



“Macroeconomic and energy impacts of Russia’s invasion of Ukraine: A comparative analysis across countries”

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ARTICLE INFO

Viktoriia Koilo (2023). Macroeconomic and energy impacts of Russia’s invasion of Ukraine: A comparative analysis across countries. *Geopolitics under Globalization*, 5(1), 19-34. doi:[https://doi.org/10.21511/gg.05\(1\).2024.02](https://doi.org/10.21511/gg.05(1).2024.02)

DOI

[https://doi.org/10.21511/gg.05\(1\).2024.02](https://doi.org/10.21511/gg.05(1).2024.02)

RELEASED ON

Tuesday, 17 December 2024

RECEIVED ON

Monday, 18 November 2024

ACCEPTED ON

Thursday, 12 December 2024

LICENSE



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JOURNAL

"Geopolitics under Globalization"

ISSN PRINT

2543-5493

ISSN ONLINE

2543-9820

PUBLISHER

LLC “Consulting Publishing Company “Business Perspectives”

FOUNDER

Sp. z o.o. Kozmenko Science Publishing



NUMBER OF REFERENCES

30



NUMBER OF FIGURES

13



NUMBER OF TABLES

3

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BUSINESS PERSPECTIVES



LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine
www.businessperspectives.org

Received on: 18th of November, 2024
Accepted on: 12th of December, 2024
Published on: 17th of December, 2024

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Conflict of interest statement:
Author(s) reported no conflict of interest

Viktoriia Koilo (Norway)

MACROECONOMIC AND ENERGY IMPACTS OF RUSSIA'S INVASION OF UKRAINE: A COMPARATIVE ANALYSIS ACROSS COUNTRIES

Abstract

The 2022 Russian invasion of Ukraine has triggered profound economic and energy-related consequences, reshaped global priorities, and exposed systemic vulnerabilities. The current study aimed to examine pre- and post-invasion trends in key economic and energy indicators for a diverse set of countries: Ukraine and Russia as directly involved parties; the European Union, the United States, and the United Kingdom as supporters of Ukraine; and China, India, and Türkiye as neutral actors maintaining economic ties with Russia. Using structural time series analysis over the period 2000–2023, the analysis maps economic booms and busts by identifying cycle deviations through a Hodrick-Prescott filter. The findings reveal significant variations in the conflict's impact, highlighting disruptions in GDP growth, energy systems, and trade dynamics across regions. The study underscores how the war has accelerated energy transitions, redefined global economic resilience, and reshaped international economic and political relationships.

Keywords

global disruption, energy transition, economic resilience, geopolitical instability

JEL Classification

F35, F51, O11, Q42

INTRODUCTION

Russia's full-scale invasion of Ukraine in February 2022 triggered widespread devastation, extending far beyond the physical battleground. The conflict has profoundly disrupted global economic systems, reshaping energy markets, trade, and socio-demographic structures while intensifying poverty and inequality worldwide. Alongside the humanitarian crisis, the war has exposed vulnerabilities in global supply chains and economic resilience, forcing governments, industries, and communities to adapt to unprecedented challenges.

From the outset, the war's catastrophic economic implications were evident. The invasion exacerbated the lingering disruptions caused by the COVID-19 pandemic, particularly in energy and food supply chains. Sanctions against Russia and the disruption of Ukrainian exports have created a ripple effect, fueling inflation, food insecurity, and a global cost-of-living crisis. Europe, in particular, has faced acute energy security challenges, prompting a shift toward renewable energy adoption while grappling with the socio-demographic consequences of refugee displacement and labor market disruptions.

1. BACKGROUND

While these economic ramifications may pale in comparison to the immense human suffering and loss of life on the battlefield, they

nonetheless pose critical challenges. Leaders face the pressing task of mitigating additional hardships caused by rising poverty, food shortages, and the escalating cost-of-living crisis. Several key global disruptions have been linked to the Russia–Ukraine war, including soaring energy prices, increased food insecurity, fluctuations in financial markets, and a growing refugee crisis.

1.1. Escalating energy prices

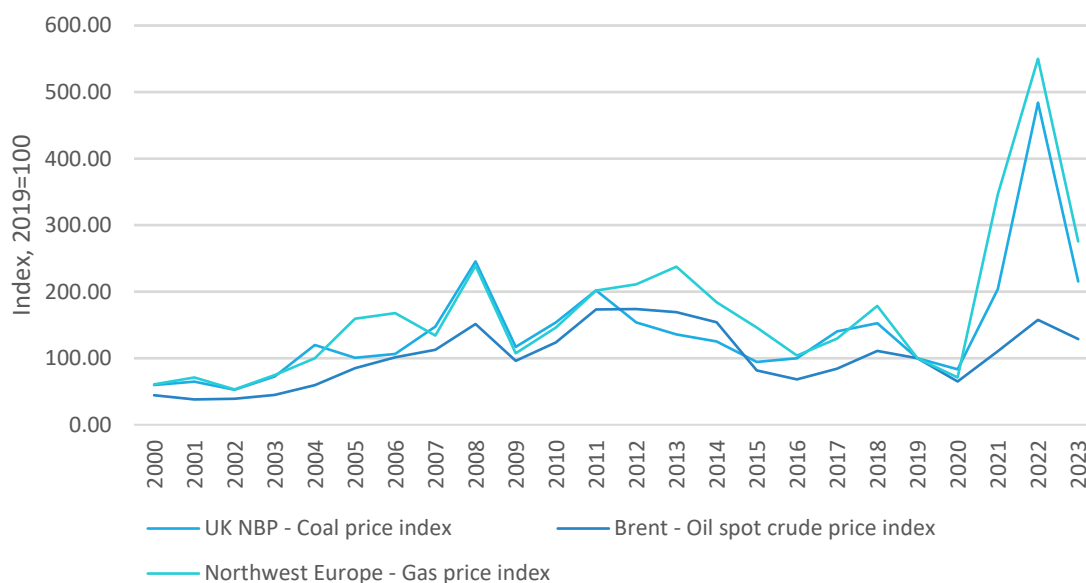
The imposition of stringent economic sanctions on Russia has led to significant spikes in global energy prices (Figure 1). These rising costs have contributed to inflationary pressures as energy expenses ripple through various stages of production, storage, and transportation within global supply chains.

In the initial two weeks of the conflict, Brent crude oil price – key benchmark for Europe rose by over 25%. By late March, natural gas prices in Europe had skyrocketed by approximately 580% compared to the previous year, though they have since moderated. European nations, including the UK, rapidly sought to decrease their reliance on Russian oil and natural gas, with the Nord Stream 2 pipeline remaining unused and both Nord Stream 1 and 2 pipelines sabotaged in September 2021. However, replacing Russian energy has prov-

en challenging, often requiring the use of more expensive alternatives such as liquefied natural gas (LNG) imported from the United States. Although the UK imports minimal gas directly from Russia, its close connection to the European wholesale energy market means that supply disruptions in continental Europe directly influence UK prices. In 2021, the European Union collectively accounted for 42% of Russian oil exports, underscoring its dependency on Russian energy. One potential long-term benefit of the surge in fossil fuel prices has been the accelerated focus on renewable energy development. Higher costs for traditional fuels have provided a stronger incentive for countries to transition to cleaner, more sustainable energy sources, further reducing fossil fuel dependency.

