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Uncertainty, stock and commodity prices during the Ukraine-Russia war*

Whelsy Bounou† Alhonita Yatié‡

Abstract

This article mainly investigates whether the war in Ukraine-Russia induces uncertainties and how this affects the returns of world stock market indices and commodity prices. To do so, we use the Economic Policy Uncertainty index (EPU), 96 stock market indices and the prices of 67 commodities worldwide over the period from January 2022 to April 2023. Our empirical results show that the war between Ukraine and Russia increases uncertainties, and which negatively affect the performance of global financial markets and lead to higher commodity prices. These negative shocks tend to be smaller the longer the war persists. We also observe that responses to war-induced uncertainties are stronger in Europe and America. Overall, we provide unique evidence of the impact of war on uncertainties and how this is transmitted to stock market performance and commodity prices.

JEL Code: H56, G11, G14, G15.

Keywords: Ukraine-Russia war, Uncertainty, Stock index.

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† PSB – Paris School of Business, Paris, France. E-mail address: w.boungou@psbedu.paris.

‡ Université Catholique de l'Ouest, EGEL, F-49000 Angers, France. E-mail address: alhonita.yatie@outlook.com.

"Uncertainty is the inability to forecast the likelihood of events occurring"
Knight (1921).

1. Introduction

On February 24, 2022, Russian troops invaded Ukraine, causing human and material damage (Bank of England, 2022; Liadze et al., 2022). Moreover, this invasion took place in a global environment already marked by great uncertainty since the COVID-19 health crisis. Indeed, the Ukraine-Russia war has led to a rise in uncertainties linked at least to the duration of the conflict, geopolitical issues and the geo-economic order of the post-war world. Moreover, levels of uncertainty linked to the conflict reached levels observed in 2021 following the discovery of the Delta variant of COVID-19 (Yotzov et al., 2022). Hence, these uncertainties create tensions and hesitations about the future, prompting economic agents to postpone spending (on consumption and investment) and accumulate assets (or sell them in a frenzy). As a result, this highly uncertain environment impacts financial performance (Smales, 2020).

Since the start of the war, global financial markets have been challenged at least in terms of stock market performance (Boungou and Yatié, 2022; Boubaker et al., 2022; Lo et al., 2022; Abay et al., 2023; Granát et al., 2023) and commodity price volatility (Fang and Shao, 2022). For instance, Boungou and Yatié (2022) highlight that world markets underperformed in the days following the invasion. Furthermore, the Russian-Ukrainian war is also leading to uncertainties over commodity prices (particularly energy and agricultural) and

potential disruptions to the supply of these commodities (Rose et al., 2023; Liadze, 2023). This is reinforced by the fact that the war involves two of the world's biggest suppliers of cereals, oilseeds and energy. According to the OECD (2022), in 2019, Russia was the world's leading exporter of natural gas (20%), second largest exporter of oil (11%) and third largest exporter of coal (15%). Similarly, Ukraine occupies a strategic geographical position between Russia and Central Europe, with highly productive agriculture on black soil (Chen et al., 2023). The uncertainties induced by the war should therefore lead to strong tensions on commodities market through higher energy prices. In addition, other non-energy commodities are also likely to see their prices rise, due in particular to higher energy prices and difficulties in sourcing these raw materials (FAO, 2022).

Against this background, this article therefore aims to analyze whether the Ukraine-Russia war induces uncertainties and how this affects stock market performance and commodity prices. We complete our analysis by investigating how these effects differ between regions (i.e. Africa, America, Asia and Europe) and commodity families (i.e. energy, non-energy and others). Based on our conceptual framework, illustrated in Figure 1, we begin our analysis with the relationship between investor sentiment and uncertainty. Indeed, the Ukraine-Russia war has had an impact on ambient uncertainty (Shen and Hong, 2023), leading to an increase in Internet searches and the publication of articles on the subject (Abakah et al., 2023). Investors uncertain about the future bankruptcy of certain companies will manifest their uncertainty through excess volatility in

equity market returns (Zhou and Lu, 2023). These panic movements will lead to (i) a fall in share prices (Lo et al., 2022), and/or (ii) an underperformance of stock market indices (among others Boungou and Yatié, 2022; Boubaker et al., 2022).

Moreover, war-related uncertainties are also likely to affect the price fluctuations of certain raw materials, given the important role played by Ukraine and Russia in the supply of raw materials. Indeed, following Russia's invasion of Ukraine, investors expect the supply chain for these raw materials to be disrupted (World Bank, 2022; Rose et al., 2023). They therefore anticipate a rise in commodity prices due to lower supply in the face of unchanged demand. To verify this, we use data from 96 global stock market indices and the prices of 67 commodities over the period from January 2022 to April 2023. To measure uncertainty, we consider the Economic Policy Uncertainty (EPU) index developed by Baker et al. (2016). For the war between Ukraine and Russia, we use a new index "the Russia-Ukraine War Economic Sanctions News Sentiment Index (RUWESsent)" developed by Abakah et al. (2023).

The main contribution of our article is to provide new evidences on the impact of rising uncertainties during the Ukraine-Russia war on the stock market performance and commodity prices. Previous efforts in the literature have focused mainly on the existence of a direct link between war and stock market performance (among others, Lo et al., 2022; Abay et al., 2023; Granát et al., 2023; Ahmed et al., 2023), omitting the fact that stock market fluctuations are induced by the uncertainties associated with war. We therefore complement this

literature by investigating the impact of war on uncertainties and how these war-induced uncertainties affect stock market performance and commodity prices. Figure 1 illustrates how war-induced uncertainty could impact equity and commodity markets. In doing so, our results highlight that the Ukraine-Russia war induces uncertainties. Moreover, this rise in uncertainties during the war negatively affects the stock market performance of global indices. We also confirm previous results by highlighting that index responses are heterogeneous across regions (Boungou and Yatié, 2022; Boubaker et al., 2022; Tong 2024), with a notably greater impact on Western stock indices. Our results also show that global stock market index responses are weaker the longer the conflict lasts. Furthermore, our findings should shed light on ongoing investigations into the impact of the conflict between Palestine and Israel, which started on October 7, 2023 (e.g., Pandey et al., 2023). Indeed, the conflict between Palestine and Israel once again highlights investors' anxiety about wars, and the need for them and policy-makers to implement resilience strategies.

