UK IN A CHANGING EUROPE

POST-BREXIT IMPORTS, SUPPLY CHAINS, AND THE EFFECT ON CONSUMER PRICES

JAN DAVID BAKKER, NIKHIL DATTA, JOSH DE LYON, LUISA OPITZ, AND DILAN YANG

FOREWORD

The degree to which Brexit has impacted, and will impact upon the UK economy has been debated since the referendum of 2016. In an attempt to contribute to this discussion, the following report sets out to analyse the effect of leaving the European Union on imports, supply chains and prices.

This piece of work has been put together by Jan David Bakker, Nikhil Datta, Josh de Lyon, Luisa Opitz and Dilan Yang of the Centre for Economic Performance at the London School of Economics. My thanks to them all for undertaking the work and responding so promptly to the myriad comments and suggestions made on earlier drafts.

Within the UK in a Changing Europe team itself, particular thanks go to Jonathan Portes for editing and commenting on the text, to Alison Howson for going over it carefully and making complicated sections far clearer, to Tom Mansfield for taking care of design and production of the finished version, and to Alan Wager and Joël Reland for beautifying a hefty number of supporting graphs and figures.

I suspect that what follows will prompt some heated debates. I very much look forward to these discussions, and am delighted that we have been able to help produce this research-based contribution to them.

Anand Menon
Director, UK in a Changing Europe

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ACKNOWLEDGEMENTS

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AUTHOR BIOGRAPHIES

Jan David Bakker is an assistant professor at Bocconi Universiy and a research associate at the Centre for Economic Performance at the London School of Economics.

Nikhil Datta is a final year PhD candidate at University College London and a researcher at the Centre for Economic Performance at the London School of Economics. From August 2022 he will be an assistant professor at the University of Warwick.

Josh De Lyon is a final year PhD candidate at the University of Oxford and a researcher at the Centre for Economic Performance at the London School of Economics. He will join the Productivity, Innovation and Entrepreneurship Division at OECD in July 2022.

Luisa Opitz is a research assistant at the Centre for Economic Performance at the London School of Economics.

Dilan Yang is a masters student at the University of Oxford and a research assistant at the Centre for Economic Performance at the London School of Economics.
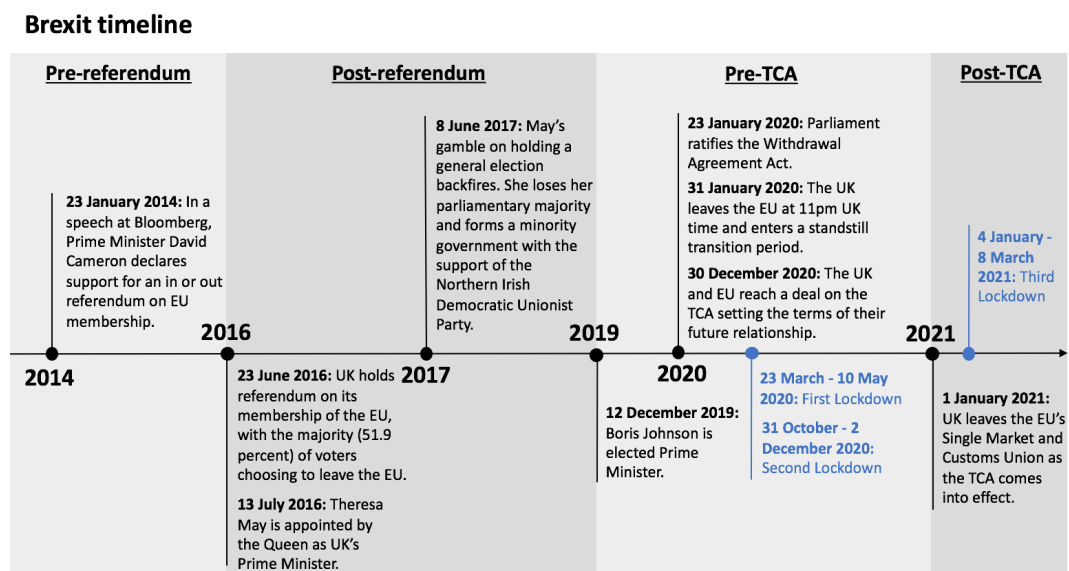
EXECUTIVE SUMMARY

- The UK's exit from the European Union led to a large increase in barriers to trade with its largest trading partner. January 2021 marked the end of the UK's participation in the Single Market and the Customs union, and the entry into force of the Trade and Cooperation Agreement (TCA).

