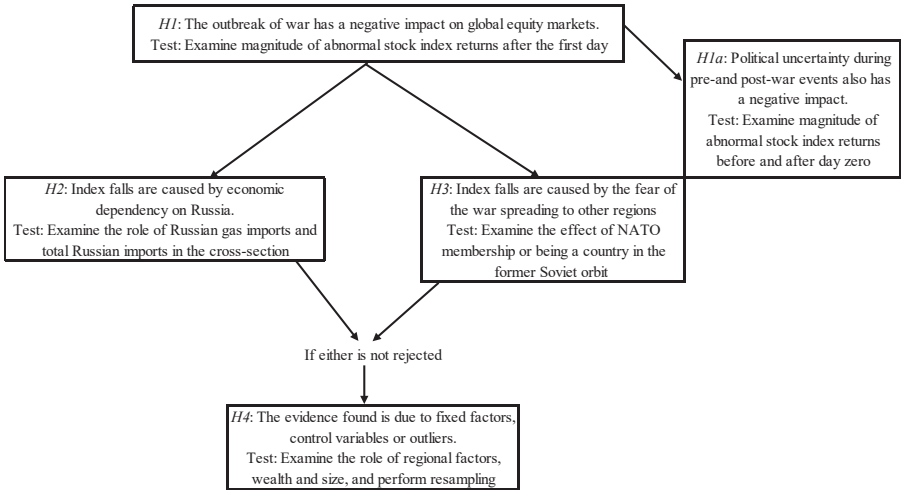


Figure 1.
Development of hypotheses and possible tests

Our initial sample consisted of 81 indices (one per country), which after applying the requirement that the number of missing or zero returns should not exceed 25% (Corrado and Truong, 2008), remained at 77 countries, from all regions of the world and exceeding 99% of global market capitalisation. The sample drops to 76 after the close of the Russian market on 26 February. Table 1 shows the main statistics for each of them.

The second part of the paper is a cross-sectional study, for which we collected different independent variables.

The first block is composed of GAS, GasRus, GasDep, IMRus, NATO and NATOEE, and could be called event variables. GasRus shows the percentage of gas imports per country that come from Russia, GasDep shows the percentage of a country's total energy consumption that comes from natural gas, and the variable GAS is the interaction between the two. IMRus is the percentage of total imports per country coming from Russia. NATO and NATOEE are two *dummies*, the former indicating whether the country belongs to NATO and the latter if it belongs to and is a country in the circle of the former Soviet Union.

GasRus and IMRus have been obtained from the UN trade data portal, GasDep has been obtained from the International Energy Agency (IEA), and NATO from its own website.

The second block would be the control variables and is composed of the regional *dummies*, wealth level, measured as the natural logarithm of GDP per capita in PPP and size, measured as the natural logarithm of total population. These last two variables have been obtained from the World Bank website. The main statistics for all these variables can be found in Table 2.

2.3 Methodology

Based on the event study methodology, we estimate abnormal returns for each of the markets. Our event window spans from eight days before the invasion to eight days after, enough to observe the evolution of the impact and to see the upstream effects. Our estimation window comprises 250 pre-event sessions.

We use an extended market model to perform the estimation, which includes an autocorrelation term and a lagged market term, given the evidence on the influence of past returns on current ones (Campbell *et al.*, 1997; Gębka and Wohar, 2013 or Xue and Zhang, 2017), and all equations are jointly regressed using SUR (Zellner, 1962; Binder, 1985). In addition, we incorporate *dummies* with the selected days to estimate abnormal returns in one step (Karafiath, 1988). For each market:

$$r_{it} = \alpha_{i0} + \alpha_{i1} * r_{it-1} + \beta_{i1} * r_{WORLD\,t} + \beta_{i2} * r_{WORLD\,t-1} + \sum_{j=-8}^{N=8} \delta_{ij} * D_j + \varepsilon_{it}$$

r_{it} is the logarithmic return of the index i on day t; α_{i0} is the constant of the model; r_{it-1}, r_{WORLDt} and $r_{WORLDt-1}$ are the autocorrelation of r_{it}, the logarithmic return of the world market index on day t and its lag, respectively. α_{i1}, β_{i1} and β_{i2} are their associated coefficients. δ_{ij} is the daily abnormal return for index i over event j, D_j is a binary variable that takes the value of one in any of the days j of the event, and ε_{it} is the disturbance term.

Joint *F*-tests of global significance are performed by restricting these coefficients (δ_{ij}), taking advantage of the main strength of this method, which is that it considers contemporaneous dependence on disturbances by taking into consideration one of the main problems of clustered events: cross-sectional correlation. Hereinafter, we refer to the average δ_{iT} coefficient as AAR (T), and the average of the cumulative abnormal returns from t_1 to t_2 as $CAAR\,(t_1;\, t_2)$.

