Evaluating the Effectiveness of EU Sanctions On Russian Financial Markets: A GARCH-Based Approach

Aleksandr Chernykh[1, 2]
[1] Independent Not-for-profit Educational Organization of Higher Education, St. Petersburg, Russia
achernykh@eu.spb.ru
[2] European University at St. Petersburg, St. Petersburg, Russia
achernykh@eu.spb.ru

This study assesses the efficiency of European Union sanctions imposed on Russia in 2022–2023, focusing on their short- and mid-term impact on financial markets. Despite Russia's restrictions on macroeconomic and international trade statistics, stock market data remains accessible, allowing an empirical investigation of market responses. Using a CCC-GARCH model, particularly conditional covariance estimation, the study analyzes volatility spillovers and contagion effects across Russian financial markets: stock, government bond, and foreign exchange markets. The findings identify key turbulence periods and the "first domino knuckle"—the initial markets most affected—shedding light on market resilience and shock transmission. Since all the sanctions remain in place and new ones continue to be imposed, assessing their long-term effects is not yet possible. However, this study could provide valuable insights on the effectiveness of economic sanctions and contribute to the broader discourse on economic coercion and market stability.

DOI
https://doi.org/10.18690/um.epf.5.2025.51

ISBN
978-961-286-984-7

Keywords:
financial markets,
GARCH,
economic sanctions,
Russia,
volatility

JEL:
C58,
F51,
G12

University of Maribor Press

1 Introduction

The Russian economy remains under stringent international sanctions. The European Union, Russia's primary trading partner until 2022, has led these efforts. While the sanctions have not achieved their stated objectives, they have inflicted some economic damage. Three years after their implementation, debate persists over their effectiveness, with arguments for both tightening and easing certain restrictions as tools of coercion or incentive. In this context, all parties must assess which existing sanctions have had the most significant impact on the Russian economy.

Since 2022, Russia has significantly restricted access to official macroeconomic and foreign trade statistics, complicating the assessment of sanctions' impact (Chernykh, 2024a). However, aside from a one-month suspension in 2022, the stock market and its indices continue to provide publicly available exchange-traded data for evaluating sanctions' effectiveness.

The stock market, particularly stock indices, has traditionally served as a tool for assessing the impact of negative events such as epidemics, trade wars, and sanctions on an economy. Beyond analyzing changes in returns, a common approach is to evaluate risk or uncertainty. In the scientific literature, uncertainty is typically measured by volatility, which serves as a proxy for the national financial market's condition during crises and as an indicator of country risk (Aganin, 2020).

This paper aims to evaluate the effectiveness of economic sanctions imposed on Russia by the European Union from 2022 to 2023 by analyzing volatility spillovers and contagion effects across different segments of the Russian stock market. Since the long-term impact of sanctions depends on both economic factors and geopolitical developments—such as the potential imposition or removal of sanctions in anticipation of peace negotiations—this study focuses on their short- and mid-term effects.

The paper is structured as follows. Following the introduction, which includes the study's motivation and a brief review of relevant research, the next section presents the methodology. This is followed by a description of the data. The paper concludes with a summary of findings.

2 Literature review

Second-moment analysis enables the estimation of market contagion effects, defined as excessive cross-country correlation during crises (Beirne et al., 2013), such as sanction periods. The generalized autoregressive conditional heteroskedasticity (GARCH) family of models provides a framework for estimating contagion effects and identifying abnormal volatility shifts during market turbulence.

Various GARCH model variations have been extensively used to assess the impact of sanctions. Economic sanctions on Iran have been analyzed using MGARCH to examine the relationship between the exchange rate, oil prices, and Iranian exports (Omidi et al., 2021). Research on the Russian stock market employed GARCH models even before sanctions were imposed; for instance, contagion effects between the U.S. and Russian stock markets were estimated using VAR-GARCH for the period 2005–2013 (Syriopoulos et al., 2015). Regarding the 2014–2021 sanctions against Russia, Afanasyev et al. (2021) applied an ARMAX-GARCH model to assess the impact of tweets on the ruble exchange rate. TGARCH (Aganin, 2021) and EGARCH (Sultonov, 2020) models have been used to analyze the relationship between the volatility of the Russian stock index and oil prices. Fedorova et al. (2024) also include 2022-2023 sanctions in their sample when estimating the volatility of Russian sectoral indices and news background using GARCH model.

