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GLOBAL SUPPLY CHAINS: LESSONS FROM A DECADE OF DISRUPTION

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This paper explores both the character and impact of three recent shocks to global supply chains: the COVID-19 pandemic, the Russian invasion of Ukraine and the US-China trade war. These were large shocks which have had significant impacts on domestic and international supply chains, but these impacts have differed in their longevity, economic impact and policy responses. We show that supply chains were remarkably resilient against shocks of such magnitude. However, this resilience was also achieved thanks to the equally remarkable size and scope of policy responses and global supply chain reorganisation. We recommend that pre-emptive policies may be justified to shield households and industry from future shocks. Given the entangled nature of these shocks and that their effects continue to reverberate, we emphasise the need for extensive future research to understand the nature of these shocks and the effectiveness of policy responses.

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1 Introduction

After decades of rapid expansion of global supply chains, the last decade has seen a series of major shocks that disrupted their functioning. The China-US trade war, COVID-19 and the Russian invasion of Ukraine have all disrupted flows of goods across borders, leading business leaders and policymakers to question the wisdom of relying on the global network of supply chains. As a result, various policies have been enacted with the explicit goal of reshaping value chains, diversifying or outright reshoring supply chains. However, fundamental questions about the nature of these shocks remain.

This paper revisits the effects of three shocks on the functioning of global supply chains. We first look at the disruption of the COVID-19 pandemic, then investigate the impact of the Russian invasion of Ukraine, before discussing the US-China trade dispute and the ensuing 'technological cold war'. The aim is to identify lessons about how policies can adapt to prevent disruption and to mitigate the effect of future shocks. We are interested both in the magnitude of shocks as well as their lasting effects. In the cases of the pandemic and the Russian invasion of Ukraine, the magnitude of the shock was very high, but dissipated relatively quickly. On the other hand, the US-China trade war has been a protracted shift in global trade, with enormous ramifications for supply chains and citizens. While the length of a shock determines whether the economic damage is enduring, even a short shock can create significant political-economy problems. This means, that even if long-term growth trends are not disrupted for extended periods, the upheaval caused by sudden large shock might still warrant the costs of mitigation measures.

Meanwhile, the mechanisms through which markets reacted were quite different across sectors. Both the pandemic and the war increased scarcity in many markets. While this was often described as 'shortages', it was not always a shortage in the narrow economic definition. Economists only describe something as a shortage if the price mechanism breaks down and a good becomes unavailable, even for those willing to pay a high price. High prices reflecting scarcity lead to economically efficient allocation of resources and set incentives for new producers to enter markets. But this mechanism can also have politically and economically undesirable effects. For instance, a government might want to protect consumers from price spikes in heating costs that could price out vulnerable consumers. Meanwhile, businesses that face high price volatility could struggle to fulfil contracts with fixed prices and risk reputational damage if they transmit price spikes to consumers.

This paper is part of the ReThinkGSC project, which studies how supply chains are adapting to a new era of more contentious global politics, climate change and the growing importance of services for trade.

2 COVID-19

The COVID-19 pandemic was a major shock to the world economy. In response to the outbreak of the pandemic, countries closed their borders, and governments forced factories and personal-services providers to cease operation, and imposed lockdowns on their populations. Amid large uncertainty,

companies adapted their supply strategies and consumers shifted consumption patterns. Meanwhile, governments in advanced economies enacted major economic stimulus programmes to support their economies and mitigate the economic impact of the pandemic. This cocktail of economic shifts had major global implications and created unexpected circumstances for companies engaged in global value chains.

Once the pandemic eased, there was a major discussion on whether supply chains have become too fragile. We argue that supply chains proved remarkably resilient in the face of a shock of such magnitude. While the overlapping of the pandemic and the Russian invasion of Ukraine make a final assessment difficult, the supply-chain related effects of the pandemic seem to have dissipated within only a few years. While the magnitude of the shock was large, it was relatively short-lived.

2.1 Timeline of economic effects

In January and February 2020, countries closed their borders to foreign travellers in response to the outbreak of the pandemic in China and the global spread that followed. As domestic cases grew exponentially regardless, countries imposed domestic lockdowns. By the end of March 2020 over 100 countries had resorted to lockdown measures[1], significantly impacting the ability of the local economy to function. Even where movement was not entirely curtailed, households restricted their movements and businesses resorted to working from home[2].

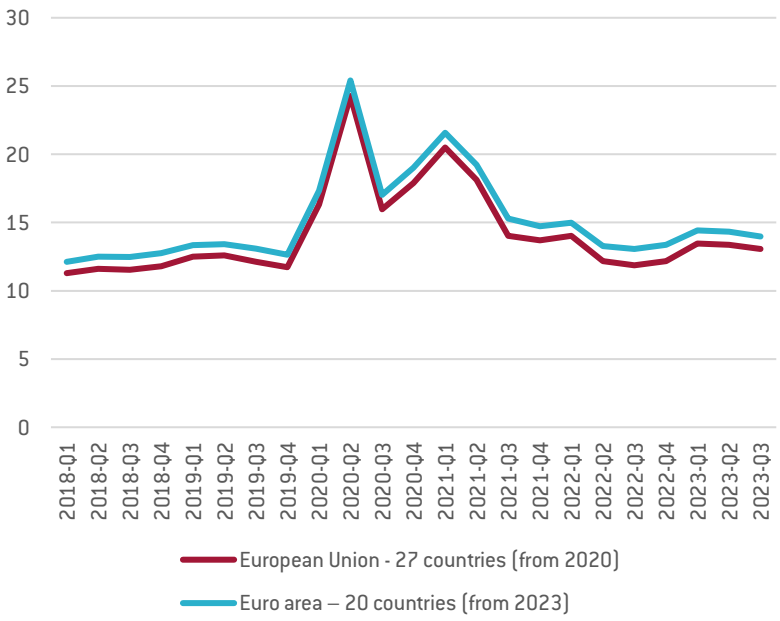
The ensuing supply-chain disruptions and negative demand shock manifested differently across sectors. In the EU, sectors requiring physical proximity, such as the creative and hospitality industries, were impacted severely, whereas the pharmaceutical and digital sectors saw relatively small contractions (De Vet *et al*, 2021). But overall, the first wave saw significant increases in unemployment and reductions in output from important industries[3].

Governments in advanced economies enacted huge stimulus programmes to support households and industry. These came in different varieties. In the EU, many governments focused on sustaining existing work relationships by implementing job-retention schemes (Arnold and Kammer, 2021). EU countries also disbursed state aid to companies of various kinds to help them survive the economic downturn. The US, on top of other measures, disbursed $293 billion in cash handouts to taxpayers as part of the $2.3 trillion CARES Act[4]. In the EU, additional spending by member states in 2020 was estimated at 3.3 percent of GDP[5].

[1] See BBC, 'Coronavirus: The world in lockdown in maps and charts', BBC News, 6 April 2020, available at https://www.bbc.com/news/world-52103747.
[2] This was documented for a large number of countries by the Google Mobility Reports, which used smartphone data to measure where people spend their time during the pandemic. Available at https://www.google.com/covid19/mobility/.
[3] For a summary on the EU during the early pandemic, see Marcus *et al* (2021).
[4] IMF COVID-19 policy tracker, available at https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19.
[5] See European Commission memo of 3 March 2021, 'Questions and answers: Communication on fiscal policy response to coronavirus pandemic', https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_885.

In economic terms, the pandemic meant a simultaneous supply and a demand shock. Demand decreased because of uncertainty amongst consumers and businesses, which led to decreased investment and consumption expenditure overall. However, the picture was mixed. The simple inability to acquire certain in-person services destroyed certain types of consumption, whereas the shift to remote work boosted demand for ICT goods that enabled the digitalisation of work processes. Parallel to the negative demand shock, the combination of high levels of uncertainty regarding future income, the suppression of consumer spending opportunities and income or employment support provided by governments led to an accumulation of large savings (Figure 1) (Attinasi *et al*, 2021). In the euro area, higher savings were mostly driven by lower consumption (Dossche *et al*, 2021).