Following the analysis of abnormal returns and using them as dependent variables, we conducted cross-sectional regressions to test hypotheses related to the political and economic causes of the conflict. Thus:

Table 1.
Daily index returns statistics by market

	Index	Special week	Mean	SD	Min	P0.05	Q1	Median	Q3	P0.95	Max	Asymmetry	Kurtosis	Region
Argentina	S&P Merval	No	0.170	1.913	−6.413	−2.913	−1.066	0.013	1.421	3.248	7.115	0.089	0.732	SA&C
Australia	S&P ASX 200	No	0.003	0.787	−3.031	−1.466	−0.412	0.050	0.495	1.174	2.167	−0.747	1.766	O
Austria	ATX	No	−0.008	1.317	−7.490	−2.139	−0.500	0.093	0.766	1.743	3.966	−1.725	7.676	E
Bahrain	BAX	Yes	0.128	0.472	−1.963	−0.544	−0.057	0.135	0.327	0.797	3.423	0.827	11.746	MENA
Bangladesh	DESEX	Yes	0.033	0.918	−4.232	−1.554	−0.516	0.002	0.597	1.535	2.882	−0.405	1.832	AS
Belgium	BEL20	No	−0.013	0.903	−3.811	−1.591	−0.515	0.048	0.579	1.255	4.091	−0.306	2.504	E
Brazil	Ibovespa	No	−0.032	1.255	−4.989	−2.333	−0.758	0.053	0.823	1.804	3.597	−0.653	1.114	SA&C
Bulgaria	SOFIX	No	0.030	0.850	−6.372	−1.200	−0.405	0.025	0.483	1.344	2.282	−1.697	11.786	EE
Canada	S&P TSX	No	0.050	0.658	−2.339	−0.981	−0.360	0.050	0.482	1.102	1.865	−0.312	1.048	NA
Chile	S&P IPSA	No	−0.002	1.605	−9.795	−2.379	−0.699	0.000	0.838	2.384	9.251	−0.429	9.046	SA&C
China	SZSE Component	No	−0.119	1.195	−3.880	−2.543	−0.717	0.000	0.665	1.769	2.999	−0.453	0.727	AS
Colombia	COLCAP	No	0.013	1.032	−2.950	−1.630	−0.551	0.000	0.533	2.010	4.057	0.269	1.448	SA&C
Côte d'Ivore	BRVM Composite	No	0.180	0.596	−3.110	−0.734	−0.114	0.149	0.488	1.155	2.638	−0.119	4.466	A
Croatia	CROBEX	No	0.016	0.728	−6.705	−0.976	−0.207	0.075	0.338	0.889	2.938	−3.147	28.473	EE
Cyprus	CYMAIN	No	0.016	1.185	−5.055	−1.786	−0.665	0.000	0.700	1.958	3.666	−0.235	2.237	E
Czechia	PX	No	0.068	0.938	−6.003	−1.203	−0.304	0.084	0.483	1.313	3.258	−1.576	11.091	EE
Denmark	OMX-C20	No	0.048	1.294	−5.093	−2.226	−0.728	0.066	0.924	1.950	4.189	−0.217	1.193	E
Egypt	EGX 30	Yes	−0.040	0.970	−3.697	−1.552	−0.656	0.000	0.621	1.473	2.656	−0.349	0.981	MENA
Finland	OMX-H25	No	−0.037	1.105	−4.728	−1.859	−0.517	0.098	0.586	1.386	3.640	−0.936	3.448	E
France	CAC 40	No	0.017	1.080	−5.093	−1.815	−0.382	0.143	0.594	1.502	3.487	−1.215	4.651	E
Germany	DAX	No	−0.028	1.084	−4.508	−1.931	−0.422	0.079	0.608	1.419	3.600	−0.833	3.350	E
Greece	ATG	No	−0.001	1.162	−6.632	−2.088	−0.419	0.107	0.645	1.595	4.290	−1.440	5.978	E
Hong Kong	HIS	No	−0.141	1.297	−4.314	−2.221	−0.935	0.000	0.669	1.853	3.360	−0.291	0.723	AS
Hungary	SE	No	−0.035	1.515	−11.672	−1.797	−0.750	0.000	0.765	1.860	6.003	−2.613	20.499	EE
Iceland	ICEX Main	No	0.037	0.915	−5.345	−1.472	−0.419	0.070	0.581	1.414	3.874	−0.700	5.679	E
India	BSE Sensex	No	0.005	1.027	−4.836	−1.796	−0.518	0.000	0.664	1.535	3.032	−0.864	2.839	AS
Indonesia	IDX Composite	No	0.031	0.755	−2.078	−1.255	−0.459	0.000	0.527	1.286	2.051	−0.040	0.214	AS
Iraq	ISX 60	Yes	0.045	1.896	−18.884	−1.370	−0.349	0.000	0.320	1.536	19.181	0.311	75.956	MENA

(*continued*)

Table 1.