The sanctions imposed on Russia since 2022 have several distinctive features that must be considered in model development. Beyond the restricted access to foreign trade data, these include the non-transparent pricing of Russian oil and oil products (Vakulenko, 2023), sanctions on public debt, and the simultaneous targeting of exports, national reserves, and imports. This pressure can generate opposing effects, which the national currency may absorb (Itskhoki & Mukhin, 2022).

This necessitates excluding foreign trade indicators and oil prices from the volatility estimation. Instead, the ruble exchange rate and the government bond market, as key financial variables, are incorporated into the model. Accordingly, this study examines the interactions among three financial variables in Russia: the stock market, the government bond market, and the ruble exchange rate.

3 Methodology

Among the GARCH models discussed, the VAR-GARCH model warrants particular attention. The choice of VAR is motivated by potential interdependencies among index returns, as financial returns often exhibit cross-correlations. Implementing VAR first eliminates autocorrelations before applying GARCH. Once dependencies are removed, the residuals exhibit volatility clustering but no strong serial correlation.

The return equation for the trivariate model follows a VAR(1) process:

$$R_t = C + \Phi R_{(t-1)} + \varepsilon_t \tag{1}$$

where:

R_t – a vector of returns for three financial variables: equity market, bond market, and foreign exchange market: $R_t = \left(r_t^m, r_t^f, r_t^c\right)'$, C – a constant vector, Φ – a (3x3) matrix of VAR(1) coefficients φ^i capturing the linear dependencies. $\varepsilon_t = \left(\varepsilon_t^m, \varepsilon_t^f, \varepsilon_t^c\right)'$ – residuals (innovations), modeled with a GARCH process. The equation for the residuals is given by:

$$\varepsilon_t = H_t^{(1/2)} z_t \tag{2}$$

where:

$H_t^{(1/2)}$ – a symmetric positive definite matrix, the square root of the conditional covariance matrix H_t, z_t – a vector of i.i.d. standard normal shocks, i.e. $z_t N(0, I_3)$

One of the most widely used specifications for modeling the matrix H_t is the full BEKK-GARCH model (Engle & Kroner, 1995). However, with two return series, optimizing eight parameters can complicate calculations and lead to biased estimates (Aganin & Peresetsky, 2018). A similar issue arises when estimating the parameters of the VAR-GARCH model (Ling & McAleer, 2003). The constant conditional correlation (CCC) specification requires estimating ten parameters, whereas the bivariate CCC-GARCH model (Bollerslev, 1990) requires only six. According to

Arouri et al. (2015), the CCC-GARCH model produces comparable results in modeling the conditional volatility of financial index returns.

The matrix H_t in the bivariate CCC-GARCH model for each pair of indices is calculated as follows:

$$H_t = D_t P D_t \tag{3}$$

where:

D_t – a matrix defined by equation:

$$D_t = diag\left(\sqrt{h_t^i}\sqrt{h_t^j}\right) \tag{4}$$

P – a constant correlation matrix:

$$P = \begin{bmatrix} 1 & \rho_{(i,j)} \\ \rho_{(i,j)} & 1 \end{bmatrix} \tag{5}$$

Conditional variances from the matrix D_t for each of the two financial variables are determined by the following equation:

$$h_t^i = \omega_i + \alpha_i \left(\varepsilon_{(t-1)}^i\right)^2 + \beta_i h_{(t-1)}^i \tag{6}$$

where:

ω – a long-term volatility component, α – impact of past squared shocks, β – persistence of volatility. All parameters should be non-negative. The sum $(\alpha + \beta)$ reflects the speed with which negative effects disappear over time. If the data take on higher values over time, for example, during periods of significant sanctions, this indicates a higher level of risk in the studied markets.

Conditional covariance of two variables is calculated as follows:

$$h_t^{(i,j)} = \rho\sqrt{h_t^i h_t^j} \tag{7}$$

where:

ρ – a constant conditional correlation coefficient.

This study hypothesizes that during periods of heightened turbulence—marked by the imposition of major economic sanctions—abnormal conditional covariance will indicate contagion between markets.

4 Data

The sanctions include both broad economic measures and reputational penalties targeting individuals or industries with minimal economic significance in Russia, such as the luxury goods sector. Research on the previous wave of anti-Russian sanctions (2014–2021) suggests that the oil and gas industry was the most affected (Vladimirov, 2017; Zaytsev & Loshchenkova, 2023). Accordingly, this study focuses on Russian oil and gas stocks, selecting companies listed in the Moscow Exchange Oil & Gas Sectoral Index (MOEXOG) as a representative sample of this key sector.