Despite the sanctions and efforts to isolate its economy, Russia remains a major global oil exporter. In 2023, it ranked as the third-largest oil producer, trailing only the United States and Saudi Arabia. Russian oil export volumes remained stable at 7.5 million barrels per day in 2023, with a decline in crude offset by increased oil product exports. While exports to the European Union, the United States, the United Kingdom, and OECD Asia fell sharply by 4.3 million barrels per day below pre-war levels, shipments to nations like India, China, and Türkiye rose significantly (Figure 2).

Source: Energy Institute (2024).



Note: Average global prices of oil, natural gas, and coal, measured as an energy index, where prices in 2019 = 100.

Figure 1. Fossil fuel price index, 2000–2023

Source: IEA (2024a)

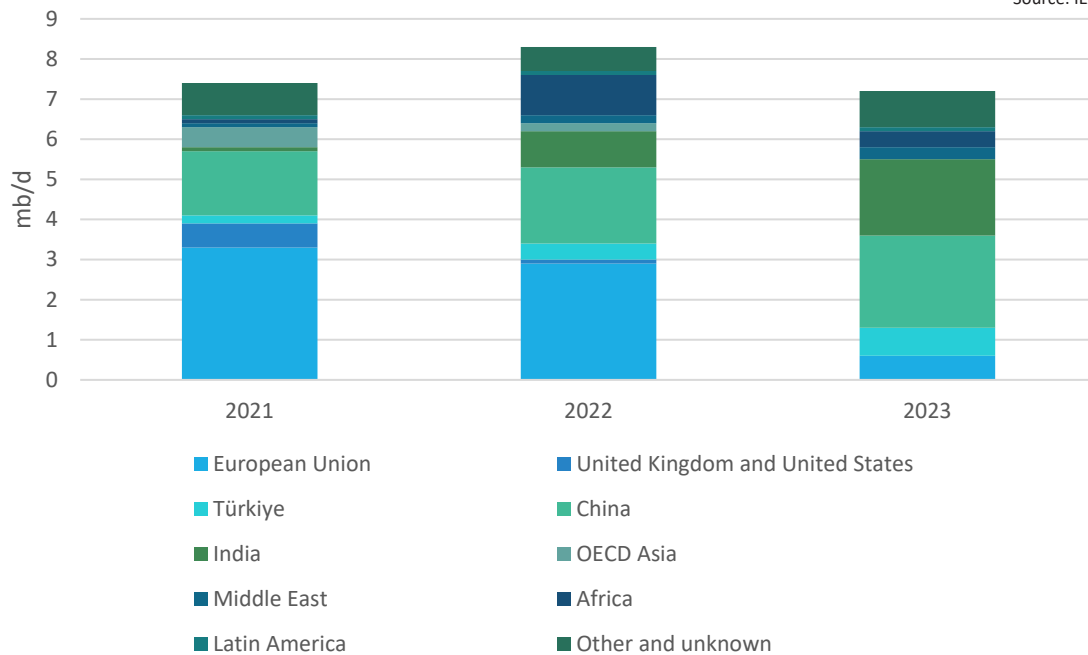


Figure 2. Average Russian oil exports by country and region, mb/d, 2021–2023

For instance, India’s imports of Russian oil surged, reaching nearly two million barrels per day, accounting for approximately 45% of its total oil imports (IEA, 2024a). Despite stable export volumes, Russian monthly oil export revenues declined by USD 4.2 billion year-over-year in 2023 due to G7-imposed price caps, increasing discounts for Russian crude, and a general decline in global oil prices. Nevertheless, the availability of discounted Russian oil has allowed countries like India to refine and re-export oil products to regions with restricted access to Russian energy, including the European Union (Gamio et al., 2023). These shifts illustrate the economic adaptability of certain nations amid evolving geopolitical dynamics, as explored further in subsequent sections.

1.2. Growing global food insecurity

Before the war, Ukraine and Russia were global leaders in wheat and sunflower oil exports. They also supplied more than half of the global sunflower oil market. Known as the “breadbasket of Europe,” the agricultural capacity of this region has been severely impacted by the war, which has destroyed farms, degraded soil, and displaced farmers. These disruptions are particularly damaging to global food security, as highlighted by the Food Security Information Network (2023).

In 2022, nearly 258 million people in 58 countries faced food crises or moderate-to-severe acute food insecurity, a stark increase from 193 million in 53 countries in 2021. This represents the highest recorded figures since the organization began collecting such data in 2017. Ukraine and Russia remain critical players in global food markets, being significant exporters of key cereal crops like wheat, maize, and barley. Additionally, they dominate the sunflower oil market, with Ukraine alone accounting for nearly half of global sunflower oil exports. Countries such as India heavily rely on these exports for their domestic food supplies, illustrating the global ripple effects of reduced output from these nations. As shown in Figure 3, around a quarter of global wheat exports originated from Ukraine and Russia in 2019.

Similarly, these countries were responsible for one-fifth of global maize and barley exports and nearly two-thirds of traded sunflower oil. The impacts of disrupted food production and exports are not uniformly distributed; some of the most vulnerable nations are those that directly depend on imports from Ukraine and Russia. Before Russia’s invasion, 98 percent of Ukraine’s grain exports were shipped through the Black Sea (ITA, 2023). However, the onset of the war disrupted Ukrainian maritime trade, significantly affecting global food security.

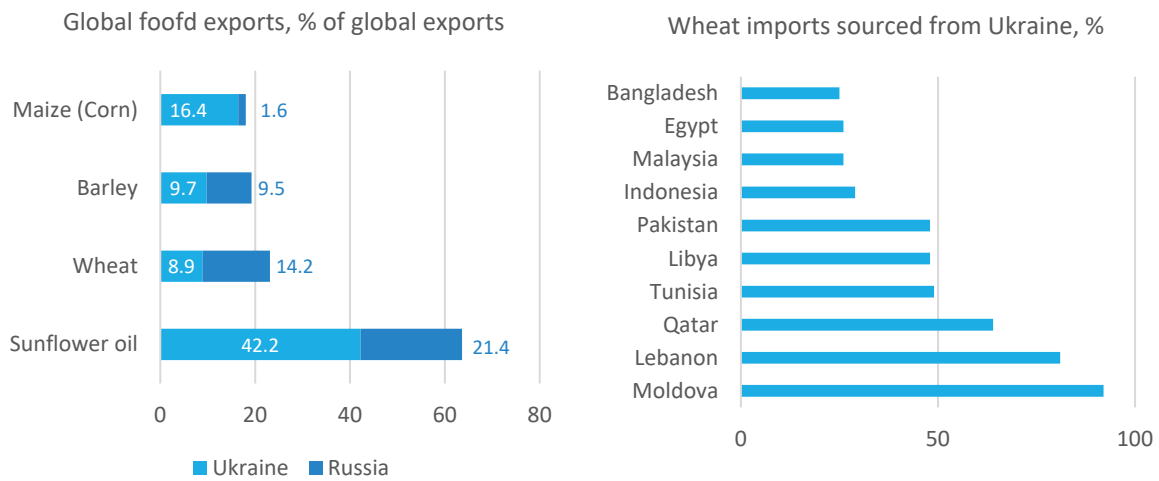


Figure 3. Global food exports: How much comes from Ukraine and Russia (left) and top 10 importers of Ukrainian wheat (right)

To address this, the United Nations negotiated the Black Sea Grains Initiative (BSGI), enabling safe passage for Ukraine grain exports from three key Black Sea ports: Odesa, Chornomorsk, and Yuzhny/Pivdennyi (Economics Observatory, 2023).