	Index	Special week	Mean	SD	Min	P0.05	Q1	Median	Q3	P0.95	Max	Asymmetry	Kurtosis	Region
Ireland	ISEQ Overall	No	−0.036	1.252	−5.692	−2.212	−0.557	0.000	0.645	1.952	3.565	−0.899	3.321	E
Israel	TA125	Yes	0.068	0.848	−3.743	−1.237	−0.381	0.033	0.544	1.347	2.316	−0.771	2.928	MENA
Italy	FTSE MIB	No	−0.018	1.179	−6.431	−1.898	−0.594	0.132	0.639	1.722	3.437	−1.188	4.810	E
Jamaica	JSE All Index	No	0.014	0.863	−6.856	−0.865	−0.301	0.000	0.317	0.974	7.888	0.843	40.221	SA&C
Japan	Nikkei 225	No	−0.084	1.200	−4.067	−2.203	−0.747	0.000	0.598	2.032	3.070	−0.270	0.375	AS
Jordan	SE All Share	Yes	0.083	0.614	−2.224	−0.936	−0.219	0.031	0.365	1.083	2.713	0.646	3.378	MENA
Kazakhstan	KASE	No	0.045	0.844	−3.046	−1.548	−0.304	0.042	0.471	1.402	2.393	−0.695	2.267	AS
Kenya	NASI	No	0.003	0.918	−3.689	−1.451	−0.512	0.014	0.481	1.466	3.812	−0.105	2.217	A
Kuwait	BK Main 50	Yes	0.116	0.557	−3.391	−0.705	−0.168	0.099	0.406	1.017	2.167	−0.725	6.335	MENA
Malaysia	KLCI	No	−0.022	0.661	−2.098	−1.056	−0.420	0.000	0.394	1.073	2.128	−0.186	0.583	AS
Malta	MSE	No	−0.021	0.721	−2.356	−1.225	−0.381	−0.012	0.301	1.359	3.393	0.559	2.494	E
Mauritius	Semdex	No	0.107	0.551	−2.735	−0.663	−0.072	0.070	0.307	0.897	2.819	−0.421	7.898	A
Mexico	IPC	No	0.046	0.885	−2.381	−1.699	−0.473	0.048	0.627	1.583	2.118	−0.252	0.023	NA
Mongolia	MNE Top 20	No	0.178	1.656	−5.145	−1.966	−0.675	0.000	0.780	3.081	6.525	1.013	3.512	AS
Morocco	MASI	No	0.048	0.551	−4.195	−0.684	−0.173	0.029	0.302	0.807	2.042	−1.827	16.289	MENA
Netherlands	AEX	No	0.001	1.048	−4.894	−1.976	−0.492	0.121	0.591	1.623	3.453	−0.633	2.137	E
New Zealand	NZSX 50	No	−0.028	0.637	−1.918	−1.073	−0.460	−0.020	0.383	1.104	1.892	0.020	−0.015	O
Nigeria	NSE All Share	No	0.045	0.587	−2.173	−0.848	−0.152	0.000	0.208	1.040	2.891	0.200	4.165	A
Norway	OBX	No	0.069	0.943	−3.405	−1.519	−0.442	0.060	0.674	1.622	2.802	−0.290	0.922	E
Oman	MSM 30	Yes	0.063	0.445	−2.904	−0.625	−0.128	0.044	0.301	0.784	1.867	−0.831	7.951	MENA
Pakistan	Karachi All Share	No	−0.027	0.839	−4.375	−1.363	−0.477	0.000	0.410	1.270	2.533	−0.543	3.187	AS
Palestine	Al-Quds	Yes	0.082	0.461	−2.243	−0.574	−0.152	0.010	0.312	0.955	1.840	0.025	3.167	MENA
Peru	S&P Lima	No	0.027	1.550	−8.061	−2.157	−0.817	0.000	0.746	2.652	5.406	−0.151	4.577	SA&C
Philippines	PSEi	No	0.016	1.162	−4.352	−1.695	−0.684	0.000	0.703	1.794	4.982	−0.068	2.105	AS
Poland	WIG20	No	0.002	1.480	−11.502	−2.032	−0.675	0.000	0.755	2.179	8.099	−1.307	16.409	EE
Portugal	PSI-20	No	0.051	0.982	−2.785	−1.711	−0.555	0.108	0.691	1.589	2.710	−0.309	0.281	E
Qatar	QE General	Yes	0.097	0.615	−2.813	−0.837	−0.194	0.090	0.385	1.187	2.732	0.215	4.055	MENA
Romania	BET	No	0.021	0.941	−5.501	−1.520	−0.311	0.064	0.534	1.377	2.223	−1.775	7.206	EE
Russia	RTS	No	−0.114	3.715	−48.292	−3.246	−0.823	0.141	0.964	2.318	23.204	−7.395	111.584	EE

(*continued*)

Table 1.

