

Supply chains and market power

CMA Microeconomics Unit

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CMA212



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Contents

1. Executive Summary	2
2. Introduction	12
3. Definitions and data sources.....	15
4. Evolution of UK supply chains	18
5. Drivers of changes to UK supply chains	36
6. Market power in the supply network.....	46
7. The UK in a global supply network.....	63
8. Propagation of shocks through the supply chain	71
9. Conclusion and policy recommendations.....	84
10. Appendix A: Figures and tables	87
11. Appendix B: Data sources	91
12. Appendix C: Methodology (high-level)	99
13. Appendix D: Methodology (detailed).....	102
14. Appendix E: Supply chain metric summary statistics	109
Acknowledgments	115
Glossary	116

1. Executive Summary

Introduction

- 1.1 Supply chains are the arteries of the economy, connecting firms through flows of inputs and outputs that ultimately shape the availability, quality and price of goods and services for consumers. Yet until recently, data quality and availability have restricted detailed analytical assessments of supply chain structures and vulnerabilities.
- 1.2 The CMA's 2023 Market Resilience Discussion Paper ([CMA, 2023](#)) introduced a framework to assess how market structures and supply dependencies shape resilience to shocks, highlighting the role of upstream market power, supply concentration, and barriers to entry. These themes align with government calls for stronger evidence on economic resilience, industrial strategy, and critical imports ([DBT](#), [HMT](#), [DSIT](#)). Recent geopolitical tensions have further highlighted the importance of understanding the role of supply chains in transmitting economic shocks.¹
- 1.1 This report builds on that foundation, using business-to-business payment flows data to offer new empirical insights into the UK's supply network, the distribution of market power, and how shocks propagate through the economy.
- 1.2 To characterise the network, we use three simple indicators:
 - (a) **Supply chain length**: the number of production stages from raw materials to final product.
 - (b) **Centrality**: a sector's importance in the network, based on its size and linkages to other sectors.
 - (c) **Import resilience**: a sector's resilience to external disruptions, calculated as a combination of the diversity of its imports and the share of its inputs that are imported.
- 1.3 We use these metrics, along with indicators of market power from the [CMA's 2024 State of UK Competition](#) report to:

¹ Although this paper has been published during a period of conflict in the Middle East that is likely to have implications for supply chains, it does not analyse or seek to draw conclusions regarding the specific impacts of that conflict.

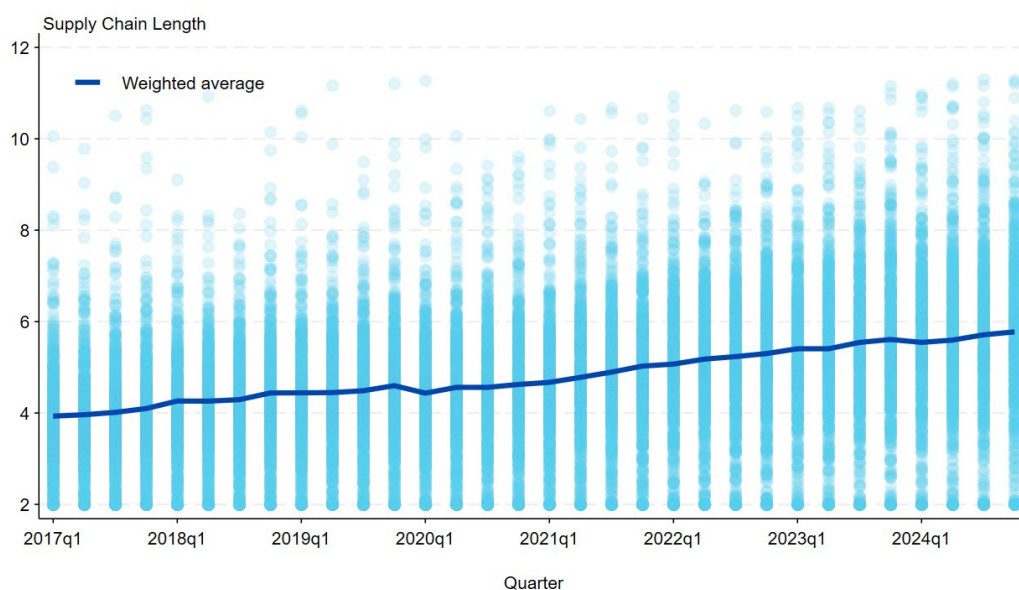
- (a) Map how UK supply chains have evolved over time.
- (b) Explore the relationship between supply chain indicators (e.g. length) and market power indicators (e.g. markups).
- (c) Assess how the interaction of supply chain structure and market power propagate external shocks to the UK economy.

How has the UK's domestic supply network evolved over time?

- 1.4 UK supply chains have lengthened significantly over the past decade. We find that supply chain lengths have increased by between 5% and 40%, depending on the data and exact period considered. This may reflect growing specialisation across firms and countries, with production processes involving more stages than before.
- 1.5 Importantly, this trend stems primarily from existing industries deepening their supply chains, as opposed to a reallocation of economic activity towards inherently complex sectors.

Figure 1: Supply chains have lengthened across UK sectors

Dark blue line represents the whole economy mean supply chain length, weighted by the share of payment flows. Each dot represents a 4-digit Standard Industrial Classification (SIC) sector in that quarter. Data from ONS UK Industry-to-industry payment flows (2017-2024).



Whole-economy mean supply chain length, weighted by share of payment flows, at 4 digit SIC level. Data from ONS UK Industry-to-industry payment flows (2017-2024).

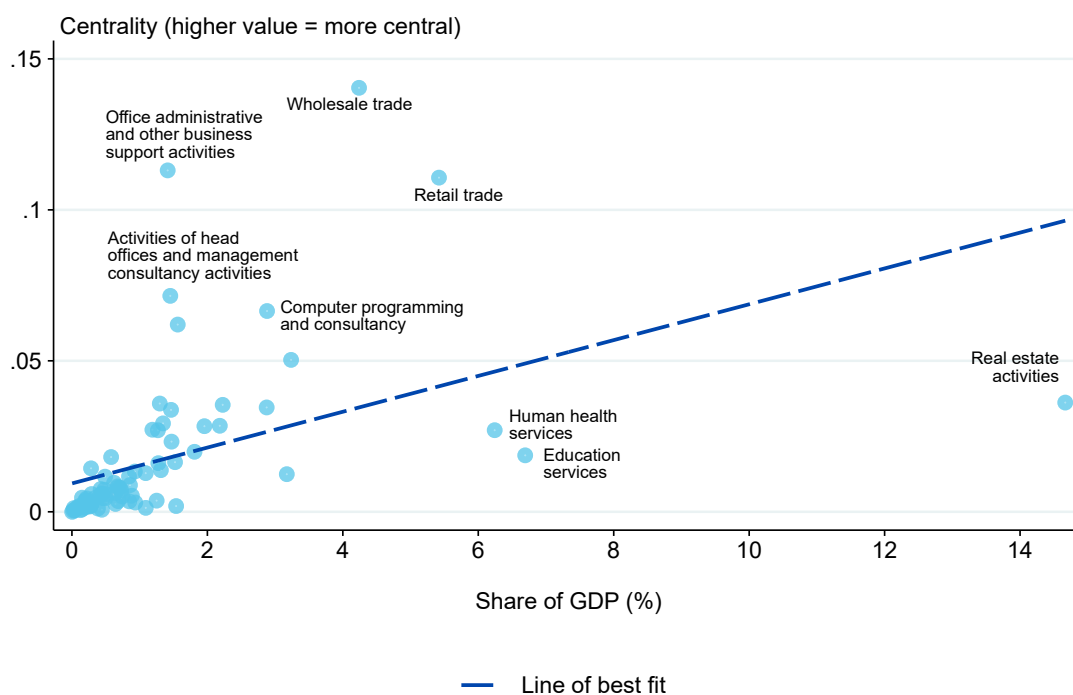
- 1.6 The sectors with the longest supply chains are primarily in manufacturing, especially beverages, electrical equipment, and basic metals, where production typically involves multiple tiers of suppliers and sub-assembly.
- 1.7 The length of supply chains for the [eight Industrial Strategy sectors](#) (IS-8) have increased broadly in line with the economy-wide average.²
- 1.8 Service sector supply chains increased in length more than any other part of the economy between 2017 and 2025. Postal activities, security services, scientific and technical services, and architectural and engineering services experienced the biggest increases, with supply chain lengths rising by 65% to 75%.
- 1.9 Links among similar activities have strengthened over time. Closely related sectors (with very granular industry groupings) traded more with each other (by value) in 2024 than in 2017, a pattern consistent with deepening specialisation.
- 1.10 Supply chains have lengthened not only in services but also in agriculture and manufacturing, suggesting broader technological and organisational drivers instead of purely a structural shift to services.
- 1.11 Our final finding on length is that sectors associated with longer supply chains tend to have higher levels of productivity, but lengthening does not subsequently cause faster productivity growth. Other forces (technology adoption, management, competition, skills, capital) matter more.
- 1.12 Alongside supply chain length, it is important to consider how critical each sector (or node) is to the network. We capture the importance of a sector by measuring its size and linkages to other sectors, a metric called centrality in the literature.
- 1.13 Despite the increasing complexity and length of supply chains, the most central sectors in the UK economy have remained stable, with wholesale trade, office administration and retail trade consistently ranking among the most central sectors in the economy. While these sectors are among the largest by Gross Domestic Product (GDP), they are central due to both their size and their importance as suppliers of other sectors within the supply network.

² The eight IS sectors are: Advanced Manufacturing, Clean Energy Industries, Creative Industries, Defence Digital and Technologies, Financial Services, Life Sciences, Professional and Business Services

- 1.14 Sectors with higher centrality than might be inferred from their GDP share often act as key enablers or “structural anchors” in production networks, meaning that their importance comes from their position as hubs or bridges connecting many other sectors, rather than from their direct value-added. For example, Figure 2 shows that enabling sectors such as consulting, wholesale trade and business support services have high centrality relative to their share of GDP.
- 1.15 We extend this analysis to consider the IS-8 sectors and find that most of the IS-8 are indeed highly central nodes in the network. These priority sectors not only contribute significantly to GDP but also serve as important hubs with extensive linkages. This suggests that the sectors chosen for their growth potential are also structurally important for the economy’s supply network, reinforcing the view that supporting them could generate broad spillover benefits, while any vulnerabilities in these sectors, such as supply bottlenecks or market power issues, could have system-wide effects.

Figure 2: Sectors such as consulting, wholesale trade and business support services have high centrality relative to their share in GDP

Sectors’ average unweighted centrality and their size in the UK economy as measured by their contribution to GDP. Data from ONS UK industry-to-industry payment flows 2017-2024. Sectors are at the 2-digit SIC level.



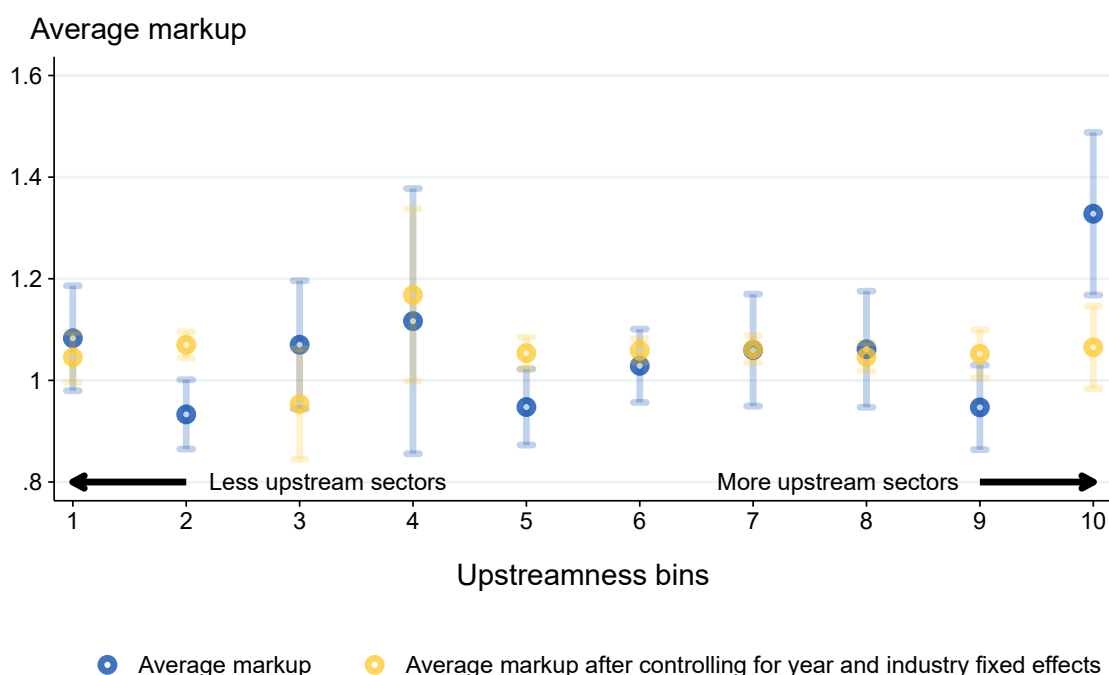
Correlations between sectors' average centrality (unweighted) and their size in the UK economy, at 2 digit SIC level. Data from ONS UK Industry-to-industry payment flows(2017-2024).

Market power in supply chains

- 1.16 We find that market power is unevenly distributed across UK supply chains and does not consistently correlate with supply chain length or centrality.
- 1.17 Echoing the findings in [State of UK Competition 2024](#), we find that there is a small positive relationship between the “upstreamness” of a sector and its markup. However, we find that this relationship is being driven by other factors, such as markup trends over time and sector-specific factors, and not by the distance of a sector from the consumer. Put differently, as a sector’s upstreamness rises over time, which does not lead to a rise in its price-cost markup, as displayed in Figure 3.

Figure 3: At face value, markups appear higher in upstream sectors

Binned scatterplot showing the average price-cost markup across upstreamness bins, both with and without controlling for year and industry fixed effects, across the period 2017 to 2022. Data from ONS UK Industry-to-Industry payment flows (2017 to 2024) and the CMA State of UK Competition Report (2024).



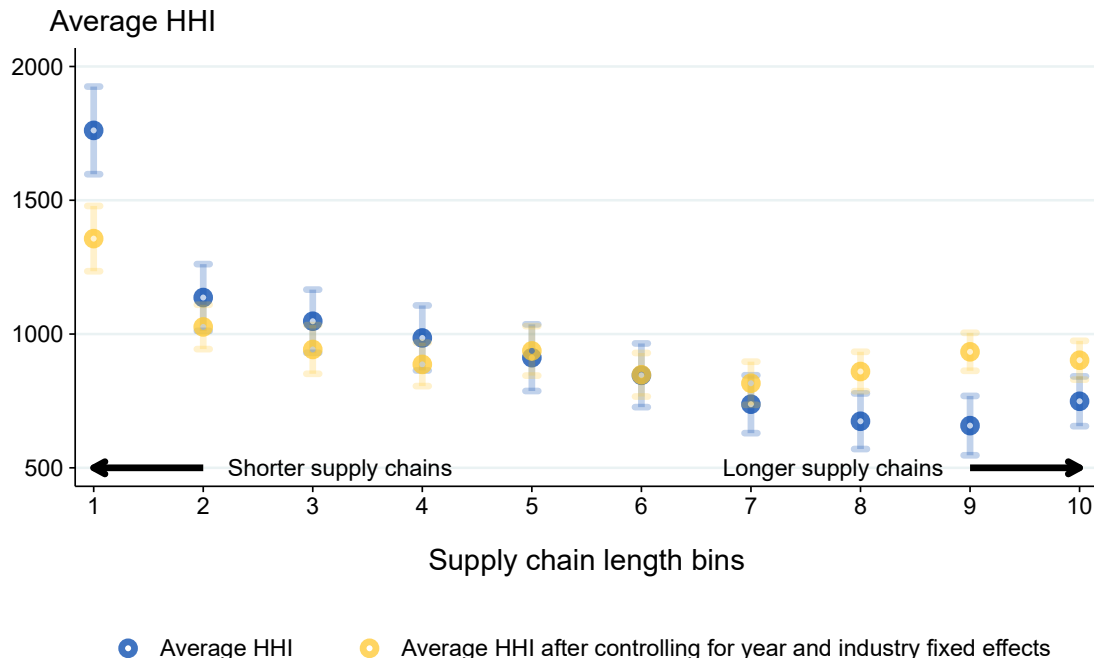
Year fixed effects control for unobserved factors which affect all sectors but vary over time, while industry fixed effects control for time-invariant 2-digit Standard Industrial Classification (SIC) sector specific characteristics. Data from *ONS UK Input-output analytical tables: product by product (2017-2021)* and *CMA State of UK Competition Report (2024)*. Data covers the period 2017 to 2021 at the 2-digit SIC level. Analysis excludes where available household, government/non-market and not-for-profit sectors.

- 1.18 We find that sectors characterised by longer sector-level supply chains tend to be associated with lower concentration, as measured by the

sectoral Herfindahl–Hirschman Index (HHI). This relationship holds when controlling for sector and year effects, indicating that it is identified by within-sector changes over time: in years when a sector’s supply chain is longer than its own average, its HHI tends to be lower on average. This relationship should be interpreted with care because supply chain length summarises the depth and complexity of upstream production linkages, whereas the HHI measures concentration within the sector itself. In particular, a sector having a lower HHI need not mean the whole upstream supply chain is fragmented or that overall market power is lower. Indeed, vertically integrated firms can coordinate multiple stages, and long chains can still contain concentrated upstream sectors. We therefore cannot make inferences about economy-wide fragmentation, market power, or resilience from this result alone.

Figure 4: Sectors with longer supply chains are associated with lower concentration

Binned scatterplot showing the average Herfindahl–Hirschman Index (HHI) across supply chain length bins, both with and without controlling for year and industry fixed effects, across the period 2017 to 2022. Data from ONS UK Industry-to-Industry payment flows (2017 to 2024) and the CMA State of UK Competition Report (2024).



Year fixed effects control for unobserved factors which affect all sectors but vary over time, while industry fixed effects control for time-invariant 3-digit Standard Industrial Classification (SIC) sector specific characteristics. Data from ONS UK Industry-to-Industry payment flows (2017-2024) and CMA State of UK Competition Report (2024). Data covers the period 2017 to 2022 at the 4-digit SIC level.

- 1.19 Importantly, we find evidence that markup-related distortions can accumulate through supply linkages, meaning downstream (consumer-facing) sectors may be exposed to larger cumulative distortions even when no single upstream sector has high markups. This is consistent with double marginalisation and underlines that assessing consumer harm may require a supply-chain perspective.³

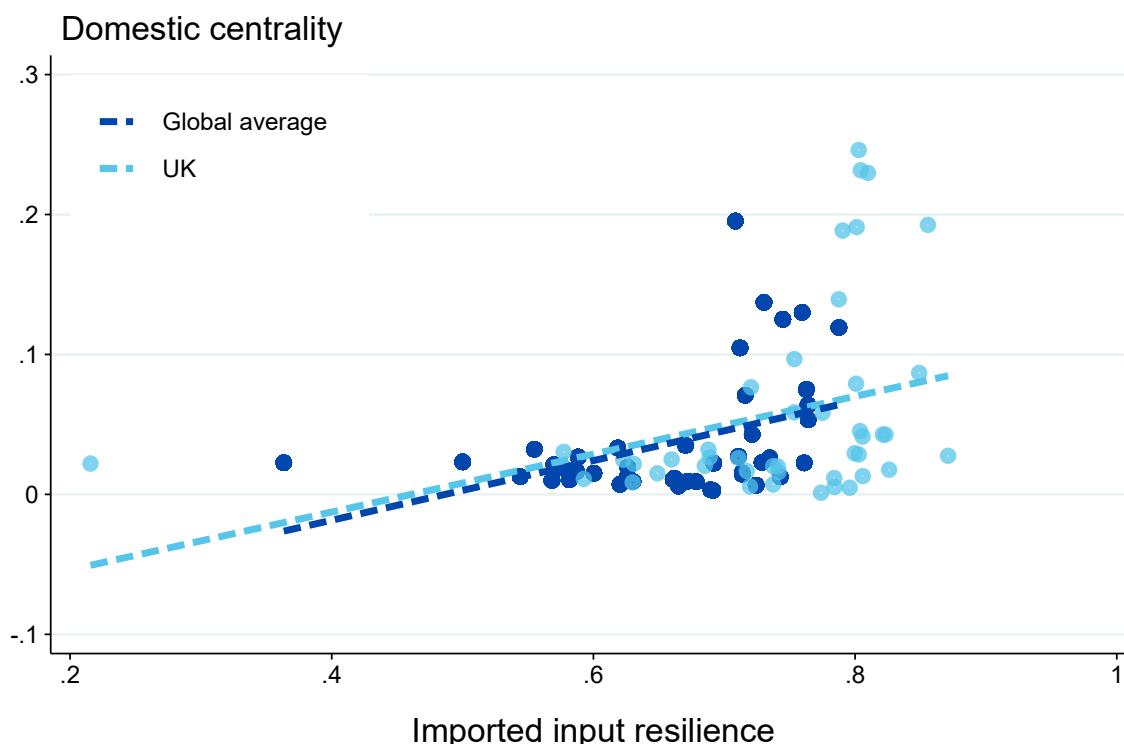
The UK in global supply networks

- 1.20 UK sectors are generally well-diversified in their sourcing of imported inputs, with the UK consistently ranking highly among advanced economies for both import and export diversification.
- 1.21 We find that the UK economy is more resilient to external disruptions than the global average. This is a measure of reliance on imported inputs, multiplied by the diversity of import supply. While an increase in the share of imports has led to a small decline in resilience in recent decades, this is part of a global trend and is not unique to the UK.
- 1.22 Sectors that are more central in the UK supply network tend to be more resilient, implying that pivotal sectors are better positioned to absorb external shocks due to broader sourcing and less reliance on imports. Figure 5 shows this relationship for 44 high-level sectors such as food manufacturing, retail trade, and education.

³ Double marginalisation is where each layer of market power adds a markup, compounding distortions (Spengler, 1950).

Figure 5: More central sectors tend to have higher levels of resilience

The relationship between domestic centrality and imported input resilience, for both the UK and the global average. Each dot represents a sector. The dark blue dots are the global average – the mean value over all 77 countries within the dataset. The light blue dots are the average values in the UK only. Centrality values are the domestic centrality of a sector, capturing importance within its own rather than the global economy. Data from OECD Inter-Country Input-Output Tables (2019).



Each point represents a sector's average resilience against its domestic centrality in 2019. The global average is an unweighted average across all 77 countries. Line of best fit shown for all 77 countries in dark blue, and for the UK only in light blue. Using OECD *Inter-Country Input-Output Tables*.

- 1.23 It seems likely that global forces, rather than UK-specific factors, are shaping supply chain evolution. Cross-country comparisons show that the UK's supply chain structure is broadly similar to peer economies. The UK's average supply chain length sits in the middle of the global distribution and the UK's position has remained stable over time. Primary sectors have seen rising diversification, services have declined slightly, and manufacturing has remained broadly unchanged. The UK's imported inputs are more diversified than those of the US in primary and manufacturing sectors, though slightly less so in services.
- 1.24 To understand how shocks propagate through UK supply chains, we examined a significant historical event: China's accession to the World Trade

Organization (WTO) in 2001, commonly referred to as the “China shock.” This marked a large increase in supply of inputs, giving UK firms access to cheaper and more abundant inputs from China, while at the same time increasing the competition they face from abroad.

- 1.25 We assessed each UK sector’s exposure to this shock by measuring the growth in imports from China in the years following WTO accession, relative to sector size. The impact varied widely:
- (a) Motor vehicles, transport equipment, and pharmaceuticals were among the most affected industries, receiving a substantial influx of Chinese components and materials.
 - (b) Accommodation, food services, and hospitality were largely unaffected, relying more on domestic inputs that China does not typically supply.
- 1.26 This uneven exposure created a natural experiment to observe how the UK production network responds to global change. Following previous related research, we study employment changes across sectors as this allow us to read the results as changes in relative labour demand induced by the trade shock.⁴ Two key findings emerged:
- (a) **Sectors exposed to the trade shock became more central:** Sectors that benefitted from cheaper Chinese inputs became more central within the UK supply network over time. These industries expanded output and began supplying more to other sectors. For example, the automotive sector, having gained access to lower-cost components, scaled up production and increased demand from its own suppliers - reinforcing its role as a key node in the network. While these sectors grew in importance, the structure of their supply chains remained stable. The shock influenced scale and output but did not fundamentally alter the number of production stages or the configuration of supplier relationships.
 - (b) **Market power did not amplify the shock:** While parts of the recent literature find that market power can shape the pass through of cost shocks, particularly for positive cost shocks or via asymmetric pass through when costs fall, our sector level results suggest that, in this episode, sectoral responses to the shock are explained primarily by how exposed a sector was to the shock, rather than by its level of market concentration.

⁴ See for instance [Acemoglu et al. \(2016\)](#).

- 1.27 We find that the China shock ultimately had a net positive effect on UK employment, largely due to indirect spillovers. Cheaper inputs reduced production costs and prices, stimulating demand in downstream sectors and creating jobs. This outweighed reduced demand in industries facing increased import competition. While our findings are specific to this case, we provide a framework and method for thinking about similar issues.

Policy implications

- 1.28 We find that UK supply chains have become longer, more fragmented, and increasingly reliant on specialised inputs. While this may reflect productivity-enhancing specialisation, it also introduces new vulnerabilities.
- 1.29 The Market Resilience framework previously produced by the CMA helps interpret these findings: longer chains and concentrated sourcing amplify disruption risks, while central sectors are key transmission channels. Policymakers should therefore treat supply chain structure, not just sector size, as a determinant of resilience.
- 1.30 For competition policy, the findings suggest that consideration of market power concerns should be targeted and evidence-led. Metrics like distortion centrality, a measure of how market imperfections such as markups accumulate within a supply network, and markup propagation may offer new ways to inform the CMA's priorities.
- 1.31 For wider government, the findings support government's call for stronger evidence on resilience and critical imports. Sectors with high centrality and diversified sourcing are more resilient; those with long chains and concentrated imports are more exposed. Rather than focusing solely on reshoring or shortening supply chains, this suggests policy should aim to build flexible, well-connected networks with multiple sourcing options.

2. Introduction

Background and purpose

- 2.1 Supply chains, the linked sequences of suppliers and producers turning raw inputs into final products, are the arteries of the global economy. Technological change and global specialisation have made supply chains longer and more complex, creating new growth opportunities as well as vulnerabilities. In a world of geopolitical uncertainty, pandemic risks, and climate shocks, understanding supply chains has become essential for ensuring economic resilience.
- 2.2 The Competition and Markets Authority (CMA) has recognised the importance of these issues. In its response to the Government's Industrial Strategy Green Paper (CMA, 2024), the CMA emphasised that addressing supply chain dependencies is key to building economic resilience. It committed to examine how upstream market power (at the supplier level) can affect downstream industries. This report by the CMA's Microeconomics Unit delivers on that commitment, providing new evidence on UK supply networks and competition as part of the CMA's Growth Programme.
- 2.3 Our analysis is also intended to support the Government's Industrial Strategy by shedding light on where vulnerabilities and market power sit in the economy's supply chain networks. We build on the CMA's 2023 Market Resilience Discussion Paper (CMA, 2023), which introduced a framework for assessing how market structures and supply dependencies shape resilience to shocks, highlighting the role of upstream market power, supply concentration, and barriers to entry. Recent geopolitical tensions highlight the importance of understanding the role of supply chains in transmitting economic shocks.⁵
- 2.4 Understanding supply chains also matters for consumers. Market power or fragility at upstream stages can shape the prices, quality, and availability of the goods and services that households ultimately depend on. Well-functioning and competitive upstream markets help ensure that benefits, whether from innovation, lower input costs, or productivity gains, flow through to consumers. Strengthening visibility of supply chain structures therefore supports the CMA's statutory objective to promote competitive markets and

⁵ Although this paper has been published during a period of conflict in the Middle East that is likely to have implications for supply chains, it does not analyse or seek to draw conclusions regarding the specific impacts of that conflict.

protect consumers from the downstream consequences of weak or distorted upstream competition.

- 2.5 This report therefore provides evidence to inform both discussions on industrial strategy and competition policy, and it contributes to the growing literature on production networks in economics (e.g. [Acemoglu et al., 2012](#); [Carvalho, 2014](#)) by investigating how network characteristics relate to productivity, propagation of shocks, and market power ([Bloom, Draca and Van Reenen, 2016](#); [Autor, Dorn and Hanson, 2016](#)).

Scope and approach

- 2.6 We map the UK's supply network and analyse the implications for competition and resilience. The report addresses five key questions for policymakers and the CMA:

- 2.7 How has the structure of the UK's domestic supply network evolved over time? We examine the length and complexity of UK supply chains across Standard Industrial Classification (SIC) codes from 2013 to 2024 using traditional and experimental data.

(a) What has driven these changes? We discuss drivers of supply network changes, including how specialisation and structural transformation might have reshaped networks.

(b) Where does market power sit within UK supply chains? We map concentration and markups across supply networks, estimate accumulated markups through supply chains, and investigate how market power might spread through the network.

(c) How do UK sectors fit into global networks? We assess the UK economy's engagement in global supply chains and evaluate its exposure to potential disruptions originating abroad.

(d) How do external shocks propagate through supply networks? We trace how large shocks propagate through UK supply networks and impact economic outcomes.

- 2.8 To tackle these questions, we use three complementary data sources:

- 2.9 First, [official input-output tables](#) from the Office for National Statistics (ONS) provide an annual snapshot of flows between around 90 broad sectors (2013 – 2022), capturing the overall structure of who supplies whom in the UK economy.

- 2.10 Second, a novel dataset derived from business-to-business (B2B) payments ([ONS-Pay.UK-Vocalink](#)) records monthly transactions between firms, classified into over 800 granular sectors (2017 – 2024). This rich dataset allows us to trace supply relationships at a finer industry granularity and observe changes at higher frequency.
- 2.11 Third, the OECD Regular Inter-Country Input-Output ([ICIO](#)) tables, which map the flows of goods and services used as intermediate inputs into production between 77 countries and 45 sectors in the period 1995 - 2020.
- 2.12 Using these sources, we construct several indicators to characterise the supply network:
- (a) **Supply chain length:** The number of production stages from raw materials to final output.
 - (b) **Centrality:** The systemic importance of a sector as a supplier within the network.
 - (c) **Import diversification and resilience:** Metrics to assess how a sector's supply chain might be affected by global shocks. We define an import diversification index (based on a normalised Import Herfindahl-Hirschman Index) to quantify how spread out a sector's imports are across source countries. Using this and the share of inputs that are imported, we construct an 'import resilience' score for each sector.
- 2.13 The remainder of this report is structured as follows. Section 3 (Definitions and data sources) provides a primer on supply chain analysis and sets out the data we have used. Section 4 (Evolution of UK supply chains) presents our findings on the structure of UK supply chains. Section 5 (Drivers of changes to UK supply chains) explores why these patterns have arisen and maps where market power lies in the network. Section 6 (Market power in the supply network) maps where market power lies in the network. Section 7 (The UK in a global supply network) places the UK within international supply networks and considers resilience to external shocks. Section 8 (Propagation of shocks through the supply chain builds on previous sections, using a historical trade shock to examine how global disruptions propagate through UK supply chains. Finally, Section 9 (Conclusion and policy recommendations) summarises the main findings and discusses cross-cutting policy implications.

3. Definitions and data sources

3.1 The UK's production network is complex, with millions of transactions between businesses every day. To analyse this network in a useful way for policymaking, we must first define what we mean by supply chains and how we measure them. In this section, we define the key concepts and metrics used to assess supply chains. We then introduce the data underpinning our analysis and discuss its strengths and limitations.

Defining supply chains

3.2 A supply chain encompasses the sequence of production stages that a good or service passes through from initial inputs to final consumption. Many firms are intermediate producers, selling not to end-consumers but to other firms. Thus, a supply chain can be thought of as a path through the input-output network, beginning with initial inputs (upstream) and ending with a finished product (downstream).

3.3 In reality, these chains intersect and form a complex web: a single firm often sells to multiple buyers and buys from multiple suppliers, creating a network of interconnections. At the scale of the entire economy, it is more accurate to think of a supply network rather than isolated linear chains.

3.4 For clarity, we define here some commonly used terms:

(a) **Upstream:** Closer to the initial inputs of production Numerically, it can be measured as the number of production stages between a sector and the final consumer. For example, mining is highly upstream.

(b) **Downstream:** Closer to final consumers This can be measured as the number of stages between initial inputs and a sector. For example, retail stores are highly downstream.

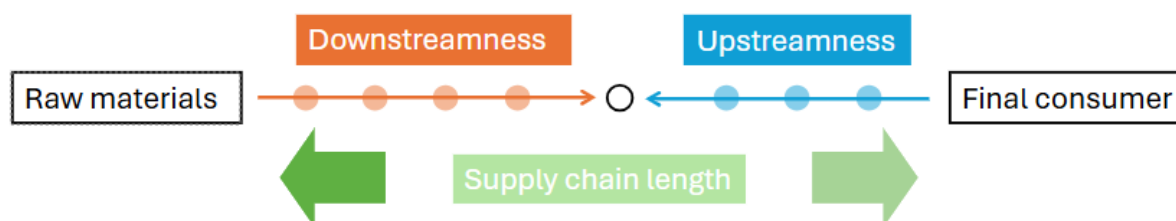
(c) **Intermediate producer:** An industry or firm that produces output used as inputs by other sectors or firms, usually sitting somewhere in the middle of a supply chain.

