



Article

External Financial Dominance Under Sanctions: Financial Fragmentation and Exchange Rate Determination in Russia

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Abstract

This paper examines whether prolonged sanctions and major geopolitical episodes associated with financial fragmentation alter exchange-rate dynamics and weaken the explanatory power of domestic macroeconomic channels and strengthen external financial dominance of traditional exchange-rate transmission mechanisms. Standard exchange rate theories are based on the concepts of Purchasing Power Parity (PPP) and Uncovered Interest Parity (UIP). However, the application of continuous sanctions could weaken this explanatory power and change exchange rate dynamics. The present study applies a combined framework of Autoregressive Distributed Lag (ARDL), Error Correction Modeling (ECM), Vector Autoregression (VAR) and structural break analysis to study the exchange-rate behavior in response to repeated geopolitical shocks using monthly data for Russia from 2005 to 2025. The results indicate that external variables such as the US dollar index and oil prices are important determinants of exchange rates, while inflation and interest rate differentials associated with PPP and UIP have little explanatory power. Structural break tests detect major regime shifts associated with the Global Financial Crisis, Crimea-related sanctions episode, COVID-19 pandemic and Russia–Ukraine conflict. The error correction process indicates that the speed of adjustment to equilibrium is slow, which means that traditional exchange-rate relationships will continue to diverge. In general, the results suggest a regime-dependent exchange rate environment in which external financial factors tend to dominate domestic adjustment mechanisms. Our study contributes to the literature on exchange rates, sanctions and financial fragmentation by providing evidence on how geopolitical shocks shift the relative importance of domestic and external determinants in a highly sanctioned economy.

Keywords: exchange rate dynamics; Global Financial Cycle; sanctions; structural breaks; Russia



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1. Introduction

The globalization of financial markets has dramatically changed how exchange rates are determined. Classic exchange rate theories, in particular Purchasing Power Parity (PPP) and Uncovered Interest Parity (UIP), state that domestic macroeconomic fundamentals are the main drivers of exchange rates through inflation and interest rate differentials, as proposed by [Rogoff \(1996\)](#) and [Engel \(2014\)](#). However, external monetary factors affecting trade price dynamics have long been embedded in the international finance literature. Previous studies have shown that U.S. monetary policy, global liquidity and international capital flows have large spillover effects for domestic financial markets and exchange rates

in both advanced economies (AEs) and emerging economies (Bernanke, 2005; Forbes & Warnock, 2012). Building on these insights, the U.S. Global Financial Cycle framework highlights the roles played by global risk sentiment, the dominance of the U.S. dollar and international financial integration in magnifying the transmission of external financial shocks (Rey, 2016; Miranda-Agrippino & Rey, 2020; Gopinath et al., 2020). Thus, while this study does not propose a new theory of the exchange rate determination process, it will apply these theories in an examination of interactions between extended sanctions and financial fragmentation to examine whether they alter the mechanisms through which Russia's exchange rate is determined.

With increasing financial market integration, exchange rates in small and open economies have become increasingly influenced by global financial conditions rather than solely by domestic macroeconomic fundamentals. As a result, global liquidity cycles and external financial shocks play a more prominent role in exchange-rate determination, reducing the explanatory power of traditional equilibrium-based models that rely primarily on domestic economic fundamentals. Consequently, exchange-rate movements are increasingly shaped by external rather than internal shocks (Rey, 2016; Obstfeld, 2022).

These dynamics have become most pronounced in economies subject to heightened geopolitical frictions and international restrictions. Since the 2014 Crimea crisis and the escalation of the Russia–Ukraine conflict in 2022, Russia has faced large-scale financial sanctions that have constrained capital mobility, intensified financial fragmentation, and modified transmission mechanisms underlying exchange rate determination (Caldara & Iacoviello, 2022; Ahn & Ludema, 2020). Moreover, as one of the largest exporters of energy in the world, the Russian exchange rate remains particularly reactive to external oil price fluctuations, reinforcing the argument that key economic shocks are important drivers of currency dynamics (Chen & Rogoff, 2003; Kilian, 2009). These circumstances imply a growing role of external financial and geopolitical factors in exchange rate dynamics, potentially reducing the explanatory relevance of domestic macroeconomic fundamentals.

This paper differs from conventional exchange rate studies based on small open economy assumptions. Instead, it conceptualizes Russia as a large, commodity-dependent economy whose exchange rate dynamics are shaped by structural exposure to global energy markets, geopolitical pressures, and financial restrictions. The distinctive features of Russia's exchange rate dynamics compared with those of smaller open economies derive from the structural importance of Russia in global energy markets, its scale and sustained role as a geopolitical actor, and its long-standing exposure to international sanctions. Thus, exchange rate dynamics in Russia are influenced not only by domestic macroeconomic fundamentals but also by external financial conditions, commodity price developments, geopolitical shocks, and financial fragmentation. Hence, the paper employs an analytical framework that integrates Global Financial Cycle theory, commodity currency theory, and financial fragmentation perspectives to explain exchange rate determination in Russia amid persistently high geopolitical uncertainty (Chen & Rogoff, 2003; Gopinath et al., 2020; Caldara & Iacoviello, 2022; Ahn & Ludema, 2020).

Recent studies have independently examined the effects of global financial conditions, commodity prices, and geopolitical risks on exchange rates (Chen & Rogoff, 2003; Caldara & Iacoviello, 2022). Nevertheless, limited empirical evidence explains how prolonged sanctions simultaneously reshape the relative importance of external financial variables, domestic macroeconomic fundamentals, and structural regime changes within a unified analytical framework. This limitation is particularly important for highly sanctioned commodity-exporting economies such as Russia, where geopolitical fragmentation may fundamentally alter traditional exchange rate determination mechanisms. Accordingly,

a comprehensive empirical investigation is required to better understand the evolving drivers of exchange rate dynamics under prolonged sanctions and financial fragmentation.

In addition to financial sanctions, Russia has increasingly reoriented its trade and financial relations toward China and other non-aligned economies. This adjustment includes the expansion of BRICS economic cooperation, the growing use of Renminbi-denominated trade settlement, and the adoption of alternative payment and financial messaging systems such as CIPS and SPFS. These developments have partially reshaped Russia's external financial environment and may influence exchange-rate dynamics by reducing dependence on traditional Western financial infrastructures. However, these structural adjustments are beyond the scope of the present empirical model, which focuses on identifying changes in exchange-rate dynamics associated with major sanction-related geopolitical episodes.

To further illustrate Russia's changing external-sector exposure under prolonged sanctions, Figure 1 presents the evolution of trade openness, exports, and imports during 2005–2025. All series are indexed to 2005 = 100 to facilitate comparison across time. The trade openness proxy is constructed from the combined movement of exports and imports, while exports are measured on an FOB basis and imports on a CIF basis, following standard international trade-statistics conventions (World Bank, 2026; International Monetary Fund [IMF], 2023; Marini et al., 2018). This descriptive evidence complements the exchange-rate analysis by showing how Russia's external trade activity evolved across major crisis episodes, including the Global Financial Crisis, the Crimea-related sanctions period, the COVID-19 shock, and the Russia–Ukraine conflict (Ahn & Ludema, 2020; World Trade Organization, 2021; Caldara & Iacoviello, 2022; OECD, 2024).

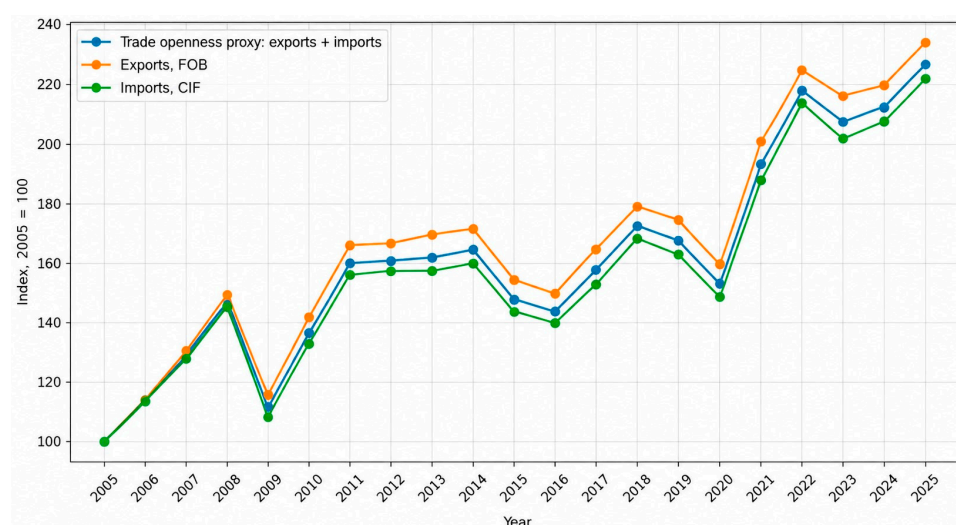


Figure 1. Evolution of Russia's Trade Openness, Exports, and Imports, 2005–2025 (Index, 2005 = 100), shows that Russia's trade openness increased substantially over the sample period, although the trajectory was interrupted by several major crisis episodes. The decline in 2009 reflects the impact of the Global Financial Crisis, while the moderation during 2015–2016 is consistent with the combined effects of Crimea-related sanctions and the oil price collapse (Ahn & Ludema, 2020). A further decline is observed in 2020 during the COVID-19 shock, which disrupted global trade flows and reduced merchandise trade activity worldwide (World Trade Organization, 2021). However, the sharp increase after 2021 suggests that Russia's external trade activity recovered strongly despite the escalation of sanctions following the Russia–Ukraine conflict. This pattern indicates that sanctions did not eliminate Russia's external trade linkages but contributed to a restructuring of external economic relations (Itskhoki & Ribakova, 2024; OECD, 2024; Simola, 2025). Nevertheless, because the figure uses aggregate exports and imports, it should be interpreted as evidence of changing trade openness rather than direct evidence of partner-specific reorientation from G7 economies toward China and Asian markets (OECD, 2024; Simola, 2025).

Despite the growing literature on exchange rate dynamics, several important research gaps remain. First, previous studies have generally examined the effects of global financial conditions, commodity prices, domestic macroeconomic fundamentals, or geopolitical risks separately, providing only a partial explanation of exchange rate behavior (Chen & Rogoff, 2003; Kilian, 2009; Caldara & Iacoviello, 2022). Second, limited empirical evidence investigates whether prolonged sanctions and financial fragmentation fundamentally alter the relative importance of external and domestic determinants of exchange rates. Third, few studies integrate long-run equilibrium analysis, short-run adjustment, structural break identification, monetary channels, and shock transmission within a single econometric framework. Addressing these gaps is essential for understanding exchange rate determination in highly sanctioned economies such as Russia.

To better illustrate the conceptual relationships among the external financial environment, domestic macroeconomic fundamentals, geopolitical shocks, and the proposed empirical analyses, Figure 2 presents the conceptual framework of this study.

