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# Role of Energy Policy in Shaping German-Russian Relations through Economic Policy Uncertainties: Insights from the Russo-Ukrainian War

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## Abstract

We shed light on the German-Russian relationship, focusing on the complexities that underlie their economic policy uncertainties over the period 1994–2023. We start with static unconditional correlation and dynamic conditional correlation analyses to examine the strength and temporal variations in the correlation between economic policy uncertainties of these two major countries. We then utilize standard and time-varying Granger causality analysis to uncover causal relationships. Importantly, we use a novel energy policy uncertainty index for Germany to explore interconnections between economic and energy policy uncertainties. We emphasize the importance of incorporating energy policy uncertainty in economic policy decision-making and international cooperation.

**Keywords:** Economic policy uncertainty, Russo-Ukrainian War, energy policy, correlation, causality

**JEL Classification:** D80, N40, Q43, Q48

## 1. Introduction

German-Russian relations are characterized by complexity and volatility, reflecting broader European trends since the 19<sup>th</sup> century. The transition from world wars to cooperative frameworks in the 21<sup>st</sup> century, including the influence of European Union (EU) energy policy, the Russo-Ukrainian War, the shale gas revolution and the emergence of the liquefied natural gas (LNG) market, has led to significant volatility. Energy became a political weapon after 2014 and the Russo-Ukrainian War in early 2022 further disrupted trade, leading to an EU- and US-led embargo on Russian petroleum products and the cessation of German technology support for Russia. These policy measures have had a significant economic impact, highlighting the complicated nature of their interactions. Historical analyses of German-Russian relations offer different conclusions, with some seeing Germany as the weaker side and others emphasizing Russia's weakness. Given the changing nature of international relations, it is important to reconsider these perspectives.

Bilateral relations are inherently uncertain, characterized by complex interactions and historical roots (Saunders, 2005). Within the EU, Germany, as a prominent member, is obligated to comply with the Union directives. Of notable significance is the Energy Union framework, which rests upon a robust energy policy framework comprising five interconnected dimensions: energy security, solidarity and trust, the internal energy market, energy efficiency as a mechanism to temper energy demand, decarbonization of the economy, and fostering research, innovation and competitiveness. As these policies take form, the task of simultaneously nurturing relations with Russia presents formidable challenges. On the other hand, Germany's standing as a North Atlantic Treaty Organization (NATO) member country engenders commitments, particularly to partners such as the United States. NATO's identification of Russia as a potential threat inevitably exerts influence on Germany's policy stances. Russia's substantial size, characterized by an authoritarian regime divergent from EU norms, and its ambitions of establishing a sphere of influence reminiscent of the Soviet Empire under Putin's leadership, further complicate matters. Notably anti-NATO, Russia's territorial expansions encompass Georgia and Ukraine, while its economy is highly dependent on oil and petroleum products, rendering oil a pivotal geopolitical factor. Given the multi-faceted burdens that both countries have to bear, it is clear that this relationship harbours substantial inherent risks and uncertainties, which are particularly evident in the determination of economic policy.

Against this backdrop, researchers are increasingly interested in the links between economic policy uncertainty (EPU) and various economic factors. The EPU index developed by Baker *et al.* (2016) is often used to study uncertainty<sup>1</sup>. However, there are few studies on the interac-

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1 See, *e.g.*, Al-Thaqeb and Algharabali (2019) and Dokas *et al.* (2023) for a comprehensive review of literature on EPU and the use of EPU index.

tion between German and Russian uncertainty. Notable studies such as Shen and Hong (2023) and Sweidan (2023) have examined the influence of geopolitical risks on EPU and emphasized the potential of one country's EPU to affect the other country and create a dynamic feedback loop. More recent studies have followed different index-based approaches. For instance, Grebe *et al.* (2024) used a high frequency Twitter-based uncertainty indicator, which is closely-correlated with Germany's EPU, revealing that uncertainty about the war has strong economic effects. Naboka-Krell (2024) constructed alternative EPU indices for Germany, Russia and Ukraine using multilingual text representations, showing that these indices are Granger-causal to economic activity. In the present study, we use static and dynamic correlation analysis as well as Granger causality tests to investigate the mutual impact of EPU between Germany and Russia from 1994 to 2023. We introduce an index of energy policy uncertainty in Germany (Azqueta-Gavaldón *et al.*, 2023) to investigate possible relationships between economic and energy policy uncertainties. The rationale is that fluctuations in German energy policy can significantly affect the economic policy landscape and have spillover effects on Russia's EPU, which is consistent with the broader dynamics of global energy markets and geopolitical interdependence.

This study has the following contributions. Firstly, it addresses a research gap in the relatively unexplored territory of bilateral economic policy uncertainties between two major countries, Germany and Russia. While there is existing research into EPU and geopolitical risks, this study uniquely focuses on how EPU in one country can affect the other due to the bilateral nature of their relationship. Secondly, this study elucidates the asymmetric influence between Germany and Russia in terms of economic policy uncertainties, shedding light on the periods when policy changes in one country significantly affect the other. Therefore, it provides a basis for discussing how geopolitical tensions, especially in the specific context of the Russo-Ukrainian War, introduce uncertainty and unpredictability into the relationship between countries, affecting economic policy (Boungou and Yatié, 2024). Thirdly, this study follows an innovative approach to understanding the bilateral dynamics of economic policy uncertainties between Germany and Russia, incorporating historical context and employing time-varying Granger causality analysis to capture the evolving nature of their relationship. This approach can be adapted for similar studies involving other countries and bilateral economic interactions. Fourthly, this study underscores the critical contribution of energy policy changes in driving economic policy uncertainties among countries, highlighting that EPU spillovers are primarily rooted in the subtleties of energy policy dynamics.

The rest of the paper is organized as follows: Section 2 provides an overview of German-Russian relations over the last fifty years. Section 3 explains the data and methodology. Section 4 presents the empirical results and the discussion. Section 5 wraps up with a conclusion.

## 2. Development of German-Russian Relations

Economic relations between Germany and Russia, which focus primarily on energy trade, began in 1970. In the first decades, gas trade was embedded in broader relations characterized by détente, trust and economic interdependence. This was in line with the strategy of Germany's Ostpolitik, which emphasized "change through compromise" and mutual benefit (Högselius, 2013). The USA, a NATO ally, was opposed to these relations from the outset. The relationship benefited both countries: Russia (formerly the USSR) received important technologies and foreign currency, while Germany (formerly the FRG) benefited from favourable gas prices and a growing market for its manufacturers. The agreement regulated price and volume risks and promoted stability through political and economic convergence. After the reunification of Germany and the dissolution of the Soviet Union, a strategic partnership was formed in the early 1990s under the paradigm of "rapprochement through interdependence".

The "special relationship", as defined by Timmins (2011), existing between the two countries flourished in the aftermath of the Cold War. Germany's entry into the Eurozone in 1999 coincided with a period of deepening economic and political cooperation between Russia and the EU, which is reflected in the EU's broader strategy towards Russia. The EU's 1999 Common Strategy on Russia, which aimed to integrate Russia into a common European economic and social space, emphasized a cooperative relationship that was crucial for both security and prosperity in Europe. For Germany, this period marked a continuation of its important role within the EU, which was now reinforced by the stability and economic strength of the Eurozone. As a key player in shaping EU policy, Germany's relationship with Russia was embedded in this broader EU context of engagement and integration. The economic foundation of the Eurozone allowed Germany to approach its relationship with Russia with greater economic confidence, reinforcing the EU's strategy of promoting stability and security through closer ties with Moscow (Szabo, 2014).

