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**RELACIÓN ENTRE INFLACIÓN, CADENAS DE
SUMINISTRO GLOBALES Y CONFLICTOS ARMADOS
INTERNACIONALES**

**RELATIONSHIP BETWEEN INFLATION, GLOBAL
SUPPLY CHAINS AND INTERNATIONAL ARMED
CONFLICTS**

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RESUMEN

Este documento tiene como objetivo analizar si los conflictos armados geopolíticos más importantes que tienen lugar hoy día, como la guerra entre Rusia y Ucrania en Europa del Este, y entre Israel y Palestina en Oriente Medio son una de las razones por las cuales las cadenas de suministro están experimentando interrupciones como cuellos de botella, escasez o retrasos a escala global.

De la misma manera, se llevará a cabo una revisión de los niveles de inflación tanto en Estados Unidos como en la Eurozona en 2022 y 2023, esta última también a nivel sectorial. Al comparar las fechas de estos eventos y revisar comunicaciones y artículos, concluiremos si la interrupción de las cadenas de suministro, causada por disputas internacionales, contribuye a impulsar la inflación, considerando las circunstancias de incertidumbre y volatilidad en que hoy vivimos.

El proceso de evaluación de los tres componentes consistirá en una explicación profunda de cada uno, seguida de una revisión de noticias e información sobre los efectos de la guerra en las cadenas de suministro y los procesos logísticos. Luego, se describirán tres índices que miden las interrupciones de las cadenas de suministro a nivel nacional (Índice de Estabilidad de la Cadena de Suministro, para EE.UU.) y mundial (Índice de Presión Global de la Cadena de Suministro e Índice de Volatilidad Global de la Cadena de Suministro), proporcionados por varias instituciones y contruados a través de diferentes metodologías. Recopilando datos de dichos índices para 2022 y 2023, contrastándolos con picos de inflación y luego comprobando si coinciden con períodos de mayor tensión en los enfrentamientos militares, podremos averiguar si las tres variables consideradas están de alguna manera relacionadas.

Por último, se recabará información de una multinacional reconocida, Apple, cuyas cadenas de suministro han sido dañadas por interrupciones, nos permitirá comprender, desde un enfoque más corporativo, cómo todos estos eventos afectan a las empresas en la vida real.

ABSTRACT

This paper aims to analyze whether the most important geopolitical armed conflicts happening today, which are war between Russia and Ukraine in Eastern Europe, and Israel and Palestine in the Middle East, are one of the reasons why supply chains are experiencing disruptions such as bottlenecks, shortages or backlogs on a global scale.

In the same way, a revision of inflation levels in both the U.S. and the Eurozone in 2022 and 2023 will be carried out, the latter at a sectoral level too. By comparing the dates of these events and revising communications and articles, we will conclude whether supply chains' disruption, caused by international disputes, is a direct driver of inflation, considering the uncertain and volatile circumstances we live in today.

The evaluation process of the three components will consist of a deep explanation of each one, followed by a revision of news and information about the effects of war on supply chains and logistics processes. Then, three indexes that measure supply chains disruptions at a national (Supply Chain Stability Index, for the U.S.) and worldwide level (Global Supply Chain Pressure Index and Global Supply Chain Volatility Index), provided by various institutions and built through different methodologies, will be described. Compiling data for said indices for 2022 and 2023, contrasting them to inflationary peaks

Relationship between inflation, global supply chains and international armed conflicts

and then checking if they match periods of higher tensions within military clashes will enable us to figure out if the three considered variables are somehow related.

Lastly, gathering information from a renowned multinational, Apple, whose supply chains have been damaged by disruptions, will allow us to understand, from a more corporate approach, how all these events affect businesses in real life.

1. INTRODUCTION

Now more than ever, we live in a constantly changing world. The development of artificial intelligence is giving industries the means to boost productivity levels, and societies' raising awareness on sustainability issues is encouraging economies to improve the way in which businesses are done. Ultimately, we are faced with opportunities for economic growth never seen before. However, for some time now we have all become aware of how uncertain and unpredictable our world can be. Gourinchas (2024) highlights the tough aftermath of the COVID-19 pandemic, recent energy and food crisis and the tightening of monetary policies, as some of the factors that have prevented worldwide economies from taking full advantage of their growth potential. Georgieva (2024) points out that trade fragmentation, as a result of current geopolitical conflicts, could translate into a global output loss of up to 7.4 trillion dollars. And tensions seem to be rising as time goes by.

Historical evidence has proven that most times, geopolitical conflicts and more specifically, wars, are closely linked to periods of high inflation. As Melin (2023) pointed out, when World War I broke out, Sweden left the gold standard and restricted domestic production, as prices for imported goods rose to the highest inflation levels the country has ever experienced. Also, after this war, certain states resorted to money printing as they were unable to pay off war debt via tax revenue; it was the case of Germany, Austria, Hungary, Poland and Russia, struck by hyperinflation at the time (Apel and Ohlsson, 2022). Post-war inflationary phenomena are not foreign to the United States either, as Friedman and Jacobson Schwartz (1980) explain: even nine years after the outbreak of World War II, wholesale prices in the U.S. had more than doubled and the stock of money was almost three times greater.

Data analysis has also been key to establishing a direct relationship between supply chains' disruptions, regardless of their causes, and inflation. Santacreu and LaBelle (2022) bring to attention bottlenecks and backlogs encountered as a result of the COVID-19 crisis in certain sectors, followed by an expansion of PPI¹ inflation. Rouse, Zhang and Tedeschi (2021) establish a parallelism between inflation experienced in the U.S. after World War II and after coronavirus episode. In the first case, they speak of a lack of household supplies or cars by the time the conflict ended, as industries had been more focused on weaponry production. This, along with the increase in personal savings that families had achieved (due to rationing of consumer goods during the war), made prices for said scarce goods grow exponentially as particulars had greater purchasing power. The post-COVID-19 situation is somewhat similar since production processes were forced to stop upon contagion possibilities. Lockdowns also motivated various components' shortages in certain industries as they could not be transported, which inevitably disrupted supply chains. In fact, U.S. auto production saw a steep decline, dropping from 11.7 million vehicles in July 2020 to under 9 million in the autumn of 2021, according to the National Bureau of Economic Research (2023), which also noted that the annual inflation rate increased from 1.7% to more than 5% between February and June 2021.

High levels of inflation are, nowadays, typical in most developed economies. As I have said, we are now faced with a tumultuous geopolitical situation. And as supply chains are

¹ According to the U.S. Bureau of Labor Statistics (2024), the *Producer Price Index* serves to measure the evolution of the average change over time in selling prices received by domestic producers of goods and services.

an essential part of the process by which we obtain all our goods, it is easy to wonder if there is a direct relationship between these three elements. Are disruptions taking place within global supply chains, motivated by geopolitical tensions, anyhow related to the high inflation levels that are being experienced worldwide?

The objective of our analysis will be to figure out whether this relationship exists according to the following structure:

- First, we will dive into what causes supply chain disruptions as well as inflation, along with the costs of this classical economic phenomenon. By providing an insight into the origins and the current situation of two of the most relevant current global conflicts, such as the Russo-Ukrainian War and the armed fight between Israel and Palestine military group Hamas, it will be easier for us to understand to what extent they can influence supply chains and inflation.
- Then, we will be looking at communications and studies that have analyzed the impacts of said disputes on supply chains since they broke out. Each war has its own idiosyncrasy, which is why effects on supply chain will be different for the two cases.
- Finally, inflation data in the United States for years 2022 and 2023, in which both conflicts burst, will be contrasted with three economic indexes to be explained, as reliable indicators of the most recent supply chain disruptions. We will also look at sectoral inflation within the Eurozone throughout the considered period to give an insight into which goods became more expensive for final consumers as a result of armed disputes.
- If disruptions of supply chains match those moments of most geopolitical tension, and levels of inflation become higher at these points too, we will conclude that the three realities are closely related.
- To tie up our analysis, after data review we will be looking at the case of technological leader Apple, analyzing the potential disruptions within its supply chain the company might have experienced recently and how that has affected consumer prices.

2. COMPONENTS OF THE ANALYSIS

The three constituents of our analysis are realities we are all, to some extent, familiar with. Anyone who lives in the current world is probably aware of the global disputes that are taking place or have been triggered over the course of the years. Also, as economic agents who need to purchase goods and hire services daily, we all have experienced the consequences of inflation in our own skin at some point. Supply chains are not such a well-known element, yet they are essential for us to meet requirements of products we purchase from time to time.

Before evaluating whether there is an existing relation between these components of our analysis, it is necessary that the three of them are fully comprehended. A throughout explanation of each concept is now provided in order to set the basis of the system that will be built further on.

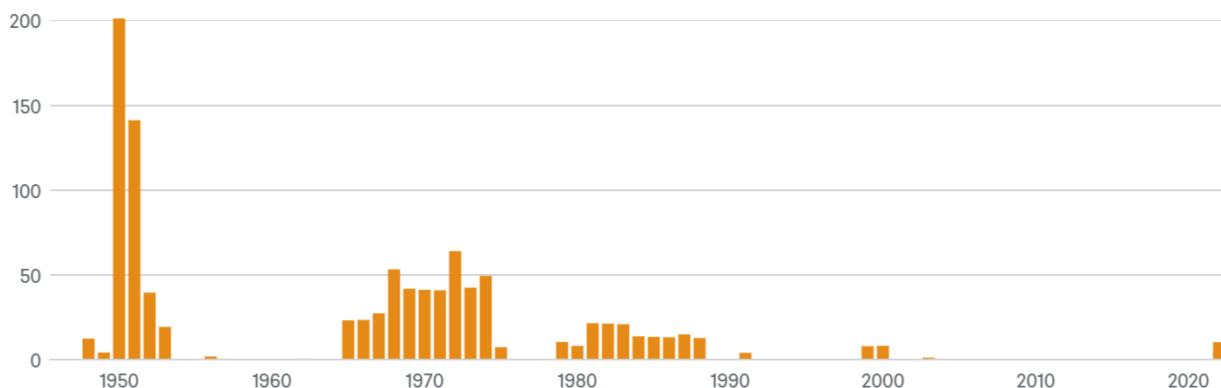
2.1. INTERNATIONAL CONFLICTS

Global clashes among countries have always been inevitably linked to economic difficulties. Sometimes, those become the source of tensions and others, they are no more than inevitable consequences. In fact, there are many cases in which economic factors have provoked frictions between states. On other occasions, political or social tensions escalate until they become armed confrontments, that spill over into a state of destruction that is no good for economic circumstances. This part of the analysis introduces both types of situations and then explores more deeply the cases of the most relevant international warlike conflicts the world has recently experienced: Russia-Ukraine and Israel-Palestine.

2.1.1. Non-warlike scenarios

Since the end of World War II, countries have become less prone to engage in warfare.

Graph 2.1.: Deaths per one million people worldwide due to ongoing interstate conflicts



Source: Council on Foreign Relations (2023), based on Uppsala Conflict Data Program and Peace Research Institute Oslo

The reasons why warlike tensions might have substantially become less frequent during the last few decades are varied. Some attribute this decrease to the rising number of democratic systems, while others give more credit to the increase in international trade.

The appearance of strong military alliances such as NATO or Institutions that advocate for peaceful resolutions, like the United Nations, may have had something to do with it too (Council on Foreign Relations, 2023). However, the world is far from being a peaceful place. Countries battle for power, wealth or other motivations through alternative ways: cyberattacks, imposition of sanctions, domestic destabilization, electoral interference, cutting off diplomatic relations with other countries... and so on.

The so-called **Trade War**, that the US and China began in 2018 is a specific example of a non-warlike tension. This rivalry had severe consequences for global economies, although it didn't lead to weaponized fights. Kapustina et al. (2019) explain that when the World Trade Organization (WTO) recognized China as a market economy back in 2017, US authorities felt threatened by their new condition and not only didn't recognize their status but also embodied their confrontational policy in the National Security Strategy. This paper put restrictions on Chinese investments and listed a series of businesses US enterprises could not transact with, among other limitations. From 2018 until two G20² summits were convened, both countries put barriers on imports worth \$450 billion of dollars altogether, according to Fajgelbaum and Khandelwal (2021). Still, threats to increase tariffs and accusations of currency manipulations were exchanged afterwards, and to relieve tensions, the 'Phase One' trade deal was signed in January 2020, for which the US agreed to reduce tariffs on some imports and China committed to increase purchases of U.S. goods and services by at least \$200 billion over two years (Bown, 2021). Despite this objective was not fully met, the pact helped the Trade War de-escalate from its peak.

And although these kinds of non-military tensions are not our focus of study, it is interesting to point out that they are closely related to inflation as the increased cost of bringing goods to markets translates into higher retail prices as well: for instance, Flaaen Hortaçsu and Tintelnot (2020) checked the retail price of washing machines in the US, one of the tariffed goods, observing a 125% increase in consumer prices when tension between countries reached its tipping point.

2.1.2. Warlike scenarios

Military conflicts trigger consequences of all sorts. They push tremendous humanitarian struggles while constraining economic means. They force workers to abandon their jobs for the fight, and in many cases leave industries undersupplied with equipment, as all resources are allocated to weaponry production. Galvin (2003) explains that military expenditure diverts funds from investments that would be more productive and helpful for economic development in the long-term, such as education, health and infrastructure; this is what Ganegodage and Rambaldi (2012) define as war opportunity cost. Combats destroy infrastructures and assets that make up production, storage, transportation or commercialization processes.

It is key here to analyze two of the most important ongoing conflicts at a global scale, their origins, and their consequences in order to figure out in which way have supply chains been affected by them.

² Berman, McBride and Siripurapu (2023) explain that the Group of Twenty are informal meetings carried out by some of the world's most important powers in which mainly economic matters are discussed, among others.