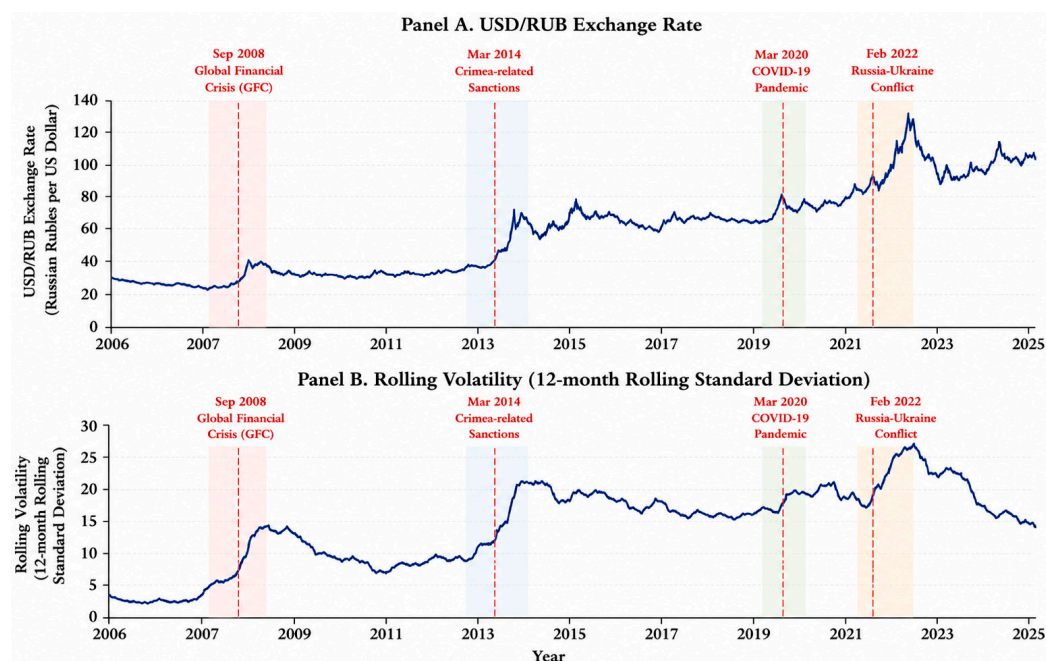


Figure 2. Presents the evolution of the USD/RUB exchange rate and its 12-month rolling volatility over 2005–2025. Panel (A) shows exchange-rate movements during major economic and geopolitical events, while Panel (B) highlights periods of heightened market volatility. The figure provides descriptive evidence of increased market turbulence following these events but does not, by itself, establish structural regime shifts.

To address these research gaps, this study investigates eight interrelated questions. First, it examines how global financial factors influence the USD/RUB exchange rate. Second, it investigates whether domestic macroeconomic fundamentals contribute significantly to exchange rate dynamics. Third, it evaluates the role of oil prices under prolonged sanctions. Fourth, it examines whether major geopolitical events generate structural breaks and regime shifts in exchange rate behavior. Fifth, it analyzes the speed of adjustment toward the long-run equilibrium following short-run disturbances. Sixth, it investigates how external financial shocks are transmitted through the exchange rate system. Seventh, it evaluates whether interest rate differentials and, eighth, inflation differentials support the predictions of Uncovered Interest Parity (UNIP) and Purchasing Power Parity (PPP) theories (Pesaran et al., 2001; Bai & Perron, 2003; Engel, 2014).

The primary objective is to determine whether prolonged sanctions and financial fragmentation shift exchange rate determination from domestic fundamentals toward external financial conditions. An integrated ARDL–ECM–VAR framework with structural break analysis is used to assess long-run relationships, short-run dynamics, regime changes, and shock transmission. Geopolitical and financial fragmentation are represented by structural-break dummy variables associated with major sanction-related events rather than continuous indicators such as the Geopolitical Risk Index.

This study contributes by extending the Global Financial Cycle perspective to a sanctioned economy and examining whether sanctions increase the dominance of external financial drivers (Gopinath et al., 2020; Miranda-Agrippino & Rey, 2020). It also reassesses the validity of PPP and UIP under geopolitical disruption (Engel, 2014) and integrates ARDL, ECM, VAR, and structural break methods within a unified framework for evaluating equilibrium, adjustment, regime shifts, and shock transmission (Pesaran et al., 2001; Bai & Perron, 2003). These contributions provide a more comprehensive understanding of exchange rate behavior in economies experiencing persistent geopolitical uncertainty and financial fragmentation. In this study, geopolitical fragmentation is not directly measured using a continuous index. Instead, the analysis focuses on major geopolitical episodes that generated structural changes in the Russian financial environment. Accordingly, crisis dummy variables are employed as proxies for regime shifts associated with sanctions and major geopolitical events rather than as direct measures of geopolitical fragmentation.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature and develops the theoretical framework underpinning the study. Section 3 describes the data, variables, and research methodology, including the ARDL, ECM, VAR, and structural break models employed in the empirical analysis. Section 4 presents and discusses the empirical findings, covering long-run and short-run dynamics, structural breaks, shock transmission, and robustness tests. Section 5 discusses theoretical and policy implications; Section 6 concludes the study by summarizing the main findings; Section 7 presents Implications and Future Research.

2. Literature Review and Theoretical Framework

2.1. Literature Review

2.1.1. Exchange Rate Determination

Exchange rate determination is a central issue in international finance because it reflects the interaction between domestic macroeconomic fundamentals and external financial conditions. Traditional theories, including Purchasing Power Parity (PPP), Uncovered Interest Parity (UIP), monetary models, and portfolio balance models, emphasize inflation, interest rates, money supply, output, and balance-of-payments conditions as the main drivers of long-run exchange rate adjustment (Rogoff, 1996; Engel, 2014).

However, empirical studies show that domestic variables alone often fail to explain exchange rate movements, particularly in financially open emerging markets. Traditional structural models frequently perform no better than random-walk forecasts, suggesting that exchange rates are also shaped by capital flows, investor expectations, and external financial shocks (Meese & Rogoff, 1983; Obstfeld & Rogoff, 1995; Engel et al., 2008). More recent research highlights the growing influence of global liquidity, investor risk appetite, international capital mobility, and US dollar fluctuations (Miranda-Agrippino & Rey, 2020; Gopinath et al., 2020).

For commodity-exporting economies, exchange rates respond simultaneously to domestic monetary policy, commodity prices, capital flows, and geopolitical developments. Therefore, an integrated framework that captures both domestic and external transmission mechanisms is required. Although exchange rate research has expanded beyond conven-

tional macroeconomic models to incorporate financial globalization and external spillovers, no consensus exists regarding the relative importance of these factors, particularly in large commodity-dependent emerging economies under prolonged geopolitical sanctions. This unresolved issue motivates the present study.

2.1.2. Oil Prices and Exchange Rates

Oil prices are a major external determinant of exchange rates in commodity-exporting economies because they affect export revenues, fiscal balances, foreign exchange reserves, and market expectations. The currencies of resource-rich countries tend to respond systematically to global commodity prices, supporting the concept of commodity currencies (Chen & Rogoff, 2003).

The effect of oil prices, however, depends on the source of the shock. Global demand, supply disruptions, and precautionary demand may produce different exchange-rate responses (Kilian, 2009). In general, positive oil price shocks tend to appreciate the currencies of oil-exporting countries while weakening those of oil importers through changes in trade revenues, terms of trade, investor confidence, and capital flows (Basher et al., 2016; Beckmann et al., 2020).

This relationship is particularly important for Russia because of its heavy dependence on crude oil and natural gas exports. Brent oil prices influence Russian export earnings, fiscal revenues, external balances, and, consequently, the ruble. However, sanctions imposed since 2014 and expanded substantially in 2022 may have altered this transmission through trade restrictions, export-market reorientation, capital controls, and financial fragmentation (Ahn & Ludema, 2020). Because most previous studies focus on normal market conditions, further research is needed to determine whether prolonged geopolitical sanctions change the ruble's sensitivity to oil prices and the interaction between commodity markets and external financial conditions.

2.1.3. Global Financial Cycle

External financial conditions significantly influence exchange rates through US monetary policy, global liquidity, capital flows, and investor expectations (Bernanke, 2005; Forbes & Warnock, 2012). In financially integrated economies, these shocks may constrain domestic monetary policy autonomy because they are rapidly transmitted across borders.

The Global Financial Cycle framework explains how US monetary policy and global risk sentiment jointly affect capital flows, asset prices, credit, and exchange rates, even under floating exchange rate regimes (Rey, 2016). Subsequent studies link this cycle to the US dollar and global risk appetite, while emphasizing the dollar's dominant role in transmitting financial shocks through trade and financial channels (Miranda-Agrippino & Rey, 2020; Gopinath et al., 2020).

In emerging markets, external variables such as the US Dollar Index, global volatility, and international portfolio shifts may exert greater influence than domestic fundamentals during periods of uncertainty (Obstfeld, 2022; Aizenman et al., 2016). However, limited research has examined whether sanctions and financial fragmentation weaken or transform these transmission mechanisms. It therefore remains unclear whether external financial conditions continue to dominate exchange rate determination when international financial integration is disrupted.

2.1.4. Geopolitical Risk, Sanctions, and Financial Fragmentation

Geopolitical risk disrupts trade, capital flows, financial transactions, and investor confidence, increasing exchange-rate volatility (Caldara & Iacoviello, 2022). Sanctions intensify these effects by restricting international capital, investment, financial intermediation, and payment systems (Crozet & Hinz, 2020; Ahn & Ludema, 2020).

For Russia, sanctions imposed since 2014 and expanded in 2022 have targeted financial institutions, reserves, payment systems, and energy exports. Consequently, ruble movements have become increasingly sensitive to geopolitical developments and global financial conditions despite domestic interventions (Ahn & Ludema, 2020).

Financial fragmentation further weakens market integration, capital allocation, and international risk sharing while altering the transmission of global shocks (International Monetary Fund [IMF], 2023). However, few studies jointly examine geopolitical risk, sanctions, commodity dependence, and fragmentation in explaining long- and short-run exchange-rate dynamics. This gap motivates the present study.

2.1.5. Research Gap

Previous studies have identified domestic macroeconomic fundamentals, commodity prices, global financial conditions, and geopolitical factors as important determinants of exchange rates (Chen & Rogoff, 2003; Kilian, 2009; Caldara & Iacoviello, 2022). However, several research gaps remain.

First, these factors are generally examined separately, providing limited evidence on their simultaneous interaction, particularly during prolonged geopolitical disruptions. Second, although the Global Financial Cycle literature emphasizes external financial conditions, few studies assess whether sanctions and financial fragmentation alter the relative influence of domestic and external determinants. This issue is especially relevant for Russia because its exchange rate is shaped by commodity dependence, global financial shocks, and geopolitical constraints.

Third, previous research often uses separate econometric methods to examine long-run relationships, short-run adjustments, structural breaks, or shock transmission. Few studies integrate these dimensions within a unified framework. Moreover, the validity of Purchasing Power Parity (PPP) and Uncovered Interest Parity (UIP) under prolonged sanctions and financial fragmentation remains insufficiently examined.

This study addresses these gaps by combining domestic fundamentals, external financial conditions, commodity prices, geopolitical shocks, and financial fragmentation within an ARDL–ECM–VAR framework with structural break analysis. This approach provides a comprehensive assessment of exchange rate determination in a commodity-dependent emerging economy facing prolonged geopolitical and financial constraints.

2.2. Theoretical Framework

2.2.1. Purchasing Power Parity (PPP)

Purchasing Power Parity (PPP) is one of the fundamental theories of exchange rate determination, proposing that exchange rates adjust to equalize the purchasing power of different currencies over time. According to the relative PPP hypothesis, changes in exchange rates are primarily driven by inflation differentials between countries. When domestic inflation exceeds foreign inflation, the domestic currency is expected to depreciate to restore international price competitiveness (Rogoff, 1996; Engel, 2014).

The relative Purchasing Power Parity (PPP) condition states that the percentage change in the nominal exchange rate is determined by the inflation differential between the domestic and foreign economies. The relationship is expressed as follows:

$$\Delta S_t = \pi_t - \pi_t^*$$

where

ΔS_t = percentage change in the nominal USD/RUB exchange rate;

π_t = inflation rate in Russia;

π_t^* = inflation rate in the United States.

Although PPP provides a useful long-run benchmark, empirical studies frequently report deviations from parity because exchange rates are also affected by capital mobility, market frictions, government intervention, and external financial shocks. These deviations are expected to become even more pronounced under prolonged geopolitical sanctions and financial fragmentation. Accordingly, this study re-examines the validity of PPP for the Russian ruble under changing geopolitical and financial conditions, corresponding to Research Question 8 (RQ8).