Measuring supply chain length

3.5 We quantify the length of a supply chain as the number of stages between initial inputs and the final consumer. At the sector level, we approximate this by summing two network distances:

- 3.6 The **upstreamness** of a sector, defined as the average number of steps between itself and consumers. We follow [Antras et al \(2012\)](#), calculating a sector's upstreamness using its connections to other sectors from the input-output structure of the economy.
- 3.7 The **downstreamness** of a sector, defined as the average number of steps between initial inputs and itself. It is computed analogously.
- 3.8 Adding upstreamness and downstreamness gives a sector's total chain length (in production stages from raw inputs to final output).
- 3.9 For example, consider the software development sector in a particular production chain. Imagine there are eight distinct sectors from the start (raw materials) to the end (final product) that involve software development as one stage. In this hypothetical chain, software development might be five steps away from the initial raw inputs (e.g. it relies on mining → metal production → semiconductor manufacturing → electronics components → software development) and four steps away from the final consumer (software development → hardware manufacturing → equipment assembly → retail → consumer). In that case, the total length of the chain involving software is nine stages. (Figure 6 schematically depicts this example with five upstream stages and four downstream stages surrounding software development.)

Figure 6: Depiction of a sector with five stages from initial inputs and four stages from final consumers



Mapping the supply network

- 3.10 Documenting UK supply networks presents several analytical challenges. Supply chains are complex, dynamic, and multi-layered, often spanning multiple sectors and geographies. Capturing this complexity in a policy-relevant way requires data that are granular, timely, and interconnected, qualities that standard economic statistics often lack. We address these challenges by combining network theory concepts with multiple data sources:
- 3.11 We apply concepts from network theory, treating each sector as a node and purchases of inputs between sectors as links connecting them ([Newman and](#)

[Park, 2018](#)). This allows us to quantify positions in the network (like centrality, described below).

- 3.12 We use input-output analysis methods ([Leontief, 1936](#); [Miller and Blair, 2009](#)) and draw on key UK datasets: ONS [Input-Output Tables](#) and new experimental B2B transactions data ([ONS-Pay.UK-Vocalink](#)). This combination allows us to map domestic supply networks at different levels of detail. To place UK supply chains in a global context, we use Organisation for Economic Co-operation (OECD) [Inter-Country Input-Output \(ICIO\)](#) data.
- 3.13 Each data source has strengths and limitations. The ONS input-output tables, from 2013 to 2022, provide a structured, economy-wide view of how goods and services flow between broad sectors. However, they are aggregated, with about 90 industry groups at the 2-digit Standard Industry Classification (SIC) level, and published annually with a lag, offering only a static snapshot. They cannot reveal firm-level dynamics or fine-grained changes in supply relationships.
- 3.14 By contrast, the experimental B2B transactions data (derived from UK interbank payment systems such as BACS and Faster Payments) offer a more granular and timely view. These data classify transactions into nearly 800 narrowly defined sectors (5-digit SIC) on a monthly basis from 2017 onwards. This high resolution lets us trace detailed supplier-buyer links and observe evolving patterns in near-real time. However, because the dataset is experimental, coverage can vary by sector (e.g. smaller firms and cash transactions can be underrepresented).
- 3.15 Using both data sources concurrently provides a richer perspective. The input-output tables give a reliable big picture, while the transactions data reveal finer detail and recent trends. Together, they enable a more nuanced understanding of supply chain structure that can better inform policy.

4. Evolution of UK supply chains

4.1 Supply chains are dynamic, not static. International evidence shows that supply chains globally have become longer and more fragmented over recent decades (Timmer et al., 2014; Antràs & Chor, 2018). In this section, we focus on the UK's experience, examining how the UK's supply network changed over the past decade and discussing potential drivers of those changes.

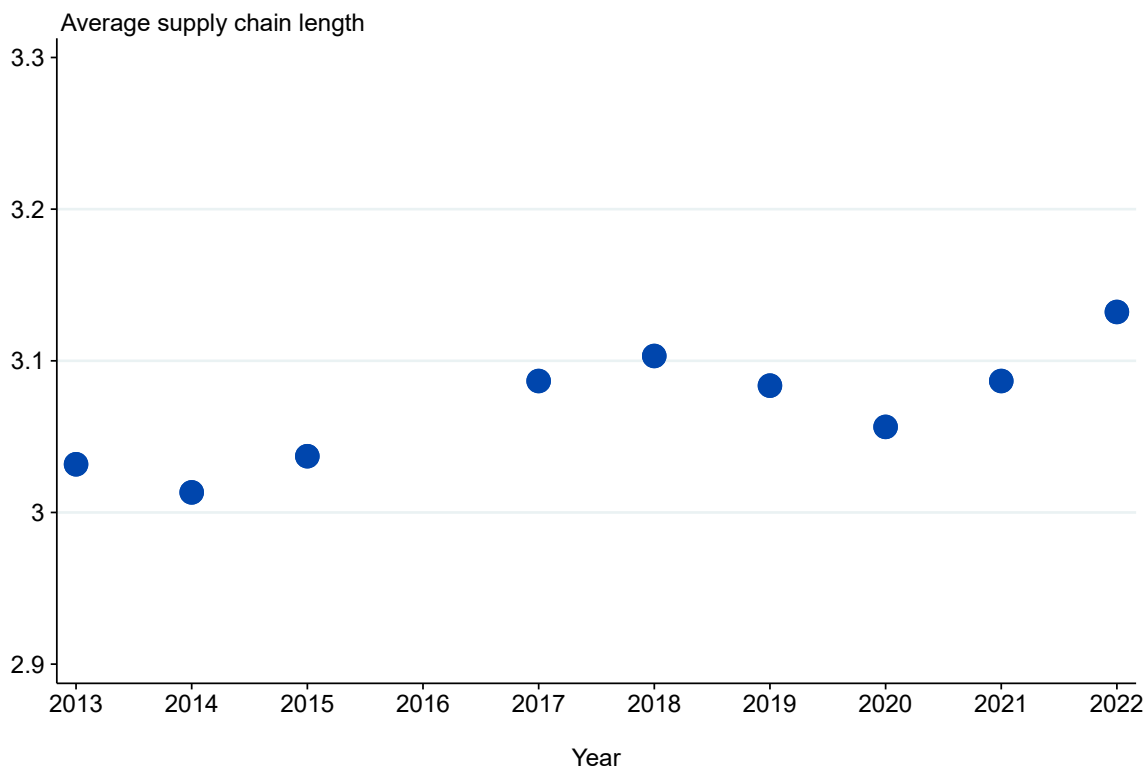
Longer supply chains

- 4.2 Our first major finding is that UK supply chains have lengthened significantly over the past 10-15 years. On average, the number of production stages between inputs and final consumers has increased substantially, by roughly 5% to 40%, depending on the dataset and time period considered.
- 4.3 This aligns with global evidence that supply chains have become more fragmented and complex over time.⁶ We observe the trend in both the annual input-output tables and the high-frequency B2B transactions data, though the magnitude differs:
- (a) Input-Output Tables (2013 to 2022): these show a modest increase in average supply chain length for the UK, from around 3.0 to 3.15 stages, roughly a 5% rise (Figure 7). The change is gradual but discernible, suggesting a slight increase in complexity over that decade.
 - (b) B2B transactions data (2017 to 2024): These suggest a much larger increase, about a 40% rise in average chain length. The average number of stages in a supply chain (measured at the 4-digit SIC level) grew from 4.0 in 2017 to 5.6 stages by 2024 (Figure 8). This indicates a marked expansion in the layers of production over a relatively short period.
- 4.4 The difference in magnitude likely reflects two factors. First, the B2B data cover a later period (from 2022 to 2024) during which rapid changes may have occurred due to the pandemic and energy price shock. In addition, this data captures the tail end of a longer upwards trend. Second, the granular nature of the B2B data uncovers more fragmentation, especially among services and small firms, that the aggregated input-output tables cannot see. In other words, many of the additional stages in supply chains are in the finer details of the network that only the detailed data reveal.

⁶ For example, Timmer, Erumban, Los, Stehrer and de Vries, 2014; Wang, Wei, Yu and Zhu, 2017; Miller and Temurshoev, 2017; Antràs and Chor, 2018.

Figure 7: The average length of supply chains across UK sectors has increased, according to annual input-output data

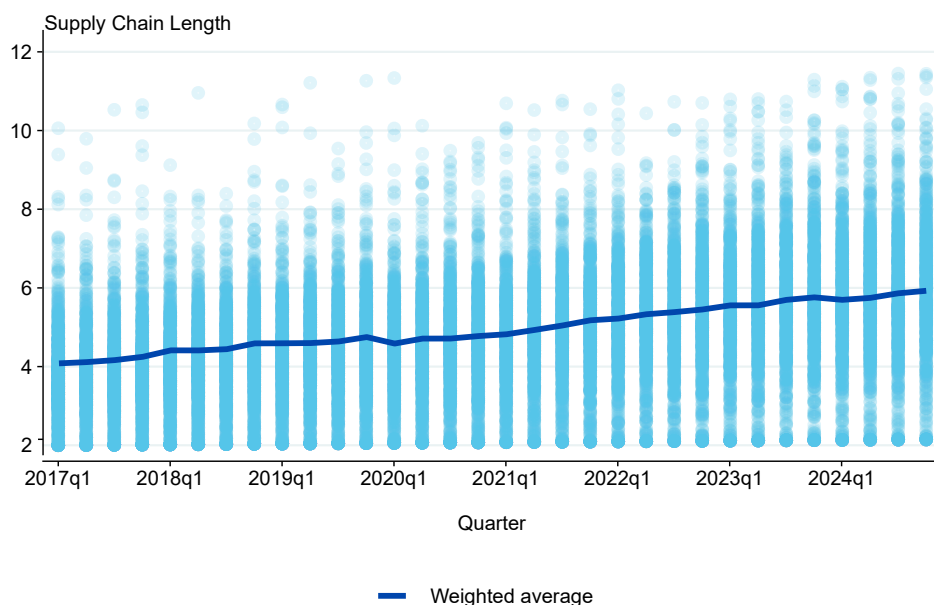
Scatterplot showing whole-economy weighted average supply chain length between 2013 and 2022. Data from ONS input-output analytical tables (2013 to 2022).



Whole-economy mean supply chain length. Weights are sector contribution to GDP. Excluding where available household, government/non-market and not-for-profit sectors. Data from ONS *UK input-output: analytical tables: product by product* (2013-2022).

Figure 8: The average length of supply chains across UK sectors has increased, according to experimental business-to-business data

Dark blue line represents the whole economy mean supply chain length, weighted by the share of payment flows. Each dot represents a 4-digit Standard Industrial Classification (SIC) sector in that quarter. Data from ONS UK Industry-to-industry payment flows (2017-2024).



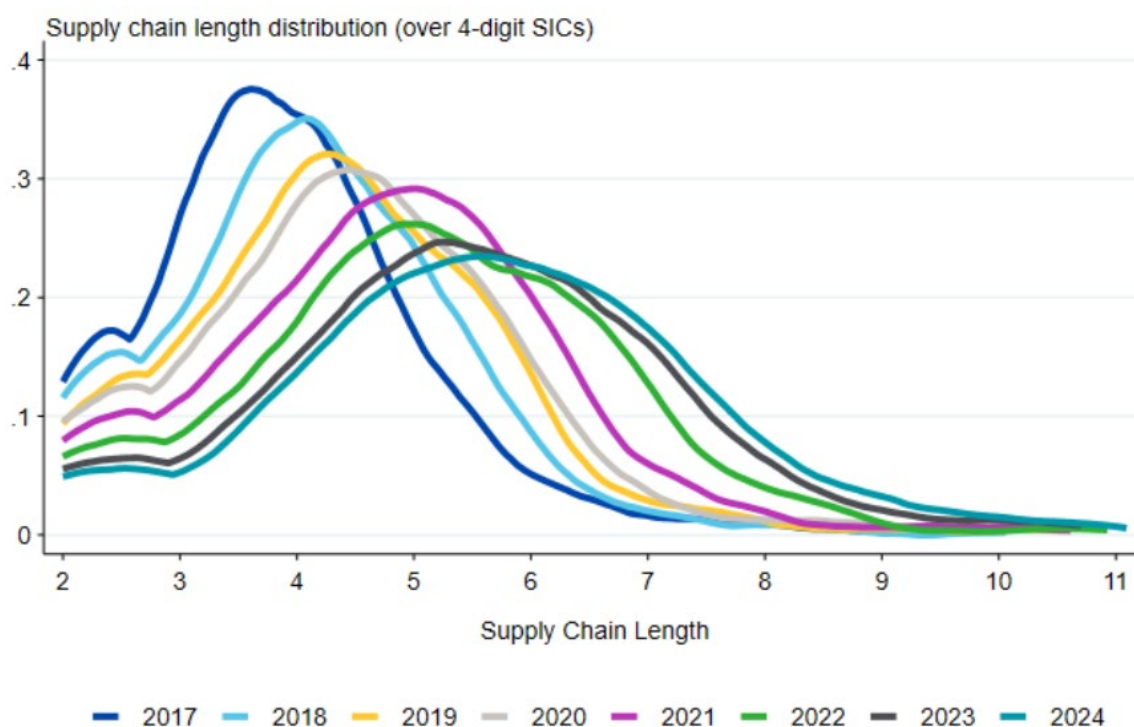
Whole-economy mean supply chain length, weighted by share of payment flows, at 4 digit SIC level. Data from ONS UK Industry-to-industry payment flows(2017-2024).

Longer chains are the result of within-sector lengthening

4.5 The lengthening of supply chains is broad-based. Analysis of the distribution of supply chain lengths across sectors shows a rightward shift over time (using the B2B data). This indicates the increase is not driven solely by a few industries but rather reflects a general trend of growing complexity across the economy. In other words, many sectors have added additional production stages or suppliers, rather than just one or two sectors becoming vastly more complex. Figure 9 illustrates this distributional shift.

Figure 9: Supply chains are becoming longer across the distribution

Distributions of supply chain length between 2017 and 2024. Data from ONS UK Industry-to-industry payment flows (2017-2024).



Data from ONS UK Industry-to-industry payment flows (2017-2024). Each line represents the distribution of supply chain length over sectors at the 4-digit, Standard Industrial Classification (SIC) level, derived from quarterly data.

- 4.6 Certain sectors have consistently longer supply chains than others. In the UK, the sectors with the longest chains are primarily in manufacturing, for example, beverages, electrical equipment, and basic metals involve multiple tiers of suppliers and sub-assembly by the nature of their production processes. By contrast, sectors like agriculture tend to have much shorter chains (e.g. farm to market).⁷ However, the increase in length is not confined to manufacturing.
- 4.7 We find that services have experienced some of the most significant lengthening. Between 2017 and 2025, service sector supply chains increased in length more than any other part of the economy. Industries such as postal and courier activities, private security services, scientific and technical

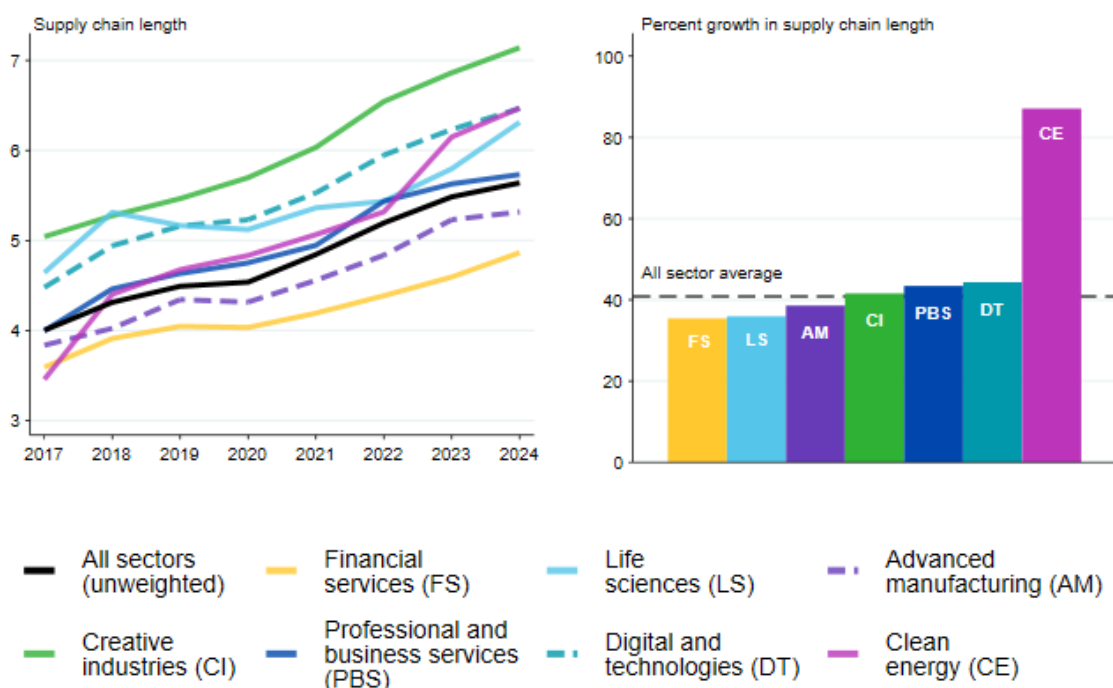
⁷ In the appendix, we provide further detail on the variation in sectors' supply chain lengths, breaking them down into upstreamness and downstreamness values. (Appendix Figure A1)

services, and architectural and engineering services saw their average supply chain stages rise by 65%–75%. This suggests that even traditionally less “tangible” sectors are developing more layered production processes, possibly through outsourcing and specialisation.

- 4.8 We also examine the eight priority sectors identified in the UK’s 2025 Modern Industrial Strategy (DBT, 2025), often called the Industrial Strategy high-growth sectors (IS-8). These are Advanced Manufacturing, Clean Energy Industries, Creative Industries, Defence, Digital & Tech, Financial Services, Life Sciences, and Professional & Business Services. These sectors collectively make up about one-third of the UK economy.
- 4.9 As depicted in the left panel of Figure 10, we find that supply chains in most of the IS-8 sectors are longer than the UK average (these industries are highly interconnected). Moreover, the lengths of their supply chains have generally increased in line with the overall economy-wide increase (right panel of Figure 10). One standout is the Green Energy sector, whose supply chain length has grown dramatically since 2017, reflecting rapid development and diversification in green energy production networks.

Figure 10: IS-8 sectors operate in supply chains that are longer than the UK average, while the Clean Energy chain has grown dramatically since 2017

Left panel: Line chart showing average supply chain length for each of the eight UK Industrial Strategy (IS) sectors, excluding defence, from 2017 to 2024. The dotted line represents the average supply chain length of all sectors, weighted by sector size. **Right panel:** Bar chart showing the overall percentage growth in supply chain length for each of the eight UK IS, excluding defence, between 2017 and 2024. The dotted line represents the average supply chain length growth of all sectors, including non-IS ones, weighted by sector size. Data from ONS UK Industry-to-Industry payment flows (2017 to 2024), using 4-digit SIC classification.



Supply chain length, and percent growth in supply chain length over 2017-2024, for the eight Industrial Strategy groups, at 4-digit SIC level and weighted by share of payment flows. Defence is excluded due to potential issues with suppression. The majority of finance sectors are excluded from calculations due to issues with interpretation. Some sectors overlap in multiple Industrial Strategy groups. Where Industrial Strategy sectors are defined at 5-digit level, we have used the 4-digit equivalent. Data from ONS UK Industry-to-industry payment flows (2017-2024).

4.10 To examine why supply chains are getting longer, we decompose the increase in average supply chain length to pinpoint its sources. An increase in economy-wide chain length could occur due to two broad mechanisms:

- (a) Within-sector lengthening: Individual sectors add more production stages (firms further specialise or add suppliers), making their own supply chains longer.
- (b) Between-sector reallocation: The economy shifts towards sectors that have longer supply chains. For instance, if manufacturing (long chains)

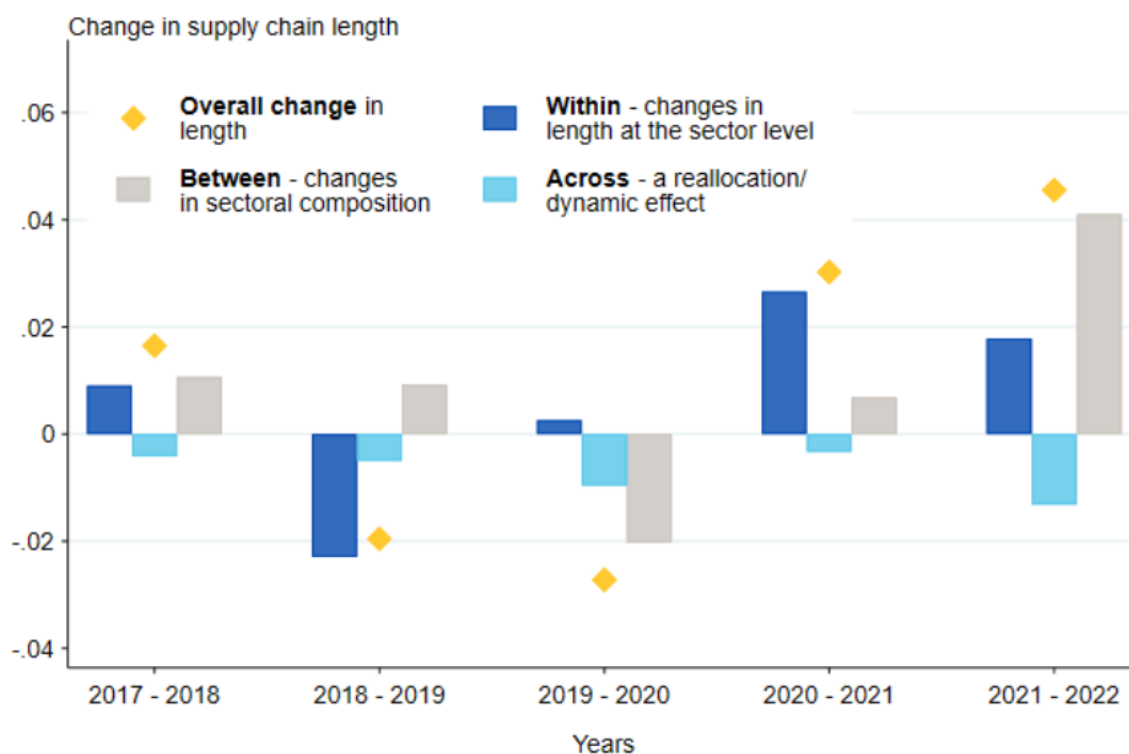
grows relative to services (shorter chains), the overall average length of supply chains would rise even if each sector's structure stayed the same.

- 4.11 Disentangling these sources is important for policy targeting. If the change comes from within sectors, it may reflect firm-level restructuring or technological changes, calling for measures like supply chain management support or adoption of digital tools. If instead it is mainly a reallocation toward complex sectors, it might be driven by broader structural transformation, suggesting different policy responses (like supporting sectors with strategic importance).
- 4.12 Our decomposition analysis offers a mixed picture, differing by dataset:
- (a) Input-output data (annual): Most of the modest increase from 2017 to 2022 is explained by within-sector lengthening.⁸ Figure 11 shows that both the “within” component and the “between” (sector composition) component contributed to the overall change, while the “across” (interaction) effect was small. In plain terms, sectors have been adding more production stages over time (perhaps due to increased outsourcing or complexity), and there was also a shift of economic activity towards sectors with longer chains, but no single dynamic dominates. Notably, the reallocation toward inherently long-chain sectors is limited.
 - (b) B2B transactions data (granular): The more dramatic lengthening observed here appears to be driven overwhelmingly by within-sector changes. Figure 12 indicates that nearly all the increase in chain length between 2017 and 2024 comes from supply chains getting longer within sectors themselves, with little to no contribution from shifts in sectoral mix. This suggests that at a fine-grained level, firms across many sectors have added layers to their supplier networks.
- 4.13 These results imply that the lengthening of supply chains involves the chains themselves becoming longer (i.e. within-sector changes), not the reallocation of economic activity towards already-longer supply chains. The fragmentation of production is a widespread phenomenon at the micro level, rather than the UK moving into different industries. The greater detail of the B2B data likely captures many subtle changes (e.g. a firm contracting out an additional component or service) that aggregate data might miss.

⁸ We consider 2017 to 2022 for better within-sector comparability, as there are no substantial sectoral changes in this period.

Figure 11: Changes in the average length of supply chains are not primarily driven by a dynamic reallocation effect

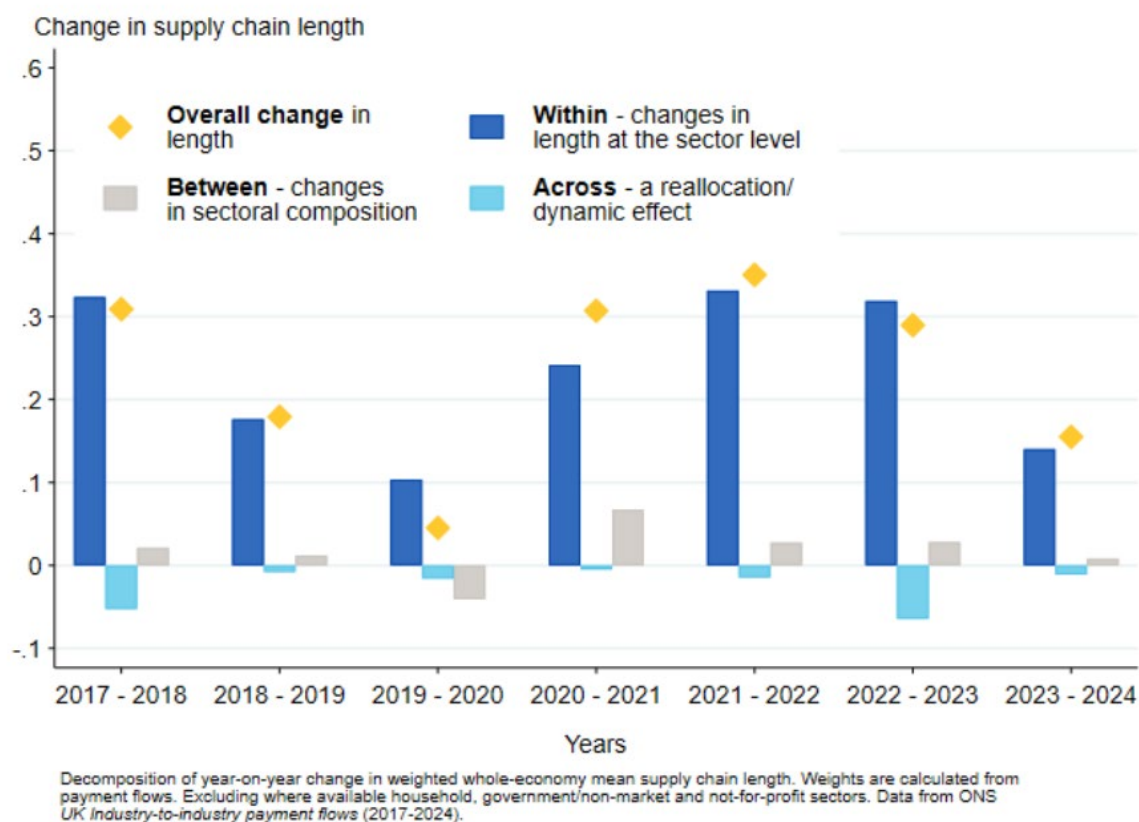
Decompositions of the year-on-year change in whole-economy mean supply chain length, weighted by sector contribution to Gross Domestic Product (GDP). Data from ONS UK Input-Output analytical tables: product by product 2017-2022.



Decomposition of year-on-year change in weighted whole-economy mean supply chain length. Weights are sector contribution to GDP. Excluding where available household, government/non-market and not-for-profit sectors. Data from ONS UK Input-Output analytical tables: product by product (2017-2022).

Figure 12: Changes in the average length of supply chains are driven by changes within industries rather than reallocation towards industries with longer supply chains

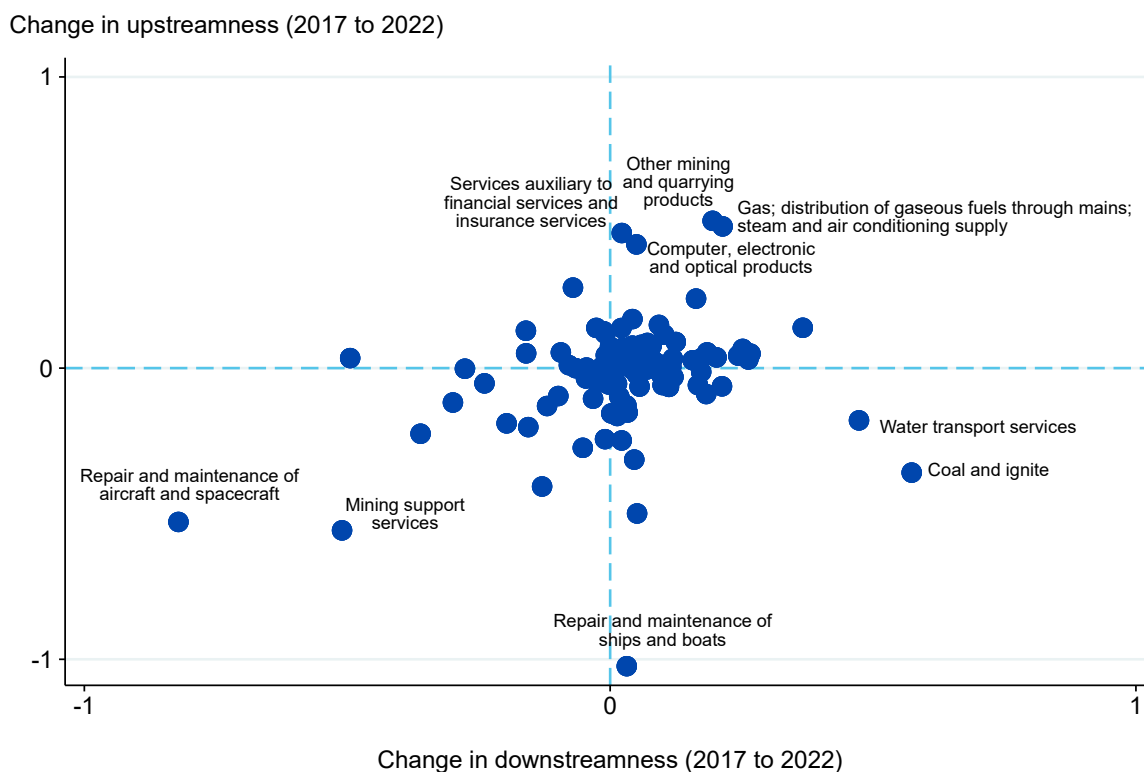
Decompositions of the year-on-year change in weighted whole-economy mean supply chain length. Data from ONS UK industry-to-industry payment flows 2017-2024. Sectors are at the 4-digit Standard Industrial Classification level and are weighted by sector share of payment flows.



- 4.14 Sectors may lengthen on the upstream side (more stages from initial inputs) and/or the downstream side (more stages to reach consumers) across sectors. We do not find a clear pattern here. For some sectors, such as financial services, utilities, mining products, and electronics supply chains have lengthened on both ends (more input layers and more steps to customers).
- 4.15 In contrast, a few sectors (e.g. aircraft repair and mining support services) saw their chains shorten on both sides, perhaps due to vertical integration. Figure 13 illustrates this by plotting changes in upstreamness vs. changes in downstreamness for sectors from 2017 to 2022: points in the upper right indicate sectors lengthening on both sides, and those in the lower left indicate shortening on both sides.

Figure 13: Almost two in three UK sectors experienced lengthening, or shortening, on both ends of their supply chains

Change in upstreamness and change in downstreamness over 2017 to 2022. Each dot represents a 2-digit sector. Data from ONS Input-Output Tables (2017-2022).



Change in upstreamness against the change in downstreamness for each 2-digit sector over 2017 to 2022. A value of -1 means that up/down-streamness in that sector fell by 1 stage over the period. Data from ONS *input-output tables* (2017 - 2022).

4.16 Overall, the UK’s domestic trends are consistent with global ones. Other studies find increasing fragmentation internationally. For example, rising foreign value-added in production [Timmer et al. \(2014\)](#) and lengthening global value chains [Wang et al. \(2017\)](#). Our UK-specific evidence confirms similar dynamics at the national level: production processes involve more steps and specialised contributors than in the past.