Our analysis also stands out from the literature by providing the first evidence of the impact of war-related uncertainties on commodity price fluctuations. We show that these uncertainties lead to higher commodity prices. As expected, energy commodities were the most sensitive to rising uncertainties during the war period. Our results are important in that they should improve understanding of the impact of war beyond the warring territories. This should

enable financial policy-makers, asset managers and investors to take a broader view of war-related issues, and thus take appropriate action.

The remainder of the paper is organized as follows. Section 2 gives a brief presentation of the conceptual framework. Section 3 presents our empirical strategy. Section 4 concludes.

2. Conceptual framework

Our study is part of the prolific literature on investors' reactions to information: *investor 'sentiments*. Investor 'sentiments is a part of behavioral finance that shows that investors are not always rational. Following news, whether founded or not, investors are filled with numerous opinions, emotions or points of view which lead them to subjective and biased decisions (Thorp, 2004; Quaye et al., 2016). According to some studies, this indicator is designated as one of the best in determining the future price of assets (Wang et al., 2009; Rehman, 2013; Zhou and Lu, 2023)¹. It is especially true, when investors lacks tangible information (future economic policy for instance) to forecast the future. In this case, they use their "*knowledges*" on how the market could behave in front of a specifically situation.

Our starting point is the study by Shen and Hong (2023), which uses time-varying Granger causality tests and shows a unidirectional relationship between the geopolitical risk induced by the Russia-Ukraine war and

¹ Many studies show the impact of investor 'sentiment on stock prices, such as Huiwen and Sun (2012), Ling et al. (2014), Zheng (2015), Krishnan and Satish (2016), Zhang et al. (2018), Ruan et al. (2018).

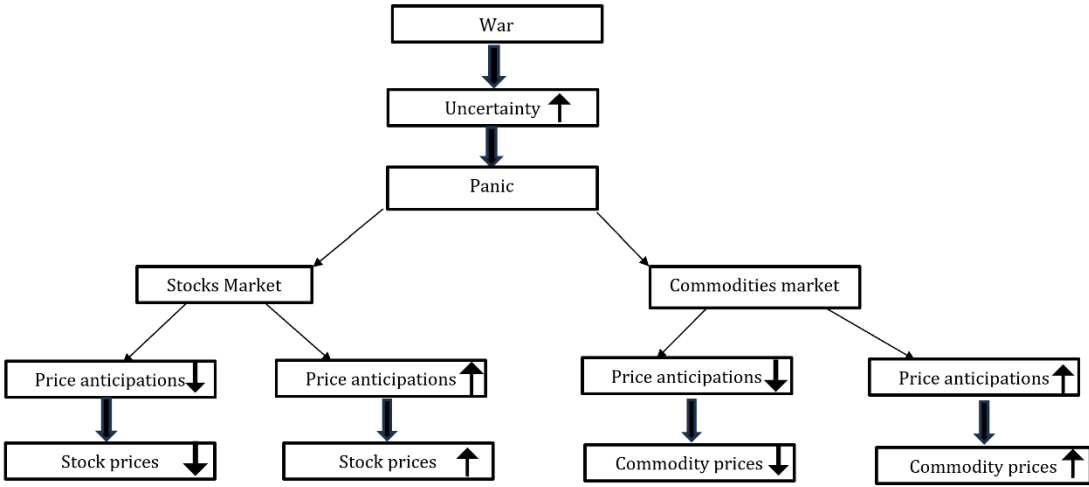
Germany's economic policy uncertainty. Precisely, Shen and Hong (2023) show that increased geopolitical risk leads to increased uncertainty in German economic policy. As a result, we follow this logic by assuming that the war in Ukraine (or associated geopolitical risks) creates widespread uncertainty, which materializes in the growth of internet searches and the publication of articles on the subject (Abakah et al., 2023). This uncertainty should therefore affect investor behavior, particularly in the equities and commodities markets, as illustrated in Figure 1 (Baker et al. 2016; Liu et al. 2021; Liu and Zhang, 2015; Noguera-Santaella, 2016).

Concerning stock markets, war-induced uncertainties create panic movements, through an excess volatility returns (Zhou and Lu, 2023)². Indeed, these panic movements are due in particular to the fear that companies with connections to territories in conflict will go bankrupt. In anticipation, investors in an attempt to escape the realization of this situation (constructed in their minds), will sell their holdings characterized as being at risk. This will lead to a fall in share prices (Lo et al., 2022). Confronted to this crisis in the market, decision-makers will put in place communications or agreements to reassure the markets. In the case of the crisis in Ukraine, the various talks to allow the continuity of economic activity have reduced uncertainties and consequently expectations of a rise in stocks price. The final consequence is the rise in stock price (Boungou and Yatié, 2022; Boubaker et al., 2022).

² An excess volatility returns is an important representation of uncertainty in stocks market (Scoones, 2019; Su et al., 2019).

Concerning commodities market, the surrounding uncertainty will create fear of a breakdown in the supply chain (World Bank, 2022). Investors will therefore anticipate a drop in the supply of commodities with an unchanged demand. As a result, they will anticipate the price of commodities to rise³. Faced with this rise in commodity prices and their crucial importance (in terms of food security for instance), decision-makers will take decisions aimed at reducing tensions on the market. The reassured markets will anticipate a drop in commodity prices and this will be effective (World Bank, 2023). Accordingly, the return to a normal situation in each market is also characterized by a reduction in general uncertainty.