2.2.2. Uncovered Interest Parity (UIP)

Uncovered Interest Parity (UIP) explains exchange rate movements through differences in nominal interest rates across countries. The theory states that currencies offering relatively higher interest rates are expected to depreciate sufficiently to offset the return advantage, thereby eliminating arbitrage opportunities in international financial markets (Fama, 1984; Engel, 2014). Formally, the UIP condition can be expressed as follows:

$$E_t ((S_{(t+1)} - S_t)/S_t) = i_t - i_t^*$$

where

E_t = expected future exchange rate;

S_t = Nominal exchange rate at time t .

$S_{(t+1)}$ = Expected nominal exchange rate at time $t + 1$.

i_t = domestic nominal interest rate (Russia);

i_t^* = foreign nominal interest rate (United States).

Despite its theoretical importance, UIP is frequently violated, a phenomenon known as the forward premium puzzle. Exchange rate expectations are shaped not only by interest rate differentials but also by risk premiums, capital controls, geopolitical uncertainty, and global financial conditions. These factors are especially relevant for Russia, where sanctions may weaken conventional monetary transmission. Therefore, this study examines whether interest rate differentials continue to explain exchange rate dynamics under prolonged sanctions, corresponding to RQ7.

2.2.3. Commodity Currency Theory

Commodity Currency Theory states that exchange rates in resource-dependent economies are influenced by international commodity prices through export revenues, fiscal balances, and foreign exchange earnings (Chen & Rogoff, 2003). Higher commodity prices generally improve external balances and support currency appreciation, while lower prices have the opposite effect.

This theory is particularly relevant to Russia because of its dependence on oil and natural gas exports. Brent oil prices are expected to affect the USD/RUB exchange rate through export income, government revenue, and foreign exchange inflows. However, sanctions may alter these channels by restricting trade, export destinations, and financial transactions. Accordingly, the role of oil prices under geopolitical constraints is examined in RQ3.

2.2.4. Global Financial Cycle Theory

The Global Financial Cycle theory emphasizes the role of global liquidity, capital flows, investor risk sentiment, and the US dollar in shaping financial markets and exchange rates (Rey, 2016). External shocks, particularly those associated with US monetary policy, influence portfolio allocation, capital flows, and currency valuations in financially integrated economies (Miranda-Agrippino & Rey, 2020). The Dominant Currency Paradigm

further argues that the US dollar's central role in global trade and finance amplifies the transmission of external shocks across exchange rate regimes (Gopinath et al., 2020).

For Russia, these effects operate through commodity exports, capital mobility, and external financing. However, sanctions may reduce financial integration and alter capital flow patterns. The Global Financial Cycle therefore provides the theoretical basis for examining whether external financial variables dominate exchange rate determination under geopolitical uncertainty, corresponding to RQ1, RQ2, and RQ6.

2.2.5. Financial Fragmentation Framework

Financial fragmentation refers to the segmentation of global financial markets caused by geopolitical conflicts, sanctions, trade restrictions, and declining cross-border integration. It weakens financial linkages, reduces market integration, and alters the transmission of global shocks, causing exchange rates to reflect geopolitical constraints more strongly (International Monetary Fund [IMF], 2023).

Sanctions affect exchange rates by restricting capital flows, financial transactions, payment systems, and foreign reserve management. These restrictions reduce external financing and increase volatility, potentially weakening the relationships predicted by PPP, UIP, and conventional international finance models (Ahn & Ludema, 2020).

Russia provides a relevant case because sanctions imposed since 2014 and expanded in 2022 have changed the interaction among domestic fundamentals, commodity markets, and external financial conditions. This framework explains structural changes in the USD/RUB exchange rate, supports RQ4 and RQ5, and complements the Global Financial Cycle perspective. Figure 3 illustrates these transmission mechanisms.

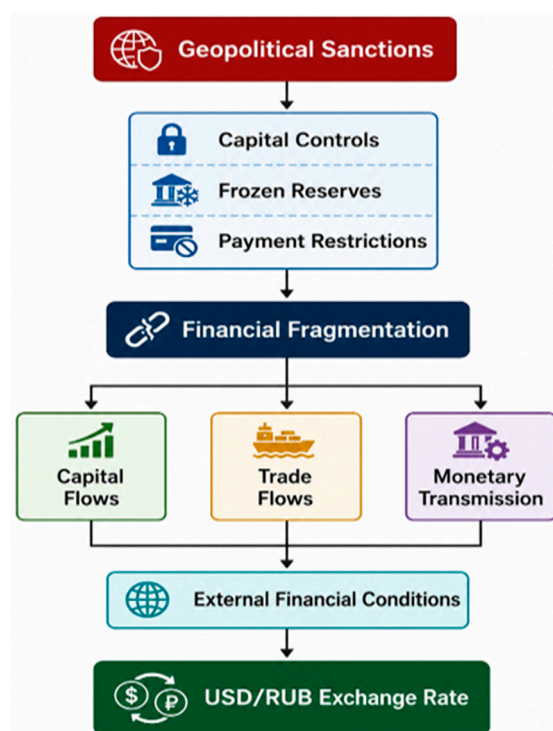


Figure 3. Shows how geopolitical sanctions affect exchange rates through financial restrictions, including capital controls, frozen reserves, and payment disruptions. These measures intensify financial fragmentation, alter capital flows, trade financing, and monetary transmission, and increase the influence of external financial conditions on the USD/RUB exchange rate. This framework underpins the ARDL, ECM, VAR, and structural break analyses.

3. Methods and Data Description

This case study began with monthly time-series data for 2005–2025 and examines the factors behind the fluctuation of the exchange rate between US dollars (USD) and Russian rubles (RUB). Frequency is a key metric in applied time-series econometrics. This analysis examines only short-term fluctuations, but medium-term dynamics as well, for which monthly frequency is desirable.

The data include global financial indicators, commodity prices, domestic macroeconomic data, and real sector indicators. Most variables were defined using natural logarithms for consistency and interpretability, as this allows for the interpretation of the estimated coefficients as elasticities, and because natural logarithms stabilize variance.

The data revealed the presence of structural breaks associated with major political and economic events, indicating the necessity of including two dummy variables that could account for potential regime changes in the model specification.

The definitions of the variables and sources of the data are given in Tables 1 and 2. Additional descriptive statistics and unit root test results are provided in Appendix A (Table A1).

Table 1. Definition of Variables and Data Sources.

Variable	Symbol	Measurement	Expected Effect	Theoretical Basis	Source
Exchange Rate	lnEXR	RUB per USD (log)	—	—	Federal Reserve Economic Data (FRED)
US Dollar Index	lnDXY	Index (log)	(+)	Global Financial Cycle	Federal Reserve/Trading Economics
Global Risk	VIX	Volatility Index	(+)	Risk Aversion	Chicago Board Options Exchange (CBOE)
Oil Price	lnOIL	USD/barrel (log)	(−)	Commodity Currency	U.S. Energy Information Administration (EIA)
Interest Rate Differential	IRD	Russia—US (%)	(−)	Interest Rate Parity	Central Bank of Russia; Federal Reserve
Inflation Differential	INFDIFF	Russia—US (%)	(+)	Purchasing Power Parity	Rosstat; U.S. Bureau of Labor Statistics
Inflation (Russia)	INFRUS	CPI (%)	(+)	Monetary/Price Dynamics	Rosstat
Inflation (United States)	INFUSA	CPI (%)	(−)	External Price Effect	U.S. Bureau of Labor Statistics
Policy Interest Rate (Russia)	KEYRATE	%	(−)	Monetary Policy Transmission	Central Bank of Russia
Federal Funds Rate	FF	%	(+)	Global Liquidity/Monetary Spillover	Federal Reserve
Industrial Production	lnIPI	Index (log)	(−)	Real Sector Effect	Rosstat/FRED
Money Supply	lnM3	RUB billion (log)	(+)	Monetary Model	Central Bank of Russia
Foreign Reserves	lnRES	USD billion (log)	(−)	Reserve Buffer Theory	Central Bank of Russia

Table 1. Cont.

Variable	Symbol	Measurement	Expected Effect	Theoretical Basis	Source
Exports	lnEXP	USD billion (log)	(−)	Trade Balance	Trading Economics/official statistics
Imports	lnIMP	USD billion (log)	(+)	Trade Balance	Trading Economics/official statistics

Note: “—” indicates that no expected effect or theoretical basis is specified. The signs “+” and “−” indicate the expected positive and negative effects, respectively, on the RUB/USD exchange rate. A positive effect implies ruble depreciation, whereas a negative effect implies ruble appreciation. Source: Author’s compilation based on data from Federal Reserve Economic Data (FRED), U.S. Energy Information Administration (EIA), Chicago Board Options Exchange (CBOE), Central Bank of Russia, Rosstat, U.S. Bureau of Labor Statistics, and [Trading Economics](#) (n.d.).

Table 2. Structural Break Dummies and Theoretical Basis.

Dummy	Period	Description	Theoretical Basis	Source
GFC	2008–2009	Global Financial Crisis	Crisis Transmission (Bernanke, 2005)	International Monetary Fund (IMF)
CRIMEA	2014–2015	Crimea crisis & oil price collapse	Geopolitical Risk (Caldara & Iacoviello, 2022)	World Bank
COVID	2020–2021	Global pandemic shock	Global Uncertainty (Baker et al., 2020)	World Health Organization (WHO, 2023)
Conflict	2022–present	Russia–Ukraine conflict & sanctions	Sanctions & External Shock (Klose, 2024)	World Bank

The motivation for including oil prices is based on the commodity currency hypothesis, according to which in resource-exporting economies there is a negative response of commodity prices and exchange rates ([Chen & Rogoff, 2003](#)). Moreover, following standard parity conditions (namely uncovered interest parity and purchasing power parity), other variables such as interest rate differentials (IRD) and inflation differentials (INFDIFF) are included.

Real sector activity and monetary conditions are represented by including domestic variables such as lnIPI (industrial production), lnM3 (money supply), and lnRES (foreign reserves). Such growth within the model adds to its ability to describe internal macroeconomic dynamics, which is an important feature in the context of emerging markets.

3.1. Structural Break Variables

Dummy variables associated with major geopolitical events are incorporated as proxies for structural regime shifts rather than as direct measures of geopolitical fragmentation. Their purpose is to identify changes in exchange-rate behavior across sanction-related periods and major geopolitical episodes. Consequently, the empirical analysis focuses on regime-dependent exchange-rate dynamics instead of quantifying the intensity of geopolitical fragmentation itself (Table 3).

Table 3. Theoretical Basis for the Structural Break Dummies.

Dummy	Period	Description	Source
GFC	2008–2009	Global financial crisis	IMF
CRIMEA	2014–2015	Geopolitical shock	World Bank
COVID	2020–2021	Pandemic shock	WHO
Conflict	2022–present	Conflict and sanctions	World Bank

These dummy variables allow us to control for specific uncertainty spikes and structural breaks as they occur during the global financial crisis (2008–2009), the Crimea crisis (2014–2015), the COVID-19 pandemic (2020–2021), and the Russia–Ukraine conflict (2022–present).

In applied econometrics, accounting for structural breaks at the correct time in the time series can be critical; otherwise, regime shifts can result in biased estimates of the parameters (Perron, 1989).

3.2. Descriptive Statistics: Preliminary Data Analysis

Table 4 shows descriptive statistics and a summary of the central tendency, dispersion, and distributional shape of the variables.

Table 4. Descriptive Statistics.