- **Russo - Ukrainian War**

Pawłuszko (2023) explains that Russia and Ukraine have taken confronting positions for a long time regarding three dimensions:

- *Leadership and social matters*: there is a strong desire within Russian elites to intimidate democratic politicians, as well as to show their 'historical success' over opponents that they perceive as weaker, like Ukraine. Although it is not always shown, Russia's highest echelons also sometimes feel menaced by the influence and strength that NATO has, despite considering Western powers weaker than themselves.
- *State and policies*: it is no secret that Russia has a strategy of domination in the former USSR area, for what its security policies began to militarize. On the contrary, Ukrainian pro-European actions such as cooperating with the EU and NATO, threatened Russian supremacy in the zone. Lastly, the regions of Crimea and Donbas were also hot spots due to the high number of Russian separatist groups acting in said zones.
- *International systems and their rules*: Eurasia faces rivalry for hegemony. Russian strategic alliance with China, at odds with the US, makes tensions between Russia and the West inevitable. The international picture is now divided into a democratic and an authoritarian block, and countries firmly defend their positions.

The conflict that broke out only about two and a half years ago comes from tensions that began to arise in March 2014, when Russian separatists living in the Ukrainian peninsula of Crimea celebrated a referendum to support union with Russia. Despite the popular favorable outcome, the decision was not internationally recognized, and separatists took over the territory with President Putin's full backing (Walker, 2023).

On 24 February 2022, Russian troops entered Ukraine through the territories of Belarus, Russia, and Crimea, setting off a full-scale war that has been going on for the last two years. As Walker (2024) states in one of his latest publications summarizing the conflict, the prospects are of "little appetite for compromise or peace".

- **Israel – Palestine Conflict**

The origin of this issue goes back over a century, when during World War I it was requested that the Jewish had a national home within the territory of Palestine, in 1917. Jewish population feeling from the Nazi occupation entered the state, unleashing Arab communities' disagreement and causing the UN to divide Palestine into two separate countries in 1947. This measure was accepted by Jews but never by Arabs, who still claimed lands were being taken away from them, and violence continued (BBC, 2024).

Israel leaders proclaimed the creation of their own state and progressively began to invade more territories at the expense of Palestinians. Alfonseca (2023) explains that further occupations took place over the years, as well as *intifadas* or Palestinian uprisings as a response. Eventually, Israeli forces left the Gaza Strip, and the territory was taken over by Palestinian military group Hamas (Robinson, 2024), which led to a blockade imposed by Israel and Egypt in 2007. Armed conflicts and military operations have been common between Israel and Hamas forces ever since, yet the surprise attack that Hamas carried out upon Israel on October 7, 2023, triggered one of the "most destructive, deadly, and intractable conflicts of the 21st century", in words of Frankel

(2024). As of today, more than 35,600 Palestinians have been killed since the beginning of the war, as stated by Gaza's Ministry of Health (Gadzo and Siddiqui, 2024).

Figure 2.1.: Historical borders between the states of Palestine and Israel



Source: University of Richmond (2023)

2.2. GLOBAL SUPPLY CHAINS

There is no such thing as a unique definition of what supply chains are. Various experts and organizations devoted to the study of this field have provided us over time of several explanations of the term. The Council of Supply Management Professionals (2013) highlights in its definition the sequence of exchanges, both material and informational, that take place in the process by which raw materials end up becoming final products and delivered to consumers via logistical processes. The approach that Christopher (2023) took when he first addressed the notion of supply chains focused more on organizations and their links in the process of creating value for customers, by developing goods and services. This explanation is more centered around the network that individual components of the supply chain make up, rather than in the transactions that take place in it. Other definitions emphasize the more business-oriented aspects of the process as to remark that out of the supply chain functioning, enterprises are able to position their products into markets and obtain revenue out of sales, such as the given by McKinsey & Company (2022). In the end, each of these definitions bring to the fore different aspects of supply chains, reflecting the varied ways in which they are understood and managed across different contexts.

Before digging deeper into supply chains disruption phenomena, it is interesting to remark that disruption is not necessarily something negative. Schumpeter (1942) spoke of *creative destruction* as a continuous cycle of industrial change, constantly reshaping

the economic landscape by replacing outdated structures with new ones, enhancing productivity in the process. Vedres & Stark (2010) established in their work a parallelism between *disruptions* and said *creative destruction*, characterizing the former as events that are necessary to promote market development. However, on the field of supply chains, disruption is no source of positive outcomes. In this context they become a series of unforeseen, unexpected occurrences, which interrupt the regular flow of goods and materials that comprise them (Craighead et al., 2007).

Causes of supply chain disruptions have been studied *ad infinitum*. They can either be external or internal, and motivated by countless events. Nonetheless, there is consensus on the strong undesirable impact that some kinds of disruptions have, over supply chains.

Table 2.1.: Causes of supply chains disruptions

Health emergencies
<p>Covid-19 pandemic has been the most recent and challenging sanitary crisis, as well as the cause of the largest global recession since the Great Depression. Gopinaz (2020) explains that the International Monetary Fund communicated in April 2020 a 6.3% downgrade since the emergency state was established in January.</p> <p>Labor shortages due to lockdowns and the impossibility to send components from one country to another, as most borders were closed for security reasons at the time, were the two main aspects in which coronavirus affected supply chains and made it hard for all to recover from this major setback.</p>
Natural disasters
<p>The 1999 Taiwan earthquake, hurricanes Katrina and Rita in 2000, the Asian tsunami in 2004 or the Chinese heatwave in 2022 are just a few examples of well-known environmental catastrophes that have somehow influenced the smooth functioning of supply chains. Of course, other unfavorable circumstances such as snowstorms, heavy rain, excessive wind, or small fires, have a direct yet minor impact over distribution networks. People in charge of supply chain management must address the severity of occurrences to figure out how to deal with incurred disruptions.</p>
Logistics delays and failures
<p>According to the Council of Supply Chain Management Professionals (2013), logistics is referred to as “the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements”. Hence, it is no other thing than one of the links that make up supply chains and must run efficiently for the latter to function appropriately, although they are often considered synonyms.</p> <p>As it is now frequent for many businesses and industries to have overseas providers, not only local, but international transportation networks are becoming more congested, and delays, more frequent as time goes on.</p>
Price fluctuations
<p>Suppliers or those in charge of transportation of intermediate goods may change their prices as supply chain and logistics processes move forward. This will sometimes trigger that enterprises take a step back in their procedures, either to re-negotiate costs with their usual providers or to partner up with new ones. Hence, supply chains may suffer disruptions derived from these unexpected shutdowns.</p>

Cyberattacks
Companies without safe enough security systems might encounter strikes of this kind, motivated by geopolitical tensions as well as digitalization rapid development (Natalucci, Qureshi and Sutheim, 2024). Those breaches can lead to miscommunications between links of supply chains and cause the whole system to be interrupted.
Product problems
Since customers are becoming more demanding over time, product quality standards are progressively being raised. Any problems in the goods that eventually reach final users can impact a firm's reputation. Therefore, it is advisable for firms to halt the supply chain process and review all procedures to ensure the quality of the items.

Source: own work based on Zignify (2022)

According to Leporati et al. (2020), there are two ways in which any of these happenings can disrupt supply chains. Some of the events of the table impact one or more of the links within the process, hindering them from satisfying demand forecasts; it is the case of logistics delays (as we have explained that logistics is only a part of the whole supply chain system), price fluctuations (lag of production processes because of re-negotiations) or cyberattacks. Others increase demand in such a meaningful way that the system has not enough capacity to meet it, such as natural disasters (scarcity of basic goods, sanitary materials or rebuilding supplies). Some of them can even have the two kinds of effects; the pandemic was an example of this, as lockdowns suspended distribution networks while demand of certain products increased exponentially worldwide. Thus, the gravity of the interruption can be assessed by the number of links that have been affected by the unexpected event, or attending to the experienced growth in customers' needs.

2.3. INFLATION

Höflmayr (2022) defines inflation as “the increase in price levels for goods and services [...], a general or broad-based increase in the price of goods and services over an extended period”. Inflation consequences unavoidably affect population as we all need to buy all kinds of said products and services daily.

Mishkin (1984) sustains in his work that throughout the past years, economists have reached certain merging of their views on the main causes of inflation. He begins by explaining that, as Friedman stated (1963), “inflation is always and everywhere a monetary phenomenon”. It is, therefore, inherently linked to monetary policies carried out by Central Banks. Mishkin also points out that, despite it is not always policy makers' intention to increase inflation levels, it usually happens because of the measures they implement to promote money growth rate over time. The increasement in money supply is, consequently, one of the key causes of inflation. But it is not the only one. According to Oner (2019), pressures on both sides of the economies, either coming from supply or demand forces, can also be inflationary. Frick (2022), despite explaining that the underlying reason is an excess of demand, in contrast to a not-so-excessive level of supply, also distinguishes between three causes of inflation:

- *Supply shocks*: when important inputs suffer a disruption and can no longer be available in the desired amount, a supply shock takes place; it is called like this as it is frequent that said goods influence others, whose prices may rise as well. If no alternatives to

this input are found, prices will continue to increase, people still willing to purchase it at any cost as we usually don't know for how long supply shocks last.

- *Money supply*: from the demand side, inflation phenomenon behaves differently. If due to monetary policies people see themselves owning larger amounts of money, they will perceive they have greater purchasing power and will want to buy more products. If supply does not increase in the meantime, which is the usual, greater spending will only lead to a rise in prices.
- *Expectations and spirals*: unexpected increases in demand or decreases in supply motivate inflation. The aim of central banks is to keep inflation under control, so that people are not worried about potential unforeseen events that trigger inflation.

Regardless of the causes that motivate it, policymakers believe that moderate and stable levels of inflation can help economic growth. It is precisely, due to consumers' expectations that prices will be lower in the future, that deflation (the opposite phenomenon) is not good for societies either, as it slows down economic activity (Oner, 2019). But why is it that inflation is generally thought of as something bad? Schiller (1997) states that, based on surveys, inflation is frequently perceived as "the most important national problem". This is challenging for regulators since it forces them to face citizens' disapproval of many decisions related to the topic. Agarwal and Kimball (2022) explain that there are three potential costs of inflation, that trigger popular dislike, which can be found in the following table:

Table 2.2.: Most typical costs of inflation

Shoe-leather costs
According to literature, those are the quintessential neoclassical costs of inflation. This concept reflects the increasement on the recurrence in which people must go to the bank, since in an inflationary context it is preferable that the cash amounts held are smaller. However, as Ireland (2009) indicates, in the desired case there was about 2% inflation, these costs would only represent 0.05% of society's annual income.
Misallocation of resources and menu costs
The latter represent firms' cost of changing their prices. Mankiw (1985) explained this is the reason why most businesses adjust their prices intermittently, with the added cost that not doing it continuously involves. Enterprises' sticking to prices may cause them to mismanage their means, as relative prices will not be accurate for the optimum asset allocation (Agarwal and Kimball, 2022). Hence, inflation is perceived as harmful by entrepreneurs as menu costs they are faced with, whenever they must adjust prices, can lead to further difficulties regarding distribution of resources. These costs are relatively little, yet they increase with higher inflation.
Unpredictability
The higher inflation is, the less predictable its behavior will become, as first suggested Friedman (1977). Despite empirical evidence indicates that this positive relation is only relevant in high-inflationary contexts (Ungar and Zilberfarb, 1993), not knowing what prices of goods will be inevitably distorts population perception of their own money. Thus, unpredictability associated to inflation will derive in what Agarwal and Kimball (2022) name <i>cognitive costs</i> .

Source: author's own work

Although these costs can have longer-term consequences over societies and are the underlying motives why high inflation is not desirable for economies, the most evident effect it has over consumers is the loss of purchasing power they experience. The higher it is, the faster prices increase and, if wages don't follow the same pace, the amount of

goods and services citizens will be able to afford will obviously decrease. A historic example of this is the index measuring the cost of living in Germany, which became 1.5 trillion times bigger its pre-World War I level, just a few years after the end of the conflict (Floyd, 2024).

Inflation, therefore, is an economic phenomenon that all societies have dealt with and must handle daily. Despite its general negative perception, it may be useful for economic growth and development, as long as it is managed appropriately, remaining stable and predictable.

3. EFFECTS OF WAR UPON SUPPLY CHAINS AND INFLATION

Since the two international military conflicts began, many studies have tried to spotlight how they have affected global supply chains and the consequences of said disruptions over economies and inflation. Before moving on to analyze indexes and specific data, it is useful for our study to review some communications and papers that establish relationships between the three elements, to help us draw further conclusions.

3.1. RUSSIA – UKRAINE EFFECTS

Russian invasion of Ukraine had a direct effect over three components of economies in the first place. Those were sanctions, raw materials' prices, and supply chains, according to Nieves (2022). In the first place, the European Union solidarized with Ukraine and intended to limit Russian capacity to finance the war by imposing measures over individuals, companies, energy or transport, among others (European Commission, 2024). Despite these sanctions did not specifically target trade in agricultural and basic goods between other countries and Russia, commercial relations were irremediably harmed by the magnitude of the conflict. Moreover, many states decided to restrict business connections with Russia in protest for the attacks.

Trade routes contraction, as a consequence of sanctions, directly affected inflation for energy, metals, oil and other commodities. In fact, oil prices rose to 100 dollars per barrel, as of February 2022 (Freightify, 2022). Russia was a major global exporter of crops such as soybean, corn and wheat. Ukraine and Russia, altogether, made up nearly 30% of wheat exports worldwide (Freightify, 2022). As shipping prices of commodities increased, the world perceived generalized inflation in the cost of purchasing said basic products, such as cereals or fertilizers, specially right after the outbreak of the war.

Graph 3.1.: Commodity prices indexes



Source: Emediegwu (2024) based on data from the World Bank (2024)

War also affected supply chains by limiting routes by which cargo could be transported. BRS Shipbrokers stated that the Black Sea was the second-largest grain-exporting region as of 2021, says Miller (2022). Bombing within the area caused freighters to search for alternative routes and avoid Ukrainian ports as a risk-management strategy. Other considered options involved moving cargo from China to the Middle East, then to Europe through railways, with the added cost in terms of time and money this implies for freight forwarders and businesses. Backlogs and shortages of certain components have become frequent ever since. The situation was so critical, that in July 2022 a United Nations deal had to be signed, for Ukrainian exports from three Black Sea ports to be unblocked and lack of certain exports, relieved (GEP, 2022).