Figure 1. Conceptual framework depicting the relationship between Uncertainty and stock (and commodity) prices



Source: Authors' construction

3. Empirical strategy

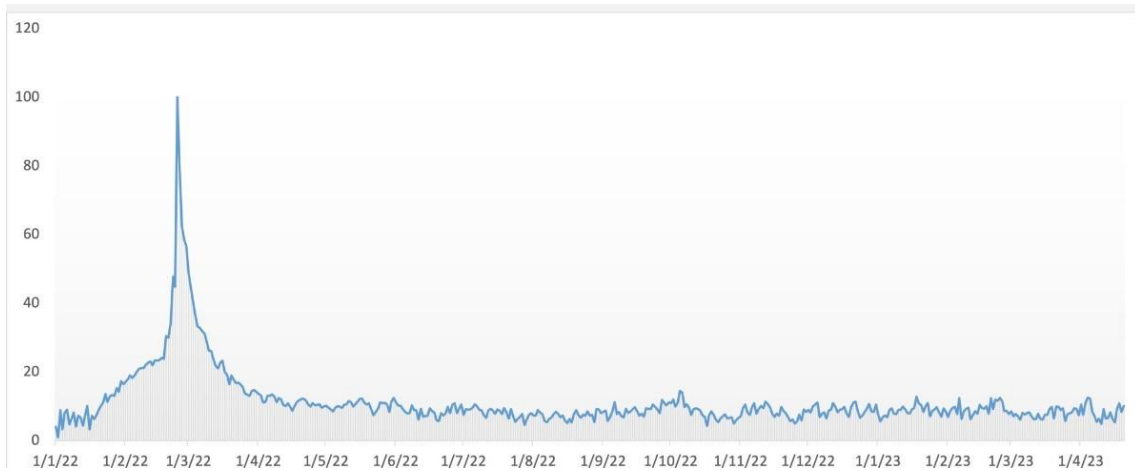
3.1. Data and model

³ The relationship between commodity prices and uncertainty has been investigated by many studies showing all an increase of commodity prices right after an increase in surrounding uncertainty: Nam (2021); Yin and Han (2014); Karabulut et al. (2020)

In this section, we present the data and methodology used for our analysis. To investigate whether the war in Ukraine-Russia induces uncertainties and how these uncertainties affect stock market performance and commodity prices, we employ monthly data from several sources over the period from January 2022 to April 2023. To measure the impact of the war, we use the Russia-Ukraine War Economic Sanctions News Sentiment Index (RUWESsent), available at <https://ruwessent.wordpress.com>. RUWESsent is a new index that reflects investor sentiment across social media, news media and internet attention regarding Russia-Ukraine war and war-induced economic sanctions, based on Twitter Sentiment, Google Trends, Wikipedia Trends and News Sentiment. This index was developed by Abakah et al. (2023) and is entirely focused on Russia-Ukraine war. In this index, *“Twitter sentiment represents public sentiment toward war and sanctions, Google trends and Wikipedia trends indicate anxiety (stress) or intensity due to intense interest in war and sanctions, and News Sentiment represents media sentiment toward war and sanctions”* Abakah et al. (2023)⁴.

Figure 2. Russia-Ukraine War Economic Sanctions News Sentiment Index (RUWESsent)

⁴ They use a first principal component analysis (PCA) to combine all the sentiment indexes in order to create the Ukraine-Russia war and economic sanctions sentiment index. They normalize this index to a scale of 1 to 100, with a low value (1 to 49) representing negative sentiment and a high value (50 to 100) representing positive sentiment. For more details on the construction of the index, see Abakah et al. (2023).

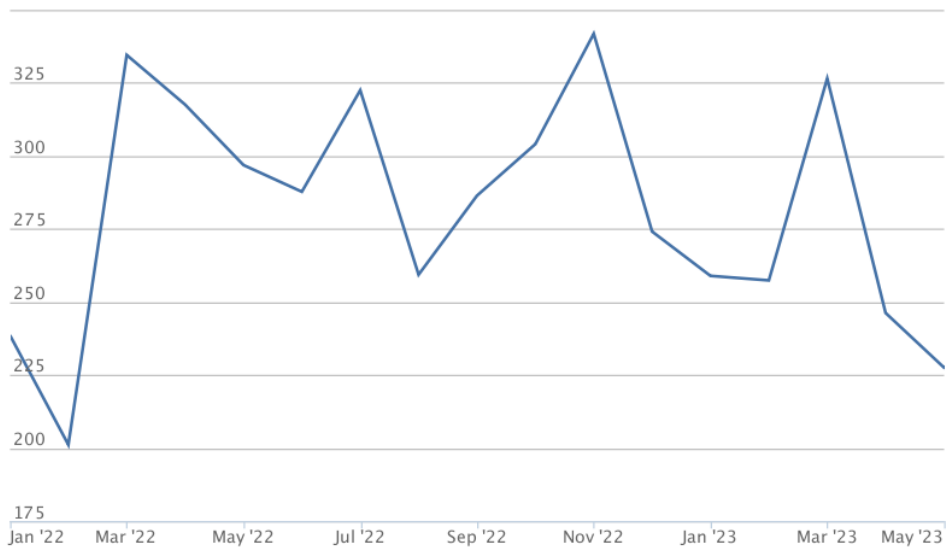


Source: Abakah et al. (2023)

In order to homogenize our time horizon, we have chosen to stop our period at April 2023, as the RUWESsent database extends to April 2023 at the time of the construction of our analysis⁵. The period under consideration includes the main peak phase in the index, as illustrated in Figure 2. Indeed, there was a peak in the index from the invasion of Ukraine onwards, and it tends to be lower as the conflict persists over time.

Figure 3. Monthly global Economic Policy Uncertainty Index

⁵ This index is designed to capture general public sentiment and response as reflected in media coverage from sources such as Twitter, Wikipedia, Google Trends and news articles. However, in its construction the index does not take into account retweets, which can also provide important information on conflict-related anxiety and concern. Similarly, tweets are not processed by country, which could have captured potential heterogeneities by country.