The 21<sup>st</sup> century brought with it considerable uncertainties and risks due to globalization, regulatory changes and geopolitical tensions. Germany continued to focus on trade, while Russia sought geopolitical influence. With the enlargement of the EU in 2004 to include Central and Eastern European countries, many of which had a historically suspicious attitude towards Russia due to their past under the Soviet influence, Germany was confronted with a more complex and cautious EU landscape. Under the leadership of Chancellor Angela Merkel, Germany had to navigate this new dynamic, balancing its historically strong economic ties with Russia against the growing concerns of the new member states. This shift required Germany to rethink its approach to Russia, taking into account the increased caution and strategic interests of its new EU partners (Timmins, 2011). Key events such as the EU's energy transition policy, Russia's annexation of Crimea, the shale gas revolution and Russia's military actions in Ukraine further

complicated relations (Westphal, 2020; Romanova, 2016). The German energy transition, which is characterized by an ambitious climate and energy policy, has further unsettled relations with Russia. Policies aimed at reducing greenhouse gas emissions and increasing the share of renewable energy highlighted the instability of fossil fuel dependency (Westphal, 2020). Meanwhile, Russia focused on long-term contracts and strategic investments in its hydrocarbon sector (Bundesregierung, 2016). The annexation of Crimea in 2014 and subsequent EU regulatory changes prompted Germany to emphasize energy security and diversification (Bryza, 2014). This was not surprising because a study on German firms revealed substantial negative effects of EU sanctions following the annexation on both the extensive and intensive margins of exports to Russia, particularly for firms exporting products subject to trade restrictions (Görg *et al.*, 2023). The launch of the Nord Stream 2 pipeline and US sanctions further increased uncertainty (Goldthau and Sitter, 2020; Lang and Westphal, 2016). Germany's shift from interdependence to asymmetric dependence and Russia's development of new markets, particularly in the Far East, reflected their evolving strategies (Yafimava, 2011). Global developments, such as the shale oil revolution in the USA and the rise of the LNG trade, have transformed the gas market from a producer-oriented to a buyer-oriented market. The influx of LNG intensified competition and weakened Russia's negotiating position. German energy policy shifted to climate-centred goals and reduced dependence on Russian gas (Lohmann, 2006).

The war in Ukraine in 2022 dramatically disrupted German-Russian trade relations and led to an almost complete breakdown. The USA banned Russian oil and gas imports, which led to Russian sanctions. The state-owned Russian energy corporation Gazprom cut gas supplies to Europe, which further exacerbated tensions. Europe's increased LNG imports and strategic interventions aimed to defuse the crisis, but uncertainty over winter supply dynamics remained (Deb and Rajendran, 2022; Simpson *et al.*, 2016; Trading Economics, 2023; European Commission, 2022). Russia's challenges included the sale of natural gas amid sanctions and the development of Arctic fields. The "Power of Siberia" pipeline projects aimed to close the gaps with China, although price differentials reduced Russia's revenues (Kutcherov *et al.*, 2020; Eiterjord, 2022; Tsafos, 2022).

To summarize, the evolving energy landscape and geopolitical dynamics have significantly deepened the complexity of German-Russian relations. Understanding the role of the economic and energy policy uncertainty is crucial to understanding their complicated relationship.

### 3. Data and Methodology

#### 3.1 Data

Economic policy uncertainties of Germany and Russia are proxied by the respective EPU indices, which are retrieved as monthly series from <https://www.policyuncertainty.com/>. Both indices are

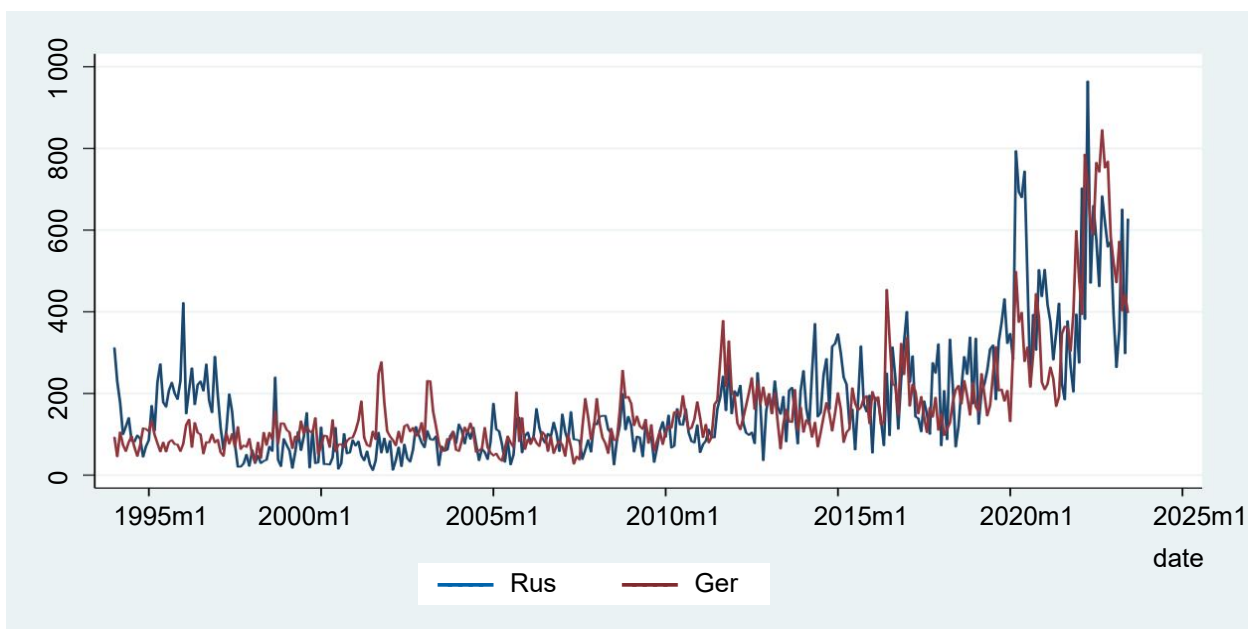
compiled using a similar methodological approach that was originally developed for the US EPU index (Baker *et al.*, 2016). This method involves counting the frequency of certain terms related to EPU, such as “uncertain” or “uncertainty”, in combination with economic or policy-related terms such as “economy”, “politics”, “taxes”, “spending”, “regulation”, “central bank” and “law” in newspaper articles. These frequency counts are then scaled against the total number of articles published in the same newspaper and in the same month to account for variations in the size or frequency of publications. To facilitate comparison, both indices are normalized to a mean value of 100 during a specific base period – before 2012 for Russia and before 2011 for Germany – which allows a better understanding of fluctuations over time in each country. In addition, both indices are updated monthly, with slight corrections possible for the previous two months due to delayed updates in the online newspaper archives. However, the two indices have some significant differences in their construction. The Russian EPU index is based exclusively on articles from the newspaper Kommersant, a prominent source of economic and political news in Russia, while the German index draws on two major national newspapers, Handelsblatt and Frankfurter Allgemeine Zeitung, providing a broader perspective on German media coverage. Note that Naboka-Krell (2024) obtained articles from Der Spiegel for Germany and from Lenta.ru for Russia to construct EPU indices. The Russian index is currently in a “beta” stage, suggesting that it can be further refined in the future, *e.g.*, by including additional newspapers, while the German index is part of a more established and standardized process that includes similar indices for other major European countries. In addition, the Russian EPU index includes specific indicators that map newspapers’ attention to major historical events in Russia, such as the Ukraine conflict, while the German index focuses exclusively on broader policy-related uncertainty without event-specific indicators. As the German index draws on several newspapers, standardization across these sources is required. The monthly newspaper series are normalized before being averaged to create the country-level index – a process that is not required for the single-source Russian index. Finally, the starting year of the German EPU index is 1993, while the Russian EPU index starts with 1994.

In Figure 1 below, we first present the EPU indices of the two countries for a brief visual inspection during the entire observation period 1994–2023.