As a financial variable representing the government bond market, this study uses the Moscow Exchange Government Bond Index (RGBITR), which measures the performance of the Russian sovereign debt market (Moscow Stock Exchange, 2025). The official exchange rate of the Russian ruble to the US dollar, provided by the Central Bank of Russia, represents the currency market. All three financial variables are analyzed as logarithmic returns.

Stationarity is tested using the Augmented Dickey-Fuller and Phillips-Perron tests. The study relies on daily observations, with missing data leading to the removal of the entire observation across all variables. The sample covers 2020–2023, with observations for 2022 beginning on March 28 due to trading restrictions in February–March.

Regressions are estimated separately for each year to account for distinct geopolitical events in the sample, including the COVID-19 pandemic, the 2022 escalation of the armed conflict in Ukraine, and the imposition of full-scale sanctions. This annual segmentation facilitates a comparison of pre- and post-sanctions periods to assess changes in volatility dynamics and aligns with the hypothesis of constant conditional correlation.

The study focuses on economic sanctions that demonstrated significance in event analysis, identified by abnormal returns during the event window—specifically, the announcement or imposition of sanctions (Chernykh, 2024b).

Table 1: List of sanctions events imposed by the EU on Russia's oil and gas industry.

	Announcement date	Event description
(1)	03 June, 2022	6th package: imposition of sanctions
(2)	02 September, 2022	8th package: announcement of the oil price ceiling
(3)	06 October, 2022	8th package: imposition of sanctions
(4)	04 February, 2023	8th package: setting of the price ceiling for Russian oil products
(5)	23 June, 2023	11th package: ban on servicing Russian oil tankers in third countries

Source: Bown, 2023.

The sample excludes the initial sanctions imposed in February–early March 2022 for the following reasons: (1) stock exchange closures during this period and (2) the overlap of sanctions-related and military events.

5 Results

The results of equations (1) and (6) are presented in Table 2. The VAR(1) return equations exhibit the following temporal dynamics:

- The equity market developed a significant autoregressive component in 2022 and a positive mean in 2023, indicating a sustained growth phase, reflecting adaptation to sanctions.
- The bond market returned to medium-term growth in 2023 after experiencing a sustained negative mean in 2022, which, in absolute terms, exceeded that of the COVID-19 period. Autoregressive dependence was present throughout the entire observation period.

- The ruble exchange rate reversed its dependence on stock market returns with the onset of full-scale sanctions, shifting to co-movement. This suggests that stock index growth was offset by a depreciation of the national currency and vice versa. Additionally, in 2022, the ruble exhibited a significant positive autoregressive component, which disappeared in 2023.

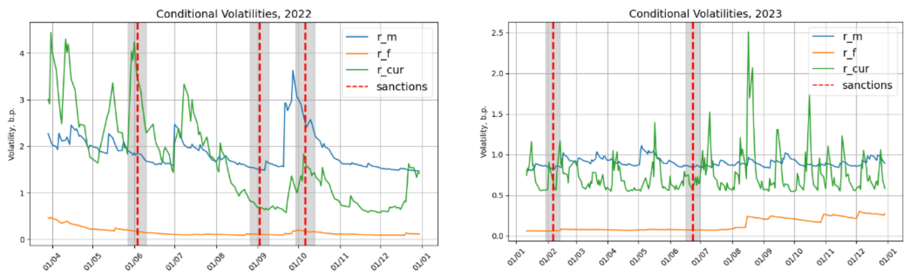
Table 2: The result of equations (1), and (6)