Source: [Economic Policy Uncertainty Website](https://www.policyuncertainty.com)

For uncertainties, we consider the global Economic Policy Uncertainty (EPU) index extracted from <https://www.policyuncertainty.com> and developed by Baker et al. (2016). EPU is based on various indicators of economic policy uncertainty, such as the frequency of references to policy uncertainty in newspapers. EPU corresponds to events widely associated with periods of extreme political uncertainty, such as the war in Ukraine-Russia (Al-Thaqeb and Algharabali, 2019). In Figure 3, we also observe a peak in EPU in early 2022, corresponding to the same period as the invasion of Ukraine by Russian troops. This should already give us the first indications of the trend between the rise of uncertainty and the outbreak of war⁶. Although EPU is primarily based on economic uncertainties, it also takes geopolitical tensions into account (Shen and Hong, 2023) and is updated regularly. EPU is based on newspapers (10

⁶ Figures 2 and 3 highlight the correlation between the war in Ukraine and the rise in uncertainty. However, the aim of this article is also to verify the existence of a causal relationship between these two elements. To this end, in the following paragraphs we employ a fixed-effects panel model to analyze this causality.

large American newspapers), policy and tax forecasts. So it is not restricted to a specific war or situation (which is not the case for RUWESent)⁷.

For stock market indices, we use the monthly log return of each stock market index from 96 countries worldwide. The world stock market index data are obtained from <https://www.investing.com> and correspond to over 1,500 monthly observations⁸. This database is a free financial markets platform providing real-time data (daily, monthly and annual), quotes, charts, financial tools, breaking news and analysis across 250 exchanges around the world in 44 language editions.

Next, we use price data for 67 commodities extracted from the World Bank Commodity prices Data database (<http://www.worldbank.org/commodities>). The World Bank's commodity total price index is composed of energy and non-energy prices (excluding precious metals), weighted by their share in 2002-04 exports. These data include the price of energy commodities, non-energy commodities, fertilizers, metals and minerals and precious metals. This database provides monthly data collected over several databases such as Bloomberg, Food and Agriculture Organization of the United Nations, International Energy Agency, World Bank, and World Food Programme.

⁷ While the EPU index is appropriate for our study and has the added advantage of providing an original first approach to estimating uncertainty levels and a comparison between countries and major economic and geopolitical events (such as the war in Ukraine), it does have a few limitations. The main limitation of the EPU index lies in the selection of the media used, which could bias the measurement of uncertainty.

⁸ One of the limitations of the Investing database is the problem of missing data, particularly for analyses requiring daily data. However, we are less concerned by this phenomenon since our analyses are carried out on a monthly basis.

In our analysis, we proceed in two stages. First, we investigate the relationship between war and uncertainty. Second, we investigate how rising uncertainties affect stock market performance and commodity prices during the war. For these analyses, we use a panel analysis with fixed effects. In doing so, we estimate the following model:

$$Uncertainty_{c,m} = c + \alpha_1 War_m + \theta_m + \lambda_c + \varepsilon_{c,m} \quad (1)$$

where $Uncertainty_{c,m}$ refers to our measure of uncertainty in country c in month m . As previously presented, we use the EPU as a measure of uncertainty. War_m refers to the Russia-Ukraine War Economic Sanctions News Sentiment Index (RUWESsent) in month m . In the second step of our analysis, we then investigate how uncertainties affect stock market performance and commodity prices. To do this, we estimate the following model:

$$Y_{c,m} = c + \alpha_1 Uncertainty_{c,m} + \theta_m + \lambda_c + \varepsilon_{c,m} \quad (2)$$

where $Y_{c,m}$ refers alternately to our measures of stock market performance and commodity prices. For stock market performance, we use the monthly log return of country c 's stock market index in month m . Similarly, for commodities we use the natural logarithm of commodity prices in month m . $Uncertainty_{c,m}$ refers to our measure of uncertainty in country c in month m . Uncertainty as people's inability to forecast the likelihood of events happening in the future, implies multiple changes or behaviors when confronted to the economic environment. Uncertainty could lead to a change or delay of important business and economic decisions, such as employment, investment, consumption, and

saving decisions. It could also raise some tensions on supply and demand by increasing financing and production, intensifying disinvestment and economic contraction (Arouri et al., 2016). Furthermore, uncertainty leads to panic over financial markets materialized by excess volatility of stocks returns (Pástor and Veronesi, 2012; Liu and Zhang, 2015; Wang and Boatwright, 2019).

In our estimates, we control for changes in level for each month by including time fixed effects, θ_m . The inclusion of time fixed effects in our estimates allows us to control for variables that are constant between entities but vary over time. Otherwise, time fixed effects allow us to capture the overall trend. Country fixed effects, λ_c , are also included to absorb the different fixed and time-invariant levels of search intensities across countries. Otherwise, we include country fixed effects because stock market performance varies from country to country and changes from year to year.

Overall, based on the analysis of Shen and Hong (2023), we suspect that the war in Ukraine will induce a rise in uncertainty. This rise in uncertainty should in turn affect stock market performance and commodity prices, given the positions occupied by Ukraine and Russia on the global commodities market.

3.2. Empirical findings

In this section, we present the results of our analysis. First, we show the results of the relationship between war and uncertainty (Table 1). Next, we investigate

how uncertainties affect stock market performance (Table 2) and how this varies from region to region (Table 3), and over time (Table 4). We complete our analysis by investigating the impact of uncertainty on commodity prices during the war (Table 5). In addition, we examine how commodity prices fluctuate as a function of uncertainty, depending on the type of commodity (Table 6), and the persistence of war over time (Table 7).

3.2.1. Ukraine-Russia war and uncertainty

The results in Table 1 highlight a positive and significant relationship between war and uncertainties, irrespective of model specifications. The results in column II of Table 1 show that the war in Ukraine-Russia induces uncertainties of 0.98%. This result is consistent with the analysis of Al-Thaqeb and Algharabali (2019), who point out that wars induce high economic uncertainties. Indeed, more than a year after the invasion of Ukraine by Russian troops on February 24, 2022, uncertainties still hang over both the evolution of the conflict and post-war scenarios. The uncertainties associated with the war are all the greater in that the war has raised a number of (as yet) unanswered questions, reinforcing this climate of uncertainty. These include when will this conflict end? What will the post-war world look like? What will be the impact on geopolitics and the geo-economic order of the world?