Figure 1 shows that the Russian EPU index initially exhibits higher volatility and more frequent fluctuations in the late 1990s and early 2000s. This could be due to Russia’s economic instability and major political events such as the 1998 financial crisis. During this period, the German EPU index remains relatively stable and shows less volatility, indicating a more stable economic and political environment. In particular, the integration into the Eurozone in 1999 could be seen as a stabilizing factor for the German economy and may have contributed to a lower level of EPU (Clausen *et al.*, 2019). The economic policy measures associated with the Eurozone, such as fiscal rules and the monetary policy managed by the ECB, are likely to have provided a more predictable

economic environment. However, following the enlargement of the EU to include new member states in 2004, there appears to be a slight increase in the German EPU index. This could be interpreted as a result of uncertainties related to the integration of these new members, many of which were former Eastern Bloc countries with different economic conditions. The enlargement likely brought new challenges and uncertainties related to economic policy, labour markets and trade relations within the EU, which may have influenced the EPU in Germany (Vaughan-Whitehead, 2003). The shifting dynamics of energy supply and demand, particularly in the context of increasing reliance on Russian energy imports, likely played a role in shaping economic policy uncertainties during this period.

**Figure 1: German and Russian EPU indices**



Note: This figure demonstrates the EPU indices of Germany (GER) and Russia (RUS) over the entire period 1994M1–2023M6.

Source: Authors' own estimations and calculations

Figure 1 also demonstrates that with the escalation of global geopolitical tensions in the 2010s, especially after the annexation of Crimea in 2014 and the subsequent imposition of international sanctions on Russia, the EPU indices for both countries experience a sharp increase in uncertainty (Naboka-Krell, 2024). This trend, with numerous patterns of spikes, becomes even more pronounced during the COVID-19 pandemic and the Russo-Ukrainian War. This resulted in an asynchronous growth of the EPU indices, in which the disrupted trade relations, particularly due to the energy sanctions, appear to have led to a stronger increase in EPU in Germany compared to Russia.

Next, Table 1 presents the descriptive statistics for the two indices, which allow a more detailed analysis of the sub-periods for COVID-19 and the Russo-Ukrainian War.

**Table 1: Descriptive statistics**

	1994M1–2023M6		1994M1–2019M12		2020M1–2022M1		2022M2–2023M6	
	GER	RUS	GER	RUS	GER	RUS	GER	RUS
<b>Mean</b>	162.88	173.03	125.94	134.12	320.44	406.65	609.24	543.58
<b>Med.</b>	120.00	123.61	110.50	109.46	304.00	377.25	589.00	571.86
<b>Max.</b>	845.00	964.14	454.00	431.25	598.00	793.64	845.00	964.14
<b>Min.</b>	28.00	12.40	28.00	12.40	132.00	185.33	394.00	264.41
<b>Std. dev.</b>	133.92	147.41	62.66	86.29	112.07	169.43	153.11	175.94
<b>Skew.</b>	2.63	2.00	1.44	0.99	0.51	0.89	−0.07	0.40
<b>Kurt.</b>	10.91	7.97	6.22	3.51	2.87	2.92	1.61	3.11
<b>Jarque–Bera</b>	1,331.00	600.50	242.40	53.81	1.11	3.28	1.39	0.45
<b>Prob.</b>	0.00	0.00	0.00	0.00	0.57	0.19	0.50	0.80
<b>Obs.</b>	354	354	312	312	25	25	17	17

Notes: This table presents descriptive statistics for EPU indices of Germany (GER) and Russia (RUS). The full sample period encompasses the period 1994M1–2023M6. We split this period into three sub-periods 1994M1–2019M12 (before COVID-19), 2020M1–2022M1 (COVID-19 period) and 2022M2–2023M6 (Russo-Ukrainian War period).

Source: Authors' own calculations

Table 1 confirms Figure 1 by suggesting that, on average, the EPU in Germany appears to be lower than in Russia over the entire period under review. However, the EPU indices seem to exhibit distinct patterns across the different time periods. Notably, while the mean and median levels of the EPU before COVID-19 are similar to their overall levels throughout the study period, they appear to increase significantly – doubling or even quadrupling – during the COVID-19 and Russo-Ukrainian War periods. The highest EPU values and the strongest fluctuations seem to occur during the Russo-Ukrainian War. This period might have led to greater EPU in Germany, likely due to the country's strong dependence on Russian energy imports, particularly natural gas. The war and subsequent sanctions appear to have disrupted energy supplies, directly threatening Germany's energy security, industrial production and overall economic stability, which in turn seems to have caused a sharp rise in Germany's EPU (Grebe *et al.*, 2024; Shen and Hong, 2023; Xin and Zhang, 2023; Xiao, 2023). This finding is consistent with the expectations

of Liadze *et al.* (2023), in which Germany was projected to be the worst-affected EU country given its heavy reliance on Russian energy. In contrast, while Russia's EPU also increased during these times, the impact appears to have been relatively less dramatic. Russia's state control over key sectors and its ability to redirect energy exports to other markets, such as China, may have provided a buffer, allowing more controlled economic policy responses (Steinbach, 2023; Wen *et al.*, 2022). Consequently, although both countries experienced increased EPU, Germany's EPU seems to have been more profoundly affected, reflecting the country's need to rapidly adapt to a new geopolitical and economic reality.

Taken together, the Russo-Ukrainian War has triggered a severe energy crisis in Europe, largely due to the imposition of sanctions on Russian energy exports, which have disrupted long-standing trade relations between Russia and Germany. This disruption seems to have prompted Germany to not only rethink its energy policy but also reassess the broader implications of economic interdependence on national security (Xin and Zhang, 2023). The once reliable flow of energy resources from Russia appears to have been significantly curtailed, leaving Germany to grapple with what looks like an urgent need to diversify its energy sources and reduce its dependence on Russian imports. This apparent collapse in trade seems to have underlined the vulnerability of such dependencies and may have triggered a strategic shift in the way Germany approaches both its energy security and its economic relationship with Russia. These growing uncertainties and the geopolitical risks associated with the conflict likely altered the balance of power and negotiation dynamics between the two countries, pushing Germany towards alternative energy partners while compelling Russia to adjust its export strategies (Shen and Hong, 2023).

### 3.2 Methodology

Ongoing uncertainties have the potential to reshape German-Russian relations. The increased EPU in Germany and geopolitical tensions may lead to a more cautious and strategically diversified approach in Germany's energy and trade policies, potentially leading to a long-term reconfiguration of its relationship with Russia. On the other hand, our preliminary observations require further analysis to better understand the underlying dynamics between the EPU indices of Germany and Russia.

In this regard, our empirical analysis commences with an examination of both the static and dynamic correlation existing within the two indices under consideration. Concerning the dynamic aspect, we use the dynamic conditional correlation GARCH (DCC-GARCH) model, originally introduced by Engle (2002). This model is an extension of the constant conditional correlation GARCH model (Bollerslev, 1990) and allows us to examine how the correlation between the indices changes over time in response to new information and developments. In addition, the DCC-GARCH model accounts for heteroskedasticity by estimating the correlation coefficients

of the standardized residuals, as described by Chiang *et al.* (2007). Moving forward, we perform a standard Granger causality test and analyse the causality relationship between the EPU indices of Germany and Russia. We also use a time-varying Granger causality test recently introduced by Baum *et al.* (2022). This choice is underpinned by our utilization of a substantial historical dataset encompassing these indices. Such an extensive temporal span is expected to encompass structural shifts in their relationship, attributable to the evolving dynamics characterizing the interactions between the two countries.

We check for robustness by employing the time-varying Granger causality test of Rossi and Wang (2019). This additional step bolsters the reliability of our findings. Furthermore, we enhance the scope of our methodological approach by incorporating the dimension of energy policy uncertainty in Germany (Azqueta-Gavaldón *et al.*, 2023). This augmentation serves the purpose of investigating potential interrelations between EPU and energy policy uncertainty, contributing to a more comprehensive empirical framework for our analysis.

## 4. Results and Discussion

### 4.1 Correlation analysis

The outcomes of the static correlation analysis can be observed in Table 2.

**Table 2: Static correlation results**

	1994M1–2023M6	1994M1–2019M12	2020M1–2022M1	2022M2–2023M6
<b>Corr.</b>	0.72*	0.39*	0.15	0.18

Notes: This table shows the results of static correlation analysis for the EPU indices of Germany and Russia with respect to relevant sample periods. \* denotes statistical significance at the 1% level.

