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rethink GSC

Rethinking Global Supply Chains

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Executive Summary

Global supply chains are undergoing profound changes, driven by technological advances, climate change, and a shifting geopolitical landscape. The Horizon Europe Project RETHINK-GSC examined how supply chains are adapting to these changes and the role that knowledge and innovation play in them. The project's research findings reveal how companies are adapting to recent challenges and the potential of trade networks to support their resilience. The project also investigated the interlinkages between knowledge flows and trade in goods. Several contributions develop and investigate knowledge-input-output tables. These allow to examine knowledge flows across countries. Some of this research focuses on the innovation economy and the relationship between research, innovation, and employment outcomes. Throughout the project, the research highlights the interlinkages between different policy areas. Innovation, tax and trade policies interact with each other and affect the other domains. This highlights the need for further investigation of these links and closer coordination between the different policy areas.

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1.Introduction

At least since the Sino-US trade war of 2018, strains to global supply chains (GSCs) have emerged that are unprecedented in modern history. The pandemic, the energy crisis triggered by the Russian invasion of Ukraine, US-China geopolitical rivalry and President Trump's trade policies have all caused major disruptions and uncertainty in GSCs. This is all happening against the backdrop of anaemic productivity growth in the EU, which points to the need to strengthen the European innovation ecosystem. The research programme of the Horizon Europe Project RETHINK-GSC was devised during the pandemic. While it could not have foreseen exactly how the international trading system would be challenged by more recent events, it did correctly identify the trends shaping supply chains. Therefore, its research programme is perhaps even more relevant today than when it was devised. By focusing on the impact of shocks on GSCs and the interplay between knowledge, innovation, and trade, the programme addresses key gaps in our understanding of GSCs.

This paper highlights the results of the studies conducted throughout the project. It is structured around three high level insights that emerged from them: First, firms adapt their supply chains in response to shocks in a differentiated way, with many reconfiguring their supplier networks. Those involved in innovative networks that facilitate knowledge sharing were the most likely to adapt. Second, knowledge and the trade of goods are deeply interconnected. Our understanding of goods flows in supply chains far exceeds our understanding of the global knowledge economy. A key part of this project was therefore to develop new insights into the links between production networks and innovation. The research shows that trade, production and innovation are connected, and that policies promoting one area also affect the others. Third, innovation drives resilience. Papers written as part of the project demonstrate a clear link between innovation, job creation and regional growth. However, Europe is still struggling to close the gap between research and its commercialisation. Strengthening this link is essential for unlocking the economic benefits of research.

2.How firms adapt to shocks

The COVID-19 pandemic was the largest trade shock in post-war history. In reaction to the shock and in anticipation of potential shortages of key goods, governments immediately started to enact unprecedented market interventions. Léry-Moffat and Poitiers (2024) look at three recent large trade shocks: the pandemic, the Russian invasion of Ukraine and the Sino-US trade war. They come to the conclusions that GSCs were remarkably resilient given the size of the economic shocks. In 2025, the re-election of President Trump, who run on a campaign promising to raise tariffs to historical levels, has put the viability of the rules-based trading system into doubt. Given the expectation of continued volatility in the trade policy environment and the risk of further geopolitical upheaval, it is paramount to understand how companies and supply chains are adapting to such shocks. Despite the resurgence of government interventions intended to shape supply chains, firms are the key players that organize and adapt them to the changing economic environment. Recent events provide a basis to study the effect that such shocks can have on them and one of the key research strands of the RETHINKG-GSC project looks at this angle.

To understand how firms react to such shocks, Bistray *et al* (2024) conducted the 'Supply Chain Disruption Survey'. In this survey, they asked firms in Austria, Denmark, Germany and Hungary about their relationship with their suppliers in the context of supply chain disruptions. 60% of the participating firms reported that they faced disruptions with suppliers outside the EU cause by the pandemic and the Russian invasion of Ukraine. Many of those reported reconfiguring their supplier networks, many did so by diversifying their suppliers. Marette *et al* (2025) study how multinational enterprises (MNEs) adapted their supply chains after the pandemic. Using a dataset of more than 650 000 firms in 29 countries, they find that MNEs outperformed domestic companies after the pandemic, and especially domestic affiliates of MNEs. The results indicate that MNEs cushioned the shock to employment of the labour force in their home country relative to wholly domestic firms and foreign affiliates of MNEs. Greppi-Maturana and Poitiers (2025) look at the effect that the pandemic had on low income and lower middle-income countries. They look at the collapse of commodity prices at the onset of the pandemic and disruptions in the textile supply chain. These two industries play crucial roles for developing countries. A lack of export diversification was a major problem for many of the countries in question, which meant that shocks to their main export goods had an immediate effect on their ability to finance imports of food and service foreign denominated debt. The paper points to the need to focus on diversification of their trade. Barata da Rocha *et al* (2025b) look at how the effect of extreme weather events can transmit through extreme weather events. They identify three main channels: disruption of manufacturing activity, disruption of infrastructure such as transport routes and the effects on agricultural production. They find that the effect of recent events has measurable but short-lived macroeconomic effects. As such extreme weather events will become more frequent and intense, the importance of adaptation and policy coordination will become more important. Meuchelböck (2025) explores one such extreme weather event in detail.