Table 1. Ukraine-Russia war and uncertainty

	Uncertainty	
	(I)	(II)
Ukraine-Russia war	0.087***	0.983***
	[0.00]	[0.00]
Number of observations	1536	1536
Number of countries	96	96
Country fixed-effect	No	Yes
Month fixed-effect	Yes	Yes
R2 (within)	0.852	0.951

Notes: Uncertainty refers to the natural logarithm of economic policy uncertainty index. Ukraine-Russia war is the Russia-Ukraine War Economic Sanctions News Sentiment Index (RUWESsent). Robust standard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

3.2.2. Uncertainties and stock market performance during the war

The rising uncertainties induced by the war between Ukraine and Russia should also make it harder for investors to make decisions. In other words, these uncertainties are likely to affect the stock market performance of the world's financial markets (Bekaert et al., 2009; Brogaard and Detzel, 2015; Demir and Ersan, 2018; Brogaard et al., 2020; Gong et al., 2022). On this basis, we investigate the influence of rising uncertainties on stock market performance (Table 2). The results of this analysis are reported in Table 2 and highlight a negative and significant relationship between stock market performance and rising uncertainty during the war in Ukraine-Russia. As evidence of this, in column II of Table 2 we observe that a 1% rise in uncertainty leads to a 0.06% reduction in the stock market performance of world indices. This represents an underperformance of around 1.24% compared with the average trend of the indicators in the study over the period under review. This result highlights the global financial cost of the war in Ukraine-Russia, which is not limited to the borders of Ukraine and Russia (among others Boubaker et al. 2022; Boungou and Yatié, 2022).

Our results are consistent with those from Demir and Ersan (2018) who find that stock returns of the Turkish tourism companies depend on domestic and international economic uncertainty⁹. In that respect, an increase of Economic Policy Uncertainty in Europe and Turkey has significant negative effects on tourism index returns. Bekaert et al. (2009) also find that stock prices can fall precipitously on negative news as the conditional volatility increases. This in line with our analysis which assess the impact of a news-related index on global stock market.

This leads us to investigate the impact of rising uncertainties on stock market indices, according to region during the war. This analysis enables us to identify whether the exposure of stock market indices to the war is similar across regions. To do this, we grouped stock market indices around four regions: Europe, Asia, America and Africa. The results of this analysis are reported in Table 3.

Table 2. Uncertainty and stock market index

	Stock	
	(I)	(II)
Uncertainty	-0.044*** [0.01]	-0.059*** [0.01]
Number of observations	1534	1534
Number of countries	96	96
Country fixed-effect	No	Yes
Month fixed-effect	Yes	Yes
R2 (within)	0.079	0.005

Notes: Stock is the monthly log return of each stock market index. Uncertainty refers to the natural logarithm of the economic policy uncertainty index. Robust standard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

⁹ Brogaard et al. (2020) measured the impact of U.S. election cycle (a proxy of global political uncertainty) and find that on average, it leads to a fall in equity returns in fifty non-U.S. countries. Gong et al. (2022) find the same results and show the stocks used for their analysis are more sensitive by the U.S. elections than the elections in their home countries.

We continue to observe a negative relationship between uncertainty and stock market performance, disregarding localization during the war period. However, we note that the impact is much more pronounced for indices located in Europe and America. This result confirms the heterogeneity of stock market index responses to the war in Ukraine-Russia. The observed effect may be due to the fact that Westerners were the first to experience a negative shock to their economies (for instance, with the fall in share prices of several companies) following Russia's invasion of the Ukraine. Moreover, several European and American countries condemned the invasion from the outset, and responded positively to the sanctions against Russia. The exposure of these countries' stock indices may also stem from their geographical proximity to Russia/Ukraine (and/or historical ties), as well as their dependence on Russian and/or Ukrainian raw materials in particular. Similarly, Boubaker et al. (2022) find that overall, developed financial markets were more heavily and negatively impacted by the war than emerging markets (for instance, Asian markets were not impacted at all). In the same vein, Bounou and Yatié (2022), the indices of countries geographically close to the conflict have been the most impacted (negatively) by the war. This heterogeneity is explained by Ngo et al. (2022) and Liadze (2023) the fact that western, developed and democratic countries in favor of sanctions against Russia, have integrated the business disruptions from these sanctions (because of the proximity of Russia and Ukraine and Europe reliance on their energy and food supplies) leading to a drop of stocks price.

Table 3. Results by region

	Stock			
	Europe	Africa	Asia	America
Uncertainty	-0.052***	-0.006	-0.027	-0.103**
	[0.01]	[0.02]	[0.03]	[0.05]
Number of observations	560	336	399	224
Number of countries	35	21	25	14
Fixed-effect	Yes	Yes	Yes	Yes
R2 (within)	0.247	0.07	0.162	0.124

Notes: Stock is the monthly log return of each stock market index. Uncertainty refers to the natural logarithm of the economic policy uncertainty index. Robust standard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

We complete our analysis by examining whether stock market index responses to war-related uncertainties change as the armed conflict continues over time. To do this, we evaluate the evolution of responses quarter by quarter since the invasion. The results of our analysis are reported in Table 4 and show that the magnitude of responses varies from one trimester to the next. We observe an underperformance of stock market indices during the first quarter following the invasion of Ukraine. We also find a significant improvement in the stock market performance of global indices during the second quarter. However, rising uncertainties adversely affected stock market performance in the third and fourth quarters. The impact in the fourth quarter (one year after the invasion) is weaker. This result is consistent with that of Boungou and Yatié (2022), who also observe a drop in the intensity of stock market index responses to conflict a few weeks after the invasion. This undoubtedly reflects the decline in intensity of the conflict as a result of the various negotiations undertaken between the West and Russia to halt the conflict which consequently led to a decline of war-related uncertainties as shown by Figure 1¹⁰. Overall, the results of our analysis

¹⁰ This decline of war-related uncertainty could also be explained by a decline of interest about the war in media coverages.

show that uncertainty has a negative impact on stock market performance, and that these effects differ between continents as the conflict persists over time.

