

Implications of Global Supply Chain Disruptions for Heavily Indebted Poor Countries: The Russian-Ukrainian Crisis as an Example.

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Abstract:

With the growing importance and role of supply chains for the global economy As the Russian-Ukrainian war broke out at the end of 2022, pressure on supply chains intensified, which has worsened dramatically since the coronavirus

Fever pandemic and increased pressure on the movement of goods and people The objective of this research is to provide a summary of the importance of supply chains, Also know the impact of the Russian-Ukrainian war on the world and this research concluded that the Russian-Ukrainian War had a clear impact on global supply chains, This is due to the importance of Russian exports, particularly in the field of energy and Ukrainian exports, especially with regard to essential materials such as wheat.

Keywords: Global Supply Chains, Russian-Ukrainian War, Global economy.

Jel classification codes:L14; F51;F02.

Résumé:

Face à l'importance et au rôle croissants des chaînes d'approvisionnement pour l'économie mondiale, la guerre russo-ukrainienne a éclaté fin 2022, et la pression sur les chaînes d'approvisionnement s'est intensifiée, s'aggravant considérablement depuis l'apparition du coronavirus.

La pandémie de fièvre a accentué la pression sur la circulation des biens et des personnes. Cette étude vise à synthétiser l'importance des chaînes d'approvisionnement. Elle a également permis de comprendre l'impact de la guerre russo-ukrainienne sur le monde. Cette étude a conclu que cette guerre a eu un impact évident sur les chaînes d'approvisionnement mondiales, en raison de l'importance des exportations russes, notamment dans le secteur de l'énergie, et des exportations ukrainiennes, notamment de matières premières essentielles comme le blé.

Mots-clés : Chaînes d'approvisionnement mondiales, guerre russo-ukrainienne, Économie mondiale

Jel classification codes: L14; F51;F02.

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I. Introduction

There is a broad consensus that the Russian-Ukrainian war, which erupted in February 2022, represents one of the most significant challenges to the post-World War II international order. This is not only due to its evocation of the devastation witnessed during the First and Second World Wars—both of which unfolded on the European continent—but also because it marks the beginning of a new geopolitical and economic reconfiguration. Emerging blocs are increasingly adopting policies that deviate from the foundational principles that underpinned the global economy after 1945. These include the development of distinct technological standards, alternative cross-border payment systems, and region-specific reserve currencies (IMF, 2022).

Moreover, the conflict poses a serious threat to the stability of the global supply chain system. This is primarily due to the central role played by the economies involved: Russia, as one of the world's largest energy and food exporters; Ukraine; and, indirectly, the European Union and the United States, two of the world's most industrialized regions. The ripple effects of the war have reached economies far removed from the actual conflict zone, particularly those economically intertwined with the nations directly engaged in the war.

Based on this context, the central research question addressed in this study is: What are the impacts of the Russian-Ukrainian war on global supply chains?

This main question gives rise to several sub-questions:

- What are supply chains, and why are they important?
- What are the core and supporting activities within supply chains?
- How has the war affected the global markets for oil, food, metals, and logistics services?

Research Objectives:

This study seeks to:

- Clarify the concept and significance of supply chains;
- Outline the primary and secondary functions within supply chain operations;
- Examine the global consequences of the Russian-Ukrainian conflict on supply chain systems.

Research Structure:

The study is organized into two main sections. The first explores the nature and strategic importance of supply chain activities, while the second analyzes the ramifications of the Russian-Ukrainian war on global supply chain dynamics.

II. Conceptual framework for supply chains

II.1 The development of the concept of supply chains

The term “supply chain” refers to the comprehensive set of activities involved in the movement and transformation of goods, beginning with the

extraction of raw materials and culminating in the delivery of finished products to the end consumer. While the concept has traditionally encompassed internal organizational processes, scholars and practitioners have debated its exact terminology, even though they largely agree on its core principles.

Some experts have preferred the term “demand chain”, emphasizing a customer-centric approach that starts with consumer needs and works backward to raw material sourcing. Others have equated the supply chain with the *value chain* introduced by Porter, focusing on the added value generated at each stage of production and service delivery (Muhammad Saleh Miralem, 2022).