- The volume of UK imports from the EU fell relative to imports from outside the EU in 2021. There is, however, significant variation across product types in terms of the extent, timing, and duration of the effect.

- Brexit has affected UK businesses' production. Two-thirds of international trade is in intermediate products used for production by domestic businesses and there has been a relative fall in imports from the EU used as intermediate inputs.

- Many UK supply chains are re-adjusting to the post-TCA trading environment by decreasing integration with the EU relative to integration with the rest of the world. There is evidence that some sectors began to reorganise their supply chains away from EU countries from 2019 onwards before the implementation of the TCA in anticipation of a change to trading arrangements. We also find evidence of stockpiling just before the implementation of the TCA for some sectors.

- The increase in UK-EU trade barriers has led to a 6% increase in food prices in the UK over the period between the end of 2019 and September 2021 in comparison to the years before December 2019.

- Covid-19 is ruled out as a factor to price changes, as key events in the pandemic are not obviously correlated with the changes and, furthermore, we are able to control for economy-wide macro-impacts such as national lockdowns.

INTRODUCTION

The UK left the Single Market and Customs Union at the end of 2020, marking the end of the transition period. Under the EU-UK Trade and Cooperation Agreement (TCA), goods continue to be traded without tariffs and quotas but the regulatory and customs framework for trade has changed, causing an increase in trade frictions between the UK and the EU. The new measures include more comprehensive customs checks, rules of origin requirements, the need to prove regulatory compliance in each jurisdiction separately, sanitary and phytosanitary (SPS) measures for trade in animals and plants, and limitations on the freedom of movement for business travel, among other restrictions, with full customs checks to be phased-in during 2022, after the period of data used in this paper.

In this report, we use 'pre-referendum' to refer to the period before the Brexit referendum on 23 June 2016 and 'post-referendum' as the period after the referendum and before Boris Johnson's election as prime minister on 12 December 2019. 'Pre-TCA' refers to the time period from the election up until the implementation of the TCA on 1 January 2021, and 'post-TCA' denotes the period from 1 January to 30 September 2021. Figure 0.1 documents the chronology of events during the Brexit process.

Figure 0.1: Timeline of key milestones in the UK-EU relationship, 2014-21

Brexit timeline

| Pre-referendum | Post-referendum | Pre-TCA | Post-TCA |

23 January 2014: In a speech at Bloomberg, Prime Minister David Cameron declares support for an in or out referendum on EU membership.

8 June 2017: May's gamble on holding a general election backfires. She loses her parliamentary majority and forms a minority government with the support of the Northern Irish Democratic Unionist Party.

23 January 2020: Parliament ratifies the Withdrawal Agreement Act.

31 January 2020: The UK leaves the EU at 11pm UK time and enters a standstill transition period.

30 December 2020: The UK and EU reach a deal on the TCA setting the terms of their future relationship.

4 January - 8 March 2021: Third Lockdown

23 June 2016: UK holds referendum on its membership of the EU, with the majority (51.9 percent) of voters choosing to leave the EU.

13 July 2016: Theresa May is appointed by the Queen as UK's Prime Minister.

12 December 2019: Boris Johnson is elected Prime Minister.

23 March - 10 May 2020: First Lockdown

31 October - 2 December 2020: Second Lockdown

1 January 2021: UK leaves the EU's Single Market and Customs Union as the TCA comes into effect.

2014   2016   2017   2019   2020   2021

In the post-referendum and pre-TCA period, the economic effects of Brexit began to materialise. Products more exposed to the uncertainty of future trading relations with the EU experienced lower trade growth. The depreciation in the value of sterling immediately following the referendum result increased the price of imports and, therefore, the cost of living and led to lower real-wage growth in sectors exposed to intermediate imports.