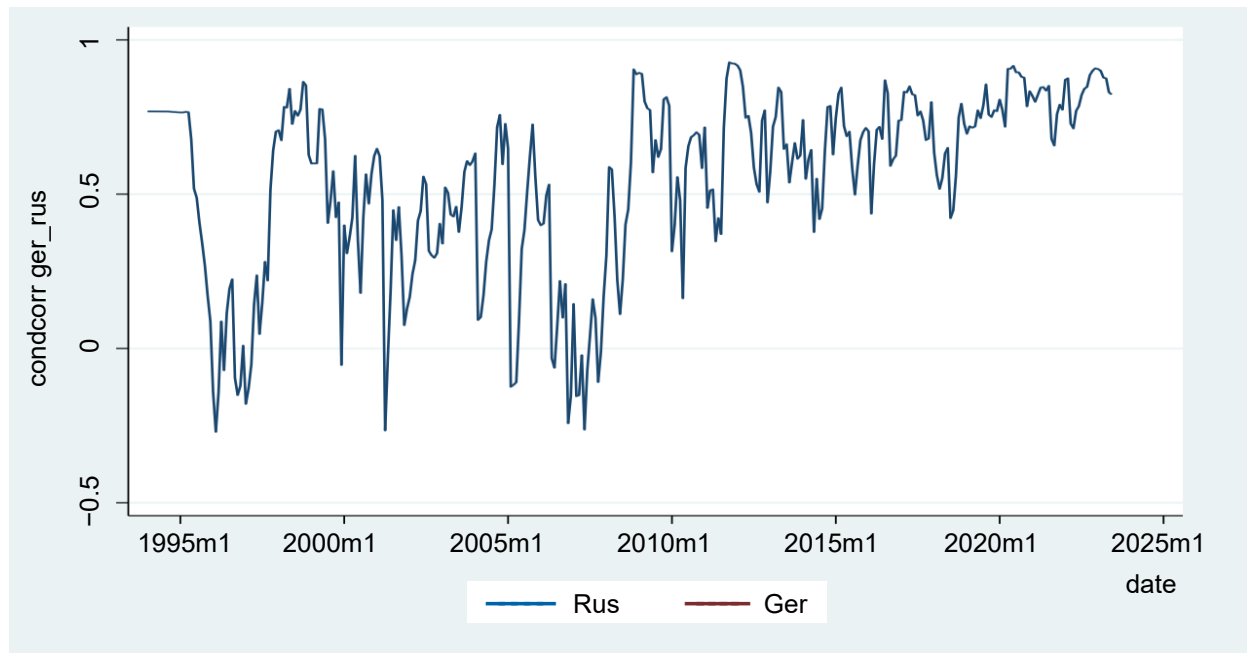
Source: Authors' own calculations

Table 2 reveals a positive correlation between the EPU indices of Germany and Russia throughout all the sample periods, albeit with varying strength. The correlation coefficient during the full sample period (1994M1–2023M6) stands at a statistically significant 0.72 (1% level), denoting a robust positive correlation across the entire timeframe. Prior to the COVID-19 era (1994M1–2019M12), the correlation coefficient rests at 0.39 (1% level), indicating a moderately positive correlation. However, during the COVID-19 period (2020M1–2022M1), the coefficient is 0.15, failing to reach statistical significance at the 1% level and suggesting a weaker correlation. Similarly, for the Russo-Ukrainian War period (2022M2–2023M6), the correlation coefficient is 0.18 (not statistically significant at the 1% level), indicating a subdued positive correlation amidst the conflict.

The declining correlations between the EPU indices of Germany and Russia across different sub-periods suggest an asynchronous growth in response to various economic and geopolitical shocks. In the era before COVID-19 (1994M1–2019M12), the moderate positive correlation between the EPU indices of Germany and Russia (correlation coefficient of 0.39) might have been driven by factors such as trade relationships, economic cooperation and global economic trends. Economic interdependencies and shared economic interests could have led to a certain level of alignment in policy uncertainty. However, the weaker positive correlation (correlation coefficient of 0.15) during the COVID-19 pandemic (2020M1–2022M1) suggests that both Germany and Russia experienced unique challenges and uncertainties in their respective economies. The pandemic had unique impacts on each country's economic environment and policy responses, which likely contributed to this reduced correlation. Germany's focus on export-oriented industries and its response to the pandemic could have differed from Russia's, leading to more asynchronous behaviour in their EPU indices. Similarly, the weak positive correlation (correlation coefficient of 0.18) during the Russo-Ukrainian War period (2022M2–2023M6) could reflect heightened geopolitical tensions and uncertainties that influenced each country differently. The conflict likely led to varying policy priorities and economic pressures, with Germany's position within the EU and its stance on the conflict diverging from Russia's. This divergence is likely contributing to the observed asynchronous growth in their EPU indices during this period. The disruption of long-standing trade relationships and the resulting energy crisis in Europe may have exacerbated economic policy uncertainties in Germany more than in Russia, which had alternative markets and state-controlled responses to buffer its economy. This appears to be consistent with the evolutionary game perspective of Xin and Zhang (2023), implying that the strategic energy choices of countries that impose sanctions may fail to influence Russia, while Russia's energy strategies would stabilize quickly.

While the static unconditional correlation analysis sheds light on the overall relationship between the EPU indices of Germany and Russia across different sub-periods, it may overlook the evolving nature of underlying factors influencing policy uncertainties. To gain a deeper understanding of the dynamics at play, a dynamic conditional correlation analysis is imperative. This approach takes into account the time-varying nature of correlations, allowing the identification of changing linkages between the two countries' EPU indices in response to shifting economic, geopolitical and policy contexts. By incorporating this dynamic dimension, we can capture nuances that static analyses might miss, offering a more comprehensive perspective on the intricate relationship between the policy uncertainties of Germany and Russia.

Figure 2 illustrates the correlation coefficients between the German and Russian EPU indices within a dynamic context, as determined by the DCC-GARCH model.

**Figure 2: Dynamic correlation results**

Note: This figure demonstrates the results of DCC-GARCH model for the time-varying correlation between the EPU indices of Germany and Russia over the entire period 1994M1–2023M6.

**Source:** Authors' own estimations and calculations

As depicted in Figure 2, the dynamic correlation between the EPU indices of Germany and Russia undergoes temporal variations while consistently maintaining a positive trend. Noteworthy fluctuations in these correlations become evident, signifying alterations in economic and geopolitical circumstances that influence the interplay between the respective EPU indices. The undulating slope and direction of the line reflect the changing nature of correlation, characterized by ascending (or descending) slopes corresponding to augmenting (or diminishing) correlation dynamics. A prime illustration of a substantive transformation in correlation is observable during the oil price shock spanning 2005 to 2008, wherein the correlation transiently assumes a negative stance. It is worth emphasizing that, although the correlations are considerably high, a careful examination of the shifts in dynamic conditional correlations throughout the periods encompassing the COVID-19 crisis and the Russo-Ukrainian War reveals downturns in the conditional correlation of the EPU indices.

## 4.2 Causality analysis

While the examination of the static unconditional correlation analysis and the dynamic conditional correlation analysis yields valuable insights into the temporal progression and interconnectedness of the EPU indices in Germany and Russia, an essential dimension that merits investigation

pertains to the latent causal relationships underpinning these observed correlations. Causality analysis presents the opportunity to delve more profoundly into the inquiry of whether alterations in the EPU index of one country possess a causal sway over the EPU index of the other, or whether external factors concurrently affect both indices. This analytical approach unravels prospective causal trajectories, disentangling the intricate matrix of interactions and illuminating the impelling dynamics contributing to the apparent patterns of correlation. Therefore, we apply standard Granger causality analysis.

However, conducting unit root tests before Granger causality analysis is essential for establishing the stationarity of time series data. It is apparent in Figure 1 above that both indices are trending. Since the presence of a trend in the data signifies non-stationarity, wherein the statistical characteristics of the variables alter over time, we conduct unit root tests. The order of integration of the variables is assessed with the ADFmax and DFGLS unit root tests of Leybourne (1995) and Elliott *et al.* (1996). Table 3 presents the unit root test results.

