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## Article

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# Russian Currency's external shocks and domestic policy effectiveness amid geopolitical tensions

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## ABSTRACT

This study examines the dynamics of the Russian currency against the US dollar, exploring its responses to geopolitical risk, domestic policies, and oil and gas price shocks. Based on our quantile and time-frequency analyses from January 1998 to July 2022, focused on a subsample that covers the Russia-Ukraine conflict (January–July 2022), our research reveals that the Russian currency has significant vulnerability to geopolitical risk. Domestic policies have a moderate impact on currency valuation, whereas oil prices play a pivotal role, exceeding the impact of domestic policies. Our findings offer strategic insights for hedging, identifying safe-haven assets, and diversification strategies based on Russian-foreign currency dynamics, oil, and gas prices. These considerations are especially relevant amid geopolitical tensions and uncertainty, across various time periods and quantile levels.

## 1. Introduction

The Russian exchange rate has experienced substantial volatility, in which various endogenous and exogenous shocks, to which the global financial crisis, sanctions, and the COVID-19 pandemic have been the main contributors. In the context of Russia, the prevalence of geopolitical risk is profound. Geopolitical risks (GPR) account for wars, terrorist attacks, geopolitical threats, tensions, and disruption in economic relationships (Caldara & Iacoviello, 2022). Prior literature argues that GPR is a prominent factor that influences investment decisions and the dynamics of financial markets, eventually leading to fluctuations in the exchange rate market (Bank for International Settlements, 2021; Elsayed & Helmi, 2021; Pástor & Veronesi, 2013). To mitigate the negative impact of geopolitical tension, Russian authorities have implemented various measures to stabilize the exchange rate. For example, economic sanctions imposed on Russia since the Crimea issue in 2014, coupled with a plunge in oil prices substantially depreciated the Russian ruble (RUB) (Balashova & Serletis, 2020; Wang et al., 2019). Consequently, the Russian Central Bank (RCB) adopted a floating exchange rate system to shift the economic benefits to hydrocarbon (i.e., oil and gas) exporters and its fiscal stance (Sohag, Gainetdinova, & Mariev, 2022). Despite

numerous recent economic sanctions on Russia (due to the Russia-Ukraine conflict, beginning in 2022), including freezing RCB reserves, disconnection from SWIFT, and international trade restrictions, the appreciation of the RUB (beginning in April 2022) raises research questions in international monetary economics. They motivate us to measure the response by the Russian exchange rate to geopolitical risk by contextualizing several important factors, such as economic policy uncertainty, oil prices, and gas prices.

We have three motivations for this study. First, the Russian economy experiences high fluctuations in its exchange rate due to various factors, such as the terms of trade, oil and gas prices, and geopolitical risk. Although the impact of these factors is well researched, the influence of unobserved factors, such as economic policy uncertainty, is less understood. Given that the exchange rate is a critical macroeconomic indicator that affects international trade, the country's budget, and business operations, it is essential to be aware of the potential impact of these unobserved factors, from the perspective of both investors and policy makers. A comprehensive understanding of how geopolitical risk and economic policy uncertainty affect the exchange rate plays a crucial role in improving forecasting accuracy and enhancing economic stability.

Second, the Russian economy is highly exposed to geopolitical

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tension, leading to high fluctuations in the exchange rate, given the floating exchange rate system adopted in the country. Anecdotal evidence shows that geopolitical risks, such as terrorist attacks, threats of war, and economic sanctions, lead to depreciation in the RUB. However, the Russia-Ukraine conflict, followed by the imposition of sanctions, appears to be an exception. By March 2022, Russia had become the most sanctioned country globally, surpassing North Korea, Syria, and Iran. Despite increasing geopolitical risk and the imposition of new restrictive measures, since the end of May 2022 the exchange rate has remained stable at roughly RUB 60 to USD 1. Geopolitical pressure poses a challenge to the economy, prompting policy makers to adjust their economic policies, leading to economic policy uncertainty, which significantly affects the exchange rate dynamics. Third, Russia is one of the world's largest exporters of hydrocarbons, making its exchange rate highly connected to oil and gas prices. Therefore, we examine the response of the RUB to oil and gas prices.

This study makes several contributions to the existing literature. First, by conducting this study we fill a gap in the literature, as it is one of the first investigations to focus purely on the role of geopolitical risk in explaining fluctuations in the value of the RUB. Previous studies have used a sample of BRICS countries (Brazil, Russia, India, China, and South Africa), rather than looking solely at Russia (Ghosh, 2021; Salisu et al., 2022). Studies that investigate the impact of geopolitical risk on exchange rates in other countries use methods such as the event-study approach (Boubaker et al., 2022; Yousaf et al., 2022), quantile-on-quantile (Bossman & Gubareva, 2023; Umar et al., 2022), causality-in-means (Bossman et al., 2023a), Time Varying Parameter-VAR (Alam et al., 2022), the wavelet coherence approach (Będowska-Sójka et al., 2022; Shahzad et al., 2023), and a GARCH-MIDAS-X model (Salisu et al., 2022); the techniques that we use are more advanced than theirs.

Second, to assess high-frequency time series, we employ a sophisticated methodology, specifically CQ, TVP-VAR, and wavelet-based quantile correlation, which are robust to high-frequency and long time-series with an abnormal distribution and extreme values (Mensi et al., 2023; Sohag, Gainetdinova, & Mariev, 2022). The CQ method decomposes the dependent and independent variables into several quantiles, allowing for consideration of both bearish and bullish market conditions, as well as short- and long-term memory. Meanwhile, the TVP-VAR estimates volatility transmission from geopolitical risk, economic policy uncertainty, oil prices, and gas prices to the exchange rate, and vice versa. Wavelet-based quantile correlation is conducted for a robustness check, showing a clear directional correlation between the returns of two assets across various market conditions.

Third, we employ a sample from January 1998 to July 2022 and analyze a subsample from January to July 2022 to evaluate the effect of geopolitical risk and assess the effectiveness of Russian economic policies during the Russia-Ukraine conflict. The results offer important insights into the impact of geopolitical risk on exchange rates. During the full sample period, geopolitical risk has a minor role in defining exchange rates, but it becomes more significant in the long run and transmits positive volatility spillover to the Russian exchange rate under bullish market conditions. However, during the 2022 subsample period, the RUB appreciates in the long run in response to increased geopolitical risk.

Fourth, the study has valuable policy implications. Despite the detrimental impact of geopolitical risk, the RUB has appreciated during the Russia-Ukraine conflict, highlighting the effectiveness of Russian macroeconomic policies in stabilizing exchange rates. These policies include the adoption of a managed floating exchange rate system, open market operations, correction of interest rates, currency control regimes, and restrictions on foreign exchange transactions. Additionally, an increase in economic policy uncertainty depreciates the RUB under bullish market conditions, suggesting that economic policies should be more stable. These findings lead to some important implications for policy makers concerning economic policy development as well as for investors

in terms of decision-making.

The remainder of the article is organized as follows. Section 2 provides a comprehensive literature review of the impact of geopolitical risk, economic policy uncertainty, oil prices, and gas prices on exchange rates. Section 3 describes the data and sources and includes our preliminary analysis and methodology. Section 4 shows the response of the exchange rate to exogenous shocks over the full time horizon and amid the Russia-Ukraine conflict, including a discussion. Section 5 concludes the study with a focus on policy implications.

## 2. Literature review

In the literature review, we divide the studies into four groups of topics: the relation between exchange rates and geopolitical risk, economic policy uncertainty, oil prices, and gas prices. Many studies show that geopolitical risk plays a crucial role in the vulnerability of currencies to geopolitical tension (Iyke et al., 2022; Kisswani & Elian, 2021). Interestingly, currency vulnerability depends largely on the macroeconomic policies implemented by a country's policy maker (Cabral et al., 2020; Chang & Lee, 2017; Mateane & Proaño, 2020). To the best of our knowledge, no study focuses purely on the Russian context to scrutinize the impact of geopolitical risk on the exchange rate, and only a few studies focus on a sample of BRICS countries (Ghosh, 2021; Salisu et al., 2022). For example, Salisu et al. (2022) find that, among the BRICS country currencies, the RUB is the most vulnerable to geopolitical tension, whereas the RMB is the most resilient because of China's tighter capital controls. BRICS currencies are more sensitive to global geopolitical risk than country-specific indexes. Ghosh (2021) find that geopolitical risk and exchange rate fluctuation have an abnormal impact on the stock market. The literature on geopolitical risk due to the Russia-Ukraine conflict is expanding, however, only a few articles consider the response of exchange rates to geopolitical risk, and others focus on the response of stock markets to geopolitical turmoil (e.g., Bossman et al., 2023a; Bossman & Gubareva, 2023; Boubaker et al., 2022; Będowska-Sójka et al., 2022; Yousaf et al., 2022) or the impact of the Russia-Ukraine conflict on various commodity markets, including those for precious metals, minerals, and food and agricultural products (e.g., Alam et al., 2022; Fang & Shao, 2022; Shahzad et al., 2023; Sohag et al., 2023; Umar et al., 2022). Various factors affect a country's exposure to geopolitical risk, including geographic proximity to the epicenter of geopolitical turmoil, international trade dependence, and ideological differences (Bossman et al., 2023b; Hossain & Masum, 2022). However, countries can mitigate the negative impact of sanctions by establishing trade relations with surrounding countries, enhancing import substitution, focusing on industrial development, and improving economic mechanisms to adjust domestic supply (Hosseinzadeh et al., 2013; Thaver & Ekanayake, 2010; Wang et al., 2019). Duan et al. (2021) find that in Venezuela geopolitical tension and oil prices have a bidirectional relationship, therefore, its high dependence on oil export revenue increases its vulnerability to geopolitical risk.

Research on the relationship between exchange rates and economic policy uncertainty can be divided into three main categories. The first category suggests that an increase in economic policy uncertainty causes a currency to appreciate in value (Beckmann & Czudaj, 2017; Kido, 2016; Li et al., 2020). For instance, Kido (2016) argues that high-yield currencies tend to depreciate in response to higher US policy uncertainty, whereas the Japanese yen appreciates due to carry-trade activities. The second category finds an inverse relationship between policy uncertainty and exchange rates (Nilavongse et al., 2020; Vithessonthi, 2014). Vithessonthi (2014) substantiates the negative impact of economic policy uncertainty on irrational investors' behavior. The third category examines the nature of the causal relationship between economic policy uncertainty and exchange rate volatility (Zhou et al., 2020). Krol (2014), Karnizova and Li (2014), Balcilar and Usman (2021), and Christou et al. (2018) find that the effect of economic policy uncertainty varies depending on the characteristics of the economies.