Over time, the concept of the supply chain has evolved through several distinct stages, which can be outlined as follows (Shah, 2009):

.- **The first stag (The basic line stage):** This stage is often referred to as the “Ford supply chain”, named after Henry Ford, who was among the first to implement the production line model based on a series of sequential manufacturing stages. His approach relied heavily on the principle of the division of labor, enabling high efficiency in producing standardized products. However, this method had significant limitations. Chief among them was the emergence of silos between departments, which hindered integration and coordination. Moreover, the system was inflexible, struggling to adapt to changing market demands, and was primarily focused on the mass production of a single product.

- **The second stage (Functional integration stage):** It was called the “Toyota supply chain”, unlike the previous stage, where management tended to coordination and integration between departments within the organization and adaptation to various changes. At the beginning of the sixties, the “Toyota model of supply chain” management emerged, which was characterized by the integration of some departments with each other, such as sales and marketing in one department, operations and production in one department, and purchasing and transportation departments in one department, were also characterized by dealing with more than one supplier to obtain inputs and build a relationship of trust between them, with their geographical proximity to their factories, which led to reducing the duration and cost of production and reducing Of wasted materials.

- **The third stage (The external integration stage):** This stage became known as the “Toyota supply chain”, marking a significant departure from the earlier Ford model. Unlike its predecessor, the Toyota approach emphasized coordination and integration across various departments within the organization, along with greater adaptability to change. In the early 1960s, the “Toyota supply chain management model” emerged, characterized by the strategic merging of related departments—such as combining sales and marketing, operations and

production, and procurement and transportation—into unified units to enhance efficiency.

A key feature of this model was its collaboration with multiple suppliers to secure input materials, fostering relationships built on trust and proximity. Suppliers were often located near Toyota's manufacturing plants, which minimized transportation costs and lead times, reduced production delays, and significantly lowered material waste.

II.2 Definition of the supply chain

Scholars and researchers have examined the concept of the supply chain from diverse perspectives and intellectual foundations. Douglas Lambert, for instance, defines the supply chain as “an integrated business model that adopts a process-oriented perspective on how different functions within an organization collaborate, and how the business interacts with both its suppliers and customers” (Linkane, 2008).

Another definition describes the supply chain as “a collection of methodologies designed to establish effective integration among suppliers, manufacturers, warehouses, and retail outlets—ensuring that goods are produced and delivered in the correct quantities, to the right locations, and at the appropriate times, all while minimizing cost and maintaining service level standards” (Khaled Ben Sassi, 2019).

According to Al-Rafi'i (2014), the supply chain encompasses “a comprehensive set of activities and procedures that begins with sourcing raw materials, continues through the various stages of production, and ends with the distribution of finished products or services to customers via marketing and distribution channels.”

From a global supply chain perspective, it is viewed as “the integration of core business processes extending from the primary supplier—who provides goods, services, and information—through to the customer, with the goal of creating added value” (Hussein, 2019).

In summary, the supply chain can be understood as a coordinated set of activities and practices aimed at enhancing the efficiency of internal organizational operations, ensuring the production and delivery of final goods or services in a manner that satisfies customer needs and expectations in collaboration with suppliers.

II.3 The importance of supply chain management:

The significance of supply chain management can be summarized through several key dimensions. According to Khaled Ben Sassi (2019), supply chain management plays a vital role in:

- Enhancing the competitive advantage of the enterprise;

- Ensuring a seamless and cost-effective flow of materials, components, and services to and from the organization;
- Maintaining appropriate safety stock levels and improving product quality;
- Building strong and effective relationships both within the organization and with external partners, particularly suppliers.

Al-Rafi'i (2014) further identifies several driving factors that motivate organizations to adopt supply chain management practices:

- The necessity of improving internal operational processes;
- The growing reliance on external sourcing;
- The need to reduce transportation and logistics costs;
- The increasing relevance and integration of e-commerce;
- Heightened competitive pressure and the growing scale of globalization;
- The rising complexity of supply chains, which calls for advanced inventory and resource management solutions.