Following the implementation of the TCA, there is a clear and sizeable drop in imports from the EU. This is evident when comparing the UK's imports from the EU with those from non-EU countries, or when comparing the UK's position relative to the EU with other countries, such as the US's imports from the EU.

This report documents the decrease in imports and shows how the patterns of imports vary across sectors. We focus on comparisons between imports from the EU and imports from non-EU countries. Some products, such as fats, oils, and waxes, experienced a sizeable decrease in trade volumes with EU countries compared to those of non-EU countries in January 2021. Other products, such as minerals, experienced minimal deviation in imports from the EU versus non-EU. We also document that the timing of import changes varies across products: in some cases, the deviation occurs pre-TCA, and there is some evidence of stockpiling; in other cases, the changes only occur post-TCA, and can be either short term or persistent.

The fall in imports from the EU will affect the UK economy through its impact on supply chains. Two-thirds of international trade is in products used as inputs to production. We show that imports from the EU fell for products that are used as inputs to production in many industries in the UK. For some sectors such as agriculture, fishing, and car manufacturing, there is evidence that imported inputs began to be sourced from non-EU countries pre-TCA. For others, including vegetable oil, animal fats, prepared animal feeds, and pharmaceuticals, the adjustments occurred post-TCA. Evidence suggests that increased access to intermediate inputs can boost productivity, so a reversal is likely to cause a fall in productivity.

Imports also provide cheaper goods to consumers, as well as a wider variety of choice. Focussing on food products, we show that the drop in imports after Brexit caused an increase in prices. Products that were more heavily reliant on imports from the EU increased in price following the election of Boris Johnson in 2019, pre-TCA and then increased further post-TCA.

This report therefore shows that changes in imports of goods from the EU have affected UK firms' supply chains. Part of this change is driven by the adjustment costs incurred as part of the new trading relationship and is likely to be short

term, but another part is likely to reflect a long-term increase in the cost of inputs from the EU, which make up a sizable contribution of total imports. This could have a knock-on effect for consumers who will face higher prices, and for workers whose jobs will be affected by adjustments in the supply chain.

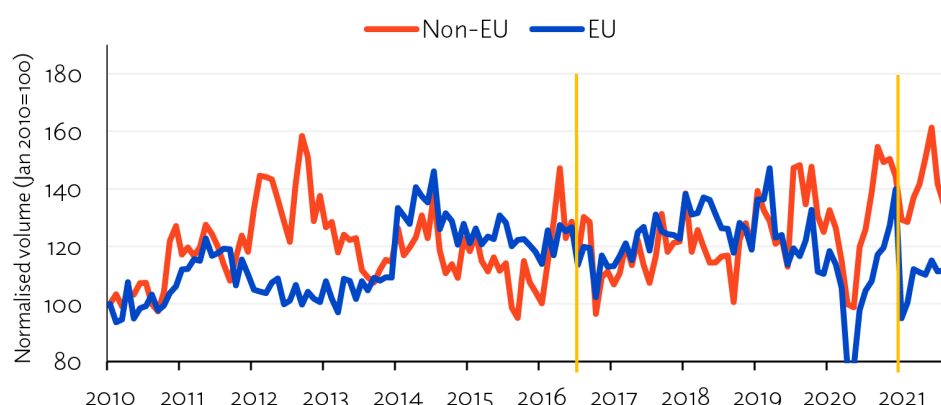# 1. THE IMPACT OF BREXIT ON TRADE FLOWS

1.1 OVERVIEW

In the following, we analyse the impact of Brexit on trade flows, highlighting those products that have experienced considerable changes in trade patterns since January 2021. These products were chosen as representative of the different patterns observed in a variety of other sectors not included in this report. We focus on imports, as they play a greater role in affecting UK supply chains and domestic consumer prices, but also because to-date the fall in imports from the EU is far more substantial and observable than the fall in exports to the EU.