Table 4. The dynamics of stock market index responses

	Stock			
	The quarters after the invasion:			
	Q1	Q2	Q3	Q4
Uncertainty	-0.006 [0.03]	0.380*** [0.08]	-0.797** [0.33]	-0.037*** [0.01]
Number of observations	288	288	288	286
Number of countries	96	96	96	96
Fixed-effects	Yes	Yes	Yes	Yes
R2 (within)	0.123	0.222	0.257	0.025

Notes: Stock is the monthly logarithm return of each stock market index. Uncertainty refers to the natural logarithm of the economic policy uncertainty index. Robust standard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

3.2.3. Uncertainties and commodity prices during the war

International observers point out that the war in Ukraine-Russia increases inflationary pressures worldwide (Caldara et al., 2022, Sokhanvar and Bouri, 2023). According to data from the World Bank (<https://donnees.banquemondiale.org/indicateur/FP.CPI.TOTL.ZG>), global inflation levels have risen from 3.5% in 2021 to 8.3% in 2022, and this trend is set to continue into 2023. According to the IMF's April 2023 forecast, global inflation is set to remain at 7% in 2023. This is mainly due to the rise in agricultural and energy prices since the invasion of Ukraine by Russian troops in February 2022. Especially, Ukraine and Russia are key producers of these raw materials. The price increases were a representation of fears of disruption to imports from Russia and Ukraine. These general pressures on commodity prices (induced by the uncertainty about Russia and Ukraine imports) use three channels: substitution, production costs and government policies (World Bank, 2022).

First, an increase in price of one commodity, led to a substitution by another one. However, the possibilities of substitutions are low, so the price pressures from the first commodity are transferred to the other ones. Second, an increase in price of some commodities led to an increase of the production costs of others and consequently, their price. Finally, at the beginning of the war some governments used tax cuts or subsidies to tackle the price pressures. Nevertheless, these policies were temporarily efficient because they did not provide benefits to the most vulnerable parts of the population and push the demand up. In our analysis, we therefore assume that the uncertainties surrounding the military conflict, as well as those relating to discussions and Western sanctions, could lead to further fluctuations in commodity prices.

Table 5. Uncertainty and commodity prices

	Commodities	
	(I)	(II)
Uncertainty	2.460*** [0.49]	0.138*** [0.05]
Number of observations	1133	1133
Number of countries	67	67
Country fixed-effect	No	Yes
Month fixed-effect	Yes	Yes
R2 (within)	0.172	0.012

Notes: Commodities is the monthly natural logarithm of the commodity price. Uncertainty refers to the natural logarithm of the economic policy uncertainty index. Robust standard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

Against this background, we investigate the impact of uncertainty during the war on commodity prices. The results of this analysis are reported in Table 5. We observe a positive and significant relationship between uncertainty and commodity prices, irrespective of model specifications. The results in column II of Table 5 show that increasing uncertainties lead to a 0.14% increase in raw material prices. This represents an increase in raw material prices of almost 3%

for the entire sample. We complete our analysis by examining whether raw materials reacted similarly to uncertainty during the war. To do this, we classify commodities into three families according to the World Bank commodity prices data: energy, non-energy commodities and others. Energy commodities include coal, crude oil and natural gas.) Non-energy commodities include raw materials for agriculture, food (grains, oils, meals and other food), and raw materials. Finally, other raw materials include fertilizers, precious metals, base metals, metals and minerals.

Table 6. Results by type of commodities

	Commodities		
	Energy	Non Energy	Others
Uncertainty	8.337*** [2.22]	1.064*** [0.35]	3.266*** [1.04]
Number of observations	136	725	255
Number of countries	8	43	15
Fixed-effect	0.669	0.125	0.29
R2 (within)	0.043	0.001	0.003

Notes: Commodities is the monthly natural logarithm of the commodity price. Uncertainty refers to the natural logarithm of the economic policy uncertainty index. Energy refers to raw materials related to coal, crude oil and natural gas. Non energy refers to agricultural raw materials, food, raw materials and other raw materials. Others refers to fertilizers, metals and minerals, base metals and precious metals. Robust standard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

The results of this analysis are reported in Table 6. We continue to observe a positive and significant relationship between commodity prices and uncertainty. We also observe that the impact has been stronger for energy commodities, which is not very surprising given Russia's place in global energy production. In the same vein, Umar et al. (2022) observe a negative impact of the war on energy and metal markets. Lo et al. (2022) also point out that the

negative shock of war to financial markets increases with dependence on Russian raw material fuels¹¹.

Furthermore, we examine how the impact of uncertainty on commodity prices varies as the conflict persists over time. The results of this analysis are shown in Table 7.

Table 7. The dynamics of commodity price responses

	Commodities			
	The quarters after the invasion:			
	Q1	Q2	Q3	Q4
Uncertainty	0.447*** [0.14]	-0.389*** [0.09]	-0.054 [0.04]	-0.112*** [0.03]
Number of observations	201	199	198	200
Number of countries	67	67	66	67
Fixed-effects	Yes	Yes	Yes	Yes
R2 (within)	0.166	0.095	0.013	0.156

Notes: Stock is the monthly logarithm return of each stock market index. Uncertainty refers to the natural logarithm of the economic policy uncertainty index. Robust standard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

We observe that the rise in uncertainties during the war leads to an increase in raw material prices in the first quarter after the invasion. However, this impact is reversed from the second quarter onwards, and tends to diminish quarter after quarter. In so doing, we provide the first empirical evidence of the impact of the uncertainties associated with the war in Ukraine on commodity price fluctuations. We also observe that these effects differ according to the commodity and the longer the war lasts.

4. Conclusion

In this paper, we analyze the influence of the Ukraine-Russia war on uncertainties and how this affects stock market performance and commodity

¹¹ Fang and Shao (2022) find also that the intensification of the Russia-Ukraine conflict significantly increases the volatility of agricultural, metal, and energy markets.

prices worldwide. Precisely, we construct a conceptual framework to recall the relationship between investor' sentiment (assessed by a new index: "RUWESent") and uncertainty and how the late one impacts financial markets. Furthermore, we empirically answer to the following questions:

1. Does the Ukraine-Russia war induce uncertainties?

We observed that Ukraine-Russia war induces uncertainties which is consistent with some analysis that point out the high economic uncertainties induced by wars (Al-Thaqeb and Algharabali, 2019). These uncertainties are built-up by investors sentiments about the duration of the war, its impact on world trade and the future geopolitics and/or geo-economic order.