Palladium, steel and other essential elements within the automotive industry, for instance, may no longer be purchased from Russia or Ukraine due to scarcity and higher war risk insurance premiums for traffic imposed over the zone (Miller, 2022).

Out of all of these events related to supply chains' disruption and rising prices for raw materials, as well as the shipping of these, we can easily conclude that consumer prices will inescapably increase too, since businesses in charge of providing final goods to markets will be forced to put higher prices as to maintain a certain level of profits derived from their economic activities.

3.2. ISRAEL – PALESTINE EFFECTS

Despite this conflict lasting for about eight months so far, less than the previous one, its economic consequences over supply chains of certain specific regions are not far behind war in Ukraine. Excelsior (2024) explains how the strategic location in which the Israel-Palestine war is taking place can be a source of trouble regarding transportation routes; many businesses, regardless of where they carry out their activities, have their products across the Middle East in their logistics procedures. The Suez Canal, as one of the most frequent routes for moving goods between Asia and Europe, is facing bottlenecks and unforeseen modifications of shipping schedules (Sidharth, 2023). Commercial container

ships in the area are now faced with struggles reaching their destination, not to mention oil and gas transportation disruptions via the Strait of Hormuz, says Anderson (2023).

However, this is not the only route facing difficulties within the area. Two other shipping networks are endangered as a consequence of the fight: the first one is the International North-South Transport Corridor (INSTC), an interconnected system of routes of all kinds of means of transport that facilitates trade between India, the Middle East and Europe. On the other hand, the project for the India Middle East Europe Economic Corridor (IMEEC) may also be threatened, being the peace deal between Israel and Saudi Arabia, now at risk, a keystone for the route to consolidate (Sidharth, 2023).

Shortages are becoming common in the zone for the electronic components industry. Israel is seeing its potential as a global supplier of certain pieces, jeopardized, as some of the most important tech companies relied on it for specific items: chips for artificial intelligence were produced by the Israel divisions of Intel and Nvidia, and silicon for Apple devices was also designed there (Anderson, 2023). As most available resources in Israel are now being allocated to war economy and defense, it is likely that many enterprises experience shortages of said components, having to reduce production levels in consequence and rising prices too.

Regarding inflation, the sector most susceptible to experiencing abrupt variations due to war is energy and oil. According to Luwedde (2024), the Middle East region holds 48.3% of global oil reserves. Despite the world being less dependent on oil supply now than it was years ago, spikes in oil prices, along with higher risk premiums derived from transportation within the zone, could cause food and fertilizers prices to peak, these increasements inevitably being translated into final consumers through inflation.

4. DATA AND INDEXES ANALYSIS

The following section will look at data from different indices used to measure supply chains' disruptions, which will be compared to the moments in time in which tensions between countries within the two explained conflicts have been higher in 2022 and 2023, and also, to inflation levels in the United States during the last two years. According to our hypothesis, the episodes in which countries have faced tougher conflicts will be similar to those of larger disruptions and, consequently, higher inflation.

4.1. SUPPLY CHAIN DISRUPTION INDICATORS' METHODOLOGY

The following indicators are elaborated by independent entities of great renown, that have studied supply chains' disruptions over time and their consequences on businesses and societies. To understand the extent of the analysis they carry out, the following subsections provide us with a general view of the methodologies used to elaborate said indices.

4.1.1. Global Supply Chain Pressure Index

The Federal Reserve Bank of New York (Fed) has become very aware, especially since the COVID-19 pandemic, of the importance of measuring supply chain disruptions intensity, to evaluate their impact over economic results (Federal Reserve Bank of New York, 2023). The AMEC³ division within this institution is responsible for elaborating the Global Supply Chain Pressure Index (GSCPI). The following variables are evaluated to compute the headline number:

- a) Three metrics related to manufacturing activities, obtained through Purchasing Managers Index (PMI) surveys⁴:
 - "Delivery time", which allows to measure the effect that delays in supply chains have on producers.
 - "Backlogs", reflects the number of orders that companies have received but have not yet begun or finished working on.
 - "Purchases stock", which is representative of the volume of inventory companies accumulate in that economy.

The NY Fed analyzes these three variables for a total of 7 representative economies, whose supply chains are sufficiently interconnected at a global level: the Euro area, China, Japan, South Korea, Taiwan, the U.K., and the U.S. This adds up to a total of 21 values, so far, which account for country-specific supply chain measures (Benigno et al., 2022).

³ AMEC is the acronym for Applied Macroeconomics and Econometrics Center, a specific department of the Federal Reserve Bank in charge of model and tool building to support forecasting using data from the New York Fed's Research Group.

⁴ S&P Global gives an insight of several economic indicators affecting a total of 45 economies compiled from questionnaires to senior executives within the private sectors (S&P Global, 2024).

- b) Two global shipping rates are also used to calculate the index:
- The average cost of transportation of dry bulk, such as grain, coal or raw materials. Information is obtained from the Baltic Dry Index (Baltic Exchange, 2023).
 - The weekly evolution in container ships' prices, published by Harper Petersen⁵ through their HARPEX Index.

Both of these indicators' values are also components of the GCSPI.

- c) Lastly, the NY Fed considers airfreight costs to compute the index. The U.S. Bureau of Labor Statistics (2024) publishes four metrics that are used to compute the GSCPI: inbound and outbound U.S. airfreight price rates, to and from Asia and Europe.

Benigno et al (2022) explain that to develop the index, they proceeded in two steps:

1. First, they isolated the supply chain element of the core indicators previously explained. To do so, they recur to demand proxies, obtained from other sub-indices of the PMI⁶.
2. Then a principal components analysis was performed over considered indicators. Through this method, large sets of data are merged into fewer, new variables, linear combinations of the initial measures (Jaadi, 2024). All indicators were standardized beforehand, to transform data to comparable scales and prevent biased results.

NY Fed's objective was to calculate a common component for their dataset, composed of monthly values of the 27 considered variables (three supply-chain related measures for seven economies, two shipping rates and four airfreight rates between the U.S. and both Asia and Europe), for the time series 1997 – 2021⁷.

The first principal component extracted from the application of the analysis represented the GSCPI 1997 – 2021. As of today, the NY Fed presents the monthly GSCPI as the standard deviation above or below the historical average. That is, a zero value reflects the average since 1997, positive standard deviations mean that pressure upon supply chains is greater than the historical average, and negative standard deviations explain the opposite. In other words, if the GSCPI increases, it means that global supply chains are more disrupted, and if it decreases, that pressure upon them is also attenuating (Benigno et al., 2022).

⁵ Harper Petersen is a renowned maritime freight company, global provider of shipbroking and commercial chartering services.

⁶ A deeper explanation on how variables are cleansed of demand-side factors is proposed in Appendix I.

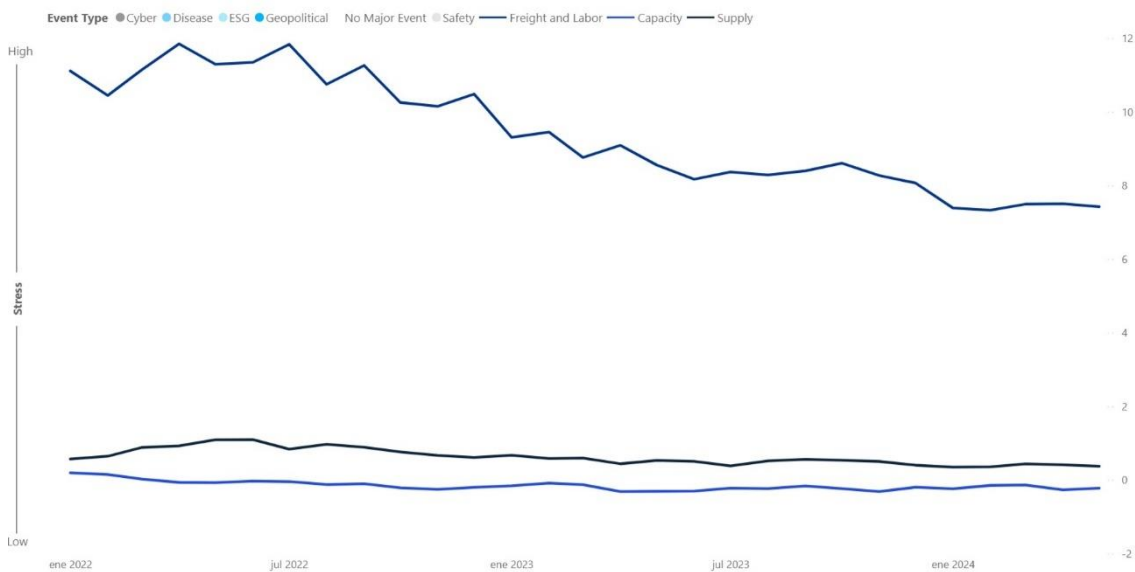
⁷ For some of the indicators, information was not available from 1997. To extract the common component for the full period, Stock and Watson's (2002) methodology on how to develop principal component analysis while dealing with data gaps was followed.

4.1.2. Supply Chain Stability Index

As uncertainty in global markets grows exponentially over time, volatility drivers affecting supply chains have become even more frequent and unpredictable. KPMG, in association with ASCM⁸, publishes periodically the Supply Chain Stability Index (SCSI), aiming to provide companies with knowledge about how well they are managing factors that cause volatility and how said variables are influencing supply chains across the United States (KPMG, 2024). Considered time series begin in 2008 and is updated monthly with new index calculations.

Index makers evaluate three components affecting global supply chains. Each factor is a sub-index itself, computed as a weighted average of variables whose variation influences the indicator's behavior, according to Higgins et al. (2022). However, weights given to each sub-index are not fixed, but calculated monthly by KPMG and ASCM, through proprietary machine-learning algorithms. This is the underlying reason why SCSI's methodology remains slightly opaque to external users of the provided information, although this is not usually a problem for companies that resort to these data as KPMG's over 14 years of experience in supply chains evaluations (KPMG, 2024) label them as a reliable source.

Graph 4.1. SCSI contributing factors' evolution 2022 - 2024



Source: KPMG (2024)

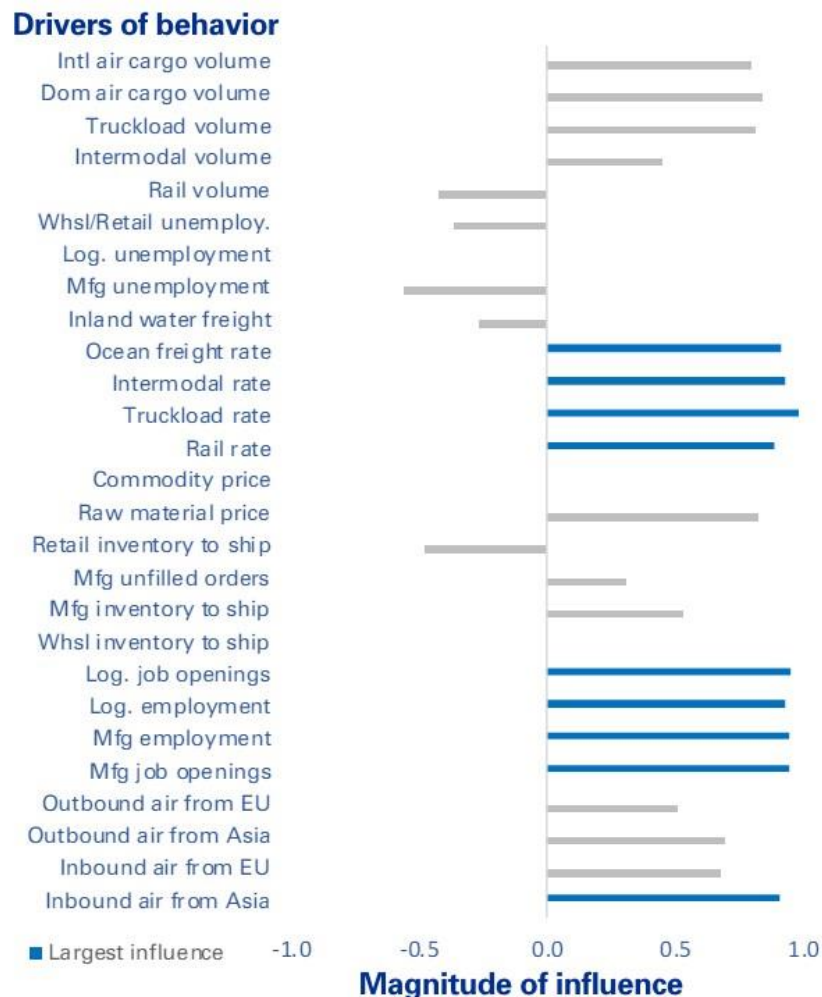
The three considered factors that make up the headline number are the following:

- Logistics: on average, since 2008, this component explains more than 70% of the variability of the index, despite having increased its weight exponentially (since 2020 it accounts for over 90%). It is the most representative factor of supply chain stress. Freight cost variables, such as ocean freight, intermodal, truck road, and

⁸ ASCM stands for Association for Supply Chain Management, the largest worldwide organization dedicated to supply chain innovation, emphasizing human development and corporate improvement across various industries (KPMG, 2024).

inbound air transport are the main drivers of logistical importance upon supply chains, as well as labor costs in logistics and manufacturing activities⁹.