**Table 3: Unit root test results**

	<b>GER</b>	<b>RUS</b>
<b>ADFmax</b>	-2.06	-3.63***
<b>ADFmax (first-difference)</b>	-15.11***	-18.19***
<b>ERS</b>	-1.67*	-2.51**
<b>ERS (first-difference)</b>	-1.78*	-0.97
<b>ADF</b>	-1.47	-1.20
<b>ADF (first-difference)</b>	-6.32***	-6.97***
<b>ADF with trend</b>	-2.99	-2.48
<b>ADF with trend (first-difference)</b>	-6.41***	-7.05***
<b>ADF with drift</b>	-1.47*	-1.20
<b>ADF with drift (first-difference)</b>	-6.32***	-6.97***

Note: This table presents unit root test results for EPU indices of Germany (GER) and Russia (RUS).

Source: Authors' own calculations

Our analysis indicates that the EPU data for both Germany and Russia are integrated at order I(1), highlighting the presence of a unit root and confirming the non-stationarity of the time series. Thus, we difference the data to achieve stationarity and then perform the Granger causality test on the stationary series. The Schwarz lag-order selection statistic recommends an optimal lag length of 2. The outcomes of our Granger causality analysis are reported in Table 4.

**Table 4: Granger causality test results**

Null hypothesis	Chi-sq	Results
<b>GER does not Granger-cause RUS</b>	19.60*	Causality
<b>RUS does not Granger-cause GER</b>	2.52	No causality

Notes: This table shows the results of standard Granger causality analysis. \* denotes statistical significance at the 1% level.

Source: Authors' own calculations

Table 4 yields a noteworthy finding: a unidirectional causal relationship emerges between the EPU indices of Germany and Russia within the entire sample period 1994M1–2023M6. Specifically, our results reveal that variations in the EPU index of Germany exhibit Granger causality over the EPU index of Russia, implying that changes in Germany's policy uncertainty precede and can be utilized to predict fluctuations in Russia's policy uncertainty. However, the converse relationship does not hold true, as we do not find evidence to support the claim that changes in Russia's EPU index exert a similar predictive influence over Germany's EPU index.

This unidirectional Granger causality confirms the findings of Sweidan (2023) and has significant implications for understanding the interactions between the two economies, particularly in the context of energy policy. The observed causal influence of Germany on Russia suggests that political changes, economic developments or other relevant factors in Germany transmit uncertainty to Russia, even though Germany is highly dependent on Russian energy resources. This finding underscores the influential role that Germany's energy policy and economic decisions can play in shaping Russia's economic and political landscape. Given Germany's status as a major economic power within the EU and globally, the German EPU is likely to have a more far-reaching impact on Russia, which is economically and politically linked to Germany. The relationship between the two countries, however, is asymmetrical: while Germany is highly dependent on Russian energy, Russia's economy also relies on revenues from energy exports to Germany and other European countries. Therefore, Germany's EPU could have a significant impact on Russia's economic environment and influence political decisions and economic conditions in Russia throughout the period under review.

The lack of reciprocal causality – where the Russian EPU index does not predict the German EPU index – could be due to different economic and geopolitical dynamics. It could suggest that the factors driving political uncertainty in Russia have no immediate or significant impact on Germany, or that the German economic structure is less sensitive to developments in Russia. Germany's economic strength, its diverse industrial base and its trade relations likely contribute to its ability to influence political uncertainty in Russia through various channels beyond energy

trade. In addition, Germany’s leading position within the EU means that its policy decisions can have a broader impact, affecting not only the economic prospects at home but also those of its economic partners, including Russia.

On the other hand, the standard Granger causality analysis assumes a constant causal relationship over time, potentially overlooking shifts caused by structural breaks or significant events. Moreover, economic systems are characterized by fluidity, subject to evolving trends, policy shifts and external shocks. Therefore, we apply a time-varying Granger causality analysis to adapt to changing dynamics, detect shifts and identify causal relationships that may wax and wane over time. This flexibility is paramount for accurately capturing the complex relationship between the EPU indices of Germany and Russia. In this regard, the time-varying Granger causality test results pertaining to the period 1994M1–2023M6 are given in Table 5.

**Table 5: Time-varying Granger causality test results**

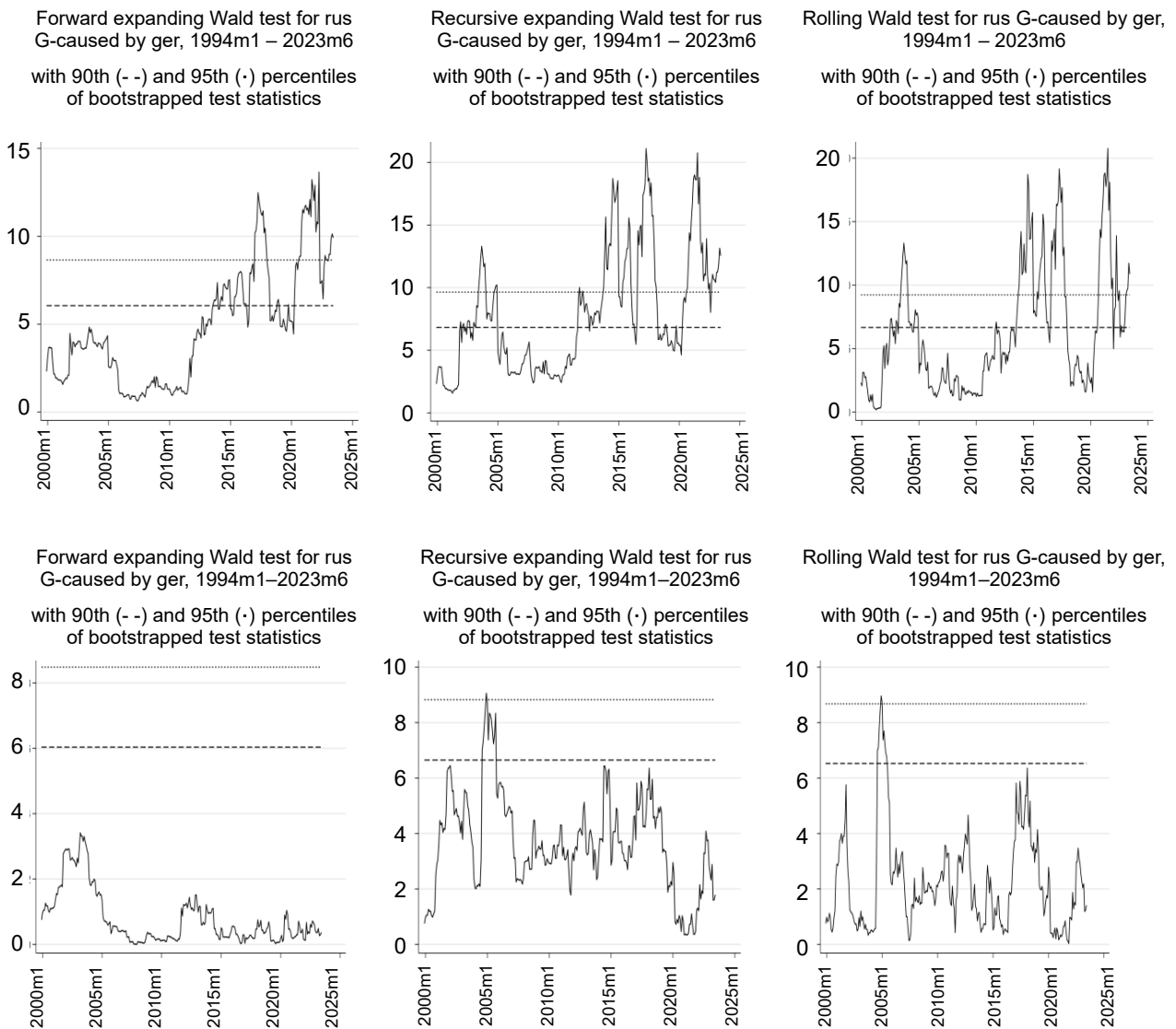
Null hypothesis	Max Wald FE	Max Wald RO	Max Wald RE	Results
<b>GER does not Granger-cause RUS</b>	13.65**	20.76***	21.11***	Causality
	(9.95)	(10.11)	(10.99)	
	[15.12]	[15.00]	[15.65]	
<b>RUS does not Granger-cause GER</b>	3.42	8.96**	9.06	No causality
	(7.84)	(8.55)	(9.12)	
	[11.46]	[11.58]	[11.67]	

Notes: This table shows the results of time-varying Granger causality analysis. \*\*\* and \*\* denote statistical significance at the 1% and 5% levels, respectively. The 95th and 99th percentiles of the empirical distribution of the bootstrap statistics are in parentheses and square brackets, respectively.