The paper studies the effect of low water levels in the Rhine River caused by drought conditions in 2018. It finds that firms relying on inland shipping reduced their exports across multiple dimensions, and that the event led to a persistent shift towards other forms of transportation.

Several studies look at Brexit as an example for sudden politically driven change in supply chains. Merchán and Görg (2025) use Brexit as a case study to investigate how trade shocks affect the compensation of executive management. Looking at German listed firms, they find a negative effect on the compensation of executives in the services sector through lower variable payments. Nevertheless, this adjustment was smaller than the measured fall in worker pay, leading to an increasing CEO-to-worker pay premium. On the other side, they do not find an effect on the renumeration of executives in the manufacturing sector beyond a compositional shift to equity payments. The authors speculate that this might be because manufacturing companies were able to adjust their export portfolio to other destinations, alleviating the losses incurred by Brexit. Davies and Specht (2024) investigate the effect that Brexit had on international students using a gravity model on migration. They find that Brexit reduced the number of foreign students immigrating to the UK by 3.8% to 4.9%. This is driven by a reduction of EU students going to the UK which is only partially off-set by an increase in student migration from other source countries. Furthermore, the number of UK students going abroad decreased by approximately 30% to 38%

Another set of studies look at the effect of geopolitics for trade. Görg *et al* (2023) study the impact of sanctions following the Russian annexation of Crimea in 2014. They find that the impact of the sanctions on German firms was concentrated in a small number of firms that exported a high share of their goods to Russia in categories that were subject to sanctions. They document a 13% decline in the probability to export to Russia driven by both fewer firms entering the Russian market and more exiting it. Those firms that still traded with Russia decreased the value, quantity and number of products they exported there. Their growth of exports to Russia decreased by 17 percentage points after the imposition of sanctions. The negative effects were not contained to products subject to sanctions. Meanwhile, President Trump has upended US trade under WTO rules which is underpinned by the most favoured nation (MFN) principle, as the US introduced historically high tariffs on a bilateral basis. Davies (2025a) explores which set of assumptions could rationalize the Trump tariffs. Fossum *et al* (2024) investigate the effect of the expiration of the preferential treatment of developing countries by the US. Like other developed economies (including the EU), the US used to run a tariff scheme under the so called 'Generalized System of Preferences' (GSP) which provided lower tariffs to developing countries. This system required frequent re-approval by the US Congress and the failure to pass such legislation led to its expiration in 2021[1]. Fossum *et al* (2024) look at the effect that this had on developing countries. They find that exports to the US from previous eligible countries fell by 5%, with twice the effect in non-industrialized countries but somewhat smaller effect for the least develop countries. This is likely due to their lower utilization rate of the scheme due to

[1] This was not the first time, that the deadline to ensure continued funding for this program was lapsed, yet this time the expiration of this program was permanent.

the administrative burden attached to it. Meanwhile, there are increasing signs of structural challenges weakening the demand for European exports from Chinese economy. Barata da Rocha *et al* (2025a) explore at what the combination of changes in the Chinese and US economy could meane for the EU. Both countries are among the top three trading partners (the UK being the third), and the upheaval in the trade relationship could become a significant headwind for the European economy. Nevertheless, the authors argue that the impact should not be exaggerated and advocate for a stronger focus on improving trade relationships with the rest of the world.

3. The link between knowledge and goods flow

The importance of technology is ever increasing, yet the EU is perceived as lagging in key technology areas such as digital and AI. As the EU seeks to improve its strategic autonomy, it has become imperative to improve its innovative capacity especially where it has one sided technological dependencies. Furthermore, innovation is key to improve productivity and thus economic growth. Global value chains play an important role in the creation of knowledge. As Sekut and Poitiers (2024) discuss, international knowledge flows as fostered through GSC play an important role for both knowledge dissemination and creation. However, the perceived political risks of technology dependencies have increased, and governments have become more willing to impose barriers to knowledge flows. Services flows are also crucial in the transatlantic trade relationship, as Bickenbach *et al* (2025) discuss. While the EU has a bilateral trade surplus with the US in goods, it has a deficit in services. They argue that services should therefore be considered in the EU-US trade negotiations with the Trump administration. This highlights the importance of understanding the role of services and the connection of knowledge flows in GSCs.