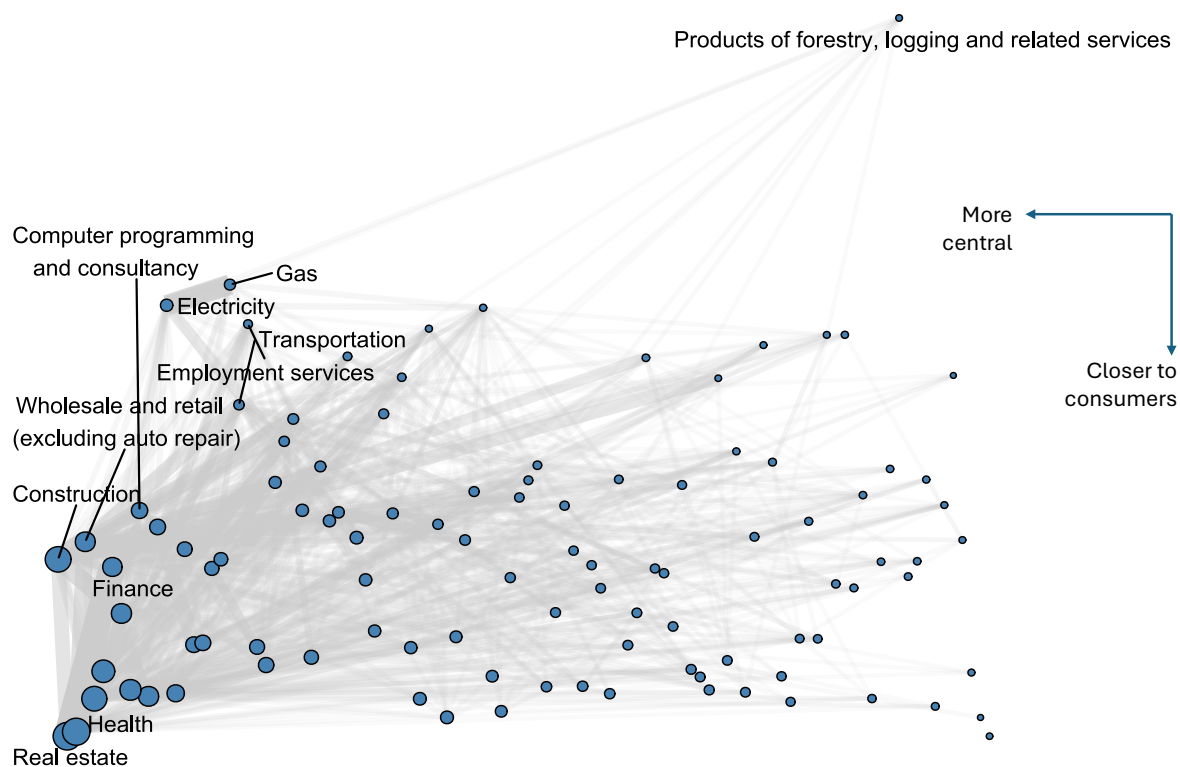
A small number of sectors are central to the UK economy

4.17 Understanding the complexity of supply chains is only one part of the picture. Equally important is the relative importance of different sectors as suppliers within the network. Small, highly connected sectors can be critical “nodes” whose disruption would have outsized effects. This section examines centrality: which sectors are the key hubs or linchpins of the UK production network.

- 4.18 When there is variation in the importance of sectors as suppliers and connectors within a supply network, small disruptions to firms can have significant aggregate impacts. Firms that are central to production networks tend to perform better in terms of profitability and growth, but also face greater exposure to shocks (Nezami, Chisam and Palmatier, 2025; Acemoglu, Ozdaglar and Tahbaz-Salehi, 2015). Understanding which sectors are most central in the UK can help identify systemic risks.
- 4.19 We measure sector centrality using an influence-based metric (Bonacich-Katz centrality, following Grassi and Sauvagnat, 2019). This measure combines a sector's size with its position in the network, effectively capturing how important a sector is as a supplier to others (including indirect, multi-step supply relationships). We also consider a simpler metric, the weighted outdegree, which is the total value of inputs a sector provides to all other sectors (essentially, how much a sector supplies into production chains).
- 4.20 By our definition, a sector is central if it supplies many others, either directly or indirectly through multi-stage chains. This approach captures more than just output volume; it reflects how embedded a sector is in the broader economy. For example, wholesale trade is highly central because it connects to nearly every other sector, while consumer-facing sectors like education are less central, as they sit at the end of the chain and are not key suppliers to other sectors. This distinction matters: sectors that are central but not large in terms of GDP may still be critical to the economy.
- 4.21 We visualised the UK supply network to illustrate these concepts (Figure 14). In a network diagram of the UK economy (based on input-output data for 2021), each node is a sector (scaled by its GDP share), and each link represents input supply relationships (with thickness showing the value of trade between sectors). Sectors are arranged left-to-right by their centrality and bottom-to-top by how downstream (close to consumers) they are.

Figure 14: A map of the 2021 UK supply network, depicting the highly connected and skewed nature of the network

Data from ONS UK Input-Output analytical tables: product by product for 2021. Each node is a 2-digit Standard Industrial Classification (SIC) sector with its size reflecting its contribution to Gross Domestic Product (GDP). Lines between nodes represent the size of intermediate flows between sectors.



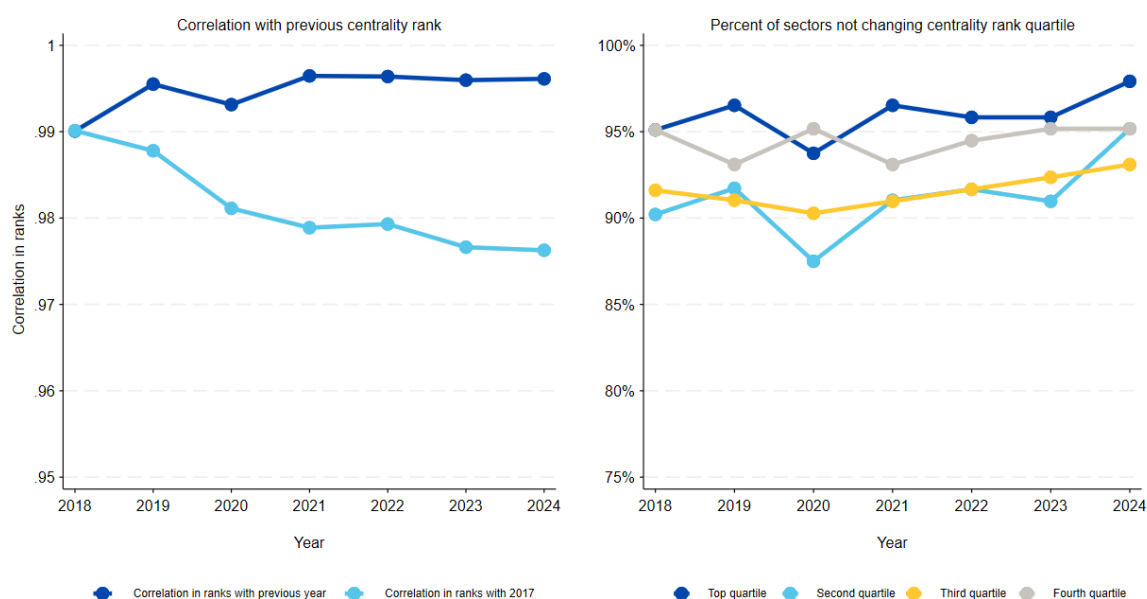
Each point is a 2-digit SIC sector, with its size reflecting its contribution to GDP. The further left a point is, the more central it is, and the lower down a point is, the closer it is to final consumers. The light grey lines connecting dots represents the flows between sectors. Data from ONS UK Input-Output analytical tables: product by product for 2021.

- 4.22 A clear finding is that despite the increasing complexity and length of supply chains, the identity of the most central sectors has remained very stable in recent years. Using our granular 4-digit data from 2017 to 2024, we find that the rankings of sector centrality hardly changed. The top few central sectors were consistently wholesale trade, office administrative services, retail trade, and management consultancy activities. These sectors serve as critical connectors or “anchors” in the network. It is perhaps not surprising given our centrality measure partly reflects size, and these are large sectors by output. But importantly, their centrality stems not just from size but from their role in linking many industries.
- 4.23 We find that the centrality ranks are highly correlated year-on-year; over 95% of sectors in the top quartile of centrality in 2017 were still in the top quartile in 2018. And over the whole period, there was very little shuffling among

quartiles of the centrality distribution (Figure 15 illustrates this stability). This indicates that structural positions in the network are persistent, at least over the medium term.

Figure 15: Sector centrality from B2B data is highly stable over time

Data from ONS UK Industry-to-Industry payment flows (2017 to 2024), using 4-digit Standard Industrial Classification (SIC). **Left panel:** correlation between sectors' centrality ranks with that in the previous year. **Right panel:** the percentage of sectors each year that remain in the same quartile of centrality ranking as in the prior year, shown separately for each quartile.



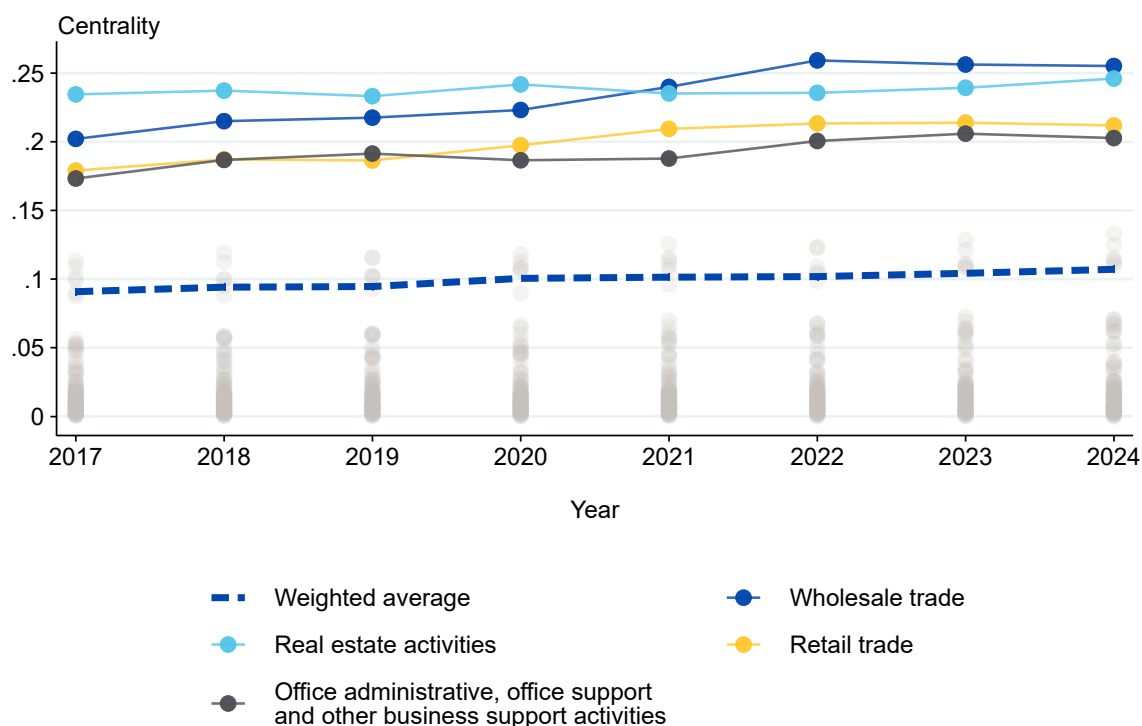
Correlation between current centrality rank and previous rank (left panel), and percent of sectors not changing rank quartile (right panel), at the 4-digit Standard Industrial Classification (SIC) level. Data from ONS UK Industry-to-industry payment flows (2017-2024).

4.24 While the order of sectors by centrality is stable, the degree of influence of the most central sectors increased between 2017 and 2024. In other words, the most influential sectors became even more influential within the production network. Figure 16 shows that the centrality of these top sectors rose, alongside a slight upward drift in the economy-wide average centrality.

Figure 16: Centrality of the most-central sectors has risen

Data from ONS UK Industry-to-Industry payment flows (2017 to 2024), using 2-digit Standard Industrial Classification (SIC). The solid lines show centrality values of the four most-central sectors, over time. Grey dots show centrality values of all other

sectors. The dashed line is the economy-wide average centrality weighted by sectoral shares of GDP.



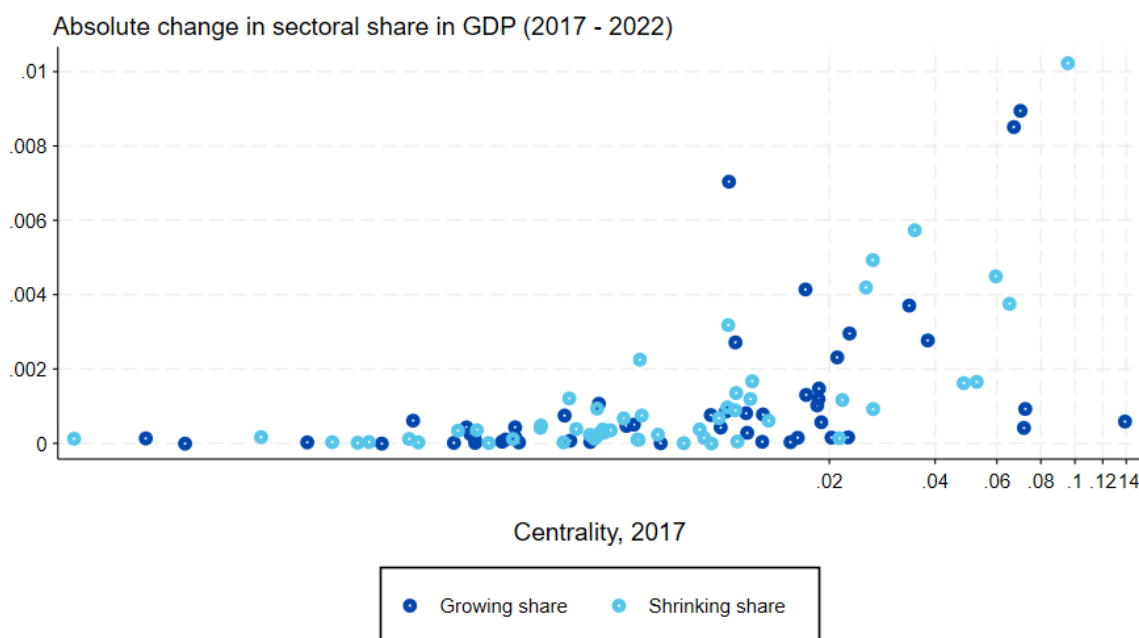
Whole-economy mean centrality, weighted by share of GDP, at 2 digit SIC level. Data from ONS *UK Industry-to-industry payment flows*(2017-2024). Dots represent individual sector observations.

4.25 Interestingly, the most central sectors have also seen the largest changes in GDP share over time. Between 2017 and 2024, sectors with above-average centrality experienced changes (positive or negative) in size four times greater than those with below-average centrality. This pattern suggests that structural economic change is occurring primarily through these sectors (as Figure 17 documents). The sectors with the greatest changes in GDP share are to the right of the graph, indicating they had higher centrality in 2017. This holds for sectors where their GDP share has risen (dark blue) or fallen (light blue). Moreover, very few of the most central nodes experience small changes in GDP share.

4.26 The stability of central sectors, coupled with their outsized influence on the direction of economic transformation suggests that long-term policy planning and monitoring should focus on a relatively fixed set of sectors when assessing systemic importance.

Figure 17: The most central sectors experience a larger (absolute) change in GDP share

Scatterplot of 2-digit sectors, comparing the absolute change in GDP share between 2017 and 2022 with the sector's centrality in 2017. Dark blue dots reflect sectors that grew and light blue dots show sectors that shrunk.

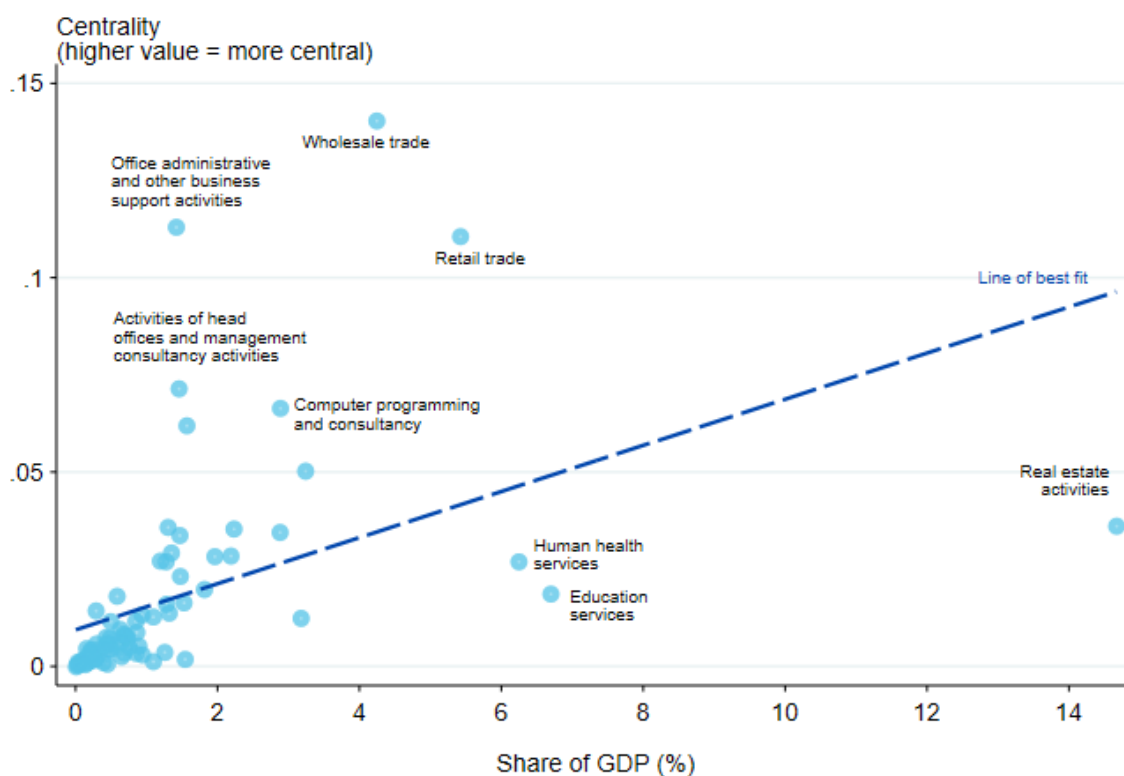


Average centrality at 2-digit Standard Industrial Classification (SIC) industry level. Excluding where available household, government/non-market and not-for-profit sectors. Data from ONS *UK input-output analytical tables: product by product (2017-2022)*.

4.27 Because centrality correlates with size by construction, one might ask what additional insight it offers. The answer is that it highlights sectors that punch above or below their weight in terms of network influence. We identified sectors whose importance as suppliers is disproportionately high relative to their direct economic size. For example, wholesale trade, retail trade, and computer programming/IT services stand out as having much higher centrality than their share of GDP alone would predict. These are sectors that serve as essential hubs or bridges in production networks. If one of these sectors were disrupted, the impact would cascade widely through the economy, even if the sector's own GDP contribution is moderate. Figure 18 illustrates this by plotting centrality vs. GDP share for each sector. Sectors above the trend line have more influence than expected from their size.

Figure 18: Sectoral centrality and share of GDP are positively correlated

Sectors' average unweighted centrality and their size in the UK economy as measured by their contribution to Gross Domestic Product (GDP). Data from ONS UK industry-to-industry payment flows 2017-2024. Sectors are at the 2-digit Standard Industrial Classification (SIC) level.

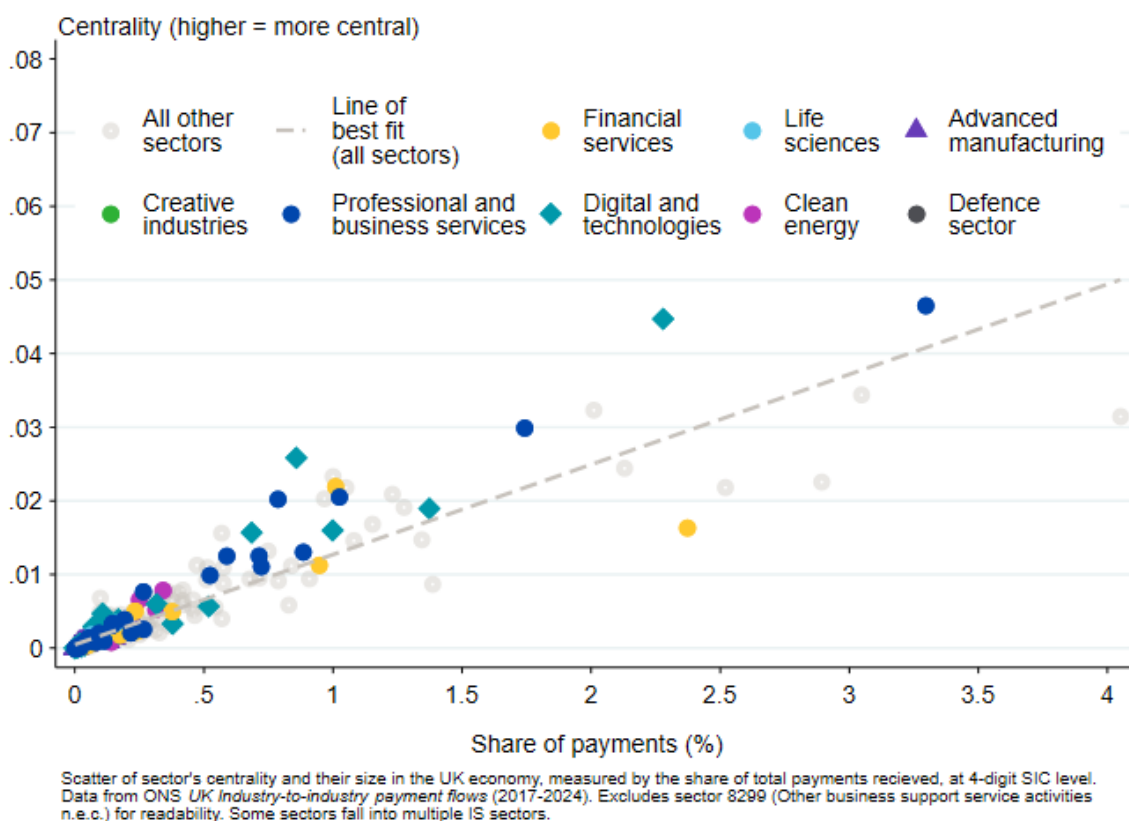


Correlations between sectors' average centrality (unweighted) and their size in the UK economy, at 2-digit SIC level. Data from ONS UK Industry-to-industry payment flows (2017-2024).

4.28 We also applied our network analysis to the government's IS-8 high-growth sectors. We disaggregated those broad categories into their constituent 4-digit industries in the B2B data (using payment flow shares as a proxy for size since GDP data at that level are unavailable). We found that most of the IS-8 sectors are indeed highly central nodes in the network, generally above the best-fit line when plotting centrality against size (see Figure 19). In other words, these priority sectors not only contribute significantly to GDP, but they also tend to serve as important hubs with many linkages. Very few of the IS-8 sectors are below expectation. This suggests that the sectors chosen for their growth potential are also structurally important for the economy's network. It reinforces the idea that supporting these sectors could have broad spillover benefits, but also that any vulnerabilities in them (e.g. supply bottlenecks or market power issues) could have system-wide effects.

Figure 19: Sectoral centrality is positively correlated with share of payment flows

Sectors' average unweighted centrality and their size in the UK economy as measured by their share of payment flows. Data from ONS UK industry-to-industry payment flows 2017-2024. Sectors are at the 4-digit Standard Industrial Classification (SIC) level. IS-8 sectors are coloured and non-IS sectors are grey. Some sectors fall into multiple IS categories. The 'Other business support service activities' sector has been excluded for readability.



4.29 The UK's supply chain networks have grown longer and more interconnected. Average supply chain length has increased significantly, mainly due to firms adding more specialised suppliers and intermediate steps (rather than just shifting toward different industries). This fragmentation is evident in both manufacturing and services, indicating an economy-wide trend toward greater specialisation.

4.30 At the same time, the identity of the key sectors of the network remains largely the same. A small set of sectors, notably in distribution, business services, UK, and retail, are persistently central, acting as the backbone of the supply UK supply network. Their influence has, if anything, grown over time. This stability means that when thinking about systemic risk or resilience,

policymakers can focus on a known set of critical sectors. Sectors that are small in terms of GDP but highly connected (like wholesale or certain business services) merit attention because disruptions could propagate through many supply chains.

- 4.31 These structural changes also relate to economic performance. Turnover-weighted regressions of centrality and supply chain length on labour productivity suggest that sectors associated with longer supply chains tend to have higher labour productivity (GVA, per worker) on average, and sectors that begin the period with longer supply chains also tend to see faster productivity growth.⁹ However, increases in supply chain length over time are not, on average, associated with faster productivity growth. By contrast, centrality is not a strong correlate of productivity levels and does not predict subsequent productivity growth; at most, there is weak evidence that sectors becoming more central are associated with slightly faster productivity growth. Taken together, the evidence suggests that longer, more specialised production structures are characteristic of higher-productivity sectors, while the role of central sectors is more relevant for understanding interdependence and the potential for shock propagation than for explaining productivity differences. This sets the stage for examining the drivers of these changes in Section 5.

⁹ Regression coefficients are displayed in Appendix Table A1. Regressions are of centrality and supply chain length on labour productivity, which is measured by Gross Value Added per worker. Data from the ONS input-output: analytical tables: product by product (2017 to 2021), the Annual Respondents Database X (2017 to 2020) and the Annual Business Survey (2021).

5. Drivers of changes to UK supply chains

- 5.1 Previous research, looking at the UK and other countries, points to four key drivers of supply chain lengthening:
- (a) **Increased specialisation:** Fragmenting production into narrower tasks, allocated to firms or countries with comparative advantage, can extend chains (Hummels, Ishii & Yi, 2001). Firms focus on core competencies and trade for the rest.
 - (b) **Technological change:** Improvements in communication, coordination, and transport can reduce the costs of complex supply chains, enabling more stages and large, international networks (McNerney et al., 2021).
 - (c) **Market structure and bargaining:** The structure of markets might influence supply chain organisation – for example, powerful buyers or suppliers could shape the chain length through their contracting practices or integration choices (Oberfield, 2018).
 - (d) **External shocks:** Major disruptions (pandemics, geopolitical events) can force changes in networks, either shortening them (e.g. reshoring for resilience) or sometimes lengthening them (e.g. firms adding alternate suppliers, Carvalho et al., 2021).
- 5.2 In this chapter, we focus on evidence for two particularly relevant forces in the UK context: specialisation and technological change. These relate directly to whether the observed lengthening reflects productivity-enhancing fragmentation and/or vulnerability-adding complexity. We also consider the role of structural economic shifts (like the rise of services) and make some international comparisons to see if the UK's trends are unique or part of a global pattern. Our aim is to discern whether increased specialisation is a plausible explanation for the UK's supply network changes, and how technology and structural transformation factor in.

Specialisation and network structure

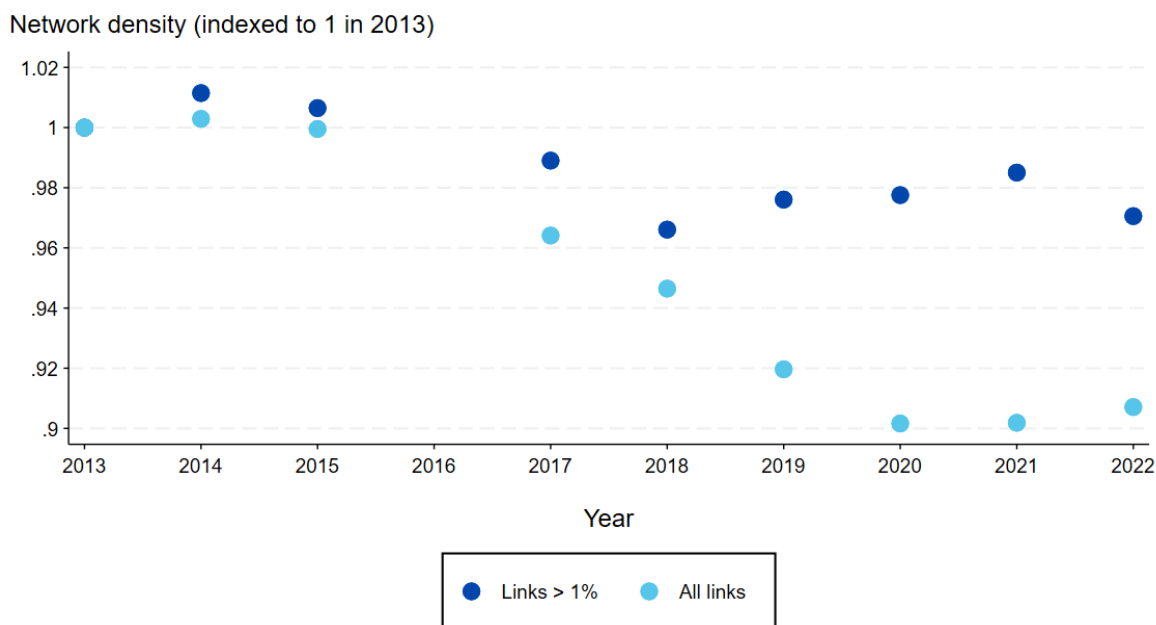
- 5.3 Increased specialisation allows firms, sectors, and countries to focus on narrower tasks within the value chain, engaging in trade with others to complete production. This fragmentation leads to more intra-industry trade, the exchange of similar goods or services within the same sector, and contributes to longer, more interconnected supply chains. Specialisation can also enhance productivity by enabling firms to concentrate on core competencies and benefit from economies of scale and learning effects. For example, Serpa and Krishnan (2018) show that productivity spillovers from

more productive customers to suppliers are a key mechanism through which specialisation improves firm-level performance.

- 5.4 To assess whether UK supply chains are becoming more specialised, we examine the structure of inter-industry connections using network metrics:
- (a) **Network density:** This measures the proportion of possible connections between sectors that actually exist (i.e. how many sector pairs trade with each other out of all possible pairs). In a highly interconnected economy, density is high; if firms specialise and trade only with a few key partners, density may decline. A drop in network density can indicate a shift toward narrower, more focused trading relationships. Research by [Rienkhemaniyom and Pazhani \(2015\)](#) suggests network density is a useful indicator of supply chain structure, with implications for both efficiency and resilience (lower density might mean efficiency through specialisation, but also potentially less redundancy).
 - (b) **Weighted outdegree distribution:** This captures how the total “supply output” is distributed across sectors. If only a few sectors supply most inputs (high outdegree concentrated in a few hubs), that suggests a hub-and-spoke structure consistent with specialisation. A stable or skewed outdegree distribution, where a handful of sectors consistently have very high outdegree, would indicate that certain sectors serve as essential suppliers to many others (a hallmark of specialisation and centralisation of certain production activities). Zhang et al. (2023) demonstrate that weighted network models can reveal such structural vulnerabilities.
- 5.5 The overall network density of the UK input-output network has fallen in the past decade. Between 2013 and 2022, density declined between 2% and 9% (Figure 20). In practice, this means the average sector is trading with slightly fewer other sectors than before, suggesting firms may be focusing on a more select group of input suppliers or customers. This is consistent with sectors narrowing their focus and forming more targeted links (for example, a car manufacturer might concentrate its procurement on a few specialised component makers rather than many generalists). However, we caution that falling density alone isn’t definitive proof of beneficial specialisation, it could also result from other factors like geographic clustering or higher coordination costs discouraging broad supplier bases.

Figure 20: Network density in the UK fell from 2013 to 2022

Network density (the share of all possible inter-sector linkages that trade) computed on ONS UK Input-Output analytical tables: product by product, from 2013 to 2022. Values are indexed to 1 in 2013, to highlight changes over time. Light blue dots compute all linkages, dark blue dots compute linkages that involve over 1% of outwards volume.

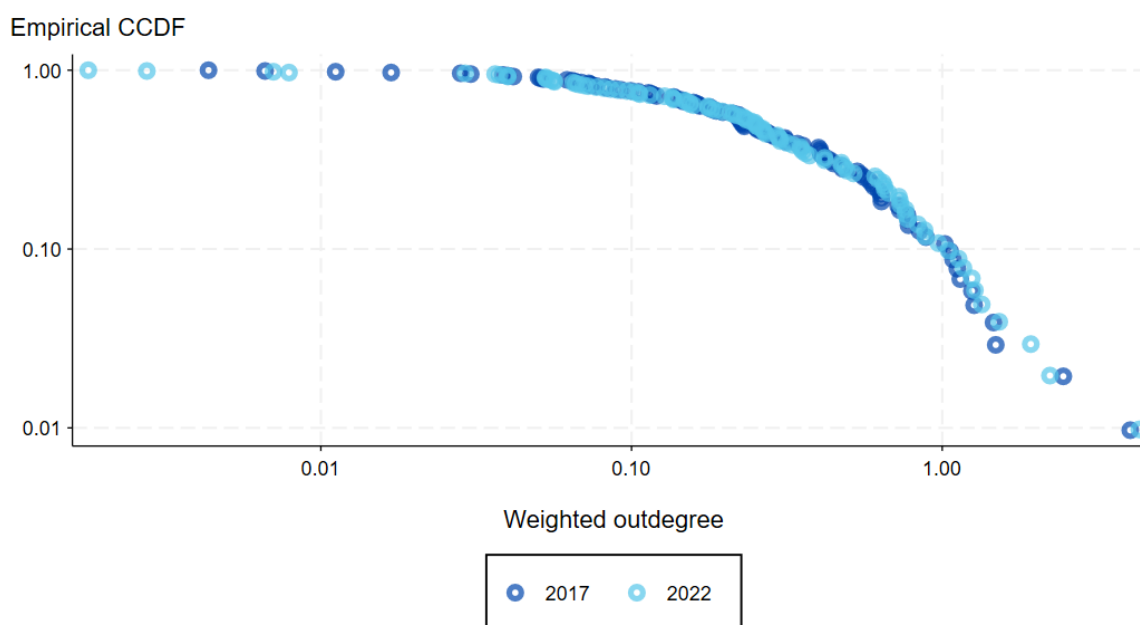


Network density computed by counting (1) all supply chain links between sectors and (2) those where A supplies at least 1% of B's inputs. Excluding where available household, government/non-market and not-for-profit sectors. Data from ONS UK input-output analytical tables: product by product (2013-2022).