**Table 1**  
Variable definitions and sources.

Variable	Definition	Measurement	Source
<i>Dependent variable</i>			
Exchange rate (ER)	Exchange rate of Russian ruble, measured in RUB per USD	RUB per USD	Central Bank of Russia <a href="https://www.cbr.ru">https://www.cbr.ru</a>
<i>Explanatory variables</i>			
Geopolitical risk (GPR)	Frequency of newspaper stories and features	Index	<a href="https://www.matteoiacoviello.com/gpr.htm">https://www.matteoiacoviello.com/gpr.htm</a>
Economic policy uncertainty (EPU)	Frequency of newspaper stories and features	Index	<a href="http://www.policyuncertainty.com/index.html">http://www.policyuncertainty.com/index.html</a>
International oil price (OP)	Spot crude oil price	US dollar per barrel	Energy Information Administration <a href="https://www.eia.gov">https://www.eia.gov</a>
Gas price (GP)	Natural gas spot price	Dollars per million Btu	Energy Information Administration <a href="https://www.eia.gov">https://www.eia.gov</a>

Note: All variables are considered in natural logarithm.

**Table 2**  
Descriptive statistics.

1998–2022										
	EPU	ER	GP	OP	GPR	EPULN	ERLN	GPLN	GPRLN	OPLN
Mean	157.188	39.83	4.254	57.889	0.736	4.751	3.571	1.335	-0.49	3.923
Median	113.534	30.816	3.64	55.83	0.572	4.732	3.428	1.293	-0.558	4.022
Maximum	860.176	120.378	23.86	145.31	9.395	6.757	4.79	3.172	2.24	4.978
Minimum	0.085	5.96	1.05	-36.98	0.135	-2.463	1.785	0.048	-2.00001	2.187
Std. Dev.	129.509	18.785	2.211	27.68	0.724	0.822	0.495	0.461	0.537	0.553
Skewness	1.99	0.815	1.704	0.332	7.353	-0.501	-0.682	0.405	1.005	-0.621
Kurtosis	8.318	2.623	7.288	2.318	75.037	4.506	5.309	2.658	5.721	2.712
Jarque-Bera	1,1671.38	740.871	7938.050	240.099	1429.588	866.831	1903.063	204.549	3027.704	430.341
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	6281	6347	6347	6347	6347	6281	6346	6346	6346	6346
January–July 2022										
Mean	452.007	84.817	5.147	5.649	96.716	6.041	4.429	1.62	1.636	4.566
Median	386.508	78.208	4.77	5.229	96.05	5.957	4.359	1.562	1.654	4.565
Maximum	733.841	120.378	7.48	9.396	123.64	6.598	4.791	2.012	2.24	4.817
Minimum	224.463	72.295	3.73	2.061	75.99	5.414	4.281	1.316	0.723	4.331
Std. Dev.	174.241	13.611	1.011	2.384	10.826	0.386	0.148	0.188	0.451	0.112
Skewness	0.456	1.303	0.756	0.315	0.144	0.088	1.179	0.521	-0.265	-0.073
Kurtosis	1.715	3.273	2.379	1.809	2.344	1.771	2.946	2.151	2.067	2.289
Jarque-Bera	8.796	24.299	9.46	6.428	1.815	5.456	19.695	6.395	4.074	1.866
Probability	0.012	0.000005	0.009	0.04	0.404	0.065	0.000005	0.041	0.13	0.393
Observations	136	136	136	136	136	136	136	136	136	136

Therefore, the literature has mixed findings on how economic policy uncertainty influences an exchange rate, which is also supported by Sohag, Gainetdinova, Hammoudeh, and Shams (2022), Chang et al. (2022), and Maydybura et al. (2023). Bartsch (2019) argues that the UK economy is more sensitive to the volume of trade and exchange rates and that US policy uncertainty insignificantly influences the exchange rate as the USD is more resilient to policy uncertainty because the US monetary policy is efficient. Jansen and De Haan (2005) reveal that an increase in the conditional volatility of the EUR-USD exchange rate is driven by statements by the European Central Bank. Chen et al. (2020) find that policy uncertainty in the US, Europe, and Japan significantly and positively influences Chinese exchange rate volatility, with an inverted U-shaped relationship. This nonlinear effect can be explained by the tendency of governments to change economic policies in periods of higher volatility in macroeconomic indicators. Dai et al. (2017) suggest that the relationship between policy uncertainty and exchange rates is bidirectional.

The literature on the influence of oil prices on exchange rates implies that, in general, a rise in oil prices leads to appreciation in the currency of oil-exporting countries and depreciation in the currency of oil-importing countries. This view is supported by several studies,

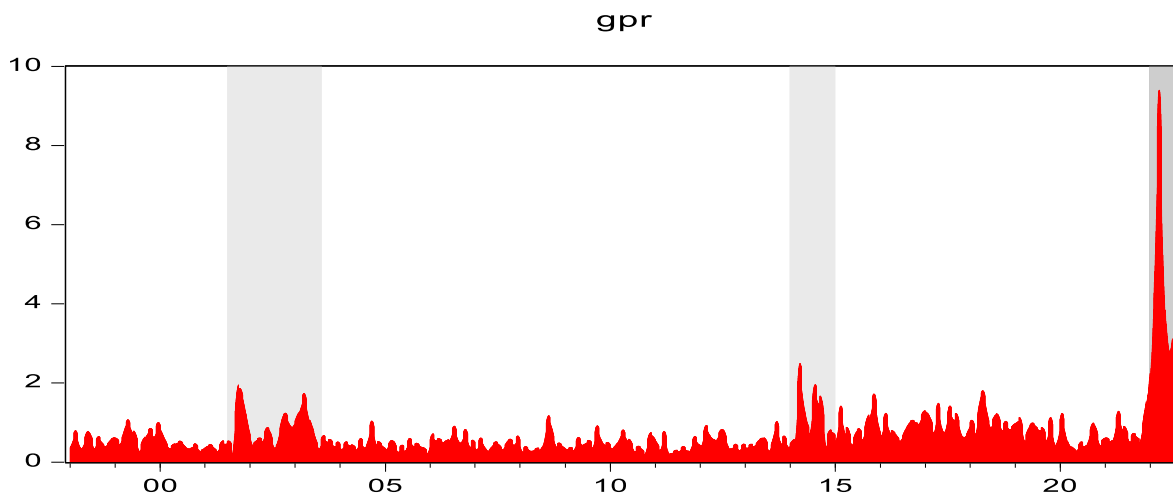


Fig. 1. Dynamics of geopolitical risks in the Russian context.

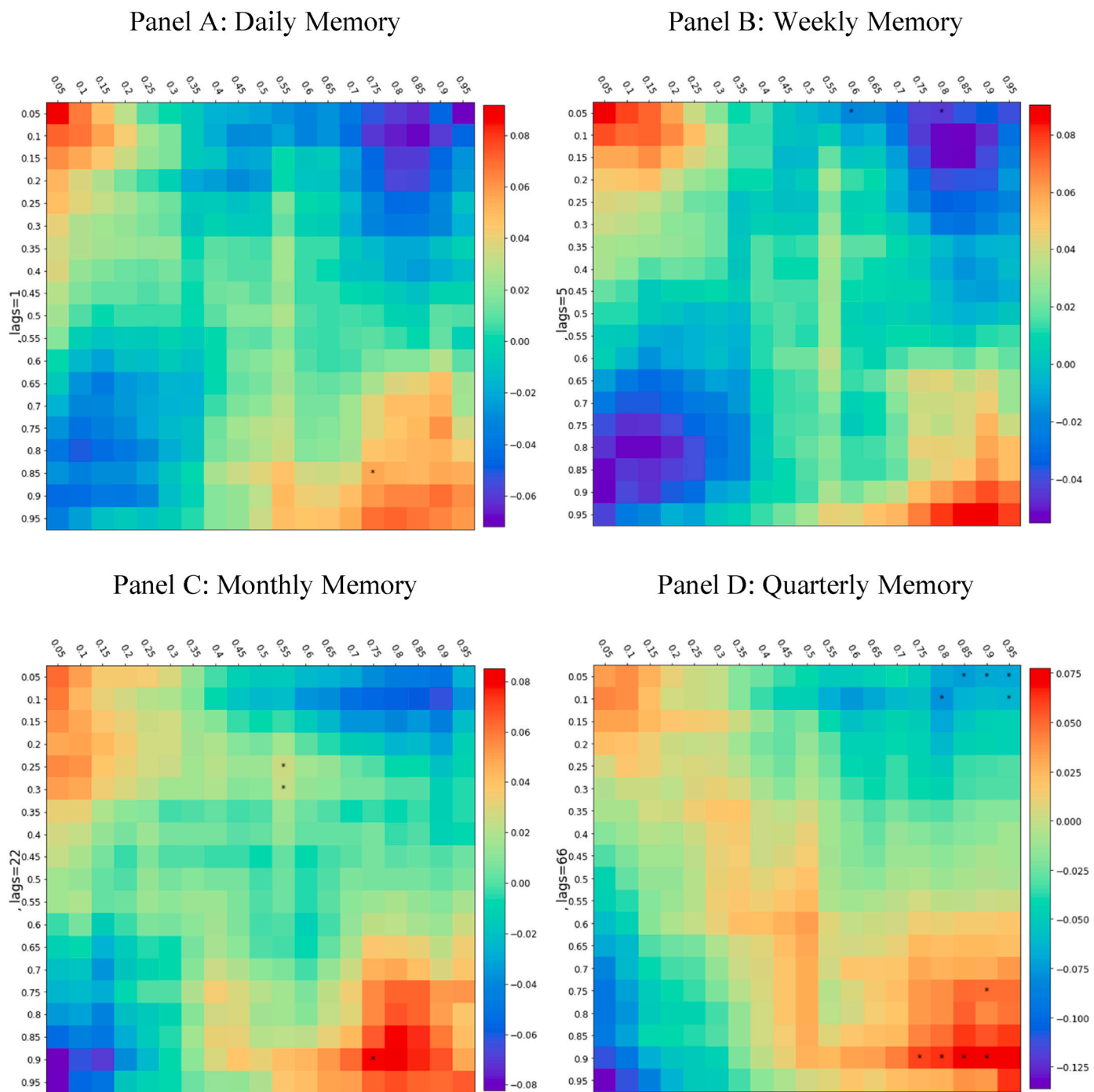


Fig. 2. Cross-quantile dependence from geopolitical risk to exchange rate.

including Krugman (1980), Bénassy-Quéré et al. (2007), Khraief, Shahbaz, Mahalik, and Bhattacharya (2021), Jiang et al. (2020), Habib and Kalamova (2007), and Lin and Su (2020). However, Lin and Su (2020) find that a supply shock leads to appreciation in the RUB and RMB. Although this finding is straightforward for Russia, as it is one of the largest oil exporters, it is not typical for China, which is one of the largest oil importers. Lin and Su (2020) attribute this anomaly to China’s effective implementation of a managed floating exchange rate regime. A few studies have reported on cointegration among oil prices, gas prices, and exchange rates (Hartley & Medlock, 2014; Isibor et al., 2022). Baumeister and Kilian (2016) and Hamilton (2013) reveal that substantial fluctuations in oil prices are due to geopolitical events and disaster risks. Some studies, such as Krugman (1980) and Bénassy-Quéré

et al. (2007), examine the short- and long-run impacts of oil price fluctuations on exchange rates. Additionally, the impact of oil prices can be analyzed in terms of asymmetric impacts (Bruna & Van Tran, 2023; Saidu et al., 2021).