	Index	Special week	Mean	SD	Min	P0.05	Q1	Median	Q3	P0.95	Max	Asymmetry	Kurtosis	Region
Saudi Arabia	TASI	Yes	0.136	0.755	−4.634	−1.086	−0.219	0.161	0.596	1.193	2.789	−1.039	6.891	MENA
Serbia	Belex 15	No	0.056	0.581	−2.591	−0.786	−0.185	0.000	0.247	0.996	4.087	1.105	10.585	EE
Singapore	FTSE Singapore	No	−0.047	0.859	−3.241	−1.422	−0.531	0.000	0.463	1.278	2.153	−0.420	0.835	AS
Slovenia	SBITOP	No	0.053	0.989	−6.660	−1.058	−0.270	0.114	0.473	1.437	3.579	−2.442	15.325	EE
South Africa	SWIX	No	0.017	0.991	−3.561	−1.701	−0.442	0.000	0.617	1.570	2.785	−0.454	1.331	A
South Korea	KOSPI	No	−0.071	0.960	−3.560	−1.565	−0.655	0.000	0.551	1.537	3.436	−0.225	0.916	AS
Spain	IBEX 35	No	−0.018	1.118	−5.084	−1.813	−0.612	0.031	0.663	1.658	3.454	−0.783	2.332	E
Sri Lanka	S&P Sri Lanka 20	No	0.076	1.441	−5.614	−2.597	−0.571	0.077	0.776	2.391	5.066	−0.204	2.244	AS
Sweden	OMXS30	No	−0.005	1.087	−4.082	−2.106	−0.600	0.062	0.659	1.683	3.008	−0.558	1.378	E
Switzerland	SMI	No	0.004	0.807	−3.914	−1.337	−0.448	0.080	0.492	1.146	2.968	−0.648	3.169	E
Taiwan	Taiwan Weighted	No	0.012	1.040	−4.192	−1.841	−0.433	0.000	0.484	1.548	5.030	−0.287	3.821	AS
Tanzania	DSE ASI	No	0.014	0.752	−6.639	−0.836	−0.215	0.000	0.246	0.906	6.498	−0.334	42.678	A
Thailand	SETI	No	0.026	0.711	−2.730	−1.368	−0.291	0.000	0.381	1.173	2.629	−0.423	1.975	AS
Tunisia	TUNINDEX	No	0.026	0.333	−1.087	−0.429	−0.162	0.000	0.174	0.619	1.606	0.516	2.966	MENA
Turkey	BIST 100	No	0.062	1.772	−10.307	−2.285	−0.539	0.111	0.905	2.440	5.313	−1.987	10.132	MENA
Uganda	Uganda All Share	No	0.000	0.981	−6.948	−1.264	−0.313	0.013	0.397	1.112	7.504	−0.235	23.555	A
UK	FTSE 100	No	0.009	0.910	−3.818	−1.687	−0.411	0.063	0.508	1.319	3.885	−0.860	4.032	E
United Arab Emirates	ADX General	Yes	0.090	0.874	−5.305	−1.031	−0.316	0.039	0.517	1.288	3.872	−0.503	8.348	MENA
US	S&P 500	No	0.020	0.918	−2.996	−1.841	−0.499	0.088	0.594	1.496	2.406	−0.303	0.543	NA
Vietnam	VN	No	0.093	1.076	−4.390	−1.981	−0.348	0.105	0.726	1.694	3.598	−0.868	2.978	AS
World	MSCI World		−0.006	0.798	−2.694	−1.584	−0.447	0.040	0.493	1.157	2.523	−0.236	0.721	
Cross-sectional average			0.024	0.061										

Note(s): This table shows the main statistics of the logarithmic returns by market. All statistics multiplied by 100, except for asymmetry and kurtosis. Special week means that trading days run from Sunday to Thursday. SD is standard deviation, Q1 and Q3 are first and third quartile, respectively, kurtosis is excess of kurtosis, P0.05 and P0.95 are the 5 and 95% percentile values, respectively. A is Africa, AS is Asia, E is Europe, EE is Eastern Europe, MENA is Middle East and Northern Africa, NA is North America, O is Oceania and SA&C is South America and the Caribbean

Table 2. Statistics of the variables used in cross-sectional regressions

Variable/Statistic	n	Mean	SD	Min	P0.05	Q1	Median	Q3	P0.95	Max
GAS	72	2.878%	6.139%	0.000%	0.000%	0.000%	0.005%	2.086%	22.461%	25.322%
GasRus	72	12.272%	23.203%	0.000%	0.000%	0.000%	0.075%	7.942%	69.003%	84.165%
GasDep	75	43.131%	32.384%	0.000%	0.840%	13.800%	36.700%	66.500%	99.900%	100.000%
IMRus	73	2.563%	5.170%	0.009%	0.141%	0.526%	1.098%	2.258%	9.192%	34.926%
GDP	77	10.104	0.883	7.738	8.474	9.432	10.346	10.761	11.203	11.498
POP	77	16.872	1.634	12.768	14.129	15.699	16.946	17.975	19.425	21.055

Note(s): n is sample size, SD is standard deviation, and Q1 and Q3 are first and third quartile, respectively. P0.05 and P0.95 are the 5 and 95% percentile values, respectively. GAS is the product of GasRus and GasDep, GasRus is the share of Russian gas imports over total gas imports per country, GasDep is the share of gas consumption over the total energy consumption per country, IMRus is the share of Russian imports over total imports per country, GDP is the natural logarithm of the GDP per capita in PPP and POP is the natural logarithm of the total population per country. Statistics of *dummy* variables are omitted since they have not the same sense. These variables are the regional fixed factors (A, AS, E, EE, MENA, NA, O and SA&C), NATO (One if the country is a member of NATO) and NATOEE (The product of EE and NATO)

$$CAR_i(t_1;\ t_2) = \alpha_0 + \gamma_1 * GAS_i + \gamma_2 * OTANEE_i + u_i$$

$CAR_i(t_1;\ t_2)$ is the cumulative return of any index from t_1 to t_2, we also use AR (0) as dependent variable. This represents the base equation, with γ_1 and γ_1 as coefficients to demonstrate the significance of the economic and political hypothesis, respectively. The remaining independent variables are added to this equation in the same way throughout the results section.