Using the granular product categories reported in the [UN Comtrade database](#), we analysed the UK's trade in goods with the EU compared to non-EU countries for 97 product categories. We focussed on changes in the patterns of trade volume around the two major Brexit events: June 2016 when the EU referendum took place, and January 2021 when the UK left the Single Market and Customs Union, and the TCA came into effect. For the implementation of the TCA, we distinguish between pre-TCA — the period between the 2019 election and the end of 2020 which is of course complicated by the beginning of the pandemic — and the post-TCA period of 2021.

Overall, UK imports from the EU have fallen both in absolute terms since the referendum and relative to imports from non-EU countries since the TCA's implementation, as shown in Figure 1.1. This is not the case for exports, where trade with the EU has followed a similar path to trade with non-EU countries so far. Forthcoming research by Rebecca Freeman, Kalina Manova, Thomas Prayer, and Thomas Sampson establishes that Brexit precipitated a 25% fall in imports from the EU, in line with the findings of existing [research](#).

Figure 1.1: EU imports declined relative to non-EU imports after the Trade and Cooperation Agreement came into effect

UK imports from the EU and non-EU countries(seasonally adjusted, normalised).

Notes: Seasonally adjusted aggregated UK imports over time based on UN Comtrade data, normalised to January 2010.

There is substantial heterogeneity across products in the effect of Brexit on trade flows, which can be grouped into three common patterns that emerge across a number of different products. First, some sectors, including textiles, experienced a slower rate of growth, if not decline, in the UK's trade volume with EU countries compared to that of non-EU countries post-referendum and pre-TCA. Second, some products experienced a sizeable drop in the UK's trade volume with EU countries compared to that of non-EU countries post-TCA, such as fats, oil, and waxes. Certain products have shown evidence of both effects — slower growth before the implementation of the TCA and a sizable drop in imports from the EU thereafter — such as photographic or cinematographic goods. Third, there are some products for which there has been no observable difference in UK-EU trade compared to UK non-EU trade (such as mineral fuels, mineral oils, and products of their distillation).

Among the commodities that experienced a disproportionate dip in imports from the EU compared to from non-EU countries, varying patterns are seen in the persistence and timing of the dip. For some products, such as fats, oil, and waxes, the dip is followed by a quick recovery back to pre-TCA trade levels. Other products experienced a persistent drop or continued to decline over time.

Import substitution from EU to non-EU countries is also evident for some products. For example, vegetables and textile products, experienced a downward trend in imports from EU countries but an upward trend of imports from non-EU countries, although the extent of the completeness of import substitution varies.

There is little evidence that trade patterns had already changed dramatically post-referendum and pre-TCA; only a small number of products, such as textiles, decreased in imports from the EU post-referendum. However, there is evidence of stockpiling for some products just before the implementation of the TCA. In particular products such as toys, games, and sports equipment increased stocks pre-TCA, even controlling for seasonality of trends due to the holiday season, before dipping post-TCA.

In the following, we analyse trade patterns for six products in relation to Brexit events that are representative of others. For each product, we present seasonally-adjusted import trends to the UK from EU and non-EU countries for the period January 2010 to September 2021, with values normalised to January 2010 levels, so figures can be interpreted as percentage deviations. Each figure additionally has markers for the EU membership referendum and the commencement of the TCA.

In nearly all cases and in line with previous [reports](), we see a decline in imports from the EU. However, the persistence of this decline differs across products, and there is considerable heterogeneity in the extent of substitution to non-EU countries. These differences are likely driven by a variety of factors including the extent and ability of firms to adapt to new regulatory barriers, the distribution of global production, and the substitutability of the underlying products from different partner countries. In sectors that are known to have high non-tariff barriers such as agriculture, food, and motor vehicles (or their supply chains), we see notable falls in imports. In early 2021, a third of businesses were reporting that they had issues importing from the EU to the UK due to Brexit, with the most-[cited]() reasons being delays at the border, additional customs and administrative costs, and regulatory checks. The impact of border delays is spread along the supply chain. Most UK companies now hold more inventory, consequently consuming more working capital, and 38% indicated they had established a subsidiary in the EU to make the process [smoother]().