Graph 4.2.: Variables with the most weight on the “logistics” sub-index



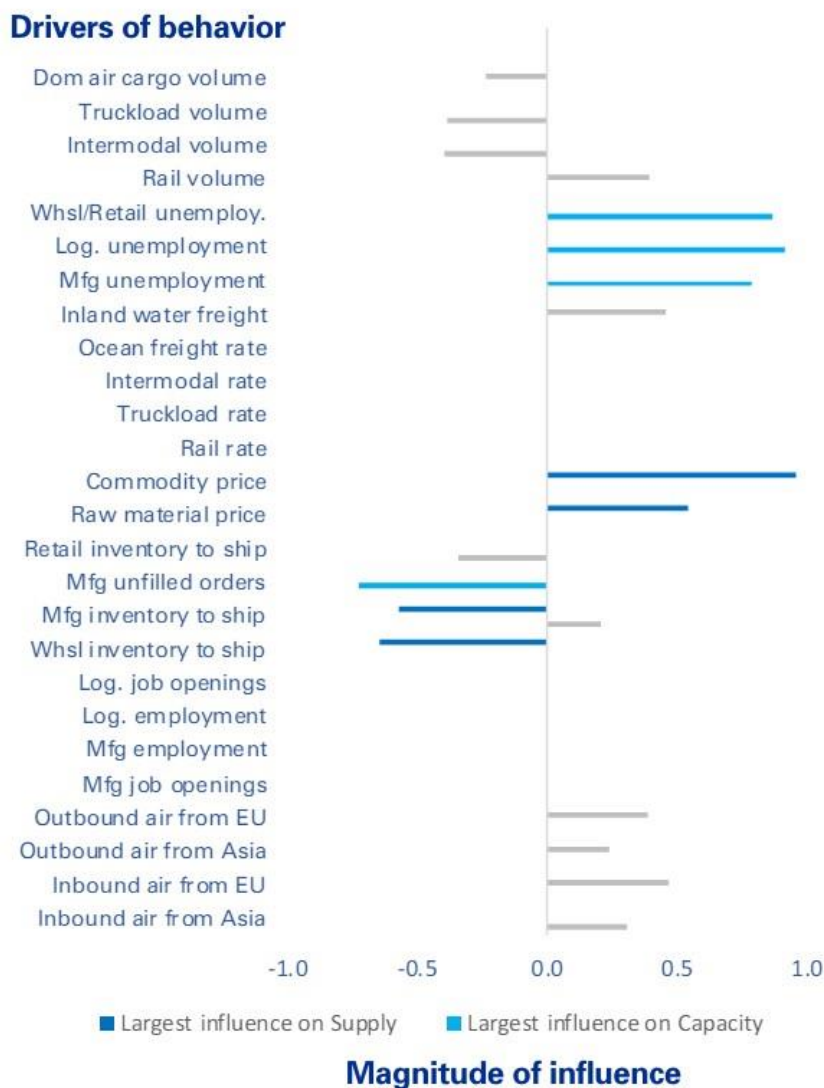
Source: Higgins et al. (2022)

- Capacity: underutilization of it within supply chains, understood as a lack of labor efficiency, explains about 19% of the index variance on average, and although it was the main cause of disruption during 2009 and peaked at the moment of the pandemic, its relative weight has not reached double-digit levels since 2020. It is most influenced by unemployment in logistics, manufacturing, wholesale and retail.
- Supply: this sub-index measures commodity and material costs, reflecting the effort businesses must make to produce inventory. It accounts for about the remaining 10% of the final index value on average, with a quite stable trajectory

⁹ The highest relevance of these variables in the logistics sub-index explains why in the previous graph, the factor is named “freight and labor”, despite in its methodology KPMG refers to it as “logistics”.

regarding its contribution to the index since 2008. Its variance is driven mainly by raw materials and commodities' prices, as well as by manufacturing and wholesale inventories to be shipped.

Graph 4.3.: Variables with the most weight on the “capacity” and “supply” sub-indices



Source: Higgins et al. (2022)

Negative values in the “magnitude of influence” axis, in both graphs 4.2. and 4.3., mean that there is an inverse relationship between the variable and the value of the sub-index, and vice versa.

Results of these three weighted averages for the sub-indices are then merged again through another weighted average, multiplying each sub-index value by the relative weight that KPMG and MSCI give to it for that particular month, computed internally, to calculate the value of the Supply Chain Stability Index; an increase in the indicator’s final number over time shows higher levels of stress upon supply chains, values reduction over time meaning the opposite.

As the firm also reflects major geopolitical events that were taking place at the time of the index development, this enables anyone who looks at the data to intuitively figure out

the reasons why factors were changing, and supply chains were being disrupted consequently.

4.1.3. Global Supply Chain Volatility Index

This indicator (GSCVI) tracks how businesses are affected by economic issues such as demand, shortages, transportation costs, inventory or backlogs. GEP¹⁰ developed it thanks to S&P Global and their *Purchasing Managers Index*; for which they compile information from 27,000 enterprises worldwide through monthly surveys to senior executives (GEP, 2024). GEP gathers from S&P Global six sub-indices that are then added up to obtain the final index:

- JP Morgan Global Quantity of Purchases Index: provides information related to “demand” data, accounting for manufacturers’ demand for raw materials and commodities¹¹.
- All Items Supply Shortages Indicator: reflects how shortages of raw materials and commodities affect stress upon supply chains.
- Transport Price Pressure Indicator: transport costs, as we have seen in previous indices, have a great impact on supply chain managerial performance.

As well as the Manufacturing PMI Comments Tracker for three issues:

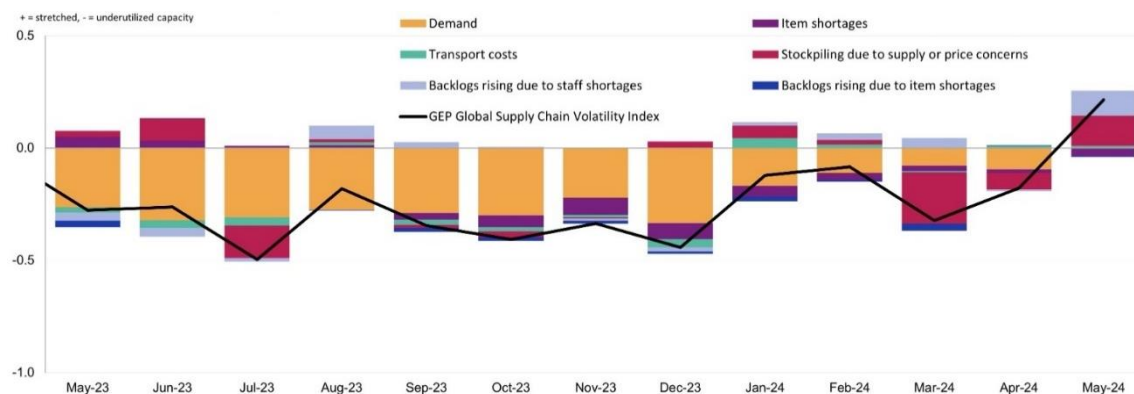
- Stockpiling due to supply or price concerns,
- Backlogs rising due to staff shortages,
- Backlogs rising due to item shortages.

GEP regresses each one of these variables on the suppliers’ delivery times to obtain information on how related they are to supply chains disruption, monthly. Results of these regressions will be the z weights by which the value of the variables will be multiplied, when calculating the weighted sum of all of them to compute the headline number of the index. The result of this aggregation can be read as a stretch or an underutilization of supply chain capacity, based on the positive or negative value of the indicator, respectively. A graph, reflective of last year’s index variation, is now provided to illustrate how GEP presents results in an intuitive, easy-to-read, way.

¹⁰ GEP is a global software and technology services provider for businesses, specialized in supply chain innovation and that is powered by artificial intelligence. It is renowned for helping companies improve their supply chain efficiency and boost productivity levels (GEP, 2024).

¹¹ Please note that for year 2023 analysis, this index will not be considered, as nearly the whole of the supply chain capacity underutilization it presents during said period, is precisely explained by reductions in commodities and raw materials’ demand. As we will only be looking at variables that entail supply-sided constraints, I have considered this index is not relevant for the evaluation of that particular year.

Graph 4.4.: GEP Global Supply Chain Volatility Index, May 2023- 2024



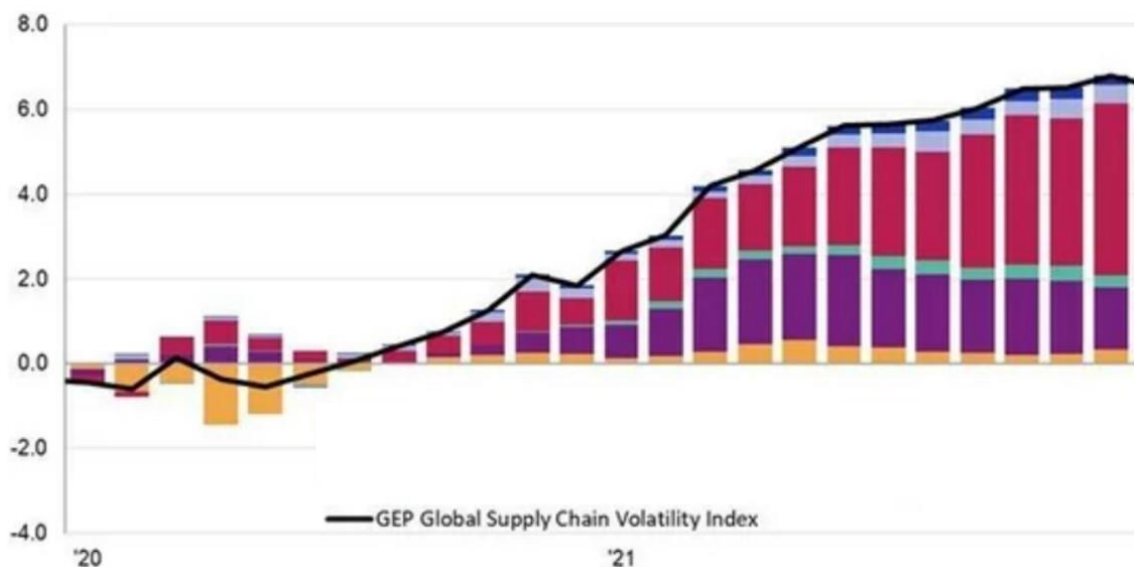
Source: GEP (2024)

GEP does not speak of a range of values within which the index can move. In the weighted sum that gives the headline number, both the weights multiplying each of the values of the variables, as well as the values themselves, change monthly and are computed by GEP through intern calculations.

However, in their periodic reports they compare the current value of the index with those that have been significantly high or low. For instance, graph 4.4 shows a -0.5 value of the index in July 2023, which has been said to be the lowest since 2009, reflecting the “greatest spare supply chain capacity since the Global Financial crisis” (GEP, 2023).

In graph 4.5. below, the opposite situation is shown. Consequences of COVID-19 impacted supply chains so deeply that capacity began to overstretch by mid-2020 and began to peak in December 2021, reaching more than a 6 value of the index, before the situation began to normalize.

Graph 4.5.: GEP Global Supply Chain Volatility Index, 2020 – 2021

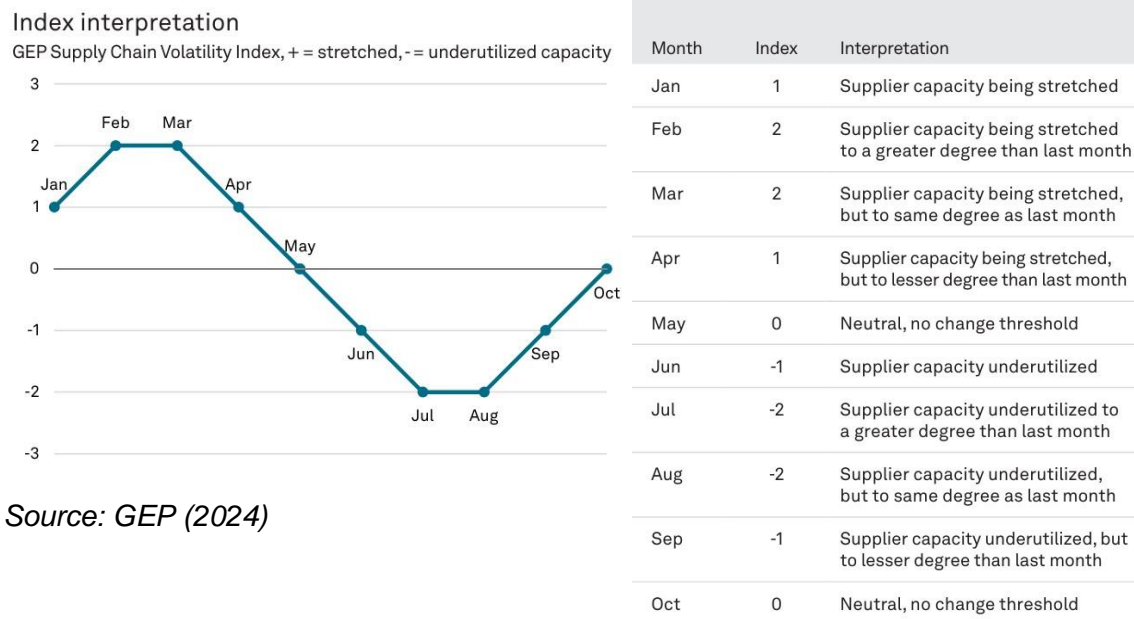


Source: GEP (2023)

Relationship between inflation, global supply chains and international armed conflicts

The following table and graph provide insight into the index interpretation according to GEP.

Graph 4.6. and Table 4.1.: GSCVI interpretation



To add to the interpretation, it is important to note that an over-stretched supply chain is a synonym for it suffering from a lot of pressure, such as the situation perceived when the pandemic hit, and an under-utilized one, reflects a lack of productivity within it, or inefficiency in the way resources are being allocated. Neither of the two extremes has positive consequences for the global economy.

Now that we have explained the three main indicators of supply chains' disruption to be used in our analysis, we will be looking at inflation data in the United States, as it is the country most closely linked to the indices¹², and also, sectoral inflation experienced in the Eurozone to provide a more global approach. We will then contrast the peaks of political tension regarding Russia-Ukraine and Israel-Palestine wars, with the moments in time in which supply chain have been mostly disrupted according to the indices and evaluate if they are consistent with those of high levels of inflation.