Nearly 33 million tons of grain were shipped under this initiative, leading to a roughly 20% reduction in global food prices (FAO, 2023 n.d.a). However, this agreement, trade volumes through the Black Sea have not returned to pre-war levels, leading Ukraine to increasingly depend on alternative export routes such as rail, road, and barge. Thus, despite these ef-

orts, food prices remain alarmingly high in many developing nations. For instance, food inflation in Nigeria surged to over 24% year-on-year in March 2023 (Olurounbi, 2023). This contrasts with European countries, which saw modest declines in food prices over the same period (Figure 4).

1.3. Impacts on global financial markets

The conflict has also significantly influenced global financial markets, affecting both businesses and consumers. Companies with sub-

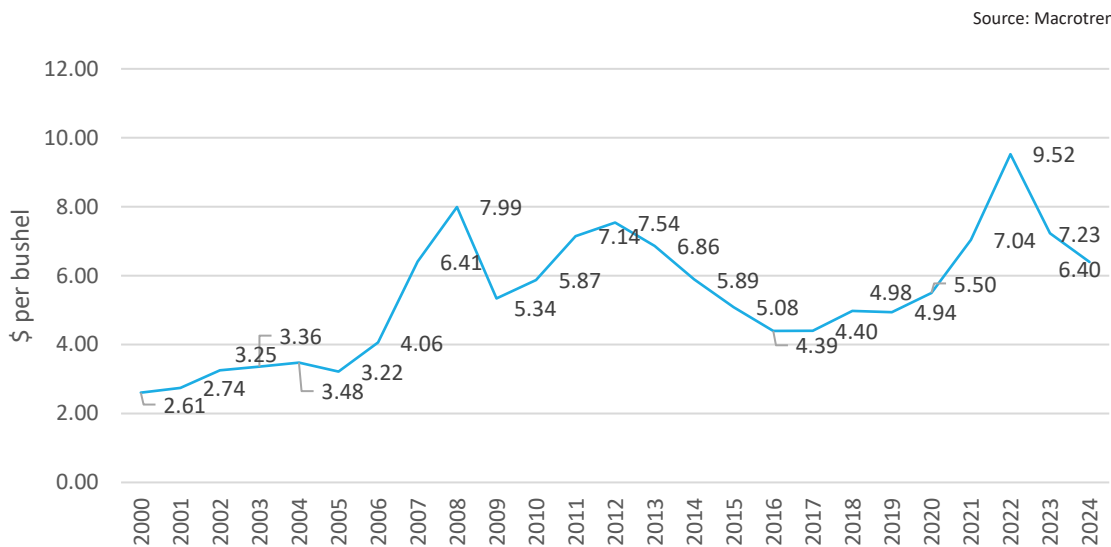


Figure 4. Wheat price, USD per bushel, 2000–2023

stantial trade or ownership ties to Russia experienced notable declines in their stock values following the invasion. Research from the London School of Economics indicates that, on average, trade connections with Russia caused a 1.53% drop in the value of each country’s aggregate stock market index (Biermann & Leromain, 2024). Pre-war, firms had an average dependence on Russia of 0.25%, meaning that a company generating USD 1 billion in revenue typically had USD 2.5 million tied to trade with Russia. However, this dependence varied significantly, with European nations bearing the greatest losses. European countries have been most affected due to their extensive trade ties with Russia, while Western European nations experienced greater impacts through ownership linkages. By contrast, countries with weaker economic ties to Russia, such as the United States and China, have faced relatively minor financial repercussions. These findings suggest that Europe will most keenly feel the long-term, international financial impact of the war.

1.4. Refugee crisis and government support

Between January 24, 2022, and October 31, 2024, more than EUR187 billion in government-to-government aid was pledged to Ukraine. The United States stands out as the leading contributor, providing EUR 88.32 billion, which exceeds the com-

bined contributions of EU member states and EU institutions (Figure 5).

Nordic and Eastern European nations, such as the Baltic states, Poland, and Czechia, have made substantial contributions relative to their GDP, particularly in areas like refugee support and military equipment donations.

Aid levels have fluctuated, with significant surges immediately after the invasion, a decrease during the summer, and a resurgence toward the end of 2022, driven by large U.S. aid announcements.

The war has forced more than six million people to flee Ukraine to date. Representing around 15% of Ukraine’s pre-war population, they leave a large hole in its national workforce. According to the report from the UN Refugee Agency (UNHCR, 2024), the full-scale war in Ukraine enters its fourth year early in 2025, with escalations in hostilities driving further displacement as coordinated aerial attacks target civilian infrastructure across the country. The 2025 Humanitarian Needs and Response Plan estimates that some 12.7 million people need multi-sectoral humanitarian assistance.

As of August 2024, 3.7 million people were displaced inside the country (Figure 6), while an additional 6.7 million refugees from Ukraine

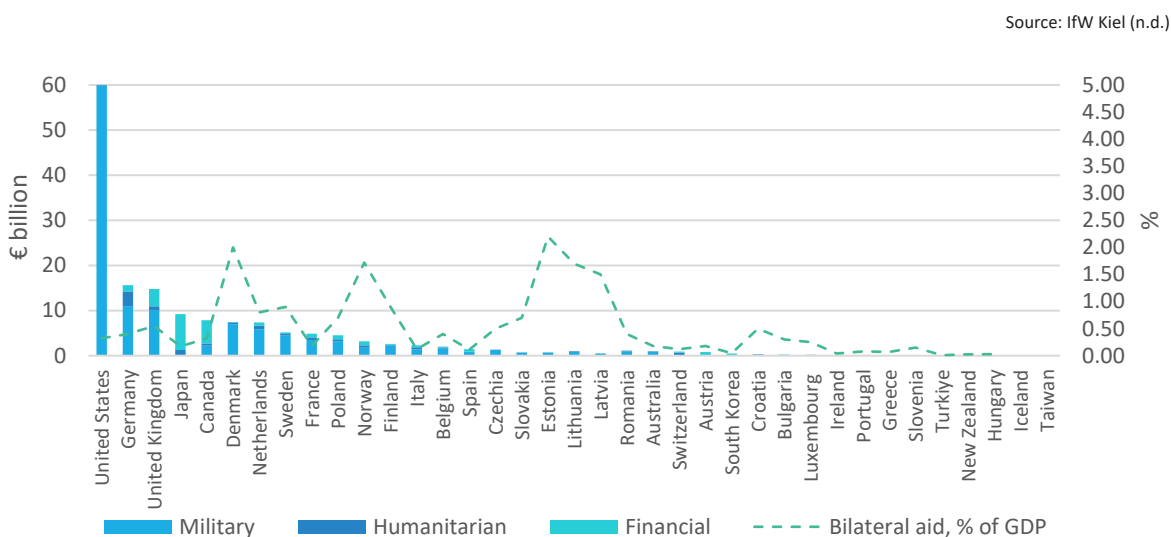
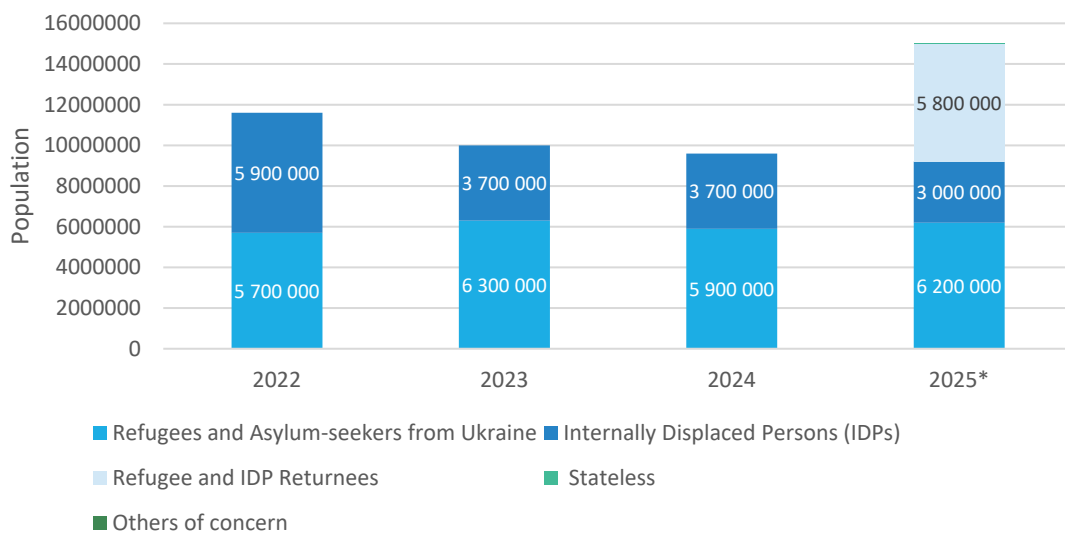