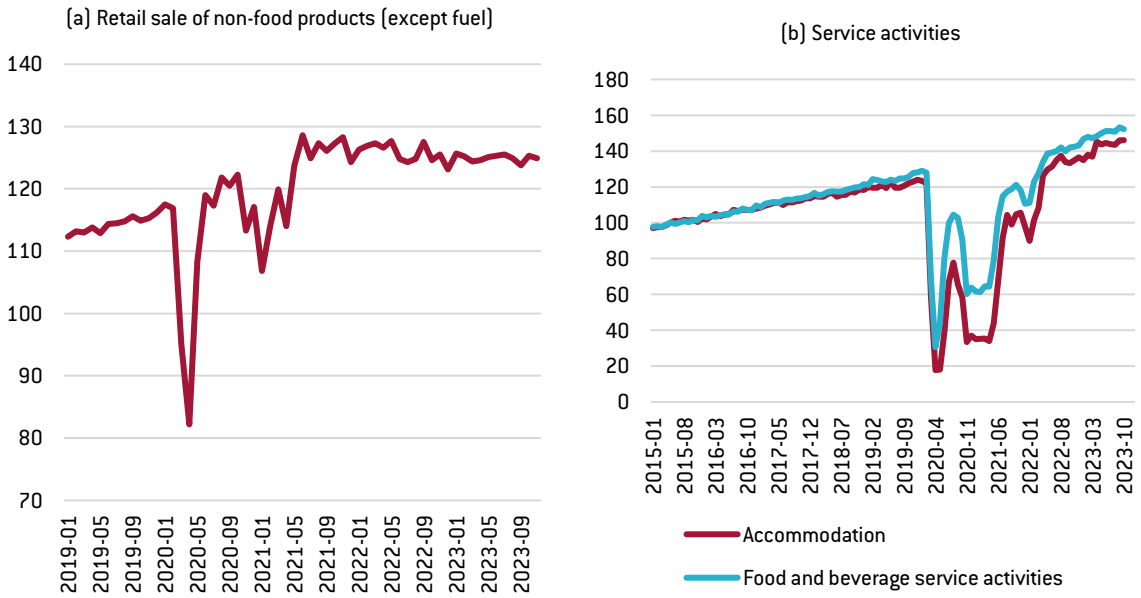
Figure 1: Pandemic-period household savings rate (%)



Source: Bruegel based on Eurostat dataset nasq_10_ki.

The supply shock resulted from difficulty in producing goods arigins from factory closures and logistical hurdles in shipping goods across borders. Certain goods became difficult to procure, as demand for them surged or because crucial steps of the supply chain became disrupted. The inability to acquire personal services led to a shift of consumption in favour of goods. Figure 2a shows the large drop in consumption of both (non-food) goods and services resulting from domestic and foreign disruption. It also shows the quick recovery made by goods relative to services.

Figure 2: Pandemic retail turnover of non-food products (except fuel) and services in the EU27

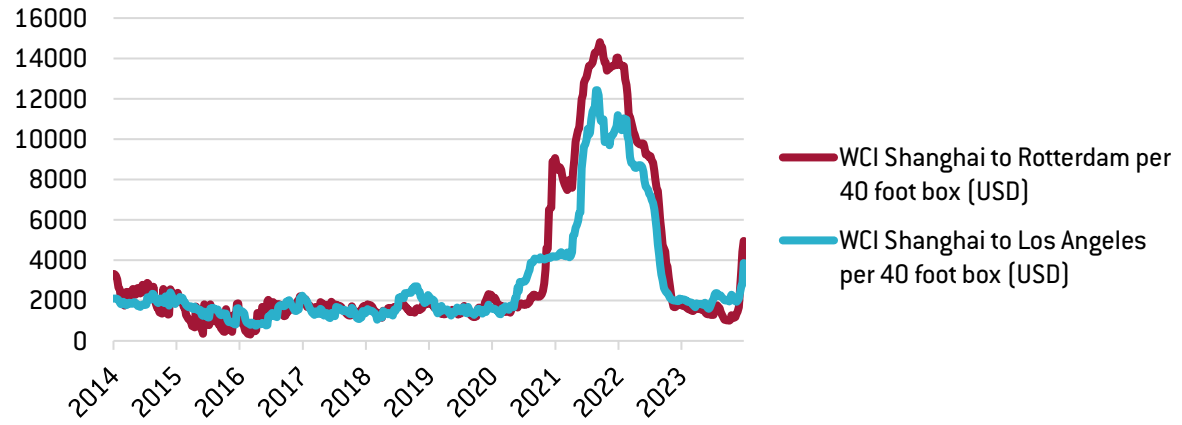


Source: Bruegel based on Eurostat datasets STS_TRTU_M and STS_SETU_M. Note: Index (2015=100), Monthly data, calendar and seasonally adjusted.

The increase in demand for goods together with logistical difficulties led to a surge in rates for freight (UNCTAD, 2021). For example, in Los Angeles, the surge in demand for traded goods together with high numbers of sick workers during the pandemic led to long waiting periods for ships in the port[6]. Similar problems were experienced around the world and were directly reflected in the costs of shipping. Figure 3 shows the freight rates for the shipping of a standard 40-foot container from Shanghai to Rotterdam and to Los Angeles. The shipping rates from China to Europe increased from around $2000 to more than $14000, a seven-fold increase in the cost.

[6] Andrew O'Reilly, 'Stalled ships, stressed crews: Covid buying boom overwhelms LA ports', *The Guardian*, 11 March 2021, https://www.theguardian.com/us-news/2021/mar/11/la-ports-stalled-ships-stressed-crews-covid-buying-boom.

Figure 3: Freight rates ($)



Source: Bloomberg.

2.2 Price volatility and shortages

The increase in scarcity and higher costs of goods production and distribution were manifested in both consumer prices and the availability of goods to consumers. A remarkable example of how these phenomena materialised was in the markets for new and used cars. Anticipating lower demand and the difficulty of procuring parts, many manufacturers disinvested their inventories and cancelled orders for inputs such as semiconductors (Burkacky *et al*, 2022). But in contrast to expectations, consumer demand for cars surged and car companies could not keep up with demand, resulting in an apparent 'shortage' of chips for carmakers. In the case of new cars, this led to long waiting periods to receive new cars, while prices remained relatively similar. Companies decided not to use market pricing in order to manage their inventories, and instead opted to increase waiting periods for consumers. Meanwhile, the second-hand car market did not have any such restrictions. In this market, prices surged until markets cleared. Figure 4 shows price indices for new and used cars. While there was a gradual increase in the prices of new cars by 19 percent, prices for used cars surged rapidly by 57 percent.

Figure 4: Used versus new cars CPI, United States

Source: Bruegel based on FRED.

This points to an interesting dynamic, with some markets able to react to supply or demand shocks through pricing, while others are less flexible. In many cases, commodity prices simply increased, leading to price volatility but not shortages. However, when there are pre-negotiated prices in contracts or reputational risks associated with massive price increases (as is the case for car manufacturers), an increase in scarcity can lead to actual shortages and longer wait times for the fulfilment of contracts.

2.3 Policy responses and the aftermath

Pandemic-induced policies played a major role in creating the market distortions experienced during the pandemic. Closed border crossings, factory closures and fiscal stimulus played important roles in the economic impact of the pandemic, and the impact on supply chains specifically. There was also an increase in export restrictions, in particular for medical goods (Evenett, 2022). At the same time, there were effective policy interventions to mitigate the effects of the pandemic on consumers and producers. After the brief implementation of an internal export restriction, European Union policymakers shifted quickly to common policies when it came to pandemic-related trade measures (Marcus *et al*, 2021). In the EU, 'green lanes' were established that enabled goods to flow across otherwise closed borders.

While the shock was huge, the pandemic is yet to leave a lasting mark in the global trade indicators. Trade in goods reverted quickly to its pre-pandemic trend, despite the initial large drop in retail trade and the price spikes in the international and domestic costs of shipping. Most pandemic-induced price spikes have come down and normalised. Inflation has not returned to its pre-pandemic trend in either the EU or the US, but this is partly driven by the effects of the war in Ukraine.

However, the pandemic has led to a rethinking among policymakers. In the EU, the single market emergency instrument (being adopted at time of writing as the Internal Market Emergency and Resilience Act, IMERA[7]) is intended to provide a sustained legal basis for the type of measures used during the pandemic. It is intended to mitigate the impact if another shock of a similar kind were to appear. Industrial-policy initiatives like the European Chips Act (Regulation (EU) 2023/1781) are directly motivated by the shortages experienced during the pandemic, and the perceived risks of long value chains have increased. The pandemic experience has also contributed to the new wave of industrial-policy initiatives, as governments have become more worried about supply chains and try to reshore production. Laws including the Inflation Reduction Act in the US and the European reaction to it (under the Temporary Crisis and Transition Framework, see Tagliapietra *et al*, 2023) attempt to localise manufacturing of goods considered critical, which is partially justified by the need for economic resilience. Such policy shifts as a result of the pandemic will likely lead to a lasting change in global supply chains, especially given the further impetus to such policies stemming from Russia's invasion of Ukraine.

3 The Russian invasion of Ukraine

Russia's full-scale invasion of Ukraine starting on 24 February 2022 came during a period of elevated commodity prices and caused record price spikes in commodity markets for energy and agricultural goods. However, the economic fallout had uneven effects across countries. Those with large dependencies on Russian or Ukrainian commodities and with few readily available substitutes experienced larger shocks than those with more diversified supply chains. This was particularly notable for infrastructurally concentrated supply chains, such as pipeline gas to the EU. The invasion exposed these major supply chain risks and has been instrumental in causing a shift of tone in the policy debate around the risks to global supply chains, compounding similar but nascent rhetoric during the pandemic. This includes trepidation about other potential choke points in global supply chains, trade diversification and infrastructural investment, and a general flurry of discourse and policy related to the idea of strategic autonomy.