Only a few papers use gas prices as a predictor of exchange rates. The RMB is also sensitive to gas price fluctuations, as it depreciates when gas prices increase (Ma & Wang, 2019). Kumar (2019) find that in India gas prices influence exchange rates asymmetrically in the long term. He et al. (2019) determine that, in the BRICS countries, gas prices have an insignificant influence on exchange rates, arguing that, because of the geographic distance between North America and the BRICS countries, the Henry Hub gas price has a smaller relationship to exchange rates in these countries. Wang and Wu (2012) find that gas prices and the USD

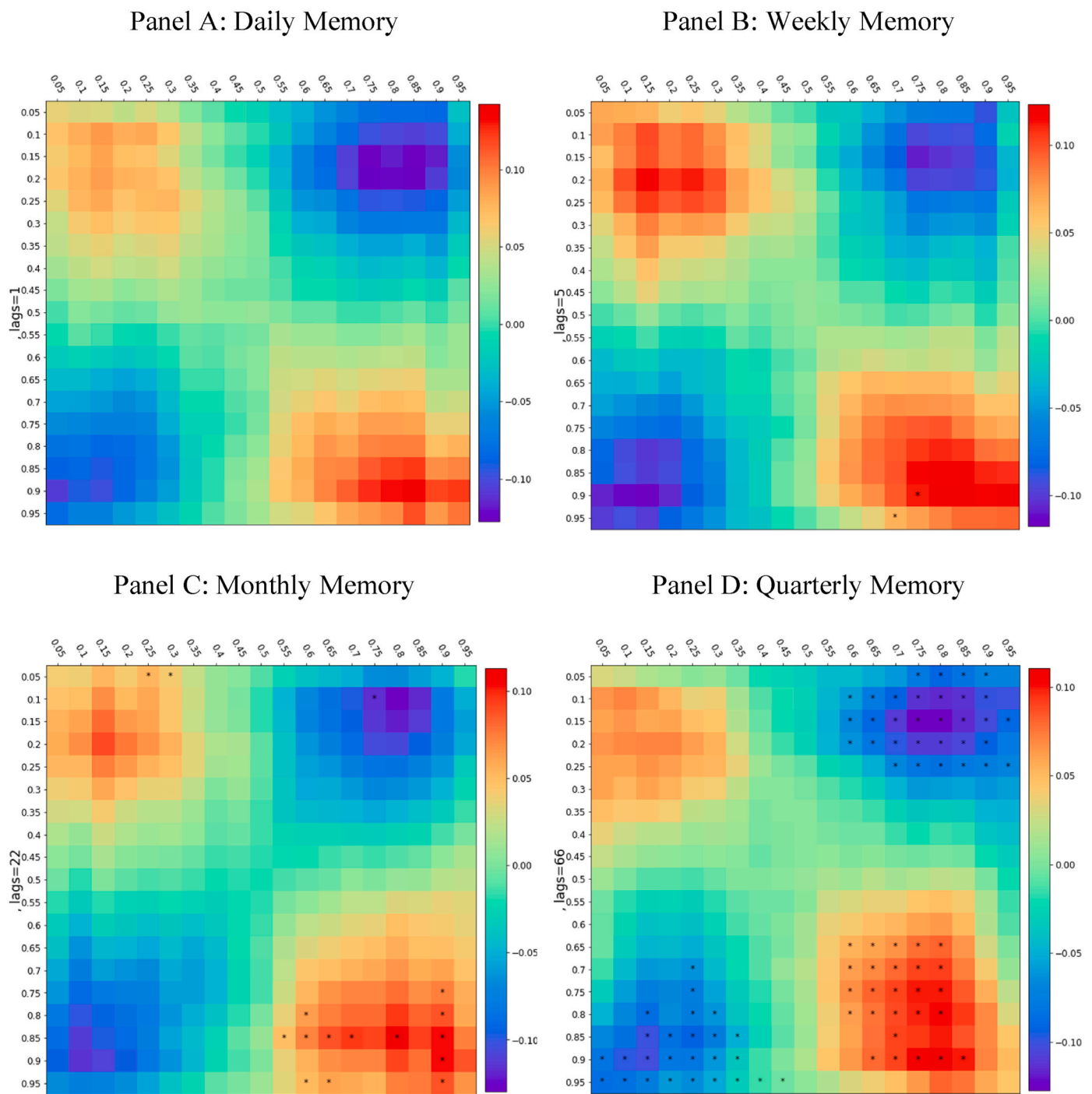


Fig. 3. Cross-quantile dependence from economic policy uncertainty to exchange rates.

have a weak nonlinear relationship. By applying Global Vector Autoregressive, Mirnezami et al. (2023) document that in resource-rich countries, such as Iran and Russia, the gross domestic product (GDP) benefits from oil price increases. The literature also shows that the gas price has a significant effect on consumer spending (Gately et al., 2013), industrial production and investment (Sahoo et al., 2014), and inflation (Casoli et al., 2022; Kilian & Zhou, 2022).

In sum, several conclusions can be drawn from the prior literature that motivate this study. First, we fill up the literature gap as other studies that analyzed the impact of geopolitical risk on exchange rate overlooked the Russian context; in addition, they provide heterogeneous results regarding the linkages analyzed, which are due to the unique

context in various countries. Moreover, the response of the exchange rate to external shocks (geopolitical turmoil or oil price shocks) is conditional on domestic policies by a country to address them, such as an exchange rate regime, monetary policy, and trade restrictions. Second, no extant literature discusses how gas prices influence the exchange rate. Finally, prior studies report that geopolitical risk is a prominent factor that influences oil and gas prices, as well as economic policy uncertainty. Likewise, economic policy uncertainty may influence oil and gas prices. Therefore, we are motivated to apply TVP-VAR dynamic connectedness and to reveal the interconnectedness among exchange rates, economic policy uncertainty, and oil and gas prices.

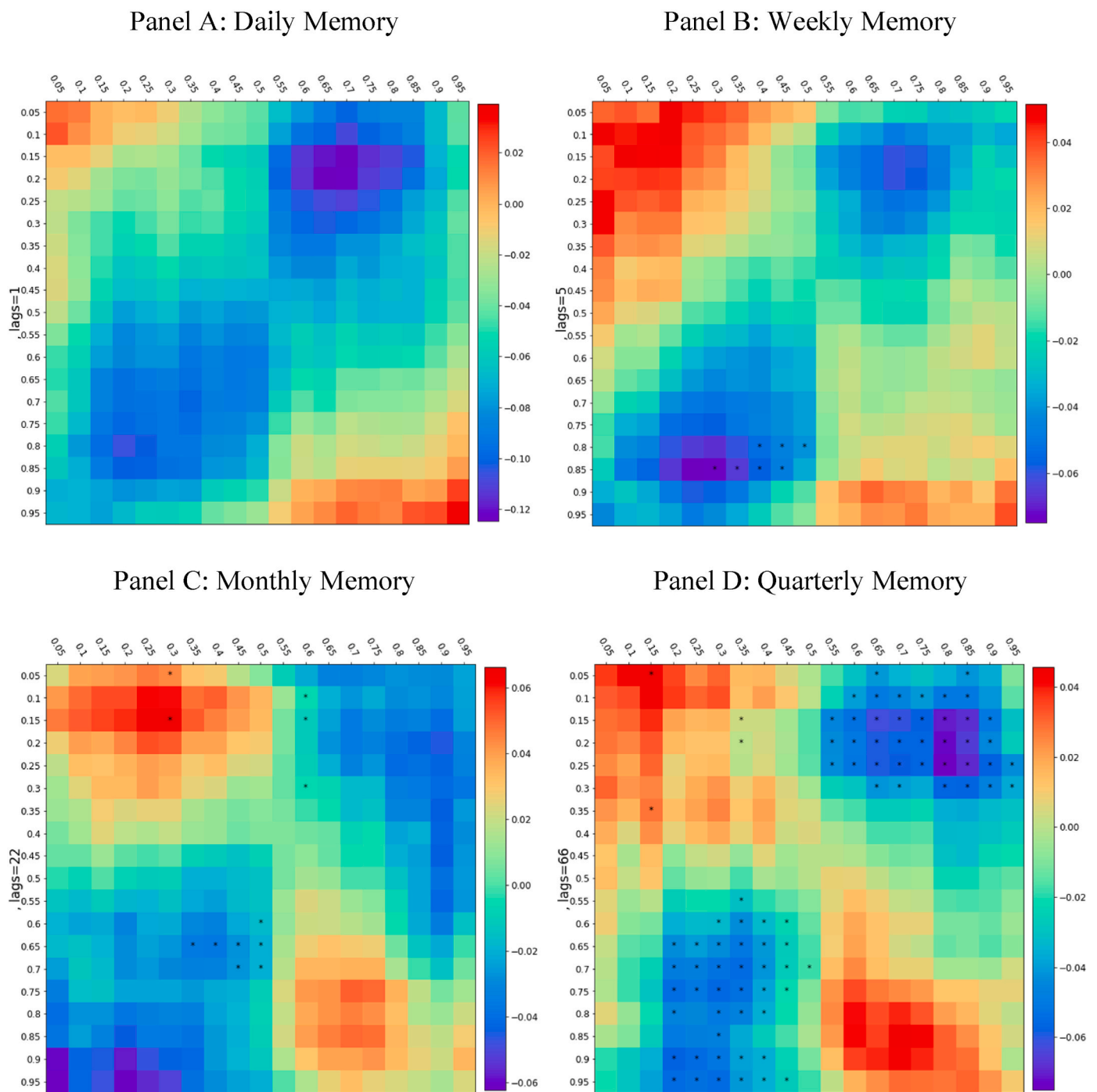


Fig. 4. Cross-quantile dependence from oil prices to exchange rates.

### 3. Methodology

#### 3.1. Data, description, and sources

We analyze monthly data from January 1998 to July 2022, using the most comprehensive data available. The variable definitions and sources are reported in Table 1. The EPU index, developed by Baker et al. (2016), considers frequency terms concerning political-economic dynamics (e.g., central bank, interest rate, inflation, tax, expenditure, bank credits, and political institutions) in *Kommersant*. Following Caldara and Iacoviello (2022), we measure geopolitical risk by counting the number of mainstream newspaper articles that cover geopolitical tensions and divided them into categories, such as nuclear threats, threats of war,

beginning of a war, threats of peace, terror threats, escalation of war, and terrorist acts. Country-specific geopolitical risk is calculated by considering the joint occurrence of the term “geopolitical risk” and the name of a country in mainstream newspapers.

The descriptive statistics of the variables are reported in Table 2, for the full sample and the 2022 subsample. The dataset consists of 6347 observations on exchange rates (ER), geopolitical risk (GPR), economic policy uncertainty (EPU), oil prices (OP), and gas prices (GP). We also analyze a subsample for the period of the Russia-Ukraine conflict. The number of EPU observations is lower because of limitations on data availability, as the publication of EPU observations is delayed.