Figure 5. Government support to Ukraine, by type of assistance, EUR billion (January 24, 2022, to October 31, 2024)

Source: UNHCR (2024).



Note: Figures for 2022–2023 are actual figures. Figures for 2024 and 2025 are planning figures.

Figure 6. Refugees and asylum-seekers from Ukraine

were seeking safety beyond Ukraine’s borders, including 6.2 million in countries across Europe.

Between January 24, 2022, and October 31, 2024, refugee-related costs were estimated at EUR125 billion. Within the EU, Germany (1,140,705 people, 27.2% of the EU total), Poland (983,880, 23.4%), and Czechia (379,370, 9.0%) hosted the highest numbers of beneficiaries under temporary protection, which explains the amount of refugee costs in these countries (Figure 7).

In general, the aid provided to Ukraine has been substantial. However, when compared to historical conflicts such as World War II, the Korean War, and the Vietnam War, it remains relatively modest in terms of donor GDP or military expenditure (Trebesch et al., 2023).

2. LITERATURE REVIEW

The Russian invasion of Ukraine in February 2022 catalyzed widespread disruptions in global economic and energy systems. This literature review

Source: IfW Kiel (n.d.).

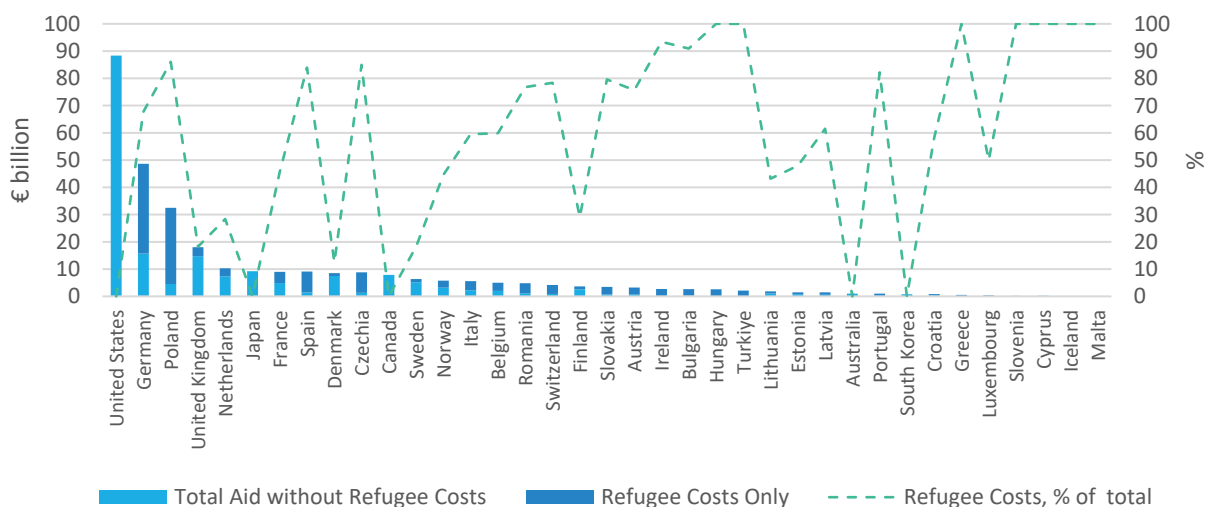


Figure 7. Government support to Ukraine: Total aid with refugee costs, EUR billion

synthesizes insights from key studies, examining the implications for human security, macroeconomic indicators, and the energy transition in affected regions and beyond.

The intersection of war and human security is a recurring theme in the literature. Osimen et al. (2022) highlight how the conflict has disrupted food and energy supplies, disproportionately affecting vulnerable populations in developing nations. Ukraine's role as a major grain exporter has made the war a critical factor in global food insecurity, exacerbating poverty and hunger in dependent regions.

The war has exposed vulnerabilities in traditional energy systems while accelerating the global shift toward renewables. Alvik (2022) explores how the war has not derailed Europe's energy transition but rather intensified efforts to reduce reliance on Russian fossil fuels. The report underscores increased investments in renewable energy, infrastructure, and diversification of supply sources. Simultaneously, the urgency of combating climate change necessitates immediate efforts to lower greenhouse gas emissions, with energy efficiency emerging as a critical tool in this fight (Kyshakevych et al., 2023).

Ben Hassen and El Bilali (2022) examined the direct and indirect effects of the Russia–Ukraine conflict on global food security. The study emphasizes that the war has triggered widespread and multifaceted repercussions, including the halt of Ukrainian exports, labor shortages due to conscription and population displacement, restricted access to fertilizers, and uncertainties surrounding future harvests.

The economic ramifications of the conflict are profound, as detailed in multiple studies. O. Popoola and J. Popoola (2023) evaluate the impact of the Russia–Ukraine conflict on the trade relationship between the European Union and the United States, guided by specific objectives. Their findings reveal that the war has negatively affected the economies of the involved nations and others, particularly in terms of net exports, investment flows, and tariffs between the EU and the US. Moreover, according to the World Bank's report, war in Ukraine, similar to the COVID-19 pandemic and the 2011 Japan earth-

quake, highlights vulnerabilities in global trade due to its interconnected nature. Dependence on foreign suppliers can disrupt production when source countries face crises like natural disasters, pandemics, or wars that trigger economic sanctions. These events have prompted discussions about balancing efficiency and resilience in production, potentially reshaping global value chains (GVCs) through strategies like reshoring, nearshoring, and diversification. However, despite these challenges, a significant reversal of GVCs is unlikely without drastic policy changes. Technological advancements, wage disparities, and other economic drivers that have supported international production fragmentation remain influential. While firms may adapt to the changing environment, these fundamentals will continue to encourage global trade and production efficiency (Ruta, 2022).