In this section, we explore how the shock played out in regions that were exposed due to high-risk supply chains. We argue that the invasion was a local shock, since shocks were not so intense in areas with more diversified supply chains. We also analyse the ensuing policy response.

3.1 Energy shock

Prior to the invasion, Europe was dependent on Russia for a significant proportion of its energy needs. In 2021, imports of Russian gas accounted for almost 40 percent of the EU's total gas consumption[8].

[7] See Council of the EU press release of 1 February 2024, 'SMEI / IMERA: Council and Parliament strike a provisional deal on crisis preparedness', https://www.consilium.europa.eu/en/press/press-releases/2024/02/01/single-market-emergency-instrument-council-and-parliament-strike-a-provisional-deal-on-crisis-preparedness/.

[8] See IEA press release of 3 March 2022, 'How Europe can cut natural gas imports from Russia significantly within a year - News', International Energy Agency, https://www.iea.org/news/how-europe-can-cut-natural-gas-imports-from-russia-significantly-within-a-year.

Almost all of the EU's gas was delivered through only four pipelines from Russia: Nord Stream, Ukraine Transit, Yamal and Turkstream (Zachmann *et al*, 2024). This represented a significant stake in the EU's energy infrastructure, which proved to be an major systemic risk.

Prior to the invasion, the EU was already experiencing an energy crisis in the second half of 2021 because of increased gas demand following the re-opening of economies post-COVID-19[9]. The Russian aggression severely compounded the crisis, causing record energy prices. Natural gas prices reached historic highs (Figure 5) in the summer of 2022 because of the reduction in supply from Russia, fears of shortages, general uncertainty and low output from hydro and nuclear electricity output in the summer (McWilliams *et al*, 2022; Gil Tertre *et al*, 2023). This led to increased wholesale electricity prices in the EU, passed through to households and industry, since the most expensive technology determines the electricity price (McWilliams *et al*, 2022; Gil Tertre *et al*, 2023).

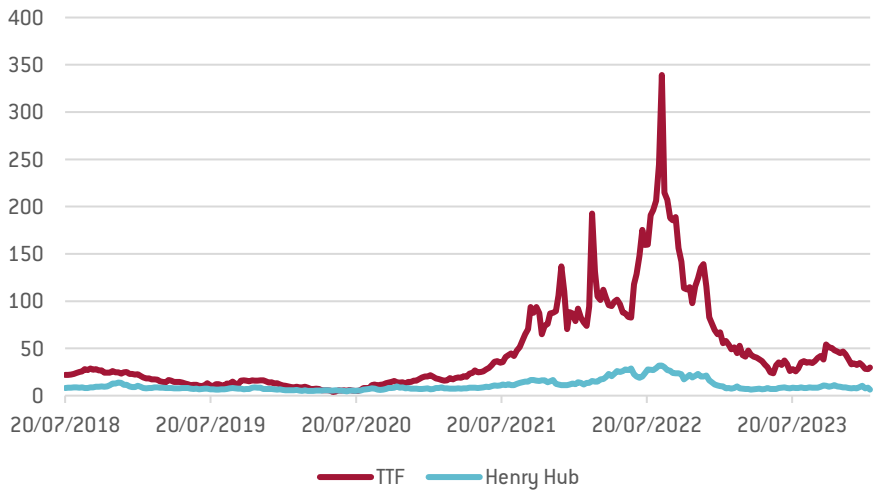
Figure 5: Last price TTF futures (€/MWh)

Source: Bloomberg.

In contrast, the US saw less price volatility (Figure 6). Large US domestic gas production and few ties to Russia and Ukraine generally meant that the US was initially shielded from the shock. The Henry Hub price, the US natural gas benchmark price, eventually increased due to the global gas markets, but not to the same degree as in Europe. In the absence of a systemic risk to the US's energy infrastructure, the kinds of policies that the EU has pursued since the invasion have not been necessary in the US.

[9] See Council of the EU, 'Energy prices and security of supply', https://www.consilium.europa.eu/en/policies/energy-prices-and-security-of-supply/.

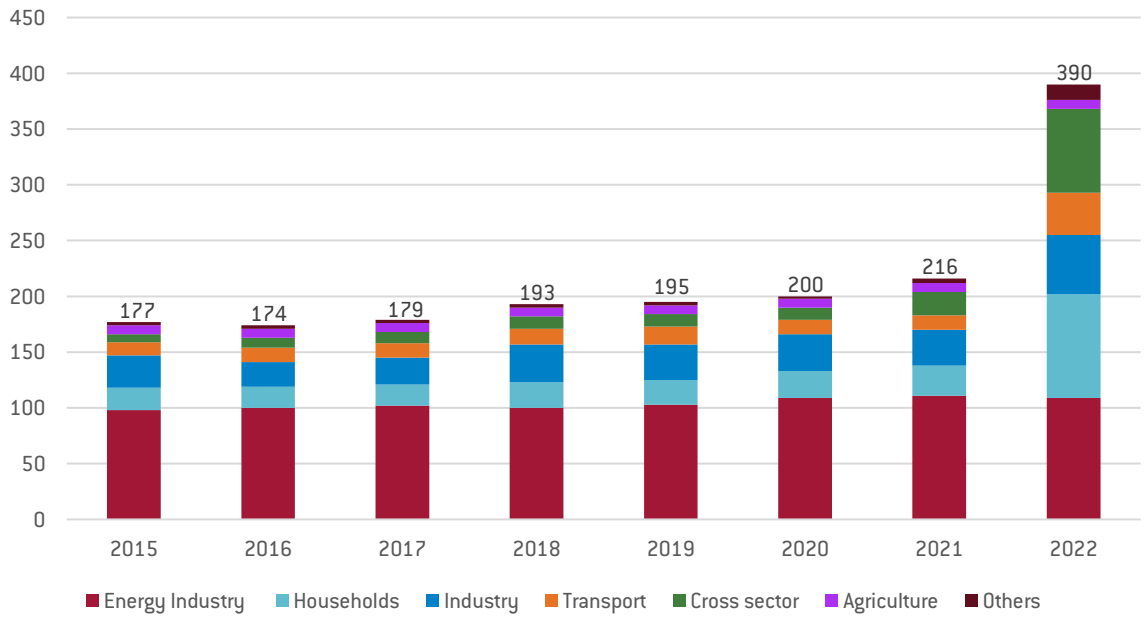
Figure 6: European vs US natural gas prices (€/MWh)



Source: Bloomberg.

There were substantial policy reactions to this shock, in particular in the EU. This included fiscal support to aid consumers and industry facing elevated prices, as well as trade diversification and investment in energy infrastructure to diversify from Russian energy. Many of these policies were of enormous magnitude, showcasing the proportionate response needed to a shock in a high risk and essential supply chain. In the EU, the immediate response was to shield households and industry from the high energy costs. Total energy subsidies in the EU increased from €216 billion in 2021 to €390 billion in 2022 through at least 230 measures to ease the burden of high and volatile prices across economic sectors. Households and industry received the majority (Figure 7) (European Commission, 2023). Subsidies were designed to lower the cost of energy to facilitate demand via tax measures, income or price support and direct transfers (European Commission, 2023). Subsidies were also used to combat the energy crisis through supporting energy efficiency and supporting infrastructure, which received 250 percent more in subsidies in 2022 than in 2021 (European Commission, 2023).

Figure 7: Energy subsidies by economic sector in the EU27, € billions (2022 prices), 2015 – 2022



Source: European Commission (2023).

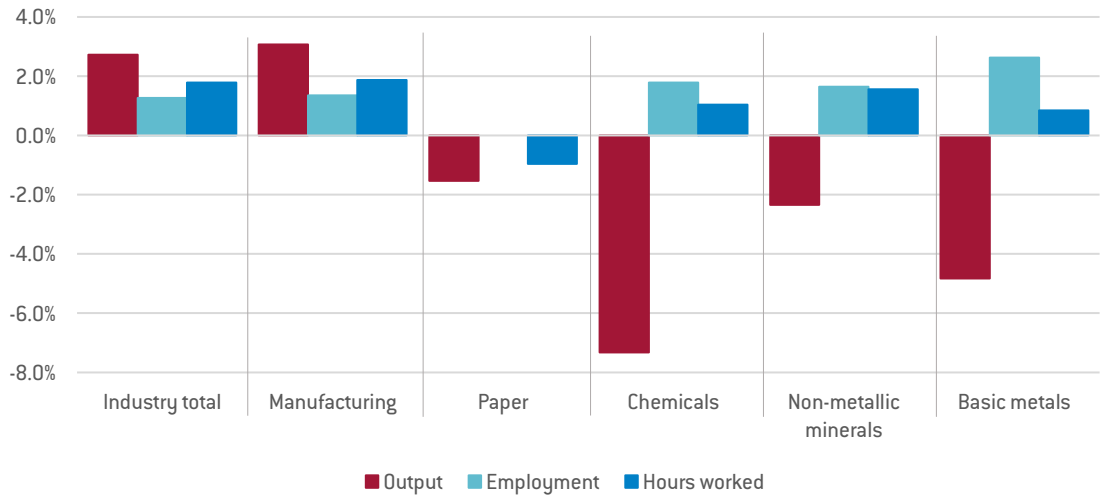
The EU has also pursued medium- and longer-term strategies to reduce the risk to energy supplies. Sgaravatti *et al* (2022) grouped the EU's multi-pronged approach to the energy crisis into energy deals, infrastructure, energy substitution, demand reduction and the development of renewables. The EU succeeded in replacing Russian gas supply through new deals, which by the end of 2022, had resulted in agreements amounting to 10.8 billion cubic metres (bcm) of new gas supply in 2023 and 47bcm later on, not including the 50bcm LNG import volume plans from the US.