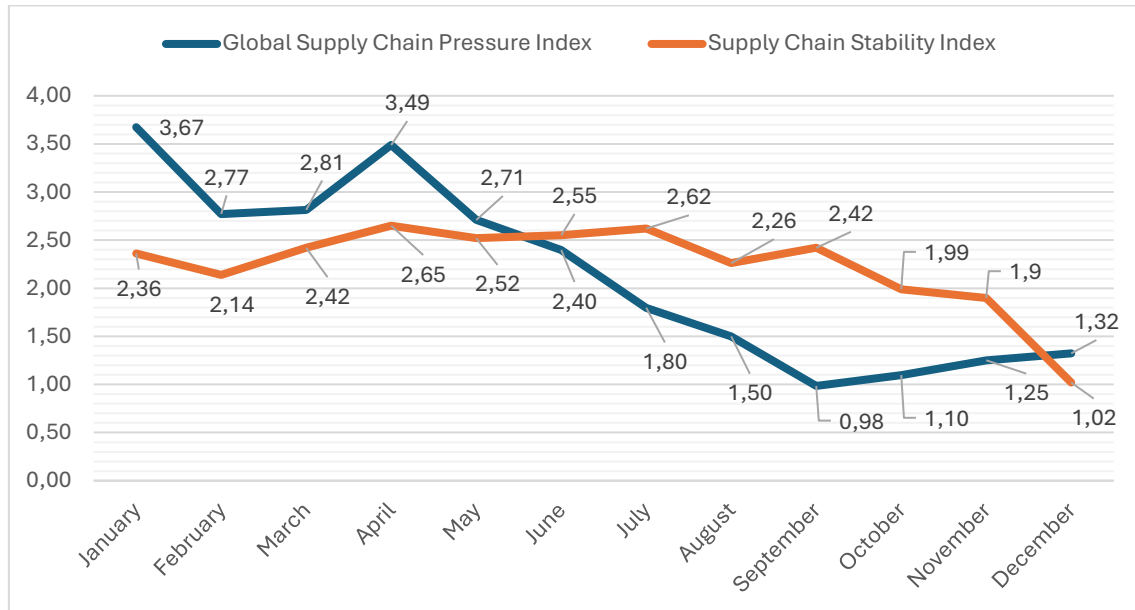
¹² For the GSCPI transportation variables, of the highest impact are airfreight costs are to and from the U.S.; and the SCSI only considers data for this country.

4.2. INDEX ANALYSIS

The first *special military operation* launched by Russia in Ukraine took place on February 24, 2022. Hence, we will be looking at index data from January 2022 to compare the evolution of supply chains with war-related events.

4.2.1. 2022

Graph 4.7.: GSCPI and SCSI values, 2022



Source: author's own work based on Federal Reserve Bank of New York (2024) and KPMG (2024)

- As we can see in the graph, values for the two considered indices increased between February and March. For the GSCPI, it means tensions within supply chains are growing bigger and that its components, such as shortages, logistical costs and transportation disruptions, are facing more difficulties. On the other hand, higher values for the SCSI do not imply better conditions, but the opposite. This index measures market volatility and stress within economic systems. The increase from 2.14 to 2.42 points reflects that, when military attacks began to take place in Ukraine, supply chains were faced with uncertainty and became harder to deal with from the managerial point of view.
- The GSCPI began to decrease progressively as supply chains adapted to the new war reality. The search for alternative routes and providers of goods that third countries could no longer obtain from Russia or Ukraine relieved a little pressure upon networks. Further rises in the index could be explained by the Ukrainian attacks on Russian vessels at the Black Sea, a strategic hot spot for trade, during fall 2022 (Tanno, 2024).
- The steady tendency that the SCSI maintains seems to oppose what has just been explained. However, this index's methodology does not only consider geopolitical issues and causes of stress, but also others such as cyberattacks, health concerns,

safety problems or ESG matters. In June 2022 the UFLPA¹³ became effective (U.S. Customs and Border Protection, 2024), restricting the list of products that could be imported to the U.S. and introducing a new source of volatility within supply chains, as table 4.2. shows, where from June on and until December, an ESG type of event is considered to contribute to supply chain instability. This is the reason behind this index not diminishing as the previous one.

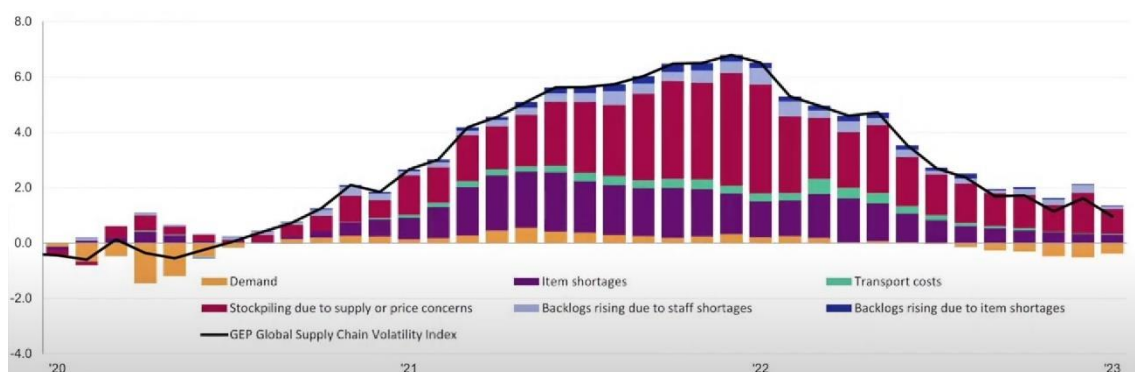
Table 4.2.: SCSI Index by type of event, 2022

Date	Sum of Event	Stability Index	Type of Event
January	1	2,36	Disease
February	1	2,14	Cyber
March	1	2,42	Geopolitical
April	1	2,65	Geopolitical
May	1	2,52	Geopolitical
June	0,5	2,55	ESG
June	0,5	2,55	Geopolitical
July	0,5	2,62	ESG
July	0,5	2,62	Geopolitical
August	0,5	2,26	ESG
August	0,5	2,26	Geopolitical
September	0,5	2,42	ESG
September	0,5	2,42	Geopolitical
October	1	1,99	ESG
November	0,5	1,90	ESG
November	0,5	1,90	Geopolitical
December	0,5	2,02	Disease
December	0,5	2,02	Geopolitical

Source: KPMG (2024)

As it has been said, KMPG analysts attribute supply chain disruptions to one or various types of events monthly. For 2022, the geopolitical component of the Russo-Ukrainian War has been considered ever since the effects of the conflict became noticeable in March.

Graph 4.8.: GSCVI, January 2020 - 2023

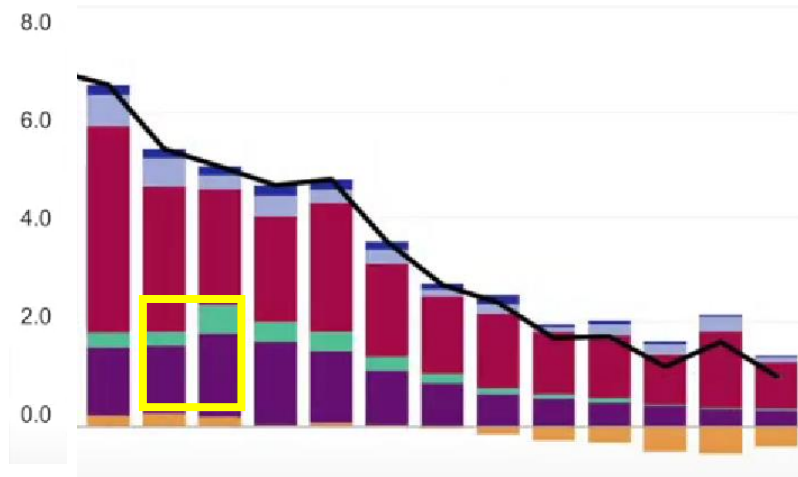


Source: GEP (2023)

¹³ UFLPA: Acronym for the Uyghur Forced Labor Prevention Act, legal text that enforced the prohibition to import to the States products that came from China, with forced labor of any kind in its manufacturing process (U.S. Customs and Border Protection, 2024).

I have separated the third index to simplify its interpretation. A closer view of the previous graph is now provided for us to focus only on the sub-indices that are most relevant to our analysis.

Graph 4.9.: Monthly GSCVI starting January 2022



Source: GEP (2024)

Positive values of the index explain that, globally, supply chains' capacity was being stretched, yet the decreasing tendency reflects companies' willingness to let go of undesired stocks as well as a strong reduction in commodities' demand. However, the parts that are truly useful for our analysis are the green and purple sections, corresponding to transport costs and item shortages respectively. From February to March, despite the index becoming smaller, these two factors faced an increase, showing once again the effect that the burst of war in Ukraine had on global supply chains.

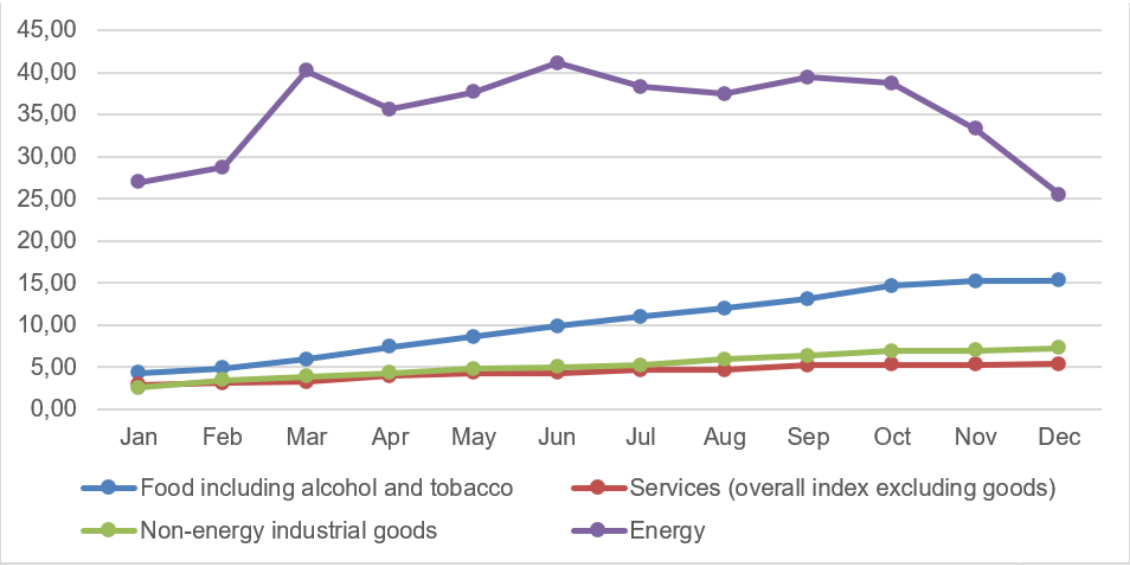
Table 4.3.: Inflation rates in the U.S., 2022, in %

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7.5	7.9	8.5	8.3	8.6	9.1	8.5	8.3	8.2	7.7	7.1	6.5

Source: Statista (2024)

Inflation in the United States increased between February and March when the first attack took place. This fact matches our previous analysis, with indexes pointing at a sharp supply chain disruption at that exact moment. Nevertheless, and after experiencing a small drop in April, inflation continued to rise until June; this leads us to think that, according to the *menu costs* theory we spoke of when explaining costs of inflation, enterprises are not able to translate inflation derived from their production processes to final products immediately. It would have probably taken some time for businesses to adapt to changes in raw materials and components prices, analyze their ratios and figure out what prices to put in final products. It is, consequently, reasonable to think that the higher inflation in May and June could have been caused by supply chains' disruption between February and March, derived from the beginning of the war.

Graph 4.10: Sectoral inflation in the Eurozone, 2022, in %

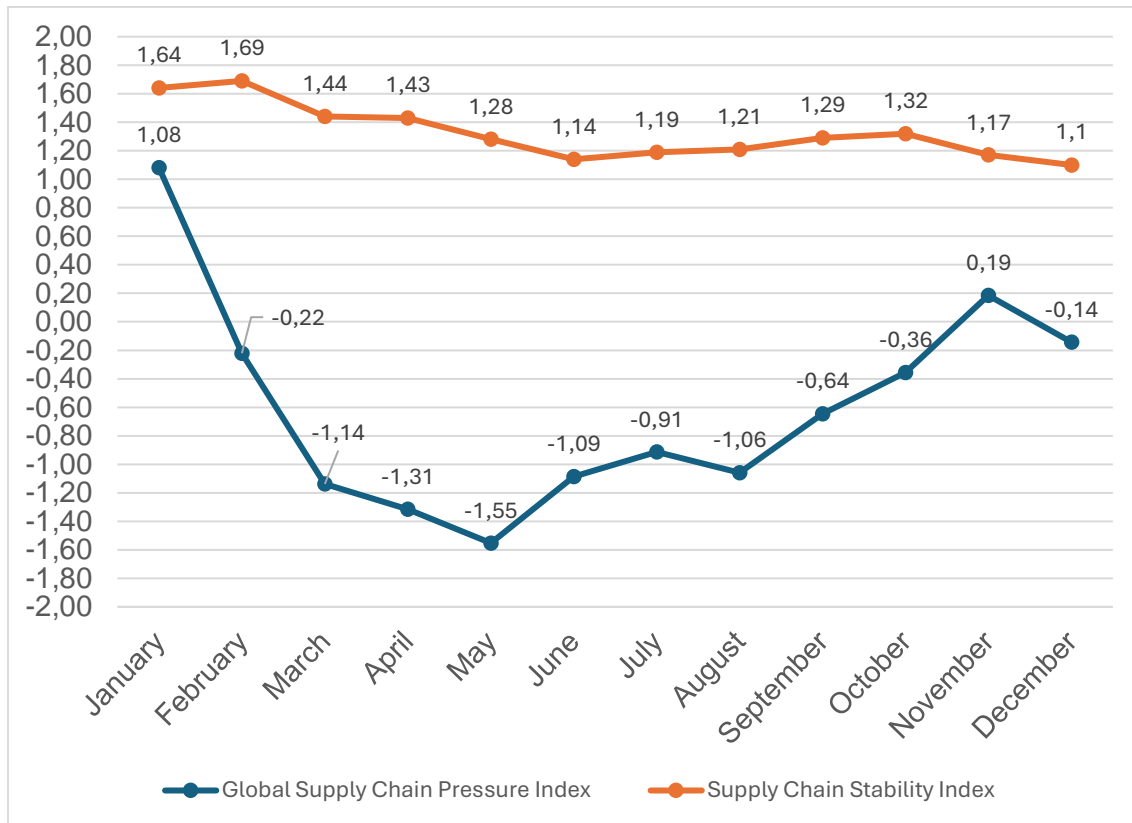


Source: Statista (2024) based on Eurostat (2024)

Energy prices in the Eurozone peaked after war burst and did not begin to decline until the end of the year, when public measures such as contributions, tax reductions or price caps were implemented to relieve households' expenses on energy bills (Cantero Guerrero and Aumayr-Pintar, 2022). The steady yet progressive positive slope of the food, alcohol and tobacco inflation is also remarkable, reflective of producers' cost increase in commodities such as crops or fertilizers.