The war has redefined geopolitical alignments, emphasizing the need for resilience and adaptability in policymaking. Osimen et al. (2022) underscore the broader geopolitical stakes, where the war has intensified tensions between global powers and reshaped alliances, especially within the EU and NATO. Atnadu and Halidu (2023) investigated the responses of the Western world and the United Nations to the Russia–Ukraine war, along with the global implications of these actions. The findings reveal that Western countries responded swiftly, employing sanctions and military support for Ukraine to weaken Russia and pressure its withdrawal. Karazanashvili (2020) examines the strategic interests of the United States in the Russia–Ukraine war, emphasizing its role and the broader implications for the global order. The analysis highlights regional impacts, explores U.S. interests as a democratic state in shaping international stability, and scrutinizes the implementation of U.S. sanctions against Russia.

The reviewed studies collectively highlight the multifaceted impacts of the Russia–Ukraine war on global economic and energy systems. While the conflict has exacerbated existing vulnerabilities, it has also accelerated critical transitions, particularly in renewable energy. Building on this foundation, the current study delves into post-invasion shifts in energy transitions and macroeconomic indicators by analyzing key metrics across multiple economies.

3. METHODOLOGY

The global economic landscape has shown divergent trajectories since 2022, with some nations recovering, others deepening their crises, and a few emerging as unexpected beneficiaries. To explore how the Russia–Ukraine conflict has shaped global economies, this study examines a selection of countries grouped by their roles in the war: directly involved nations (Ukraine and Russia), supporters of Ukraine (the European Union, the United States, and the United Kingdom), and countries maintaining economic ties with Russia (China, India, and Türkiye).

The study employs structural time series analysis to analyze the economic cycles of these nations from 2000 to 2023. This method decomposes an observed time series (x_t) into a trend (g_t), a cycle (c_t), a seasonal (s_t), and an irregular (i_t) component:

$$x_t = f(g_t, c_t, s_t, i_t). \quad (1)$$

In this analysis, both seasonal (s_t) and an irregular (i_t) can be considered as integral parts of the cycle component (c_t). The cycle component can be derived by subtracting the trend component (g_t), from the observed series (x_t):

$$c_t = x_t - g_t. \quad (2)$$

Simplified, the model focuses on trend and cycle components, enabling the identification of economic fluctuations using the Hodrick-Prescott (HP) filter. The HP filter minimizes the variance of the cycle component while penalizing variations in the trend's second difference, balancing smoothness and accuracy in trend estimation (Koilo & Grytten, 2019). Smoothing parameters are chosen based on the nature of the data, with $\lambda = 100$ for annual figures, ensuring robust analysis of macroeconomic trends.

The analysis draws on key macroeconomic indicators sourced from authoritative databases, including the World Bank, ILO, IEA, and IMF. Indicators include:

- a) *DEBT* – Central government debt, total (% of GDP);
- b) *IMP* – Imports of goods and services (% of GDP);

- c) *EXP* – Exports of goods and services (% of GDP);
- d) *GDP* – GDP growth (annual %);
- e) *INV* – Foreign direct investment, net inflows (% of GDP);
- f) *INF* – Inflation, consumer prices (annual %);
- g) *MIL* – Military expenditure (% of GDP);
- h) *EXCH* – Official exchange rate (LCU per USD, period average);
- i) *UNM* – Unemployment, total (% of total labor force).

Additionally, the compound annual growth rate (CAGR) is employed to provide a smoothed perspective on year-to-year energy transition, accounting for volatility. It was found by dividing the ending value by the beginning value, raised to one, dividing by the number of compounding periods, and subtracting by one (Koilo, 2020). Data used:

- a) *CO2* – Carbon dioxide (CO2) emissions excluding LULUCF (t CO2e/capita);
- b) *ENER* – Energy intensity level of primary energy (MJ/USD 2017 PPP GDP);
- c) *REN* – Renewable energy consumption (% of total final energy consumption).

4. ANALYSIS

4.1. Macroeconomic indicators

The macroeconomic and social impacts of the Russia–Ukraine war have been significant, with notable differences in how countries have responded and performed during the period from 2000 to 2023. Table 1 reveals that GDP growth in Ukraine peaked in 2023, despite prior challenges, while military expenditures and unemployment rates surged in 2022, reflecting the strain of ongoing conflict. A general trend among many countries is the prioritization of defense spending, with security concerns taking precedence.

Table 1. Cycle peaks in the period of 2000–2023 as natural logarithms

Variable	DEBT, %	EXP, %	INV, %	GDP, %	IMP, %	INF, %	MIL, %	EXCH	UNM, %
UKR	0.390 (2015)	0.166 (2004)	0.967 (2021)	1.421 (2023)	0.097 (2000)	2.031 (2015)	1.020 (2022)	0.358 (2016)	0.486 (2022)
RUS	0.240 (2014)	0.125 (2018)	0.912 (2021)	0.600 (2007)	0.070 (2021)	0.897 (2015)	0.288 (2023)	0.280 (2016)	0.231 (2009)
USA	0.110 (2020)	0.127 (2000)	0.652 (2000)	0.658 (2021)	0.092 (2008)	0.749 (2008)	0.124 (2010)	0.109 (2008)	0.533 (2020)
EUU	0.066 (2013)	0.072 (2022)	0.618 (2021)	0.780 (2021)	0.109 (2022)	1.065 (2011)	0.350 (2023)	0.109 (2008)	0.171 (2013)
GBR	0.151 (2000)	0.092 (2011)	1.495 (2020)	0.771 (2021)	0.097 (2022)	0.808 (2022)	0.088 (2009)	0.094 (2001)	0.212 (2011)
NOR	0.240 (2006)	0.242 (2022)	0.497 (2019)	0.658 (2007)	0.092 (2019)	0.868 (2008)	0.161 (2002)	0.132 (2015)	0.221 (2005)
CHN	0.102 (2009)	0.199 (2006)	0.680 (2021)	0.589 (2021)	0.168 (2004)	1.105 (2004)	0.060 (2009)	0.056 (2005)	0.096 (2003)
TUR	0.258 (2001)	1.432 (2021)	0.896 (2006)	1.040 (2000)	0.456 (2022)	1.236 (2021)	0.928 (2023)	0.320 (2023)	0.257 (2009)
IND	0.072 (2020)	0.129 (2013)	0.727 (2008)	0.757 (2021)	0.154 (2012)	0.438 (2010)	0.142 (2009)	0.073 (2002)	0.177 (2019)

It is important to note that despite the increasing central government debt, currently at 82% in 2023 (IMF, 2023), the cyclical component of the debt reached its peak back in 2015, with debt at 79%. This occurred after the first invasion of Ukraine, highlighting a significant effect. For the EU and Norway, 2022 was marked by significant import-export peaks, primarily driven by energy trade. For Norway, this was a pivotal year as it stepped in to replace Russia's gas market share, capitalizing on the surging demand for energy across Europe amidst geopolitical tensions.

Trade restrictions and sanctions have significantly impacted Russia, with key trade indica-

tors such as imports, exports, and investments reaching troughs in 2022 (Table 2), underscoring the profound effect of sanctions on its economy. Additionally, foreign direct investments were a weak point not only for Russia but also for the United Kingdom, the EU, and China in 2023, highlighting broader global economic challenges in attracting foreign investments during this period.