Fig. 1 illustrates the dynamics of geopolitical risk. We observe high volatility in the geopolitical risk index from 1998 to 2022. In particular,

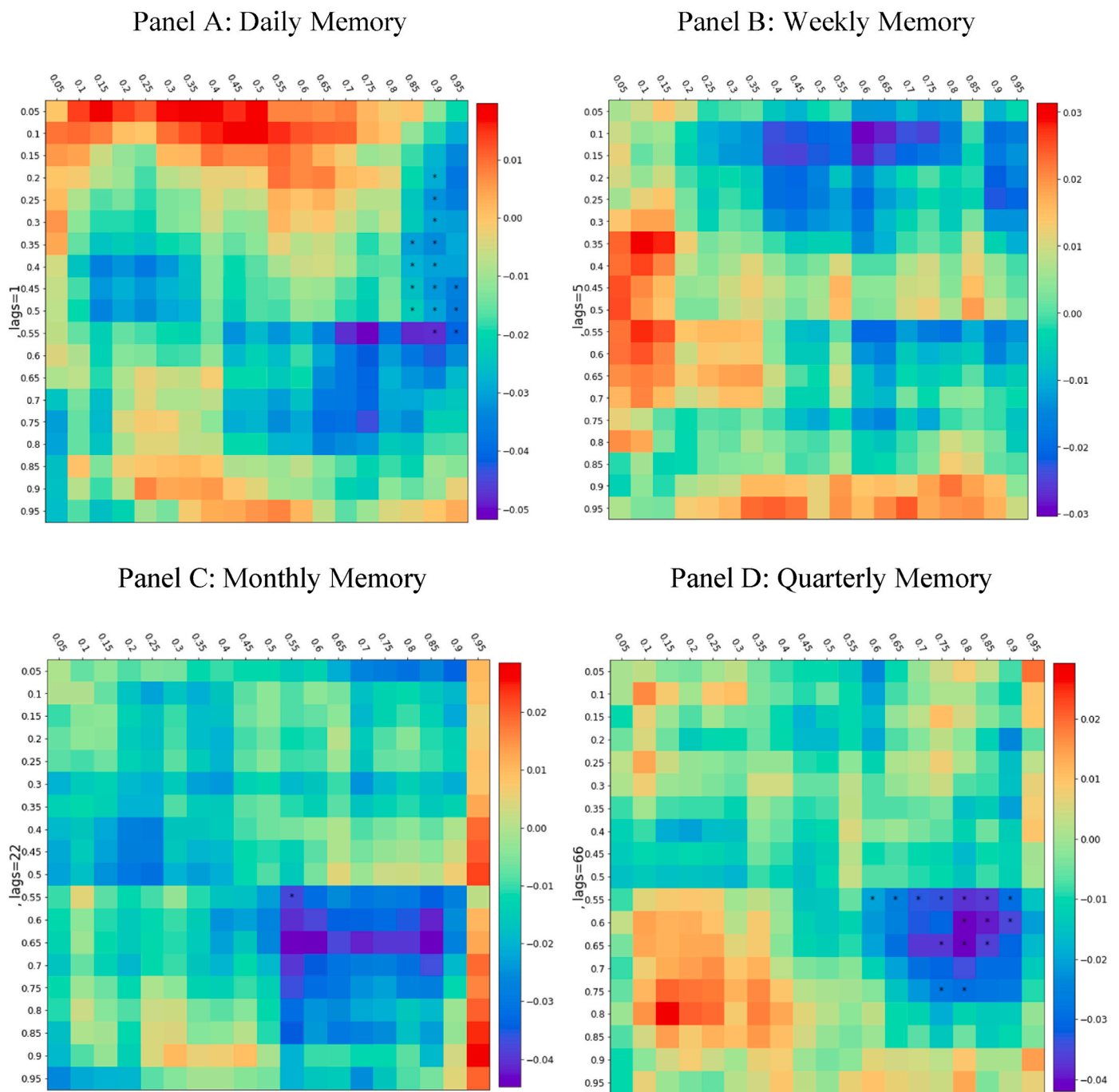


Fig. 5. Cross-quantile dependence from gas prices to exchange rates.

high spikes in 2002–2003 are connected to the Nord-Ost terror attack (the seizure of the crowded Dubrovka Theater by Chechen terrorists on 23 October 2002) and the Chechen military conflict (counter-terrorism measures on the territory of Chechnya and the border regions of the North Caucasus), while spikes in 2014–2015 are associated with the Russia-Ukraine conflict in 2014 and the annexation of Crimea. The highest spike was observed in 2022 during the Russia-Ukraine conflict, therefore, we are motivated to investigate a subsample for January to July 2022.

### 3.2. Cross-quantilogram approach

To measure how geopolitical risks (GPR), economic uncertainty, and oil and gas prices influence the Russian exchange rate (RUB per USD),

we use the cross-quantilogram (CQ) method proposed by Han et al. (2016) for several reasons. This technique is suitable for analyzing different segments of a distribution, including extreme observations along with the central portion of the distribution. The CQ method can be used to calculate the size and duration of the effect of the specific regressors on the regressed variable. The CQ method does not rely on any parametric assumptions, making it useful for analyzing data with nonstandard distributions. The CQ method employs quantile matching, which does not require moment conditions, making it suitable for analyzing data with fat-tailed distributions. The CQ method examines the direction of causation between two variables, including taking into account long-term lags during the estimation process. The CQ method can be applied across multiple time horizons, enabling us to examine the connection between the variables for shorter and longer periods. Finally,

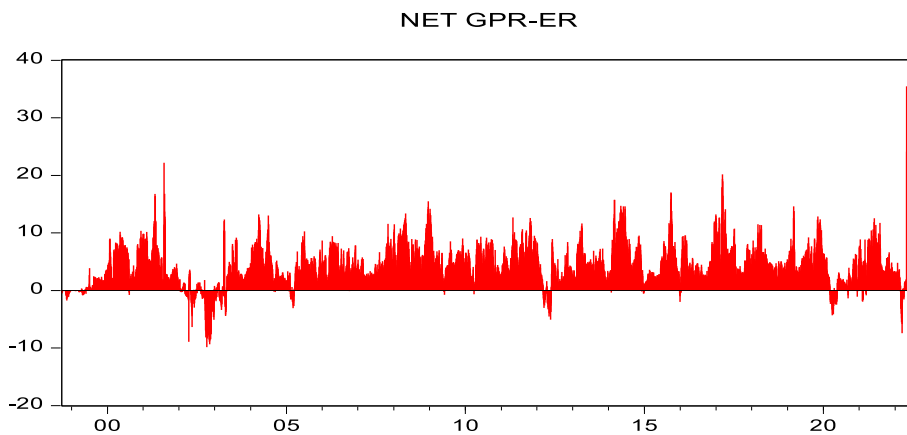


Fig. 6. Net pairwise frequency connectedness between geopolitical risk and exchange rates.

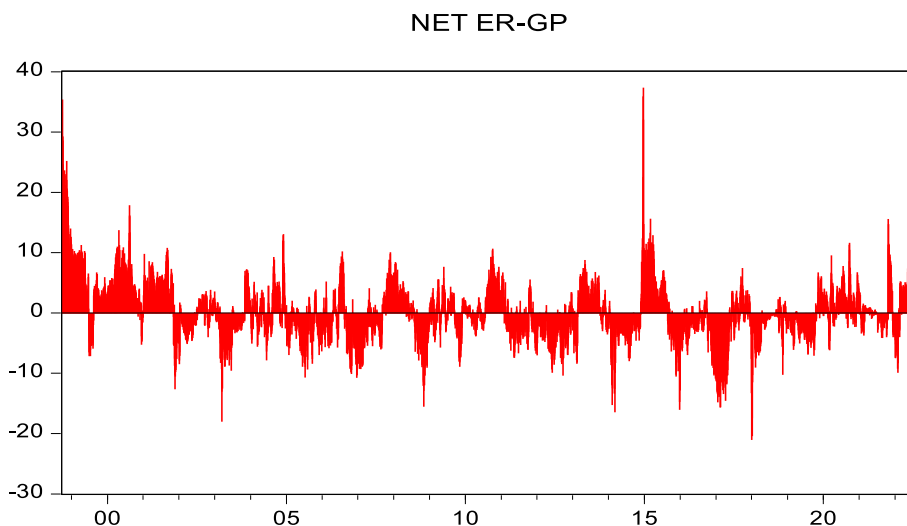


Fig. 7. Net pairwise frequency connectedness between exchange rates and gas prices.

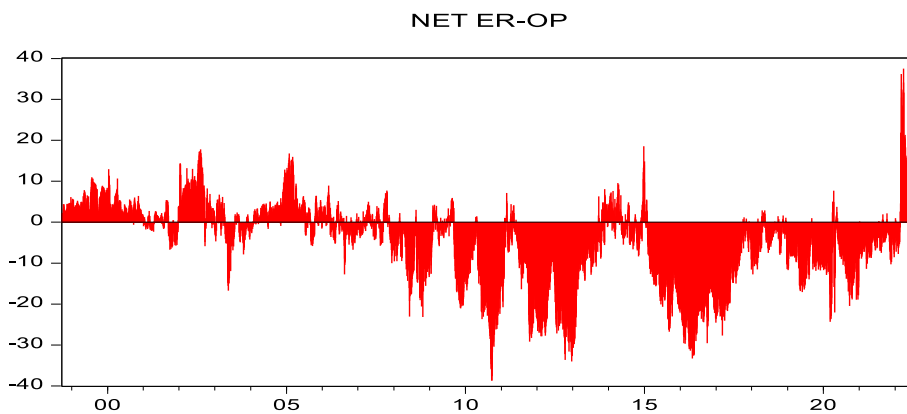


Fig. 8. Net pairwise frequency connectedness between exchange rates and oil prices.

the technique considers different lags, thus evaluating the spillover transmission in a shorter and longer memory that specifies the extent and sign of the coefficients.

Equation (1) gives the CQ between the vectors  $\{y_{1t} \leq q_{1t}(\tau_1)\}$  and  $\{y_{2t-k} \leq q_{2t-k}(\tau_2)\}$ , where  $k$  is the length of the lag for the pair  $\tau_1 - \tau_2$ :

$$\rho_\tau(k) = \frac{E[\psi_{\tau_1}(y_{1t} \leq q_{1t}(\tau_1))\tau_1]y_{1t} \leq q_{1t} \psi_{\tau_2}(y_{2t-k} \leq q_{2t-k}(\tau_2))]}{\sqrt{E[\psi_{\tau_1}^2(y_{1t} \leq q_{1t}(\tau_1))]} \sqrt{E[\psi_{\tau_2}^2(y_{2t-k} \leq q_{2t-k}(\tau_2))]}} \quad (1)$$

where  $y_{i,t}$  is a stationary time series,  $i = 1, 2, 3, \text{ or } 4$ , and indicates GPR, EPU, OP, or GP. Moreover,  $t$  is the time ( $t = 1, 2, \dots, T$ ).  $F_i(\cdot)$  and  $f_i(\cdot)$  are the distribution and density functions  $y_{it}$ ,  $i = 1, 2, 3, 4$ .