4.2.2. 2023

Graph 4.11.: GSCPI and SCSI values, 2023



Source: author's own work based on Federal Reserve Bank of New York (2024) and KPMG (2024)

2023 began with sharp fallings of the GSCPI, which meant there were no further consequences of the Russo-Ukrainian conflict upon supply chains. During winter months situation remained quite stable; Ukrainians had no chance of carrying out counteroffensives as Russia destroyed their energetic network, leaving the country with no access to electricity and other basic supplies (Tanno, 2024). Attacks over the Kremlin were not resumed until May; it is precisely here when the index rebounded for the first time in the year. The upwards tendency is maintained during the rest of the considered period, with a greater spike between October and November. Considering that Hamas' surprise attack over Israel took place on October 7, 2023, it all leads us to believe that this could have affected pressure upon supply chains.

The SCSI peaked In February 2023 due to the Dole Ransomware cyberattack; and despite the downwards tendency of the index, Figure 4.1. shows that the Russia-Ukraine conflict was always a reason for market volatility and supply chains instability. The small upturn, from 1.29 to 1.32 between September and October is attributed by KPMG to Israel – Hamas war burst, which is also considered key for the rest of the year.

Table 4.4.: SCSI by type of event, 2023

Date	Sum of Event	Stability Index	Type of Event
January	0,5	1,64	ESG
January	0,5	1,64	Geopolitical
February	1	1,69	Cyber
March	1	1,44	Geopolitical
April	0,5	1,43	Cyber
April	0,5	1,43	Geopolitical
May	1	1,28	Geopolitical
June	1	1,14	Geopolitical
July	1	1,19	Geopolitical
August	1	1,21	Cyber
September	1	1,29	ESG
October	0,5	1,32	ESG
October	0,5	1,32	Geopolitical
November	1	1,17	Geopolitical
December	1	1,10	Geopolitical

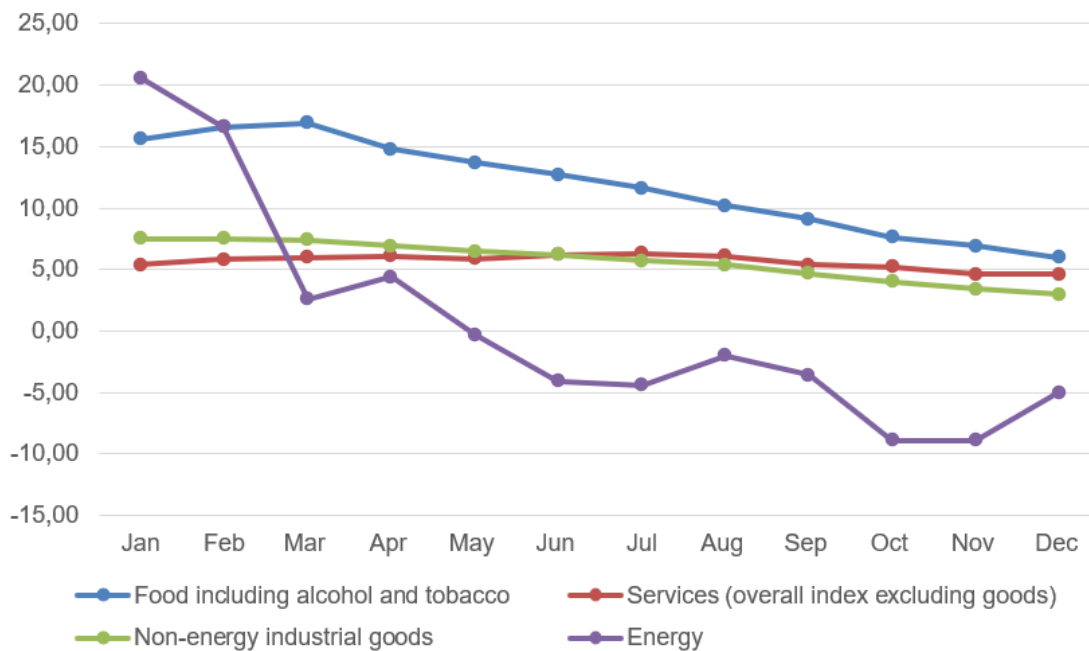
Source: KPMG (2024)

Table 4.5.: Inflation rates in the U.S., 2023, in %

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.4	6	5	4.9	4	3	3.2	3.7	3.7	3.2	3.1	3.4

Source: Statista (2024)

Inflation rates followed in 2023 the same path they did in 2022, showing a tendency that is quite like GSCPI's. In this case, inflation does not rebound by the time Ukraine resumed its attacks, but a little later, between July and August. Once again, economies take a little longer to adjust prices, but they eventually do, which enables us to deduce, once again, that armed conflicts cause inflation by disrupting supply chains. In contrast, conflict taking place in the Middle East does not seem affect inflation in the U.S., probably because of the little dependence this nation has of Israel or Palestine in terms of oil and gas, as major producers themselves.

Graph 4.12.: Sectoral inflation in the Eurozone, 2023, in %

Power prices in the Eurozone, as a consequence of the exhaustive search of alternatives to overcome energy dependence on Russia and Ukraine, reached negative numbers in 2023 (Gkousarov, 2023). This is the reason behind the steep falls in inflation levels, which remained negative throughout most of the year. However, and despite still being below 0, by the few last months' inflation numbers seemed to increase a little, which may look indicative of the effect that the Israel-Palestine war could have had upon the European Union due to its dependence on the Middle East region for supplies as liquified natural gas (Marino, 2024). Remaining sectors did not seem to be affected, with food industries facing progressive but continuous decreases of inflation, with the same situation taking place for non-energy industrial goods, and services maintaining inflationary stability throughout the year.

The general outcome of indexes and inflation data evaluation is that relevant moments of geopolitical tensions within the last two years, match those of higher disruption of the supply chains and inflation in the United States and the Eurozone, with the energetic industry being the most affected in the last case, and the Russo-Ukrainian conflict having a more profound effect upon inflation than the Israel – Palestine. This can also be due to the previous experience governments gained when the first global dispute burst, leading to a better management of potential inflationary threats the second one could imply for European economies. A deeper, more detailed sub-sectoral analysis of inflation levels in the Eurozone can be found in Appendix II, which also shows impact of war in Ukraine over the sector transport in early 2022 because of fuels' prices increases, and in late 2023 because of the same situation taking place in the Middle East regions.

5. CASE STUDY: SUPPLY CHAIN DISRUPTION IN APPLE

To illustrate our analysis, putting into a specific example of an actual business the difficulties that supply chains' disruption cause, motivated by international confrontations, may prove useful. We will be looking at the particular case of Apple, the largest tech multinational by revenue, which has recently experienced shortages of certain components caused by both wars, in Ukraine and Israel. On top of that, Apple, as an American company, will serve us to analyze the impact of supply chains' disruption over consumer prices within the zone of which we have evaluated inflation levels.

Semiconductors are essential components of all kinds of technological devices, being this the sector in which Apple is one of the undisputable global leaders. However, as soon as the conflict between Russia and Ukraine broke out, semiconductors industry was at high risk. According to Clark and Jones (2022), Russia is a worldwide palladium provider, basic for producing semiconductors. The state accounts for about 40% of global palladium supply, Ukraine also contributes extraordinarily to semiconductors manufacturing industry, with between 70 and 80% of world's neon provisions. Considering that 40% of neon demand is intended for semiconductors' production, it is quite intuitive to realize that blockages to trade from Ukraine derived from the war, would affect substantially semiconductors industry.

As raw materials become scarcer over time, their prices consequently rise. Right after 2014 Russian annexation of Crimea, long before the current conflict burst, neon prices rose by 600 percent (Clark and Jones, 2022). This leads us to believe that it could happen again, with the impact that said increase in costs would have in such an interconnected supply chain as the semiconductors is.

With regard to the other dispute we spoke of, the Israel-Palestine conflict, it is likely to impact semiconductors industries as well as top producers are located in Israel, such as Intel or Nvidia, best known for being the most important manufacturer of chips for artificial intelligence (GoodElectronics, 2023). But for Apple, the main challenge they are faced with now is design and production of their own chips, some of it carried out in Israel. The company will not be able to avoid the lack of semiconductors within the territory, caused by materials' shortages as well as scarcity of qualified workforce to produce said items. Naturally, prices in semiconductors in Israel have also seen an increase in the last years. After dropping from 1,000-million-dollar revenue in 2022 to only 970 million dollars in 2023, inflation within the sector will translate into nearly 1,034-million-dollar income in 2024, the year after the war began (Statista, 2024), according to predictions on current prices.

Apple communicated in 2022 that their second-quarter stock had fallen in 7.8%, and that supply chains constraints would cost them from 4 to 8 billion dollars in revenue, as they were not going to be able to produce at pre-war levels (Gurman, 2022). Despite still maintaining high profits, it is likely that Apple will not settle for this, and prices of devices will increase. From previous experiences, customers noticed that in 2020, Apple increased the starting price of their best-selling model of iPhone at the time, from 699 to 799 dollars, as affirmed by Leswing (2022). The last time there had been chip shortages, the company announced they would translate the increased cost to the prices of final products (Charlton, 2021). Consequently, the Japanese market realized that back in 2022, iPhone prices were also risen in about a fifth. If that happened only a couple of years ago, before any of these two tensions turned into what they are today, prices for Apple devices are expected to increase further, sooner or later.

Apple's case highlights, once again, the importance of supply chains within our lives, since if it was not for these processes nobody would be able to own any of the goods we have and that reach us through such complex and volatile, yet necessary, systems. Having said this, it is important to become aware that supply chains demand responsible and efficient management, in order to minimize the effects over customer prices and inflation of disruption, such as the one in semiconductors' industry Apple is currently dealing with.

6. CONCLUSIONS

At the beginning of the paper, we emphasized the uncertainty that current global situation is faced with and how likeable the economic framework is to change within really short periods of time. Worldwide instability accounts for many of today's challenges that affect not only those who carry out economic activities, but the whole society. Being able to predict and anticipate events is strategic and useful for businesses, although it is not always possible.

Geopolitical disputes of such a magnitude as the ones we have extensively analyzed are proof that, despite tensions between states being more than evident, economic systems are never ready to fully integrate the effects of war outbreaks. Components' shortages, bottlenecks, delays and cost increases in transportation and supplies are some of the events that can disrupt supply chains, among other unpredictable occurrences.

Considering inflation as a phenomenon that is inherent to all economies and that we all must have to deal with at certain points, it is remarkable that said disruptions of the supply chains have a direct impact over worldwide availability of goods and may be the source of scarcity, causing consumers to be willing to pay more for products than they would in other circumstances. Companies' desire to obtain profits from their economic activity can also motivate prices rising, as costs increase that disrupted supply chains imply are usually translated into final consumers through inflation.

Through communications and news review, it has become clear that enterprises have seen their supply chains disrupt as a direct consequence of both Russia – Ukraine war and Israel – Palestine armed conflict. Indices that reflect pressure and volatility upon supply chains reflect the same, with increasing values at the times in which tensions have burst more heavily. As said indexes are elaborated recurring to data mainly from the United States, checking inflation for this country seemed the most appropriate thing to do. Results have shown that the most stressful times, in terms of supply chains disruption, and peaks of strain in the geopolitical context, are consistent of those of higher inflation levels. At a European level, it has been shown that the Russo – Ukrainian war has also impacted inflation, especially for the energetic sector, leading to the implementation of measures to help families overcome economic difficulties derived from this situation and the need for alternative sources of energy. Finally, the case of Apple has shown that explained phenomena is not something that remains theoretical, but that becomes real for companies as they struggle to deal with shortages and difficulties of all sorts, while managing supply chains in the best possible way.

Worldwide economies are being forced to learn from this turbulent kind of situation and, although times may seem hard, overcoming of other periods of recession such as the 2008 financial crisis or the downturn faced right after pandemic hit back in 2020, have

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made societies and global leaders more resilient and trained to address unfavorable economic conditions.

7. BIBLIOGRAPHY

Agarwal, R.; Kimball, M. 2022. The Future of Inflation part II. How costly is Inflation? Analytical Series. In: *Finance & Development Magazine*, April 7. International Monetary Fund. [Accessed: 12 June 2024]. <https://www.imf.org/en/Publications/fandd/issues/2022/03/Future-of-inflation-partII-Agarwal-kimball>

Alfonseca, K. 2023. Timeline: A look into the long history of the Israeli-Palestinian conflict. In: *ABC News*, November 10. [Accessed: 7 May 2024]. <https://abcnews.go.com/International/timeline-long-history-israeli-palestinian-conflict/story?id=103875134>

Anderson, L. 2023. Israel-Hamas War & Impacts on the Supply Chain. In: *LMA Consulting Group. Lisa Anderson's Supply Chain Briefing*, October 23. [Accessed: 17 May 2024]. <https://www.lma-consultinggroup.com/israel-hamas-war-impacts-on-the-supply-chain/#:~:text=Regional%20Impacts&text=If%20the%20war%20in%20Israel,to%20oil%20and%20gas%20shipping>.