3. Results and discussion

Table 3 presents the results of our first hypothesis for all periods examined. As we might expect, the most striking feature is the magnitude and importance of AR (0). It reaches an average of −2.98%, which is 48 times the standard deviation of the mean of the period. The magnitude is noticeable in that that 68 out of 77 markets obtained negative values.

Also, the cumulative value slightly exceeds that of day zero in the widest window (although it is true that Russia is out of the sample in windows including values after day one). This could be interpreted as meaning that, despite previous and subsequent rallies and market corrections, on the day of the invasion virtually all relevant information was on the table.

Two other facts are striking: the small difference in the estimators that incorporate figures before day zero compared to those that do not (which is especially true for estimators that do not include Russia), and the positive significance of the days preceding and following the invasion, especially the latter, which could be interpreted as a rebound effect resulting from overreaction.

Despite the significance detected by the *F*-test, it is interesting to directly compare the number of negative cases with the number of significant cases, considering that the latter refers to their individual relevance within their time series, and not in the cross-section.

Here we observe a highly unusual level of negative cases in almost all windows, but especially in the shorter ones. However, this sign relevance is not matched by its individual

	n	Mean	SD	Max	Min	*F*-test	Negative	Significant
CAAR (−8, 0)	77	−2.419	6.945	4.601	−52.850	3.011***	59.740%	48.052%
CAAR (−5, 0)	77	−2.459	6.631	4.400	−51.216	6.915***	66.234%	44.156%
CAAR (−2, 0)	77	−2.680	5.758	2.080	−45.960	17.030***	81.818%	40.260%
CAAR (−1, 0)	77	−2.651	5.962	1.529	−48.511	26.722***	81.818%	40.260%
CAAR (−8, 8)	76	−3.039	7.421	11.563	−22.767	8.204***	64.474%	43.421%
CAAR (−5, 5)	76	−1.881	5.211	7.015	−18.452	6.825***	56.579%	35.526%
CAAR (−2, 2)	76	−1.692	3.154	6.363	−14.448	6.101***	71.053%	27.632%
CAAR (−1, 1)	77	−1.558	3.451	3.302	−26.826	4.739***	77.922%	24.675%
AAR (−1)	77	0.328	1.069	2.573	−4.026	2.512***	32.468%	23.377%
AAR (0)	77	−2.979	5.718	1.364	−47.987	34.782***	88.312%	67.532%
AAR (1)	77	1.093	2.858	21.685	−3.040	5.201***	29.870%	38.961%
CAAR (0, 1)	77	−1.886	3.269	2.513	−26.302	4.331***	84.416%	45.455%
CAAR (0, 2)	76	−1.969	2.788	4.578	−10.288	6.589***	80.263%	48.684%
CAAR (0, 5)	76	−2.450	4.377	4.895	−15.544	7.944***	71.053%	44.737%
CAAR (0, 8)	76	−3.670	6.305	9.712	−17.819	4.949***	73.684%	47.368%

Table 3.
Abnormal returns statistics and joint hypotheses of global significance

Note(s): All statistics multiplied by 100, except *n* and *F*-test. *n* is the sample size, SD is the cross-sectional standard deviation, *F*-test is the critical value of the joint hypotheses of global significance (abnormal returns different from zero), negative is the percentage of abnormal returns lower than zero over the sample and significant is the percentage of abnormal returns individually significant at the standard levels over the sample. *** means significance at 1%

importance; the zero-day data are impressive, but they fall and stabilise at around 30–40% in all windows. The event seems globally relevant and negative on average but affects about one third of the markets in a persistent and profound way.

As a robustness test, we changed the estimation period since, after all that happened post-COVID-19, we could assume that the returns behaviour in recent years is not the usual one. Therefore, we chose the same number of trading days but prior to December 31, 2019. These results are not reported since the conclusions remain intact.

The panel A of Table 4 presents the initial cross-sectional specification. It consists of one variable to test the economic hypothesis and one to test the political hypothesis. However, the choice is not accidental; before choosing this model, we tested whether it worked better by splitting the variables GAS and NATOEE; none of the combinations improved the specification presented.

The relevance and consistency of both variables does not allow any hypothesis to be discarded, although it is true that NATOEE is not significant in CAR (0, 5).

In AR (0) a market with a level of Russian gas imports of 7.95% and a gas dependence of 66.5% (Q3) would get an additional −0.60% over a market in Q1. While a market belonging to NATO and the former Soviet orbit would get an additional −3.57%.

The panel B within Table 4 shows the results when we replace dependence on Russian gas with dependence on Russian products in general. Therefore, we check whether there really was a penalty for countries that depend on Russian gas.