To better understand these links, several papers construct and explore 'knowledge input-output tables' (KIO). Building on the concept of goods input-output tables (IOT), this project sought to build analogous datasets for the role of knowledge creation. Such a KIO provides a dataset linking the 'input' of knowledge by origin with the 'output' of knowledge and thus allowing to identify the role of cross-country linkages for innovation. Davies *et al* (2023) build a KIO for patents. They construct a dataset covering 10 countries (plus the rest of the world) and 131 technologies between 1980 and 2019[2]. While patents themselves are not equivalent to innovation per se, they are perhaps the closest measurable proxy. The dataset opens promising new avenues for research. For example, Davies *et al* (2023) report a jump in the number of patents around 2015 when there was a sharp acceleration of patent activity in China, which has become the largest country by number of patents. The paper also highlights the importance of cross-country linkages, with slightly less than half of citations being cross-country citations. China stands out as being relatively isolated. Davies and Yang (2024) show that there is generally a strong similarity between KIO and traditional IOT of goods. They show that knowledge flows are more international than product flow, but there are less cross sector flows. However, Western countries are more dominant in KIO and Asian countries are somewhat more isolated in them compared to IOT. In a similar spirit to the patent-based KIO, Békés *et al* (2023) construct a KIO based on open-source software (OSS) development. They construct a

[2] This dataset draws on PATSTAT. For data quality reasons, they restrict the dataset to patents from the "big five" offices: the European Patent Office, the US Patent Office, the Chinese Patent Office, the Japanese Patent Office, and the Korean Patent Office. These account for approximately 85% of patents worldwide (source: WIPO).

dataset of cross-country collaborations in open-source projects for the Java-Script programming language. They combine two datasets[3] to create an OSS input output table for the period between 2013 and 2019 that they intent to use to study the OSS ecosystem as example of international links in knowledge creation.

Koch and Nocco (2024) study the role that buyer networks play for supply chain organisation and knowledge transmission. They show that companies can save on the costs of their intermediate inputs if they participate in such networks. These cost savings are higher in buyer networks that feature efficient knowledge transmission within the network. Efficient knowledge transmission also boosts innovation and product quality improvements. Heiland and Šváb (2024) estimate a gravity trade model with trade in value added rather than gross trade data. They do not find that conventional gravity equations hold for such value-added trade flows. Based on their results, they advise caution when considering such trade in value added gravity models, as they show that they can easily be mis-specified. Meanwhile, Görg and Jäkel (2024) look at the role of gender norms and institutions in trading partner countries on the performance of female entrepreneurs in Denmark. They find clear evidence for a disadvantage for female entrepreneurs when trading with countries that have strong biases against women. This effect exists both in the extensive and intensive margin: female entrepreneurs are both less likely to trade with less gender-equal countries, and those that do have relatively lower exports to these countries[4].

[3] Libraries.io and GHtorrent for information on software dependencies and user activity on the software development platform Github, respectively.
[4] However, there is no clear effect on the intensive margin for imports.

4.How innovation drives resilience

The last strand of research in the project looks at the determinants of innovative capacities of universities as well as the link between innovation, GSC and employment outcomes. Parteka *et al* (2024) construct a novel dataset (KC-HEI) on higher education institutions (HEI) in Europe, combining information on their patenting activities with information on the institutions themselves. European universities lag in patenting – less than 10% of patents come from them indicating weak research-to-market transfer. They document that there is a very high level of concentration of patenting activities, with 70% of HEIs not patenting at all and 5% of universities accounting for half of all patent applications. Wolszczack *et al* (2025) use this dataset to document the role that university funding structures play for the transfer of knowledge. The transfer of knowledge from research to markets is a key problem in the European innovation landscape. To understand how this could be improved, they investigate the role that funding structures play in explaining the differences in outcomes. They find that those HEI that patent are richer and have a higher share of third-party revenues. However, third party funding seems to have no positive impact on patenting activity in low-income regions. The results thus suggests that incentives to diversify funding activities can increase innovation in wealthy regions, whereas such a policy is unlikely to work in poorer regions. Wolszczak-Derlacz (2024) look at co-patenting between universities and companies. She finds that larger, richer and older universities are more active in patenting, both along the extensive and intensive margin. Public universities are more likely to be patenting than private ones. However, the results are somewhat different when looking at co-patenting: smaller and younger universities are more likely to engage in co-patenting. However, here the results diverge across the extensive and intensive margins, with larger and older universities more likely to co-patent but if they do they have less co-patents.