Source: Authors’ own calculations

Table 5 suggests that there is evidence of Granger causality running from the EPU of Germany to the EPU of Russia, while we largely fail to reject the null hypothesis of no Granger causality from Russia’s EPU to Germany’s EPU. The plots in Figure 3 offer a dynamic overview of the causal relationships underpinning the EPU indices of Germany and Russia. In general, these plots all support our previous conclusion that there is a robust and unidirectional causal relationship flowing from Germany’s EPU to Russia’s EPU.

**Figure 3: Time-varying Granger causality tests**



Note: This figure shows the time-varying Granger causality test results between the EPU indices of Germany and Russia. Panel A (Panel B) involves plots demonstrating the estimations using the FE, RE and RO for the Granger causality running from Germany (Russia) to Russia (Germany).

Source: Authors’ own estimations and calculations

The plots in Figure 3 show that the Granger causal relationships are extremely dynamic and that the patterns of causation found in the data depend on the type of recursive algorithm used. Specifically, the estimations indicate that especially after the great recession of 2008–2009, there is evidence of Granger causality from the EPU of Germany to the EPU of Russia (Panel A). Interestingly, the channel is evident around the COVID-19 and Russo-Ukrainian War periods. These results collectively accentuate the sensitivity of causality dynamics to historical events and underscore the interplay between economic uncertainties in these periods, wherein fluctua-

tions in Germany's policy landscape exert a discernible influence on Russia's policy uncertainties. However, if we focus on the period around the outbreak of the Russo-Ukrainian War in 2022 more closely, it becomes clear that the strength of this causal relationship decreases. While Germany's EPU continues to influence Russia's EPU, the strength of this causality decreases during the war period. This trend suggests that the severe geopolitical and economic disruptions caused by the conflict may have altered the usual dynamics between the two countries (Shen and Hong, 2023). As Germany's EPU rises sharply due to energy supply disruptions and economic instability, the ability of its political uncertainty to predict changes in Russia's EPU appears to weaken. This observation is consistent with our earlier results, which indicate a sharp rise in Germany's EPU after the war. It suggests that while Germany's EPU remains influential, the unprecedented nature of the Russo-Ukrainian War introduces complexities that reduce the predictive power of Germany's EPU for the Russian economic situation in this particular period. This diminishing causality may reflect Russia's strategic responses, including the redirection of energy exports and the implementation of measures to mitigate the impact of Western sanctions, which might have reduced the direct influence of Germany's EPU on Russia's EPU during the war (Xin and Zhang, 2023). It is also plausible to argue that the imposition of sanctions against Russia has disrupted established businesses in Germany to such an extent that the country's EPU was heavily and negatively affected, deteriorating its previously predictable influence on Russia's policy environment (Boungou and Yatié, 2024; Lado-Sestayo *et al.*, 2023; Liadze *et al.*, 2023; Ngo *et al.*, 2022).

On the other hand, the lack of evidence for causal linkage from Russia to Germany is obvious in most of the study period (Panel B). However, the RE and RO estimations provide isolated instances of evidence pointing to a unidirectional causality running from Russia to Germany in 2005 and 2006. These years witnessed significant fluctuations on global energy markets, characterized by fluctuations in oil and gas prices. Given Russia's substantial role as an energy exporter and Germany's energy consumption patterns, changes in Russia's energy policies or supply dynamics during this period may have temporarily influenced Germany's policy uncertainties. These energy market dynamics could have transmitted signals that resonated with Germany's economic landscape, contributing to the observed causal linkage. It is also worth noting that the causal power of the Russian EPU on the German EPU appears to have increased after the Russo-Ukrainian War, suggesting that the conflict and associated energy supply disruptions may have increased Russia's influence on political uncertainties in Germany during this period. This underscores the need for a more in-depth examination of how energy policy uncertainties shape the evolving relationship between these two countries (Lado-Sestayo *et al.*, 2023; Shen and Hong, 2023).

### 4.3 Robustness check

For robustness, we employ a recent Granger causality procedure that is robust to the presence of instabilities in a vector autoregressive framework (VAR; Rossi and Wang, 2019). This is important because the traditional Granger causality test assumes stationarity; thus, it is not reliable in the presence of instabilities and may lead to incorrect inference. Therefore, it is vital to allow for changes over time when doing VAR-based statistical inference. Table 6 reports the results.

**Table 6: Robust time-varying Granger causality test results**

Null hypothesis	ExpW	MeanW	Nyblom	SupLR	Results
<b>GER does not Granger-cause RUS</b>	43.62*	65.66*	4.11	94.73*	Causality
<b>RUS does not Granger-cause GER</b>	6.29	10.67	2.60	16.71	No causality

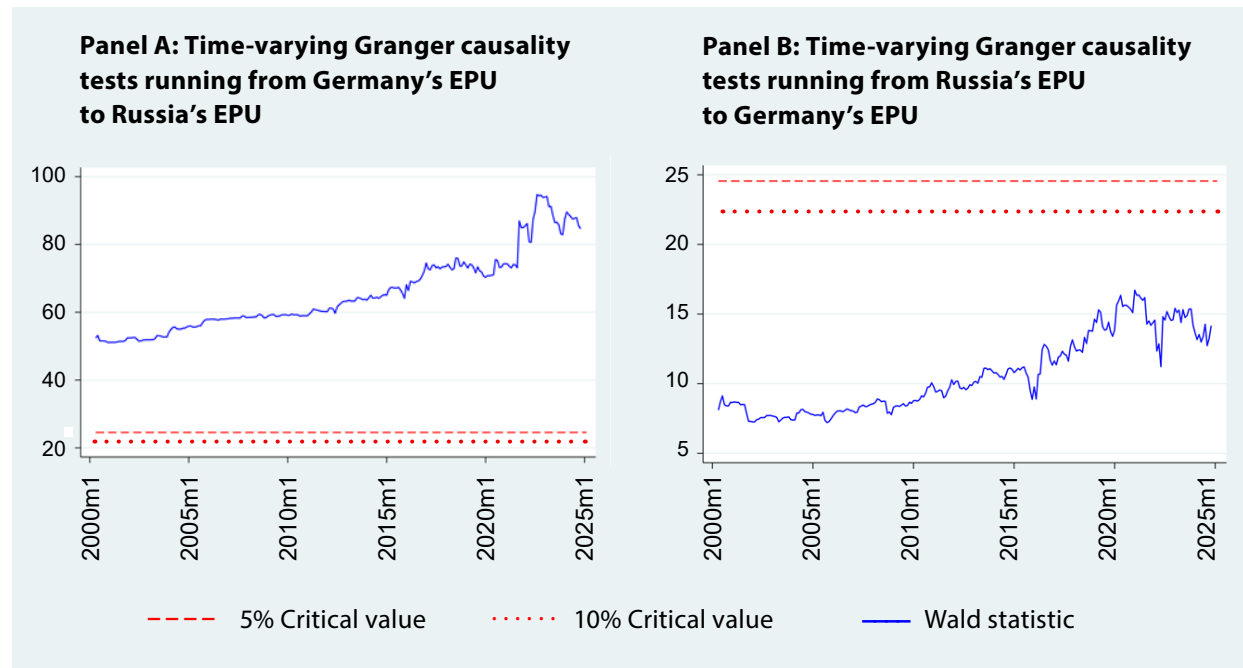
Notes: This table shows the results of a robust time-varying Granger causality analysis. \* denotes statistical significance at the 1% level. ExpW, MeanW, Nyblom and SupLR denote the exponential Wald test, the mean Wald test, the Nyblom test and the Quandt likelihood test, respectively (Rossi, 2005).