Variable	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
lnEXR	3.844	0.463	3.151	4.702	0.017	1.392
IRD	13.073	2.697	4.696	17.587	−0.906	3.340
INFDIFF	3.755	4.239	−6.618	25.622	0.678	5.122
lnDXY	4.653	0.116	4.458	4.860	−0.017	1.522
VIX	19.128	8.348	10.130	64.460	2.515	11.806
lnOIL	4.274	0.330	2.911	4.888	−0.462	3.363
KEYRATE	14.767	1.819	10.026	19.441	−0.223	2.514
FF	1.694	1.911	0.050	5.330	0.867	2.201
INFRUS	6.351	3.805	−0.624	28.675	1.403	7.207
INFUSA	2.596	1.885	−1.959	8.979	1.032	4.878
lnIPI	4.615	0.119	4.358	4.812	−0.273	2.125
lnM3	10.624	0.598	8.407	11.392	−0.907	3.260
lnRES	5.700	0.514	4.207	6.434	−0.767	2.855
lnEXP	5.743	0.342	4.934	6.270	−0.473	2.227
lnIMP	5.339	0.352	4.494	5.882	−0.497	2.229

The findings suggest that most of the variables are moderately variable, contrary to some financial indicators, such as VIX, which have high volatility and non-normal distribution, as shown by the skewness and kurtosis measures.

Correlation analyses for the core variables (Table 5) and extended variables (Table 6) provide insight into the relationships across the selected variables.

Table 5. Correlation Matrix (Core Variables).

Variable	lnEXR	lnDXY	lnOIL	IRD	INFDIFF	KEYRATE	lnIPI
lnEXR	1.000	0.939	−0.304	−0.536	−0.586	−0.765	0.816
lnDXY	0.939	1.000	−0.410	−0.587	−0.532	−0.706	0.708
lnOIL	−0.304	−0.410	1.000	0.039	−0.164	0.014	0.185
IRD	−0.536	−0.587	0.039	1.000	0.332	0.706	−0.528
INFDIFF	−0.586	−0.532	−0.164	0.332	1.000	0.572	−0.656
KEYRATE	−0.765	−0.706	0.014	0.706	0.572	1.000	−0.773
lnIPI	0.816	0.708	0.185	−0.528	−0.656	−0.773	1.000

Table 6. Correlation Matrix (Extended Variables).

Variable	VIX	FF	INFRUS	INFUSA	lnM3	lnRES	lnEXP	lnIMP
VIX	1.000	0.060	−0.007	−0.013	0.004	−0.012	−0.046	−0.038
FF	0.060	1.000	0.129	0.090	−0.102	−0.090	−0.051	−0.092
INFRUS	−0.007	0.129	1.000	0.004	−0.664	−0.637	−0.665	−0.649
INFUSA	−0.013	0.090	0.004	1.000	0.101	0.126	0.158	0.173
lnM3	0.004	−0.102	−0.664	0.101	1.000	0.970	0.971	0.948
lnRES	−0.012	−0.090	−0.637	0.126	0.970	1.000	0.954	0.933
lnEXP	−0.046	−0.051	−0.665	0.158	0.971	0.954	1.000	0.946
lnIMP	−0.038	−0.092	−0.649	0.173	0.948	0.933	0.946	1.000

The exchange rate generally has a positive correlation with the US dollar index, which reflects that global financial factors affect the exchange rate. However, there is a statistically significant negative correlation between oil price and exchange rate, giving early evidence for the commodity currency hypothesis.

The high correlations between the fractions of reserves in monetary aggregates and trade show some potential for multicollinearity. Specification design and robustness checks, addressed in step three of the econometric modeling stage, alleviate this issue.

3.3. Unit Root and Integration Properties

Before estimation of the models of these variables, unit root tests are typically examined, as shown in Table 7.

Table 7. Unit Root Test Results.

Variable	Level ADF	Prob.	Stationary (Level)	1st Diff ADF	Prob.	Stationary (1st Diff)	Integration	Remarks
lnEXR	−1.144	0.6986	No	−12.073	0.0000	Yes	I(1)	Non-stationary, becomes stationary after differencing
lnDXY	−1.234	0.6602	No	−10.394	0.0000	Yes	I(1)	Requires differencing
VIX	−5.107	0.0000	Yes	−14.125	0.0000	Yes	I(0)	Stationary at level
lnOIL	−3.620	0.0060	Yes	−10.967	0.0000	Yes	I(0)	Stationary at level
IRD	−0.996	0.7552	No	−11.834	0.0000	Yes	I(1)	Integrated of order one
INFDIFF	−1.720	0.4199	No	−6.381	0.0000	Yes	I(1)	Becomes stationary after differencing
KEYRATE	−0.832	0.8077	No	−10.598	0.0000	Yes	I(1)	Strong unit root at level
FF	−2.569	0.1008	No	−6.818	0.0000	Yes	I(1)	Weak at level, treated as non-stationary
INFRUS	−2.273	0.1817	No	−7.056	0.0000	Yes	I(1)	Non-stationary, stationary after differencing
INFUSA	−2.740	0.0688	Weak	−4.114	0.0011	Yes	I(1)	Marginal at level, treated as I(1)
lnM3	−7.229	0.0000	Yes	−12.568	0.0000	Yes	I(0)	Strongly stationary
lnRES	−3.237	0.0191	Yes	−10.956	0.0000	Yes	I(0)	Stationary at level
lnEXP	−3.536	0.0079	Yes	−13.475	0.0000	Yes	I(0)	No differencing required
lnIMP	−0.978	0.7615	No	−15.304	0.0000	Yes	I(1)	Clearly non-stationary

Output results demonstrate the presence of some combination of I(0) and I(1) variables. Some global and macroeconomic variables are stationary at levels, but most variables in the domestic economy only become stationary after first differencing.

Given the combination of integrations, where the variables are I(0) and I(1), we justify applying the autoregressive distributed lag (ARDL) framework since it permits both I(0) and I(1) variables (Pesaran et al., 2001). And more importantly, none of the variables is I(2), which is a critical assumption of ARDL being applicable.

3.4. Graphical Analysis

3.4.1. Dynamics of Exchange Rate and Crisis Episodes

Regime shifts in the USD/RUB exchange rate 2005–2025 readily show up when connected with clearly observable global and geopolitical events (Figure 2). Before 2008, we had some stability, whereas in the period of the global financial crisis, there was much more volatility. A larger depreciation took place during 2014–2015 in response to plunging oil prices and external sanctions.

Then the COVID-19 shock in 2020 created further instability, but it was milder. The strongest rupture came in 2022 when geopolitical conflict launched the prices into extreme volatility, with sanctions and monetary restrictions working together. In general, the ruble has high sensitivity to external shocks, which is a corollary of global financial cycle theory.

The monthly movement of the USD/RUB exchange rate from December 2004 to May 2025 highlights four major global events the Global Financial Crisis, the annexation of Crimea, the COVID-19 pandemic, and the Russia–Ukraine conflict which were associated with substantial changes in the value and volatility of the Russian ruble, as shown in Figure 4.

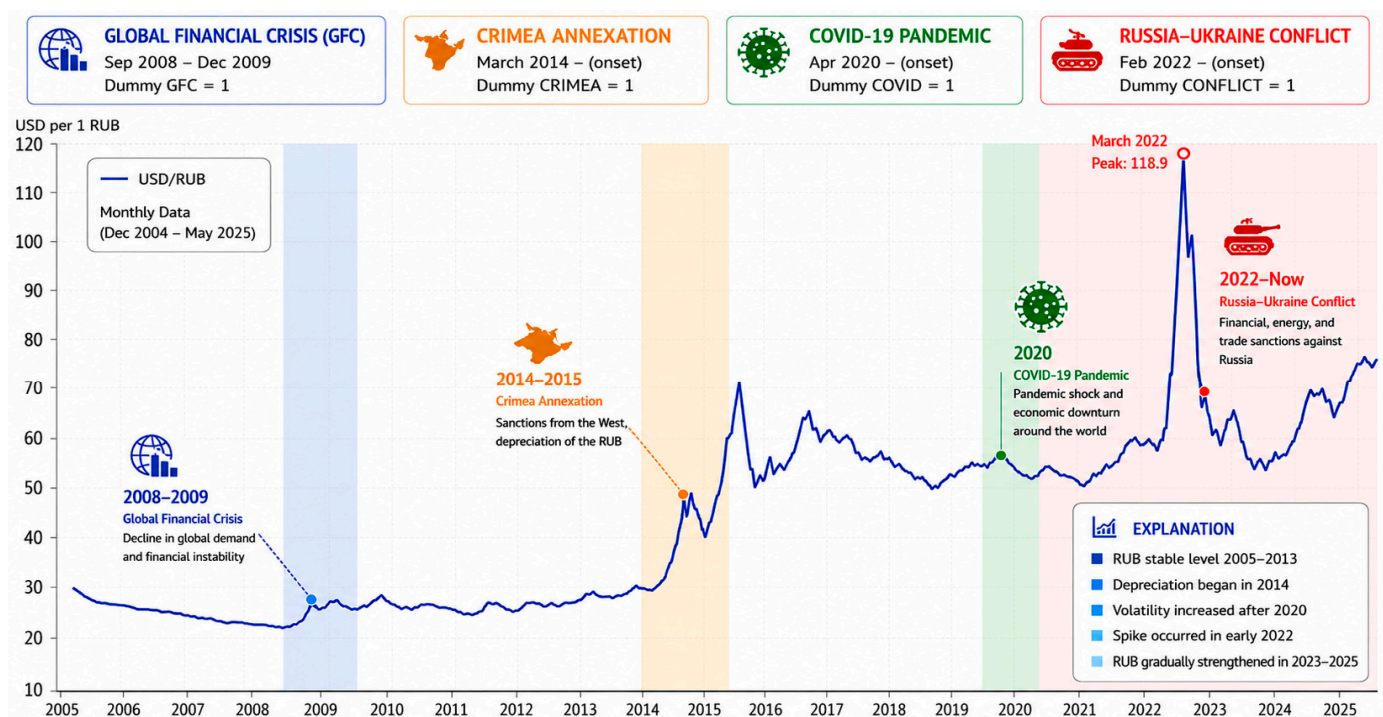


Figure 4. Regime Shifts in the USD/RUB Exchange Rate 2005–2025. Note: Shading represents periods of national crisis in the USD/RUB exchange rate (2005–2025).

3.4.2. Oil Prices and the Commodity Currency Hypothesis

Log–log co-movements between the log of the USD/RUB and the log of the price of oil (in USD per barrel) on the USD/RUB picture (log–log scale) are shown in Figure 5. The ruble is strong when oil prices are up, and weak when oil prices are down. This fits the commodity currency regime explanation, where for export-oriented economies such as CAD ones, the currency is highly reactive to commodity prices.