5.6 The distribution of weighted outdegree has remained highly skewed and stable from 2017 to 2022 (Figure 21). Only a few sectors act as the key suppliers in the economy, while most sectors have much lower values of weighted outdegree. This means that the pattern of some sectors being major hubs (supplying many others with inputs) persisted. The fact that this distribution did not flatten suggests that even as supply chains lengthened, the overall architecture still relies on a few big supplier hubs. We interpret this combination, falling density but stable hub concentration, as suggestive evidence of increased specialisation: sectors may be trimming peripheral links but maintaining or deepening ties with core partners (the major suppliers).

Figure 21: Stable distribution of UK sectors' role as suppliers to other sectors

The empirical complementary cumulative distribution function (CCDF) shows the proportion of sectors with weighted outdegree above a particular value. We plot this distribution for weighted outdegree across 2-digit sectors in 2017 and 2022. In both years, only 10% of sectors obtain a weighted outdegree greater than one.



Weighted outdegree is the importance of sectors as suppliers within the network, plotted on a log scale. Empirical CCDF shows the probability of a sector having a weighted outdegree larger or equal to some value (Carvalho, 2014). Data from ONS *UK input-output analytical tables: product by product (2013-2022)*.

- 5.7 While the distribution of weighted outdegree has stayed stable, it is possible that sectors have changed their roles in the supply network, if the order of their ranking has changed. For example, the second most important supplier in the network may have fallen to the twelfth most important supplier. We check this by examining the correlation of weighted outdegree within sectors in 2017 and 2022, and by checking changes in the rank ordering over time. The correlations are high, indicating stability in weighted outdegree. The top 15 sectors in weighted outdegree exhibit high persistence, with 13 sectors retaining their top-tier status by 2022.

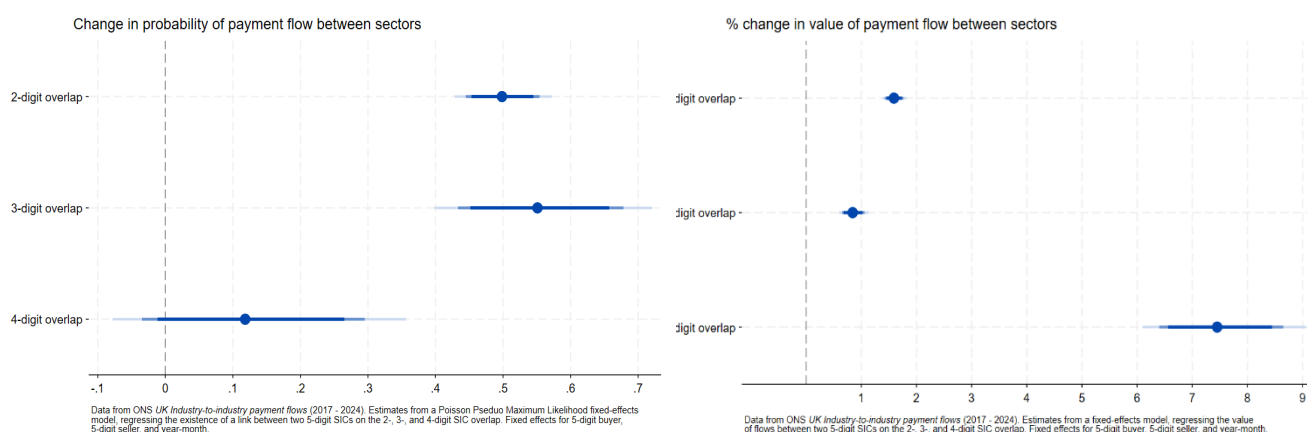
Inter-industry trade and the margins of specialisation

- 5.8 To further investigate whether UK supply chains are becoming more specialised, we turn to patterns of **inter-industry trade**, the exchange of goods and services between distinct sectors. This analysis complements our network-based approach by providing a more granular view of how production relationships evolve across the economy. It allows us to assess whether sectors are forming new connections or deepening existing ones, both of which are consistent with different forms of specialisation.

- 5.9 We analyse these dynamics using the concepts of the extensive and intensive margins. The **extensive margin** captures whether trade occurs at all between two sectors, i.e., whether a buyer-supplier relationship exists. A decline in the number of such relationships may indicate that sectors are narrowing their focus, engaging only with those partners most relevant to their specialised tasks. The **intensive margin**, by contrast, measures the value or volume of trade within existing relationships. An increase in trade intensity suggests that sectors are deepening their engagement with key partners, even if the overall number of connections is falling. Together, these margins help us distinguish between broad-based integration and targeted specialisation within the UK production network.
- 5.10 We find that narrowly defined industries (5-digit SIC level) are not significantly more likely to trade with each other just because they fall under the same broader industry group (4-digit SIC). In other words, just sharing an industry classification does not automatically mean two sub-sectors trade. This implies the extensive margin is limited by specialisation. Many potential links even within the same industry grouping do not occur, perhaps because each sub-sector focuses on its own niche. Figure 22 (left panel) confirms that being in the same 4-digit sector doesn't strongly increase the probability of a buyer-supplier link at the 5-digit level.
- 5.11 However, when closely related sub-sectors do trade with each other, the intensive margin is high: the value of those transactions is significantly greater than average flows. Figure 22 (right panel) shows that if two 5-digit industries within the same 4-digit category engage in trade, the volume exchanged is large. This highlights that when specialisation occurs within an industry cluster, it often involves substantial, high-value exchanges. This reflects strong internal value chains where one specialised segment heavily supplies another.

Figure 22: Closely related sectors are no more likely to trade, but exchange a lot when they do trade

Regression coefficients estimating the role of sectoral overlap on trade between pairs of 5-digit SIC sectors. The independent variables indicate whether a given pair of 5-digit sectors shares the same 2-digit, 3-digit, or 4-digit parent classification. **Left panel** shows the change in probability of a link forming (“extensive margin”) based on the level of SIC overlap. **Right panel** shows the percentage change in value for existing links (“intensive margin”) based on the level of SIC overlap. Data from ONS UK Industry-to-Industry payment flows (2017 – 2024).

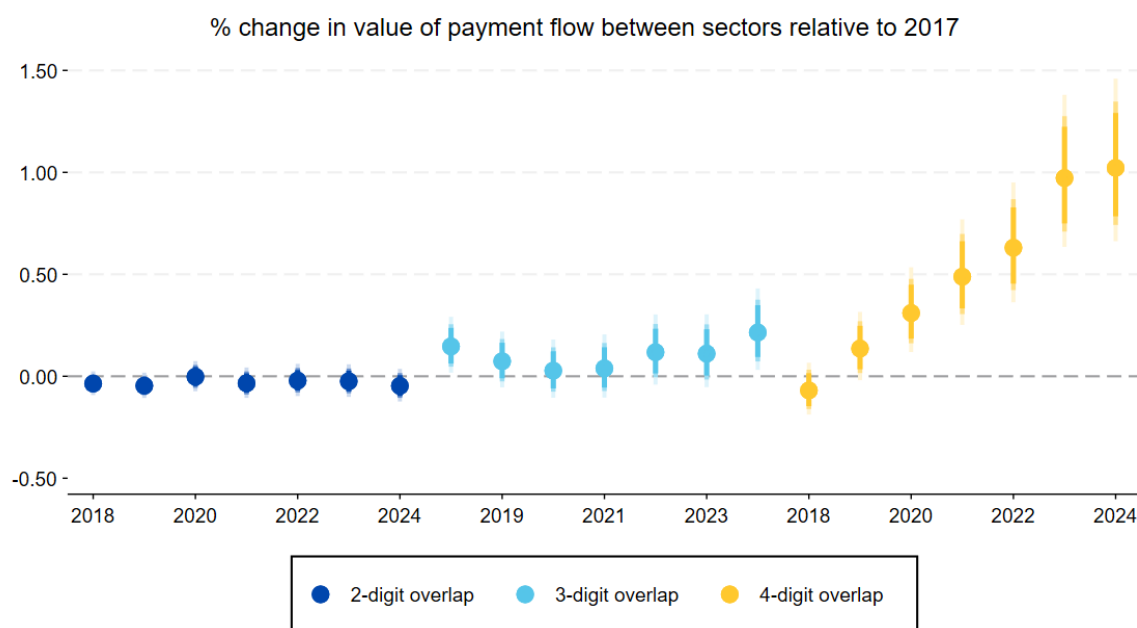


5.12 Moreover, this pattern has intensified over time. Figure 23 illustrates that from 2017 to 2024, the value of trade within these narrow industry clusters (intra-industry trade at a fine level) has grown markedly. So, while the overall number of trading links might not have risen (and possibly even fell, as per the density result), the economic importance of the existing close-knit links has increased. Put simply, the UK economy appears to be composed of increasingly specialised clusters of industries that trade a lot with each other, rather than a broad web where everyone trades with everyone.

5.13 To summarise: there is limited trade between very granular industries unless they are tightly related, but when such trade exists, it is of high value and growing importance. This is a hallmark of specialisation – industries forming tight supply chain clusters (for example, a cluster of electronics components makers supplying a cluster of electronics assembly firms). The data suggest the UK has moved further in this direction over the past few years.

Figure 23: Increasing importance of the intensive margin for closely related sectors

Data from ONS UK Industry-to-Industry payment flows (2017 to 2024), using 5-digit SIC classification. Graph displays the change in value of payments between 5-digit sectors that have overlap with each other using either 2-, 3- or 4-digit SIC overlap. The change in value is given as a percentage change relative to 2017 payments. Each dot represents the estimated change, while the vertical lines represent the 95% confidence interval.



Data from ONS UK Industry-to-industry payment flows (2017 - 2024). Estimates from a fixed-effects model, regressing the value of flows between two 5-digit SICs on the 2-, 3-, and 4-digit SIC overlap. Fixed effects for 5-digit buyer, 5-digit seller, and year-month.

Structural transformation and the evolution of UK supply chains

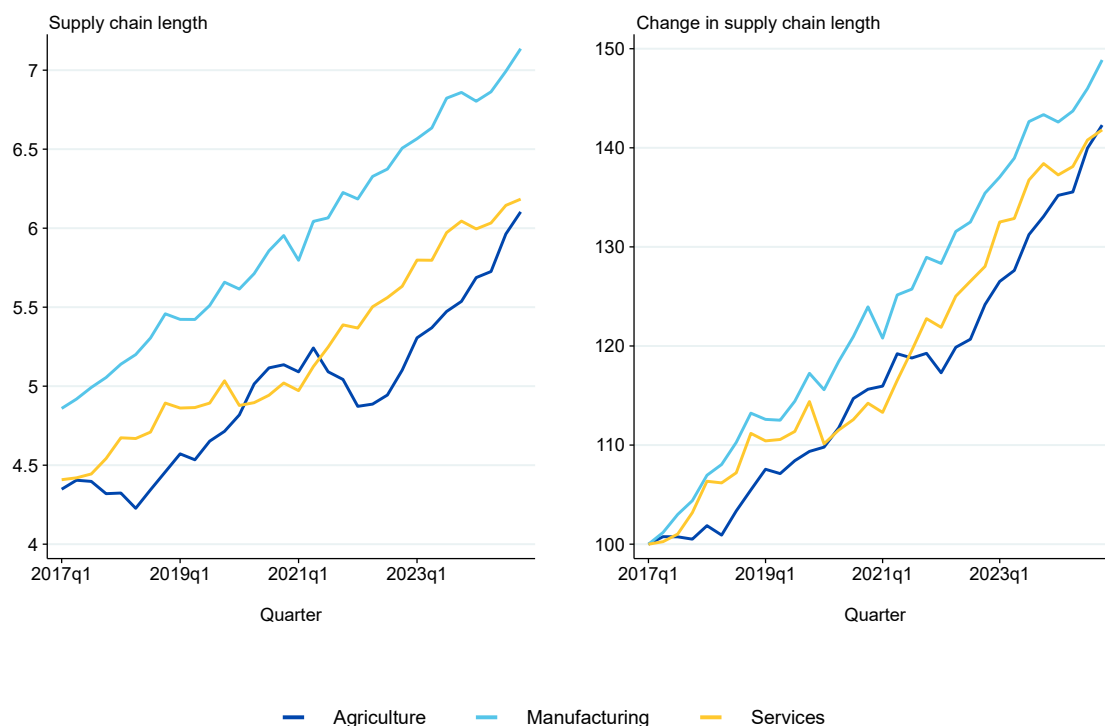
- 5.14 The structure of the UK economy has shifted dramatically in the past few decades, notably with the decline of manufacturing and the rise of services. Manufacturing’s share of gross value added (GVA) fell from ~17% in 1990 to under 9% by 2024, while services now dominate output and employment. This structural change inevitably affects supply chain configurations, for example, service-based supply networks might look different from manufacturing ones.
- 5.15 As the UK has become increasingly service-orientated, its supply chains have evolved accordingly. Services such as logistics, finance, and software now play central roles in production, often acting as key hubs in supply networks. These sectors differ from traditional manufacturing in their cost structures, competitive dynamics, and the nature of their inputs and outputs. Given the intangible nature of many services, we might expect their supply chains to be organised differently. Our data supports this: while manufacturing still hosts

the longest supply chains, some of the longest chains now involve service inputs, suggesting a growing role for services in complex production systems.

- 5.16 This transformation is shaped by both global and domestic forces. Technological change and globalisation have altered the costs and feasibility of coordinating production across borders, while domestic industrial policy has influenced the allocation of activities across sectors (CMA, 2025). These changes affect supply chains in several ways: they increase reliance on service hubs, alter the geographic footprint of production, and change the structure of inter-sectoral relationships.
- 5.17 Despite these shifts, supply chains have lengthened across all broad sectors, agriculture, manufacturing, and services. Each has seen a similar percentage increase in supply chain length, approximately 40% between 2017 and 2024 (Figure 24). Manufacturing remains the sector with the longest chains, while agriculture tends to have the shortest. However, the rate of growth has been broadly consistent across sectors, suggesting that lengthening is a general phenomenon rather than one confined to specific industries.

Figure 24: Supply chain length has risen similarly across broad UK sectors

Left panel shows the average mean supply chain length by sector type over time. **Right panel** shows the growth in average mean supply chain length over time with base period 2017 Q1. Sectors are at the 2-digit Standard Industrial Classification (SIC) level and are weighted by share of payment flows. Sectors are grouped into three categories – agriculture, manufacturing, and services. Data from ONS Industry-to-industry payment flows (2017-2024).



Whole-economy mean supply chain length, weighted by share of payments, at 2 digit SIC level. Data from ONS UK Industry-to-industry payment flows (2017-2024). Agriculture includes fishing and mining, while services includes construction and utilities.

5.18 To see if the UK’s changes are unique or part of a global trend, we compared UK supply chain metrics with peer economies using the OECD data. The high-level patterns are broadly similar across advanced economies:

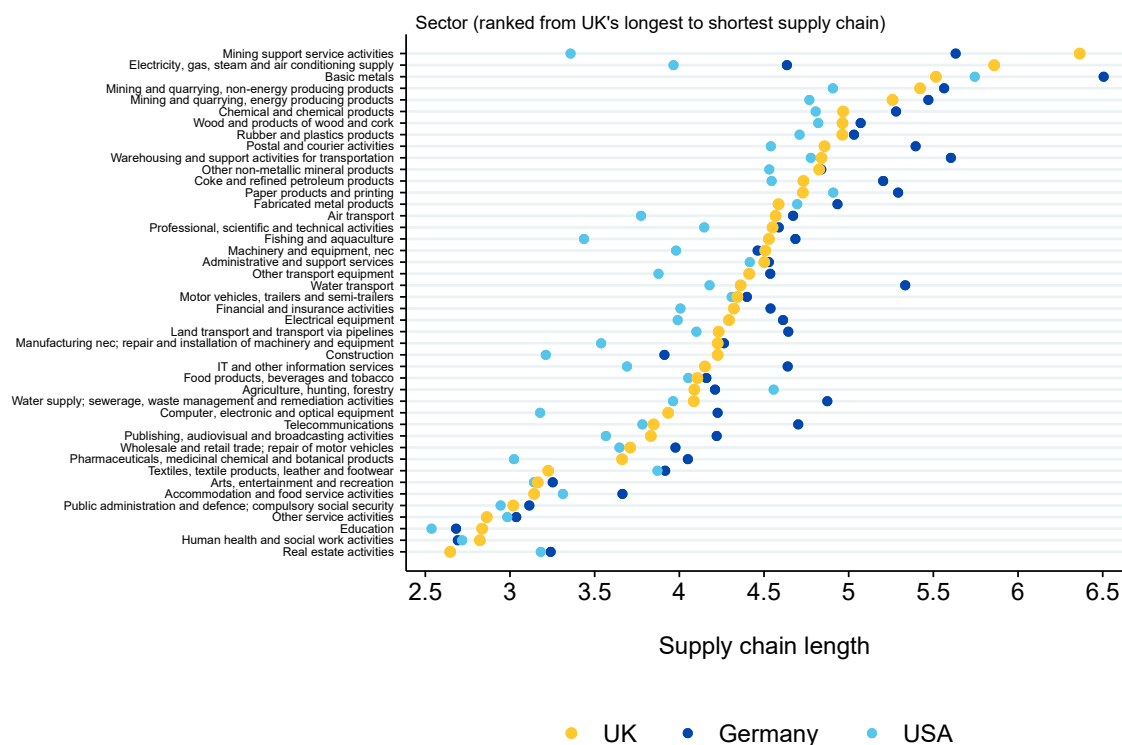
- (a) Supply chain length is comparable across countries like the UK, Germany, and the US, and has not diverged drastically over the last two decades. The UK’s average chain length sits in the middle of the pack globally and has been relatively stable recently.
- (b) The most central sectors tend to be similar across countries: typically finance, wholesale/retail trade, professional services, real estate, and construction are among the hubs in many economies. Germany and the US also show manufacturing sectors as central hubs to a greater extent (e.g. machinery, chemicals in Germany are very central, reflecting their

industrial base). The UK, with a larger services sector, has slightly different emphasis but still shares common hub sectors with peers.

5.19 One difference is that the UK shows a somewhat higher reliance on foreign inputs in certain sectors compared to, say, the US (reflecting the UK's openness to trade and smaller domestic industrial base). But overall, the structure of supply networks appears to be shaped by global technological and economic forces that affect many countries similarly. Figure 25 provides a cross-country comparison: for instance, it ranks sectoral chain lengths in the UK versus Germany and the US. We see that if a sector has a long chain in the UK, it often does in the other countries too (and vice versa), with a few exceptions due to local factors.

Figure 25: The structure of UK supply chains is broadly similar to that of Germany and the USA

Comparison of the UK's average supply chain length in 2019 to Germany and the USA. Ranked from the UK's longest to shortest. Using OECD Inter-Country Input-Output tables.



Using OECD *Inter-Country Input-Output tables*. For 2019.

6. Market power in the supply network

- 6.1 Market power, the ability of a firm (or group of firms) to set and maintain prices above competitive levels, is not confined to final consumer markets. It can accumulate and propagate through supply chains, affecting prices, competition and consumer outcomes at multiple stages (Spengler, 1950; Baqaee & Farhi, 2020). However, understanding how market power travels through a network is complex. It depends on the structure of inter-sector relationships, bargaining dynamics, and the availability of alternative options (Melo, Moita and Sunao, 2021; Toxvaerd, 2025).
- 6.2 In this chapter, we investigate how market power is distributed across UK supply chains. We ask whether sectors that are more upstream (further from consumers), more central in the network, or part of longer supply chains tend to exhibit greater market power. We also examine whether market power can accumulate along supply chains (multiple markups compounding) and whether it propagates between connected sectors (do powerful upstream firms confer or constrain power downstream, and vice versa?).

Measuring market power

- 6.3 We draw on three key indicators of market power and market structure:
- (a) **Markups:** The ratio of price to marginal cost. A markup greater than one indicates prices above competitive levels (CMA, 2024).
 - (b) **Concentration:** Measured using the Herfindahl-Hirschman Index (HHI), which ranges from near 0 (many small firms) to 10,000 (monopoly). While not a perfect proxy for competition, HHI provides a useful indicator of market structure and the distribution of economic gains (Spiegel, 2021).
 - (c) **Distortion centrality:** A measure of how market imperfections (e.g. markups) accumulate within a supply network, identifying sectors whose size deviates from optimal levels due to upstream distortions (Liu, 2019).
- 6.4 Using these measures, we examine patterns and test hypotheses about market power in the network.

Theoretical perspective

- 6.5 Three key models help explain how market power manifests in supply chains:
- (a) **Bargaining models:** Surplus is split between upstream and downstream according to relative bargaining power. Upstream monopoly power can

raise input prices, but downstream firms may retain some rent if they have countervailing power (Toxvaerd, 2025).

- 6.6 **Cumulative markups (double marginalisation):** Each layer of market power adds a markup, compounding distortions.¹⁰ Vertical integration or coordination can reduce these effects by internalising pricing externalities (Spengler, 1950).
- (a) **Network bottlenecks:** Certain sectors act as critical sectors (nodes) in the network whose removal would disrupt supply. These bottlenecks can extract high markups, and their influence can spillover to connected sectors, meaning that firms that are not bottlenecks themselves might enjoy some market power if they are connected to a bottleneck (Elliott, Carvalho, and Spray, 2025).
- 6.7 Empirical research supports both bargaining and cumulative markup models, with Alvarez-Blaser et al. (2025) highlighting bargaining dynamics and Duran-Micco & Perloff (2022) finding evidence supporting the compounding effects of markups.¹¹

Market power across UK supply chains

- 6.8 Previous CMA analysis suggested that more upstream sectors tend to have higher markups (CMA, 2024).¹² However, this correlation may not be causal. Upstream sectors often face higher fixed costs, stronger network effects, greater exposure to international trade, or higher capital intensity. These factors may drive both upstreamness and elevated markups.
- 6.9 To disentangle these effects, we apply two standard approaches:
- (a) **Control for observable factors:** We incorporate control variables for other sector characteristics (like capital intensity, import competition, etc., where data are available) in regression analysis to see if upstreamness still predicts markups after accounting for these factors.
- (b) **Within-sector variation over time:** We look at changes within the same sector over time. Essentially, we ask: when a given sector becomes

¹⁰ Relative to the price equalling marginal cost (as in perfect competition) at each stage of the supply chain.

¹¹ Alvarez-Blaser et al. (2025) analyse a multinational manufacturer and its retailers. They show that total supply chain markups (from production cost to retail price) remained relatively stable even as costs changed, suggesting that manufacturer and retailer markups often move in opposite directions over time. When the producer raised its margin, retailers tended to absorb some of that (reducing their own markup) and vice versa.

¹² We present similar findings in Appendix Figure A2, which suggests there is positive, but weak, correlation between supply chain metrics and markups.

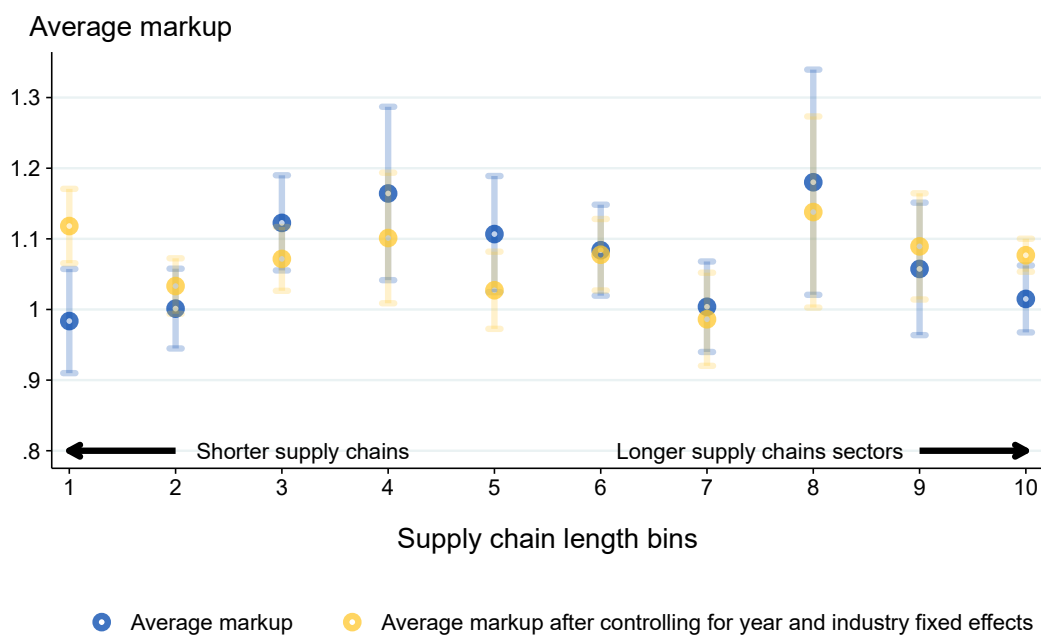
relatively more upstream or central (or its supply chains lengthen) compared to its past self, do its markups change accordingly? This difference-in-differences style approach filters out static differences between sectors (each sector serves as its own control to some extent).

6.10 Using these methods, our analysis yields a nuanced picture.

6.11 **Supply chain length vs. markups:** On simple comparison, sectors with longer supply chains do not show higher price-cost markups on average. A binned scatterplot (Figure 26) of markups against supply chain length deciles shows no clear upward trend; average markups are broadly stable across the distribution. This pattern remains after accounting for sector and year fixed effects: the estimated relationship between supply chain length and markups is small and statistically indistinguishable from zero. In other words, greater supply-chain complexity, as captured by chain length, does not appear to be associated with higher pricing power as reflected in the sector's (final) markup. This is notable because one might conjecture that complex supply structures could coincide with greater pricing power, but we do not see higher sector markups simply due to longer chain length.

Figure 26: Longer supply chains do not have higher price-cost markups

Binned scatterplot showing average markups across supply chain length bins, both with and without controlling for year and industry fixed effects, across the period 2017 to 2021. Data from ONS UK Industry-to-Industry payment flows (2017 to 2024) and the CMA State of Competition Report (2024).



Year fixed effects control for unobserved factors which affect all sectors but vary over time, while industry fixed effects control for time-invariant 2-digit Standard Industrial Classification (SIC) sector specific characteristics. Data from ONS UK Input-output analytical tables: product by product (2017-2021) and CMA State of UK Competition Report (2024). Data covers the period 2017 to 2021 at the 2-digit SIC level. Analysis excludes where available household, government/non-market and not-for-profit sectors.

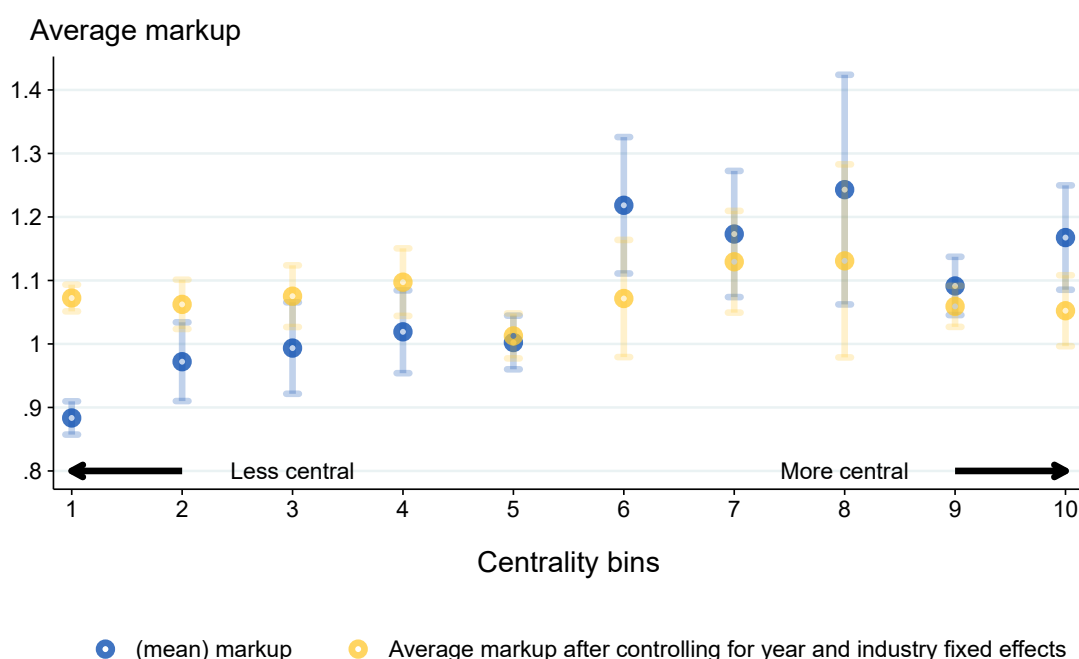
6.12 Upstreamness vs. markups: In line with previous CMA analysis, we observe a small positive correlation between upstreamness and markups (upstream sectors tend to have slightly higher markups). However, our analysis suggests this is not a direct causal link. When we control for fixed sector characteristics and time effects, the relationship largely vanishes. It appears that other factors drive this pattern, such as more upstream sectors potentially having higher markups due to higher fixed costs.

6.13 Centrality vs. markups: When comparing across sectors, more central sectors have higher average markups (blue points in Figure 27, without controls). This pattern could reflect that sectors acting as key hubs, often supplying many others, face weaker substitution or greater bargaining leverage, and centrality may also partly capture sector size and embeddedness. However, once we include sector and year fixed effects, the relationship disappears (or slightly reverses): when a given sector becomes more central over time, we do not observe its markups rising. Taken together, the contrast suggests that higher markups in central sectors are more likely

driven by persistent sector characteristics (e.g., scale economies, regulation, intangible assets, or other structural features) rather than centrality itself generating market power. In policy terms, this tempers a bottleneck narrative: being a hub is not, on its own, sufficient to imply rising pricing power.

Figure 27: Price-cost markups are higher in more central sectors, but not when we look at within-industry variation

Binned scatterplot showing average markups across centrality bins, both with and without controlling for year and industry fixed effects, across the period 2017 to 2021. Data from ONS UK Industry-to-Industry payment flows (2017 to 2024) and the CMA State of Competition Report (2024)



Year fixed effects control for unobserved factors which affect all sectors but vary over time, while industry fixed effects control for time-invariant 2-digit Standard Industrial Classification (SIC) sector specific characteristics. Data from *ONS UK Input-output analytical tables: product by product (2017-2021)* and *CMA State of UK Competition Report (2024)*. Data covers the period 2017 to 2021 at the 2-digit SIC level. Analysis excludes where available household, government/non-market and not-for-profit sectors.

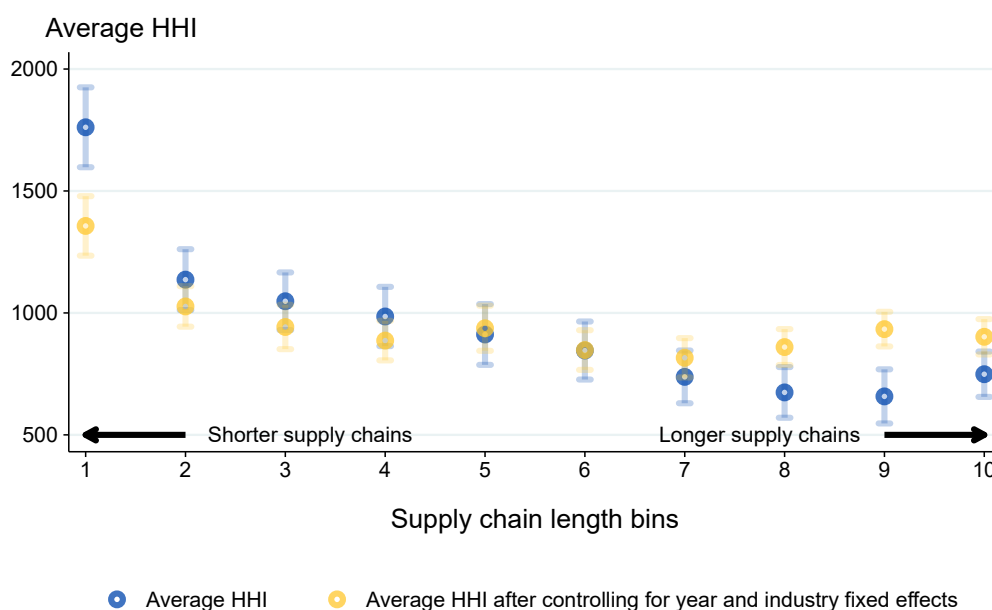
6.14 Next, we turn to concentration (HHI) and how it relates to supply chain structure.

6.15 **Supply chain length vs. concentration:** We find a negative relationship between supply chain length and market concentration. Sectors with longer, more complex supply chains tend to have lower HHI, meaning they are less concentrated (more fragmented within the sector) on average than sectors with shorter supply chains. Figure 28 shows this clearly: moving to the right (longer chains), the average HHI drops, even after controlling for sector and year fixed effects. Of course, this is a correlation: it could be that less concentrated industries encourage outsourcing and fragmentation (thus

longer chains). This relationship should be interpreted with care because supply chain length summarises the depth and complexity of upstream production linkages, whereas the HHI measures concentration within the sector itself. Sectors with longer supply chains and lower HHI may be more fragmented within that sector, but this does not mean the whole supply chain is fragmented or that overall market power is lower. Vertically integrated firms can coordinate multiple stages, and long chains can still contain concentrated upstream sectors. We therefore cannot infer economy-wide fragmentation, market power, or resilience from this result alone.

Figure 28: Concentration is systematically lower in sectors with longer supply chains

Binned scatterplot showing the average Herfindahl–Hirschman Index across supply chain length bins, both with and without controlling for year and industry fixed effects, across the period 2017 to 2022. Data from ONS UK Industry-to-Industry payment flows (2017 to 2024) and the CMA State of Competition Report (2024).