Additionally, Gebermichael and Rao emphasize that the true importance of supply chain management lies in its capacity to generate value throughout the entire supply process—from raw material procurement to the delivery of finished products. This value creation is not merely embedded in the physical attributes of the product but is primarily driven by the customer experience and how well the product aligns with consumer expectations and preferences (Zaradinat Muhamad, 2020).

II.4 Supply chain activities

The supply function comprises a set of core and supporting activities that collectively form what is referred to as the *‘‘supply chain.’’* These interconnected activities are essential for ensuring the smooth flow of goods and services across all stages of the production and distribution process (Bakhta, 2019). The following are the key components involved:

II.4.1 Basic activities: It consists of:

- Supplier relationship management:

The supply chain encompasses a range of core and supporting activities that are crucial to the overall efficiency and competitiveness of an organization. These activities include:

-Supplier Relationship Management: This involves how the organization engages with its suppliers and develops strong, collaborative partnerships. Effective supplier relationships can serve as a source of competitive advantage.

- Customer Service: This refers to a set of practices aimed at managing and strengthening the relationship with customers. The ultimate goal is to ensure customer satisfaction by delivering services and products with high efficiency and responsiveness.

- Information Systems: These systems facilitate the exchange and sharing of information and knowledge critical to supply chain operations. Access to timely and accurate data enhances decision-making and boosts the overall performance and responsiveness of the supply chain.

- Storage: This function pertains to holding inventory until it is needed, thereby providing a time utility by ensuring product availability when demand arises.

- Transportation: This activity covers the movement of materials and goods from suppliers to the organization and from the organization to customers. Transportation often accounts for the largest portion of total supply chain costs, making its efficiency vital to cost control.

- Physical Distribution: This is a key component of the supply chain, focusing on delivering the final product to the consumer in the right quantity, at the right time, and in the right place. It also considers consumer preferences and purchasing behavior to ensure customer satisfaction.

II.4.2 Supporting activities: It consists of:

In addition to the previously mentioned components, the supply chain includes several other essential activities that support the continuity and effectiveness of operations. These include:

- Purchasing: This function ensures that the organization acquires the necessary raw materials, equipment, and machinery in a timely manner. It plays a critical role in maintaining sufficient inventory levels, preventing production disruptions, and ultimately reducing overall operational costs.

- Demand Management: This activity involves forecasting demand, scheduling production, managing procurement, overseeing distribution, and processing customer orders. Effective demand management helps align supply chain operations with market needs and organizational capabilities.

- Material Handling: This task involves the preparation, loading, unloading, lifting, and positioning of materials. Its primary objective is to facilitate the smooth and safe movement and storage of goods throughout the supply chain.

- Packaging: Packaging involves enclosing products in containers of various shapes and sizes to protect them from damage during transportation and storage. It also aids in the ease of handling and can enhance product presentation.

III. The repercussions of the Russian-Ukrainian war on global supply chains

The initial wave of optimism surrounding the potential recovery of the global economy, which was heralded by reports from international organizations and bodies after the decline of the COVID-19 pandemic, proved to be short-lived. This period of hope followed the easing of restrictions imposed by numerous countries on individuals and various economic entities starting in 2020, in an

effort to curb the spread of the virus. However, just as the global economy began to show signs of revival, it suffered a significant blow—arguably one of the harshest in decades—due to the outbreak of the Russian-Ukrainian war. Russia, a key player in global energy and food markets, and Ukraine, a major global food producer, together form a central nexus for critical resources, with repercussions extending to the largest industrial economies, such as the European Union and the United States.