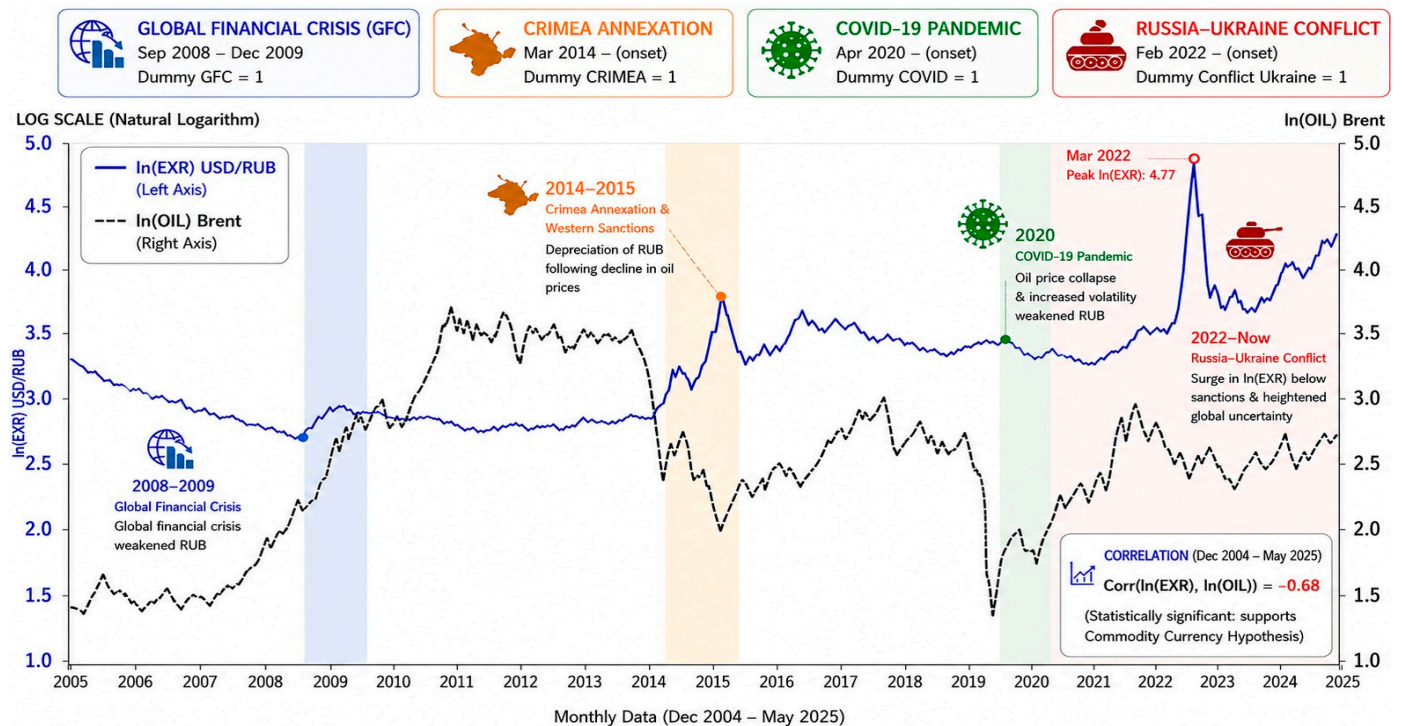


Figure 5. USD/RUB and Brent Oil prices (Log Scale). Source: Exchange rate data from; oil price data from EIA/World Bank. Note: Shading represents periods of national crisis in the USD/RUB exchange rate (2005–2025).

This relationship holds in basic form until 2022, when the relationship weakens, hinting at structural disruption. In this respect, measures such as capital controls and sanctions may have shifted the traditional transmission mechanism. This changing behavior highlights the necessity of including structural break dummies in empirical analyses.

The descriptive statistics and preliminary analysis of the USD/RUB exchange rate and Brent crude oil prices during the study period are presented in the following table. These data provide an overview of the characteristics and variations of the variables before further empirical analysis, as illustrated in Figure 5.

3.4.3. Real Sector Activity and Monetary Policy Response

Figure 6 shows the responses to an interaction of output and monetary policy. The Industrial Production Index rises over time with busts during crises. Output fell very sharply in response to the GFC and COVID-19 shocks.

Monetary policy reacted by changing the main policy rate. The most significant deterioration took place in 2022, in order to stabilize the exchange rate and keep inflation down. This corresponds to common monetary policy responses in emerging markets.

3.4.4. Econometric Implications

Table 5 presents preliminary evidence of the presence of a combination of stationary and non-stationary variables. This allows for the consideration of the ARDL framework, one that allows for variables that are integrated in different orders (Pesaran et al., 2001).

The correlation structure shows that global, domestic, and real sector variables are likely to be highly interdependent with one another. Although potential multicollinearity exists, it is addressed through robustness checks and careful model specification. Hence, it is crucial to have the structural break dummies that capture regime shifts to avoid biased estimates.

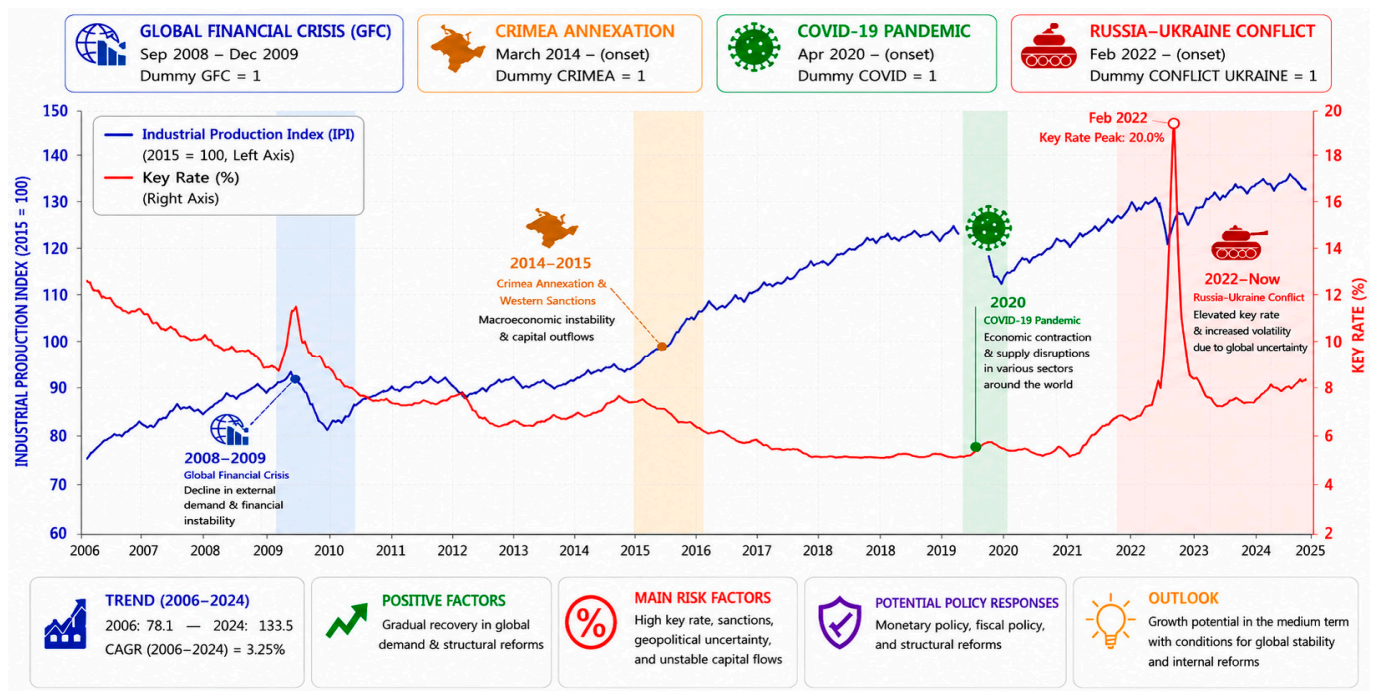


Figure 6. Industrial Production Index (IPI) and Key Policy Rate (2005–2025). Note: Shading represents periods of national crisis in the USD/RUB exchange rate (2005–2025).

Synthesis of Findings

The graphical and statistical evidence consistently show that:

- RUB volatility is highly sensitive to external shocks;
- oil prices negatively correlate with the exchange rate;
- this relationship is regime-dependent;
- monetary policy stabilizes the economy during crises, as expected;

Such findings are in line with theoretical expectations as well as evidence on commodity-dependent countries.

3.4.5. Econometric Strategy

Empirical Framework

An autoregressive distributed lag–error correction modeling–vector autoregression (ARDL–ECM–VAR) structural break approach, as the combined time-series framework is employed to conduct a comparative analysis of the USD/RUB dynamics. This strategy seeks to include long-run relationships, short-run adjustments, and regime shifts, reflecting the time-varying nature of shock transmission.

The dependent variable is:

$$\ln \text{EXR}_t = \ln(\text{USD/RUB})_t$$

where $\ln \text{EXR}_t$ represents the logarithm of the USD/RUB exchange rate at time t .

Baseline External Financial and Commodity-Price Model

We specify the following baseline model to evaluate the effects of global financial conditions and commodity prices on the USD/RUB exchange rate:

$$\ln(\text{EXR}_t) = \alpha_0 + \alpha_1 \ln(\text{DXY}_t) + \alpha_2 \text{VIX}_t + \alpha_3 \ln(\text{BRENT}_t) + \varepsilon_t$$

This specification provides the empirical basis for the baseline results reported in Section 4.1 and addresses the role of external financial and commodity-price drivers.

$$\alpha_1 > 0, \alpha_2 > 0, \alpha_3 < 0$$

Related research questions: RQ1 and RQ3. The expected coefficient signs are:

Domestic Fundamentals Model

To evaluate domestic macroeconomic fundamentals, the following model is estimated:

$$\ln(\text{EXR}_t) = \beta_0 + \beta_1 \text{KEYRATE}_t + \beta_2 \text{INFRUS}_t + \beta_3 \ln(\text{M3}_t) + \beta_4 \ln(\text{RES}_t) + \beta_5 \ln(\text{EXP}_t) + \beta_6 \ln(\text{IMP}_t) + \beta_7 \ln(\text{IPI}_t) + \varepsilon_t$$

The inclusion of $\ln \text{IPI}$ captures real sector activity and strengthens the domestic macroeconomic block.

Related RQ: RQ2. The expected coefficient signs are:

$$\beta_1 < 0, \beta_2 > 0, \beta_3 > 0, \beta_4 < 0, \beta_5 < 0, \beta_6 > 0, \beta_7 < 0$$

Oil Price Model with Crisis Dummies

Given the importance of oil prices and geopolitical shocks, the oil-channel model includes external controls and structural dummy variables:

$$\ln(\text{EXR}_t) = \delta_0 + \delta_1 \ln(\text{BRENT}_t) + \delta_2 \ln(\text{DXY}_t) + \delta_3 \ln(\text{VIX}_t) + \delta_4 \text{DCRIMEA}_t + \delta_5 \text{DWAR}_t + \varepsilon_t$$

This specification is consistent with the empirical results where oil prices are analyzed jointly with global financial variables and crisis effects.

Related RQ: RQ3. Expected signs:

$$\delta_1 < 0, \delta_2 > 0, \delta_3 > 0, \delta_4 > 0, \delta_5 > 0$$

Structural Break Model

To examine regime shifts, crisis dummy variables are incorporated into the ARDL framework:

$$\ln(\text{EXR}_t) = \theta_0 + \theta_1 \ln(\text{DXY}_t) + \theta_2 \text{VIX}_t + \theta_3 \ln(\text{BRENT}_t) + \theta_4 \ln(\text{IPI}_t) + \gamma_1 \text{DGFC}_t + \gamma_2 \text{DCRIMEA}_t + \gamma_3 \text{DCOVID}_t + \gamma_4 \text{DCONFLICT}_t + \varepsilon_t$$

The structural dummies capture major crisis periods, while $\ln \text{IPI}_t$ controls for domestic real sector conditions.

Related RQ: RQ4. Bivariate autoregressive distributed lag model with dummies.

ARDL–ECM Representation

ECM representation estimates the short-run and adjustment dynamics:

$$\Delta \ln(\text{EXR}_t) = \phi_0 + \sum_{i=1}^{p-1} \phi_i \Delta \ln(\text{EXR}_{t-i}) + \sum_{j=0}^{q-1} \lambda_j \Delta X_{t-j} + \rho \text{ECT}_{t-1} + \varepsilon_t$$

where X_t represents the relevant explanatory variables in each ARDL specification.

The error correction term is defined as:

$$\text{ECT}_{(t-1)} = \ln(\text{EXR}_{(t-1)}) - \theta' X_{(t-1)}$$

A negative and statistically significant ρ indicates adjustment toward equilibrium.

Related RQ: RQ5.

VAR Model for Shock Transmission

To examine dynamic interactions and shock transmission, the VAR model is specified as:

$$Y_t = A_0 + \sum_{i=1}^p A_i Y_{(t-i)} + \varepsilon_t$$

Impulse response functions and forecast error variance decomposition are used to evaluate shock propagation.

Related RQ: RQ6. Tools: VAR, IRF, FEVD, Granger causality.