New infrastructure investment included expanded LNG capacity, the Baltic pipeline between Norway and Poland, gas interconnectors and floating storage and regasification units. Also, interest in alternative supply chains bypassing Russian territory has increased. The European Bank for Reconstruction and Development announced a $100 million investment in the Kazakh railway system to support the middle corridor, an alternative route avoiding the trans-Siberian railway to transport goods from China (Eldem, 2022).

The combination of policies described above has been broadly successful. Whilst it is too soon to fully evaluate the success of energy subsidies in combating historically elevated energy prices, there are signs of their contribution to the EU's resilience during the crisis. Evidence suggests that subsidies to households were well targeted in the EU, shielding the most-vulnerable consumers from the pass through of elevated energy costs (see Arregui *et al*, 2022). Furthermore, industry overall increased output and employment in 2022 (Figure 8). On the other hand, industries for which energy input represents a larger proportion of production costs, such as the chemicals industry, experienced a contraction in output in the third quarter of 2022 relative to the third quarter of 2021 (Sgaravatti *et al,*

2023). Finally, the development of new infrastructure to accommodate new sources of energy contributed to lower gas prices, and has secured a low-risk and diversified energy supply for the future.

Figure 8: Change in EU industrial output: Q3 2022 vs Q3 2021



Source: Sgaravatti *et al* (2023).

The EU experienced a huge shock requiring an equally huge fiscal, infrastructure and trade response. These policies were largely successful, demonstrating the EU's multi-faceted resilience to the shock. It should be emphasised that this resilience came with a large price tag that it would be undesirable to repeat.

3.2 Agriculture

At the point Russia invaded Ukraine, the two countries, along with Kazakhstan, were responsible for 25 percent of global cereal exports, and Russia and Ukraine alone were responsible for 12 percent of all calories traded (Zachmann *et al*, 2022; Glauber *et al*, 2022). Russia and Ukraine accounted for 20 percent and 10 percent of global wheat exports, respectively, and are crucial suppliers of barley, sunflower oil, maize and rapeseed to global markets (OECD and FAO, 2022).

Ukraine exported 96 percent of its agricultural products via the robust network of Black Sea ports (USDA, 2023). Russia's invasion initially blocked all of Ukraine's ports for a period of almost six months from February to July 2022. Major ports including Mykolayiv, Mariupol and Kherson were either affected by the fighting or destroyed (Zachmann *et al*, 2022).

Like energy exports, agricultural commodities were already at relatively high prices in 2021 and early 2022, as a result of pass-through of high input prices. Following the invasion, global fears about Ukraine's ability to harvest and export agricultural commodities compounded these already elevated

prices, leading to record prices (Devadoss and Ridley, 2024). Wheat was particularly affected, reaching record levels (Figure 9).

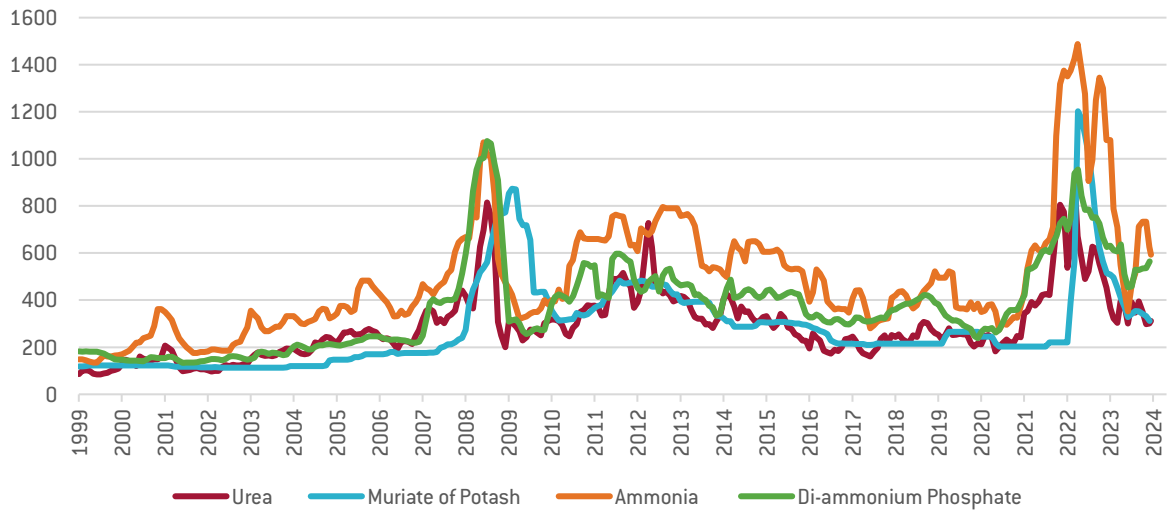
Figure 9: Wheat futures

Source: Bloomberg.

The increase in food prices was driven partly by developments in global input markets, in which Russia played an important role by providing not only energy, but also fertilisers. Russia accounted for over 15 percent of global fertiliser exports in 2020, and was the world's largest exporter of nitrogen fertilisers (eg urea, ammonia), second largest exporter of potassic fertilisers (eg muriate of potash) and third leading exporter of phosphorous fertilisers (eg di-ammonium phosphate) (OECD and FAO, 2022).

Uncertainty surrounding the supply of Russian fertiliser led to increased prices. Fertiliser prices reached record highs (Figure 10). This, combined with rising energy prices, contributed to higher food prices, given the energy intensity of the agri-food sector (OECD and FAO, 2022).

Figure 10: Fertiliser prices ($)

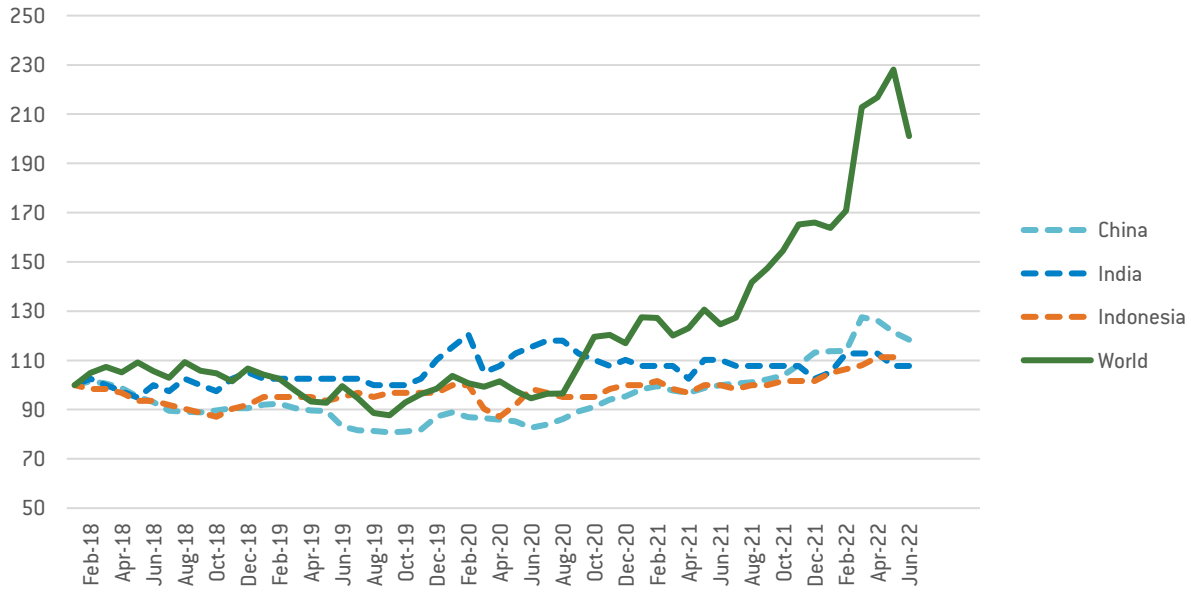


Source: Bloomberg.