Source: Authors' own calculations

According to Table 6, the statistically significant values of ExpW, MeanW and SupLR indicate that the test rejects the null hypothesis that the EPU of Germany does not Granger-cause the EPU of Russia. Furthermore, the outcome of the analysis indicates that the null hypothesis, positing the absence of Granger-causal impact of Russia's EPU on Germany's, does not lend itself to rejection. Figure 4 below shows the whole sequence of the Wald statistics across time, which gives more information on when the Granger causality occurs.

The sequence of the Wald statistic – depicted by a continuous line – is above (below) the critical value line – depicted by the dashed lines – over the entire period 1994M1–2023M6 in Panel A (Panel B). In summary, the amalgamation of our results paints a vivid picture of the Granger-causal relationship between the two countries and it is worth noting that the findings justify our previous arguments.

**Figure 4: Robust time-varying Granger causality tests**



Note: This figure shows the Wald statistics testing whether the EPU of Germany (Russia) Granger-causes the EPU of Russia (Germany) against the alternative of a break in Granger causality at time date (reported on the x axis) in Panel A (Panel B).

Source: Authors' own estimations and calculations

#### 4.4 Additional analysis: energy policy uncertainty

Azqueta-Gavaldón *et al.* (2023) constructed indicators for an alternative EPU index in the four largest Eurozone countries, including Germany, by applying two unsupervised machine learning algorithms to news articles. The authors compared their alternative index for Germany created using this approach with the German EPU index developed by Baker *et al.* (2016) and found a strong correlation (0.69) between the two, despite differences in methods. In addition, the authors adopted a topic modelling approach and selected those topics that best describe the sources of policy uncertainty in the European region. The authors noted that one of the eight components that best fit the European context is “energy”.<sup>2</sup> Consequently, the authors constructed issue-specific uncertainty indices that include the “energy” component from 1995M1 to 2019M12. Therefore, we are able to replicate our correlation and causality analyses within this period by including this new energy policy uncertainty index in our empirical framework to uncover its relationship with the German EPU.

2 Other components are fiscal, monetary, political, geopolitical, trade/manufacturing, European regulation and domestic regulation (see Table 3 in Azqueta-Gavaldón *et al.* (2023)).

The findings presented in Appendix A demonstrate that Germany's EPU is influenced by its energy policy uncertainty. This implies that the connections in correlation and causation between the EPU indices of Germany and Russia may be instigated by energy policy uncertainty, in line with our earlier assertions.

## 5. Conclusion

In the dynamic landscape of international relations, the interplay between EPU and energy policy is a critical facet that shapes the trajectories of countries. This study delved into the complex and intricate web of German-Russian relations, examining how these two major countries are influenced by policy uncertainties, particularly against the backdrop of the Russo-Ukrainian War.

We first analysed the static and dynamic correlations between the EPU indices of Germany and Russia. The findings reveal significant fluctuations and a generally positive correlation across different periods, although the strength of this relationship varied depending on specific geopolitical events. The Granger causality tests, both standard and time-varying, unveiled a unidirectional causal relationship where fluctuations in Germany's EPU exhibited Granger causality over Russia's EPU. This is particularly significant given the asymmetric nature of the relationship, where Germany's policy uncertainties, influenced heavily by its energy policy, appear to transmit uncertainty to Russia rather than the other way around. We also showed that fluctuations in Germany's energy policy have the potential to trigger correlation and causality linkages between the EPU indices of Germany and Russia. In an interconnected world where energy and economics are deeply intertwined, this insight underscores the need to consider the ripple effects of energy policy decisions on economic policy uncertainties.

In particular, the Russo-Ukrainian War highlights the importance of energy policy in this relationship as it has shaped global perceptions of energy markets. The war and subsequent sanctions have disrupted the long-standing energy trade between Germany and Russia, compelling Germany to rethink its energy strategy. Our findings suggest that while Germany's EPU remains a strong predictor of Russia's EPU, the strength of this causality has diminished in the wake of the war. This could be due to Russia's strategic adjustments, such as redirecting energy exports to other markets and implementing policies to mitigate the impact of Western sanctions. Individually, for Germany, the future of its relationship with Russia will likely involve a continued shift away from dependency on Russian energy and towards diversification of its energy sources. The country should actively pursue and utilize alternative energy sources such as solar, wind, hydro and biomass to lessen its dependence on conventional energy sources. This shift will be critical in reducing Germany's vulnerability to external shocks and ensuring greater stability in its economic policy environment. At the macro level, Germany's role within the EU and its leadership in shaping

energy policies will continue to influence its broader geopolitical stance, including its relations with Russia. For Russia, the diminishing causal power of Germany's EPU over its own suggests a need for increased resilience in the face of external uncertainties. Russia's ability to maintain economic stability despite Western sanctions indicates a degree of success in its strategic pivot towards other markets, particularly in Asia. However, the long-term sustainability of this strategy remains uncertain, especially as the global energy dynamics continue to evolve. To this end, Russia might consider strengthening its communication with Germany and other Western countries and potentially easing counter-sanctions to release friendly signals and proactively resolve the crisis.

While this study introduces energy policy uncertainty as a significant factor, the analysis relies on the availability of relevant data. In this regard, one of the key limitations of this study is the challenge of obtaining comprehensive and reliable data on energy policy uncertainty. This limitation underscores the critical need for the development and availability of a comprehensive energy policy uncertainty index, particularly in the context of studies exploring the interplay between economic policy uncertainties and energy policy. This would significantly enhance the understanding of the complex interplay between energy and economic policies, particularly in the context of international relations. Future research focusing on the development of such an index would not only benefit researchers but also provide valuable tools for policymakers, investors and other stakeholders seeking to navigate the intricate landscape of energy and economic uncertainties. Another concern is that although the German and Russian EPU indices follow a largely similar methodological approach, the differences in the source data, the number of newspapers involved and the stage of development of the indices may affect their comparability. Future studies could explore the use of alternative data sources, such as social media, as in Grebe *et al.* (2024), to create more comprehensive and timelier EPU indices.

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## Conflicts of interest

The authors hereby declare that this article was not submitted no published elsewhere.

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## Appendix A

We replicate our empirical analyses to explore the relationship between the energy policy uncertainty and EPU in Germany.

Firstly, the static correlation between the German energy policy uncertainty and the German EPU in the period 1995M1–2019M12 is 0.71, which is quite high.<sup>3</sup>

Secondly, Figure A1 visualizes the results of the DCC-GARCH model, which aims to explore the dynamics in the correlation coefficients between the German energy policy uncertainty index and the German EPU index produced by Azqueta-Gavaldón *et al.* (2023).

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3 We cannot split the period into sub-periods due to data unavailability. The authors state that they will be able to calculate their indices until 2019 for the time being due to technical problems in downloading the newspaper-based data. Please see <https://www.bde.es/wbe/en/areas-actuacion/analisis-e-investigacion/recursos/indices-epu-para-la-zona-euro-basados-en-topic-modelling.html> for further details.

**Figure A1: Dynamic correlation results**



Note: This figure demonstrates the results of DCC-GARCH model for the time-varying correlation between the energy policy uncertainty index and the EPU index of Germany over the entire period 1995M1–2019M12. Source: Authors’ own estimations and calculations

The trend in Figure A1 shows that the dynamic correlation between the two indices for Germany has a positive trend and becomes heightened in the last decade.