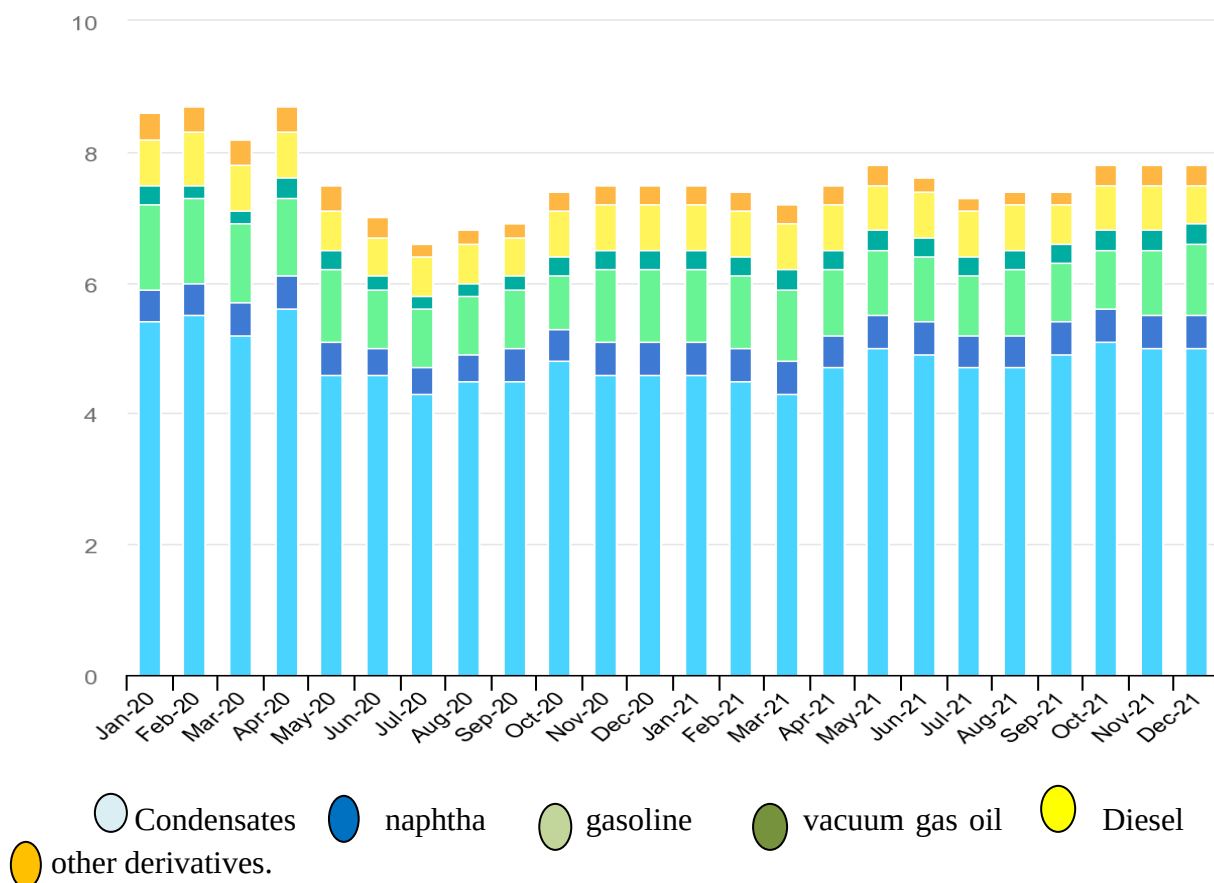
This section examines the impact of the Russian-Ukrainian conflict on global supply chains, focusing on the war's effect on the fundamental pillars of these supply chains: energy, raw materials, food commodities, and transportation.

III.1 The repercussions of the Russian-Ukrainian war on the global energy market

Russia ranks as the third-largest oil producer in the world, following the United States and the Kingdom of Saudi Arabia. On average, Russia produces approximately 11 million barrels of oil per day, with production reaching 11.3 million barrels per day in January 2023, including 10 million barrels of crude oil, 960,000 barrels of condensate, and 340,000 barrels of gas liquids (Oil Market and Russian Supply, IEA, 2023). Additionally, Russia is the world's largest exporter of oil to global markets and the second-largest exporter of crude oil, after Saudi Arabia.

In December 2021, Russia exported 7.8 million barrels per day, with crude oil and condensates accounting for 5 million barrels per day, or 64% of total exports. The remaining petroleum product exports totaled 2.85 million barrels per day, including 1.1 million barrels per day of gas oil, 650,000 barrels per day of fuel oil, 500,000 barrels per day of naphtha, and 280,000 barrels per day of vacuum gas oil (VGO). Gasoline, liquefied petroleum gas, aviation fuel, and petroleum coke together represented the remaining 350,000 barrels per day. According to the International Energy Agency, over 50% of Russian oil and petroleum product exports are directed to European Union countries, which are adversaries in the ongoing conflict, while 10% are sent to the United States, 28% to Asian countries, and 11% to other regions worldwide.