**Table 3**  
Market volatility spillovers.

	GPR	ER	EPU	OIL	GP	FROM others
GPR	66.95	10.45	3.32	12.97	6.32	33.05
ER	17	64.24	9.04	6.39	3.34	35.76
EPU	4.11	3.53	70.32	6.96	15.08	29.68
OIL	14.02	6.34	8.84	59.94	10.86	40.06
GP	7.45	1.4	15.11	11.19	64.85	35.15
TO others	42.57	21.72	36.31	37.5	35.6	173.7
Including own	109.51	85.96	106.63	97.44	100.46	TCI
NET	9.51	−14.04	6.63	−2.56	0.46	34.74

Notes: NET is calculated by subtracting volatility connectedness received from other variables.

$q_{it}(\tau_i) = \inf\{v : F_i(v) \geq \tau_i\}$  is the relevant quantile function for  $\tau_i \in (0, 1)$ , and  $\psi_a(u) = 1 [u < 0] - a$  is the process of a quantile hit.

### 3.3. Time-varying parameter-vector autoregression

This paper uses the dynamic time-varying parameter (TVP) vector autoregression (VAR) technique introduced by Antonakakis, Chatziantoniou, and Gabauer (2020), which enables us to examine the degree to which the exchange rate, geopolitical risk, economic policy uncertainty, oil price, and gas price are correlated with volatility.

The method is useful because it enables us to change the variance using a Kalman filter estimation of stochastic volatility and forgetting factors (Koop & Korobilis, 2014). Therefore, the TVP-VAR reveals inconsistent parameters because of a random selection in the size of the rolling window. This approach also enables the use of data with lower frequency and shorter intervals.

## 4. Results and discussion

### 4.1. Response of the exchange rate to exogenous shocks over a time horizon

We analyze the response of the exchange rate to exogenous shocks over the full sample period. The results obtained from the CQ approach are illustrated in a heatmap diagram that considers daily, weekly, monthly, and quarterly lags (1, 5, 22, and 66 days, respectively). The diagram consists of a  $19 \times 19$  grid, with a color spectrum that ranges from blueish (negative) to reddish (positive) to indicate exchange rate responses to geopolitical risks (GPR). An asterisk is used to denote the 10 percent significance level.

Our findings indicate that the exchange rate responds to geopolitical risks at varying memory lengths. In daily observations (Panel A, Fig. 2), the exchange rate falls within the 0.75–0.85 quartile range of geopolitical risks. In terms of weekly lags, higher GPR values at the 0.6 and 0.8 quantiles lead to a negative exchange rate response at the 0.05 quantile, indicating appreciation of the RUB. At 22 lags, GPR at the 0.55 quantile results in positive volatility spillovers at lower quantiles, whereas GPR at the 0.75 quantile leads to positive volatility spillovers below the 0.9 quantile.

Fig. 3 shows cross-quantile dependence between economic policy uncertainty and the exchange rate. Daily lags have an insignificant impact. With a five-day lag, positive volatility spillovers from economic policy uncertainty occur at the 0.7 and 0.75 quantiles to the exchange rate at the 0.9 and 0.95 quantiles. This impact is amplified over longer time frames. Monthly lags lead to positive volatility spillovers from economic policy uncertainty at lower quantiles to the exchange rate at the lowest quantile. Under bullish market conditions, a stronger positive association is observed for both quantiles. Quarterly lags show negative volatility spillovers from economic policy uncertainty at lower quantiles to the exchange rate under bullish market conditions. At the highest

quantile, economic policy uncertainty has negative volatility spillovers under bearish conditions and positive spillovers under bullish conditions in both markets.

Fig. 4 illustrates volatility spillovers from oil prices to the exchange rate. In the short term, only the weekly lag is significant, revealing a negative link between the 0.3–0.5 quantiles of oil prices and the 0.8 and 0.85 quantiles of the exchange rate. Monthly lags demonstrate positive spillovers from oil prices under the 0.3 quantile to the 0.05 and 0.15 quantiles of the exchange rate, whereas 0.35–0.5 quantiles lead to negative spillovers at the 0.6–0.7 quantiles. With a quarterly lag, oil prices generally lead to appreciation in the RUB. Higher quantiles result in negative spillovers to lower exchange rate quantiles, whereas lower quantiles lead to negative spillovers to higher exchange rate quantiles.

Fig. 5 illustrates the impact of oil price changes on exchange rates across quantiles. Our analysis reveals a consistently negative relationship between gas prices and exchange rates, indicating appreciation in the RUB when gas prices rise. Notably, at a lag of one, higher quantiles of gas prices lead to negative volatility spillovers to lower and middle quantiles of the exchange rate. However, with a weekly lag, gas prices have insignificant influence on the exchange rate. In monthly memory, gas price volatility at the 0.55 quantile negatively impacts exchange rate volatility at the same quantile. Lastly, at a quarterly lag, significant negative volatility spillovers are observed from gas prices in the 0.6–0.9 quantiles to the exchange rate in the 0.55–0.75 quantiles.

### 4.2. Time-frequency analysis of exchange rate and exogenous shocks

Our time-frequency connectedness analysis in Figs. 6–8 yields valuable insights into the intricate relationships among the economic variables studied. Fig. 6 shows that geopolitical risk generally contributes to exchange rate volatility, except in 2003, 2006, 2013, and 2020. Fig. 7 reveals a bidirectional relationship between gas prices and the exchange rate, due to Russia’s significant reliance on gas revenue, as the world’s largest gas exporter.

Fig. 8 shows the net pairwise frequency connectedness between exchange rates and oil prices. Our analysis indicates that, in general, oil prices contribute to exchange rate volatility. However, notable exceptions include periods such as 1999–2001, 2003, 2005, and 2022, suggesting the significant influence of exchange rates on oil prices. One plausible explanation is Russia’s status as a major net oil exporter, even though it is not a member of the Organization of the Petroleum Exporting Countries. Overall, we observe abnormal interconnectedness during the period January–July 2022, which covers the Russia-Ukraine conflict. Therefore, we are motivated to conduct additional analysis focused on this period.

### 4.3. Response of exchange rates to exogenous shocks during the Russia-Ukraine conflict

Table 3 presents the TVP-VAR results on the frequency connectedness among the variables analyzed. Geopolitical risk receives 33.05 percent of the volatility from all markets, transmitting 42.57 percent to others, and 17 percent to itself. Exchange rate is the largest recipient (35.76%) and smallest contributor (21.72%). Economic policy uncertainty receives 29.68 percent, transmitting 36.31 percent. Oil prices receive 40.06 percent, transmitting 37.5 percent. Gas prices receive 35.15 percent, transmitting 35.6 percent. The Total Connectedness Index (TCI) is 34.74 percent. Geopolitical risk is the highest net positive spillover transmitter (9.51%), whereas exchange rates receive the highest net spillover (14.04%). Economic policy uncertainty contributes a net 6.63 percent, gas prices marginally contribute 0.46 percent, and oil prices receive a net 2.56 percent.

Fig. 9 illustrates net pairwise connectedness, aligning with Table 3. Throughout 2022, geopolitical risk (GPR) is a net contributor to exchange rates and Russian economic policy uncertainty. Geopolitical risk mostly contributes to oil and gas price volatility, except in May–June

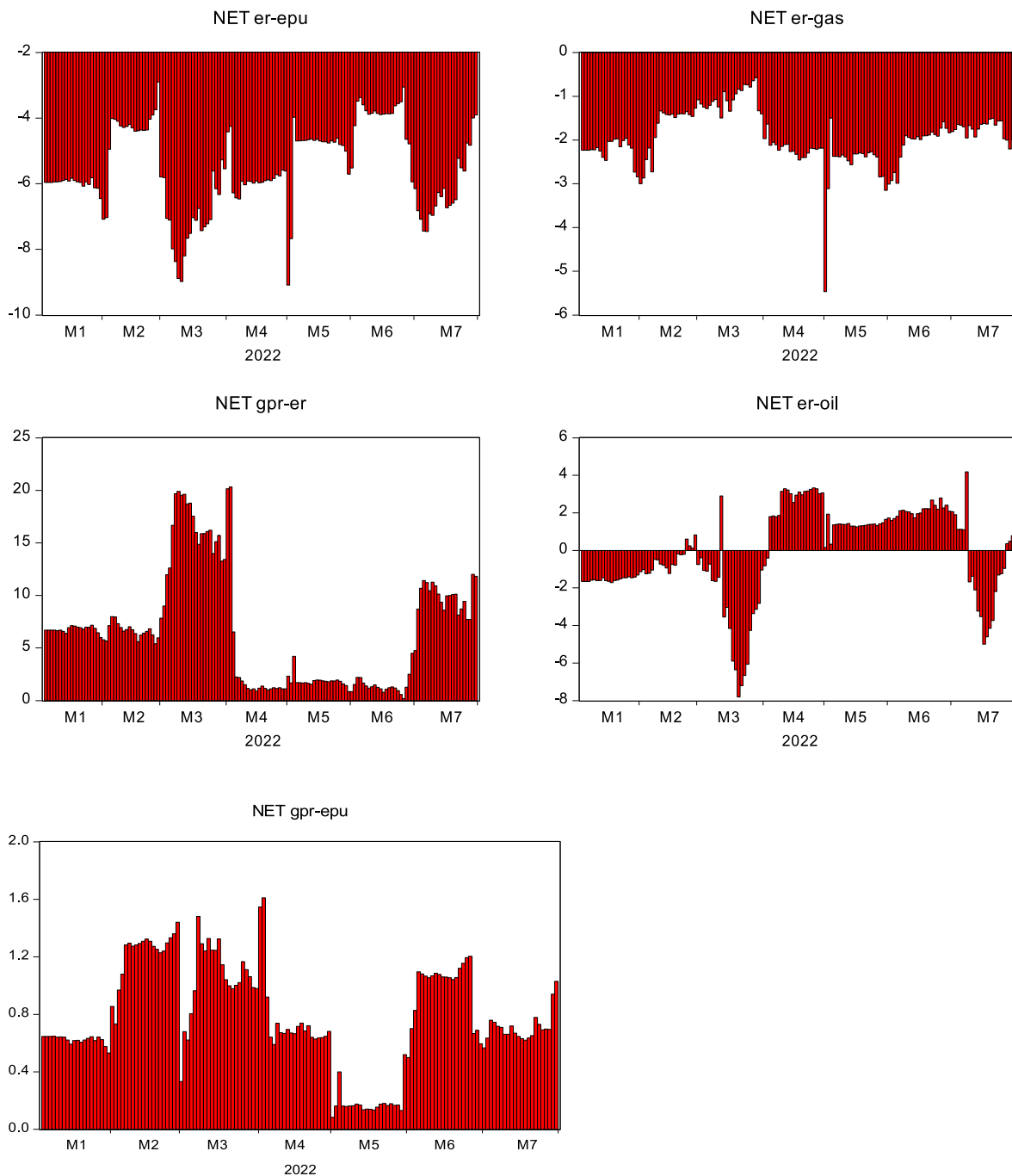


Fig. 9. Net pairwise connectedness.