Apel, M.; Ohlsson, H. 2022. Monetary policy and inflation in times of war. *Sveriges Riksbank Economic Review* 2022, 2. [Accessed: 6 June 2024]. https://www.riksbank.se/globalassets/media/rapporter/pov/artiklar/engelska/2022/221216/2022_2-monetary-policy-and-inflation-in-times-of-war.pdf

BBC. 2024. Israel Gaza war: History of the conflict explained. April 5 [Accessed: 19 June 2024]. <https://www.bbc.com/news/newsbeat-44124396>

Benigno, G.; di Giovanni, J.; Groen, J.J.J.; Noble, A. I. 2022. A New Barometer of Global Supply Chain Pressures. *Federal Reserve Bank of New York Staff Reports*, no. 1017. [Accessed: 1 July 2024]. https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr1017.pdf

Berman, N.; McBride, J.; Siripurapu, A. 2023. What does the G20 do? In: *Council on Foreign Relations*, October 11. [Accessed: 25 June 2024]. <https://www.cfr.org/backgrounder/what-does-g20-do>

Bown, C.P. 2021. Anatomy of a flop: Why Trump's US-China phase one trade deal fell short. In: *Peterson Institute for International Economics*, February 8. [Accessed: 15 May 2024]. <https://www.piie.com/blogs/trade-and-investment-policy-watch/anatomy-flop-why-trumps-us-china-phase-one-trade-deal-fell#:~:text=Much%20of%20the%20deal%20was,pandemic%20only%20partly%20to%20blame>

Brenner, V. 2014. Causes of Supply Chains Disruptions. An Empirical Analysis in Cold Chains for Food and Pharmaceuticals. Dissertation Jacobs University Bremen. Springer Gabler. ISBN 978-3-658-08661-9 <https://books.google.es/books?hl=es&lr=&id=VeBsBgAAQBAJ&oi=fnd&pg=PP5&dq=papers+on+supply+chain+disruptions+reasons&ots=vR3ebswmi8&sig=JjpWYL8ALd0ue1ucQwM7qdhm8CA#v=onepage&q&f=false>

Cantero Guerrero, M.; Aumayr-Pintar, C. 2023. Measures to lessen the impact of the inflation and energy crisis on citizens. In: *Eurofound. Resources. Industrial relations and social dialogue*, 30 January. [Accessed: 28 June 2024].

<https://www.eurofound.europa.eu/en/resources/article/2023/measures-lesser-impact-inflation-and-energy-crisis-citizens#:~:text=Reducing%20household%20energy%20bills,reductions%20or%20setting%20price%20caps>.

Charlton, H. 2021. Apple Products Could See 'Noticeable' Price Rises Amid Increased Chip Costs. In: *MacRumors*, September 6. [Accessed: 20 June 2024]. <https://www.macrumors.com/2021/09/06/noticeable-price-rises-expected/>

Christopher, M. 2023. Logistics and Supply Chain Management. 6th ed. Pearson Education. ISBN 978-1292416182.

Clark, L.; Jones, S. 2022. Russia-Ukraine war: impact on the semiconductor industry. KPMG. [Accessed: 18 June 2024]. <https://assets.kpmg.com/content/dam/kpmg/ua/pdf/2022/05/impact-on-semiconductor-industry.pdf>

Council of Supply Chain Management Professionals. 2013. Supply Chain Management Terms and Glossary. [Accessed: 1 May 2024]. https://cscmp.org/CSCMP/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx

Council on Foreign Relations. 2023. What is Interstate Conflict? In: *CFR Education: Conflict and Warfare*, May 16. [Accessed: 6 June 2024]. <https://education.cfr.org/learn/reading/what-interstate-conflict>

Craighead, C.W.; Blackhurst, J.; Rungtusanatham, M.J.; Handfield, R.B. 2007. The Severity of Supply Chain Disruptions: Design Characteristics and Mitigation Capabilities. *Decision Sciences*, **38** (1), pp.131-156. <https://doi.org/10.1111/j.1540-5915.2007.00151.x>

Emediegwu, L. 2024. Update: how is the war in Ukraine affecting global food prices? In: *Economics Observatory*, February 23. [Accessed: 12 June 2024]. <https://www.economicsobservatory.com/update-how-is-the-war-ukraine-affecting-global-food-prices>

European Commission. 2024. EU sanctions against Russia following the invasion of Ukraine. In: *EU Solidarity with Ukraine. European Commission*. [Accessed: 10 June 2024]. https://eu-solidarity-ukraine.ec.europa.eu/eu-sanctions-against-russia-following-invasion-ukraine_en

Excelsior. 2024. How Does the Israel War Affect Global Logistics and Freight Forwarding? [Accessed: 18 June 2024]. <https://excelsior.ph/how-does-the-israel-war-affect-global-logistics-and-freight-forwarding/#:~:text=The%20war%20in%20Israel%20has,to%20adapt%20to%20changing%20circumstances>.

Fajgelbaum, P.; Khandelwal, A. 2021. The economic impacts of the US-China Trade War. *NBER Working Paper Series*, Working Paper 29315. [Accessed: 12 May 2024]. <http://www.nber.org/papers/w29315>

Federal Reserve Bank of New York. 2024. Global Supply Chain Pressure Index. [Accessed: 30 April 2024]. <https://www.newyorkfed.org/research/policy/gscpi#/interactive>

Flaen, A.; Hortaçsu, A.; Tintelnot, F. 2020. The Production Relocation and Price Effects of US Trade Policy: The Case of Washing Machines. *American Economic Review*, **110** (7), pp. 2103 – 27, July. ISSN 0002-8282. <https://doi.org/10.1257/aer.20190611>

Floyd, D. 2024. 10 Common Effects of Inflation. In: *Investopedia. Economics*, June 17. [Accessed: 1 June 2024]. <https://www.investopedia.com/articles/insights/122016/9-common-effects-inflation.asp>

Frankel, J. 2024. Half a year into the war in Gaza, here's a look at the conflict by the numbers. In: *AP News*, April 6. [Accessed: 24 June 2024]. <https://apnews.com/article/israel-hamas-gaza-war-statistics-95a6407fac94e9d589be234708cd5005>

Freightify. 2022. Impact of Russia-Ukraine war on global logistics and supply chain. [Accessed: 6 May 2024]. <https://www.freightify.com/blog/russia-ukraine-war-global-supply-chain-problems>

Frick, W. 2022. What Causes Inflation? In: *Harvard Business Review*, December 23. [Accessed: 19 June 2024]. <https://hbr.org/2022/12/what-causes-inflation>

Friedman, M. 1977. Inflation and Unemployment. *Journal of Political Economy*, 85, pp. 451-472. [Accessed: 30 May 2024]. <http://pombo.free.fr/friedman1977.pdf>

Friedman, M.; Jacobson Schwartz, A. 1980. *World War II Inflation, September 1939 - August 1948. From New Deal Banking Reform to World War II Inflation*. Princeton University Press, pp. 129 – 176. ISBN 0-691-00363-7. <http://www.nber.org/chapters/c11389>

Gadzo, M.; Siddiqui, U. 2024. Israel war on Gaza updates: 32 killed as Israel hits displaced Palestinians. In: *Aljazeera*, June 25. [Accessed: 25 June 2024]. <https://www.aljazeera.com/news/liveblog/2024/6/25/israel-war-on-gaza-live-leaked-un-report-warns-high-famine-risk-remains>

Galvin, H. 2003. The impact of defence spending on the economic growth of developing countries: A cross-section study. *Defence and Peace Economics*, **14** (1), pp. 51–59. <https://doi.org/10.1080/10242690302932>.

Ganegodage, K.R.; Rambaldi, A.N. 2012. Economic Consequences of War: Evidence from Sri Lanka. *Research Papers in Economics*. The University of Queensland School of Economics. [Accessed: 13 June 2024]. <https://core.ac.uk/reader/6719094>

Georgieva, K. 2024. *The Economic Possibilities For My Grandchildren*. IMF Managing Director's Keynote Speech at King's College, Cambridge, March 14, 2024. International Monetary Fund. [Accessed: 22 May 2024]. <https://www.imf.org/en/News/Articles/2024/03/08/sp031424-kings-college-cambridge-kristalina-georgieva>

GEP. 2022. Russia – Ukraine War: Global Impact on Logistics. GEP blog. [Accessed: 6 June 2024]. <https://www.gep.com/blog/mind/russia-ukraine-war-logistics-impact#:~:text=The%20Russia%2DUkraine%20war%20led,the%20availability%20of%20warehousing%20space>

GEP. 2023. *GEP Global Supply Chain Volatility Index: August 2023* [video]. 1 min. [Accessed: 2 July 2024]. <https://www.youtube.com/watch?v=uM21yWG-stk&list=PL1zVbWyMHSjXvACWC4ySAhsFKBUFOS-rv&index=8>

GEP. 2024. Who We Are. [Accessed: 1 July 2024]. <https://www.gep.com/company>

GEP. 2024. Global Supply Chain Volatility Index. [Accessed: 9 May 2024]. <https://www.gep.com/knowledge-bank/global-supply-chain-volatility-index>

Gkousarov, T. 2023. Weather tracker: power prices dip to negative in Europe amid clean energy boost. In: *The Guardian*, May 29. [Accessed: 29 June 2024]. <https://www.theguardian.com/environment/2023/may/29/weather-tracker-power-prices-dip-to-negative-in-europe-amid-clean-energy-boost>

GoodElectronics, 2023. Israel-Palestinian conflict to impact electronics supply chain. Research. News, October 13. [Accessed: 20 June 2024]. <https://goodelectronics.org/israel-palestinian-conflict-to-impact-electronics-supply-chain/>

Gopinaz, G. 2020. The Great Lockdown: Worst Economic Downturn Since the Great Depression. In: *IMF Blog*, April 14. [Accessed: 15 May 2024]. <https://www.imf.org/en/Blogs/Articles/2020/04/14/blog-weo-the-great-lockdown-worst-economic-downturn-since-the-great-depression#:~:text=This%20is%20a%20downgrade%20of,than%20the%20Global%20Financial%20Crisis.>

Gourinchas, P. O. 2024. Global Economy Remains Resilient Despite Uneven Growth, Challenges Ahead. In: *IMF Blog*, April 16. [Accessed: 20 June 2024]. <https://www.imf.org/en/Blogs/Articles/2024/04/16/global-economy-remains-resilient-despite-uneven-growth-challenges-ahead>

Gurman, M. 2022. Apple Expects Supply Shortages to Slash Sales by Up to \$8 Billion. In: *Time. Business*, April 29. [Accessed: 28 June 2024]. <https://time.com/6172193/apple-supply-shortages-slash-sales/>

Higgins, B.; Lee, J.; Kent, D.; Imfeld, M. 2022. *Seeking supply chain stability in an era of volatility*. KPMG. ASCM global assets. [Accessed: 29 June 2024]. https://www.ascm.org/globalassets/ascm_website_assets/docs/stability-index-report.pdf

Höflmayr, M. 2022. *Inflation explained: What lies behind and what is ahead?* European Parliament, August. [Accessed: 19 May 2024]. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/729352/EPRS_BRI\(2022\)_729352_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/729352/EPRS_BRI(2022)_729352_EN.pdf)

Ireland, P. N. 2009. On the Welfare Cost of Inflation and the Recent Behavior of Money Demand. *American Economic Review*, **99** (3), pp. 1040–52. <https://doi.org/10.1257/aer.99.3.1040>

Jaadi, K. 2024. A Step-by-Step Explanation of Principal Component Analysis (PCA). In: *Builtin.com. Data Science*. [Accessed: 1 July 2024]. <https://builtin.com/data-science/step-step-explanation-principal-component-analysis>

Kapustina, L.; Lipková, L.; Silin, Y.; Drevalov, A. 2020. US – China Trade War: Causes and Outcomes. *SHS Web of Conferences*, **73**. <https://doi.org/10.1051/shsconf/202073010>

Kopp, C. M. 2023. Creative Destruction: Out with the old, In with the new. In: *Investopedia*. [Accessed: 9 May 2024]. <https://www.investopedia.com/terms/c/creativedestruction.asp#:~:text=Schumpeter%20>

[characterized%20creative%20destruction%20as,incessantly%20creating%20a%20new%20one.%22](#)

KPMG. 2024. Supply Chain Stability Index. [Accessed: 2 May 2024]. <https://kpmg.com/us/en/articles/2023/supply-chain-stability-index.html>

Leporati, M.; Martul, L.; Morales, M. 2020. *Supply chains in the next pandemic: How to avoid disruptions on supply chains*. EAE Business School, July. ISBN: 978-84-17476-79-3

Leswing, K. 2022. How inflation will affect Apple. In: *CNBC*, July 1. [Accessed: 28 June 2024]. <https://www.cnbc.com/2022/07/01/wealthy-customers-will-help-apple-resist-the-effects-of-inflation.html>

Luwedde, J. 2024. Middle East turmoil and its impact on global supply chains. In: *EPRC* [blog]. [Accessed: 15 June 2024]. <https://eprcuq.org/blog/middle-east-turmoil-and-its-impact-on-global-supply-chains/>

Mankiw, N.G.; Romer, D. 1991. *New Keynesian Economics. Vol.1.: Imperfect competition and sticky prices*. Cambridge: MIT Press. ISBN 978-0262631334.