2. Do war-induced uncertainties impact stock market performance?

We noticed a negative and significant relationship between stock market performance and rising uncertainty during the war in Ukraine-Russia. A 1% rise in uncertainty leads to a 0.06% reduction in the stock market performance of world indices. This war has a global financial cost which is not restricted to the borders of Ukraine and Russia. Moreover, these rising uncertainties have a different impact depending on the geographical origin of the stock. The negative impact of uncertainty is much more pronounced for indices located in Europe and America. This result shows the heterogeneity of stock market index responses to the war in Ukraine-Russia and are consistent with those from Boubaker et al. (2022) and Boungou and Yatié (2022).

3. Do war-induced uncertainties impact commodity prices?

We empirically observed a positive and significant relationship between uncertainty and commodity prices. An increasing uncertainty of 1% leads to a 0.14% increase in raw material prices, i.e. an increase in raw material prices of almost 3%. We complete our analysis by examining whether raw materials reacted similarly to uncertainty during the war. Moreover, we noticed that this reaction has been stronger for energy commodities compared to metal commodities. Furthermore, we showed that the rise in uncertainties leads to an increase in raw material prices in the first quarter after the invasion and this impact is reversed from the second quarter onwards, and tends to diminish quarter after quarter.

The results of this analysis highlight policy recommendations for policymakers and investors. For policy-makers, it is a reminder that all peace-building initiatives are useful to boost confidence in the future (especially for investors), and that it is necessary to reduce countries' dependence on certain raw materials. On the investor side, this study could be used as an informative view of how financial markets react to war-related uncertainty. This should lead to less panic on financial markets, especially as the impact tends to be weaker the longer the war persists.

As avenues for future research, it might be interesting to extend our study by examining: (i) the impact of war-related uncertainties on the crypto-asset market; (ii) stock market index responses to war-related cyber-attacks; (iii) the impact of war-induced economic uncertainties on socio-economic factors (such as income inequality and the environment).

References

- Abakah E.J.A., Adeabah D., Tiwari A.K., Abdullah M., 2023. Effect of Russia-Ukraine war sentiment on blockchain and FinTech stocks. *International Review of Financial Analysis*, 90, 102948.
- Abay K., Breisinger C., Glauber J., Kurdi S., Laborde D., Siddig K., 2023. The Russia-Ukraine war: Implications for global and regional food security and potential policy responses. *Global Food Security*, 36, 100675.
- Ahmed, S., Hasan, M.M., Kamal, M.R., 2023. Russia-Ukraine crisis: The effects on the European stock market. *European Financial Management* 29, 1078-1118.
- Al-Thaqeb S., Algharabali B., 2019. Economic policy uncertainty: A literature review. *The Journal of Economic Asymmetries*, 20, e00133.
- Arouri M., Estay C., Rault C., Roubaud D., 2016. Economic policy uncertainty and stock markets: Long-run evidence from the US. *Finance Research Letters*, 18, 136-141.
- Baker S., Bloom N., Davis S., 2016. Measuring Economic Policy Uncertainty. *The Quarterly Journal of Economics*, 131 (4), 1593-1636.
- Bank of England. (2022). Monetary and financial stability and the invasion of Ukraine – speech by Jon Cunliffe.

- Bekaert G., Engstrom E., Xing Y., 2009. Risk, uncertainty, and asset prices. *Journal of Financial Economics*, 91(1), 59–82.
- Boubaker S., Goodell J., Pandey D., Kumari V., 2022. Heterogeneous impacts of wars on global equity markets: Evidence from the invasion of Ukraine. *Finance Research Letters*, 48, 102934.
- Boungou W., Yatié A., 2022. The impact of the Ukraine–Russia war on world stock market returns. *Economics Letters*, 15, 110516.
- Brogaard J., Dai L., Ngo P.T., Zhang B., 2020. Global political uncertainty and asset prices. *The Review of Financial Studies*, 33, 1737–1780.
- Brogaard J., Detzel A., 2015. The Asset-Pricing Implications of Government Economic Policy Uncertainty. *Management Science*, 61, 3–18.
- Caldara D., Conlisk S., Iacoviello M., Penn M., 2022. The Effect of the War in Ukraine on Global Activity and Inflation. *Federal Reserve Notes*.
- Castelnuovo E., Lim G., Pellegrino G., 2017. A Short Review of the Recent Literature on Uncertainty. *Australian Economic Review*, 50, 68–78.
- Chen S., Bouteska A., Sharif T., Abedin M., 2023. The Russia–Ukraine war and energy market volatility: A novel application of the volatility ratio in the context of natural gas. *Resources Policy*, 85.
- Demir E., Ersan O., 2018. The impact of economic policy uncertainty on stock returns of Turkish tourism companies. *Current Issues in Tourism*, 21(8), 847–855.
- Fang Y., Shao Z., 2022. The Russia-Ukraine conflict and volatility risk of commodity markets. *Finance Research Letters*, 50, 103264.

- FAO, 2022. The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine. Information Note.
- Gong X., Fu C., Huang Q., Lin M., 2022. International political uncertainty and climate risk in the stock market. *Journal of International Financial Markets, Institutions and Money*, 81, 101683.
- Granát M., Lehmann K., Nagy O., Neszveda G., 2023. Expect the unexpected: Did the equity markets anticipate the Russo-Ukrainian war? *Finance Research Letters*, 58, 104301.
- Huiwen Z., Sun L., 2012. The Influence of Investor Sentiment on Stock Return and Its Volatility under Different Market States. *Fifth International Conference of Business Intelligence and Financial Engineering BIFE*, Lanzhou, 18-21 August 2012, pp. 337-341.
- Karabulut, G., Bilgin, M.H., Doker, A.C., 2020. The relationship between commodity prices and world trade uncertainty. *Economic Analysis and Policy*, 66, 276-281.
- Knight F. H., 1921. Risk, Uncertainty, and Profit. *Hart, Schaffner & Marx, Houghton Mifflin Company*, Boston, Massachusetts
- Krishnan K. M., Satish R., 2016. Investors Sentiments to Mergers Announcement Stock Market Reaction. *International Journal of Applied Engineering Research*, 11, 1266-1272.