Fig 01: Russian oil production and exports during the period January 2020 - December 2021



Source: Oilmarket and russiansupply, at : <https://www.iea.org>.

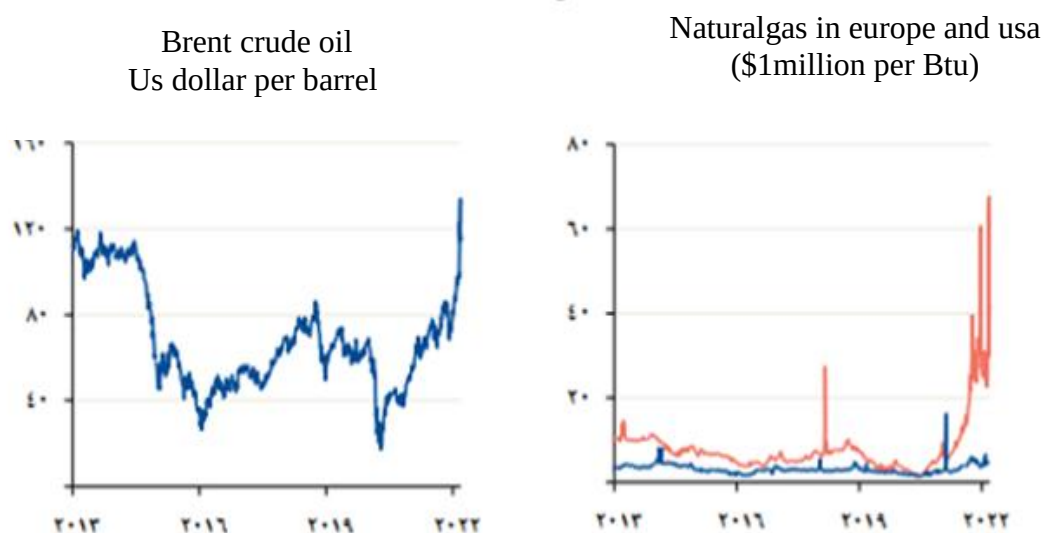
In the same context, Germany imports over 50% of its natural gas from Russia, while some European Union countries rely entirely on Russian gas imports, such as North Macedonia, Bosnia and Herzegovina, and Moldova. Additionally, Finland and Latvia depend on Russia for more than 90% of their gas supplies, with Serbia at 89%. Italy is also among the most dependent countries, importing 46% of its gas from Russia, while France imports 24% of its gas needs from Russia (Draya-eg.org).

Given the above statistics, it is not difficult to foresee the potential consequences for the global oil market if Russia's ability to supply oil to global markets is disrupted or restricted. Under these circumstances and amidst growing concerns about the impact of oil supply disruptions, energy prices saw a significant increase, approaching levels not seen since the fall of 2014. At the beginning of 2022, Brent crude prices reached \$80 per barrel, and by the end of the year, the average price for the year stood at \$108 per barrel. Speculative

activities further fueled the rise in prices, driving Brent crude to trade at \$139 per barrel.

The sensitivity of natural gas prices to the consequences of the Russian-Ukrainian war on global energy markets was even more pronounced, especially since the conflict erupted during the winter season, when demand for natural gas peaks. Notably, within less than a month of the war's onset, the price of U.S. natural gas surged by between 72% and 75% compared to 2021 levels. In Europe, the repercussions were even more severe, with natural gas prices increasing by 821% over the course of 2021. Similarly, although European countries had sought to reduce their reliance on coal as an energy source, coal prices also followed the same upward trajectory as oil and natural gas, rising by more than 325% (Draya-eg.org).