2022, possibly due to Russia’s role as a significant non-OPEC oil and gas exporter. The policy implemented in April of accepting only rubles in payment for gas purchases contributes to volatility in hydrocarbon markets, affecting international relations. Appendixes A, B, and C show volatility spillovers, received spillovers, and TCI, respectively. A significant spike in early May coincides with the imposition of a fifth set of sanctions, intensifying market volatility.

#### 4.4. Robustness check for hedging properties

Next, we investigate the hedging properties of the RUB concerning oil and gas prices, as well as heightened geopolitical tension and uncertainty in Russian policy. Our methodology employs the wavelet-based quantile correlation (WQC) method introduced by Kumar and

Padakandla (2022). This approach offers a distinct advantage by providing a clear directional correlation between the returns on two assets under various market conditions.

Fig. 10 visually represents the quantile correlation (QC) between EX and OP in different trading periods, using wavelet transformation. Notably, QC has a negative trend at lower to middle quantiles for daily trading, suggesting safe-haven and hedging behavior when foreign reserves are held against Russian currency and future oil prices. Conversely, at the middle quantile, a positive QC indicates potential for diversification. In weekly (4–8 days) and yearly (128–256 days) trading periods, QC hovers close to zero across almost all quantiles. In the monthly trading cycle, QC is positive from the lower to middle quantiles, illustrating a diversification effect.

During periods of market volatility, assets with safe-haven

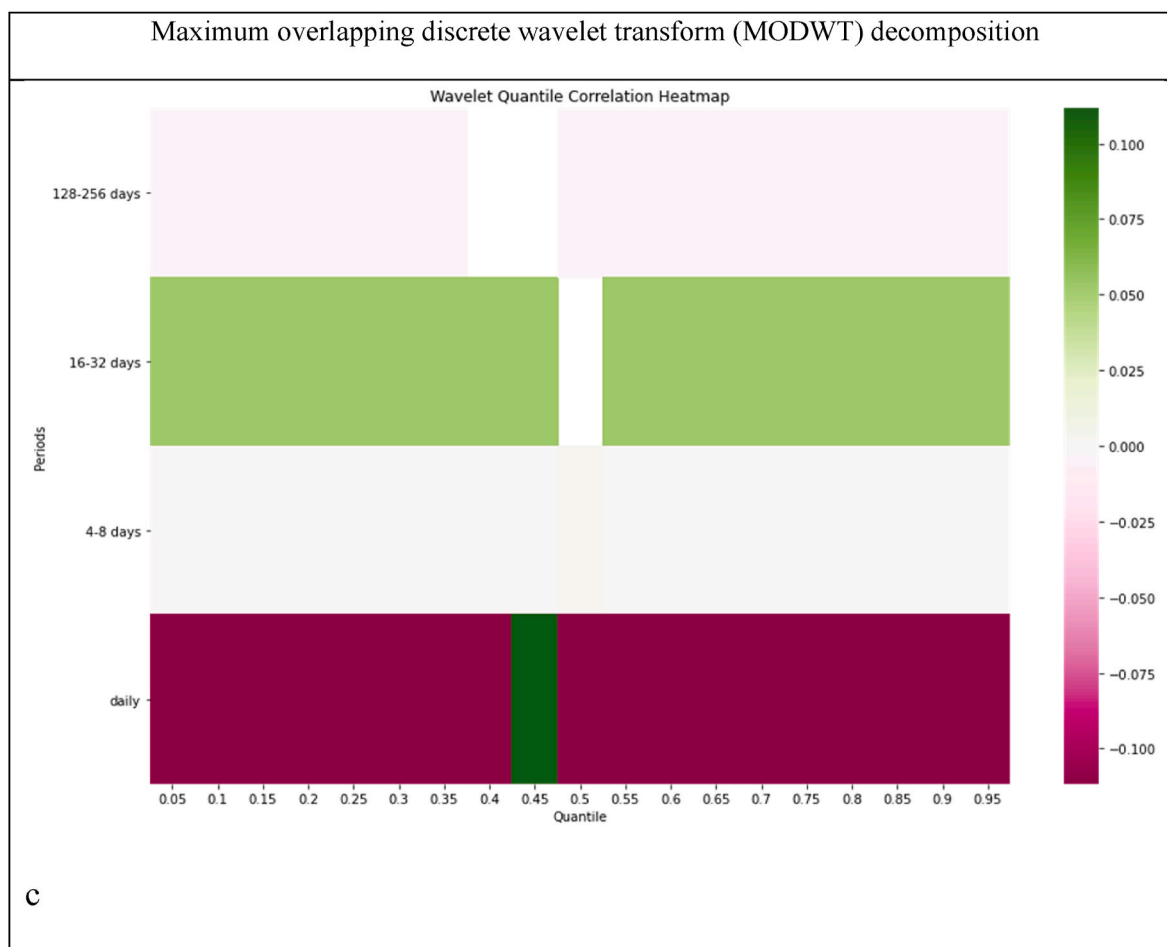


Fig. 10. Wavelet-quantile correlation between EX and OP.

characteristics should ideally have a negative or no correlation with other assets, identifiable at lower quantiles. Gas prices have a negative association with EX at daily intervals, suggesting safe-haven and hedging behavior in the holding of foreign reserves and future gas prices (Fig. 11). In weekly to monthly intervals, EX and GP have a positive correlation, indicating diversification characteristics.

In times of heightened geopolitical tension, EX is positively correlated from medium to higher quantiles at daily intervals, signifying diversification characteristics (Fig. 12). Consequently, it is considered safer to hold foreign currency than the RUB. However, from weekly to monthly intervals, it becomes a safer asset. During periods of high policy uncertainty, EX is unrelated at daily intervals, indicating a safe investment, whereas foreign reserves have diversification characteristics relative to the RUB at weekly intervals (Fig. 13).

#### 4.5. Discussion

Our full sample analysis confirms that GPR has a mixed effect on exchange rate dynamics. At the lowest level of GPR, the Russian exchange rate appreciated from extreme depreciation, whereas the ER fell when the GPR reached a peak. Our findings are partly in line with Salisu et al. (2022), who find that when the market is bullish, GPR transmits positive spillover to volatility in the Russian exchange rate under a floating exchange rate regime. At the bullish states of GPR and ER, our finding corresponds to that of Wang et al. (2019), who find that the imposition of sanctions leads to depreciation in the currencies of sanctioned countries. Our subsample analysis highlights that the exchange rate is highly responsive to GPR over a medium-size time horizon (22 days). Our results suggest that, after a geopolitical shock, the value of

the RUB falls to its lowest point after one month. However, the detrimental impact of geopolitical risk is offset after a quarter.

We also find that, in general, the value of the RUB against the US dollar rose because of Russian domestic economic policy, which reflects anecdotal evidence of the results of the Russian government's implementation of macroeconomic policy to stabilize the exchange rate. For example, an abrupt increase in interest rates by the RCB from 9 percent to 20 percent helped to solve the liquidity problem by increasing demand for the RUB. Additionally, the RCB imposed restrictions on operations using foreign currency. The government also introduced trade restrictions, such as the acceptance only of RUB in payment for purchases of gas and wheat, which account for a significant share of Russian exports. Furthermore, Russia required oil exporters to convert 80 percent of their revenue from oil sales into RUB. Thus, we confirm an assumption by Salisu et al. (2022), who argued that macroeconomic policies matter in exchange rate resilience to external shocks. Russia strives to enhance trade integration with its strategic partners, such as China and India, in order to smooth out the detrimental impact of sanctions through export and import channels, as suggested by Wang et al. (2019), Thaver and Ekanayake (2010), and Haidar (2017). Overall, our findings shed light on the complex interactions between geopolitical risk and exchange rates and offer insights into the measures taken by the Russian government to stabilize the economy in a time of crisis.

With regard to the transmission of volatility from economic policy uncertainty to the exchange rate in quarterly lags, economic policy uncertainty has a symmetric negative impact on the exchange rate. In particular, a negative association is observed at lower quantiles of economic policy uncertainty and higher quantiles of the exchange rate as well as higher quantiles of economic policy uncertainty and lower

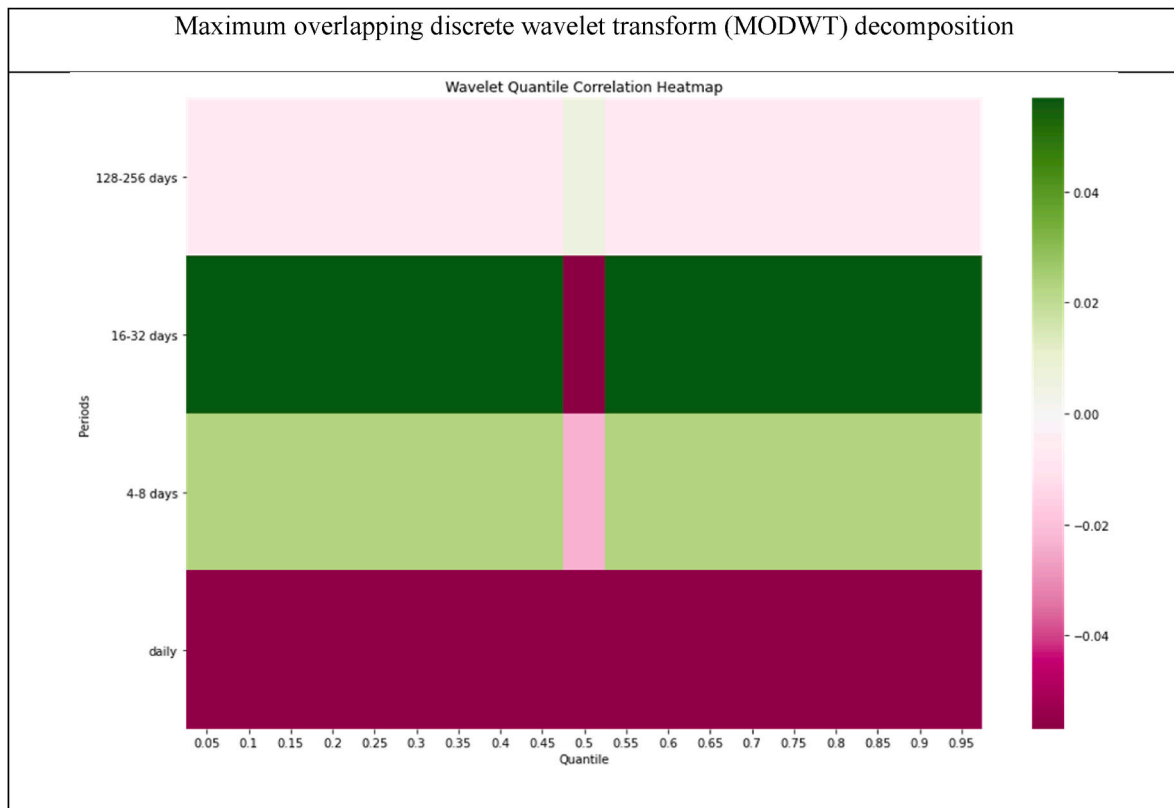


Fig. 11. Wavelet-quantile correlation between EX and GP.