The loss of significance of the variable is substantial, ceasing to be relevant in four out of eight periods (additional time windows can be found in Appendix). We can also observe that the size of the coefficients is smaller in absolute terms, in (−5, 5) it reaches its largest size where a market with an average level of imports would obtain −0.66%, while in the same period a market with average Russian gas dependence would obtain −1.13%. The adjusted R2s also support these findings.

$n = 72$	CAR (−5, 5)	CAR (−5, 0)	AR (0)	CAR (0, 5)
Panel A: Main equation				
Const	−0.584 (0.617)	−1.082*** (0.400)	−1.792*** (0.258)	−1.294** (0.512)
GAS	−39.261*** (5.046)	−11.783** (4.530)	−11.410*** (3.424)	−38.888*** (4.594)
NATO EE	−3.213** (1.305)	−5.436*** (1.524)	−3.568*** (1.209)	−1.345 (1.156)
R^2 Adj	0.295	0.316	0.334	0.318
Panel B: Cross-sectional results substituting GAS for IMRus (n = 73)				
Const	−0.743 (0.651)	−1.036** (0.393)	−1.951*** (0.252)	−1.673*** (0.562)
IMRus	−25.659*** (5.243)	−11.433** (4.615)	−2.201 (5.459)	−16.342** (8.082)
NATO EE	−6.345*** (1.561)	−6.347*** (1.519)	−4.538*** (1.193)	−4.524*** (1.489)
R^2 Adj	0.181	0.290	0.270	0.108
Panel C: Cross-sectional results substituting NATOEE for EE (n = 72)				
Const	−0.596 (0.621)	−1.089*** (0.402)	−1.819*** (0.261)	−1.327** (0.513)
GAS	−39.497*** (5.427)	−11.381** (5.001)	−12.341*** (3.537)	−40.457*** (4.756)
EE	−2.635* (1.339)	−4.804*** (1.515)	−2.638* (1.333)	−0.468 (1.275)
R^2 Adj	0.287	0.268	0.271	0.312

Note(s): All coefficients multiplied by 100. Const is the constant of the model, GAS is a variable product of the share of Russian gas in total gas imports per country and its dependence on gas in energy consumption, IMRus is the share of imports from Russia in the total imports, EE is a *dummy* being one if the country is in Eastern Europe

NATOEE is a *dummy* product of being a country in Eastern Europe and belonging to NATO and R^2 Adj is the adjusted coefficient of determination. ***, ** and * indicate significantly different from zero at 1, 5 and 10%, respectively

Table 4.
Cross-sectional results

Finally, the panel C represents another robustness test, but in this case for the NATOEE variable. Here we evaluate whether returns depend on a political factor, such as having belonged to the Soviet orbit and then joining NATO, rather than on a geographical factor.

The results for EE are consistent and similar to those of NATOEE, although they lose significance (except for the (−5, 0) period) and size, as do the coefficients of determination. Note that the key difference is that EE includes Serbia, one of Russia's few "friendly" countries.

In the panel A of Table 5, we add control variables to check whether the relationships found are the product of a spurious relationship. This specification is the first to outperform the original one in terms of explanatory power, having higher R2s in five of the eight lengths (see additional results in Appendix). However, it is not responsible for significance of GDP nor POP, which are significant only twice.

The role played by our two main variables is hardly altered. Using the same example as in the first specification, during AR (0) a Q3 GAS market would obtain −0.56% over a Q1 one, while being Eastern European and a NATO member would cost −3.62% compared to those countries that do not meet at least one of the restrictions.

Panel B shows the results for the best possible specification introducing regional fixed effects. Here we check whether there are any relevant effects at the geographical level that the previously chosen variables could not capture correctly. It is important to know that to arrive at this part of Table 5, we first tested all possible combinations with regional dummies (we also added control variables again), and this specification, with NA and E was the one that yielded the most consistent results and higher R2s; in fact, we reached a maximum of all tested specifications and regressions of 43.7% for the longest period. This is a truly staggering figure for a cross-sectional regression.

It is worth noting the significance of the NA variable, significant at 1% (except for (−5, 5), which is significant at 5%, and (−5, 0), which is non-significant) and positive in all windows (see Appendix) and reaching a maximum in the lengths that do not include the pre-war days,

$n = 72$	CAR (−5, 5)	CAR (−5, 0)	AR (0)	CAR (0, 5)
Panel A: Cross-sectional results adding control variables				
Const	−9.544 (7.981)	−6.792 (6.098)	5.557 (5.172)	2.805 (7.787)
GAS	−38.542*** (5.489)	−11.801*** (4.348)	−10.636*** (3.784)	−37.377*** (5.117)
NATO EE	−2.830** (1.179)	−5.283*** (1.564)	−3.621*** (1.229)	−1.168 (1.153)
GDP	0.024 (0.678)	0.178 (0.406)	−0.484* (0.285)	−0.638 (0.623)
POP	0.514** (0.239)	0.231 (0.199)	−0.146 (0.181)	0.137 (0.225)
R^2 Adj	0.301	0.285	0.338	0.321
Panel B: Cross-sectional results adding regional fixed effects				
Const	0.032 (0.606)	−0.985** (0.466)	−1.632*** (0.280)	−0.617 (0.454)
GAS	−30.517*** (8.009)	−9.920* (5.656)	−7.625* (4.088)	−28.222*** (6.725)
NATOEE	−4.747*** (1.471)	−5.730*** (1.598)	−4.126*** (1.228)	−3.145** (1.251)
NA	1.665** (0.802)	0.813 (0.546)	2.154*** (0.459)	3.007*** (0.681)
E	−2.978* (1.678)	−0.591 (0.943)	−1.153* (0.597)	−3.540** (1.350)
R^2 Adj	0.338	0.283	0.390	0.437