Davies *et al* (2025a) study the relationship between innovation and employment in the EU. They find that the number of patents filed within a region has a strong positive correlation with employment, and especially so for innovation that is well connected through citation networks. This effect is strongest in manufacturing and for high-skilled workers. However, innovation is highly concentrated, with 50% of patents in the dataset coming from only 22 regions in the EU. Furthermore, diversification of innovation seems to have positive effects on employment. Regions where innovation is concentrated in only a few technological areas tend to have lower levels of employment. Davies *et al* (2025b) look at the link between innovation (as measured by patents) and employment growth within firms. They confirm the finding that MNEs are drivers of innovation and patent more than purely domestic firms, and their presence in a region is linked to higher patenting activities. Innovative firms are faster growing, a pattern that is more pronounced for multinationals. Affiliates of MNEs do not only benefit in term of employment growth from their own innovations but also of innovations in other affiliates. This research not only confirms the importance of MNEs as key actors in the innovation landscape but also the role they play for technology transfers across borders.

Similarly, by combining different datasets on supplier-buyer relationships of Hungarian firms, Bisztray and Muraközy (2023) show that suppliers that have GSC connected or particularly productive buyers are more likely to cooperate with them. Firms that are cooperating and those that have productive buyers are more innovative and especially in the green technologies and have higher productivity growth.

Blanas *et al* (2024) look at the effect of value chain participation on labour productivity and employment. Looking at a dataset covering 62 countries between 2000 and 2019, they find that both forward and backward participation in supply chains increased labour productivity. However, while sourcing inputs from GSCs led to both output and labour losses, the sale to GSCs had an ambiguous effect. Depending on the estimation specification, the results suggest it was either driven by output gains or employment losses. Unlike high-income countries, in low-income countries sourcing from GSCs actually increased output. Selling to GSCs raises employment and output in high income countries, but it lowers employment relative to decreasing output in low-income countries (leading to an increase in labour productivity). The authors speculate that the counter intuitive result that selling more to GSC leads to lower output in low-income countries could simply be driven by relative performance of the sectors that increased their GSC participation in the period studied. Davies (2025b) look at the effect of patenting activity on decarbonisation in 20 different European manufacturing industries. The paper finds that reverse causality is a significant factor in explaining the link between green patenting and emissions reductions. Such reverse causality exists, for example, because there is higher political and consumer pressure on high emission sectors to reduce their emissions which can both explain emission reduction and more green patenting activity. Controlling for this effect, the paper finds no link between green patenting and emissions reductions.

5.Conclusion

The RETHINK-GSC project sought deepen our understanding of supply chains. After a series of sever shocks to GSC and at a time when the fundamental tenants of global trade governance are in question, understanding these links is more important than ever. It focused on the role of knowledge and innovation as well as how GSC are adapting to economic shocks and the changing economic environment. From this research, a few high-level policy learnings emerged from the research.

First, GSCs have proven themselves remarkably resilient in face of a set of sever adverse shocks. Firms have adapted to them in a differentiated manner, including by diversifying their suppliers. Second, GSCs play an important role in the knowledge economy. This link is crucial for understanding how to promote innovation and productivity growth and decrease one-sided technological dependencies. It also means that innovation policy has direct implication for trade, while trade policy shapes the innovative capacity of the European economy. Tax policy interacts with both, and none of the three should be considered in isolation. Secondly, Europe is lacking behind in its capacity to transform research into commercial successful innovation. Only a small number of universities and comparable higher education institutions are actively involved in commercialising research through patenting activities. All of this points to the need to further strengthen the knowledge economy, through adequate funding and the right incentives for research institutions as well as a focus on how other policies such as trade and tax policy can contribute to advancing the European innovation landscape.

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ABOUT RETHINK-GSC

The project ‚Rethinking Global Supply Chains: Measurement, Impact and Policy' (RETHINK-GSC) captures the impact of knowledge flows and service inputs in Global Supply Chains (GSCs). Researchers from 11 institutes are applying their broad expertise in a multidisciplinary approach, developing new methodologies and using innovative techniques to analyse, measure and quantify the increasing importance of intangibles in global supply chains and to provide new insights into current and expected changes in global production processes.

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