Despite the war, Ukraine's GDP showed signs of recovery in 2023, with growth resuming after a sharp decline in 2022 (Figure 8). The Ukrainian Hryvnia exhibited resilience, with inflation dropping from 20% to 13%. These improvements were

Table 2. Cycle troughs in the period of 2000–2023 as natural logarithms

Variable	DEBT, %	EXP, %	INV, %	GDP, %	IMP, %	INF, %	MIL, %	EXCH	UNM, %
UKR	-0.700 (2007)	-0.171 (2023)	-3.209 (2015)	-3.723 (2022)	-0.196 (2020)	-4.497 (2013)	-0.996 (2021)	-0.356 (2013)	-0.226 (2019)
RUS	-0.426 (2007)	-0.128 (2023)	-1.737 (2022)	-3.654 (2009)	-0.202 (2022)	-0.665 (2018)	-0.184 (2021)	-0.195 (2013)	-0.152 (2007)
USA	-0.132 (2007)	-0.142 (2020)	-0.798 (2020)	-2.194 (2009)	-0.148 (2009)	-2.582 (2009)	-0.097 (2015)	-0.110 (2015)	-0.305 (2007)
EUU	-0.120 (2007)	-0.113 (2009)	-0.952 (2023)	-2.764 (2020)	-0.109 (2009)	-2.952 (2015)	-0.114 (2022)	-0.110 (2015)	-0.247 (2008)
GBR	-0.178 (2007)	-0.067 (2015)	-2.390 (2023)	-2.662 (2020)	-0.101 (2020)	-1.497 (2015)	-0.078 (2017)	-0.146 (2007)	-0.181 (2019)
NOR	-0.247 (2011)	-0.235 (2020)	-1.789 (2016)	-3.631 (2009)	-0.132 (2022)	-1.278 (2004)	-0.103 (2008)	-0.100 (2013)	-0.295 (2007)
CHN	-0.096 (2008)	-0.174 (2001)	-1.013 (2023)	-0.807 (2020)	-0.167 (2009)	-3.527 (2009)	-0.073 (2000)	-0.052 (2014)	-0.145 (2000)
TUR	-0.420 (2000)	-1.434 (2023)	-0.639 (2020)	-3.033 (2001)	-0.166 (2020)	-1.322 (2022)	-1.032 (2021)	-0.468 (2000)	-0.241 (2000)
IND	-0.097 (2000)	-0.109 (2017)	-0.546 (2003)	-3.516 (2020)	-0.190 (2020)	-0.509 (2017)	-0.102 (2007)	-0.103 (2007)	-0.213 (2022)

Source: World Bank (2024).

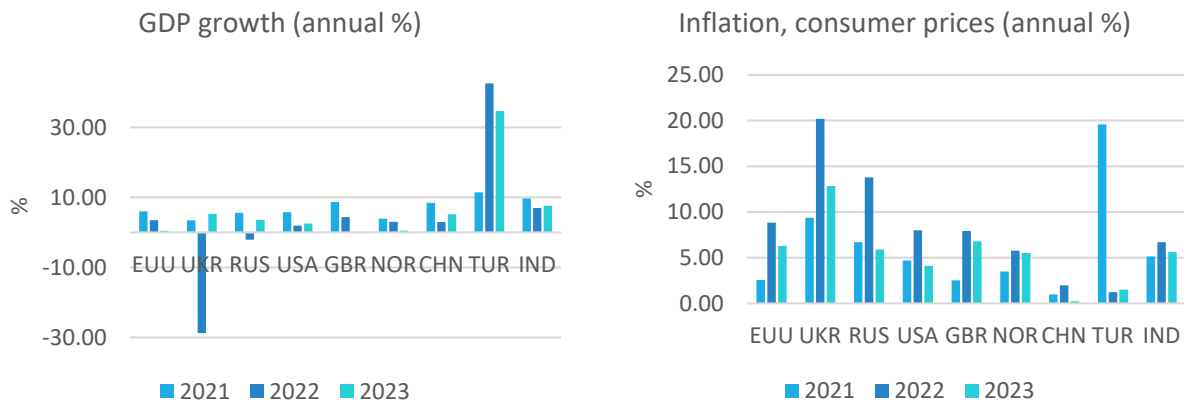


Figure 8. GDP growth (left) and inflation (right), 2021–2023

heavily supported by foreign financial aid, which increased from USD 31.1 billion in 2022 to USD 42.5 billion in 2023. It is necessary to note that countries maintaining trade relationships with Russia, such as India, Türkiye, and China, did not show notable peaks in GDP growth or significantly lower inflation, except Türkiye.

While this assistance – largely in the form of concessional loans – was crucial in stabilizing the economy, unemployment remains a critical issue. Approximately 2.8 million people, including vulnerable groups, are still unemployed, exacerbated by an estimated USD 125 billion in infrastructure damage (Figure 9).

Military expenditures surged dramatically in Ukraine, rising from 3.23% to 33.55% of GDP in 2022 and further to 37% in 2023 (Figure 10). Türkiye also saw a sharp increase in defense spending, climbing to 23% from 1.9% in 2021, reflecting heightened geopolitical concerns.

In conclusion, while Ukraine has shown remarkable resilience amid unprecedented challenges, the war’s broader economic impacts are uneven. Countries that maintained economic ties with Russia have not universally benefited, and increased defense spending across regions highlights the prioritization of security over other economic concerns. However, sustained foreign assistance and structural reforms will remain critical for Ukraine’s continued recovery and stability.

4.2. Environmental and energy indicators

The ongoing conflict in Ukraine has profoundly influenced the global energy landscape, particularly in Europe, where energy security and the transition to sustainable energy sources have become top priorities. The war has disrupted global energy markets, causing price volatility, supply shortages, and heightened concerns about energy security. However, these challenges have also cata-

Source: ILO (n.d.).

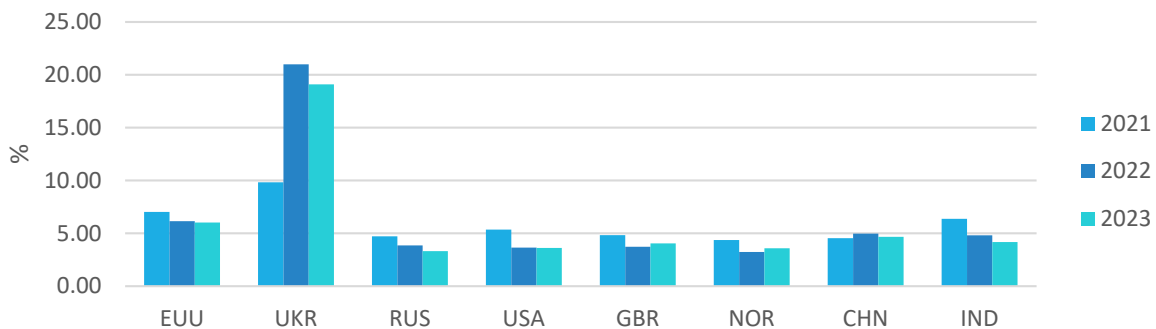


Figure 9. Unemployment, total (% of total labor force), 2000–2022

Source: World Bank (2024).