1.2 VEGETABLES, ROOTS, AND TUBERS

A wide variety of vegetable and root products are consumed in the UK, such as tomatoes, onions, and potatoes. In 2015, the UK imported $3 billion worth of produce from the EU, in comparison to $1 billion from the rest of the world. As a share, 77% of imports came from the EU.

Imports from both EU and non-EU partners have been relatively stable post-referendum and pre-TCA. Post-TCA, imports from the EU dipped by 13.2%, whereas imports from non-EU countries rose by 24.9%. This was then followed by a period of persistently low imports from the EU and relatively high imports from non-EU countries, with some evidence of a slow upward adjustment for EU and downward trend for non-EU. If this trade substitution is driven by increases in EU-UK trade costs, then it is reasonable to expect that it may have price implications for UK consumers. Specifically, with regards to perishable goods, there is growing concern that current border delays are leading to a decrease in the quality and value of products.

Products that follow a similar pattern are organic chemicals, copper (and cooper products), and furniture.

Figure 1.2: The UK substituted EU with non-EU imports for vegetables, roots and tubers after the TCA came into effect

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UK imports from the EU and non-EU countries of vegetables, roots and tubers (seasonally adjusted, normalised).
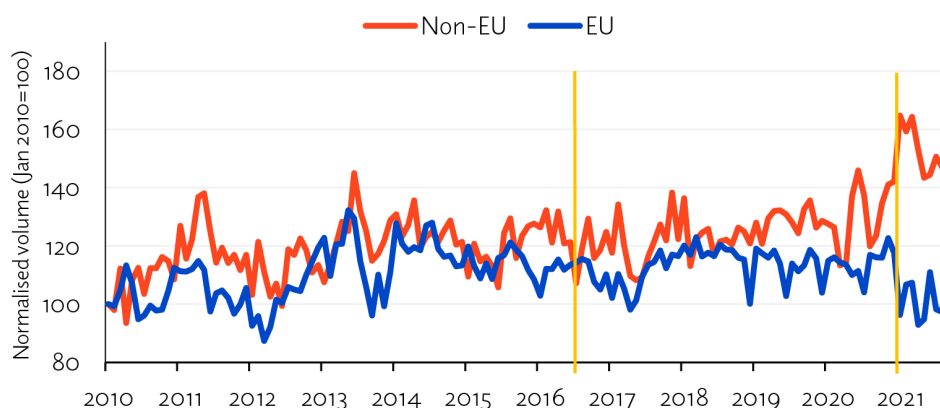
Notes: Seasonally adjusted aggregated UK imports over time based on UN Comtrade data, normalised to January 2010.
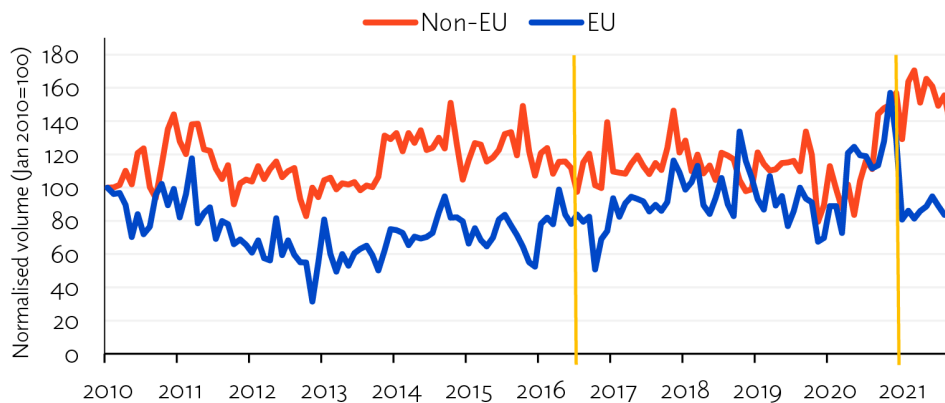
1.3 TOYS, GAMES, AND SPORTS EQUIPMENT

Toys, games, and sports equipment include products used in UK households such as game consoles, board games, and tennis racquets. In 2015, the UK imported $1 billion worth of such products from the EU, in comparison to $5 billion from the rest of the world, meaning that, around 16% of imports came from the EU.