Thirdly, we display the results of the standard Granger causality analysis in Table A1.<sup>4</sup>

**Table A1: Granger causality test results**

Null hypothesis	Chi-sq	Results
<b>GER energy policy uncertainty does not Granger-cause GER EPU</b>	8.87**	Causality
<b>GER EPU does not Granger-cause GER energy policy uncertainty</b>	10.91***	Causality

Notes: This table shows the results of standard Granger causality analysis. \*\*\* and \*\* denote statistical significance at the 1% and 5% levels, respectively.

Source: Authors’ own calculations

<sup>4</sup> Note that the unit root test results are unreported for brevity, but are available in full on request.

Table A1 implies that the causal relationship between the energy policy uncertainty and EPU in Germany is bidirectional. From a practical standpoint, this means that, for example, a significant shift in energy policy could lead to increased economic uncertainty. Conversely, economic policies, such as trade regulations or fiscal decisions, could affect energy policy and, by extension, energy-related uncertainties in Germany. This highlights the need for a holistic approach when addressing policy changes or developments. It also underscores the idea that changes in one area can have repercussions that extend beyond their immediate scope, influencing broader economic and energy-related dynamics.

Fourthly, Table A2 demonstrates the time-varying Granger causality test results.

**Table A2: Time-varying Granger causality test results**

Null hypothesis	Max Wald FE	Max Wald RO	Max Wald RE	Results
<b>GER energy policy uncertainty does not Granger-cause GER EPU</b>	5.92	11.92**	11.92**	Causality
	(9.87)	(8.88)	(9.88)	
	[15.43]	[14.99]	[15.43]	
<b>GER EPU does not Granger-cause GER energy policy uncertainty</b>	10.67**	12.14**	12.82**	Causality
	(7.88)	(8.59)	(8.59)	
	[13.34]	[15.70]	[16.28]	

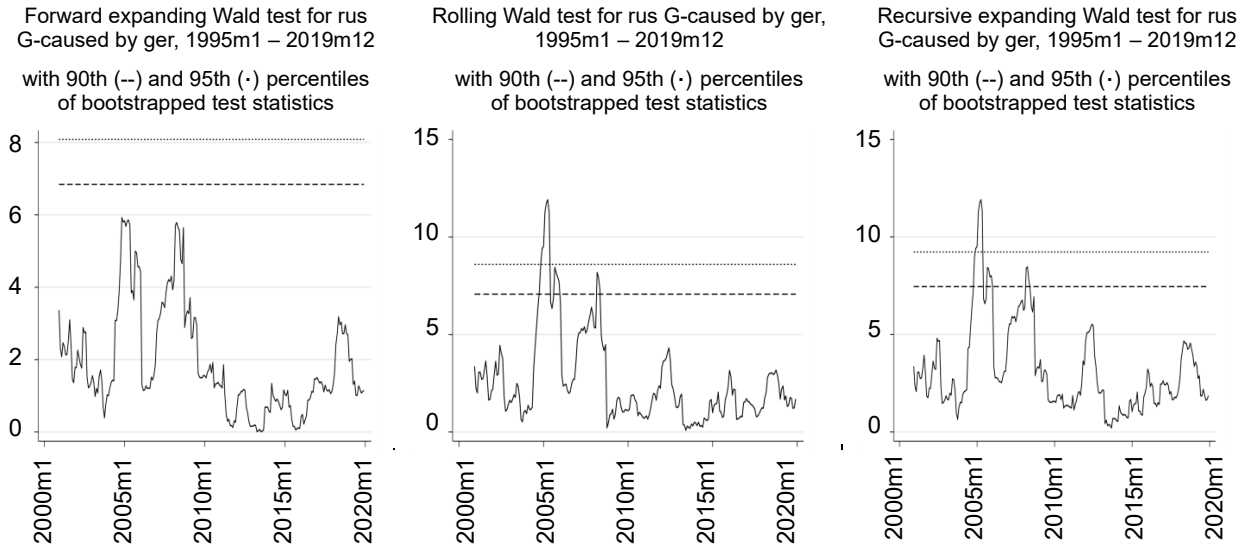
Notes: This table shows the results of time-varying Granger causality analysis. \*\*\* and \*\* denote statistical significance at the 1% and 5% levels, respectively. The 95<sup>th</sup> and 99<sup>th</sup> percentiles of the empirical distribution of the bootstrap statistics are in parentheses and square brackets, respectively.

Source: Authors' own calculations

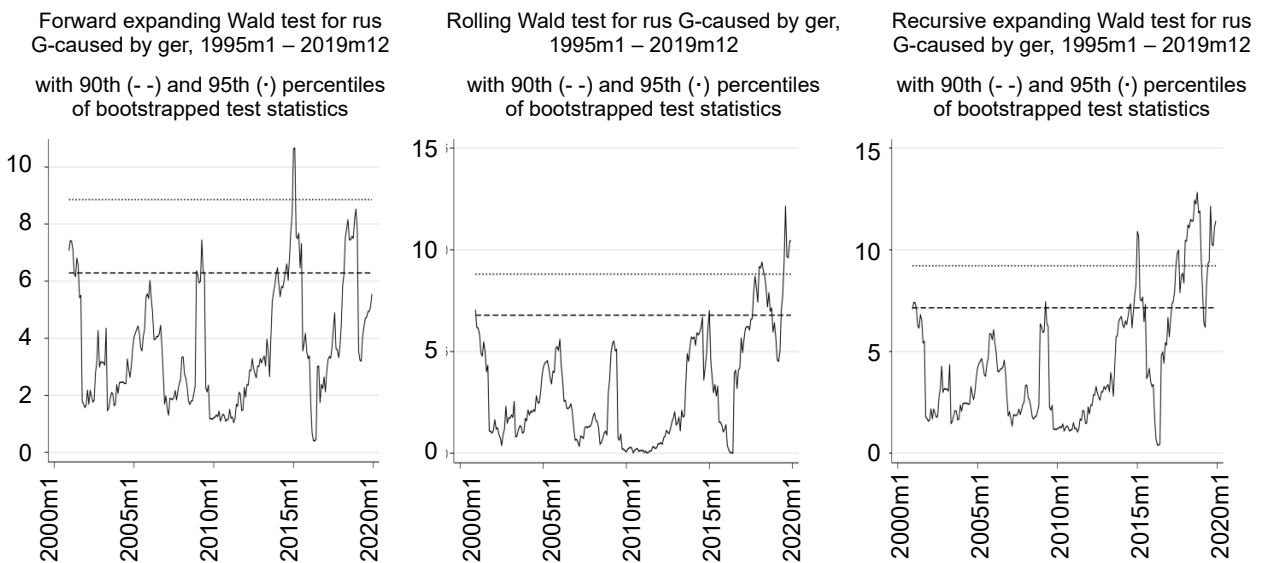
The bidirectional causal relationship between the energy and economic policy uncertainties of Germany is also evident from Table A2. This relationship is plotted in Figure A2 as follows.

**Figure A2: Time-varying Granger causality tests**

**Panel A: Time-varying Granger causality tests running from Germany’s energy policy uncertainty to its EPU**



**Panel B: Time-varying Granger causality tests running from Germany’s EPU to its energy policy uncertainty**



Notes: This figure shows the time-varying Granger causality test results between the energy policy uncertainty and EPU indices of Germany. Panel A (Panel B) involves plots demonstrating the estimations using the FE, RE and RO for the Granger causality running from Germany energy policy uncertainty (Germany’s EPU) to Germany’s EPU (Germany energy policy uncertainty).

Source: Authors’ own estimations and calculations

According to the time-varying Granger causality test results, the causal relationship runs from energy policy uncertainty to economic policy uncertainty prior to 2010. However, after 2015, this direction of causality is significantly reversed. It is worth noting that our unreported results suggest that there is a unidirectional causal relationship running from energy policy uncertainty of Azqueta-Gavaldón *et al.* (2023) to the EPU index of Baker *et al.* (2016) in Germany. Thus, it is crucial to consider energy policy uncertainty as a leading indicator when making economic decisions. In essence, fluctuations and uncertainties in energy policy can exert a notable influence on economic policy decisions in Germany, emphasizing the importance of proactive strategies to manage and mitigate these uncertainties for more stable economic outcomes.

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