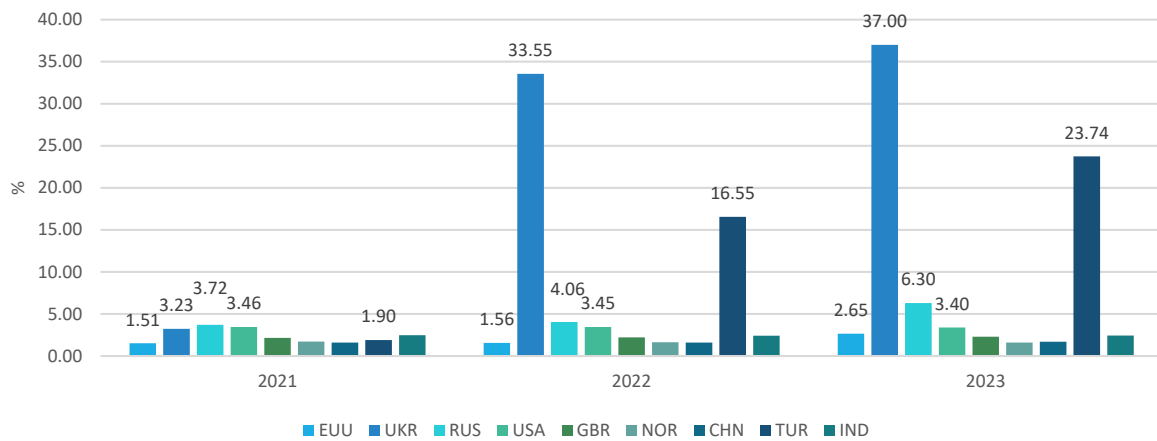


Figure 10. Military expenditure (% of GDP), 2000–2023

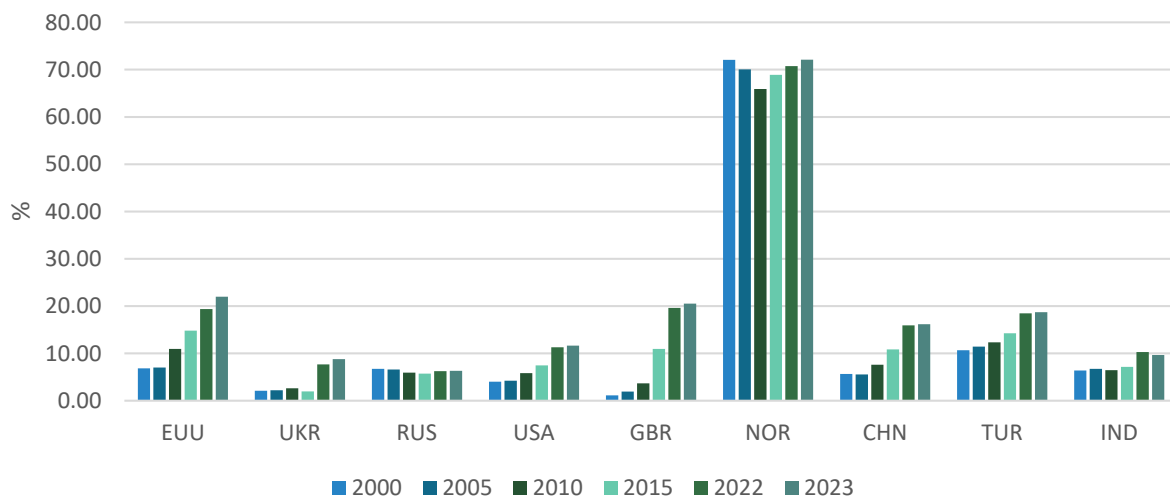
lyzed progress in some aspects of the energy transition. Europe, for instance, is accelerating efforts to reduce dependence on Russian fossil fuels by increasing investments in renewable energy and improving energy efficiency, positioning these efforts as dual solutions to enhance energy security and combat climate change.

Figure 11 illustrates the pace of renewable energy adoption. Norway stands out, with a significant increase in the share of renewable energy in total consumption between 2021 and 2022. In contrast, both China and the United States experienced declines in renewable energy consumption dur-

ing this period. Ukraine’s energy transition has slowed significantly, which is unsurprising given the severe challenges faced by its energy sector, including consistent supply disruptions and extensive infrastructure damage caused by the war.

Despite the difficulties, Figure 12 shows that Ukraine has made notable progress in reducing CO2 emissions. Although energy intensity (energy consumed per unit of GDP) in Ukraine is gradually decreasing, it remains one of the highest among the countries analyzed. For instance, thermal power plants account for the largest share of energy production in Ukraine. However, these

Source: Energy Institute (2024).



Note: Measured as a percentage of primary energy. Renewables include hydropower, solar, wind, geothermal, bioenergy, wave, and tidal, but not traditional biofuels, which can be a key energy source, especially in lower-income settings.

Figure 11. Renewable energy consumption, % of total final energy consumption

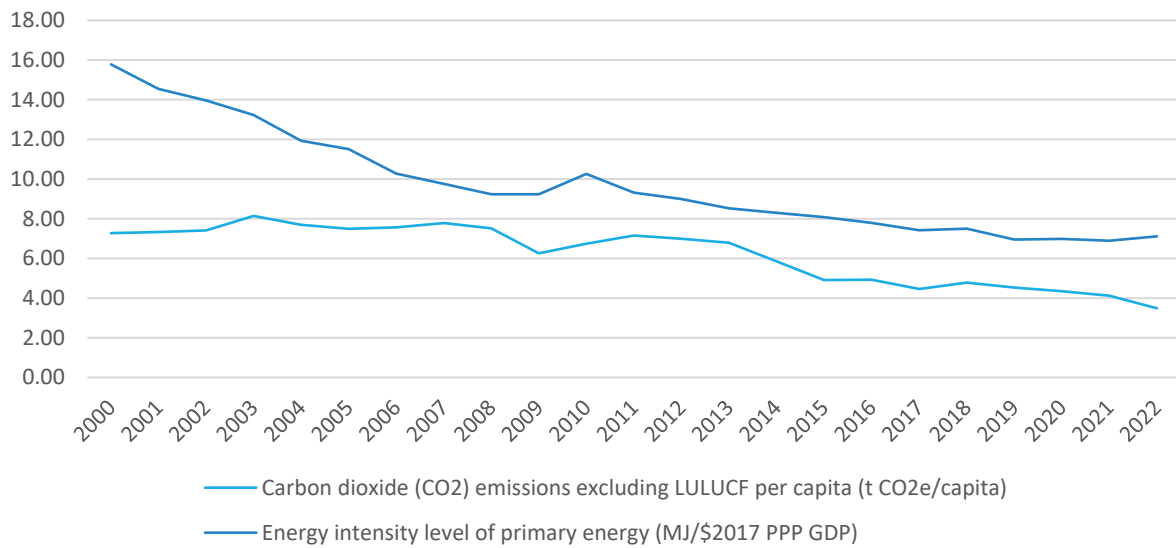


Figure 12. Energy intensity and CO2 emissions in Ukraine, 2000–2022

plants face two major challenges: they are the leading contributors to atmospheric pollution and are highly energy-intensive (Koilo, 2019).

consumption has generally increased. However, Russia has seen a relative decline in renewable energy consumption compared to the early 2000s.

Encouragingly, Ukraine’s CO2 emissions have reached their lowest levels compared to previous years, as shown in Figure 13.