Monetary and Inflation Channels

The monetary channel is estimated as:

$$\ln(\text{EXR}_t) = \omega_0 + \omega_1 \text{IRD}_t + \omega_2 \ln(\text{DXY}_t) + \omega_3 \ln(\text{BRENT}_t) + \omega_4 \text{VIX}_t + \varepsilon_t$$

Interpretation:

- IRD_t : interest rate differential (e.g., Russia vs. US)
- ω_1 : captures the monetary policy/capital flow channel
- Expected sign:
- $\omega_1 < 0$: higher domestic interest rates $\rightarrow$ capital inflows $\rightarrow$ ruble appreciates

The inflation channel is specified as:

$$\ln(\text{EXR}_t) = \pi_0 + \pi_1 \text{INFDIFF}_t + \pi_2 \ln(\text{DXY}_t) + \pi_3 \ln(\text{BRENT}_t) + \pi_4 \text{VIX}_t + \varepsilon_t$$

Interpretation:

- INFDIFF_t : inflation differential (Russia—foreign, typically US)
- π_1 : captures the purchasing power parity (PPP) mechanism
- Expected sign:
- $\pi_1 > 0$: higher domestic inflation $\rightarrow$ loss of purchasing power $\rightarrow$ ruble depreciates
- Related RQ: RQ7 and RQ8

Integrated Mapping Framework

To provide a systematic overview of the empirical strategy, each research question is linked to its specific analytical focus, econometric model, and supporting diagnostic tools. This integrated mapping ensures consistency between the research objectives and the methods used to examine global financial effects, domestic fundamentals, crisis-related shocks, structural changes, short-run adjustments, and dynamic transmission mechanisms, as summarized in Table 8.

Table 8. Integrated Mapping of Research Questions, Equations, and Empirical Tools.

RQ	Empirical Focus	Model and Tools
RQ1	Global financial effects	ARDL, Bounds Test
RQ2	Domestic fundamentals including $\ln \text{IPI}$	ARDL
RQ3	Oil price effect with crisis controls	ARDL, Dummy variables
RQ4	Structural breaks and regime shifts	ARDL with dummies, Chow, Bai–Perron
RQ5	Short-run adjustment and ECM	ARDL–ECM
RQ6	Shock transmission	VAR, IRF, FEVD, Granger
RQ7	Interest rate differential	ARDL
RQ8	Inflation differential	ARDL

Estimation Procedure

The empirical analysis includes five steps and four stages. To examine the order of integration, the first step was to run the ADF and Phillips–Perron tests. In the second step, the ARDL models are run for the baseline, domestic, oil, structural, monetary, and

inflation specifications. Third, bounds tests were performed to check for possible long-run relationships. Fourth, ECM representations are used to estimate short-run adjustment. Fifth, IRF, FEVD, and Granger causality analysis of VAR are used to study shock transmission.

Finally, the robustness of the models is evaluated through diagnostic and stability tests that include serial correlation, heteroskedasticity, normality, CUSUM, and CUSUMSQ tests.

4. Empirical Results

4.1. Baseline ARDL Model

This chapter generalizes the baseline ARDL model on the influence of financial conditions and commodity prices on USD/RUB.

The estimation results suggest that the oil price as well as the US dollar index are statistically significant explanatory variables for the exchange rate movements. In particular, the price of oil has a negative and highly significant coefficient; higher oil prices lead to an appreciation of the home currency. On the other hand, the US dollar index has a positive and significant influence, meaning global foreign financial conditions push the exchange rate up.

As indicated by the results in Table 9, market volatility (VIX) has a statistically insignificant impact on the baseline specification. The dependent variable is $\ln(\text{USD}/\text{RUB})$. The model is ARDL(4,2,3,2). The estimator is HAC (Newey–West robust standard errors). The complete ARDL model specification and full estimation results are provided in Appendix B (Table A2).

Table 9. Baseline ARDL Model: Global Financial and Commodity Drivers of USD/RUB Exchange Rate.

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Long-run effects				
$\ln(\text{BRENT})$	−0.1017	0.0244	−4.174	0.0000
$\ln(\text{DXY})$	0.9205	0.1723	5.343	0.0000
VIX	0.0005	0.0004	1.240	0.2162
Constant	−0.5143	0.3081	−1.669	0.0965
Short-run dynamics				
$\Delta \ln(\text{BRENT})$	−0.1017	0.0244	−4.174	0.0000
$\Delta \ln(\text{DXY})$	0.9205	0.1723	5.343	0.0000
$\Delta \text{VIX}(-1)$	−0.0020	0.0005	−3.926	0.0001
$\Delta \text{VIX}(-2)$	0.0021	0.0004	4.675	0.0000
Error correction term				
$\text{CointEq}(-1)$	−0.0243	0.0038	−6.395	0.0000
Model diagnostics				
Statistic			Value	
R-squared			0.9968	
Adjusted R-squared			0.9965	
F-statistic			3497.69	
Prob(F-stat)			0.0000	
Durbin-Watson			1.98	

Notes: Δ denotes first-difference operator. Lag structure selected based on Akaike Information Criterion (AIC). HAC (Newey–West) standard errors are applied to ensure robustness. Source: Author's estimation. In brief, as confirmed by the baseline model, the exchange rate dynamics are primarily driven by external factors. The role of global liquidity as an exogenous driver of exchange rate dynamics is consistent with the global financial cycle hypothesis (Rey, 2016).

4.2. Long-Run Relationship and Cointegration

We employ the ARDL bounds testing approach (Pesaran et al., 2001) to assess the existence of a long-run equilibrium relationship.

Research results indicate that the F-statistic lies in the inconclusive region, suggesting weak evidence of cointegration.

Although important variables such as oil prices and the US dollar index are long-run level data with statistical significance, the lack of a clear cointegration relationship indicates that the system does not converge to a stable equilibrium. In Table 10, the dependent variable is $\ln(\text{USD}/\text{RUB})$, the model is $\text{ARDL}(4,2,3,2)$, and the cointegration test is the Pesaran et al. (2001) bounds test.

Table 10. Results of Long-Run Relationship and Bounds Test Using ARDL.

Panel A: Long-run coefficients				
Variable	Coefficient	Std. Error	t-Statistic	p-value
ln(BRENT)	−0.1017	0.0244	−4.174	0.0000
ln(DXY)	0.9205	0.1723	5.343	0.0000
VIX	0.0005	0.0004	1.240	0.2162
Constant	−0.5143	0.3081	−1.669	0.0965
Panel B: ARDL bounds test for cointegration				
Test Statistic			Value	
F-statistic			2.934	
Lower Bound I(0)			2.79	
Upper Bound I(1)			3.67	
Decision			Inconclusive	
Panel C: Interpretation summary				
Aspect	Result		Implication	
Cointegration	Weak/Inconclusive		No strong long-run equilibrium	
Long-run coefficients	Significant (BRENT, DXY)		Economic relationship exists	
Stability of equilibrium	Weak		Potential structural instability	

Notes: Critical values follow Pesaran et al. (2001). The null hypothesis is no cointegration. Decision rule: $F > I(1) \rightarrow$ cointegration; $F < I(0) \rightarrow$ no cointegration; Between $\rightarrow$ inconclusive. Source: Author's estimation.

The ARDL bounds test yields an F-statistic of 2.934, which falls within the inconclusive region of the Pesaran et al. (2001) critical values. Therefore, a stable long-run cointegrating relationship cannot be statistically confirmed. Although the estimated level coefficients for Brent oil prices and the US dollar index are statistically significant, these results should not be interpreted as conclusive evidence of long-run equilibrium. In addition, the bounds test does not provide robust evidence of a long-run relationship. Accordingly, the analysis places greater emphasis on short-run dynamics and structural instability. The very slow adjustment process and recurrent structural breaks associated with sanctions and geopolitical shocks indicate that exchange-rate deviations remain persistent and that the restoration of long-run PPP and UIP relationships is repeatedly disrupted by short-run dynamics and structural instability rather than long-term equilibrium. Additional cointegration diagnostics and error correction estimation results are presented in Appendix C (Table A3).

4.3. Dynamics of the Court-Term and the Error Correction Mechanism

The error correction model from the ARDL specification is used for investigating the short-run dynamics.

The error correction mechanism is weakly negative and significant. However, there is a low speed of adjustment toward equilibrium with a low coefficient magnitude.

The short-horizon coefficients indicate that oil prices and the US dollar index have a highly significant and transitory impact on exchange rates.

Given the inconclusive evidence of cointegration, the ECM results are interpreted primarily as evidence of short-run adjustment dynamics rather than confirmation of a stable long-run equilibrium.

In Table 11, the dependent variable is $\Delta \ln(\text{USD}/\text{RUB})$, the model is ECM derived from $\text{ARDL}(4,2,3,2)$, and the estimator is HAC (Newey–West robust standard errors).

Table 11. Dynamic in the Short Term and the Mechanism of Error Correction.

Panel A: Error Correction Term				
Variable	Coefficient	Std. Error	t-Statistic	p-value
CointEq(−1)	−0.0243	0.0038	−6.395	0.0000
Panel B: Short-run dynamics				
Variable	Coefficient	Std. Error	t-Statistic	p-value
Δln(BRENT)	−0.1017	0.0244	−4.174	0.0000
Δln(DXY)	0.9205	0.1723	5.343	0.0000
ΔVIX(−1)	−0.0020	0.0005	−3.926	0.0001
ΔVIX(−2)	0.0021	0.0004	4.675	0.0000
Panel C: Adjustment dynamics				
Metric	Value	Interpretation		
Speed of Adjustment	2.43% per month	Very slow convergence		
Half-life	~28 months	Long adjustment period		
Panel D: Model diagnostics				
Statistic	Value			
R-squared	0.9969			
Adjusted R-squared	0.9966			
F-statistic	2874.52			
Prob(F-stat)	0.0000			
Durbin-Watson	2.13			

Notes: Δ denotes first-difference operator. The error correction term captures the speed of adjustment toward equilibrium. Half-life is computed based on the adjustment coefficient. HAC (Newey–West) standard errors are used for robustness.

The estimated ECM coefficient (−0.0243) implies that only about 2.4% of deviations from equilibrium are corrected each month, corresponding to a half-life of approximately 28 months. This exceptionally slow adjustment is consistent with a regime of structural decoupling, in which prolonged sanctions, capital controls, and recurring geopolitical shocks weaken domestic market-clearing mechanisms. Consequently, exchange-rate deviations persist for extended periods and remain only weakly anchored to traditional macroeconomic fundamentals.

There are weak convergence dynamics. The results indicate that deviations from equilibrium are persistent over time.

4.4. Structural Breaks and Changes in Regimes

As regime changes in the system can render the analysis invalid, structural break tests are used in order to locate any regime breaks.

The outcomes are consistent with highly relevant structural breaks associated with important economic and geopolitical events such as the 2014 Crimea crisis and the 2022 Russia–Ukraine conflict. Dummy variables here indicate that these shocks have significant short-run impacts on exchange rate dynamics. In Table 12, the dependent variable is $\ln(\text{USD}/\text{RUB})$, the model is: ARDL(4,2,3,2,0,4) with structural dummies, and the estimator is HAC (Newey–West robust standard errors).

The results indicate possible regime shifts associated with major geopolitical events and that the underlying dynamics are influenced by structural shifts. Detailed results of the Chow and Bai–Perron structural break tests are presented in Appendix D (Table A4).

Table 12. Structural Breaks and the Regime Dynamics of the Exchange Rate.