Note(s): All coefficients multiplied by 100. Const is the constant of the model, GAS is a variable product of the share of Russian gas in total gas imports per country and its dependence on gas in energy consumption, NATOEE is a *dummy* product of being a country in Eastern Europe and belonging to NATO, GDP is the natural logarithm of the GDP per capita in PPP, POP is the natural logarithm of the total population of a country, NA is a *dummy* being one if the country is in North America, E is a dummy being one if the country is in Europe and R^2 Adj is the adjusted coefficient of determination. ***, ** and * indicate significantly different from zero at 1, 5 and 10%, respectively

Table 5.
Robustness checks

an additional 3% in the CAR (0, 5). Belonging to North America is the only variable that could have a positive impact on returns at the outbreak of war of all the variables analysed, although we must be cautious with this finding, since NA only includes three markets (Canada, Mexico and the USA).

With respect to NATOEE we obtain similar results, even with somewhat larger coefficients in absolute terms, and it is now significant in all windows. The opposite is true for GAS, where we obtain somewhat smaller coefficients, and it is no longer significant in one of the periods. However, the effect of these variables on returns resists any modification.

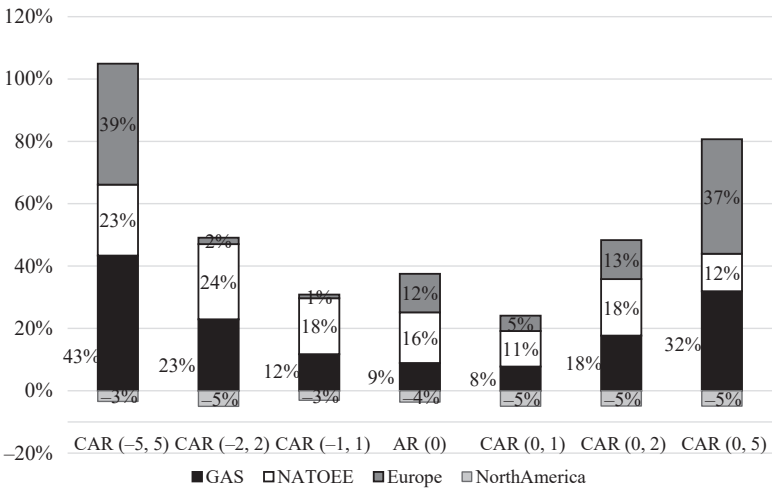
The results of the cross-section resampling robustness check are not shown as they did not provide any relevant changes.

Figure 2 shows visually the results of our last specification. In it, we can see how each variable affects returns on average. For example, we could say that belonging to Europe caused 12% of the global average fall on day zero.

In general, we observe that our model explains much better the longer periods, obtaining the worst data (a higher weight of the constant) in CAR (0, 1) and CAR (−1, 1). This improvement is due to the exponential increase in the importance of GAS and E, while NATOEE and NA remain more stable. Dependence on Russian gas accounts for 43% of the global average fall in CAR (−5, 5), and together with E variable they reach an impressive 82% in that window.

The implications of our research are manifold. We show that investors view the outbreak of war in Ukraine negatively. Logically, the beginning of the conflict alters investors' expectations, generating uncertainty that negatively affects prices until it is resolved, especially if we take into account that one of the actors is Russia (a regional and global superpower) and another is Ukraine, which despite its minor geopolitical relevance is supported by NATO and the European Union.

What is most interesting, however, is that the uncertainty, which so affects assets in such an event, loses its immaterial character and is broken down into economic, political and geographic factors. Here we show that part of the falls suffered in markets around the world is due to dependence on Russian gas. They are also due to the fact of having belonged to the



Note(s): Each percentage represents the load of the factor in the estimation of the global average equation in each length

Figure 2.
Price contribution by factor and length

Soviet orbit and then signing the Atlantic Treaty, which Russia might perceive as a betrayal, and which would make their markets more vulnerable to possible economic or military retaliation.

Moreover, it is also noticeable that belonging to Europe is not positive, probably because of its proximity to the conflict and cross-interests. Unlike belonging to North America, considering that its markets could benefit greatly (at least in the short term) by making up for the shortages of gas, as well as other goods needed during the conflict. Finally, the research also contributes to the field of finance in general, as we show that a very important part of the impact on capital markets following an extreme event can be explained by rational and quantifiable values and is not the result of emotions and illusory factors. In many cases explaining more than 50% of the average falls. Investors' reaction possibly anticipated the current cutbacks in GDP growth and inflation that are hitting the world, but especially Europe.