	MOEXOG				RGBITR				USD/RUB			
Year	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
Obs.	232	241	189	245	232	241	189	245	232	241	189	245
Results for mean equation R_t VAR(1)												
c	-0.034 (-0.275)	0.0196 (0.242)	-0.116 (-0.790)	0.165 (2.762) ***	-0.011 (-2.008) **	0.012 (3.131) ***	-0.039 (-2.487) **	0.017 (1.662) *	0.113 (1.768) *	-0.021 (-0.613)	-0.018 (-0.131)	0.047 (0.908)
φ^m	0.071 (0.967)	0.067 (1.027)	0.166 (2.280) **	0.190 (3.013) ***	-0.008 (-2.396) **	-0.0005 (-0.184)	0.0021 (0.286)	0.0059 (0.553)	-0.129 (-3.342) ***	-0.075 (-2.676) ***	0.0742 (1.083)	0.126 (2.330) **
φ^f	0.666 (0.387)	1.015 (0.733)	-1.172 (-1.602)	-0.637 (-1.655) *	-0.055 (-0.738) **	0.230 (3.620) ***	0.208 (2.701) ***	0.137 (2.110) **	1.649 (1.829) *	1.489 (2.499) **	0.464 (0.672)	0.079 (0.240)
φ^c	-0.335 (-2.711) ***	0.155 (1.059)	-0.086 (-1.088)	-0.048 (-0.626)	0.013 (2.470) **	-0.007 (-0.983)	0.006 (0.713)	0.0139 (1.088)	0.086 (0.186)	-0.076 (-1.213)	0.249 (3.334) ***	0.098 (1.499)
$f_\theta(x)$	-486.3	-205.9	-733.3	-487.1	-486.3	-205.9	-733.3	-487.1	-486.3	-205.9	-733.3	-487.1
Results for variance equation H_t CCC-GARCH(1,1)												
ω	0.1224 (1.801) *	0.0522 (0.998)	0.1919 (0.753)	0.1438 (0.779)	0.0002 (0.578)	0.0001 (1.515)	0.001 (2.071) **	0.0001 (0.169)	0.0977 (2.133) **	0.0297 (1.268)	0.0326 (1.260)	0.1729 (3.184) ***
α	0.1210 (2.689) ***	0.0350 (1.527)	0.0575 (1.697) *	0.0477 (0.649)	0.3345 (0.850)	0.0884 (1.980) **	0.0877 (1.064)	0.0301 (0.388)	0.0990 (1.847) *	0.0951 (1.352)	0.1702 (2.843) ***	0.3318 (2.297) **
β	0.8409 (20.58) ***	0.9291 (21.30) ***	0.8848 (20.72) ***	0.7763 (2.79) ***	0.6655 (1.781) *	0.8752 (13.79) ***	0.8438 (11.37) ***	0.9699 (6.343) ***	0.7910 (11.53) ***	0.7944 (6.861) ***	0.8298 (17.57) ***	0.4134 (3.816) ***
$f_\theta(x)$	-436.5	-383.1	-386.5	-320.7	337.5	372.130	101.2	161.8	-301.5	-178.2	-341.6	-266.6

Notes: t-statistics in parenthesis. *,**,*** denote rejection of the null hypothesis at the 10%, 5%, and 1% levels, respectively

The results in Table 2 for the conditional variance equation indicate that equity market volatility parameters declined by 2023. The immediate impact of past shocks was significant only during the COVID-19 period, while the long-run response decreased to minimal levels. In contrast, the bond market exhibited an extended duration of shock impacts, with β coefficients peaking in 2023. A significant long-term volatility component was also present in 2022, suggesting persistent volatility following the onset of sanctions. The ruble exchange rate, similar to the equity market, exhibited a decreasing long-term memory for volatility over time but became more sensitive to immediate shocks. In 2023, the foreign exchange market also experienced sustained high average volatility (0.173).

Figure 1 illustrates the conditional variance for the two sanctions years for all of the markets.



(1) (2)

Figure 1: Conditional volatilities of the three indices estimated using equation (6).

A notable change in scale is evident: in the first sanctions year, volatility spikes exceeded 4 basis points (Fig. 1.1), whereas in 2023, only the ruble exchange rate reached 2.5 basis points (Fig. 1.2). Additionally, a general downward trend in conditional variance is observed. Regarding sanctions events, the ruble exchange rate exhibited increased risk in response to the first and third sanctions events from Table 1. The stock market showed a minor reaction to the second sanctions event. A notable spike in equity market volatility occurred before the third event window; however, this was unrelated to sanctions and instead coincided with the Ukrainian military counteroffensive in September–October 2022 (Fig. 1.1).

Figure 2 illustrates the conditional covariances for each pair of indices, enabling the analysis of contagion effects between financial markets during the first two sanctions years.