Marino, F. 2024. The Middle East crisis and its impact on the EU energy security. In: *Newsletter on the European Union. Energy*, April 22. [Accessed: 29 June 2024]. <https://www.newslettereuropean.eu/the-middle-east-crisis-and-its-impact-on-the-eu-energy-security/>

McKay, F. 2022. The Impact of the COVID-19 Supply Chain Disruption. In: *Jabil.com* [blog]. [Accessed: 14 May 2024]. <https://www.jabil.com/blog/covid-19-supply-chain-impact.html>

McKinsey & Company. 2022. What is Supply Chain? McKinsey Explainers, August. [Accessed: 25 May 2024]. [https://www.mckinsey.com/~media/mckinsey/featured%20insights/mckinsey%20explainers/what%20is%20supply%20chain/what is supply chain.pdf](https://www.mckinsey.com/~media/mckinsey/featured%20insights/mckinsey%20explainers/what%20is%20supply%20chain/what%20is%20supply%20chain.pdf)

Melin, T. 2023. War and conflict often lead to high inflation. In: *University of Gothenburg*, March 30. [Accessed: 5 June 2024]. <https://www.gu.se/en/news/war-and-conflict-often-lead-to-high-inflation#:~:text=In%20modern%20history%2C%20there%20are,Senior%20Lecturer%20in%20Economic%20History>

Miller, G. 2022. Shipping braces for impact as Russia – Ukraine crisis intensifies. In: *Freight Waves*, February 22. [Accessed: 20 June 2024]. <https://www.freightwaves.com/news/shipping-braces-for-impact-as-ukraine-crisis-intensifies>

Mishkin, F. S. 1984. The causes of inflation. *NBER Working Paper Series*, no.1453. National Bureau of Economic Research. [Accessed: 1 June 2024]. https://www.nber.org/system/files/working_papers/w1453/w1453.pdf

Natalucci, F.; Qureshi, M.S.; Sutheim, F. 2024. Rising Cyber Threats Pose Serious Concerns for Financial Stability. In: *IMF Blog*, April 9. [Accessed: 4 June 2024]. <https://www.imf.org/en/Blogs/Articles/2024/04/09/rising-cyber-threats-pose-serious-concerns-for-financial-stability>

National Bureau of Economic Research. 2023. Unpacking the Causes of Pandemic-Era Inflation in the US. The NBER Digest, September. [Accessed: 27 May 2024]. https://live-nber.pantheonsite.io/sites/default/files/2023-08/Sep23_0.pdf

Nieves, V. 2022. The war between Russia and Ukraine strains the supply chain and puts the operations of thousands of companies at risk. In: *El Economista. Economía*, March 9. [Accessed: 14 May 2024]. <https://www.eleconomista.es/economia/noticias/11654848/03/22/La-guerra-entre-Rusia-y-Ucrania-tensa-la-cadena-de-suministro-y-pone-en-riesgo-las-operaciones-de-miles-de-empresas.html>

Oner, C. 2019. Inflation: Prices on the Rise. *Finance & Development Magazine*, July 2019, pp. 30-31. International Monetary Fund. [Accessed: 31 May 2024]. <https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/Inflation>

Pawłuszko, T. 2023. The conflict between Russia and Ukraine: The causes of the war, security studies and the formation of an epistemic community in Poland. *Security theory and practice*, 3 (LII). ISSN 1899-6264. <https://doi.org/10.48269/2451-0718-btip-2023-3-001>

Robinson, K. 2024. What is Hamas? In: *Council of Foreign Relations*, April 18. [Accessed: 20 June 2024]. <https://www.cfr.org/backgrounder/what-hamas>

Rouse, C.; Zhang, J.; Tedeschi, E. 2021. Historical Parallels to Today's Inflationary Episode. In: *The White House. Council of Economic Advisors. Written Materials* [blog], July 6. [Accessed: 20 June 2024]. <https://www.whitehouse.gov/cea/written-materials/2021/07/06/historical-parallels-to-todays-inflationary-episode/#:~:text=%5B1%5D%20Prices%20also%20surged%20after,%2C%20and%20pent%2Dup%20demand>.

Santacreu, A.M.; LaBelle, J. 2022. Global Supply Chain Disruptions and Inflation During the COVID-19 Pandemic. *Federal Reserve Bank of St. Louis Review, Second Quarter 2022*, 104 (2), pp. 78 – 91. <https://doi.org/10.20955/r.104.78-91>

Schiller, R.J. 1997. Why Do People Dislike Inflation? In: C.D. Romer; D.H. Romer (eds.). *Reducing Inflation: Motivation and Strategy*. University of Chicago Press, pp. 13-70. ISBN 0-226-72484-0. <http://www.nber.org/chapters/c8881>

Sidharth, R. 2023. The Impact of the Israel-Hamas War on Global Logistics and Supply Chains. In: *Logistics Insider*, November 10. [Accessed: 15 June 2024]. <https://www.logisticsinsider.in/the-impact-of-the-israel-hamas-war-on-global-logistics-and-supply-chain/>

Statista. 2024. Harmonized index of consumer prices (HICP) inflation rate of the European Union from January 2002 to December 2023, by category. [Accessed: 29 June 2024]. <https://www.statista.com/statistics/328540/monthly-inflation-rate-eu/>

Statista. 2024. Monthly 12-month inflation rate in the United States from May 2020 to May 2024. [Accessed: 20 June 2024]. <https://www.statista.com/statistics/273418/unadjusted-monthly-inflation-rate-in-the-us/>

Statista. 2024. Semiconductors – Israel. Market Insights. Technology. [Accessed: 21 June 2024]. <https://www.statista.com/outlook/tmo/semiconductors/israel>

Stock, J.H.; Watson, M.W. 2002. Macroeconomic Forecasting Using Diffusion Indexes. *Journal of Business & Economic Statistics*, vol. 20, no. 2, April. [Accessed: 1 July 2024].

https://scholar.harvard.edu/files/stock/files/macroeconomic_forecasting_using_diffusion_indexes.pdf

Tanno, S. 2024. The war in Ukraine in 12 key moments. In: CNN World. Europe, February 24. [Accessed: 4 June 2024]. <https://edition.cnn.com/2024/02/24/europe/ukraine-war-second-anniversary-key-moments-intl/index.html>

University of Richmond. 2023. Map of the Week: Unraveling the Borders of Israel and Palestine Through Time. *Mappenstance* [blog]. [Accessed: 15 May 2024]. <https://blog.richmond.edu/livesofmaps/2023/12/18/map-of-the-week-unraveling-the-borders-of-israel-and-palestine-through-time/>

Ungar, M.; Zilberfarb, B.Z. 1993. Inflation and Its Unpredictability. Theory and Empirical Evidence. *Journal of Money, Credit and Banking*, **25** (4), pp. 709-720. <https://doi.org/10.2307/2077800>

U.S. Bureau of Labor Statistics. 2024. Producer Price Index (PPI). [Accessed: 31 May 2024]. [https://www.bls.gov/ppi/overview.htm#:~:text=The%20Producer%20Price%20Index%20\(PPI,producers%20of%20goods%20and%20services](https://www.bls.gov/ppi/overview.htm#:~:text=The%20Producer%20Price%20Index%20(PPI,producers%20of%20goods%20and%20services)

U.S. Customs and Border Protection. 2024. Uyghur Forced Labor Prevention Act. [Accessed: 20 June 2024]. <https://www.cbp.gov/trade/forced-labor/UFLPA>

Vedres, B.; Stark, D. 2010. Structural Folds: Generative Disruption in Overlapping Groups. *American Journal of Sociology*, **115** (4), pp. 1150-1190. <https://doi.org/10.1086/649497>

Walker, N. 2023. Conflict in Ukraine: A timeline (2014 – eve of 2022 invasion). *House of Commons Library*, number CBP 9476, August 22. [Accessed: 18 June 2024]. <https://researchbriefings.files.parliament.uk/documents/CBP-9476/CBP-9476.pdf>

Walker, N. 2024. Conflict in Ukraine: A timeline (current conflict, 2022-present). *House of Commons Library*, number CBP 9847, March 18. [Accessed: 18 June 2024]. <https://researchbriefings.files.parliament.uk/documents/CBP-9847/CBP-9847.pdf>

Zignify. 2022. What is supply chain disruption and what are its causes. [Accessed: 10 May 2024]. <https://zignify.net/what-is-supply-chain-disruption-and-what-are-its-causes/>

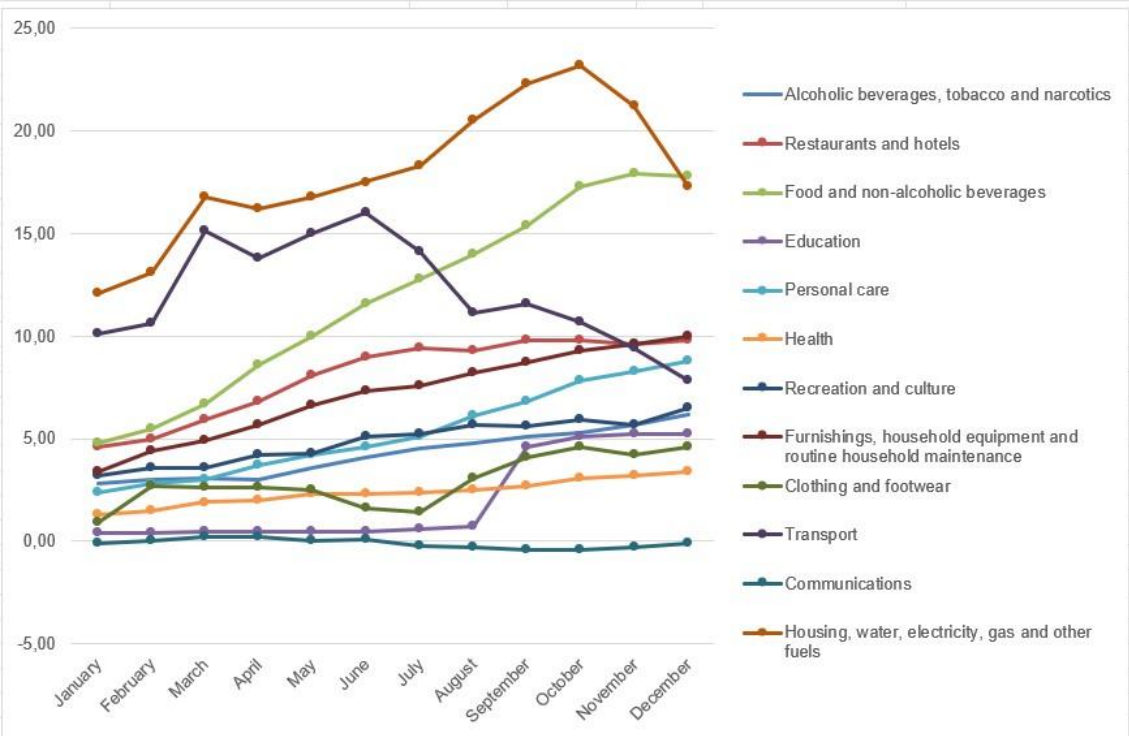
APPENDIX I: GSCPI METHODOLOGY

As explained in subsection 4.1.1., the first step that was carried out to successfully develop the Global Supply Chain Pressure Index was the removal of demand-side effects from the variables that were going to be used in the calculus of the headline number. That was done differently for two sets of the included variables:

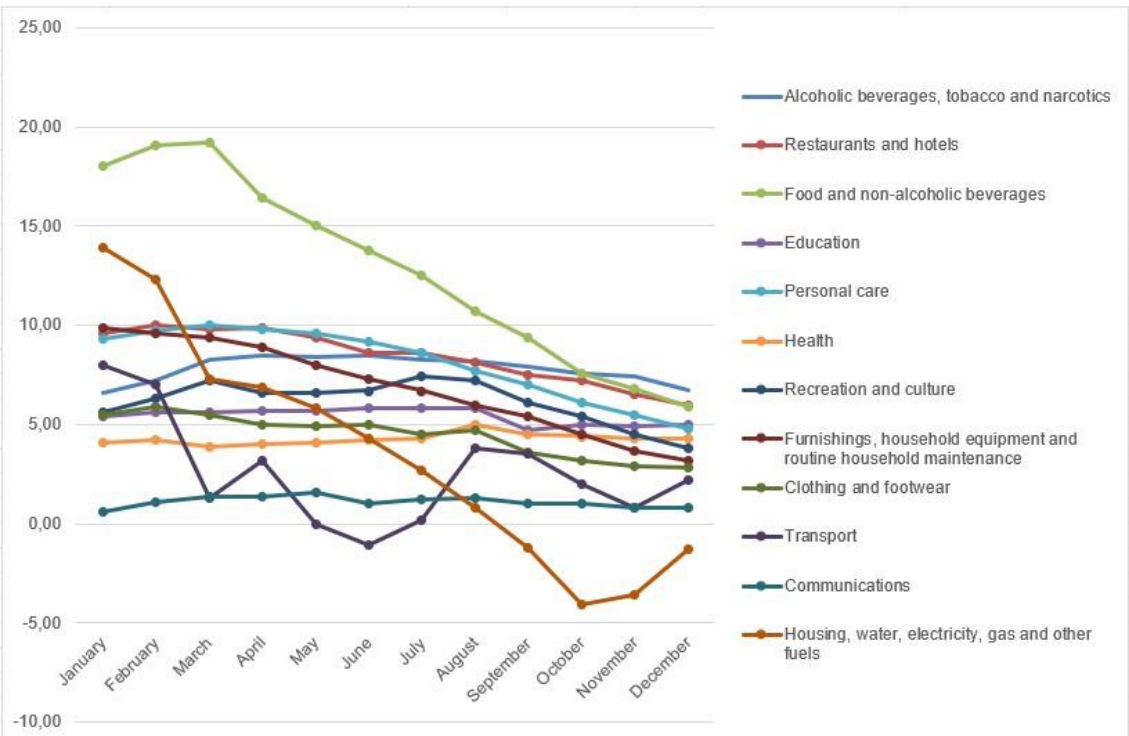
- For the 21 set of country-specific measures, obtained from the evaluation of the “delivery time”, “backlogs” and “purchases stock” for the seven mentioned economies. As information was extracted by the NY Fed from the Purchasing Managers Index (PMI) surveys, another variable from this source is used to cleanse from demand-side factors: the “new orders” PMI variable, which explains clients’ demand for products.
All of the previous variables considered were then regressed on the contemporaneous value and two lags of the “new orders” variable. The residuals of regressions performed were the values of the variable that eventually, the NY Fed utilized to carry out the principal components analysis and figure out the value of the GSCPI.
- For the remaining variables (those were, the two shipping rates and four airfreight price rates), “new orders” variable was resorted to again, as well as a PMI “quantities purchased” measure, which served as proxy for manufacturers’ input demand (closely related to the transport costs they were faced with). GDP-weighted averages for the considered seven regions were then calculated, and regressions on them and their lags, performed, for the six transport variables. Again, residuals were the eventual inputs used in the principal components analysis from which the index was extracted. (Federal Reserve Bank of New York, 2024).

APPENDIX II: SECTORAL INFLATION IN THE EUROZONE

Annex graph 1: Inflation rates in % in the Eurozone, 2022



Annex graph 2: Inflation rates in % in the Eurozone, 2023



Source: Statista (2024) based on Eurostat (2024)