Post-referendum and pre-TCA, import trends were very similar across the EU and non-EU for toys, games, and sports equipment. There is a structural break in this pattern from post-TCA onwards. In particular, although imports from non-EU countries continued to evolve as before, imports from the EU fell by approximately one-third. Similar import trends are reported for aluminium and aluminium products, carpets, and other floor coverings.

Figure 1.3: Imports of toys, games and sports equipment have seen a structural change since the TCA came into effect

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UK imports from the EU and non-EU countries of toys, games and sports equipment (seasonally adjusted, normalised).

Notes: Seasonally adjusted imports of toys, games and sports equipment over time based on UN Comtrade data, normalised to January 2010.
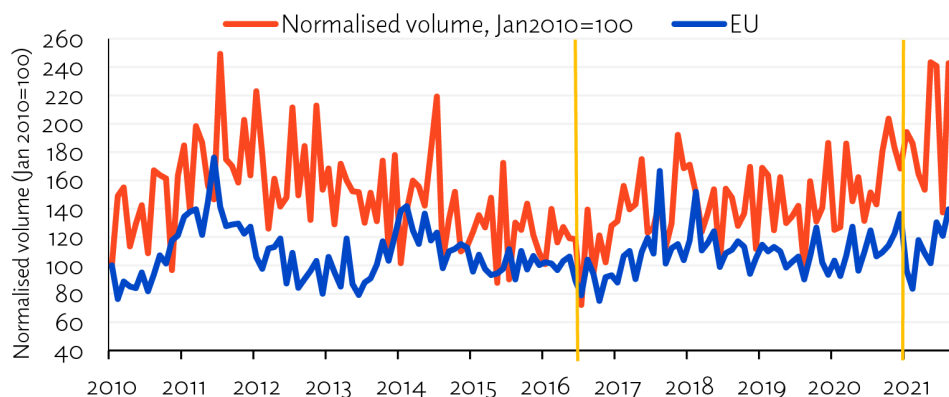
1.4 FATS, OIL, AND WAXES

Fats, oil, and waxes encompass household products such as olive oil, vegetable oil, and candles as well as industrial inputs such as glycerine, which is used in the production of a huge variety of products ranging from laxatives to e-cigarettes and anti-freeze. In 2015, the UK imported $1.5 billion worth of fats, oil, and waxes from the EU compared to $0.6 billion from non-EU countries: 71% of imports came from the EU.

There is no obvious change in import trends for these products post-referendum, however post-TCA there is a well-pronounced temporary dip of almost 50% in imports from the EU, with no similar drop in imports from outside the EU. The drop in imports from the EU took approximately six months to recover. Products that followed the same pattern are tobacco and manufactured tobacco substitutes, apparel and clothing accessories, wood and wooden goods.

Figure 1.4: Imports of fats, oil, and waxes from the EU fell sharply after the TCA came into force

UK imports from the EU and non-EU countries of fats, oil, and waxes (seasonally adjusted, normalised).

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Notes: Seasonally adjusted imports of fats, oil and waxes over tiem based on EU Comtrade data, normalised to January 2010

1.5 PHARMACEUTICALS

Pharmaceuticals cover all kind of medicinal products such as vitamins, antibiotics, and insulin, but also products such as vaccines and first-aid kits. In 2015, the UK imported $25 billion worth of pharmaceutical products from EU partners compared to $8 billion from non-EU countries. In other words, 75% of imports came from the EU.

The steep rise in imports from the EU by the end of pre-TCA suggests stockpiling, and that this is observed for imports from the EU and not for other imports suggests it is not driven by Covid-19. Similar to fats, oil, and waxes, pharmaceutical products also experienced a large dip in imports from the EU post-TCA. The recovery of import values however was much slower, whereas imports from non-EU countries increased considerably during this period. The contraction in imports is large in absolute terms, the UK imported on average approximately $2 billion of pharmaceuticals every month from the EU, which is about four times more than the imports from non-EU countries. Therefore, the increase in imports from outside the EU would be unlikely to fill the gap created by declining imports from the EU.