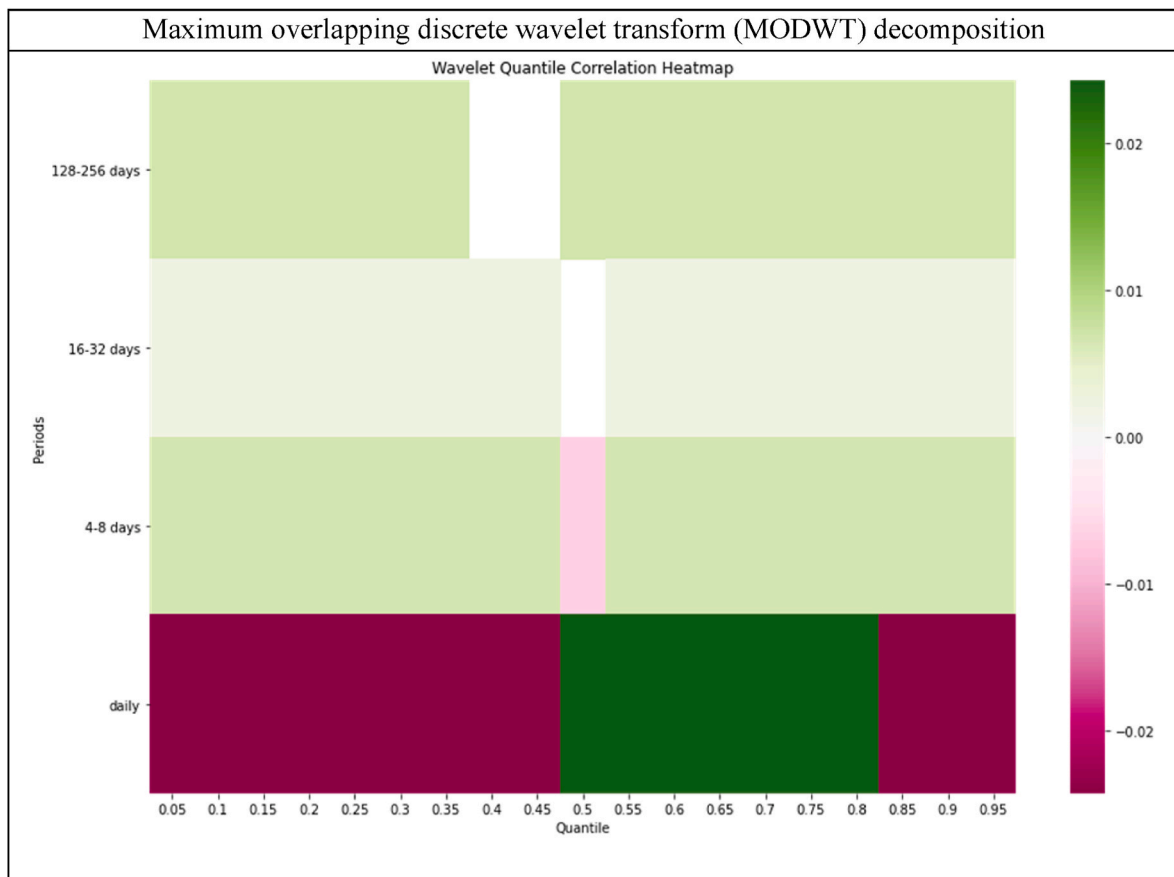


Fig. 12. Wavelet-quantile correlation between EX and GPR.

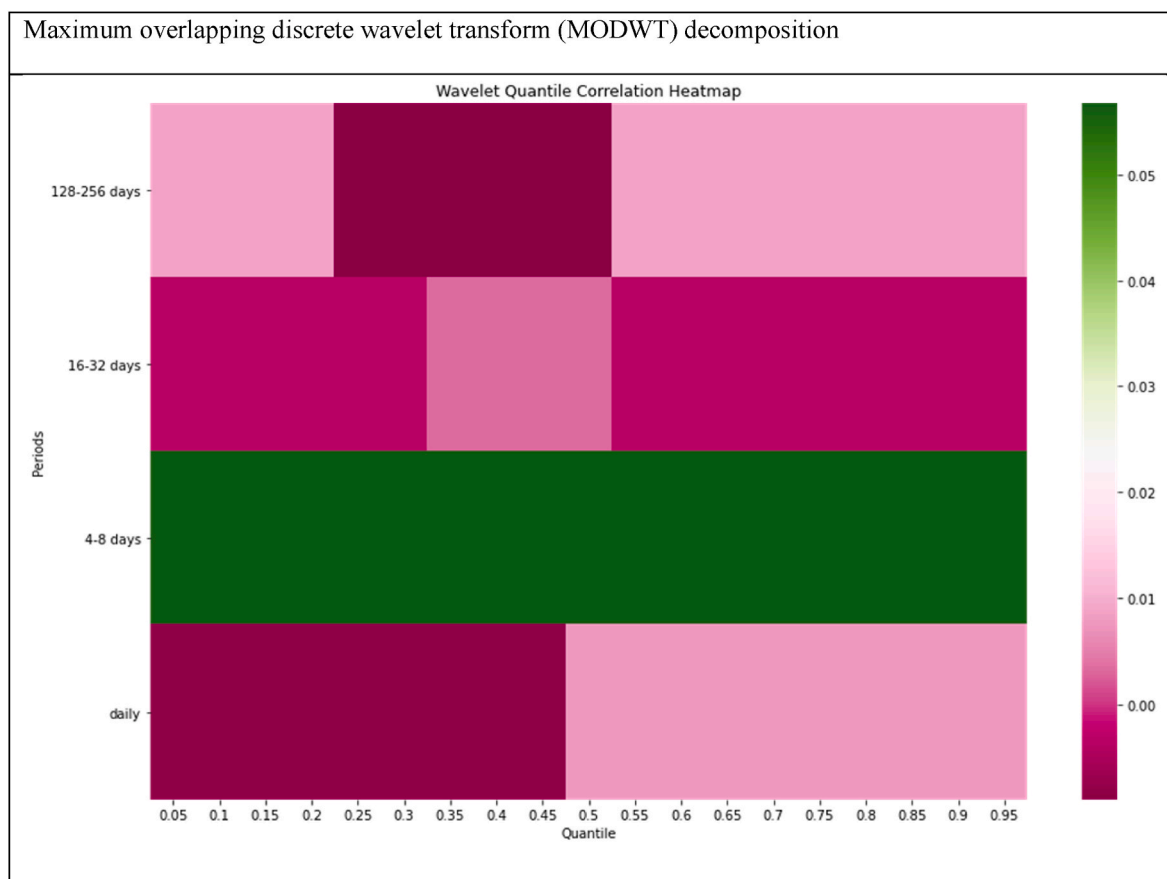


Fig. 13. Wavelet-quantile correlation between EX and EPU.

quantiles of the exchange rate. Moreover, economic policy uncertainty transmits a positive volatility spillover effect under bullish conditions in both markets. These findings are in line with those by [Sohag, Gainetdinova, Hammoudeh, and Shams \(2022\)](#), who also confirm that the impact of economic uncertainty is ambiguous. Furthermore, our findings are in line with those by [Kido \(2016\)](#), [Beckmann and Czudaj \(2017\)](#), and [Li et al. \(2020\)](#), who reveal that an increase in economic policy uncertainty leads to appreciation in a country's currency. Accordingly, our results are consistent with those by [Nilavongse et al. \(2020\)](#), [Vithessonthi \(2014\)](#), and [Rosa \(2011\)](#), who find the opposite result. By analyzing the Russia-Ukraine conflict, we discover that an increase in economic policy uncertainty leads to appreciation in the RUB in the short run. However, in the long run, the impact of economic policy uncertainty becomes positive, perhaps because the introduction of new policy measures is associated with uncertainty, and the influence of uncertainty increases over time.

Our time-frequency analysis of exchange rates and exogenous shocks shows that geopolitical risk tends to be a net contributor to exchange rate volatility, with some exceptions in 2003, 2006, 2013, and 2020. Volatility contribution sharply spikes in 2022, corresponding to the period of the Russian-Ukrainian conflict. Throughout 2022, geopolitical risk is a net volatility contributor to the exchange rate and economic policy uncertainty. Except in May–June 2022, geopolitical risk contributes to volatility in oil and gas prices perhaps because Russia, though a non-OPEC member, is a large oil and gas exporter. This finding is partly in line with that of [Baumeister and Kilian \(2016\)](#) and [Hamilton \(2013\)](#), who find that substantial fluctuations in oil prices are driven by geopolitical events and the risk of natural disasters. In April 2022, Russia began to implement the policy requiring gas purchases to be paid in RUB, inducing volatility in hydrocarbon markets. Hence, an increase in the price of energy deteriorates international relations. All graphs

illustrate a huge spike at the beginning of May 2022, implying that during this period volatility increased simultaneously in all markets. We believe that this spike is associated with the imposition of the fifth package of sanctions, which included additional trade restrictions.

However, determination of the primary factor that affected the valuation of the RUB— international oil prices or domestic policies—remains a subject of debate. The surge in oil prices in the spring of 2022 undoubtedly contributed to the increase in the total value of Russian exports. Nevertheless, it is imperative to acknowledge that proactive measures taken by the RCB effectively anticipated and mitigated speculative behavior such as purchases of foreign currency. Therefore, we included both dimensions in the analysis: international oil prices and economic policy uncertainty.

We consider economic policy uncertainty as a proxy for domestic policy, recognizing its significance. At the same time, we also consider international oil and gas prices, because of Russia's high dependence on revenue from sales of these two energy sources, making them pivotal factors in determining the exchange rate. Our analysis of the cross-quantilogram results for a 2022 subsample reveals that oil prices had a smaller impact on the RUB than economic policy uncertainty did. In particular, the increase in oil prices led to depreciation in the RUB under daily and weekly memory, with a mixed effect in monthly memory, resulting in depreciation at lower quantiles and appreciation at higher quantiles of the exchange rate.

With respect to economic policy uncertainty, an escalation in uncertainty corresponds to appreciation in the exchange rate at both higher and lower quantiles in daily and weekly memory, but in monthly memory, it led to depreciation. Gas prices were predominant in contributing to depreciation in the RUB. Moreover, the results of our TVP-VAR dynamic connectedness analysis indicate that 9.04 percent of the exchange rate volatility comes from economic policy uncertainty

contributes, whereas 6.39 percent of the volatility spillover to the exchange rate is transmitted by oil prices. Consequently, our analysis suggests that oil prices and domestic policy both played pivotal roles in the appreciation of the RUB.