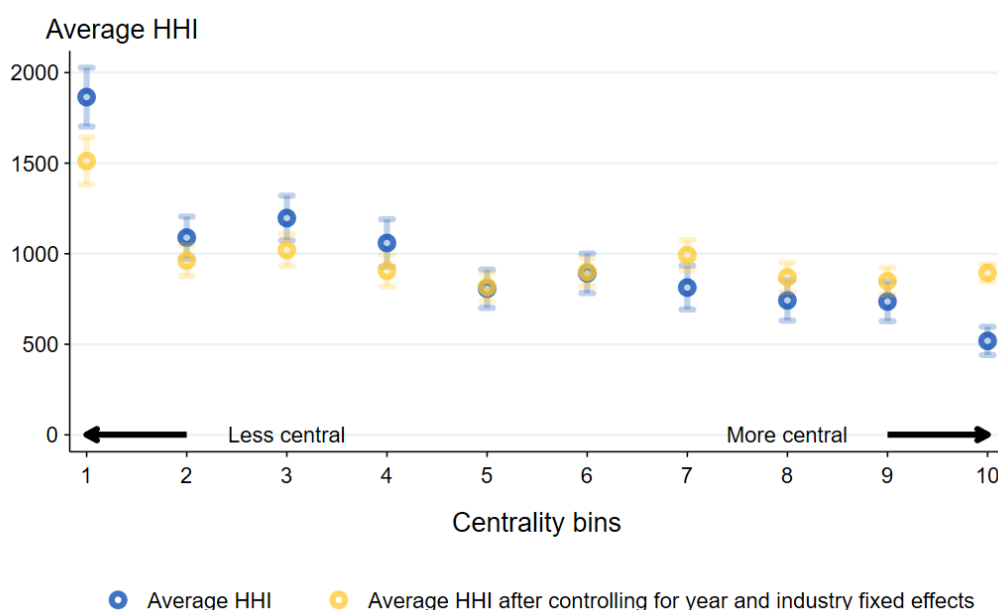
Year fixed effects control for unobserved factors which affect all sectors but vary over time, while industry fixed effects control for time-invariant 3-digit Standard Industrial Classification (SIC) sector specific characteristics. Data from ONS UK Industry-to-Industry payment flows (2017-2024) and CMA State of UK Competition Report (2024). Data covers the period 2017 to 2022 at the 4-digit SIC level.

6.16 Centrality vs. concentration: We find a negative association between sector centrality and within-sector concentration. Plotting HHI against centrality (Figure 29) shows a downward pattern: sectors that are more central, i.e. those that supply many other sectors directly and indirectly, tend to have lower HHI on average than less central sectors. This relationship holds when controlling for sector and year fixed effects, indicating that within a given sector, periods of higher centrality are associated with lower concentration

relative to that sector's own average. One interpretation is that sectors that are structurally important in the production network may be more contestable or attract more entry, limiting concentration. Another possibility is reverse causality: sectors that are highly concentrated may be less well integrated into broad supply relationships and therefore appear more peripheral. While we do not identify direction of causality here, the correlation suggests that centrality in the network is not generally accompanied by higher within-sector concentration.

Figure 29: Concentration is lower in sectors that are more important for the supply network

Binned scatterplot showing the average Herfindahl–Hirschman Index across centrality bins, both with and without controlling for year and industry fixed effects, across the period 2017 to 2022. Data from ONS UK Industry-to-Industry payment flows (2017 to 2024) and the CMA State of Competition Report (2024).



Year fixed effects control for unobserved factors which affect all sectors but vary over time, while industry fixed effects control for time-invariant 3-digit Standard Industrial Classification (SIC) sector specific characteristics. Data from ONS UK Industry-to-Industry payment flows (2017-2024) and CMA State of UK Competition Report (2024). Data covers the period 2017 to 2022 at the 4-digit SIC level. Analysis excludes where available household, government/non-market and not-for-profit sectors.

6.17 Taken together, these findings suggest that the lengthening and increased complexity of UK supply chains has not been accompanied by a systematic increase in sector-level market power. Sector markups do not increase with supply chain length, and longer-chain sectors tend to have lower within-sector concentration (lower HHI) on average. This is consistent with supply chains becoming more specialised without a broad-based increase in concentration within sectors, though it does not allow us to infer concentration or market power across the supply chain as a whole.

6.18 That said, we do identify some sectors with relatively high markups that may warrant attention because of their position in production networks. For example, construction is a largely downstream sector but draws on a long upstream input structure, meaning cost or supply pressures upstream could plausibly matter for final prices in construction-intensive goods and services. While we do not estimate “accumulated markups” along the chain in this analysis, these kinds of sectors are natural candidates for further work on upstream exposure and pass-through.

Accumulated network distortions

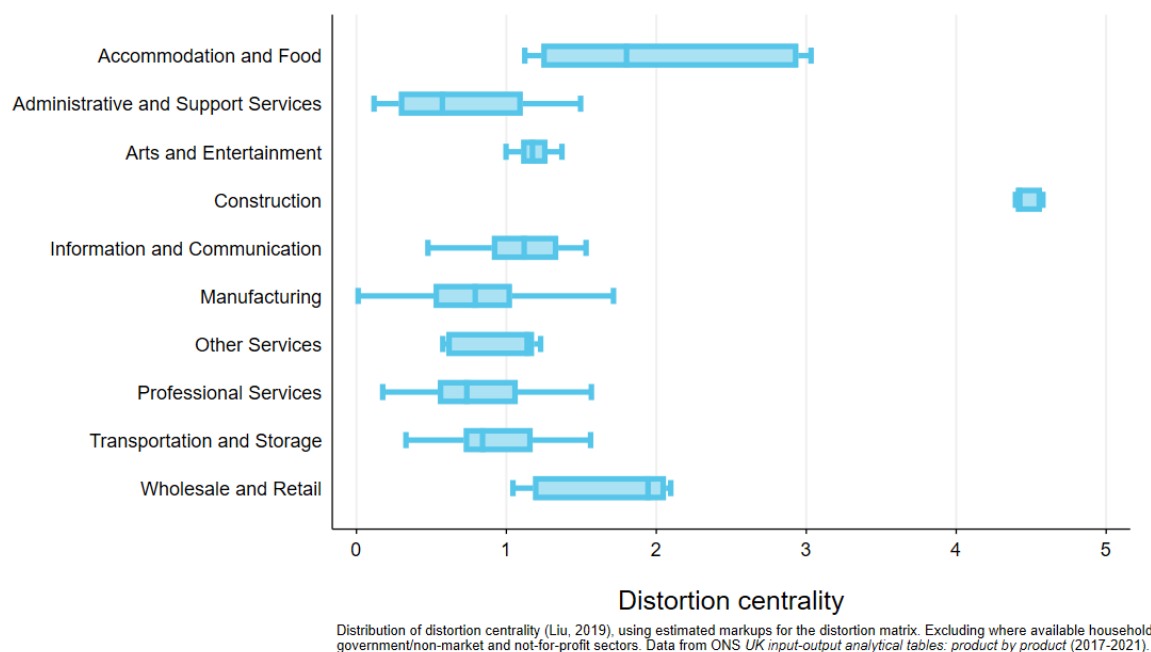
6.19 The previous section investigated sectoral markups and concentration across the length and centrality of supply chains. This section explores a measure of network *distortion centrality*, a measure which approximates how market imperfections (such as markups) ‘accumulate’ within a supply network.

6.20 Following (Liu, 2019), we estimate how markups across sectors “accumulate” based on sectoral linkages. Our accumulated markup is the weighted average of the markups that exist in a sector’s supply chain, including indirect suppliers through multi-step input-output linkages. More concretely, for each sector we compute the average markup of sectors that supply it, weighted by the share of inputs they supply.

6.21 A value near one indicates limited distortion (e.g., markups close to one on average), will arise in an efficient market with minimal markups. Values greater than one suggest an accumulation of markups. Values less than one indicate other distortions in the market, such as subsidies. Figure 30 documents the distribution of distortion centrality across broad sectoral groups. The most “distorted” sectors are in construction, accommodation and food, wholesale and retail.

Figure 30: Many UK sectors have limited distortions, except accommodation and food, construction, and wholesale and retail

Data from ONS UK Input-output analytical: product by product (2017 to 2021), using CPA classification. It plots the distribution of distortion centrality for sectors contained within each sectoral grouping, from the 25-percentile distortion centrality value to the 75-percentile value. The vertical line represents the median distortion centrality.



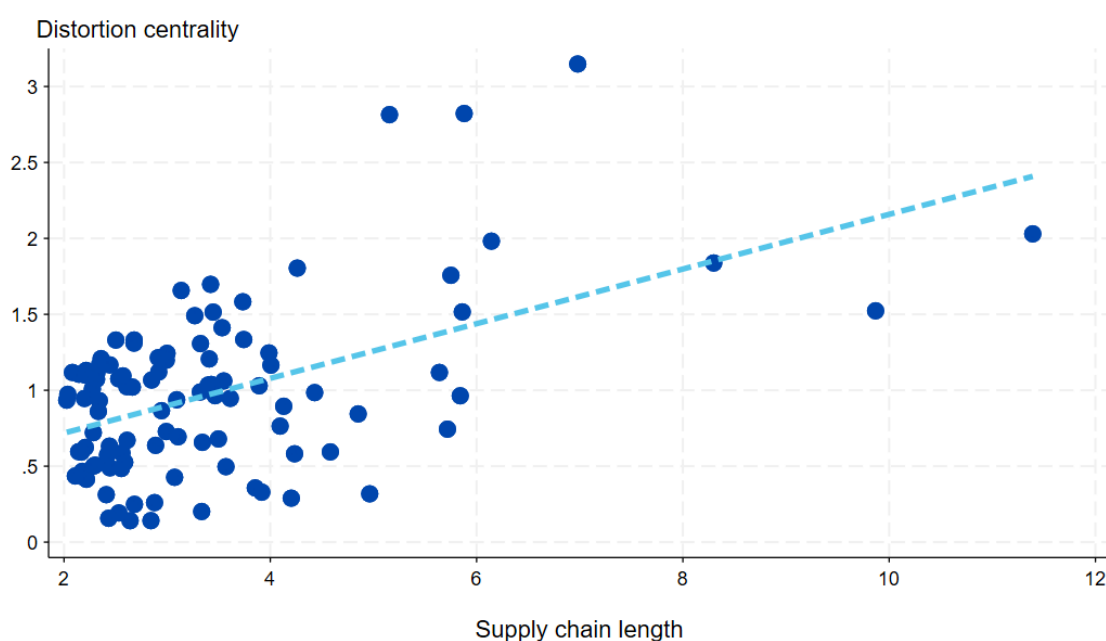
- 6.22 Assessing the relationship between distortion centrality other supply chain metrics allows us to better understand the relationship between supply chain structures, competition and consumer outcomes.
- 6.23 As expected, given the construction of the measure, distortion centrality is strongly positively correlated with centrality, downstreamness, and overall supply chain length. The correlation coefficients are high (0.8 or above with centrality and downstreamness, around 0.67 with total length). This means sectors that are more downstream and that play a big role in the network (which often means they have many inputs) tend to accumulate more markup. This is logical: a sector that sits toward the end of a long chain will incur all the upstream markups along that chain. The positive correlation with length is consistent with a double marginalisation mechanism in which markups can accumulate across stages.
- 6.24 This matters because even if each individual stage is reasonably competitive (low markups), a sufficiently long chain can still result in a significant total price distortion by the end. Conversely, a short chain with one highly distorted (high markup) stage might impose less total distortion than a long chain of

moderate markups. For policymakers, this highlights that looking at single sectors in isolation can underestimate the true degree of market power affecting consumers: supply-chain position and upstream linkages may matter. The presence of cumulative markups suggests that interventions to streamline supply chains or promote competition upstream could deliver amplified benefits for downstream sectors.

6.25 Figure 31 illustrates the relationship between distortion centrality and chain length, showing that sectors with longer chains indeed have higher accumulated distortions on average.

Figure 31: Positive correlation between distortion centrality and supply chain length

Data from ONS UK Input-output analytical: product by product (2017 to 2021), using CPA classification. Each point is a sector's average distortion centrality and supply chain length, with a best fit line.



Data from ONS UK input-output analytical tables: product by product (2017-2021). Each point represents a CPA sector, averaged over 2017-2021.

Mapping market power in connected sectors

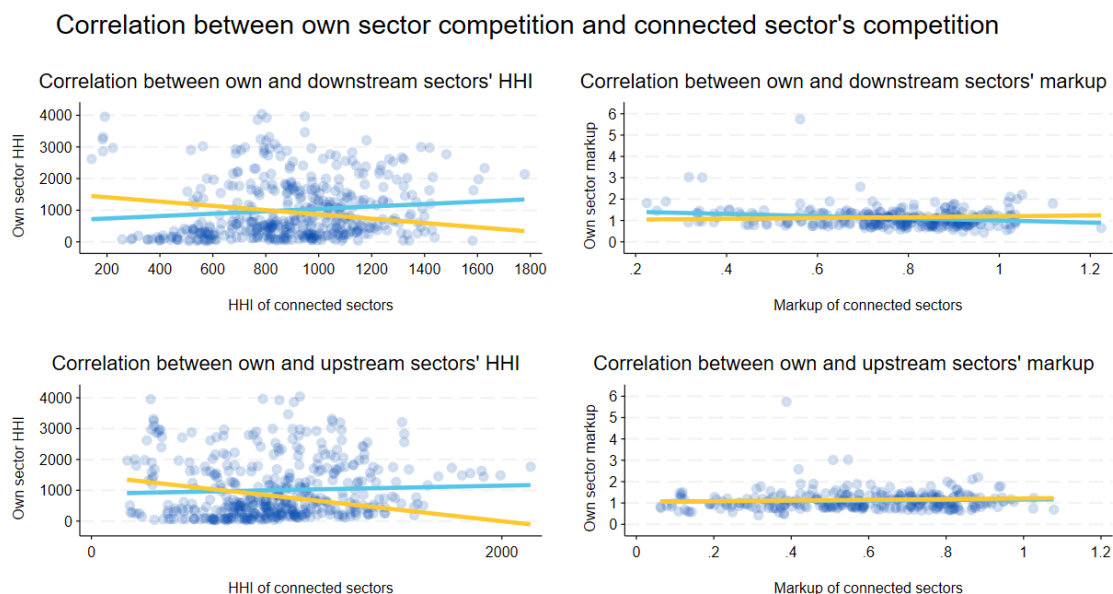
6.26 A separate question is whether sectors with high market power tend to have economic connections with other sectors that have high market power. This may be informative as to how market power travels through supply networks. There is some evidence on the connectedness of market power upstream and downstream in supply networks. For example, [Alvarez-Blaser et al. \(2025\)](#) find a negative correlation between retailer and manufacturer markups in the UK, US and Canada.

- 6.27 We use two measures of connection:
- (a) Upstream Connected Market Power: For each sector, we calculate the average HHI (and separately average markup) of the sectors supplying inputs to it, weighted by input shares. This gives a sense of how concentrated the markets are among its suppliers.
 - (b) Downstream Connected Market Power: Similarly, we compute the weighted average HHI/markup of the sectors that buy outputs from that sector (i.e. its customer industries).
- 6.28 Plotting a sector's own market power against the average of its connected sectors' market power provides insight. Figure 32 summarises these relationships.
- 6.29 There is a weak positive correlation between a sector's own concentration (HHI) and that of its connected sectors in the unweighted data: more concentrated sectors are slightly more likely to be linked to other concentrated sectors, though the relationship is small. However, when we weight by sector size (so that larger sectors receive more weight), the correlation flips sign: large, highly concentrated sectors tend to be connected to less concentrated sectors on average. This suggests that, for the major economic flows, concentration does not strongly cluster across adjacent industries; instead, high concentration in large sectors often coincides with trading relationships with more fragmented sectors. One possible explanation is that market structure differs systematically between upstream and downstream stages, or that bargaining and sorting lead powerful sectors to interact with more competitive counterparts.
- 6.30 For markups, we find no meaningful correlation. Sectors with high markups are not systematically linked to sectors with high or low markups upstream or downstream. In other words, markup power does not obviously cluster, a high-markup sector might have low-markup suppliers and customers, or vice versa. This could reflect that markups are influenced by very sector-specific factors (technology, preferences, import competition) that aren't easily transmitted through input-output linkages.
- 6.31 Regression results confirm the correlation patterns. Unweighted, a 100-point higher sector HHI is associated with a 37–54 point higher downstream connected HHI, but this relationship flips negative when weighting by sector size. For markups, we find no significant relationship between a sector's markup and the markups of its trading partners upstream or downstream.
- 6.32 Overall, the results suggest limited clustering of concentration across connected sectors. If anything, the patterns are consistent with a mild

opposites-attract tendency: sectors that are more concentrated on one side of a trading relationship are often connected to less concentrated sectors on the other side. One possible interpretation is bargaining: concentrated supplier sectors may transact with many fragmented buyer sectors, while concentrated buyer sectors may source from many fragmented suppliers. We treat this as a suggestive interpretation rather than a causal finding, but it aligns with a relative bargaining-power perspective in which market structure on one side is offset by fragmentation on the other.

Figure 32: Lack of correlation between sector's level of competition and the weighted average of its connected sectors

Data from ONS UK Input-output analytical: product by product (2017 to 2022) and CMA State of Competition Report (2024), using 2-digit SIC classification. Blue lines show unweighted best fit, the yellow lines are output-weighted best fit. **Left panels:** correlation between a sector's own HHI, and the HHI of downstream (top panel) or upstream (bottom panel) sectors. **Right panels:** correlation between a sector's own markup, and the markup of downstream (top panel) or upstream (bottom panel) sectors. In all panels the HHI or markup of connected sectors is weighted by importance of the connected sector to the own sector.



Correlation between a sector's markup and Herfindahl-Hirschman Index (HHI), and the markups and HHI of connected sectors, between 2017 and 2022. Sectors are classified using 2-digit Standard Industrial Classification (SIC) level. The strength of a connection is weighted either by how important a connected sector is for selling inputs (connected downstream), or by how important a connected sector is for buying outputs (connected upstream). Data from ONS UK Input-output analytical, tables product by product (2017-2022) and CMA State of Competition 2024. The blue lines show best fit, while the yellow ones show best fit weighted by size.

Market power passing through the supply chain

6.33 An important question to ask is whether changes in market structure move together across connected parts of the supply chain. For example, when

upstream supplier sectors become more concentrated, do their downstream customer sectors tend to become more or less concentrated?

- 6.34 To explore this, we examine year-to-year changes (and lags) in sectoral concentration and markups.
- 6.35 We estimate regression analysis that relate the *changes* in a sector's own HHI/markup to the (input-share-weighted) average *changes* in HHI/markup among its connected sectors upstream and downstream. We find strong evidence of *contemporaneous* co-movement in concentration measures across connected sectors.
- 6.36 In particular, when upstream supplier sectors become more concentrated (higher HHI), downstream sectors tend to become less concentrated (lower HHI) in the same period. Symmetrically, when major downstream customers become more concentrated, their upstream suppliers' concentration tends to fall. These patterns are robust across specifications and are suggestive of relative bargaining power dynamics ([Toxvaerd, 2025](#)), in which changes in market power upstream tend to be offset downstream, and vice versa.
- 6.37 For markups, we find at most a weak negative contemporaneous association in one direction: in years when downstream sectors' markups rise, the (input-weighted) markups of their upstream suppliers fall slightly. One possible interpretation is bargaining: downstream sectors with higher markups (a proxy for pricing power) may be able to squeeze supplier margins. Evidence for the reverse direction (upstream markup increases being associated with downstream markup increases) was not robust, except in some specifications focused on the single largest trading partner, which may reflect countervailing power by large buyers when key suppliers raise prices. Overall, these markup co-movement effects are weaker than the HHI results and are not consistent across all tests.
- 6.38 When focusing on the largest trading partners (the single biggest buyer-supplier relationship for each sector), we find that increases in the largest buyer's market power, proxied by a higher markup or HHI, are associated with a decline in the seller sector's market power. This is intuitive: when a sector's primary customer consolidates or gains pricing power, suppliers may face tougher terms, which can reduce their own markups or concentration.
- 6.39 We also checked for lagged effects, recognising that contractual arrangements may mean changes take time to pass through. We find limited evidence of delayed propagation: most of the correlations appear in the same year, and lagged effects are generally weak or statistically insignificant. This suggests that, if market-power changes do propagate through supply links,

they do so relatively quickly (within an annual timeframe). Alternatively, the contemporaneous patterns may reflect common external shocks (for example, global demand or input-cost shocks) affecting multiple connected industries at the same time.

- 6.40 Overall, these results support the idea of ripple effects in supply chains: changes in concentration on one side of a trading relationship are often associated with offsetting changes on the other side in the same period. For competition policy, this suggests that a merger or other reduction in competition in one sector may have knock-on effects in connected upstream or downstream sectors, potentially mitigating impact if countervailing consolidation occurs, or exacerbating them if it removes a remaining pocket of competition. This suggests there may sometimes be a need for a network perspective in competition assessments: to consider not just the market in question but its position in wider supply networks.

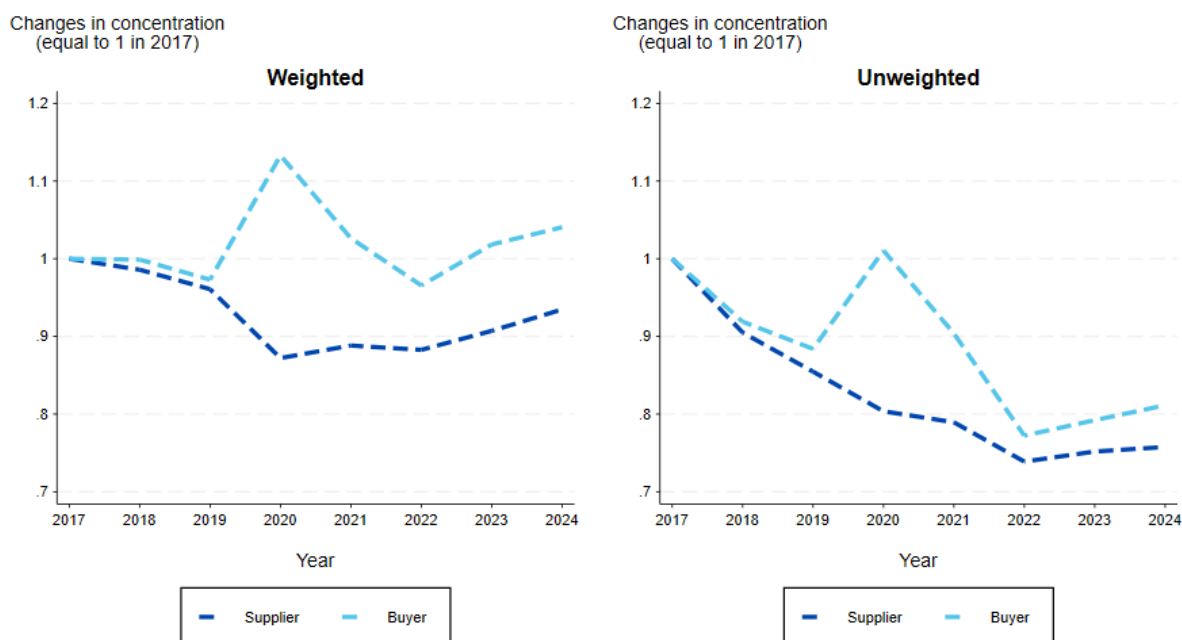
Within-network concentration

- 6.41 Concentration can vary across supply networks: the set of buyers a seller sells to may be more (or less) concentrated than the set of suppliers it buys from. We document this by computing buyer and supplier concentration measures using detailed 5-digit sectoral data, following [Alvarez, Fioretti, Kikkawa and Morlacco, 2025](#). These measures describe the distribution of trading relationships upstream and downstream.
- 6.42 Buyer and supplier concentration help characterise how concentrated a sector's trading relationships are within the supply network. We adapt an HHI-style index to measure (i) how concentrated a sector's customers are (buyer concentration) and (ii) how concentrated its input sources are (supplier concentration). We compute these measures for each 5-digit sector in each year and summarise trends using both unweighted averages (treating each sector equally) and size-weighted averages (giving more weight to economically larger sectors).
- 6.43 Intuitively, buyer concentration is high when a sector sells mainly to a small number of customer sectors, and supplier concentration is high when it sources inputs from a small number of supplier sectors. For example, if a single sector accounts for all purchases from the insurance sector, insurance faces a monopsony customer, and its buyer concentration would be 10,000. By contrast, if insurance sources inputs from many sectors in roughly equal proportions, its supplier concentration would be low (under equal shares, 10,000 divided by the number of suppliers).

- 6.44 Figure 33 shows trends in the economy-wide buyer concentration and supplier concentration, plotted both unweighted (treating each 5-digit sector equally) and size-weighted (giving more weight to larger sectors). The underlying concentration measures are computed at the 5-digit sector level.
- 6.45 The results suggest that average buyer and supplier concentration have remained stable between 2017 and 2024 (left panel of Figure 33). The weighted averages are similar when comparing 2017 to 2024, aside from temporary movements around the pandemic period.
- 6.46 By contrast, the unweighted buyer and supplier averages show a pronounced decline over time (right panel of Figure 33). This indicates that concentration in trading relationships has fallen for the typical sector when each sector is given equal weight, with the decline concentrated among smaller industries and therefore less visible in the size-weighted series.

Figure 33: Steady trends buyer and seller concentration in the UK.

Data from ONS UK Industry-to-Industry payment flows (2017 to 2024), using 5-digit SIC classification. It plots changes in the economy-wide average buyer and seller supply chain network concentration, relative to 2017. A higher value represents more concentrated supply chain networks.



Concentration measured by Herfindahl-Hirschman Index (HHI) for buyer and seller sectors, using ONS UK industry-to-industry payment flows (2017 - 2024).

- 6.47 The aggregate trends in buyer and supplier concentration in Figure 33 mask substantial heterogeneity across sectors. To understand which network

features are associated with higher buyer or supplier concentration, we estimate regressions at the 4-digit sector level (Table 1). These regressions include 4-digit sector and year fixed effects, so the coefficients are identified by within-sector changes over time.

6.48 The results indicate that higher supplier concentration is associated with greater centrality, longer supply chains, and higher markups. Higher buyer concentration is also associated with greater centrality and longer supply chains but shows no statistically meaningful relationship with markups.¹³

6.49 Overall, these findings suggest that concentration in trading relationships (on both the buyer and supplier side) is systematically linked to sectors' positions and roles in the supply network.

Table 1: Log-log regression of centrality, supply chain length and markups on buyer and seller concentration

	(1) Centrality	(2) Supply chain length	(3) Markup	(4) Centrality	(5) Supply chain length	(6) Markup
Supplier HHI	0.316*** (0.050)	0.088*** (0.017)	0.058** (0.028)			
Buyer HHI				0.251*** (0.062)	0.056*** (0.020)	0.048 (0.032)
N	4416	4260	1990	4534	4368	1999

Standard errors in parentheses. All regressions include 4-digit and year fixed effects.

** p < 0.10, ** p < 0.05, *** p < 0.01*

6.50 In summary, market structure and supply chain configuration move together: changes in concentration/markups and changes in network structure are correlated, consistent with a two-way relationship.

6.51 We find no systematic link between longer supply chains and higher sector markups, with longer chains tending to have lower within-sector HHI on average. However, network measures suggest that concentrated upstream relationships can still matter for downstream outcomes, so a network perspective can help flag upstream areas where market power may have amplified effects through supply linkages.

¹³ Note that the sample size falls by over 50% for the markup regressions, due to having a much smaller sample of 4-digit estimated markups from the CMA's [State of UK Competition Report 2024](#).

7. The UK in a global supply network

- 7.1 UK supply chains are tightly integrated into global networks. Research on global value chains (Gereffi et al., 2005; Timmer et al., 2014) and supply chain resilience (Miroudot, 2020; OECD, 2023) highlights the importance of international linkages and diversification in managing risk.
- 7.2 This section examines how global integration and import diversification affect the UK's economic resilience to disruptions abroad. Broadly, economic openness can spread risk, for instance, if a domestic supplier fails, an imported alternative might cushion the impact. However, heavy reliance on one or two foreign sources for key inputs can be a critical vulnerability. We explore the trade-offs between efficiency and risk in global sourcing, aligning with literature that shows trade openness can mitigate domestic volatility (Caselli et al., 2020) but also create new channels for shock transmission.

Measuring diversification and resilience

- 7.3 To assess the resilience of sectors to external disruptions, we construct an import resilience indicator for each sector, drawing on methodologies from recent studies (Jiménez et al., 2022; OECD, 2023; De Michelis and Somale, 2023; Ahn and Tan, 2025). This measure combines two dimensions:
- (a) Import source diversification: How widely a sector's imported inputs are spread across different countries. We use a normalised Herfindahl–Hirschman Index (HHI) for inputs source to quantify this. An index value near 1 indicates that imports are very diversified (sourced evenly from many countries), whereas near 0 indicates highly concentrated imports (one or two countries dominate).
 - (b) Domestic versus import inputs: The share of a sector's inputs that are imported versus sourced domestically. A sector that only imports 5% of its inputs is inherently less exposed to foreign shocks than one that imports 50%, all else equal.
- 7.4 We combine these into a single resilience score. A sector scores high on resilience if it sources inputs from a broad range of countries and maintains a balanced mix of domestic and imported inputs. Low scores reflect concentrated sourcing or high import dependence.

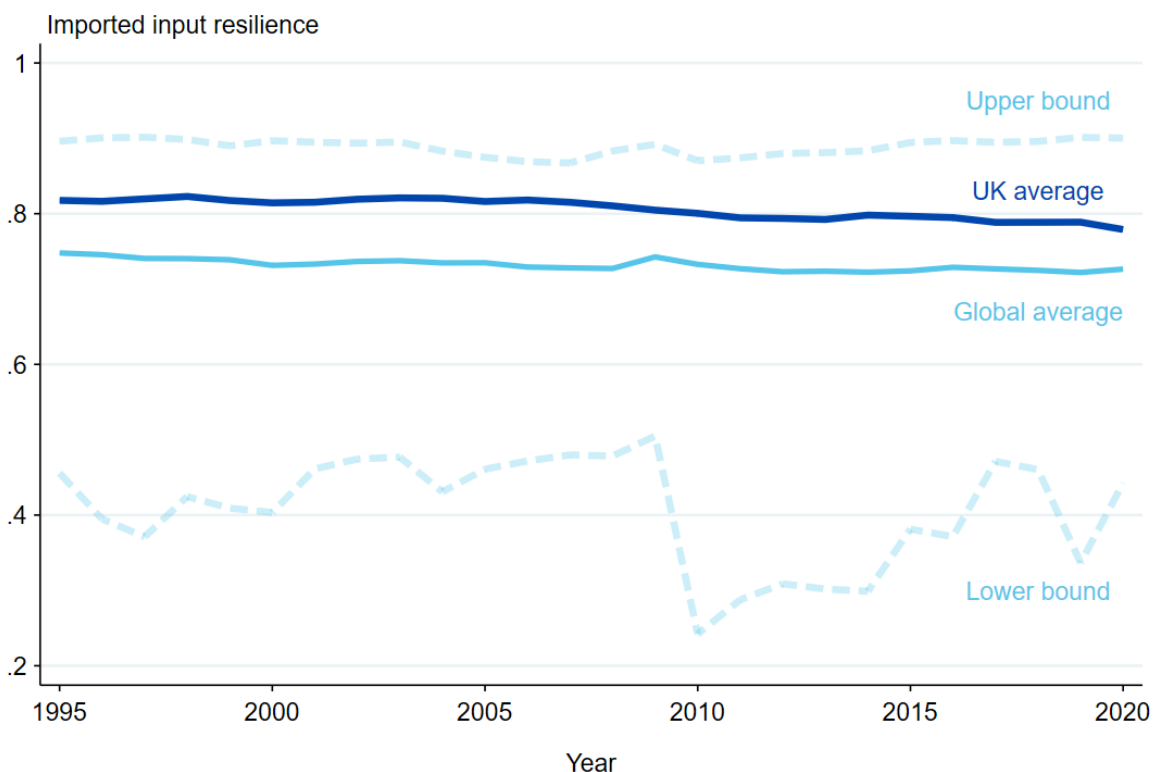
Diversification and resilience: UK Findings

- 7.5 Looking at our resilience index for the UK and other countries over time, a few results emerge.

- 7.6 The UK ranks above the global average in imported input resilience. In fact, among advanced economies the UK consistently scores as one of the more resilient by this metric. This is because UK sectors typically import from a wide array of trading partners (high diversification) and many sectors still have a substantial domestic supplier base. Figure 34 illustrates this, showing the UK's resilience score over time relative to the distribution of countries.
- 7.7 That said, the UK's resilience has declined slightly over the past 25 years. This is mainly due to an increasing import share (more inputs coming from abroad, especially in manufacturing and some services) which outweighs improvements in diversification. However, this pattern is not unique to the UK and mirrors global trade trends. As globalisation advanced from the 1990s to mid-2010s, most countries saw rising import dependence and thus a bit more vulnerability to external shocks. The UK's small decline should be viewed in that context (not as a UK-specific effect, but part of a general trend of deeper global integration).

Figure 34: The UK's imported inputs are among the most resilient across the sample

Distribution of imported input resilience over time. The solid dark blue line is the UK's average imported input resilience, the solid light blue line is the global average, and the dotted light blue lines represent the upper and lower country's average value in each year. Using OECD Inter-Country Input-Output Tables (1995-2020).