As noted above for energy, volatility in global agricultural markets was distributed unevenly. Figure 11 shows the divergence of world prices for wheat and wheat flour compared to prices in China, Indonesia and India. These countries shielded their populations, aggravating the shortfall in traded agricultural products and creating upward price pressures (Kleimann, 2023). This was partly done through export restrictions (Figure 12), which the International Food Policy Research Institute estimate covered 17 percent of traded calories in April 2022 (Glauber *et al*, 2022). Many poor countries in the Middle East and Africa, including Lebanon, Pakistan and Ethiopia, relied hugely on imported wheat from Ukraine[10]. The diverging incidence of price stability between regions with secure or riskier supply chains has been once again captured in this shock.

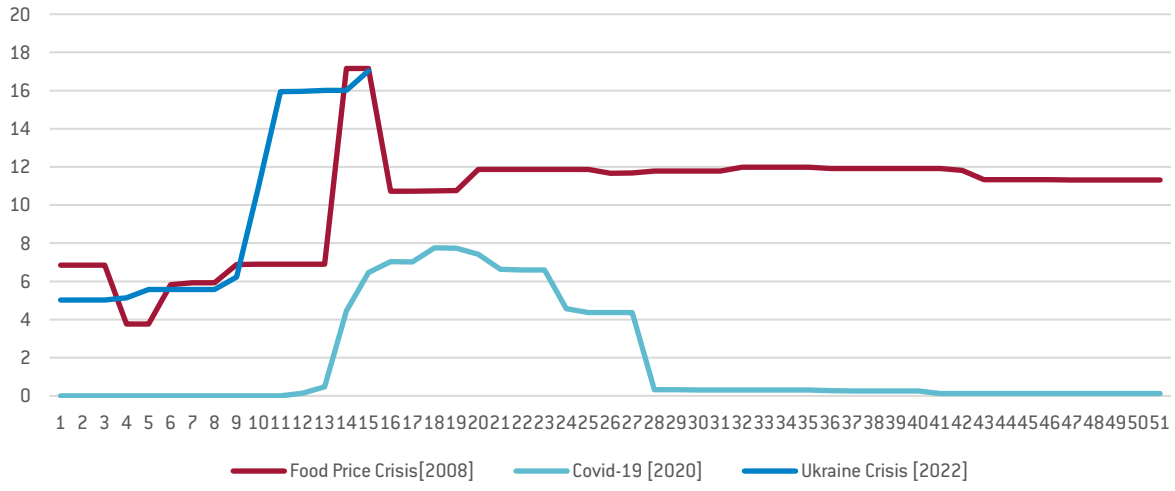
[10] Kali Robinson, 'Russia Killed the Black Sea Grain Deal. These Countries Could Suffer Most', *In Brief*, Council on Foreign Relations, 19 July 2023, https://www.cfr.org/in-brief/russia-killed-black-sea-grain-deal-these-countries-could-suffer-most.

Figure 11: Wheat and wheat flour prices on the world market and in China, India and Indonesia (January 2018 = 100)



Source: Bruegel based on FAO Food Price Monitoring and Analysis Tool.

Figure 12: Evolution of the share of global trade, in calories, impacted by export restrictions (%)



Source: Glauber *et al* (2022). Notes: x-axis shows the week of the year. 1 = first week of the year.

The EU played an important role in trying to facilitate Ukrainian grain exports in order to ease global food prices. During the six months before the Black Sea Grain Initiative, which unblocked and facilitated commercial food and fertilizer exports from key Ukrainian ports, some trade diversification took place to facilitate exports of Ukrainian grain overland. Solidarity lanes were established in May

2022 to create alternative routes for Ukraine's essential exports via rail, road and inland waterways[11]. Agricultural goods were exported via Poland and Germany to ports on the Baltic Sea, and via the Romanian port of Constanta, but land transport could only handle 10 percent to 15 percent of the volumes previously handled by Black Sea ports (Zachmann *et al*, 2022).

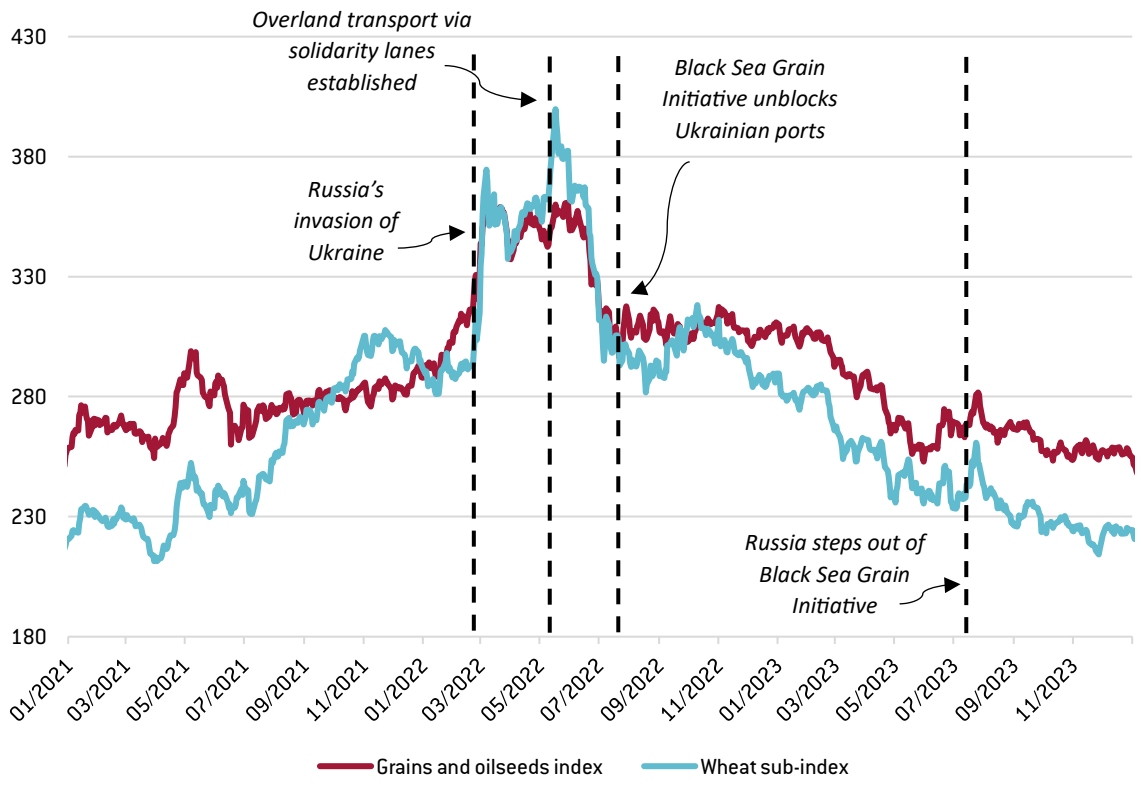
The Black Sea Grain Initiative unblocked Ukraine's ports from July 2022 until Russia announced its withdrawal from the initiative on 17 July 2023. Under the agreement, 33 million tonnes of agricultural goods was exported[12]. The deal created security for exports from Ukraine's crucial ports of Odesa, Chornomorsk and Pivdennyi, which were responsible for 37 percent of Ukraine's pre-war exports (Glauber *et al*, 2023).

There has also been wider reorganisation of supply chains. The local marine-logistics-intensive region has seen huge reorganisation in response to insecurity and the destruction of infrastructure in the Black and Azov seas. Ukraine has increased the use of Reni, Izmail and Kilia ports on the Danube on its border with Romania, but these ports cannot support all vessel sizes (OECD, 2023). Seaborne activities in the neighbouring countries of Romania, Moldova and Georgia have also increased. These countries have seen increases in port calls and greater capacity at their ports (OECD, 2023).

This quick development of alternative routes, in particular solidarity lanes and the Black Sea Grain Initiative, and the reorganisation of supply routes contributed to reductions in food prices on global markets. However, unlike the energy crisis in Europe, many of the countries bearing the brunt of increased food prices did not have similar levels of fiscal support.

[11] See European Commission, 'EU-Ukraine Solidarity Lanes', https://eu-solidarity-ukraine.ec.europa.eu/eu-assistance-ukraine/eu-ukraine-solidarity-lanes_en.
[12] See Council of the EU, 'Ukrainian grain exports explained', https://www.consilium.europa.eu/en/infographics/ukrainian-grain-exports-explained.

Figure 13: Wheat and grain prices (January 2000 = 100)



Source: Council of the EU, 'Ukrainian grain exports explained', https://www.consilium.europa.eu/en/infographics/ukrainian-grain-exports-explained and International Grain Council.