## 5. Conclusion and implications

This study investigates the impact of geopolitical risk on the exchange rate of the ruble, including economic policy uncertainty, oil price, and gas price. To provide a comprehensive analysis, we use two high-frequency time series: the first from January 1, 1998, to July 30, 2022, and the second for 2022, which encompasses a period of unprecedented geopolitical pressure on Russia. Our results show that geopolitical risk plays a minor role in defining exchange rate dynamics in the longer sample. However, geopolitical risk has a more pronounced impact on exchange rate depreciation with a quarterly lag in a bullish market. The cross-quantile dependence for 2022 illustrates that the detrimental impact of geopolitical risk is offset in quarterly memory, likely due to several macroeconomic policies by the Russian government, including an abrupt increase in interest rates, restrictions on the use of foreign currency, and an obligation for oil and gas exporters to accept only RUB for payment. Economic policy uncertainty has a pronounced effect on the exchange rate, so the RUB falls in value under

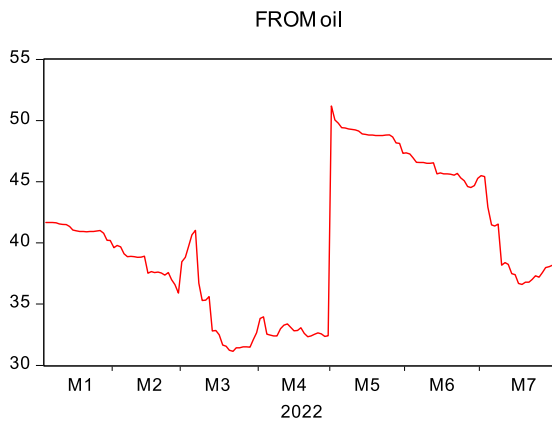
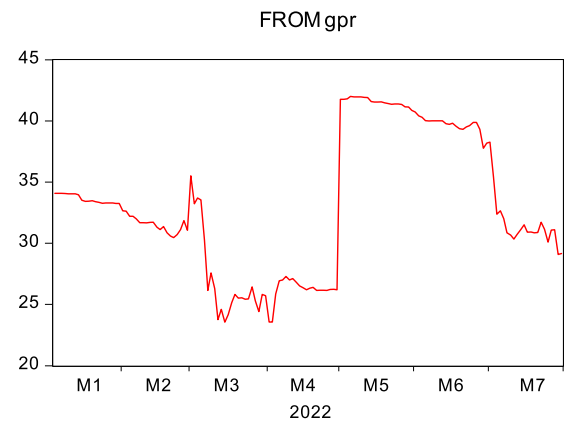
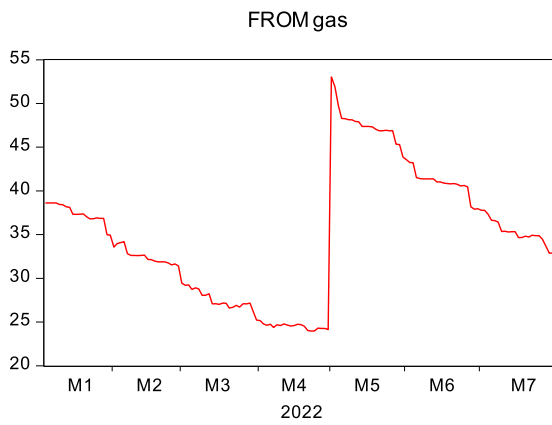
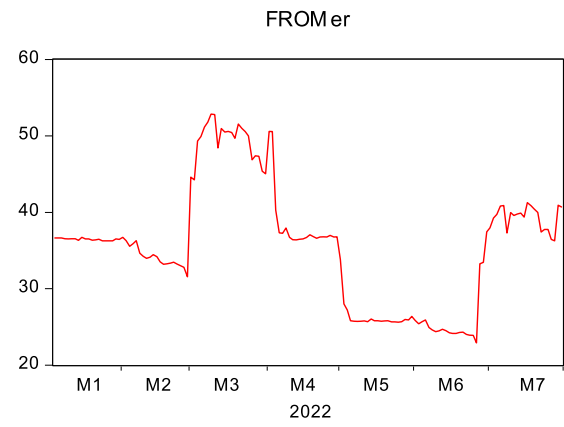
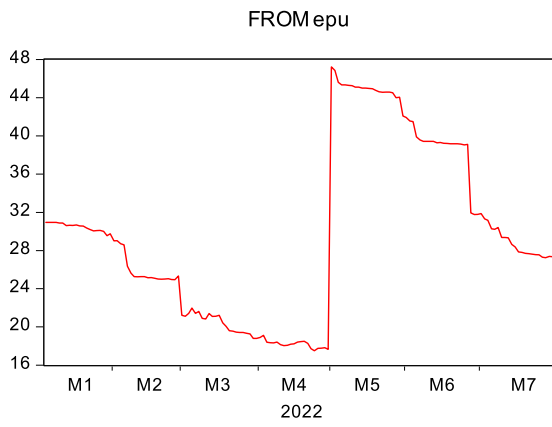
bullish market conditions and rises in value when market conditions are bearish.

Finally, our results lead to some important policy implications. Theoretically, the RUB should be sensitive to the impact of geopolitical risk because Russia has a floating exchange rate system. However, our results highlight the effectiveness of Russian domestic economic policies for minimizing the detrimental impact of geopolitical risk. In particular, measures such as the adjustment of interest rates, currency controls, restrictions on foreign exchange transactions, and the introduction of the domestic payment system (Mir) allowed Russia to mitigate the negative impact of economic sanctions and stabilize its exchange rate. Moreover, Russia has established closer trade relations with strategic partners, such as China and India. Our findings also show that an increase in economic policy uncertainty leads to depreciation in the RUB under bullish market conditions, implying that greater stability in economic policy is beneficial for the exchange rate. Moreover, our results should be of interest to policy makers involved in economic policy development and to investors in decision-making.

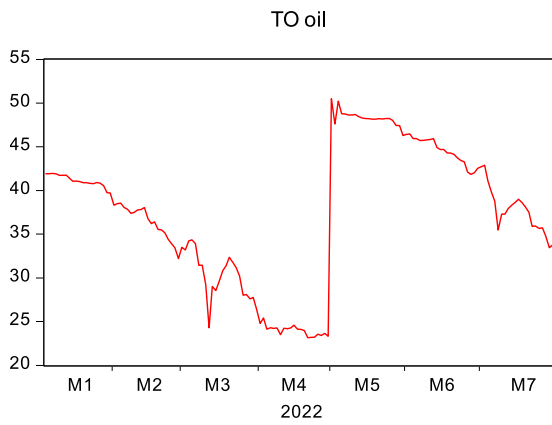
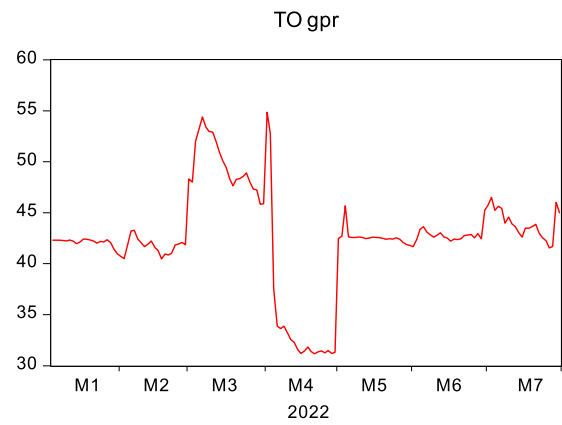
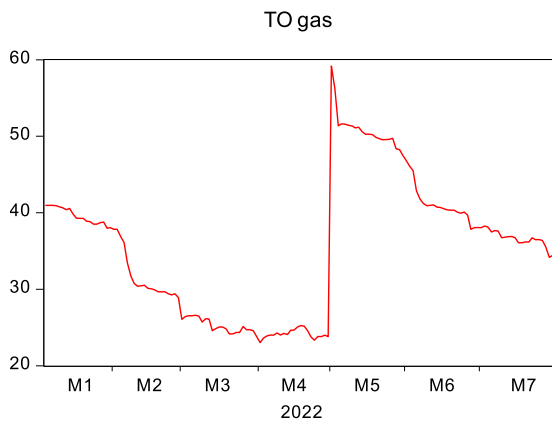
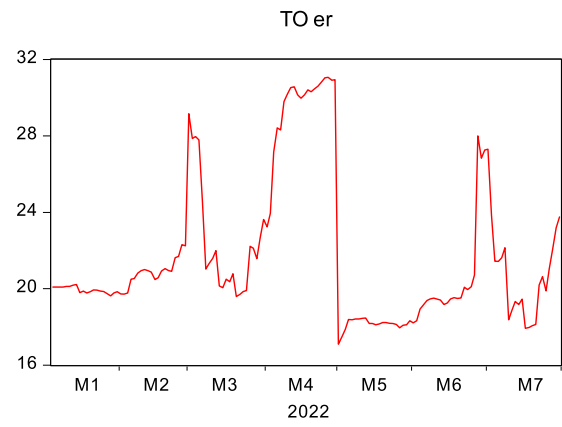
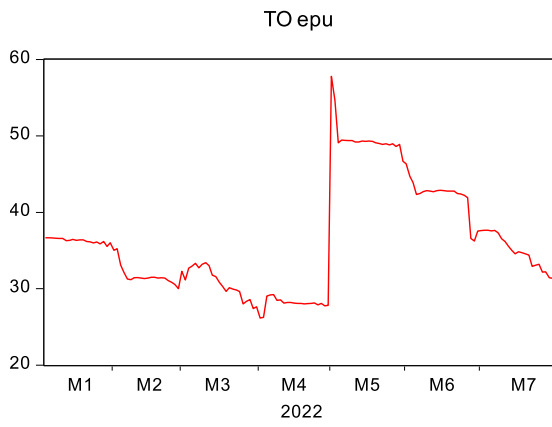
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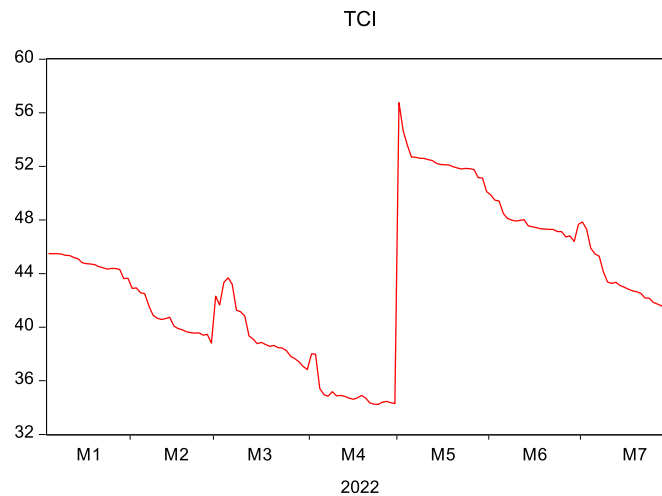
## Appendix A. Volatility Transmission from exchange rate, economic policy uncertainty, geopolitical risk, oil price and gas price



**Appendix B. Volatility Transmission to exchange rate, economic policy uncertainty, geopolitical risk, oil price and gas price**



**Appendix C. Total connectedness index**



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