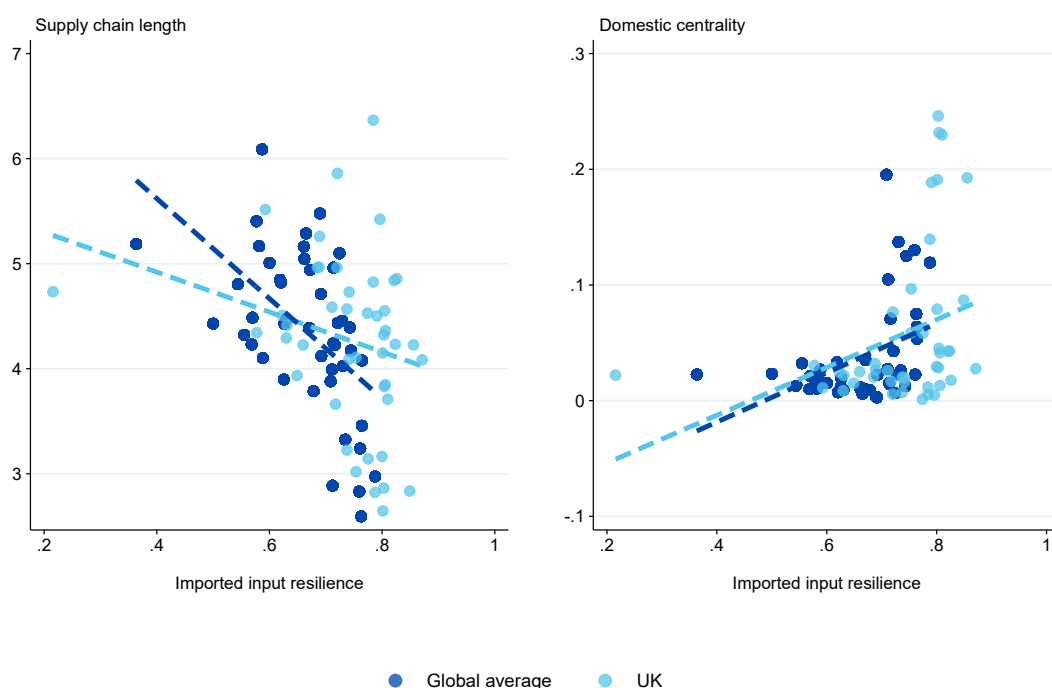
Using OECD *Inter-Country Input-Output Tables*. The lower and upper bound are the lowest and highest imported input resilience of a country in each year respectively. The global average is the unweighted average imported input resilience across all 77 countries.

7.8 There is an observed negative relationship between supply chain length and resilience: sectors with very long supply chains tend to have slightly lower resilience scores (each additional production stage corresponds to an estimated few percentage-point drop in resilience, on average). Intuitively, long supply chains may involve more international sourcing at each step (more potential points of import dependency). However, we also found that this relationship disappears when controlling for sector fixed effects, meaning certain sectors drive the pattern, rather than length per se universally causing lower resilience. In other words, it is not that if a sector lengthens its chain, it automatically becomes less resilient; rather, sectors that are global and complex (like electronics or machinery) tend to have both long chains and more import reliance.

7.9 Central sectors tend to be more resilient. We find a positive correlation between a sector's domestic centrality (importance in the UK network) and its imported input resilience. One interpretation is that sectors which are pivotal in the UK economy have, out of necessity or prudence, developed broader sourcing strategies and rely less on any single foreign input source. For example, a central sector like food manufacturing sources inputs from many countries (spices, ingredients from around the world) but also domestically, it cannot afford to be dependent on one region. Meanwhile, a less central sector might have a narrower supply chain and could be heavily reliant on a single country's imports. Figure 35 (right panel) shows that UK sectors with higher centrality often have above-average resilience scores (light blue dots generally above the trendline compared to the global average in dark blue). This suggests a virtuous aspect: being well-integrated domestically often goes hand-in-hand with having diverse international links.

Figure 35: Longer supply chains tend to have lower resilience on average

Left panel shows the relationship between supply chain length and imported input resilience, for both the UK and the global average. **Right panel** shows the relationship between domestic centrality and imported input resilience, for both the UK and the global average. Each dot represents a sector. The dark blue dots are the global average values over all 77 countries within the dataset. The light blue dots are the average values in the UK only. Centrality values are the domestic centrality of a sector, capturing importance within its own rather than the global economy. Data from OECD Inter-Country Input-Output Tables (2019).



Using OECD *Inter-Country Input-Output Tables*. An unweighted average across all 77 countries in 2019. Each point represents a sector's average resilience against their supply chain length or domestic centrality.

7.10 Diving deeper, we examine which UK sectors are most and least diversified:

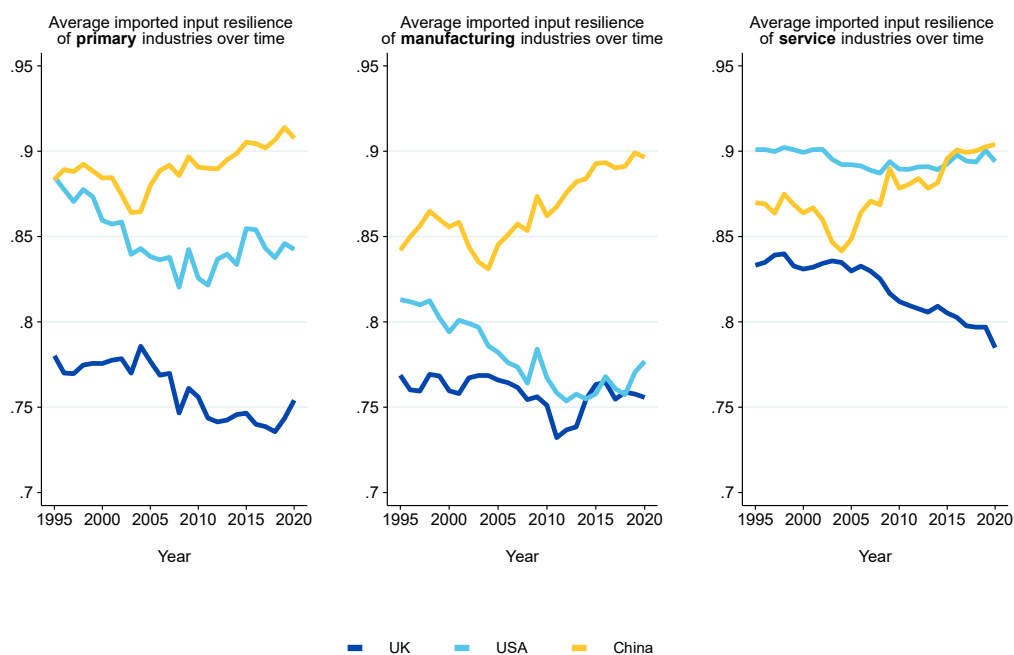
- (a) Most UK sectors are reasonably well-diversified in their import sourcing. A few exceptions stand out: Electricity & Gas and Refined Petroleum have low diversification (often imports come from a limited set of countries or regional pipelines). However, those sectors also rely heavily on domestic inputs (e.g. the UK produces some of its own gas, and refineries use local crude to an extent), so their overall resilience is not as low as the diversification index alone would suggest. In fact, electricity and gas only import about 10% of their inputs, so despite low source diversity, they score moderately on resilience due to domestic supply.

(b) Since the mid-2000s, one trend is a decline in input resilience for UK services. Services sectors have gradually increased their import usage, and some have concentrated sourcing perhaps due to global vendors dominating certain markets. By contrast, UK manufacturing's resilience has been steadier; manufacturing improved its diversification somewhat in the 2000s before import dependence grew in the 2010s. Compared to the US, UK sectors currently show slightly less imported input resilience across the board, but the gap has been closing for manufacturing. The US saw a notable decline in manufacturing resilience as it offshored production in the 2000s, bringing it closer to the UK level. China, interestingly, has increased its import resilience as it became more diversified in sourcing raw materials and components from many countries.

7.11 Figure 36 shows these trends by broad sector (primary, manufacturing, services) for UK, US, China. The UK's service sector's resilience has trended downward steadily (though from a high base; UK services were very domestically oriented historically). Manufacturing in the UK is now more resilient than in the US in terms of inputs (the UK sources, for example, parts from all over Europe and Asia, whereas US manufacturers might rely heavily on Mexico/China, though this is changing).

Figure 36: Average imported input resilience by sector type over time for the UK, the USA and China

The average imported input resilience over time for the UK, USA, and China, split by industry type. The average is weighted by sector share of GDP. Primary sectors are extractive sectors, and manufacturing sectors are those that produce goods (including construction). Service sectors are those that supply services. Using OECD Inter-Country Input-Output Tables (1995-2020).



Using OECD *Inter-Country Input-Output tables*. Primary sectors are extractive, and manufacturing sectors are goods producing (including construction). Sectors are weighted by share of GDP.

7.12 To better understand the nuances, we plotted the two components of resilience for UK sectors (Figure 37): import diversification on one axis and share of domestic inputs on the other. This helps identify different cases:

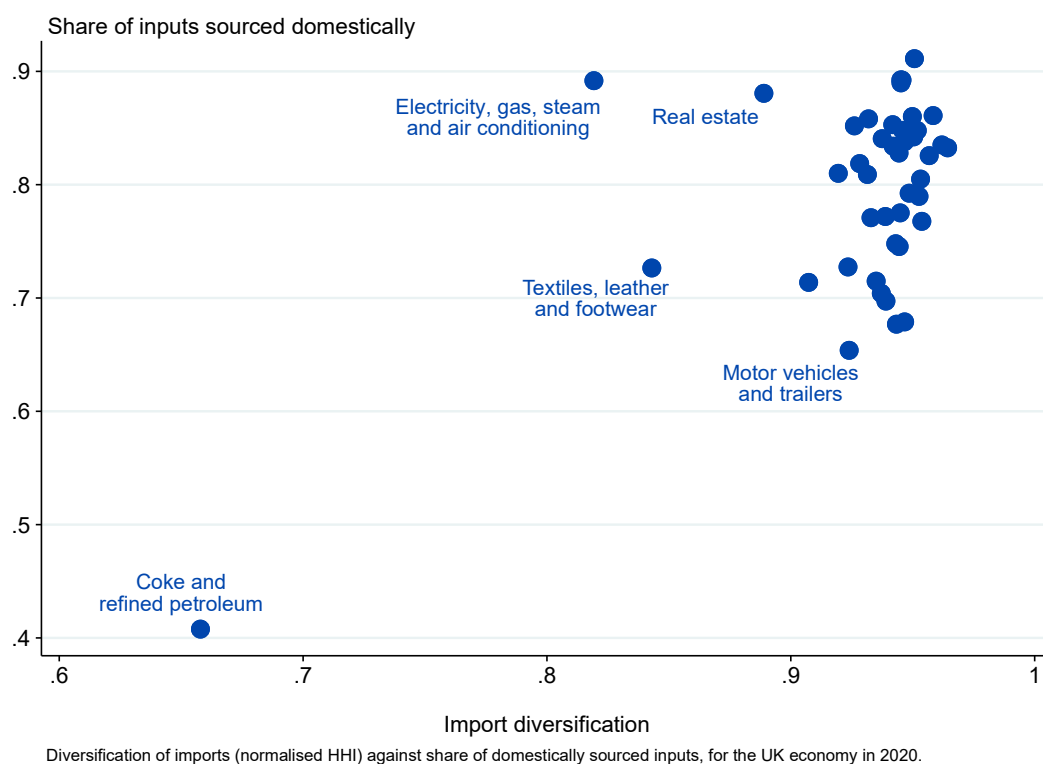
- (a) Some sectors have low diversification but high domestic sourcing (upper left area). These are quite resilient because they do not overly rely on imports to begin with. Electricity generation is a prime example: it imports very little fuel (some gas, some interconnection for electricity, but largely domestic sources) but what it does import might be from a single region. Its resilience is high because even if that import stopped, most inputs are local.
- (b) Some have high diversification but also high import reliance (lower right area), they spread their imports out, but they import a lot overall. These sectors are moderately vulnerable because if there is a global shock

affecting all suppliers (like a commodity price surge), they are exposed, but they are protected against any one country's situation.

7.13 Overall, the UK's strategy of having diverse trading partners has paid dividends for resilience (according to this definition of resilience). It means that even as the UK imports a lot, it is not excessively beholden to one country for critical supplies in most cases. This provides flexibility, if one source is cut off (due to political, natural, or economic problems), alternatives can step in more readily.

Figure 37: There are a few standout sectors that have low import diversification and/or a low share of imports that are sourced domestically.

Each point represents a sector in the UK economy in 2020.¹⁴ The position on the y-axis is its share of inputs that are sourced domestically and its position on the x-axis its import diversification. Import diversification is calculated using a normalised HHI method. Using OECD Inter-Country Input-Output Tables (2020).



¹⁴ Sectors are defined using the ISIC Rev. 4 framework. The United Nations' International Standard Industrial Classification of All Economic Activities, Revision 4, a globally agreed framework for classifying economic activities into a consistent hierarchy to support international comparability of statistics.

8. Propagation of shocks through the supply chain

- 8.1 Understanding how economic shocks propagate through supply chains is central to assessing the resilience and competitiveness of the UK economy. The previous chapters have shown how UK supply chains are structured, how they have changed, and where market power resides. We now turn to the dynamic question: what happens when an external shock hits the system? How do interlinked networks transmit or dampen the effects of such shocks, and do certain network characteristics (such as being upstream or having concentrated markets) influence that propagation?
- 8.2 As a case study, we examine the so-called “China shock”, the period of rapid growth in Chinese manufacturing and exports following China’s accession to the World Trade Organization (WTO) in 2001. This was a major structural shift in the global trading environment. China’s integration vastly increased the global supply of many manufactured inputs and consumer goods, providing cheaper imports for UK firms and consumers, but also introduced fierce competition for some UK industries.

How do shocks propagate? Theoretical refresher

- 8.3 Traditional macroeconomic thinking often assumed sector-specific shocks average out at the macro level; one industry’s slump might be offset by another’s boom, leaving the aggregate largely unaffected. However, more recent network-based theories challenge that, arguing that because firms and sectors are interconnected, a shock in one node can cascade and amplify through the web of supplier-customer relationships.
- 8.4 Key ideas include:
- (a) Input-output linkages amplification: If Sector A is hit by a shock (say, a supply disruption), it cuts its purchases from its suppliers, who in turn cut their own output and purchases from their suppliers, and so on, a downstream propagation. Similarly, if demand for A’s output falls, all its upstream suppliers may be affected (upstream propagation). This can turn what would be a modest sectoral shock into a larger impact ([Leontief, 1941](#); [Acemoglu et al., 2012](#); [Carvalho, 2014](#)). The structure of the network (who is central, who is a bottleneck) affects how far and how strongly these effects travel.
 - (b) Granular impact of large sectors/firms: [Gabaix \(2011\)](#) pointed out that if one sector or firm is very large (or central), a shock to it is not necessarily offset by others. The presence of dominant sectors means idiosyncratic shocks do not average out. In supply chain terms, if a large manufacturer

is hit by an import disruption, it might affect national production because of its size and supplier network. Market structure (the extent to which a few firms or sectors dominate) thus plays a role in propagation.

(c) Static vs. dynamic networks: In the short term, supply chains can be rigid, relationships and technologies are fixed, so a shock propagates along existing links as a mechanical multiplier. But over time, firms can adjust: they might find new suppliers, alter inputs, or innovate (Atalay et al., 2011; Antràs and Chor, 2022; Bachmann et al., 2022). So, the long-run propagation may be dampened as the network reconfigures. This is an important policy point: are supply chains flexible or stuck? The answer can determine if a shock's effects are transient or permanent.

8.5 With this framework, our empirical analysis focuses on two aspects: the direct and indirect effects of the China shock on UK sectors, and whether certain factors (like market power or network position) influenced those effects.

The China Shock and UK exposure

8.6 China joined the WTO in December 2001, which led to a surge in Chinese exports globally through the 2000s. For the UK, this meant suddenly cheaper and abundant supplies of various inputs and final goods from China but also increased competition in both UK domestic markets and foreign markets where both the UK and China export and compete, outside their own domestic markets.

8.7 Following the literature (Autor et al., 2013; Bloom, Draca and Van Reenen, 2016; Aghion et al., 2021), we quantify each UK sector's exposure to the China trade shock as the growth in imports from China in that sector (either for intermediate or final goods) relative to the sector's size (e.g. per worker or as a share of output). We consider both horizontal exposure (imports in the same product category as the sector's output, indicating direct competition) and vertical exposure (imports of inputs that the sector uses, indicating supply chain integration).

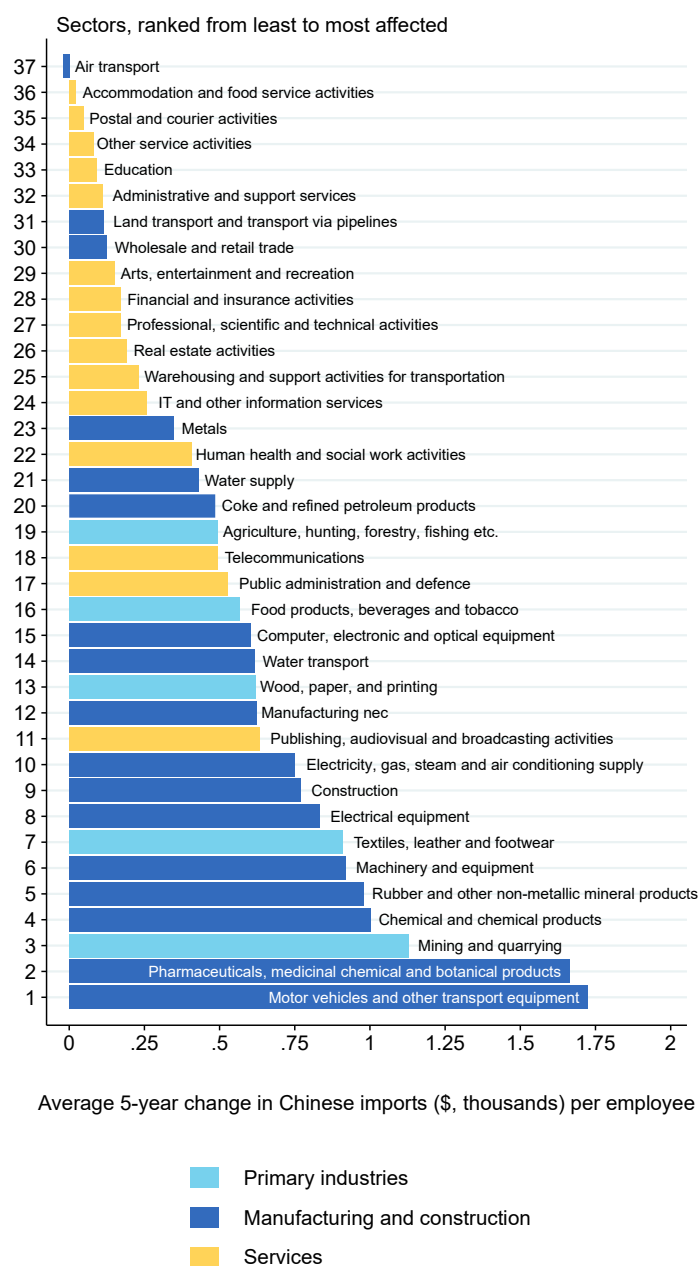
8.8 Some UK sectors saw a large influx of Chinese imports, others very little. For example:

(a) Most exposed: Sectors like motor vehicles, other transport equipment, pharmaceuticals, textiles and chemical products experienced very large increases in Chinese import penetration. These sectors either started importing a lot of Chinese components or faced Chinese finished goods competition (or both). As a result, they got much cheaper inputs but also had to adapt to a new competitive landscape.

(b) Least exposed: Sectors like accommodation & food services, many public services, and finance and insurance activities saw minimal direct impact. These sectors relied mostly on domestic inputs and faced domestic competition.

Figure 38: Exposure to Chinese imports varied by sector, with the largest changes concentrated in manufacturing and construction sectors, and the smallest changes concentrated in service sectors.

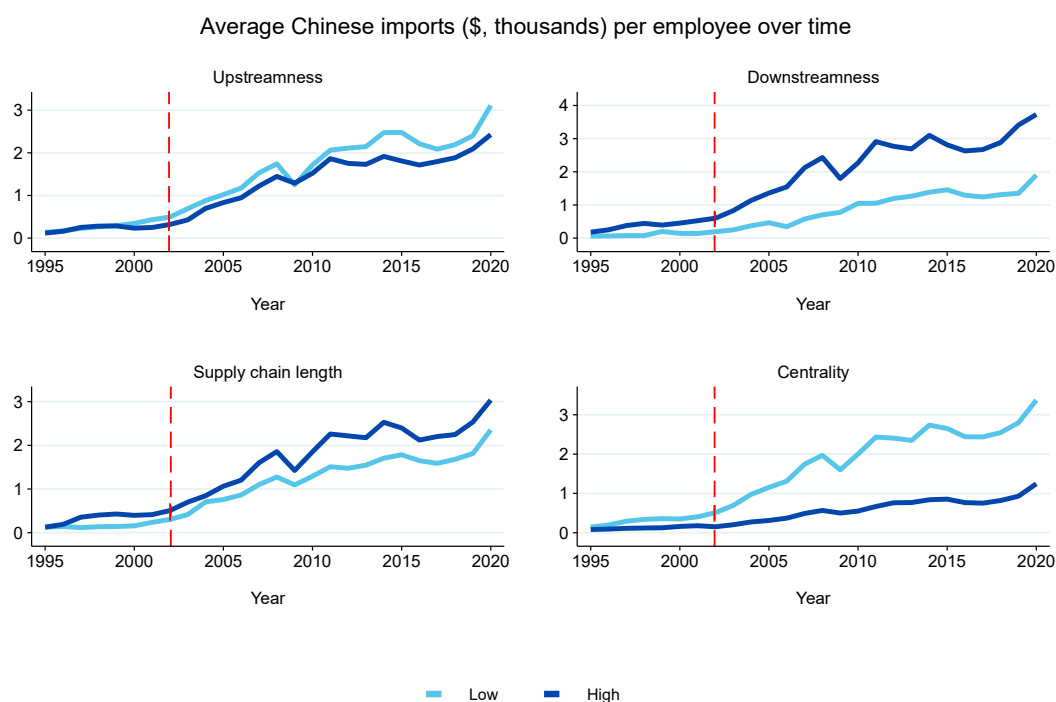
Bar chart of exposure to Chinese imports, proxied as the average 5-year change of Chinese imports in thousands of US dollars per employee over time (2000-2020) for each sector. Sectors are ranked from least to most affected, and coloured by sector type (primary, manufacturing and construction, and services). Data from OECD Inter-Country Input-Output Tables (2000-2020) and EUKLEMS (2000-2020).



8.9 Chinese imports grew fastest in downstream and less central UK sectors, those closer to final demand and less embedded in domestic production networks. Figure 39 plots average Chinese imports per worker over time, split at the median for various supply chain metrics. For example, the top right panel depicts the rise in Chinese imports per employee for sectors with high or low downstreamness (number of stages from raw inputs to production). Sectors with high downstreamness experience a greater rise in this trade exposure after China joined the WTO in 2001.

Figure 39: Exposure to Chinese imports grew fastest in sectors with low centrality and situated further to initial inputs in their supply chains

The average value of Chinese imports in thousands of US dollars per employee over time, for low versus high supply chain measure sectors. A sector is categorised as being high in a given supply chain measure if it had a value above the median in 1995. The red vertical line represents the date when China joined the World Trade Organisation on 11th December 2001. Centrality is the sector's centrality within the UK (domestic) supply network.



Using OECD *Inter-Country Input-Output tables*. The red vertical line represents the date when China joined the WTO on 11 December 2001. Centrality is the sector's centrality within the UK supply network.

8.10 To quantify sectoral exposure and reactions to import competition from China, we calculate the yearly level and the five-year change in the value of UK imports from China for each sector (Autor et al., 2013). We normalise this change by sector size, using either employment or gross output in the initial

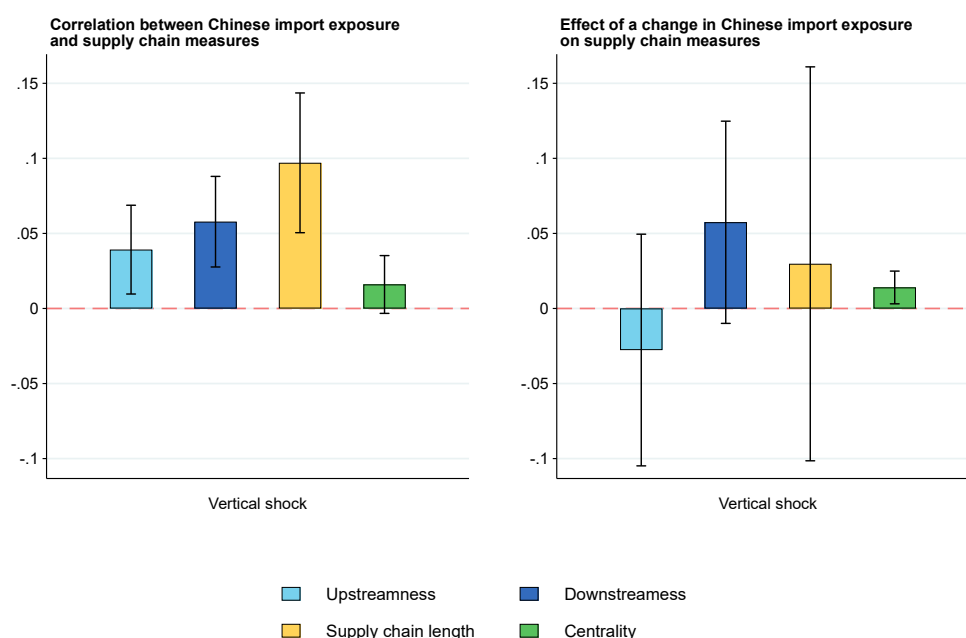
year, to ensure comparability across sectors. We extend this approach by disaggregating Chinese imports into horizontal (imports from the same sector) and vertical (imports from different sectors), allowing us to isolate competitive pressure and productivity gains, respectively ([Aghion et al., 2021](#)).

- 8.11 We find that sectors more exposed to vertical Chinese inputs became more central in the UK network. In other words, those industries that benefited from access to inexpensive components or materials from China were able to scale up and increase their role as suppliers within the domestic economy.
- 8.12 For example, consider the UK automotive sector. With cheaper imported parts (engines, electronics, tyres, etc. from China), UK car producers could lower costs, expand production, and possibly lower prices, increasing demand for their cars. As they grew, they would buy even more inputs from their UK suppliers (like plastics, design services, etc.), thus those suppliers also expand. The automotive sector in this scenario becomes a more important node, it supplies more vehicles to other sectors and buys more from upstream, reinforcing its network ties.
- 8.13 This dynamic is reflected in what we observe empirically: sectors that had high vertical import exposure (i.e. lots of new Chinese inputs available) saw their domestic centrality rise over subsequent years. They did not necessarily add more stages to their supply chain (the chain length often remained stable for them, they slotted the Chinese inputs into existing processes), but they produced more output and often diversified their domestic supplier base because they were growing. This underscores that a positive shock (cost reduction) can propagate forward, relaxing supply constraints of downstream sectors by providing them with cheaper inputs, as well as backward, benefiting upstream domestic sectors via increased demand from the expanding sector.
- 8.14 The right panel of Figure 40 shows this structural change: sectors more exposed to vertical import competition became more central within the UK production network, suggesting that some sectors responded to competitive pressure by deepening or diversifying domestic connections. These results no longer hold when we consider only intra-industry (horizontal) imports from China.
- 8.15 This reshaping of supply chains in response to an external shock is consistent with existing evidence. For example, Japanese firms adjusted their supply relationships in response to an unexpected infrastructure shock, to maintain or improve performance ([Bernard, Moxnes and Saito, 2019](#)). Despite the China trade shock affecting sectors differently based on their supply chain

characteristics, we find that the shock did not lead to a significant change in average supply chain length.

Figure 40: Sectors using more Chinese inputs became more central in the UK economy

Results from an OLS regression of Chinese vertical import exposure on supply chain measures (**left panel**) and an OLS regression of a 5-year change in Chinese vertical import exposure on the 5-year change in supply chain measures (**right panel**). y-axis values are coefficients on Chinese vertical import exposure. All regressions control for employment controls, fixed year and sector fixed effects, and weight by employees. Data from OECD Inter-Country Input-Output Tables (2000-2020) and EUKLEMS data (2000-2020).



Using OECD *Inter-Country Input-Output tables*. Centrality is the centrality within the UK supply network. Controlling for employment controls, fixed year and sector effects, and weighting by employees.

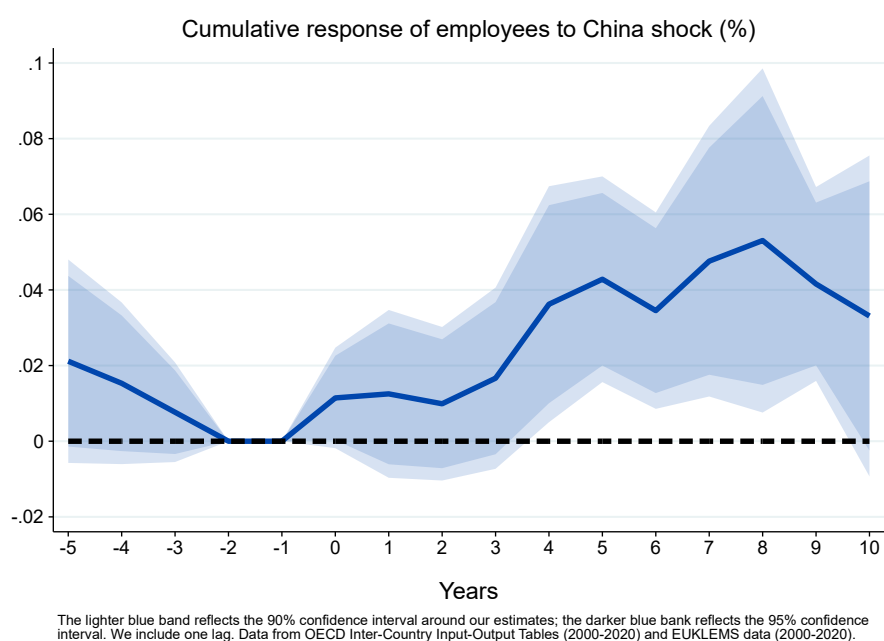
Detailed impact: Employment and network changes

8.16 We examined the impact of the China shock on two types of outcomes: sectoral performance (such as employment and productivity) and network metrics (such as changes in centrality or supply-chain length). We estimated these effects using both OLS regressions and an instrumental-variables (IV) approach. Because Chinese export growth to the UK is not fully exogenous, we use China’s export growth to other similar countries as an instrument. This isolates the supply-driven component of the shock that is exogenous from the UK perspective, consistent with standard practice in this literature.

- 8.17 **The impact of the shock on employment was gradual.** We estimate that the shock unfolded over roughly eight years (2001–2009), displayed in Figure 41. This mirrors the US experience of a gradual effect of the China shock through the 2000s (Autor, Dorn, Hanson, 2021). In the UK, we see that sectors did not instantaneously change in 2001; rather, those exposed see divergent paths over the subsequent decade compared to unexposed ones. Employment in exposed sectors might first dip or grow slowly, then pick up as cost savings are realised or as competition forces consolidation and eventually stabilisation.
- 8.18 The persistence of the shock’s effects means that short-run analyses (one or two years) would severely understate the true impact. For policymakers, this indicates that the labour market adjustments to trade shocks are prolonged, requiring support (retraining, relocation aid, etc.) over many years, and that the benefits (like lower consumer prices, new jobs in importing sectors) also accrue gradually.

Figure 41: The effect of the China supply shock on average employment across UK sectors evolved gradually over time

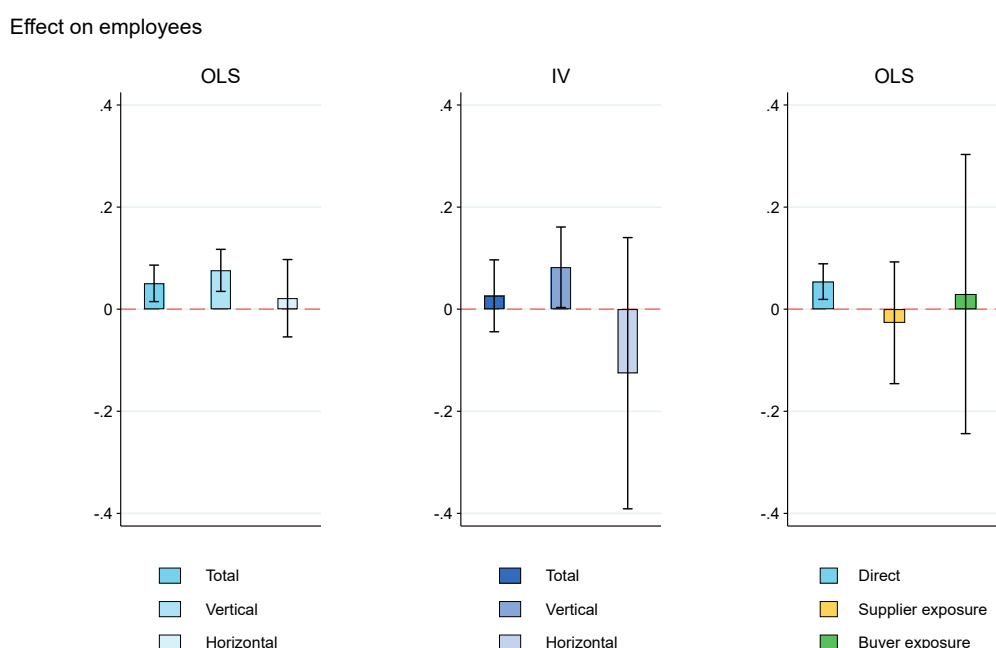
Impulse response function of the cumulative response of employees to the China shock over a 10-year period. The lighter blue band reflects the 90% confidence interval around our estimates; the darker blue band reflects the 95% confidence interval. Regression controls for employment controls, fixed year and sector fixed effects, and weights by employees. We include one lag, identified as the most optimal number of lags by Akaike and Bayesian Information Criterion (AIC and BIC respectively) tests. Data from OECD Inter-Country Input-Output Tables (2000-2020) and EUKLEMS data (2000-2020).