3.3 In perspective: the shock and the response

The Russian invasion resulted in a large shock that reverberated down specific supply chains, especially those for commodities including food and energy. The effect was especially acute in markets that were linked directly to the Russian economy through infrastructure such as pipelines in the case of European gas markets. However, global trade overall continued to grow. In first year of the invasion, world exports grew by 14 percent, global exports reached a record high, and measures of backward and forward global value chain participation increased, indicating increased integration with foreign partners for production and foreign trade (World Trade Organisation, 2023). In light of the war, policymakers have embarked on a quest to diversify supply chains for essential goods and to ensure supply chains are more diversified than they have been in recent history. This will mean that the EU is at lower risk for certain commodities. However, there is still much debate currently about the extent to which the EU should pursue a policy even more in the direction of autarky. In view of the risk of future shocks, high-risk supply chains on which crucial supplies depend should be identified. It should also be noted that the EU was able to shield households and industry during the period of development of new supply chains. Other economies might not be so fortunate, and the identification of such high-risk supply chains with the potential for dire human consequences is important.

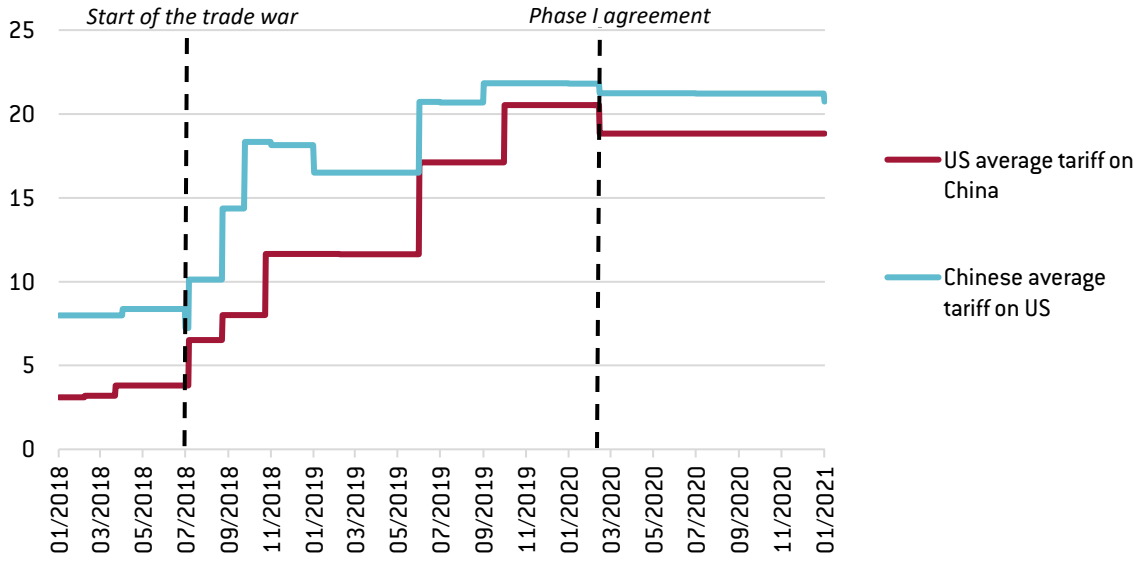
4 The China-US trade war

The third supply chain disruption that we consider is the US-China trade conflict, which impacted global supply chains during the period of the Trump administration with, in particular, an escalation of trade restrictions on semiconductors. The US-China trade relationship has been tense for quite some time, and the accession of China to the World Trade Organisation in 2001 has been increasingly seen as a mistake by US policymakers. The US's main complaints about China include forced technology transfers, such as requirements to form joint ventures when entering the Chinese market, restrictions on foreign investment in many sectors, unfair procurement practices at the government level and by state-owned enterprises, and subsidies given by the Chinese government to Chinese companies either directly or through opaque state-run organisations (such as state-run banks or governmental holding structure; see Mavroidis and Sapir, 2021).

4.1 The Trump-Biden trade wars

During the Trump Administration, trade tensions between the US and China escalated into an all-out trade war. In 2018, the US government started to ramp up tariffs on Chinese imports on a broad basis. It imposed tariffs on an increasing number of Chinese imports (Bown, 2021). The average tariff rate applied to US imports of Chinese goods increased from 3 percent to 21 percent (Figure 14). The Chinese government retaliated by ramping up tariffs on a variety of US goods. The average tariff applied to Chinese imports of US goods similarly increased from 8 percent to 22 percent. The mutual escalation of tariffs meant approximately $450 billion in trade flows was covered by tariffs (Pablo Fajgelbaum *et al*, 2023).

Figure 14: The US-China trade war: US-China tariff rates toward each other (%)



Source: Bown (2021).

The escalation of the trade war came in two waves. The first wave began in July 2018, when the Trump Administration imposed the first trade-war tariffs on $34 billion of imported products, to which China responded in equal measure (Bown, 2021). The tariffs escalated up to December 2018, when a 90-day truce was announced, which was subsequently extended. The US then started again to increase tariffs following failed negotiations in Beijing in May 2019. Tariff increases continued into the autumn of 2019, with China retaliating each time (Bown, 2021). Notably, goods for which China has large market shares, such as ICT goods, and in relation to which there might have been a strong impact on consumer prices, were not included in the trade war tariffs. China also avoided putting tariffs on semiconductors and semiconductor manufacturing equipment (Bown, 2021).

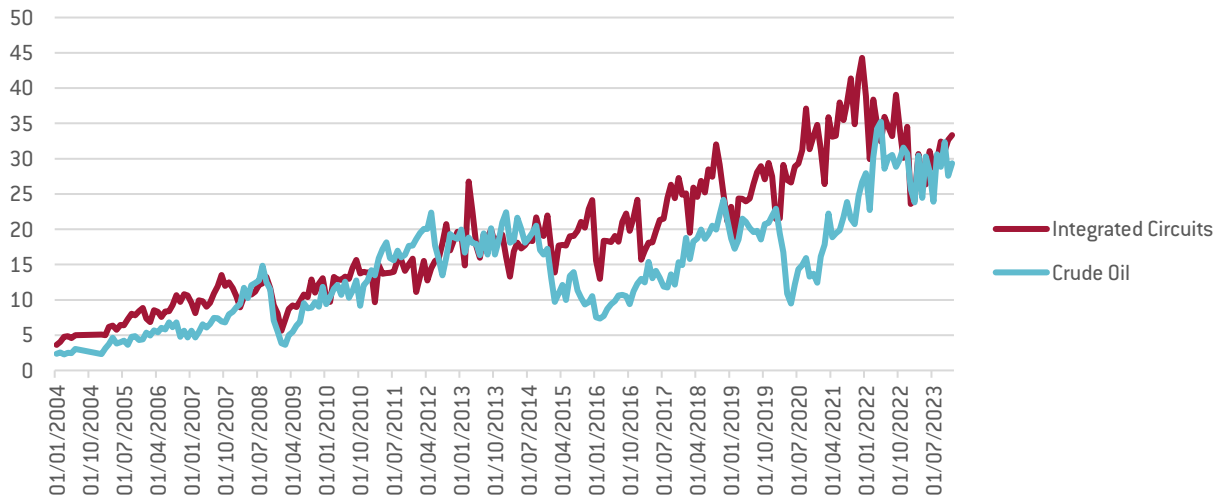
By the end of 2019, US tariffs covered almost two-thirds of imports from China, and Chinese counter-tariffs covered over 58 percent of imports from the US (Bown, 2021). Tensions eased by the end of 2019, and culminated in the Phase I agreement in 2020. This included a number of Chinese purchasing commitments, but did not significantly reduce the punitive tariffs that both sides have imposed on each other (Bown, 2021). Chinese purchasing commitments included promises to increase its imports from the US by $200 billion over two years, which China completely failed to do (Bown, 2022).

The Phase I agreement was supposed to be accompanied by a Phase II agreement which never came to be. Despite China's failure to fulfil its purchasing commitments, the Biden Administration has stuck with the Phase I agreement (Bown, 2022). The Biden Administration has stuck with the tariffs, continuing a similar trade policy towards China as the Trump Administration.

4.2 The chip wars

China has a major exposure to foreign-produced semiconductors. This has become increasingly weaponised by the US in order to achieve foreign policy goals. China's primary tech exports are ICT goods, which constitute 96 percent of its high-tech exports to the US (Poitiers and Weil, 2021). The main high-tech components in these exports are semiconductors, for which China relies on imports. The importance of these semiconductor imports is such that chips compete with oil as China's largest single import item (Figure 15).

Figure 15: Chinese imports of integrated circuits vs crude oil ($ billions)



Source: Bloomberg.