Similar trends in stockpiling can be observed for products of cocoa and cocoa preparations, of meat, fish, and crustaceans, and of lac, gums, resins and other vegetable saps and extracts.

Figure 1.5: UK was stockkpiling pharmaceutical products from the EU right before the TCA came into effect

UK imports from the EU and non-EU countries of pharmaceutical products (seasonally adjusted, normalised).

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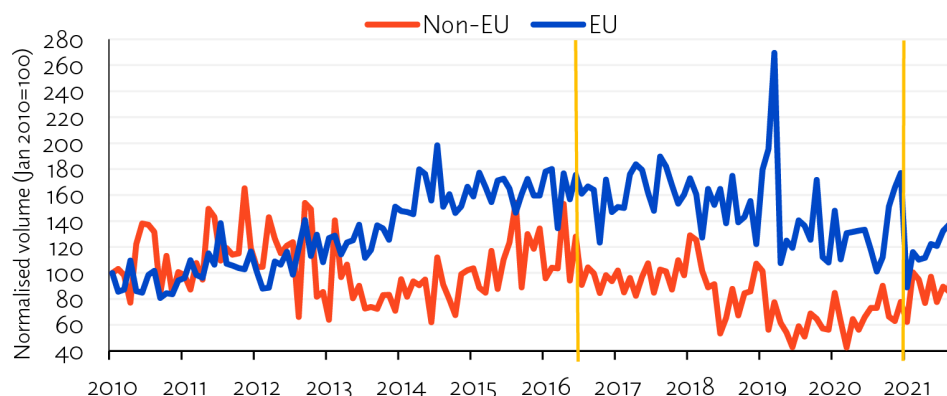
Notes: Seasonally adjusted imports of pharmaceuticals over time based on UN Comtrade data, normalised to January 2010.

1.6 COFFEE, TEA, AND SPICES

This product category groups together any kind of coffee (roasted or unroasted, caffeinated or decaffeinated) and tea (green or black) products plus spices such as vanilla, cinnamon or cumin.

In 2015, the UK imported $0.6 billion worth of coffee, tea, and spices from the EU and $1.1 billion from non-EU partners, so that 35% of imports came from the EU.

Imports from non-EU countries of coffee, tea, and spices grew by 43.6% from December 2020 to March 2021. Meanwhile, imports from the EU experienced a sudden drop of 50.4% post-TCA. Since then, imports from the EU have been persistently low whereas imports from non-EU countries remained at a high level. In absolute terms imports from the EU dropped from approximately $80 million to just under $40 million per month, whereas imports from outside the EU only grew from $80 million to approximately $110 million, implying a net decrease in imports of $10 million a month. Given that the raw materials of coffee, tea, and spices are predominantly cultivated outside the EU, the partial import substitution may represent a diversion away from EU wholesalers that provided low-level processing or packaging before being shipped to the UK.

Fruit, nuts, cereals, animal or vegetable fats, and oils demonstrate similar import patterns over time.

Figure 1.6: Imports of coffee, tea and spices from the EU decreased dramatically, without a comparable increase in non-EU imports

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UK imports from the EU and non-EU countries of coffee, tea and spices (seasonally adjusted, normalised).

Notes: Seasonally adjusted imports of coffee, tea and spices over time based on UN Comtrade data, normalised to January 2010.
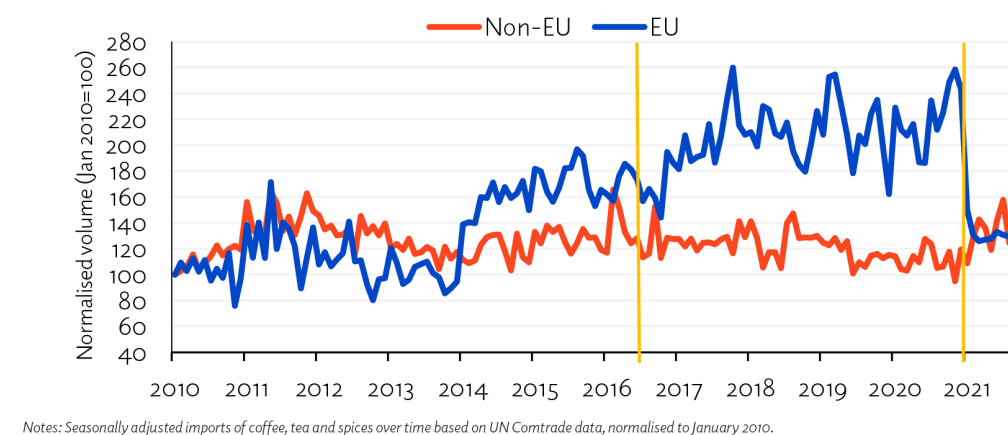
1.7 TEXTILES