- 8.19 **Sectors that experienced a greater increase in Chinese import penetration for inputs (vertical shock) saw, on average, increases in employment.** This aligns with the notion that cheaper inputs lower costs, output expands, and employment goes up. This contrasts with results from the US, where Chinese import competition reduced employment, although this finding was based solely on the horizontal shock in manufacturing (Autor et al., 2013). In the UK, we find a mild positive effect on average (Figure 42), which is closer to the findings of Bloom et al. (2016) for Europe, who found firms adapted with technology and moved up the value chain rather than simply shedding jobs. We found no significant average change in productivity measures like output per worker, implying the employment gains matched output gains proportionately.
- 8.20 **No significant indirect (network spillover) effects on average.** When we calculated supplier exposure (how much suppliers were affected by China) and buyer exposure (how much customers were affected), we did not see clear additional impacts on a sector's employment or output beyond its own direct exposure. In practical terms, this means that any benefit from cheaper upstream inputs, or any loss from reduced downstream demand, is already reflected in a sector's own import-export exposure measure. We did not detect a systematic pattern in the aggregate data, which may indicate that these second-order effects were either diffuse or occurred simultaneously with the direct effects. So, while shocks do propagate, empirically the first-order effect (direct import exposure) was the dominant factor in explaining a sector's outcomes, and the remaining variation in the data was not large enough to allow us to precisely detect the second order effects.

Figure 42: The China trade shock impacted UK employment positively, primarily directly through the vertical shock (trade between different sectors)

Results from OLS (left panel) and IV (centre panel) regressions of employees on total, vertical-only and horizontal-only Chinese import exposure and an OLS regression of employees on the direct, supplier, and buyer exposure to Chinese import exposure (right panel). Y-axis values are coefficients on Chinese import exposure. All regressions control for employment controls, fixed year and sector fixed effects, and weight by employees. Data from OECD Inter-Country Input-Output Tables (2000-2020) and EUKLEMS data (2000-2020).



Y-axis values are coefficients on Chinese import exposure. All regressions control for employment controls, fixed year and sector fixed effects, and weight by employees. Data from OECD Inter-Country Input-Output Tables (2000-2020) and EUKLEMS data (2000-2020).

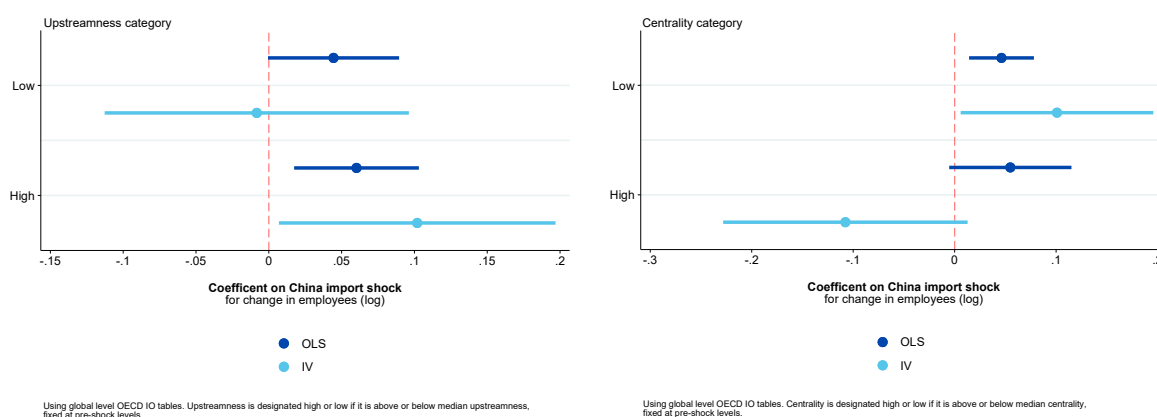
8.21 We find evidence for differential effects by network position:

- (a) We found that more upstream sectors experienced stronger positive employment effects from the China shock (left panel Figure 43). One possible explanation for our result is that Chinese inputs primarily entered at intermediate stages; those upstream UK industries that could incorporate them became more competitive and expanded (e.g. a UK electronics assembly firm can buy cheaper subcomponents and grows, hiring more workers). Upstream sectors also typically face derived demand, if downstream industries obtained cheaper parts and grew, they in turn demanded more from their upstream UK suppliers. So even sectors not directly importing from China but were upstream of those who did, saw gains.

(b) On the other hand, as displayed in the right panel of Figure 43, less central (more peripheral) sectors saw more pronounced impacts (positive or negative). The central, well-connected sectors perhaps had more resilience, they could pivot or had other trading partners, whereas a peripheral sector that was heavily exposed to Chinese competition might just shrink significantly because it had nowhere else to turn in the network. This suggests centrality in the domestic network provided some buffer or flexibility, which aligns with our earlier finding that central sectors tend to be diversified and resilient.

Figure 43: Employment grew – in response to the China shock – more strongly in high upstreamness and low centrality sectors

Coefficients from sector-level regressions of change in (log) employees on the China import shock, for sectors with upstreamness (**left panel**) or centrality (**right panel**) above and below the pre-shock fixed median. The dark blue lines are coefficients from OLS regressions, and the light blue lines are coefficients from IV regressions. Lines represent 95% confidence intervals around the estimated coefficient point. All regressions control for employment controls, fixed year and sector fixed effects, and weight by employees. Data from OECD Inter-Country Input-Output Tables (2000-2020) and EUKLEMS data (2000-2020).



8.22 We do not find evidence that market structure materially altered the propagation of the China shock. We explicitly tested if sectors with high concentration or high initial markups saw different employment outcomes due to the China shock. The results (Figure 44) showed no significant differences. More concentrated sectors did not lose fewer jobs than less concentrated sectors when faced with import competition, both adjusted similarly. Likewise, high-markup sectors did not show a systematically distinct response from low-markup sectors. This reinforces the conclusion that, at least in the context of this trade shock, market structure was unlikely the key determinant of how

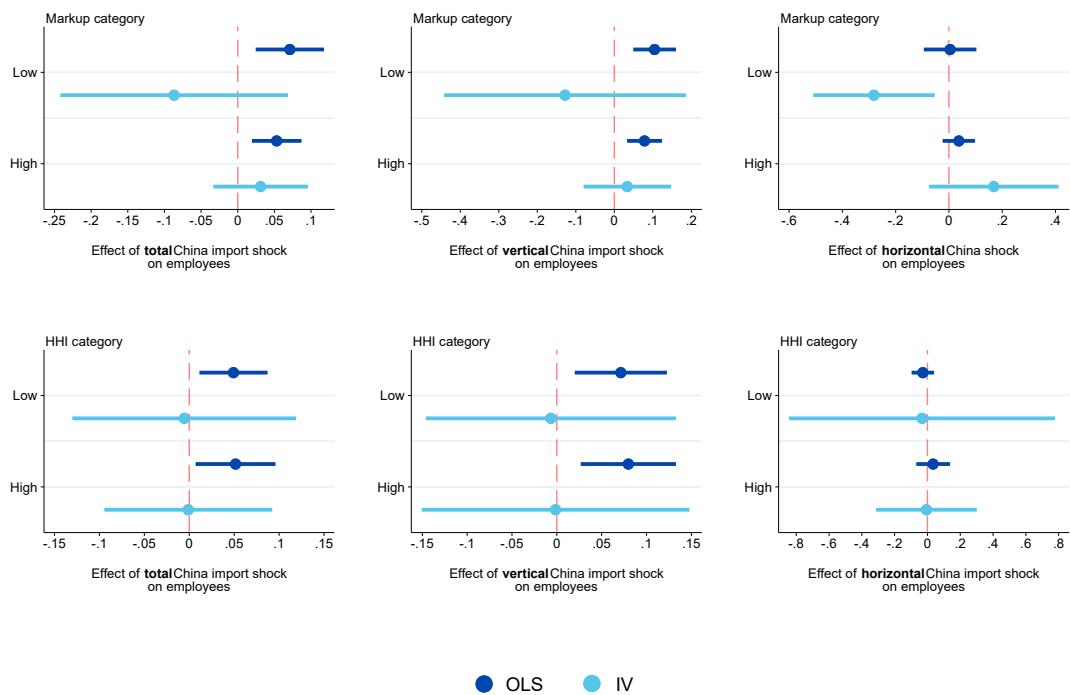
benefits and losses were distributed, it was more about exposure and position in the network.

- 8.23 It is important to note the limitations of our analysis. Markups were only available for a subset of sectors, 76% of sectors, accounting for 68% of employees across the economy. The analysis on the role of competition should therefore be interpreted with caution. Sector fixed effects absorb systematic differences across industries, but changes in sample composition can still affect the estimates. If the omitted sectors tend to have lower markups and greater exposure to the China import shock, then the average employment effect could be larger in those omitted sectors. In that case, differences by markup level may be statistically significant (i.e. positive employment effects for lower markup sectors). The limited coverage means we cannot fully rule out a meaningful role for market power.

Figure 44: Market power and market structure do not seem to mediate the average effect of the China trade shock on employment

Coefficients from sector-level regressions of change in (log) employees on the China import shock, for sectors with markup (top row of panels) or HHI (bottom row of panels) above and below the pre-shock fixed median. The columns split the results by the total China shock (column 1), the vertical shock (column 2), and the horizontal shock (column 3). The dark blue lines are coefficients from OLS regressions, and the light blue lines are coefficients from IV regressions. Lines represent 95% confidence intervals around the estimated coefficient point. All regressions control for employment controls, fixed year and sector fixed effects, and

weight by employees. Data from OECD Inter-Country Input-Output Tables (2000-2020) and EUKLEMS data (2000-2020).



High/low markup and HHI defined as above or below the median markup/HHI value (fixed at pre-shock levels).

9. Conclusion and policy recommendations

9.1 This report has examined how the structure of UK supply chains interacts with market power and resilience. Three findings stand out:

- (a) First, UK supply chains have become longer and more specialised, with firms relying on fewer but more embedded supplier relationships. This creates efficiency gains but also tighter interdependence. These patterns align with the CMA's previous conclusion that fragility arises when markets depend on concentrated or critical suppliers with few alternatives (CMA, 2023).
- (b) Second, the UK's position in global supply networks could be considered a strength. We have found that UK sectors tend to have relatively diversified imported inputs, reflecting multiple sourcing and strong international linkages, which reduces exposure to shocks in any single supplier or location. This implies the UK will have higher import resilience than many peers.
- (c) Third, market power is unevenly distributed across the supply network, and its role in shock propagation is nuanced. Upstream sectors typically have higher markups and can, in principle, transmit distortions downstream. This pattern was noted in the CMA's State of UK Competition Report 2024, which highlighted that markups tend to be higher further upstream and called for further work on how these propagate through the economy. Our analysis supports this concern but also shows that in the case of a major positive trade shock (China's WTO accession), sectors with higher markups did not systematically pass on fewer benefits or amplify negative effects. In that episode, the size and nature of the shock mattered more than market power per se.

9.2 Overall, the evidence supports the central message of the CMA's previous work on resilience: competition and resilience are complements. Competitive, diversified markets can both deliver lower prices and adapt more effectively to shocks, while concentrated, brittle structures can magnify disruption.

Implications for the CMA and competition policy

9.3 Our findings reinforce and extend previous CMA work:

- (a) Upstream concentration matters, especially where sectors are also highly central. Network-based diagnostics, such as centrality, import resilience and markup propagation, may help identify where CMA action may have the greatest downstream benefits.

- (b) Not all central sectors pose competition risks. Some are central because of scale and efficiency. This supports the CMA’s emphasis on targeted, evidence-led intervention.
- (c) Shock context matters. The China-shock example shows that competitive pressure, including through imports, can ensure benefits pass through to downstream sectors, reinforcing the CMA’s view that competition delivers resilience by encouraging adaptability.

9.4 For the CMA, these findings can help to guide prioritisation within the context of existing statutory tests. Within its existing remit, the CMA can:

- (a) Consider carefully the impact of market power in upstream essential input markets on downstream customers.
- (b) Consider using its market tools to investigate sectors that appear fragile or structurally exposed.
- (c) Provide advice to government where wider policy tools (trade, industrial, regulatory, procurement) affect supply-chain robustness.

Implications for wider government policy

9.5 The CMA has been clear that competition policy alone cannot secure resilience; many key levers sit with government.

9.6 Our results suggest three priorities:

- (a) Understanding vulnerabilities within the wider context of global integration: The CMA’s 2023 Market Resilience Discussion Paper ([CMA, 2023](#)) identified “lack of supply diversity” as a key cause of fragility in certain markets, highlighting how concentrated supply chains can amplify vulnerability. Within this analytical framework, a diversified import base can support resilience by reducing exposure to single-points-of-failure. In thinking about how best to strengthen resilience, it may therefore be helpful to focus on areas where supply-chain dependencies appear most acute, while recognising that policy choices in this space involve significant economic and strategic trade-offs. For example, the CMA notes that onshoring policies, if not carefully designed, can “create or entrench concentrations” and thereby increase the risk of disruption rather than mitigate it. This suggests that tailored, risk-specific interventions may, in some contexts, be more effective than broad economy-wide reshoring strategies.

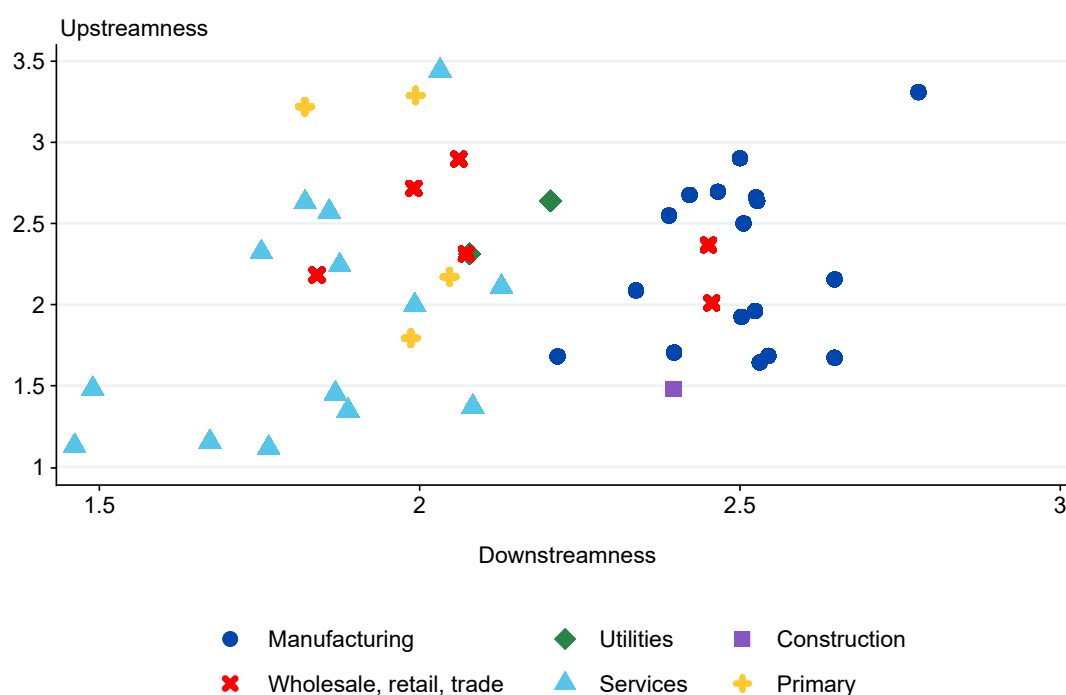
- (b) Use public policy to promote supply diversity and entry. Procurement, regulatory design, and industrial programmes could be assessed for their effects on supplier diversity, barriers to entry and financial health of crucial suppliers, mirroring the CMA's analysis of fragility drivers.
- (c) Strengthen monitoring and early-warning systems. The findings of this report suggest that upstream markups and supply-chain fragility are areas requiring deeper analysis. This includes developing and utilising more timely data sources, like the B2B transactions data.

9.7 Taken together, our assessment aligns with recent government policy, which emphasises strengthening supply-chain resilience through improved risk analysis, diversified sourcing and targeted mitigation of high-risk dependencies, as set out in the [Critical Imports and Supply Chains Strategy \(2024\)](#). This direction is reinforced by the [Modern Industrial Strategy \(2025\)](#), which invests in logistics infrastructure and establishes a national Supply Chain Centre to enhance monitoring and early-warning capabilities. Together, these developments point to a policy emphasis on openness, diversification and reducing concentrated vulnerabilities, complementary to the resilience themes highlighted in this report.

10. Appendix A: Figures and tables

Figure A1: Upstreamness and downstreamness describe distinct segments of supply chains, and have systematically different lengths across sectors

Scatterplot of sector upstreamness and downstreamness. Each point represents a sector. Upstreamness measures the average number of production stages between a sector and final consumers, while downstreamness measures the average number of stages between a sector and its most upstream inputs. Together, these metrics describe different “sides” of a sector’s position in the production network and illustrate how the components of total supply chain length vary across sectors.



Using OECD *Inter-Country Input-Output Tables*. Each point represents the average upstreamness/downstreamness of a sector, averaged over 77 countries for 2019.

Figure A2: Supply chain metrics are positively correlated with each other, but only weakly correlated with markups

Pairwise correlations between supply chain metrics and market power measures. Heatmap showing correlations between the supply-chain metrics used throughout the report (including upstreamness, downstreamness, total supply chain length, and centrality) and sector-level market power measures (markups). The figure illustrates that the supply chain metrics are generally positively correlated with each other, while their simple correlations with markups are weaker. Supply chain metrics are constructed from the input-output structure of the economy. Markups are taken from the CMA’s State of UK Competition 2024 measures used in the report.

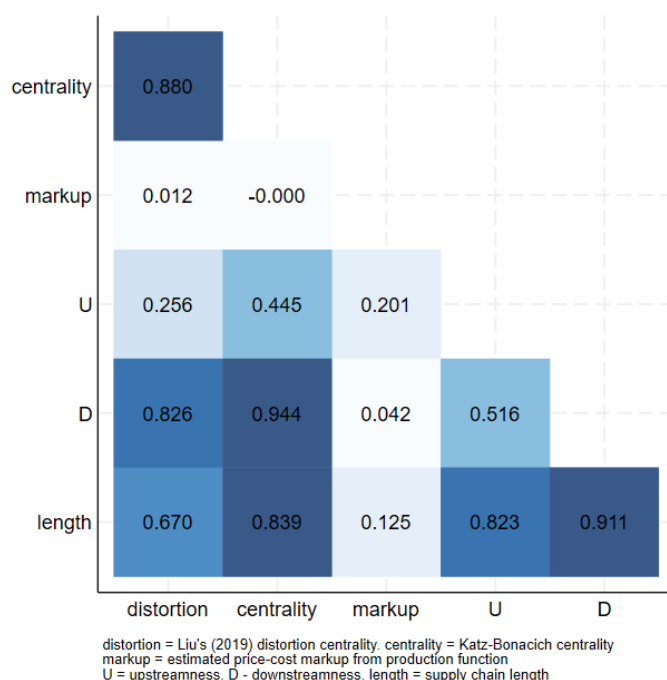


Figure A3: Supply chain metrics are broadly consistent across data sources

Correlation of supply chain metrics across datasets, using annual values of 2-digit sectors. 'ONS' comes from ONS UK Input-output analytical: tables product by product using 2017-2022, 'Payment Flows' comes from ONS UK Industry-to-industry payments using 2017-2024, 'Payment' Flows (alt) uses output weights from the ONS GVA, 'OECD global' comes from OECD Inter-Country Input-Output Tables using 1995-2020, while 'OECD domestic' is calculated by excluding all trade to focus on UK Input-Output only. Actual overlap is limited to the 2017-2024 period with smaller overlaps for some data sources. Note that the ONS, Payment Flows and OECD tables use different industry classifications, where possible we have compared with the closest equivalent sector.

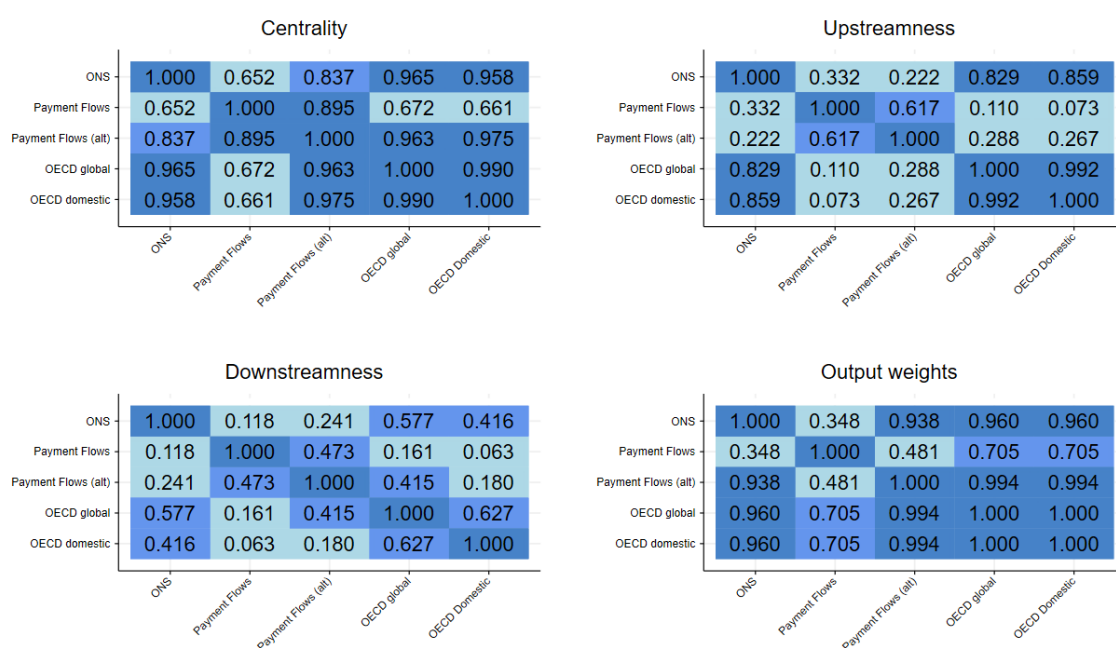


Table A1: Correlations of labour productivity, centrality and supply chain length

Coefficients from regressions of centrality and supply chain length on labour productivity, which is measured by Gross Value Added per worker. Data from the ONS input-output: analytical tables: product by product (2017 to 2021), the Annual Respondents Database X (2017 to 2020) and the Annual Business Survey (2021).

	(1) Mean log of GVA per worker	(2) Mean log of GVA per worker	(3) CAGR log of GVA per worker	(4) CAGR log of GVA per worker	(5) CAGR log of GVA per worker	(6) CAGR log of GVA per worker
Mean centrality	-1.780 (1.990)					
Mean supply chain length		0.534*** (0.104)				
CAGR centrality			0.053* (0.030)			
CAGR supply chain length				-0.004 (0.125)		
Centrality (2017)					-1.206 (4.747)	
Supply chain length (2017)						0.680*** (0.257)
Constant	4.047*** (0.108)	2.139*** (0.362)	0.752*** (0.158)	0.715*** (0.161)	0.766*** (0.256)	-1.620* (0.896)
Observations	90	90	90	90	89	89
R ²	0.009	0.231	0.034	0.000	0.001	0.075

CAGR stands for compound annual growth rate. GVA stands for Gross Value Added. Coefficients from OLS regressions of various specifications of supply chain metrics on log of GVA per worker. All regressions have been weighted by turnover. Data from the ONS input-output: analytical tables: product by product (2017 to 2021), the Annual Respondents Database X (2017 to 2020) and the Annual Business Survey (2021).

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

11. Appendix B: Data sources

11.1 This appendix describes the datasets used in this report and how they are used in the analysis. Table B1 provides a high-level summary of each source (its scope and time period, sector aggregation, and role in the report). Sections 11.2–11.6 describe our core input-output style datasets used to construct the supply-chain metrics (ONS Input-Output analytical tables, UK Industry-to-Industry Payment Flows, and OECD ICIO). Sections 11.7–11.10 summarise the additional datasets used for market power measures, outcomes and controls (including the State of UK Competition measures, EU KLEMS, and ARDX/ABS). Finally, Sections 11.11–11.15 provide a dedicated discussion of the experimental Payment Flows dataset, covering key limitations, our mitigation approach, and consistency checks against conventional input-output sources.

Summary of data sources

Table B1: Summary of data sources

Table summarises the main datasets used in this report, setting out (for each source) its scope and time period, the level of sector aggregation, and how we use it in the analysis.

Dataset	Scope and time period	Sector aggregation	Our use
ONS Input-Output analytical tables (product-by-product)	UK; used for 2013–2022 (annual; gaps)	Approx. 2-digit SIC equivalents (via aggregated CPA groups)	Supply chain metrics; pass-through of market power (robustness)
ONS Industry-to-industry payment flows (Pay.UK/Vocalink; experimental)	UK; 2017–2024 (monthly; continuous coverage to late-2024 in the dataset described)	2-, 4- and 5-digit SIC	Primary source for supply chain metrics and market-power relationships (granularity + frequency)
OECD Inter-Country Input-Output (ICIO) tables	OECD countries; 1995–2020 (annual; no gaps)	ISIC Rev. 4 (45 sectors)	Global network metrics; import diversification/resilience; China-shock exposure
State of UK Competition 2024 (CMA)	UK; markups (to 2021) and HHI (to 2022)	2- and 4-digit SIC (varies by)	Industry-level market power/structure measures used in Chapter 6 analysis

		underlying construction)	
EU KLEMS	EU/UK coverage; 2000–2020 (annual)	NACE Rev. 2	Employment/output controls/outcomes for China-shock analysis
ARDX / ABS	UK; ARDX 1997–2020; ABS 2021	Approx. 2-digit SIC	Labour productivity (GVA per worker) used in productivity correlations

Core datasets used to construct supply-chain metrics

- 11.2 We construct the supply-chain metrics using three complementary input-output style sources. The ONS Input-Output analytical tables provide an annual, national-accounts-consistent view of inter-industry flows for the UK; the experimental UK Industry-to-Industry Payment Flows data provide a more granular and higher-frequency picture of domestic transactions; and the OECD ICIO tables provide a harmonised international input-output framework that allows comparable metrics to be calculated in a global setting. Using these sources together lets us estimate the same underlying supply-chain concepts across different time periods and levels of sector detail.
- 11.3 **Cross-cutting data exclusions:** We exclude (where available) households, government/non-market and not-for-profit sectors from the ONS IOATs, UK Payment flows, and OECD ICIOs. We also exclude finance from all datasets, due to issues with interpreting ‘inputs’.¹⁵
- 11.4 **ONS Input-Output analytical tables (product by product)**
- (a) The ONS Input-Output analytical tables provide an annual, national-accounts-consistent view of flows between broad industries in the UK (used in this report for 2013–2022), at approximately 2-digit SIC equivalents via aggregated CPA groups. We use these tables to construct supply-chain metrics and as a robustness dataset alongside the Payment Flows estimates, including for market-power pass-through analysis.
- 11.5 **UK Industry-to-industry payment flows (UK Payment flows; 2017 to 2024)**
- (a) UK Payment flows is a novel dataset released in January 2025. The data, provided by Vocalink, covers payment transactions from both Bankers’

¹⁵ For instance, a payment flow from the finance sector to another sector in the UK Payment flows dataset may be the finance sector purchasing an input, or it may be the finance sector providing a loan.

Automated Clearing Services (BACS) and Faster Payments Service (FPS). The dataset captures payment flows from over 3 million UK organizations (approximately 50% of all UK organizations), with continuous coverage from January 2017 to November 2024.

- (b) Firms are assigned by the ONS into one of approximately 700 granular sectors (at 5-digit level), allowing us to create an input-output style matrix, using payments made between each sector.¹⁶
- (c) UK Payment flows data are used for the estimation of measures describing the structure of UK supply chains, at the 2-digit, 4-digit and 5-digit data. They are also used for estimating the pass through of market power in the supply chain. To our knowledge, this is the first time these metrics have been calculated using UK Payment flows.¹⁷
- (d) The 5-digit data is most granular, with 6 million (unsuppressed and non-missing) payee-payer-month observations. The 2-digit data has around 540,000 (unsuppressed and non-missing) observations. To mitigate data issues, we do not use 5-digit data directly- this is explained further below.
- (e) The Payment flows dataset is more frequent than traditional input-output tables (monthly, rather than annual), and more granular (roughly 700 sectors compared to around 100 in ONS IOAT and 45 in OECD ICIO). This allows for a more precise understanding of UK supply chains than has been possible with traditional datasets.
- (f) A key assumption made to calculate supply chain metrics is that payments made from business A to business B represent a purchase of inputs by business A. There are several limitations to this assumption, as well as to the dataset more generally, which we detail below.

11.6 **OECD Inter-Country Input-Output tables (ICIO, 1995 to 2020)**

- (a) OECD ICIO tables map the flows of goods and services used as intermediate inputs into production between 76 countries and 45 sectors, during 1995-2020. These are constructed using the maximum possible amount of officially published statistics, notably National Accounts, Balance of Payments, Supply and Use tables, Input-Output tables and

¹⁶ For instance, in January 2022 the 'logging' sector made around GBP 2.9 million of payments to 'Support services to forestry', and GBP 500,000 to 'Freight transport by road,' among other payments.

¹⁷ With the exception of [Hötte \(2025\)](#), which calculates centrality ranks and measures of distribution for 2023, though with the aim of validating the dataset rather than our aim of studying evolution of supply chains over time.

bilateral trade in goods and services statistics. The sectors in the ICIO tables are based on ISIC Rev.4.

- (b) The structure of the tables is a matrix of domestic and international industry-to-industry monetary (current million USD) flows of intermediate inputs, a matrix of output meeting final demand, and vectors of total output by country and industry and the value added generated in production. The details of how these tables are constructed and developed can be found here: [Development of the OECD Inter Country Input-Output Database](#).
- (c) These tables are used for three different aspects of our analysis: estimation of measures describing the structure of cross-country supply chains; measures of import diversification and resilience; and sectoral exposure to the China shock.
- (d) For each country-sector, we calculate our supply chain metrics at the global-level, using the entire ICIO table to analyse a country-sector's position within the global supply chain. This means that flows between countries of intermediate goods (i.e. intermediate imports and exports) are included in our measures and ensuing analysis. We calculate GDP-based centrality, which uses the sector's share of gross domestic product and tells us the importance of a given sector in the *domestic* production network, whilst still accounting for linkages between countries.

Datasets used for market power, outcomes, and controls

- 11.7 The datasets in this section provide the outcome variables and control series used in the empirical analysis, alongside independent measures of market power and market structure. They allow us to relate the supply-chain metrics to competition indicators (markups and concentration) and to economic outcomes such as employment, output and productivity, including in the China-shock analysis.
- 11.8 **State of UK Competition (markups, HHI):** The State of UK Competition 2024 dataset provides industry-level indicators of market power and market structure, including markups (to 2021) and HHI (to 2022), at 2- and 4-digit SIC (depending on the measure).
- 11.9 **EU KLEMS** is an international, industry-level database providing annual series on economic outcomes (including employment and output) for the UK and other countries, with industries classified using NACE Rev. 2; in this report, we use EU KLEMS primarily for employment and output outcomes/controls in the China-shock analysis.

11.10 **ARDX (Annual Respondents Database X) and the Annual Business Survey (ABS)** are ONS sources that we use to construct industry-level labour-productivity measures (Gross Value Added per worker), at approximately 2-digit SIC; these productivity measures are used in our analysis of correlations between productivity and the supply-chain metrics (centrality and supply-chain length).

Discussion of UK Industry-to-industry payment flows data

11.11 The ONS UK Industry-to-Industry Payment Flows dataset (Pay.UK/Vocalink) is an experimental, transaction-based source that records payments between UK organisations and assigns them to detailed SIC industries. We use it because it provides much greater granularity and timeliness than traditional input-output tables, allowing us to construct supply-chain metrics at finer sector levels and at higher frequency.

11.12 Given the experimental nature of the dataset, this section sets out the key limitations relevant to interpreting the metrics, the steps we take to mitigate those limitations (including aggregation, exclusions and alternative weighting choices), and consistency checks against more conventional input-output sources.¹⁸

11.13 Limitations and consistency of UK Payment flows data

- (a) The UK Payment flows data has significantly greater time-frequency and improved granularity than traditional input-output datasets. This is countered by a number of limitations.
- (b) Below, we outline the key limitations identified; our approaches to mitigating these limitations; and our checks to ensure consistency with other datasets. Our checks suggest that calculations based on the Payment flows dataset are a reasonable approximation to a traditional input-output dataset.
- (c) **Assumption of payments as inputs:** The key assumption made when converting Payment flows data is that payments made from business A to business B represent a purchase of inputs by business A. This need not be the case. For instance, a payment from a sector to the financial sector may represent using the financial sector as an intermediary for a different transaction. Payments from businesses to the government sector are

¹⁸ Limitations of an earlier version of this dataset are further discussed in Chapter 5 of [Hötte \(2025\)](#).

highly cyclical and likely represent tax transfers. Payments could include inventory purchases.