Fig 02: Evolution of oil and natural gas prices in Europe and the United States of America



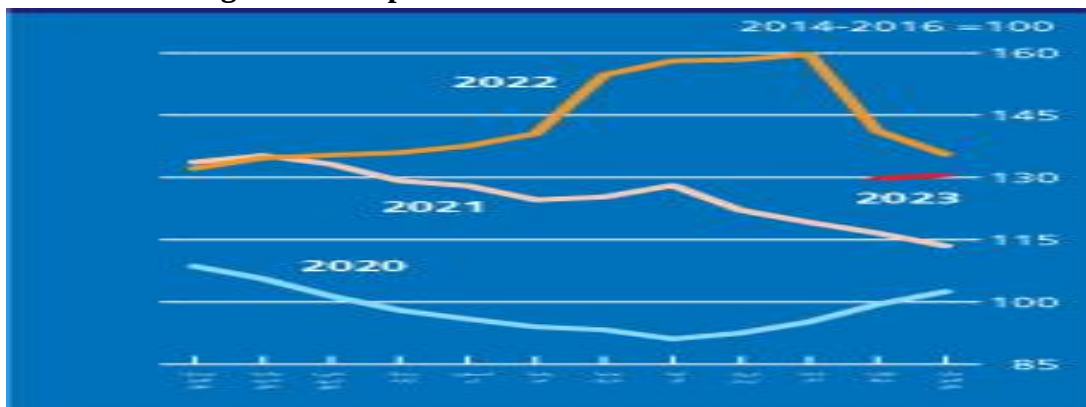
Source: <https://www.imf.org/ar/Blogs/Articles>

III.2 The repercussions of the Russian-Ukrainian war on global food prices :

Russia, Ukraine, and Belarus are the countries most directly involved in the Russian-Ukrainian conflict, and at the same time, they are among the most significant suppliers of essential global food staples, such as wheat, corn, and sunflower oil. These countries are often referred to as the "global breadbasket," according to the Food and Agriculture Organization (FAO). Russia and Ukraine alone account for approximately 30% of global wheat exports, 20% of corn exports, and 80% of sunflower oil exports. As such, it is evident that the war in

these nations has far-reaching implications for global food prices. In this context, the FAO reported that the FAO Food Price Index reached its highest level ever in March 2022, hitting 159.3 points, and averaged 158.2 points in April of the same year (United Nations, 2022).

Fig 03: Development of the FAO Food Price Index



Source : <https://www.fao.org/worldfoodsituation/foodpricesindex/ar>

In detail, the FAO Cereal Price Index rose by 17.1% in March 2022 compared to February of the same year. The Vegetable Oil Index also saw a significant increase of 23.2%, driven primarily by the rise in prices of sunflower seed oil, of which Ukraine is the world's leading supplier. Similarly, the FAO Sugar Price Index rose by 6.7% during the same period. These percentages highlight the extent of the pressure imposed on the global food basket by the repercussions of the Russian-Ukrainian conflict.

Another factor contributing to the increase in global food prices, directly related to the war, is the surge in shipping costs for grains and dry bulk commodities. According to the United Nations Conference on Trade and Development (UNCTAD), this factor is expected to contribute to a 1.2% increase in consumer food prices, with higher increases anticipated in middle-income countries, which rely more heavily on dry bulk shipping for food imports. In contrast, the impact on developing countries will be less pronounced, as they depend on container shipping for processed food imports (UNCTAD, 2022).

Although the index value declined at the beginning of 2023, as reported by the FAO, this decline was influenced by several factors, including the approval of the Black Sea Grain Transport Initiative in July 2022 by Russia, Ukraine, and the United Nations. As a result, the index stabilized at 129.8 points in February 2023 (FAO, 2023).