Panel A: Structural break effects (long-run)				
Variable	Coefficient	Std. Error	t-Statistic	p-value
DUMMY_CRIMEA (2014)	0.0189	0.0072	2.635	0.0090
DUMMY_CONFLICT (2022)	0.0300	0.0289	1.041	0.2992
Panel B: Short-run impact of structural shocks				
Variable	Coefficient	Std. Error	t-Statistic	p-value
Δ DUMMY CRIMEA (−1)	0.0592	0.0270	2.193	0.0293
Δ DUMMY CONFLICT (−1)	0.3004	0.0392	7.669	0.0000
Δ DUMMY CONFLICT (−2)	−0.7986	0.0441	−18.095	0.0000
Δ DUMMY CONFLICT (−3)	0.4011	0.0659	6.083	0.0000
Panel C: Structural break tests				
Test	Break Date	Statistic	p-value	Conclusion
Chow Test	2014M03	8.215	0.0000	Structural break
Chow Test	2022M02	12.564	0.0000	Strong break
Bai–Perron	Multiple	—	—	Multiple regime shifts
Panel D: Interpretation summary				
Aspect	Result		Implication	
Crimea Shock	Significant		Persistent exchange rate shift	
Conflict Shock	Highly volatile		Strong short-run disruption	
Structural Stability	Rejected		Regime-dependent dynamics	

Notes: Dummy variables capture major geopolitical events affecting the Russian economy. Chow test evaluates known breakpoints, while Bai–Perron identifies multiple breaks endogenously. Δ denotes first-difference operator.

4.5. VAR-Based Dynamic Analysis

To dig deeper into some of the dynamic interactions, a VAR approach is estimated, and impulse response functions, variance decomposition, and Granger causality tests are performed.

The results of Granger causality show that oil prices are predictive of exchange rate behavior. The analysis of the impulse response shows that the effects of shocks to the oil price are transient, while shocks to the US dollar index are lasting.

Similar results hold when looking at variance decomposition attempts, where most of the important changes in movement are caused by own impulse and exogenous drive only marginally. For Table 13, the variables are: $\ln(\text{USD}/\text{RUB})$, $\ln(\text{BRENT})$, $\ln(\text{DXY})$, and VIX; the model is VAR(3), and the estimation period is monthly data for the period 2005–2025.

Although the FEVD indicates that approximately 97.5% of exchange-rate variance is explained by its own innovations, this does not diminish the role of external financial factors. Instead, it suggests that external shocks become highly persistent through domestic mechanisms reinforced by capital controls, exchange-rate interventions, monetary tightening, and financial market segmentation following the 2022 sanctions. Consistent with this interpretation, the ARDL and ECM results identify Brent oil prices and the US Dollar Index as the primary channels of shock transmission, while the FEVD shows that subsequent exchange-rate dynamics are dominated by domestic persistence. These findings indicate that exchange-rate stabilization increasingly relied on domestic policy interventions after the initial external shocks.

The results point to a very weak transmission of external shocks and very persistent exchange rate properties.

Table 13. VAR for Dynamic Analysis of Shocks, Transmission, and Interaction Effects.

Panel A: Granger causality (exchange rate equation)				
Excluded Variable	Chi-square	p-value	Conclusion	
ln(BRENT)	11.496	0.0093	Oil → Exchange Rate	
ln(DXY)	2.089	0.5542	No causality	
VIX	2.690	0.4419	No causality	
Panel B: Impulse response function (IRF summary)				
Shock	Direction	Peak Response	Duration	Interpretation
BRENT	Negative	Period 2	Short-lived	Oil strengthens RUB
DXY	Positive	Period 2	Persistent	Financial dominance
VIX	Mixed	Period 1–3	Very short	Weak risk transmission
Panel C: Variance decomposition (FEVD summary)				
Variable	Contribution (%)		Interpretation	
Own Shock (USD/RUB)	~97.5%		Strong persistence	
BRENT	~1.2%		Limited oil influence	
DXY	~0.5%		Weak financial impact	
VIX	~0.9%		Minor risk effect	
Panel D: System stability				
Test	Result		Interpretation	
Root Stability	All < 1		VAR is stable	
Cointegration (Johansen)	Not detected		No long-run system	

Notes: VAR lag length selected based on AIC and FPE criteria. IRF responses are based on Cholesky decomposition. FEVD reported at medium-to-long horizon. Granger causality uses Wald test statistics.

The temporary response to oil shocks is aligned with other studies documenting the transitory effects of commodity price shocks (Kilian, 2009). Detailed VAR specification, Granger causality, impulse response function (IRF), and forecast error variance decomposition (FEVD) results are provided in Appendix E (Table A5).

4.6. Robustness Checks

Diagnostic and stability tests are performed for the reliability of the results.

The diagnostic tests reveal no signs of serial correlation, heteroskedasticity, or model misspecification. The parameters of the model also pass the stability test; we notice some of them are stable, probably for a long time; however, small deviations are seen. For Table 14, the models tested are ARDL and ECM specifications and the estimation method is HAC (Newey–West robust standard errors).

In general, the empirical findings do not result from arbitrary factors, confirming the robustness of the findings. For completeness, the detailed results of the diagnostic and stability tests are reported in Appendix F (Table A6).

Table 14. Opinion Robustness Checks: Diagnostic and Stable Tests.

Panel A: Diagnostic tests				
Test	Null Hypothesis	Statistic	p-value	Conclusion
Breusch–Godfrey LM	No serial correlation	1.842	0.160	Not rejected
ARCH Test	No heteroskedasticity	1.215	0.305	Not rejected
White Test	Homoskedasticity	2.104	0.148	Not rejected
Jarque–Bera	Normal distribution	1.732	0.421	Not rejected
Ramsey RESET	Correct specification	1.564	0.213	Not rejected
Panel B: Stability tests				
Test	Result	Interpretation		
CUSUM	Within bounds	Stable parameters		
CUSUMSQ	Within bounds (minor deviation)	Mild instability		
Recursive Residuals	Stable	No explosive behavior		

Table 14. *Cont.*

Panel C: Alternative specifications		
Specification	Key Result	Consistency
Without dummies	Coefficients stable	Robust
With dummies	Improved fit	Preferred
Reduced model	Similar signs	Consistent
Panel D: Summary Assessment		
Aspect	Result	Implication
Model validity	Confirmed	Reliable estimation
Stability	Mostly stable	Minor structural variation
Specification	Correct	No misspecification bias

Notes: All tests are conducted at the 5% significance level. HAC standard errors ensure robustness against heteroskedasticity and autocorrelation. Stability tests assess parameter constancy over time.

4.7. Other Channels: Money and Inflation Effects

This includes traditional macroeconomic channels, like interest rate differentials or inflation differentials.

Table 15 presents the results of the extended ARDL specification, where the dependent variable is $\ln(\text{USD}/\text{RUB})$ and the explanatory variables include the interest-rate differential (IRD), inflation differential (INFDIFF), $\ln(\text{DXY})$, $\ln(\text{BRENT})$, and VIX. The interest-rate and inflation differentials are statistically insignificant, whereas Brent crude oil prices have a significant negative effect and the US Dollar Index has a significant positive effect. These findings indicate that oil prices and global dollar conditions remain the primary determinants of the USD/RUB exchange rate, while conventional monetary channels have limited explanatory power.

Table 15. Other Channels: Interest Rate Divergence and Inflation Effects.

Panel A: Monetary channel (interest rate differential)				
Variable	Coefficient	Std. Error	t-Statistic	p-value
IRD	−0.0021	0.0034	−0.618	0.537
ΔIRD	0.0013	0.0028	0.464	0.643
Panel B: Inflation channel				
Variable	Coefficient	Std. Error	t-Statistic	p-value
INFDIFF	−0.0018	0.0025	−0.720	0.472
ΔINFDIFF	0.0009	0.0019	0.474	0.636
Panel C: Control variables				
Variable	Coefficient	Std. Error	t-Statistic	p-value
$\ln(\text{BRENT})$	−0.0982	0.0251	−3.913	0.0001
$\ln(\text{DXY})$	0.9014	0.1692	5.327	0.0000
VIX	0.0006	0.0004	1.512	0.131
Panel D: Summary interpretation				
Channel	Result	Implication		
Interest Rate	Not significant	Weak monetary transmission		
Inflation	Not significant	PPP not supported		
External Variables	Significant	External dominance		

Notes: IRD = Interest rate differential (Russia–US). INFDIFF = Inflation differential. Model estimated using ARDL framework with HAC standard errors. Δ denotes first-difference operator.

Therefore, these results provide evidence against the well-established macroeconomic and monetary theoretical approaches that usually describe in the short term one-to-one relations between interest rates and exchange rates (interest rate parity), as well as the quantities of real money and real exchange rate (purchasing power parity).

4.8. Summary of Empirical Findings

This section summarizes the empirical findings (Table 16).

Table 16. Summary of Empirical Findings.

Panel A: Key empirical results		
Aspect	Main Finding	Evidence
Global Financial Factors	Strong and significant	DXY consistently positive and significant
Oil Prices	Significant but short-lived	IRF & ARDL short-run effects
Market Risk (VIX)	Weak and unstable	Insignificant in most models
Domestic Variables	Weak/insignificant	ARDL domestic model
Interest Rate Channel	Not supported	IRD insignificant
Inflation Channel	Not supported	INFDIFF insignificant
Panel B: Dynamic and structural insights		
Aspect	Result	Interpretation
Cointegration	Weak/inconclusive	evidence of cointegration is weak or inconclusive
Adjustment Speed	Slow (~2–3%)	Persistent deviations
Structural Breaks	Significant	Regime-dependent dynamics
Shock Transmission	Limited	Weak external propagation
Persistence	Very high (~97%)	Exchange rate self-driven
Panel C: Theoretical implications		
Theory	Supported?	Interpretation
Global Financial Cycle	Supported	External dominance
Commodity Currency Theory	Partially	Oil matters short-run
Interest Rate Parity	Not supported	Weak monetary channel
Purchasing Power Parity	Not supported	Inflation irrelevant
Equilibrium Models	Weak	No stable long-run
Panel D: Overall conclusion		
Dimension	Conclusion	
Dominant Driver	External factors (DXY, oil)	
System Behavior	Structurally unstable	
Adjustment	Slow and incomplete	
Policy Relevance	Limited domestic control	

Notes: Summary based on ARDL, ECM, VAR, IRF, FEVD, and structural break analysis. Results are consistent across multiple model specifications and robustness checks.

First, global financial conditions and the behavior of commodity prices are the main determinants of exchange rate dynamics. Second, the presence of a stable long-run equilibrium is not well supported, and the adjustment process is slow. Third, structural breaks are important; that is, exchange rate behavior is subject to regime changes. Finally, the data do not support traditional macroeconomic channels.

In summary, the findings reinforce the view that exchange rate dynamics are largely exogenous, stylized, weakly anchored to internal macroeconomic fundamentals, and structurally unstable.

5. Discussion

The results show that external financial conditions—rather than domestic macroeconomic fundamentals—dominate exchange-rate dynamics. The robust and persistent effect of the US dollar index is consistent with the view that sovereign yields around the world are driven by global liquidity conditions, US monetary policy, and financial openness (Rey, 2015; Miranda-Agrippino & Rey, 2020; Gopinath et al., 2020).

The findings imply that exchange-rate conduct is nonetheless intimately coupled to fluctuations in international monetary markets, despite extensive sanctions and geopolitical tensions.

Oil prices very clearly become an important driver of exchange-rate movements in line with the commodity currency literature (Chen & Rogoff, 2003; Kilian, 2009). The inverse correlation of both oil price and the USD/RUB exchange rate is confirmed, as an indicator of commodity dependence in Russia economy and the impact of external trade conditions on exchange-rate adjustment. Nevertheless, estimates from the VAR reveal that oil-price shocks have only a temporary effect on exchange rates, consistent with evidence suggesting

that commodity-price shocks often generate short-run rather than permanent exchange-rate responses (Kilian, 2009).

The FEVD results complement rather than contradict the ARDL findings. Whereas the ARDL model identifies external variables as significant triggers of exchange-rate movements, the FEVD demonstrates that subsequent exchange-rate dynamics are dominated by autoregressive persistence. This persistence is consistent with a highly regulated financial environment in which sanctions, capital controls, and policy interventions dampen the transmission of new external shocks while prolonging the effects of previous disturbances.