- (d) **Suppression:** Statistical disclosure control by the ONS has suppressed 7% of the value at 5-digit level, and 1% at 1-digit level. At an aggregate level, this is not a large proportion of value and is unlikely to have a significant effect on aggregate trends. The suppression does however apply to a large number of payee-payer-month observations. At the 5-digit level for instance, 27 million of 40 million observations are suppressed. Suppressed sectors are more likely to have fewer active firms, or a single dominant firm, and as such may represent relatively concentrated sectors.
- (e) Suppression can lead to supply chain metrics for specific sectors being incorrect. For instance, if all business payments made to a particular sector have been suppressed, this sector will have an upstreamness value of 1- the calculations assume that all output is being sold directly to consumers. This is unlikely to be correct. Our comparison between 2-digit data (less affected by suppression) and 5-digit data (more affected) confirms that there is little aggregate effect from suppression, but certain individual sectors are highly affected.
- (f) **Coverage:** Payment flows data covers some 3 million organizations, or over half of UK businesses. The half of UK businesses missing are likely to be smaller firms, making the dataset potentially unrepresentative on firm size. In addition, it does not cover CHAPS payments, which account for 1% of UK financial transaction volume, but 90% of value. CHAPS is understood to be primarily used by the financial sector, and the omission likely leads to the financial sector being under-represented.
- (g) **Foreign trade:** Payments to and from foreign companies will only show up if the foreign company has a UK subsidiary. If there is no UK subsidiary, the transaction would use a non-UK payment system such as SWIFT. It is unclear what proportion of foreign trade would be captured by UK subsidiaries.
- (h) **Treatment of taxes and capital investment:** Payment flows may be pre-tax and may include capital investment. Supply chain metric calculations assume that we can observe the purchase of intermediate goods by businesses from other businesses and thus require us to be able to disentangle taxes and capital investment.
- (i) **Issues with classification:** Many enterprises span more than one industry, but the industry code is likely to only reflect the activity of its headquarters unit (the 'headquarters effect.'). Some vertical integration

and in-house production will be captured (more than one financial account can be observed per business, so flows between these are accounted for), but it is unlikely that this is entirely captured. Finally, of non-missing and non-suppressed transactions, approximately half are with the 'unclassified' sector.

- (j) **Timings:** Payments between businesses may be 'lumpy' (infrequent), causing significant variation in monthly data which does not reflect actual changes in input use. Additionally, the data is not seasonally adjusted.
- (k) **Long term trends:** Trends over the 2017-2024 period may be influenced by changes in payment preferences, namely the entry and exit of organisations into using BACS or FPS payments. We have also spotted sectors where there are clear structural breaks in the data without a clear reason.
- (l) **Calculation issues:** Unlike a standard input-output matrix, a matrix created from payment flows may be non-invertible. This stems from the difference between a sector's output (used in standard input-output tables) and the total payments made to a business from other businesses (available with this dataset).

11.14 Our approach to mitigating limitations

- (a) **Comparisons:** We have calculated supply chain metrics for the UK using two more conventional datasets, the ONS IOAT and the OECD ICIO, to allow a direct comparison to metrics calculated using the Payment flows dataset. We provide results below and find good correlation in estimated metrics.
- (b) **Aggregation:** We have avoided using 5-digit monthly data and instead use 5-digit quarterly and 4-digit quarterly as our baseline when using granular data. We also used 2-digit quarterly data to check the direction of results continues to hold. This aggregation helps mitigate issues arising from lumpy payments, seasonal adjustments, and suppression.
- (c) **Exclusion:** We have excluded finance and public administration from calculating supply chain metrics. This addresses issues with interpreting payments to and from these sectors as buying inputs and selling outputs.
- (d) **Alternative output weights:** We have also calculated supply chain metrics using ONS sectoral value-added data to get output weights, rather than weighting by the share of payments. This alternative way of

weighting sectors allows us to ensure that results are not driven by payment share being an unreliable proxy for sectoral output.¹⁹

- (e) **Calculation changes:** To prevent the input-output matrix from becoming non-invertible, we took steps to ensure that rows do not sum to 1. Additionally, due to missing payments from consumers, we use payments made by a sector (inputs purchased) rather than payments to a sector (output sold) as our measure of sectoral output. We have run regressions to confirm that inputs are a reasonable proxy of output, with high consistency over time.
- (f) **Caution over interpretation:** We caution using results to draw conclusions on specific granular sectors at the 4-digit level. At individual sector levels, the effects of issues such as suppression are likely to be more salient than at an aggregate level.

11.15 Consistency checks

- (a) We have found that correlation between payee-payer-year observations in the Payment flows dataset and the corresponding observations in ONS IOAT, for the overlapping 2017-2021 period, is approximately 0.45. This is stable over time, ranging from 0.42 to 0.46 if calculated yearly. Given the different methodologies in creating the ONS IOAT and the Payment flows datasets, we consider this to be high correlation. [Hötte \(2025\)](#) performs a more in-depth correlation exercise, which provides evidence of a reasonable match with a number of macroeconomic variables, including GDP growth and inflation.
- (b) We have estimated correlation between measures calculated in five different ways: from the ONS IOAT, from the UK Payment flows, both our baseline version and the version calculated using alternative weights described in paragraph 37 above, and from the OECD ICIOs, both using all global flows as well as a version using only UK domestic flows. We find good correlation given the different methodologies used to create these data sources. Centrality has the highest correlation between datasets, with weaker though still positive correlation for upstreamness and downstreamness.

¹⁹ We did not use these alternative weights as the baseline specification, as they are only produced at 2-digit SIC level, whereas we frequently use 4-digit SIC data. In addition, these alternative weights use GVA, rather than GDP, though changes over time in GVA are likely to be consistent with GDP changes.

12. Appendix C: Methodology (high-level)

12.1 This appendix summarises the core methodological choices used throughout the report. Sections 12.2–12.8 define the supply-chain metrics constructed from input-output style data. Sections 12.9–12.10 set out our empirical approach to relating supply-chain structure to market power. Section 12.11 defines the import diversification and import resilience measures used in the global analysis. Finally, Sections 12.12–12.13 outline the “China shock” design, including construction of sector-level exposure measures and the baseline OLS specification and IV robustness strategy.

Supply chain metrics.

- 12.2 **Upstreamness (U).** Upstreamness measures the average number of stages between a sector and final demand/consumers, calculated using the input-output structure following Antràs, Chor, Fally and Hillberry (2012). Conceptually, it uses a Leontief-inverse-based transformation of the matrix of inter-sector purchases to map how far a sector sits from final demand.
- 12.3 **Downstreamness (D).** Downstreamness measures the average number of stages between a sector and its most upstream inputs, using an analogous Leontief-inverse construction based on the transpose/input share structure.
- 12.4 **Supply chain length (L).** We define sector supply chain length as the sum of upstreamness and downstreamness: $L = U + D$.
- 12.5 **Centrality (Bonacich-Katz).** We measure sector centrality using an influence-based metric that captures how important a sector is as a supplier to other sectors, including through indirect (multi-stage) supply relationships. Following the approach described in the annex, centrality is computed using the Leontief inverse and a vector of final demand shares.
- 12.6 **Distortion centrality.** Distortion centrality is a network measure intended to capture how markup-related distortions can accumulate within a production network. In practice it combines influence weights with markup-related terms to identify where distortions may be most consequential in the network.
- 12.7 **Network density.** Density is the share of potential inter-sector links that are present in the observed network (relative to the maximum number of directed links).
- 12.8 **Weighted outdegree (used in the “drivers/specialisation” analysis).** Weighted outdegree summarises how strongly a sector supplies others,

calculated as the row-sum of the relevant adjacency/share matrix (i.e., the total intensity of outgoing supply links).

Market power in supply chains

12.9 We study how market-power indicators (markups and HHI) relate to supply chain characteristics (e.g., length and centrality) using two complementary approaches:

(a) **Regression framework.** We regress each market-power indicator on the supply chain characteristic, controlling for year fixed effects and industry fixed effects. Standard errors are clustered at the same level as the industry fixed effects. Variables are standardised for ease of interpretation, and regressions are unweighted.

(b) **Fixed-effects granularity (payment flows).** For regressions using the ONS payment flows dataset, we use industry fixed effects at the 3-digit SIC level (even when the supply chain measures are constructed at 4-digit SIC), because more granular fixed effects absorb most of the variation in the supply chain measures; we present robustness checks using alternative fixed-effect granularities.

12.10 **Binned scatterplots.** We present binned scatterplots in which the x-variable (e.g., length or centrality) is divided into 10 quantile-based bins and we plot mean outcomes within each bin. We show both (i) raw bin means and (ii) “adjusted” bin means where the outcome has been residualised with respect to year and industry fixed effects (residual + sample mean). As a robustness check, we also assess bin choices using an IMSE-minimising selection approach; results are consistent.

Diversification and resilience

12.11 We measure import diversification for each country-sector using the concentration of imports across origin countries (an HHI over origin shares), normalised so that 1 corresponds to perfectly even sourcing across countries and 0 corresponds to all imports coming from one country. We define import resilience by combining diversification with the share of inputs that are imported, to reflect that concentrated imports matter less when import dependence is low.

Shock propagation

12.12 We use OECD ICIO tables to construct sector-level exposure measures based on intermediate inputs imported from China, and link these to EU

KLEMS outcomes (notably employment and output), focusing on UK sectors and aggregating variables at the 2-digit level for a balanced panel over 2000–2020. We distinguish horizontal (within-industry) and vertical (across-industry) import channels to separate competitive pressure from input-cost mechanisms.

- 12.13 For the baseline employment results, we estimate sector-level OLS regressions using multi-year changes in log employment and changes in Chinese import exposure, including controls and fixed effects with clustered standard errors. As a robustness check for endogeneity, we implement an IV strategy using the change in Chinese imports to a set of peer countries as an instrument for UK import exposure.

13. Appendix D: Methodology (detailed)

13.1 This appendix provides the formal methodological detail that underpins the analysis in the main report and Appendix C. Sections 13.2 – 13.7 set out the notation and full definitions for the supply-chain metrics used. Section 13.8 – 13.14 document the empirical implementation used to relate market power measures (markups and HHI) to supply-chain characteristics. Sections 13.15 – 13.21 provide the formal definitions for import diversification and import resilience, including normalisation choices and alternative indices. Finally, Sections 13.22 – 13.28 set out the China-shock methodology in detail, covering construction of exposure measures from the OECD ICIO tables, the baseline OLS specification, the IV robustness strategy, and the additional robustness and heterogeneity checks carried out.

Supply chain metrics

13.2 **Upstreamness:** captures the average number of stages between a sector and its final consumers. We calculate a sector's upstreamness using its connections to other sectors from the input-output structure of the economy. Following [Antras, Chor, Fally and Hillberry \(2012\)](#), we use the formula $U = (I - \Gamma)^{-1}\mathbf{1}$, where:

I is the NxN identity matrix (where N is the number of sectors),

Γ is a NxN matrix whose (i,j) -th element is $d_{ij}Y_j/Y_i$, the share of sector i 's total output that is purchased by industry j ,

$(I - \Gamma)^{-1}$ is the Leontief inverse of Γ , and

$\mathbf{1}$ is a column vector of ones.

13.3 **Downstreamness:** The average number of stages between a sector and its raw inputs. We calculate a sector's downstreamness using its connections to other sectors from the input-output structure of the economy. We use the formula $D = (I - A')^{-1}$, where:

I is the NxN identity matrix (where N is the number of sectors),

A is a NxN matrix whose (i,j) -th element is $d_{ij}Y_i/Y_j$, the share of sector j 's total output that is purchased by industry i , and

$\mathbf{1}$ is a column vector of ones.

13.4 **Supply chain length:** The number of production stages from raw materials to final output. We calculate this by combining our measures of Upstreamness

and Downstreamness to capture overall supply chains of a sector using the formula $L = U + D$.

13.5 Centrality:

(a) **Bonacich-Katz centrality:** The influence of a sector within the supply network, accounting for its size and importance as a supplier to other sectors in the production network. A sector is central if it supplies many others, either directly or indirectly through multi-stage chains. This captures more than just output volume, as it reflects how embedded a sector is in the wider production economy. The centrality of an industry is equal to the importance of that industry as a supplier to the final demand plus the weighted sum of the centrality of its customer industries. Following Grassi and Sauvagne (2017), we use the formula $\beta'(I - \Gamma)^{-1}$, where:

Γ is a $N \times N$ matrix whose (i,j) -th element is $d_{ij}Y_j/Y_i$, the share of sector i 's total output that is purchased by industry j ,

$(I - \Gamma)^{-1}$ is the Leontief inverse of Γ , and

β is the vector of final demand share.

(b) **Distortion centrality:** A measure which approximates how market imperfections, such as markups, accumulate within a supply network. According to the theoretical framework of Liu (2019), this tells us the sectors in which distortions have led sector size to deviate from its optimal level. For each sector, we compute the average markup of sectors that supply it, weighted by the share of inputs they supply. A value of 1 indicates that sectors are "undistorted" (as Influence weights (Bonacich-Katz centrality) and Domar weights coincide in an efficient economy). A value above 1 indicates an accumulation of markets' aggregate sectoral misallocation. Following Liu (2019), we calculate distortion centrality as $\frac{\beta'(I - \Gamma)^{-1}}{\gamma_i}$, where:

$\beta'(I - \Gamma)^{-1}$ is the Bonacich-Katz Centrality, and

$\gamma_i = \frac{\sigma_i}{\sigma_i - 1}$ is the Domar weight of sector i , where

$\frac{\sigma_i}{\sigma_i - 1}$ is the markup of sector j , the price wedge over marginal cost of production.

13.6 **Network density:** A network-wide measure describing the share of potential flows that arise in equilibrium. There is always a maximum of $N \times (N - 1)$

potential connections in a network with N sectors. For example, if there are three sectors, and each supplies just one of the other two, there are 3 relationships in the network (out of a maximum of 6 ($3 \times (3 - 1) = 3 \times 2 = 6$)), and so the network density is $0.5 \left(\frac{3}{6}\right)$.

- 13.7 **Weighted outdegree:** Describes the importance of a sector as a supplier within the network, by considering how intensively a sector sources from others. Unlike Bonacich-Katz centrality, the weighted outdegree treats all buyer sectors equally and so does not account for the fact industries can be a key supplier to another important supplier industry. Weighted outdegree takes a value between 0 and N (the number of sectors). When the weighted outdegree is equal to zero, it means that this sector is not a supplier to any other sector, and therefore only serves final demand. A sector with a weighted outdegree equal to N would be the sole supplier to all the other sectors of the economy. We use the formula $\sum_i \Gamma_{ij}$, the sum of the j^{th} row of the network adjacency matrix Γ .

Market power in supply chains

- 13.8 To explore how indicators of market power - markups and the Herfindal Hirschman Index (HHI) – relate to the supply chain characteristics of supply chain length and centrality, we conduct regression analysis and produce binned scatterplots.
- 13.9 Our analysis focuses on estimates of supply chain characteristics calculated using the ONS UK Industry-to-Industry payment flows dataset due to its granularity, although we replicate the regression analysis using estimates from the ONS UK input-output analytical tables.
- 13.10 For the regression analysis, we regress the market power indicator on the supply chain characteristic, controlling for year fixed effects (capturing shocks common to all industries in a given year) and industry fixed effects (capturing industry specific characteristics which are time-invariant). We cluster standard errors at the same level as the industry fixed effect to allow for serial correlation and heteroskedasticity within, but not across, sectors. This allows for robust valid statistical inference, even in the presence of serial correlation and heteroskedasticity. To ease interpretation of the regression results, all variables have been standardized. The regressions are unweighted.
- 13.11 For our regressions using the ONS UK Industry-to-Industry payment flows dataset, we include industry fixed effects at the 3-digit Standard Industrial Classification (SIC) level, despite our data being at the 4-digit SIC level.

- 13.12 This is because 4-digit SIC fixed effects explain most of the variation in centrality and supply chain length. Therefore, in our baseline regression, we instead include 3-digit industry fixed effects. For completeness, we plot coefficients from each regression with varying levels of industry fixed effects.
- 13.13 In addition to regression analysis, we visualise the relationship between the market power indicators and supply chain characteristics using binned scatterplots, where the x-variable (either supply chain length or centrality) is divided into 10 quantile-based bins. Within each bin, we compute the mean of the y-variable (either markups or the Herfindahl–Hirschman index).
- 13.14 In addition to plotting averages of the raw values of the y-variable, we also plot averages of values that have been adjusted to control for year, and 3-digit SIC sector fixed effects. To obtain these adjusted values, we:
- (a) Regress the y-variable on year and industry fixed effects.
 - (b) Obtain the residual from this regression.
 - (c) Add the residual back to the overall sample mean.

For our plots in the report, we divide our x-variable into 10 bins for consistency. As a robustness check, we also produce the plots using the number of bins which minimises the asymptotic integrated mean squared error (IMSE), which we obtain using the *binsregselect* command in Stata. Our findings are consistent across binning approaches.

Diversification and resilience

- 13.15 Import diversification is a measure of the distribution of the countries that a country-sector imports from. To measure this, we calculate, for each country-sector, the HHI of imports (the sum of squared shares of imported inputs from each country).
- 13.16 We then normalise this value such that a sector has a diversification value of 1 if it imports equally from every country, and 0 if all imports come from one country. We calculate the export diversification in a similar way but using the share of exports to each country instead.
- 13.17 We extend the concept of import diversification by calculating a measure of import resilience, which accounts for the extent to which a country sources its inputs domestically. This aims to capture the effect that sourcing domestically has on supply chain resilience.

- 13.18 For example, the UK electricity sector is relatively un-diverse in its imports (diversification measure of around 0.82) *but* these imports only account for around 10% of the sector's total inputs. This makes the sector more *resilient* to shocks abroad, than a scenario in which it relies on imports for 100% of its inputs.
- 13.19 The resilience measure is calculated as: $ID_{it} \times (1 - \frac{M_{ij}}{X_{ij}})$, where ID_{it} =import diversification, and $\frac{M_{ij}}{X_{ij}}$ =share of inputs imported.
- 13.20 We also calculate alternative measures of diversification using the Theil index and Gini coefficient. All three measures are highly correlated, but we focus on the HHI measure for ease of explanation.
- 13.21 In this context, the Theil index is a measure of the inequality of the distribution of imports/exports for a given country-sector, and the Gini coefficient is a measure of the inequality between a country-sector's trading partners. To enable us to compare these to the HHI measure, we normalise both such that 1 equals maximum equality in distribution of imports and is 0 equals maximum inequality.

Shock propagation

- 13.22 To construct our exposure measures, we use the OECD Inter-Country Input-Output (ICIO) Tables to calculate the value of intermediate inputs imported from China for each country-sector-year. We link these data with EU KLEMS indicators of economic performance, specifically employment and gross output, and supplement them with industry-level competition metrics, including the Herfindahl-Hirschman Index (HHI) and cost markups, sourced from the State of UK Competition 2024 report.²⁰
- 13.23 We restrict our analysis to UK sectors and aggregate ICIO-derived variables at the 2-digit industry level. This yields a balanced panel of 37 sectors over the period 2000–2020, capturing the most significant phase of China's export expansion following WTO accession. This timeframe allows us to examine both short- and medium-term effects of trade shocks on UK supply chains and sectoral outcomes.
- 13.24 We extend this approach by decomposing Chinese imports into two distinct channels, which is the industry-level counterpart to the approach by Aghion et

²⁰ EU KLEMS is an industry level, growth and productivity research project. EU KLEMS stands for EU level analysis of capital (K), labour (L), energy (E), materials (M) and service (S) inputs. [EU KLEMS: capital, labour, energy, materials and service - Economy and Finance](#)

al. (2021). Horizontal imports are trade flows between firms operating within the same industry, and vertical imports are flows between firms in different industries. This enables us to isolate two mechanisms: competitive pressure from foreign producers (horizontal) and productivity gains from access to imported inputs (vertical). These channels may exert distinct effects on domestic sectors, with horizontal imports potentially displacing UK output and vertical imports enhancing production efficiency.

13.25 We follow [Dorn and Levell \(2021\)](#) and estimate the impact of the China Shock on UK employment using a sector-level OLS regression. The dependent variable is the five-year change in log employment; the key independent variable is the five-year change in Chinese imports, normalised by sector employment. We include controls for assets, gross value added, and employment, apply employee-based regression weights, and use year and sector fixed effects with clustered standard errors.

13.26 It is possible that the China shock might not be the only cause of changes in employee outcomes. For example, there could be reverse causality where higher employment leads to an increase in imports from China or omitted variable bias, which would bias our estimated impact of the shock. To address this endogeneity, we follow [Autor et al. \(2013\)](#) and implement an instrumental variable (IV) strategy as a robustness check. IVs help to clarify the relationship by isolating the variation of interest arising from the shock. Our instrument is the change in Chinese imports to 12 UK peer countries, chosen for their similar exposure to China's WTO accession but independent from UK employment trends, making it a supply-driven plausibly exogenous shock.²¹

13.27 We test robustness by:

- (a) Using alternative outcomes (e.g. productivity measures).
- (b) Constructing an alternative import penetration metric based on aggregate UK demand.
- (c) Including lagged employment as a control and weight.
- (d) Varying fixed effects and clustering.
- (e) Disaggregating by industry and shock type (vertical vs horizontal).

²¹ These 12 countries are as follows: Belgium, Switzerland, Denmark, Spain, Finland, France, Italy, Netherlands, Poland, Portugal, Sweden, United States of America.

13.28 To assess how supply chain features mediate the shock, we interact the China shock with binary indicators for upstreamness, downstreamness, centrality, and supply chain length (for example, 1 if the sector is above median upstreamness and 0 otherwise). We also regress supply chain metrics on import exposure to examine static relationships, using the same controls and specification as our baseline to understand the features of sectors that experience larger China shocks.

14. Appendix E: Supply chain metric summary statistics

- 14.1 This appendix provides supporting summary statistics for the supply-chain metrics used throughout the report and benchmarks these estimates against selected published results. It is intended to help readers interpret the scale and variation of the metrics across alternative data sources and sector aggregations, and to assess how comparable our estimates are when calculated using different input-output frameworks (including open- versus closed-economy constructions and differing sector classifications and coverage periods).
- 14.2 Comparisons should be interpreted with care because datasets differ in sector classifications, time coverage, and whether the IO structure is treated as open or closed economy.

Table E1: Upstreamness – summary statistics across datasets

Summary statistics (mean, minimum, maximum and standard deviation) for upstreamness across our alternative datasets and sector aggregations.

Citation	Data source	Country and period	Mean	Minimum	Maximum	Standard deviation
CMA (2025)	ONS IO Tables	UK, averaged across 1984-2022	1.81	1	4.91	0.56
CMA (2025)	Payflow, 2-digit SIC level	UK, averaged across 2017-2022	2.96	1	5.58	1.00
CMA (2025)	Payflow, 4-digit SIC level	UK, averaged across 2017-2022	2.63	1	8.26	1.27
CMA (2025)	OECD ICIO Tables (Closed economy)	UK, averaged across 1995-2020	2.20	1.07	4.70	0.66
CMA (2025)	OECD ICIO Tables (Open economy)	UK, averaged across 1995-2020	2.19	1.07	4.32	0.63

Table E2: Upstreamness (comparison to Antràs et al. (2012))

Benchmarking table comparing our upstreamness estimates to published values in Antràs et al. (2012), noting differences in data construction and any open-economy adjustments used in the underlying IO framework.

Citation	Data source	Country and period	Mean	Minimum	Maximum	Standard deviation
Antras et al. (2012)	Bureau of Economic Analysis IO Tables (Open economy adjustment) ²²	US, 2002	2.09	1	4.65	0.85
CMA (2025)	OECD ICIO Tables (Closed economy)	US, 2002	1.98	1.03	3.19	0.54
CMA (2025)	OECD ICIO Tables (Open economy)	US, 2002	1.98	1.04	3.12	0.53

²² The matrix of US input-output coefficients does not distinguish between flows of domestic and international exchanges, so an 'open economy adjustment' is made, whereby it is assumed the share of industry i's exports (imports) used by industry j producers is identical to the share of industry i output used in industry j (at home or abroad).

Table E3: Upstreamness (comparison to Grassi and Sauvagnat (2019))

Benchmarking table comparing our upstreamness estimates to published values in Grassi and Sauvagnat (2019), using the closest comparable country-year and dataset variants where available.

Citation	Data source	Country and period	Mean	Minimum	Maximum	Standard deviation
Grassi and Sauvagnat (2019)	INSEE Symmetric Domestic Input-Output Table (SIOT) (Closed economy)	France, 2015	1.64	1	2.43	0.48
CMA (2025)	OECD ICIO Tables (Closed economy)	France, 2015	2.24	1.06	3.42	0.64
CMA (2025)	OECD ICIO Tables (Open economy)	France, 2015	2.22	1.06	3.50	0.64

Table E4: Upstreamness (comparison to WIOD / Antràs & Chor (2017))

Benchmarking table comparing our upstreamness estimates to published values derived from WIOD-based approaches (e.g., Antràs & Chor), to assess comparability when using different international input-output datasets and coverage periods.

Citation	Data source	Country and period	Mean	Minimum	Maximum	Standard deviation
Antras and Chor (2017)	World Input-Output Database (WIOD) ²³	All countries, 1995	1.98	n/a	n/a	n/a
Miller and Temursho (2015)	World Input-Output Database (WIOD)	All countries, 1995	2.04	1	3.87	0.61
CMA (2025)	OECD ICIO Tables (Open economy)	All countries, 1995	2.11	1	5.77	0.70
Antras and Chor (2017)	World Input-Output Database (WIOD)	All countries, 1995-2011	2.10	n/a	n/a	0.65
CMA (2025)	OECD ICIO Tables (Open economy)	All countries, 1995-2011	2.16	1	14.2	0.71

²³ The [World Input-Output Database \(WIOD\)](#) is created from a set of harmonised supply and use tables alongside data on international trade in goods and services. Antras and Chor (2017) use the 2013 release, which covers 35 sectors (classified according to ISIC Rev. 3) and 40 countries with a model for the rest of the world for the period 1995-2011.

Table E5: Centrality – summary statistics across datasets

Summary statistics (mean, minimum, maximum and standard deviation) for our centrality measure across datasets and sector aggregations.

Citation	Data source	Country and period	Mean	Minimum	Maximum	Standard deviation
CMA (2025)	ONS IO Tables	UK, averaged across 1984-2022	0.017	0.000	0.543	0.031
CMA (2025)	Payflow, 2-digit SIC level	UK, averaged across 2017-2022	0.016	0.000	0.171	0.026
CMA (2025)	Payflow, 4-digit SIC level	UK, averaged across 2017-2022	0.002	0.000	0.125	0.006
CMA (2025)	OECD ICIO Tables (Closed economy)	UK, averaged across 1995-2020	0.037	0.001	0.189	0.045
CMA (2025)	OECD ICIO Tables (Open economy)	UK, averaged across 1995-2020	0.062	0.001	0.384	0.068

Table E6: Centrality (comparison to Grassi and Sauvagnat (2019))

Benchmarking table comparing our centrality estimates to published values in Grassi and Sauvagnat (2019), using the closest comparable country-year and dataset variant reported in the table.

Citation	Data source	Country and period	Mean	Minimum	Maximum	Standard deviation
Grassi and Sauvagnat (2019)	INSEE Symmetric Domestic Input-Output Table (SIOT) (Closed economy)	France, 2015	0.044	0.002	0.167	0.038
CMA (2025)	OECD ICIO Tables (Closed economy)	France, 2015	0.036	0.000	0.159	0.045
CMA (2025)	OECD ICIO Tables (Open economy)	France, 2015	0.061	0.000	0.297	0.067

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Glossary

ABS (Annual Business Survey)

ONS business survey used (with ARDX) to construct labour productivity measures such as GVA per worker.

ARDX (Annual Respondents Database X)

ONS microdata used (with ABS) to construct labour productivity measures such as GVA per worker.

B2B (business-to-business)

Transactions or relationships between businesses (rather than between businesses and consumers).

BACS (Bankers' Automated Clearing Services)

A UK interbank payments system included in the ONS payment flows dataset (via BACS and Faster Payments).

Binned scatterplot

A plot that groups the x-variable into bins (e.g., deciles) and plots average outcomes within each bin; used in the report to visualise relationships between market power (markups/HHI) and supply chain metrics.

CAGR (compound annual growth rate)

A growth rate calculated over multiple years, used in the annex table notes.

Centrality

A measure of how important a sector is within the supply network, accounting for its size and its direct and indirect supply links to other sectors (i.e., whether it supplies many others directly or through multi-stage chains).

CHAPS

A UK high-value payments system not covered by the payment flows dataset (noted as a coverage limitation in the annex).

Clustering (standard errors)

An inference approach used in regressions to allow for correlation of errors within clusters (here, clustered at the same level as the industry fixed effect).

CPA (Classification of Products by Activity)

A product classification used in national accounts; the ONS product-by-product IO tables use aggregated CPA product groups that broadly map to SIC divisions.

Distortion centrality

A network measure intended to capture how market imperfections (such as

markups) can accumulate within a supply network, indicating where distortions may be more consequential in the network.

Downstream

Closer to final consumers. In the report, it can be measured as the number of production stages between initial inputs and a sector.

Downstreamness (D)

A metric capturing the average number of stages between a sector and its raw/initial inputs (i.e., how many steps are required for a sector to receive all its inputs from initial production).

Extensive margin

Whether a buyer-supplier relationship exists at all (e.g., do two sectors trade with each other?).

Fixed effects (year / industry)

Regression controls that soak up common shocks in a given year (year fixed effects) and time-invariant characteristics of an industry (industry fixed effects).

FPS (Faster Payments Service)

A UK payments system included in the ONS payment flows dataset.

GVA (Gross Value Added)

A measure of economic output net of intermediate consumption; used (per worker) as a measure of labour productivity.

HHI (Herfindahl–Hirschman Index)

A measure of concentration: the sum of squared market shares in a market/sector (higher means more concentrated). Used as an indicator of market structure alongside markups.

ICIO (Inter-Country Input-Output tables, OECD)

OECD tables mapping intermediate input flows across countries and sectors; used for global network analysis, import diversification/resilience, and China-shock exposure.

IMSE (integrated mean squared error)

A criterion used to choose the “optimal” number of bins in binned scatterplots (used as a robustness check via bin selection methods).

Input-output table

A matrix describing flows of goods/services between sectors (who buys inputs from whom), used to construct network/supply chain metrics.

Intermediate producer

A sector/industry that produces outputs used as inputs by other sectors (i.e., not purely upstream inputs and not final consumption).

Intensive margin

How much trade occurs within an existing buyer-supplier relationship (e.g., the value/volume of transactions conditional on a link existing).

IOAT (ONS input-output analytical tables: product-by-product)

ONS input-output tables used to compute supply chain metrics and as a robustness dataset alongside payment flows.

ISIC / NACE / SIC

Industry classification systems used across datasets: ISIC (OECD ICIO), NACE (EU KLEMS), and SIC (UK ONS/CMA sector definitions).

Leontief inverse

A standard input-output concept used to translate direct input requirements into total (direct + indirect) requirements through the network; used in the formal definitions of upstreamness/downstreamness/centrality in the annex.

Longitudinal Business Database / Business Structure Database

CMA microdata sources that underpin competition metrics referenced as inputs to the State of UK Competition measures.

Markup / price-cost markup

A measure of market power: the ratio of price to marginal cost (higher implies prices are further above costs).

Market power

The ability of a firm (or group of firms) to set prices above costs, often due to limited competition; proxied here using markups and concentration measures.

Network density

A network-wide measure: the share of potential links between sectors that are present in the observed network.

ONS industry-to-industry payment flows (Pay.UK/Vocalink)

Experimental dataset of payment transactions used to build an input-output-style matrix at granular SIC levels; used extensively for supply chain metrics and related analysis.

Resilience (import resilience)

A measure intended to capture how exposed a sector is to external disruptions,

combining (i) how diversified its import sources are and (ii) how much it relies on imported inputs.

Sector (in this report)

An industry grouping defined using standard classifications (e.g., SIC); the analysis is at the sector-level (not firm-level).

Specialisation

A shift towards narrower tasks and more interdependence across firms/sectors, often associated with more fragmentation and longer/more complex supply networks.

Standardisation (of variables)

Transforming variables to have a common scale (e.g., mean 0 and standard deviation 1) to ease interpretation of regression coefficients.

Supply chain

The sequence of production stages through which goods/services move from initial inputs to final consumption; in an economy-wide context, many chains overlap and form a supply network.

Supply chain length (L)

The number of production stages from raw inputs to final output; in the annex, defined as upstreamness + downstreamness ($L = U + D$).

Supply network

The economy-wide web formed by many intersecting supply chains (firms/sectors buy from and sell to multiple counterparties).

Upstream

Closer to initial inputs of production (e.g., mining). Numerically, it can be measured as the number of production stages between a sector and the final consumer.

Upstreamness (U)

A metric capturing the average number of stages between a sector and final consumers (distance to final demand).

Weighted outdegree

A measure summarising how strongly a sector supplies others in the network, based on the intensity of its outgoing links (how many/ how strongly it supplies other sectors).