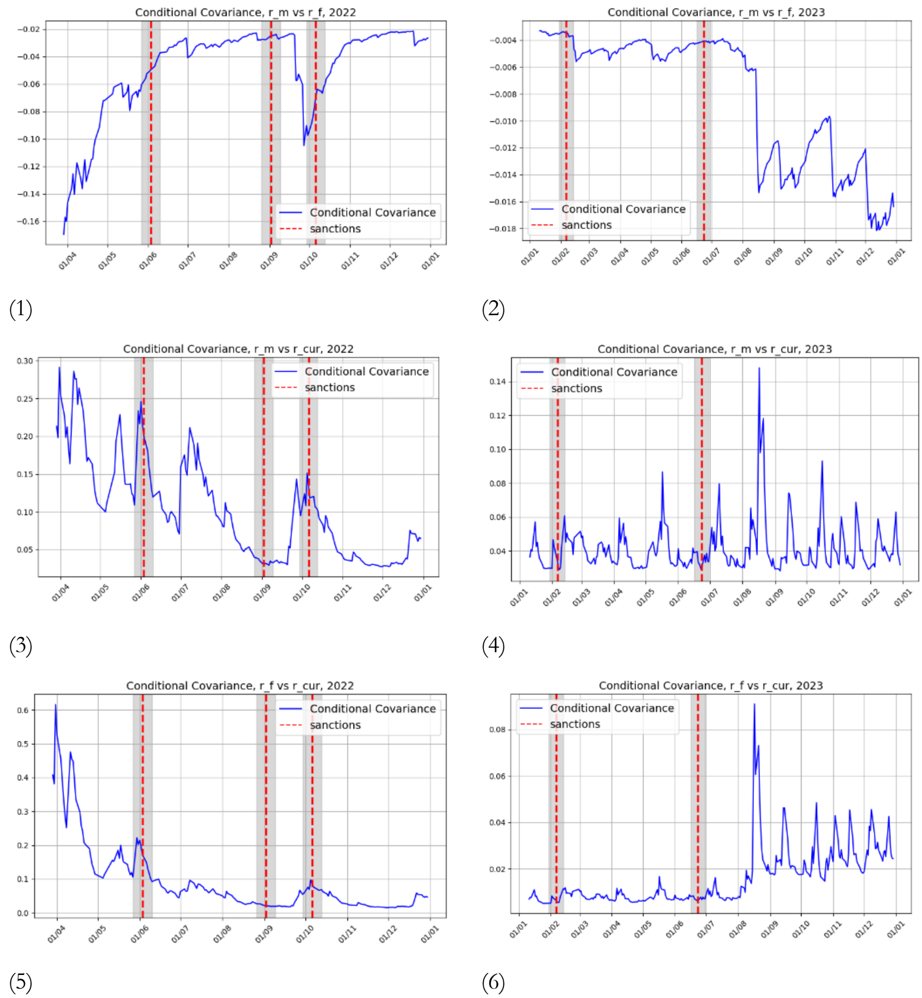


Figure 2: Conditional covariances for each index pair estimated using equation (7).

The negative correlation between the stock and bond markets (Figs. 2.1–2.2) reflects their differing risk profiles: risk-free government bonds versus the riskier stock market. Notably, volatility linkages strengthened during the fourth sanctions event (Fig. 2.2) but weakened during the first event window.

For the stock market and the ruble exchange rate, volatility linkages intensified during the first, third, and fourth event windows (Figs. 2.3–2.4). The bond and currency markets exhibited an identical reaction to these events (Figs. 2.5–2.6).

6 Conclusions

This paper analyzed three segments of the Russian financial market: the stock market, represented by the oil and gas index, the government bond market, and the foreign exchange market. The returns of these indices were examined using a VAR model before and after the imposition of EU sanctions. The residuals from these regressions were estimated using CCC-GARCH(1,1) models to identify contagion effects between markets. The introduction of the sixth and eighth package of sanctions resulted in excess volatility of the ruble exchange rate, transmitted also to stock and bond indices. The imposition of a price cap on Russian oil products also led to moderate increase in volatility in the equity market. By the second year of sanctions, the Russian oil and gas equity market had adapted by reducing risk perception indicators, whereas the government bond market exhibited a stronger long-term reaction to shocks. Overall, events unrelated to sanctions had a greater impact on Russian financial markets than the announcement or implementation of EU sanctions.