III.3 The repercussions of the Russian war on metal prices

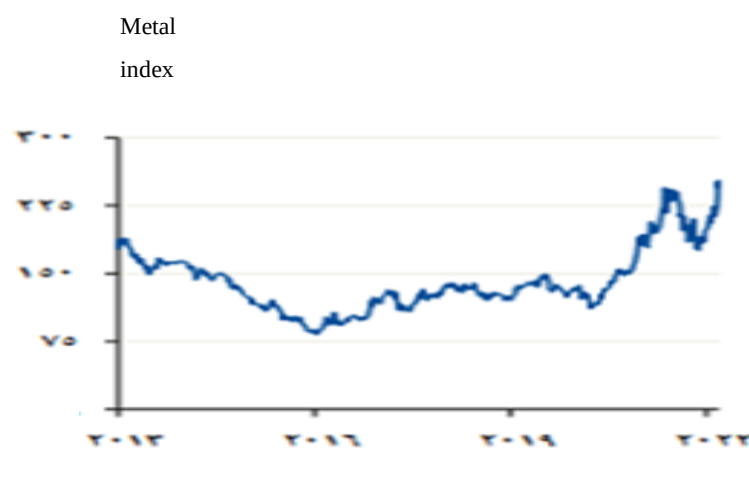
The repercussions of the Russian-Ukrainian war have also extended to the global metal market, as both countries are among the world's richest suppliers of certain metals. For example, Russia and Ukraine together produce 71 million

tons and 21 million tons of iron annually, respectively. Russia also accounts for approximately 9% of global nickel supplies, and it is the largest supplier of palladium, contributing about 40% to the global market. It is clear that the ongoing conflict between these nations is exerting inflationary pressures on the prices of these and other metals.

For instance, nickel prices surged by 250% in just two days in March 2022, reaching \$100,000 per ton, marking the highest price ever recorded for this metal. Similarly, the price of palladium rose by 8.7%, reaching \$3,263.25 per ounce, which had a significant impact on the global automotive industry. During the same period, the price of aluminum per ton climbed to \$4,026.5, while copper prices hit an all-time high of \$10,845 per ton (Alaraby, 2022).

The price of gold, considered a safe-haven investment during times of war and crisis, followed a similar upward trend. Futures contracts for gold traded on the New York Mercantile Exchange (NYMEX) rose by 3.4% within 24 hours in March 2022, reaching \$1,938 per ounce. This marked the highest value for gold since the end of 2020.

Fig04: Development of the metal price index during the period 2013-2022



Source: <https://www.imf.org/ar/Blogs/Articles>

III.4 The repercussions of the Russian-Ukrainian war on the global logistics sector:

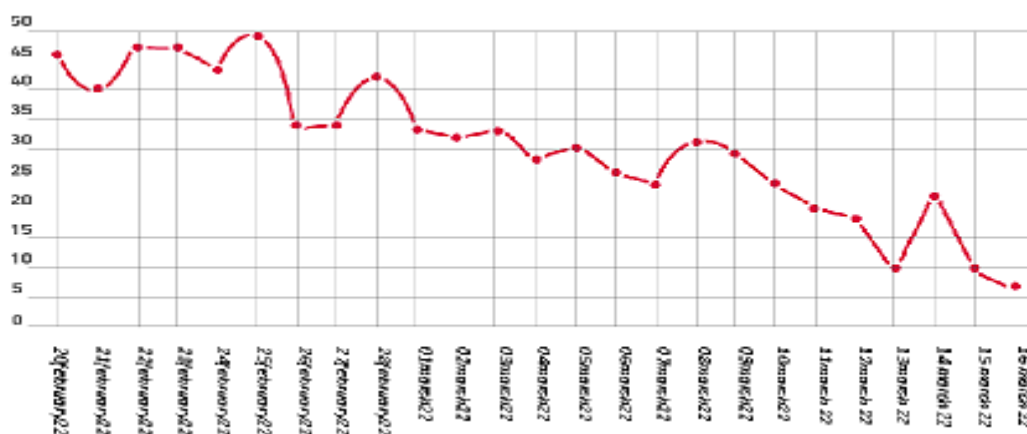
The previous discussion on the repercussions of the Russian-Ukrainian war on global energy, mineral, and food markets provides important insights into the expected effects of the war on global supply chains. Energy, minerals, and coarse grains (such as corn, wheat, and sunflower seeds) are essential inputs in the production of most, if not all, final consumer products. This analysis focuses on

the impact of the Russian-Ukrainian war on one of the most critical pillars of global supply chains: transportation, in all its forms.