In 2020, the US started applying secondary sanctions relating to chips on the Chinese telecommunications company Huawei, depriving it of imports of certain foreign-manufactured chips (Barkin, 2020). Over time, the US expanded the scope of these export restrictions on chips. This was in contrast to China's ambitions to reduce its dependency on foreign chips, which included ambitious domestic production targets in its Made in China 2025 strategy (García-Herrero and Weil, 2022). The US also convinced the Dutch government to impose export controls on chip-manufacturing equipment from the leading manufacturer ASML, which has a monopoly on chip-manufacturing machines. Furthermore, in 2023, the US enacted wide-ranging controls on exports of advanced chip sets to China – in particular those suited for artificial intelligence applications. Thus far, China has retaliated only in a limited way. It has imposed export controls on certain types of critical raw materials, which could lead to bottlenecks in the US.

4.3 The impact

The US-China trade war is still in progress, and it may be decades before its full implications become apparent. It has coincided with COVID-19 and the Russia-Ukraine war, and has evolved from an intense trade dispute to a loaded geopolitical tool in the context of Taiwan. Unlike the relatively immediate impacts of COVID-19 and the Russian invasion of Ukraine, the US-China trade war is a protracted decoupling, with potentially seismic implications for world trade.

The first-order impacts of the trade war on US-China trade are starting to crystallise. Estimates suggest that bilateral trade has suffered acutely. Bown and Wang (2023) estimated that US exports to China were 23 percent lower than what they would have been in the absence of the trade war, with manufactured products, energy exports and services particularly affected. Conversely, Chinese exports to the US have also taken a hit, with levels in 2022 approximately the same as in 2017,

despite the overall increase in US imports of around $900 billion over this period (Huang and Slosberg, 2023).

These titanic shifts in trade between the world's two largest economies have had ripple effects throughout global trading relationships as the US and China have sought to develop alternative, compensatory supply chains. Evidence increasingly suggests that third countries have increased exports of goods affected by the trade-war tariffs. Fajgelbaum *et al* (2023) found that countries whose exports substituted those of the US and China have been major beneficiaries of the trade war. Some of the most successful are Vietnam, Thailand, Korea and Mexico, which exploited and increased exports in product markets in which there is declining US-China participation. One estimate suggests the benefit reaped by Vietnam as a result of trade diversion at as much as 8 percent of GDP[13]. However, it may be misleading to suggest those countries have replaced the US or China in certain product markets. There is evidence that such countries tend to be more integrated into China's supply chains, suggesting diversion rather than replacement. Indeed, countries whose exports to the US grew more quickly during the trade war also had more intense intra-industry trade with China in those same sectors, suggesting greater integration with China through the medium of another country (Freund *et al*, 2023). There is less evidence on the impact on the EU – an area to be explored further.

Aside from the geopolitical reorganisation, the trade war has unsurprisingly had large costs for certain industries, and for US and Chinese citizens. Some importers and exporters initially faced turmoil in the face of higher tariffs. In July 2018, US exports to China of soybeans essentially halted following China's retaliatory tariffs of 25 percent on the $12 billion a year soybean flow from the US to China (Hopkinson, 2019). To mitigate the shock, tens of billions of dollars were disbursed in subsidies to farmers in the US between 2018 and 2020 (Bown, 2021). The same wave of tariffs also included 25 percent tariffs on cars, with a simultaneous reduction in China's most-favoured nation tariff on cars from 25 percent to 15 percent, benefiting Japan, Germany and South Korea at the expense of US automakers (Bown, 2021). On the consumer side, Fajgelbaum and Khandelwal (2022) found that the trade war has lowered real income in both the US and China. In the US specifically, they found that US consumers of imported goods have borne the brunt of tariffs through higher prices.

The economic impact of the chip wars is less clear. It has sparked a series of expensive industrial policies in China, the US and also Europe (Poitiers and Weil, 2021, 2022; García-Herrero and Weil, 2022; Kleinhans and Baisakova, 2020). While it is unlikely that China will be able to replace ASML or its suppliers with equivalent domestic manufacturing capacity anytime soon, the chip war has increased the incentives for the development of an autonomous chip production. Evidence of Western components in Russian and Iranian military equipment in Ukraine (Bilousova *et al*, 2023; Byrne *et al*, 2022), highlights the difficulty of enforcing sanctions on chip technologies.

[13] Rob Subbaraman, Sonal Varma and Michael Loo, 'US-China Trade Diversion: Who Benefits?', Nomura, June, https://www.nomuraconnects.com/focused-thinking-posts/us-china-trade-diversion-who-benefits.

5 Policy lessons from a decade of trade shocks

The last decade has certainly been a test for the resilience of global supply chains. Geopolitical tensions, war and a pandemic have all disrupted the trade that many European businesses relied on. However, while the shocks have been massive, global supply chains have proven remarkably resilient. Global trade recovered from the pandemic within two years, while European energy markets took less than two years to diversify their imports away from Russia. The macroeconomic effect of the US-China trade war has also been limited, as trade diversion has mitigated the negative effects of high bilateral tariffs. However, while producer prices have come down from their highs, consumer price inflation is still significantly higher than before the pandemic. Furthermore, especially during the pandemic and the European energy crisis, huge government interventions were necessary to stabilise markets and mitigate the impacts of the shocks on firms, workers and consumers. While the overall picture suggests a return to pre-existing trends for global supply chains, new policies are still being adapted to prevent and mitigate future disruption. The effect of these policies on supply chains are still playing out.

Some overarching policy lessons can be drawn from these experiences. The first is that supply chains are more resilient than conventional wisdom suggests. The shocks experienced were of extraordinary magnitude and yet trade has been able to recover relatively quickly. Second, despite their resilience, the magnitude of the shock has created significant disruption for businesses and consumers. necessitating unprecedented government intervention. This justifies pre-emptive policies that reduce the magnitude of future shocks, both for simple economic reasons and because of the political economy of managing the interventions. Lastly, scarcity expressed itself both in price surges and in actual unavailability of certain goods. Both mechanisms have a role to play in making sure economic efficiency and distributional effects of such shocks are well managed.

Some key questions need to be addressed. The macroeconomic effects of these shocks on inflation and labour markets are still playing out, and the debate on the adequacy of policy intervention is still ongoing. Where were policies insufficient and when did they overreach? Moreover, as policymakers derive lessons and try to improve the resilience of supply chains, the role of governments in intervening and setting incentives for the private sector through industrial policy remains heavily debated. More research should be done to understand these effects and help manage the policy trade-offs involved.

References

Arnold, N. and A. Kammer (2021) 'Europe's COVID-19 Crisis Response: A Race Well Run, But Not Yet Won', Intereconomics, 2021(56): 194–96, available at https://www.intereconomics.eu/contents/year/2021/number/4/article/europe-s-covid-19-crisis-response-a-race-well-run-but-not-yet-won.html

Arregui, N., O. Celasun, D. Iakova, A. Mineshima, V. Mylonas, F. Toscani ... J. Zhou (2022) 'Targeted, Implementable, and Practical Energy Relief Measures for Households in Europe', *Working Paper* No. 2022/262, International Monetary Fund, available at https://www.imf.org/en/Publications/WP/Issues/2022/12/17/Targeted-Implementable-and-Practical-Energy-Relief-Measures-for-Households-in-Europe-526980

Attinasi, M.G., A. Bobasu and A.-S. Manu (2021) 'The implications of savings accumulated during the pandemic for the global economic outlook', *Economic Bulletin Issue* 5/2021, European Central Bank, available at https://www.ecb.europa.eu/pub/economic-bulletin/focus/2021/html/ecb.ebbox202105_01~f40b8968cd.en.html

Barkin, N. (2020) *Export controls and the US-China tech war*, Merics Report, available at https://merics.org/en/report/export-controls-and-us-china-tech-war

Bilousova, O., A. Zagrebelska, V. Vlasiuk and N. Shapoval (2023) 'Foreign Components in Russian Military Drones', Yermak-McFaul International Working Group on Russian Sanctions & KSE Institute

Bown, C.P. (2021) 'The US-China Trade War and Phase One Agreement', *Working Papers* 21-2, Peterson Institute for International Economics available at https://www.piie.com/publications/working-papers/us-china-trade-war-and-phase-one-agreement

Bown, C.P. (2022) 'China bought none of the extra $200 billion of US exports in Trump's trade deal', *Realtime Economics*, Peterson Institute for International Economics, available at https://www.piie.com/blogs/realtime-economics/china-bought-none-extra-200-billion-us-exports-trumps-trade-deal

Bown, C.P. and Y. Wang (2023) 'Five years into the trade war, China continues its slow decoupling from US exports', *Realtime Economics*, Peterson Institute for International Economics, available at https://www.piie.com/blogs/realtime-economics/five-years-trade-war-china-continues-its-slow-decoupling-us-exports

Burkacky, O., J. Deichmann, P. Pfingstag and J. Werra (2022) 'Semiconductor shortage: How the automotive industry can succeed', McKinsey, 10 June, available at https://www.mckinsey.com/industries/semiconductors/our-insights/semiconductor-shortage-how-the-automotive-industry-can-succeed