References

Afanasyev, D., Fedorova, E., & Ledyaeva, S. (2021). Strength of words: Donald Trump's tweets, sanctions and Russia's ruble. *Journal of Economic Behavior & Organization, 184*, 253-277. https://doi.org/10.1016/j.jebo.2021.02.002

Aganin, A. D. (2020). Russian Stock Index volatility: Oil and sanctions. *Voprosy Ekonomiki, 2*, 86-100. https://doi.org/10.32609/0042-8736-2020-2-86-100

Aganin, A. D., & Peresetsky, A. A. (2018). Volatility of ruble exchange rate: Oil and sanctions. *Applied Econometrics, 52*, 5-21. https://ideas.repec.org/a/ris/apltrx/0353.html

Arouri, M. E. H., Lahiani, A., & Nguyen, D. K. (2015). World gold prices and stock returns in China: Insights for hedging and diversification strategies. *Economic Modelling*, *44*, 273-282. https://doi.org/10.1016/j.econmod.2014.10.030

Beirne, J., Caporale, G. M., Schulze-Ghattas, M., & Spagnolo, N. (2013). Volatility Spillovers From Mature Stock Markets. *Review of International Economics, 21*, 1060-1075. https://doi.org/10.1111/roie.12091

Bollerslev, T. (1990). Modelling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model. *The Review of Economics and Statistics*, 498-505. https://doi.org/10.2307/2109358

Bown, C. P. (2023). Russia's war on Ukraine: A sanctions timeline. https://www.piie.com/blogs/realtime-economics/russias-war-ukraine-sanctions-timeline

Chernykh, A. (2024). Assessing the effectiveness of anti-Russian economic sanctions in a data-restricted context: A review of methodologies and approaches. *International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management*, 381-388. https://doi.org/10.46541/978-86-7233-416-6_49

Chernykh, A. (2024). Event-Driven Analysis of the Effectiveness of European Economic Sanctions Against Russia (2022–2024). *International Scientific Conference Strategic Management and Decision*

Support Systems in Strategic Management, 73-79. https://doi.org/10.46541/978-86-7233-428-9_399

Engle, R. F., & Kroner, K. F. (1995). Multivariate simultaneous generalized ARCH. *Econometric theory*, *11*(1), 122-150.

Fedorova E., Nevredinov A., & Chernikova L. (2023). The Impact of Sanctions on the Capitalization of Russian Companies: The Sectoral Aspect. *Journal of Corporate Finance Research, 17*(2), 50-67. https://doi.org/10.17323/j.jcfr.2073-0438.17.2.2023.50-67

Glosten, L. R., Jagannathan, R., & Runkle, D. E. (1993). On the relation between the expected value and the volatility of the nominal excess return on stocks. *The Journal of Finance*, *48*(5), 1779-1801. https://doi.org/10.1111/j.1540-6261.1993.tb05128.x

Itskhoki, O., & Mukhin, D. (2022). Sanctions and the Exchange Rate. *Intereconomics, 57*, 148–151. https://doi.org/10.1007/s10272-022-1050-9

Kaempfer, W. H., & Lowenberg, A. D. (1988). The theory of international economic sanctions: A public choice approach. *The American Economic Review*, *78*(4), 786-793. http://www.jstor.org/stable/1811175

Ling, S., & McAleer, M. (2003). Asymptotic theory for a vector ARMA-GARCH model. *Econometric Theory*, *19*(2), 280-310. https://doi.org/10.1017/S0266466603192092

Moscow Stock Exchange. Government Bond Indices. https://www.moex.com/en/index/RGBITR

Omidi, Z., Farazmand, H., Anvari, E., & Arman, S. A. (2021). Investigating the impact of exchange rate and oil price fluctuations on Iran's steel exports to China with sanctions in focus: A wavelet and multivariate-GARCH approach. *International Journal of Iron & Steel Society of Iran*, *18*(1), 98-105. https://doi.org/10.22034/ijissi.2021.540392.1209

Sultonov, M. (2020). The impact of international sanctions on Russian financial markets. *Economies*, *8*(4), 107. https://doi.org/10.3390/economies8040107

Syriopoulos, T., Makram, B., & Boubaker, A. (2015). Stock market volatility spillovers and portfolio hedging: BRICS and the financial crisis. *International Review of Financial Analysis*, *39*, 7-18. https://doi.org/10.1016/j.irfa.2015.01.015

Vakulenko, S. (2023). A Price Cap or Smoke and Mirrors? How Much Does Russian Oil Actually Cost? *Re:Russia*. https://re-russia.net/en/expertise/049/

Vladimirov, E. (2017). Systemic Risk of the Russian Economy. *Finance and Business, 4*(13), 117-130. https://finbiz.spb.ru/wp-content/uploads/2017/10/vladimir.pdf

Zaytsev, Y., & Loshchenkova, A. (2023). The impact of sanctions on the activities of Russian companies in the manufacturing sector of the economy in 2014-2021. *Journal of the New Economic Association*, *60*(3), 50-65. https://ideas.repec.org/a/nea/journl/y2023i60p50-65.html