Maritime transport accounts for approximately 80% of global trade (UNCTAD, 2022). The Russian-Ukrainian war has altered trade routes across the seas, compelling buyers to seek alternative suppliers that are often farther away, but using safer and more expensive routes. For instance, Nigeria has turned to importing potash from Canada, while Egypt has been forced to source part of its wheat needs from India. Southeast Asian countries and the European Union have requested additional quantities of Brazilian corn. This shift has placed additional congestion pressure on many international ports, especially in Europe, and severely disrupted shipping operations. As an example, the waiting times for cargo ships to unload their goods at American ports reached 20 days.

In a related context, nine of the ten largest global container shipping lines suspended their operations in the Black Sea region. Many companies in the logistics sector were also forced to exit the Russian market, either for security reasons or out of concern for falling under US and European sanctions. Additionally, several countries, including the UK, Canada, Norway, and Italy, closed their ports to Russian vessels. The figure below illustrates the sharp decline in the number of cargo ships departing from Russian ports during the early days of the war.

Fig 05: Number of cargo ships departing from Russian ports during the period 02-22-2022 to 03-16-2022



Source: Future Center for Advanced Studies and Research, How will the Ukrainian crisis affect the global logistics sector, April 2022.

At the beginning of 2022, the Shanghai Containerized Freight Index (SCFI) reached an unprecedented level, surpassing the 5000-point threshold. However, it

then began to decline, eventually settling below the 1500-point mark in December of the same year. This downward trend continued into the early part of 2023, with the index reaching 909.72 points on March 27, 2023 (see figure below). The ConTex Container Ship Charter Index followed a similar trajectory, reaching its peak in March 2022, exceeding 3500 points, before experiencing a decline starting in April 2022.

Fig06: The evolution of the SCFI index during the period from January 2020 to March 2023.



Source: <https://en.sse.net.cn/indices/scfinew.jsp>

Air transport of goods was also significantly affected by the repercussions of the Russian-Ukrainian war on global supply chains. In this context, the prices of the Freightos Baltic Index (FBX) for air freight, which measures global container shipping prices by calculating the spot prices of 40-foot containers across 12 global commercial aircraft routes, experienced a noticeable increase. This rise was particularly evident in shipments between production and manufacturing centers in China and consumers in the United States and Europe. For example, the price between Europe and China rose by 80%, reaching approximately \$11.63 per kilogram in the first week of March 2022, compared to the previous week. It then settled at \$9,416 on March 28, 2022. This increase was primarily due to the closure of several air routes, forcing logistics companies to adopt longer, more costly routes. Additionally, circumventing Russian airspace, which was closed to flights from Western countries, added more than 34 million euros in additional weekly costs for airlines (<https://draya-eg.org>).

Fig 07: Development of the FreightosBaltic Index (FBX) for air freight during the period 01-01-2017 until 01-01-2022.



Source: <https://fbx.freightos.com>

IV. Conclusion

In conclusion, the Russian-Ukrainian war has had an unprecedented impact on international trade and supply chains, with its consequences likely to persist for many years. This impact can be summarized in the following points:

- Increase in the prices of essential commodities: Basic materials such as wheat have seen a significant price rise due to a decrease in exports, as the war has disrupted supply chains. The search for alternatives to Russian and Ukrainian exports will be costly, especially for Arab countries, which may struggle to bear the burden if the war continues for an extended period.

- Rising energy prices: The prices of energy sources such as oil, gas, and minerals have surged, which has had a profound effect on European industries, particularly the automobile industry and sectors reliant on electronic chips. The need to find alternatives to Russian gas has become critical, especially since Russia has used its energy supplies as a leverage tool in response to sanctions imposed by the European Union and the United States.

- Increased revenues for oil-exporting countries: Oil-dependent countries, such as those in the Middle East and the United States, have seen their incomes rise due to higher global energy prices. In contrast, oil-importing countries are experiencing deficits in public finances and rising inflation rates.

- Ongoing disruptions in supply chains: Continued interruptions in global supply chains are expected, which will negatively affect industries worldwide.

This is particularly true in sectors with highly integrated and interconnected production stages, where the components of a single product rely on multiple countries, leading to increased production costs.

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