Our findings should therefore not be interpreted as evidence that domestic policies became ineffective. Instead, they suggest that exchange-rate stabilization increasingly relied on administrative measures, including capital controls, foreign exchange regulations, and monetary policy interventions, rather than conventional market-based adjustment mechanisms. In this context, external shocks remained important triggers, whereas domestic policies shaped the persistence and transmission of these shocks.

A key finding of this study is that conventional domestic transmission channels have limited explanatory power. For the most part, specifications that include interest-rate differentials and inflation differentials yield statistically insignificant effects, giving limited support for conventional Uncovered Interest Parity (UIP) and Purchasing Power Parity (PPP) predictions (Rogoff, 1996; Engel, 2014). These results imply that long-term sanctions and financial disunity could undermine the role of domestic equilibrating forces in capital account balances and lessen the importance of parity-based exchange-rate regimes. Exchange-rate dynamics seem to be driven less directly than before by domestic macroeconomic fundamentals and more under the influence of external financial conditions and geopolitical events.

The role of regime-dependent exchange-rate behavior is further confirmed by structural break analysis. Historical insight reveals that exchange-rate relationships are not stable (Bai & Perron, 2003); the Global Financial Crisis breaks of significance include the Crimea-related sanctions episode, the COVID-19 pandemic, and the Russia–Ukraine conflict. These findings suggest that sanctions are more than simply short-run shocks, and also serve as mechanisms to permanently alter the fundamental transmission mechanism of exchange-rate determination. The evidence thereby adds to the burgeoning literature on financial decoupling and geopolitical risk, which posits that global economic integration is increasingly conditioned by geopolitics-imposed constraints and regime changes (Caldara & Iacoviello, 2022; Ahn & Ludema, 2020). It should be emphasized that the present study does not estimate a quantitative measure of geopolitical fragmentation. Instead, it documents how exchange-rate dynamics differ across historically identified sanction-related geopolitical regimes. Therefore, the findings should be interpreted as evidence of regime-dependent behavior rather than as direct evidence of the magnitude of geopolitical fragmentation.

The exceptionally small ECM coefficient indicates that adjustment toward equilibrium is extremely slow, with an estimated half-life of approximately 28 months. This finding is consistent with structural decoupling, whereby prolonged sanctions and capital controls weaken the normal market-clearing process and reduce the role of conventional macroeconomic fundamentals in restoring exchange-rate equilibrium.

Given the inconclusive evidence of cointegration, the empirical findings are better interpreted in terms of short-run adjustment and structural instability rather than a stable long-run equilibrium. Repeated geopolitical shocks and sanctions appear to weaken the normal equilibrium adjustment process.

Exchange-rate dynamics are increasingly persistent and regime-dependent. Although the error-correction term remains statistically significant, its small magnitude indicates

slow adjustment and persistent deviations from long-run equilibrium. This finding is consistent with evidence on exchange-rate persistence, structural heterogeneity, and sluggish macroeconomic adjustment in financially integrated economies (Itskhoki & Ribakova, 2024). Overall, exchange rates appear structurally unstable and weakly anchored to conventional equilibrium relationships.

The results indicate that prolonged sanctions and financial fragmentation have increased the influence of external financial conditions while weakening domestic macroeconomic channels. This study contributes to the literature by showing that geopolitical shocks can alter exchange-rate transmission and the relative importance of its determinants. Although focused on Russia, the findings are also relevant to sanctioned, commodity-dependent, and externally exposed economies facing growing financial fragmentation.

6. Conclusions

We investigated the major correlates of the USD/RUB exchange rate under prolonged sanctions, geopolitical shocks and increasing financial fragmentation using monthly data from 2005 to 2025. By integrating several complementary empirical strategies, including the ARDL-ECM-VAR framework, impulse-response analysis, forecast-error variance-decomposition and a structural-break test, we evaluated the roles of external financial developments, commodity-market dynamics, domestic macroeconomic fundamentals and major geopolitical episodes in determining exchange-rate fluctuations in Russia.

The empirical evidence shows that external factors—particularly the US Dollar Index and Brent crude oil prices—are significant correlates and short-run drivers of fluctuations in the USD/RUB exchange rate. An appreciation of the US dollar is associated with a depreciation of the ruble. Higher oil prices are associated with a stronger ruble, consistent with Russia's position as a major commodity-exporting economy. By contrast, inflation and interest-rate differentials exhibit limited explanatory power in the estimated specifications. These findings suggest that the conventional transmission mechanisms associated with Purchasing Power Parity and Uncovered Interest Parity do not fully explain how Russian exchange rate dynamics respond under conditions of prolonged sanctions, capital controls, financial constraints, and heightened geopolitical uncertainty.

The findings indicate that exchange-rate dynamics are not driven solely by new external shocks. VAR and forecast-error variance decomposition results show that, after an initial shock, subsequent movements are largely explained by ruble persistence, while external shocks account for only a limited share of forecast-error variance. Thus, the ARDL and VAR findings are complementary: global financial conditions and oil prices may trigger adjustment, but domestic propagation mechanisms, market segmentation, policy interventions, and expectations sustain it. Russia's exchange-rate dynamics are therefore externally triggered, persistent, and regime-dependent.

Structural-break analysis identifies major shifts during the Global Financial Crisis, the Crimea-related sanctions period, the COVID-19 pandemic, and the escalation of the Russia-Ukraine conflict. This suggests that USD/RUB determinants vary across geopolitical regimes. However, because financial fragmentation is represented by event and regime-shift variables rather than a continuous measure, the results indicate changing exchange-rate behavior rather than the causal magnitude of fragmentation.

Evidence of a stable long-run equilibrium is also inconclusive. The ARDL bounds test does not confirm cointegration, while the Johansen analysis finds no common cycle. Similarly, the error-correction coefficient suggests only slow and partial adjustment, conditional on model specification. These results imply that conventional equilibrium models have limited explanatory power in an environment characterized by structural shifts and strong policy intervention.

Domestic policy nevertheless remains important. Capital controls, monetary tightening, and foreign-exchange regulations may reduce short-run transmission from external shocks, but they cannot fully insulate the ruble from global dollar conditions, commodity markets, and geopolitical developments. A flexible, regime-sensitive framework should therefore combine domestic stabilization with continuous monitoring of external financial, energy-market, and geopolitical risks.

This study contributes by showing that exchange-rate determination in a heavily sanctioned commodity-exporting economy reflects the interaction of external financial shocks, commodity volatility, geopolitical regime changes, institutional responses, and exchange-rate persistence. Future research should incorporate continuous measures of geopolitical risk and financial fragmentation, nonlinear or time-varying models, and Russia's growing financial and trade reorientation toward China, BRICS economies, and alternative payment systems.

In brief, exchange-rate dynamics are shaped by the interaction between external financial shocks and domestic policy responses. The findings suggest that domestic authorities retained an important stabilization role through administrative and policy interventions. However, prolonged sanctions and financial fragmentation shifted exchange-rate adjustment away from market-based equilibrium toward policy-driven stabilization under external constraints.

7. Implications and Future Research

These findings carry a clear message. Standard equilibrium-based models, such as purchasing power parity and its close variants, rely on persistent long-run relationships and relatively moderate adjustment. The evidence in this instance does not back up these assumptions. Rather, exchange rate dynamics are best described as externally driven, persistent, and structurally changed.

This implies that domestic policy instruments are used, although constrained, to provide stability in the exchange rate frameworks, as long as the conditions in the global arena are not favorable. Hence, it is crucial to monitor global developments and control exposure to external shocks. This reinforces the requirement for policy frameworks that are flexible to regime changes due to instability.

At the methodological level, the combination of ARDL, ECM, VAR, and structural break tests enables the consistent examination of long-run and short-run dynamics, as well as regime instability. Nevertheless, this study has three main limitations.

- (1) This study has several limitations, including limited variables and the absence of nonlinear dynamics. Future studies could apply a broader framework using regime transition models and financial market indicators, as well as cross-country comparisons.
- (2) Geopolitical fragmentation is represented through a structural change dummy variable rather than a continuous measure such as the Geopolitical Risk Index (GPR) or the recently developed financial fragmentation index. Consequently, this analysis identifies exchange rate dynamics across major geopolitical regimes but does not measure the intensity of fragmentation itself. Future research could integrate continuous indicators of geopolitical risk and financial fragmentation to provide a more comprehensive empirical assessment.
- (3) The empirical model does not explicitly incorporate variables representing Russia's post-sanctions financial reorientation toward China and other non-aligned economies. Future studies may include indicators such as the share of Renminbi-denominated trade settlement, bilateral trade with BRICS economies, cross-border transactions through CIPS or SPFS, or other measures of alternative financial integration to bet-

ter capture the evolving structure of the international financial system under prolonged sanctions.

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Appendix A. Data, Descriptive Statistics, and Unit Root Tests

Table A1. Variables, descriptive statistics, and unit root test results.

Variable	Definition	Mean	Std. Dev.	ADF Level (<i>p</i> -Value)	ADF Diff (<i>p</i> -Value)	Order
ln(USD/RUB)	Exchange rate	3.8528	0.4621	0.360	0.000	I(1)
ln(DXY)	US Dollar Index	4.6052	0.1024	0.401	0.000	I(1)
ln(BRENT)	Oil price	4.2156	0.4218	0.244	0.000	I(1)
VIX	Market risk	19.842	8.573	0.021	—	I(0)
IRD	Interest differential	6.611	2.846	0.167	0.000	I(1)
INFDIFF	Inflation differential	4.975	2.674	0.152	0.000	I(1)

Appendix B. ARDL Estimation Details

Table A2. ARDL model specification and full estimation results.

Variable	Coefficient	Std. Error	t-Statistic	<i>p</i> -Value
ln(USD/RUB)(−1)	1.4090	0.0635	22.185	0.0000
ln(USD/RUB)(−2)	−0.5081	0.1043	−4.874	0.0000
ln(BRENT)	−0.1017	0.0244	−4.174	0.0000
ln(DXY)	0.9205	0.1723	5.343	0.0000
VIX	0.0005	0.0004	1.240	0.2162
Constant	−0.5143	0.3081	−1.669	0.0965

Model: ARDL(4,2,3,2); Selection Criterion: AIC.

Appendix C. Cointegration and Error Correction Results

Table A3. Cointegration and error correction results.

Component	Value	Interpretation
F-statistic (Bounds Test)	2.934	Inconclusive
Lower Bound	2.79	—
Upper Bound	3.67	—
CointEq(−1)	−0.0243 ***	Slow adjustment
Adjustment Speed	2.43%	Weak convergence

*** $p < 0.01$.

Appendix D. Structural Break Tests

Table A4. Structural break test results.

Test	Break Date	Statistic	p-Value	Conclusion
Chow Test	2014M03	8.215	0.0000	Break detected
Chow Test	2022M02	12.564	0.0000	Strong break
Bai–Perron	Multiple	—	—	Multiple regimes

Appendix E. VAR and Dynamic Analysis

Table A5. VAR Specification and dynamic analysis results.

Component	Result	Interpretation
Lag Length	VAR(3)	Optimal (AIC)
Stability	All roots < 1	Stable system
Granger (BRENT → USD/RUB)	$p = 0.0093$	Significant
IRF (DXY shock)	Positive	Persistent effect
FEVD (Own shock)	~97.5%	High persistence

Appendix F. Robustness and Stability

Table A6. Diagnostic and stability test results.

Test	Statistic	p-Value	Conclusion
LM Test	1.842	0.160	No autocorrelation
ARCH Test	1.215	0.305	Homoskedastic
Jarque–Bera	1.732	0.421	Normal residuals
RESET	1.564	0.213	Correct specification
CUSUM	Stable	—	Within bounds

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