- Liadze I., Macchiarelli C., Mortimer-Lee P., Juanino S. (2022). The Economic Costs of the Russia- Ukraine Conflict. *National Institute of Economic and Social Research*, 32.
- Liadze, I., Macchiarelli, C., Mortimer-Lee, P., Sanchez Juanino, P., 2023. Economic costs of the Russia-Ukraine war. *The World Economy*, 46, 874–886.
- Ling D. C., Naranjo A., Scheick B., 2014. Investor Sentiment, Limits to Arbitrage and Private Market Returns. *Real Estate Economics*, 42, 531-577.
- Liu L., Zhang T., 2015. Economic policy uncertainty and stock market volatility. *Finance Research Letters*, 15, 99–105.
- Lo G.-D., Marcelin I., Bassène T., Sène B., 2022. The Russo-Ukrainian war and financial markets: the role of dependence on Russian commodities. *Finance Research Letters*, 50, 103194.
- Luu Duc Huynh T., 2020. The effect of uncertainty on the precious metals market: New insights from Transfer Entropy and Neural Network VAR. *Resources Policy*, 66, 101623.
- Ngo, V.M., Huynh, T.L.D., Nguyen, P.V., Nguyen, H.H., 2022. Public sentiment towards economic sanctions in the Russia–Ukraine war. *Scottish Journal of Political Economy*, 69, 564–573.
- Noguera-Santaella J., 2016. Geopolitics and the oil price. *Economic Modelling*, 52.
- OECD, 2022. The impacts and policy implications of Russia’s aggression against Ukraine on agricultural markets. *OECD Policy Responses on the Impacts of the War in Ukraine*.

- Pandey K., Kumari V., Palma A., Goodell J., 2023. Are markets in happier countries less affected by tragic events? Evidence from market reaction to the Israel-Hamas conflict. *Finance Research Letters*, 104893, forthcoming.
- Pástor L., Veronesi P., 2012. Uncertainty about Government Policy and Stock Prices. *The Journal of Finance*, 67, 1219–1264.
- Ph, H., Uchil, R., n.d. Conceptual framework on market factors affecting investor's sentiments and the effect of behavioral pitfalls on investment decision making. *IOSR Journal of Economics and Finance*.
- Quaye I., Mu Y., Abudu B., Agyare R., 2016. Review of Stock Markets' Reaction to New Events: Evidence from Brexit. *Journal of Financial Risk Management*, 05, 281–314.
- Rehman M. U., 2013. Investor's Sentiments and Stock Market Volatility: An Empirical Evidence from Emerging Stock Market. *Pakistan Journal of Commerce and Social Sciences*, 7, 80-90.
- Rose, A., Chen, Z., Wei, D., 2023. The economic impacts of Russia–Ukraine War export disruptions of grain commodities. *Applied Economic Perspectives and Policy*, 45, 645–665.
- Ruan Q., Yang H., Lv D., Zhang S., 2018. Cross-correlations between individual investor sentiment and Chinese stock market return: New perspective based on MF-DCCA. *Physica A: Statistical Mechanics and Its Applications*, 503, 243–256.

- Shen L., Hong Y., 2023. Can geopolitical risks excite Germany economic policy uncertainty: Rethinking in the context of the Russia-Ukraine conflict. *Finance Research Letters*, 51, 103420.
- Smales A., 2020. Examining the relationship between policy uncertainty and market uncertainty across the G7. *International Review of Financial Analysis*, 71, 101540.
- Sokhanvar A., Bouri E., 2023. Commodity Price Shocks Related to the War in Ukraine and Exchange Rates of Commodity Exporters and Importers. *Borsa Istanbul Review* 23(1):44-54.
- Su Z., Fang T., Yin L., 2019. Understanding stock market volatility: What is the role of U.S. uncertainty? *The North American Journal of Economics and Finance*, 48, 582-590.
- Tong, E., 2024. Repercussions of the Russia-Ukraine war. *International Review of Economics & Finance*, 89, 366-390.
- Umar M., Riaz Y., Youssaf I., 2022. Impact of Russian-Ukraine war on clean energy, conventional energy, and metal markets: Evidence from event study approach. *Ressources Policy*, 79, 102966.
- Umar Z., Polat O., Choi S.-Y., Teplova T., 2022. The impact of the Russia-Ukraine conflict on the connectedness of financial markets. *Finance Research Letters*, 48, 102976.
- Wang H., Boatwright A.L., 2019. Political uncertainty and financial market reactions: A new test. *International Economics*, 160, 14-30.

- Wang Y. M., Li C. A., Lin C. F., 2009. The Impact of Investor Sentiment on the Futures Market: Evidence from the Taiwan Futures Exchange. *International Research Journal of Finance and Economics*, 29, 134-151.
- World Bank, 2022. Commodity Markets Outlook, April 2022: The Impact of the war in Ukraine on Commodity Markets.
- World Bank, 2023. Commodity Markets Outlook, October 2023: Under the Shadow of Geopolitical Risks.
- Yin L., Han L., 2014. Macroeconomic uncertainty: does it matter for commodity prices? *Applied Economics Letters*, 21, 711-716.
- Yotzov I., Thwaites G., Mizen P., Bunn P., Bloom N., Anayi L., 2022. The impact of the war in Ukraine on economic uncertainty. *CEPR*.
- Zhang Z., Zhang Y., Shen D., Zhang W., 2018. The Dynamic Cross-Correlations between Mass Media News, New Media News, and Stock Returns. *Complexity*, 2018. Scopus.
- Zheng Y., 2015. The Linkage between Aggregate Investor Sentiment and Metal Futures Returns: A Nonlinear Approach. *The Quarterly Review of Economics and Finance*, 58, 128-142.
- Zhou H., Lu X., 2023. Investor attention on the Russia-Ukraine conflict and stock market volatility: Evidence from China. *Finance Research Letters*, 52, 103526.