Byrne, J., J. Watling, J. Bronk, G. Somerville, J. Byrne, J. Crawford and J. Baker (2022) *The Orlan Complex: Tracking the Supply Chains of Russia's Most Successful UAV*, Royal United Services Institute, available at https://rusi.org/explore-our-research/publications/special-resources/orlan-complex-tracking-supply-chains-russias-most-successful-uav

Devadoss, S. and W. Ridley (2024) 'Impacts of the Russian invasion of Ukraine on the global wheat market', *World Development* 173: 106396, available at https://doi.org/10.1016/j.worlddev.2023.106396

De Vet, J.M., D. Nigohosyan, J.N. Ferrer, A.-K. Gross, S. Kuehl and M. Flickenschild (2021) *Impacts of the COVID-19 pandemic on EU industries*, Study for the European Parliament Policy Department for Economic, Scientific and Quality of Life Policies Directorate-General for Internal Policies, available at https://www.europarl.europa.eu/RegData/etudes/STUD/2021/662903/IPOL_STU(2021)662903_EN.pdf

Dossche, M., G. Krustev and S. Zlatanos (2021) 'COVID-19 and the increase in household savings: an update', *ECB Economic Bulletin* 5/2021, European Central Bank, available at https://www.ecb.europa.eu/pub/economic-bulletin/focus/2021/html/ecb.ebbox202105_04~d8787003f8.en.html

Eldem, T. (2022) 'Russia's War on Ukraine and the Rise of the Middle Corridor as a Third Vector of Eurasian Connectivity. Connecting Europe and Asia via Central Asia, the Caucasus, and Turkey', *SWP Comment* 2022/C 64, SWP Centre for Applied Turkey Studies

European Commission (2023) '2023 Report on Energy Subsidies in the EU', COM(2023) 651 final

Evenett, S. (2022) *COVID-19-Era Trade Policy Interventions Affecting Medical Goods: Form, Frequency, Duration, and Scale*, World Bank, available at https://policycommons.net/artifacts/2610390/covid-19-era-trade-policy-interventions-affecting-medical-goods/3632944/

Fajgelbaum, P.D. and A.K. Khandelwal (2022) 'The Economic Impacts of the US–China Trade War', *Annual Review of Economics*, 14(1): 205–28, available at https://doi.org/10.1146/annurev-economics-051420-110410

Fajgelbaum, P., P.K. Goldberg, P.J. Kennedy, A. Khandelwal and D. Taglioni (2023) 'The US-China Trade War and Global Reallocations', *Working Paper* 29562, National Bureau of Economic Research, available at http://www.nber.org/papers/w29562

Freund, C., A. Mattoo, A. Mulabdic and M. Ruta (2023) 'Is US Trade Policy Reshaping Global Supply Chains?' *Policy Research Working Papers* 10593, World Bank, available at https://documents1.worldbank.org/curated/en/099812010312311610/pdf/IDU0938e50fe0608704ef70b7d005cda58b5af0d.pdf

García-Herrero, A. and P. Weil (2022) 'Lessons for Europe from China's quest for semiconductor self-reliance', *Policy Contribution* 19/2022, Bruegel, available at https://www.bruegel.org/policy-brief/lessons-europe-chinas-quest-semiconductor-self-reliance

Gil Tertre, M., I. Martinez and M. Rivas Rábago (2023) 'Reasons behind the 2022 energy price increases and prospects for next year', *VoxEU*, 20 July, available at https://cepr.org/voxeu/columns/reasons-behind-2022-energy-price-increases-and-prospects-next-year

Glauber, J., D. Laborde and A. Mamun (2022) 'From bad to worse: How Russia-Ukraine war-related export restrictions exacerbate global food insecurity', *IFPRI Blog*, 13 April, International Food Policy Research Institute, available at https://www.ifpri.org/blog/bad-worse-how-export-restrictions-exacerbate-global-food-security

Glauber, J., B. McNamara and E. Olivetti (2023) 'Russia terminates the Black Sea Grain Initiative: What's next for Ukraine and the world?' *IFPRI Blog*, 20 July, International Food Policy Research Institute, available at https://www.ifpri.org/blog/russia-terminates-black-sea-grain-initiative-whats-next-ukraine-and-world

Hopkinson, J. (2019) *China's Retaliatory Tariffs on U.S. Agricultural Products*, Congressional Research Service, available at https://crsreports.congress.gov/product/pdf/if/if11085

Huang, Y. and G. Slosberg (2023) 'What Exactly Does Washington Want From Its Trade War With Beijing?', Carnegie Endowment for International Peace, 11 April, available at https://carnegieendowment.org/2023/04/11/what-exactly-does-washington-want-from-its-trade-war-with-beijing-pub-89503

Kleimann, D. (2023) 'Food security: the role and limits of international rules on export restrictions', *Bruegel Blog*, 8 June, available at https://www.bruegel.org/blog-post/food-security-role-and-limits-international-rules-export-restrictions

Kleinhans, J.-P. and D.N. Baisakova (2020) 'The global semiconductor value chain', *Policy Brief*, Stiftung Neue Verantwortung, available at https://www.stiftung-nv.de/sites/default/files/the_global_semiconductor_value_chain.pdf

McWilliams, B., G. Sgaravatti, S. Tagliapietra and G. Zachmann (2022) 'A grand bargain to steer through the European Union's energy crisis', *Policy Contribution* 14/2022, Bruegel, available at https://www.bruegel.org/sites/default/files/2022-09/PC%2014%202022_3.pdf

Marcus, J.S., N.F. Poitiers, L. Guetta-Jeanrenaud and M. Grzegorczyk (2021) *The impact of COVID-19 on the Internal Market*, Study for the European Parliament, Policy Department for Economic, Scientific and Quality of Life Policies, available at https://www.europarl.europa.eu/thinktank/en/document/IPOL_STU(2021)658219

Mavroidis, P.C. and A. Sapir (2021) *China and the WTO: Why Multilateralism Still Matters*, Princeton University Press

OECD (2023) 'Impacts of Russia's war of aggression against Ukraine on the shipping and shipbuilding markets', Organisation for Economic Co-operation and Development, 10 November, available at https://www.oecd.org/ukraine-hub/policy-responses/impacts-of-russia-s-war-of-aggression-against-ukraine-on-the-shipping-and-shipbuilding-markets-4f925e43/

OECD and FAO (2022) *OECD-FAO Agricultural Outlook 2022-2031*, Organisation for Economic Co-operation and Development and Food and Agriculture Organization of the United Nations, available at https://doi.org/10.1787/f1b0b29c-en

Poitiers, N.F. and P. Weil (2021) 'A new direction for the European Union's half-hearted semiconductor strategy', *Policy Contribution* 17/2021, Bruegel, available at https://www.bruegel.org/policy-brief/new-direction-european-unions-half-hearted-semiconductor-strategy

Poitiers, N.F. and P. Weil (2022) 'Is the EU Chips Act the right approach?' *Bruegel Blog*, 2 June, available at https://www.bruegel.org/blog-post/eu-chips-act-right-approach

Sgaravatti, G., S. Tagliapietra and C. Trasi (2022) 'National energy policy responses to the energy crisis', *Bruegel Dataset*, available at https://www.bruegel.org/dataset/national-energy-policy-responses-energy-crisis

Sgaravatti, G., S. Tagliapietra and G. Zachmann (2023) 'Adjusting to the energy shock: the right policies for European industry', *Policy Brief* 11/2023, Bruegel available at https://www.bruegel.org/policy-brief/adjusting-energy-shock-right-policies-european-industry

Tagliapietra, S., R. Veugelers and J. Zettelmeyer (2023) 'Rebooting the European Union's Net Zero Industry Act', *Policy Brief* 15/2023, Bruegel, available at https://www.bruegel.org/policy-brief/rebooting-european-unions-net-zero-industry-act

UNCTAD (2021) 'Container Shipping in Times of Covid-19: Why Freight Rates Have Surged and Implications for Policy Makers', *UNCTAD Policy Brief* 84, available at https://doi.org/10.18356/27082822-84

USDA (2023) 'Ukraine Grain Transportation', Agricultural Marketing Service, US Department of Agriculture, June, available at https://www.ams.usda.gov/sites/default/files/media/UkraineJune2023.pdf

World Trade Organisation (2023) *Global Value Chain Development Report 2023: Resilient and sustainable GVCs in turbulent times*, World Trade Organization Report, available at https://www.wto.org/english/res_e/booksp_e/gvc_dev_rep23_e.pdf

Zachmann, G., B. McWilliams, U. Keliauskaitė and G. Sgaravatti (2024) 'European natural gas imports', *Bruegel Dataset*, available at https://www.bruegel.org/dataset/european-natural-gas-imports

Zachmann, G., P. Weil and S. Cramon-Taubadel (2022) 'A European policy mix to address food insecurity linked to Russia's war', *Policy Contribution* 23/2022, Bruegel, available at https://www.bruegel.org/policy-brief/european-policy-mix-address-food-insecurity-linked-russias-war

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