4. Conclusions

In this article we analyse the short-term effect of the Ukrainian invasion on stock markets.

First, we find a significant negative impact, which is long-lasting over time, even in our largest window of 17 days. However, it is also true that most of this impact is concentrated on day zero, so we understand that a large part of investors did not believe that the war was warranted.

Second, we found that the reaction was related to fundamental factors: political and economic. In particular, the markets of countries belonging to both NATO and the former Soviet orbit, as well as those most dependent on Russian gas, specially suffered.

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Appendix
Additional lengths for Tables 4 and 5

$n = 72$	CAR (−2, 2)	CAR (−1, 1)	CAR (0, 1)	CAR (0, 2)
Panel A: Main equation				
Const	−0.890** (0.340)	−0.856*** (0.225)	−1.229*** (0.219)	−1.229*** (0.318)
GAS	−14.375** (5.480)	−5.417* (3.020)	−5.495*** (1.812)	−15.491*** (4.213)
NATO EE	−4.236** (1.860)	−2.269** (0.922)	−1.707*** (0.589)	−3.273** (1.257)
R^2 Adj	0.299	0.183	0.151	0.305
Panel B: Cross-sectional results substituting GAS for IMRus (n = 73)				
Const	−0.914*** (0.342)	−1.011*** (0.231)	−1.354*** (0.222)	−1.431*** (0.332)
IMRus	−10.776*** (2.871)	1.689 (2.101)	0.784 (2.134)	−4.342 (5.205)
NATO EE	−5.372*** (1.591)	−2.742*** (0.854)	−2.186*** (0.553)	−4.561*** (1.062)
R^2 Adj	0.266	0.159	0.120	0.216
Panel C: Cross-sectional results substituting NATOEE for EE (n = 72)				
Const	−0.884** (0.341)	−0.857*** (0.226)	−1.239*** (0.221)	−1.243*** (0.321)
GAS	−13.484** (5.937)	−5.148 (3.235)	−5.788*** (1.874)	−15.794*** (4.556)
EE	−3.993** (1.741)	−2,049** (0.877)	−1.328** (0.633)	−2.658** (1.305)
R^2 Adj	0.293	0.169	0.125	0.275

Note(s): All coefficients multiplied by 100. Const is the constant of the model, GAS is a variable product of the share of Russian gas in total gas imports per country and its dependence on gas in energy consumption, IMRus is the share of imports from Russia in the total imports, EE is a *dummy* being one if the country is in Eastern Europe
NATOEE is a *dummy* product of being a country in Eastern Europe and belonging to NATO and R^2 Adj is the adjusted coefficient of determination. ***, ** and * indicate significantly different from zero at 1, 5 and 10%, respectively

Table A1.
Additional cross-sectional results

$n = 72$	CAR (−2, 2)	CAR (−1, 1)	CAR (0, 1)	CAR (0, 2)
Panel A: Cross-sectional results adding control variables				
Const	−10.017** (4.43)	−0.377 (3.708)	5.753* (3.322)	0.509 (4.896)
GAS	−14.279*** (5.104)	−5.155* (3.068)	−4.686** (2.070)	−14.661*** (4.403)
NATO EE	−3.967** (1.719)	−2.232** (0.953)	−1.743*** (0.585)	−3.162** (1.208)
GDP	0.241 (0.351)	−0.104 (0.262)	−0.485** (0.224)	−0.335 (0.344)
POP	0.395** (0.151)	0.033 (0.114)	−0.124 (0.106)	0.097 (0.154)
R^2 Adj	0.314	0.162	0.177	0.303
Panel B: Cross-sectional results adding regional fixed effects				
Const	−0.965*** (0.316)	−0.890*** (0.248)	−1.256*** (0.239)	−1.127*** (0.320)
GAS	−13.457* (6.848)	−5.029 (3.671)	−4.194* (2.467)	−12.241** (5.131)
NATOEE	−4.258** (1.989)	−2.276** (0.983)	−1.817*** (0.643)	−3.717*** (1.317)
NA	2.060*** (0.702)	0.902*** (0.329)	1.857*** (0.398)	2.334*** (0.695)
E	−0.135 (0.981)	−0.054 (0.582)	−0.291 (0.525)	−0.945 (0.822)
R^2 Adj	0.297	0.168	0.185	0.338

Note(s): All coefficients multiplied by 100. Const is the constant of the model, GAS is a variable product of the share of Russian gas in total gas imports per country and its dependence on gas in energy consumption, NATOEE is a *dummy* product of being a country in Eastern Europe and belonging to NATO, GDP is the natural logarithm of the GDP per capita in PPP, POP is the natural logarithm of the total population of a country, NA is a *dummy* being one if the country is in North America, E is a dummy being one if the country is in Europe and R^2 Adj is the adjusted coefficient of determination. ***, ** and * indicate significantly different from zero at 1, 5 and 10%, respectively

Table A2.
Additional results-robustness checks