In summary, while the energy transition has gained momentum in certain regions like Europe, the variability in renewable energy adoption and emissions reduction among countries highlights the complexity of achieving global sustainability goals, especially amid geopolitical challenges. For Ukraine, significant strides in reducing emissions have been overshadowed by the vulnerabilities in its energy infrastructure, underscoring the critical need for international support in rebuilding and transitioning its energy systems.

While most countries have steadily reduced CO2 emissions, a few – including Russia, China, Türkiye, and India – show a positive compound annual growth rate in emissions (Table 3).

On the positive side, energy intensity has decreased across all selected nations, and renewable energy

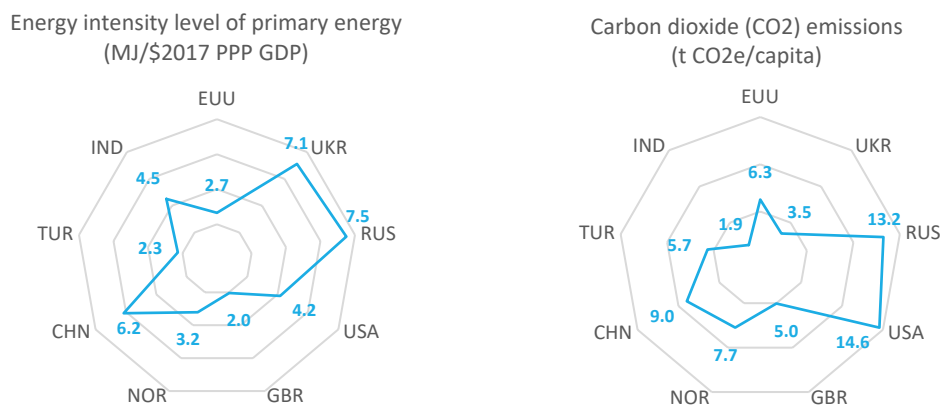


Figure 13. Energy intensity and CO2 emissions in selected countries, 2022

Table 3. Compound annual growth rate of energy intensity and CO2 emissions in selected countries, 2000–2022, %

Country	ENER	CAGR, %	CO2	CAGR, %	REN, %	CAGR, %
EUU	-0.019	↓	-0.012	↓	0.050	↑
UKR	-0.034	↓	-0.031	↓	0.061	↑
RUS	-0.020	↓	0.007	↑	-0.003	↓
USA	-0.021	↓	-0.016	↓	0.045	↑
GBR	-0.030	↓	-0.026	↓	0.128	↑
NOR	-0.013	↓	-0.008	↓	0.000	↑
CHN	-0.025	↓	0.050	↑	0.045	↑
TUR	-0.015	↓	0.021	↑	0.024	↑
IND	-0.019	↓	0.031	↑	0.017	↑

5. DISCUSSION

These results underscore the interconnectedness of global economies and the complex interplay between geopolitical events and systemic vulnerabilities. The above-mentioned emphasis suggests several conclusions.

5.1. Macroeconomic impacts

The macroeconomic indicators analyzed reveal divergent trajectories among countries based on their proximity to and involvement in the conflict. Ukraine, despite facing unprecedented challenges, demonstrated resilience through GDP growth recovery in 2023, supported by substantial foreign financial aid. However, high unemployment rates and infrastructure damage remain critical barriers to sustained recovery. In contrast, Russia experienced a significant economic downturn due to sanctions and trade restrictions, with trade indicators such as imports and exports hitting troughs in 2022. Nonetheless, Russia's economy showed adaptability by shifting toward domestic production and trade relationships with countries like China, India, and Türkiye (O. Popoola & J. Popoola, 2023).

Countries supporting Ukraine, including the European Union, the United States, and the United Kingdom, prioritized military expenditures and energy diversification. These nations faced increased inflation and a reallocation of resources, highlighting the trade-offs between economic resilience and security imperatives (Osimen et al., 2022). Such countries as India and Türkiye capitalized on discounted Russian energy resources, demonstrating economic benefits in specific sectors despite global disruptions.

5.2. Energy transition

One of the most profound impacts of the conflict has been its acceleration of energy transitions, particularly in Europe. The need to reduce dependency on Russian fossil fuels prompted significant investments in renewable energy and energy efficiency. The European Union, for example, demonstrated notable progress in renewable energy adoption, positioning itself as a leader in the green transition (Alvik, 2022). However, the war's energy implications were not uniformly positive. Ukraine's energy sector suffered extensive damage, slowing its transition efforts despite reductions in CO2 emissions. Globally, renewable energy adoption increased among the nations. The variability in renewable energy consumption and emissions reduction underscores the complexity of achieving sustainability goals amidst geopolitical challenges (Ben Hassen & El Bilali, 2022). The findings highlight the need for targeted international support to bridge these disparities.

5.3. Food and trade dynamics

The disruption of agricultural exports from Ukraine and Russia significantly contributed to global food insecurity. The war exacerbated pre-existing vulnerabilities in developing nations reliant on Ukrainian grain and sunflower oil. Initiatives such as the Black Sea Grain Initiative provided temporary relief, reducing global food prices by approximately 20%, yet persistent inflation in many countries underscores the fragility of food systems (FAO, 2022 n.d.a). The reorientation of trade flows also demonstrated regional disparities. While Europe and the United States experienced trade shocks and inflationary pressures, countries maintaining ties with Russia leveraged economic opportunities through discounted en-

ergy imports and refined product exports. This reconfiguration of trade relationships highlights the evolving dynamics of global economic interdependence (Karazanashvili, 2020).

5.4. Geopolitical realignments

The war has reshaped international alliances, emphasizing the strategic importance of en-

ergy independence and economic resilience. Western nations have intensified sanctions on Russia, while countries like China and India have adopted more cautious stances, balancing economic benefits with geopolitical considerations (Atnadu & Halidu, 2023). These shifts underscore the broader geopolitical stakes and the need for coordinated policies to address global challenges.

CONCLUSION

The 2022 Russian invasion of Ukraine has triggered profound economic and energy-related consequences, reshaped global priorities, and exposed systemic vulnerabilities. This study analyzed pre- and post-invasion trends in key economic and energy indicators for a diverse set of countries: Ukraine and Russia as directly involved parties; the European Union, the United States, and the United Kingdom as supporters of Ukraine; and China, India, and Türkiye as neutral actors maintaining economic ties with Russia.

Using structural time series analysis over the period 2000–2023, the paper mapped economic booms and busts by identifying cycle deviations through a Hodrick-Prescott filter. Key findings include the following.

Economic Impacts: Ukraine's GDP rebounded in 2023 with growth of 5.3%, supported by USD 42.5 billion in foreign financial aid. In contrast, Russia's GDP fell from 5.6 to 3.6% relative to pre-invasion forecasts, with trade indicators like exports dropping in 2023.

Energy Systems: Renewable energy consumption in Europe increased significantly, with Norway achieving a notable rise in renewable share, while Ukraine has reduced CO₂ emissions by 0.031 CAGR from 2000 to 2022 despite infrastructure challenges. Conversely, Russia's CO₂ emissions have grown at 0.007 CAGR during the same period.

The study underscores how the war has accelerated energy transitions, redefined global economic resilience, and reshaped international economic and political relationships. These findings highlight the critical need for sustained international cooperation to address systemic vulnerabilities and support affected nations in achieving stability and sustainability.

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Validation: Viktoriia Koilo.

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