The category of textiles includes materials such as polyester, nylon, gum, and plastics suitable for industrial use. In 2015, the UK imported $0.3 billion worth of textiles from the EU compared to $0.15 billion from non-EU countries, meaning 65% of imports came from EU trading partners.

Textile imports from the EU were already declining post-referendum and pre-TCA, whereas imports from outside the EU increased. However, the large spike in imports from the EU at the end of pre-TCA suggests there was a surge in purchases from the continent and potential stockpiling. There is evidence of a drop in UK imports from the EU post-TCA with a relatively quick recovery to pre-TCA levels. Some product lines in the textile sector saw tariffs fall as part of the new UK tariff schedule, which may explain part of the rise from non-EU countries.

The downward sloping trend for imports from the EU also seems frequent for other products post-referendum and pre-TCA, for example paper and paperboard. Meanwhile, photographic or cinematographic goods, meat and edible offal experienced a downward sloping trend but without a contemporaneous increase in imports from non-EU countries.

Figure 1.7: UK imports of textiles declined after the referendum, even before the TCA came into force

UK imports from the EU and non-EU countries of textiles (seasonally adjusted, normalised).
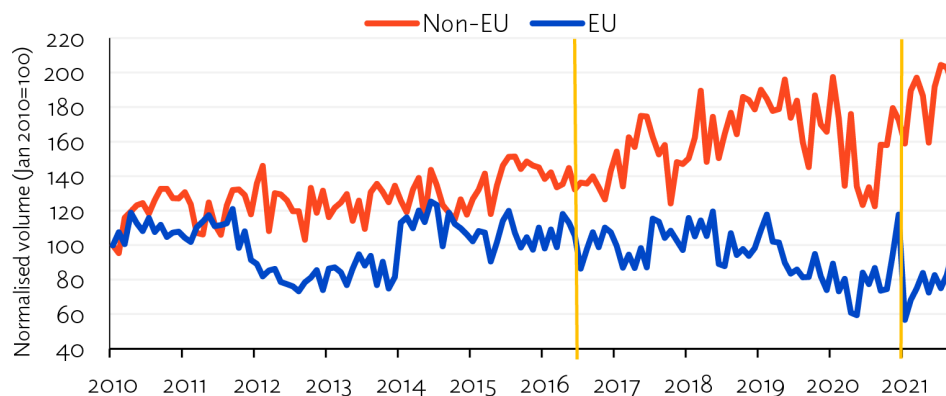
Notes: Seasonally adjusted imports of textile fabrics over time based on UN Comtrade data, normalised to January 2010.

2. CHANGES IN IMPORTS AND THE RE-ORGANISATION OF UK SUPPLY CHAINS

2.1 INTRODUCTION

Around two-thirds of international trade is in intermediate products — inputs to the production of other products. Importing intermediate goods and services can boost productivity of domestic businesses by increasing the efficiency of their production process. Therefore, changes in the import environment will affect the industries that rely on imports for production, in addition to there being direct impacts on consumers.

Many sectors make use of intermediate goods in production and rely on imported products at different points in their supply chain. In the sectoral analyses that follow, we account for this by computing a weighted average of imports from the EU and non-EU, including how important each good is in the production process, and how important imports are overall to the sector. We do not include data on services, which will further affect supply chains. It is to be noted that in many cases, the most important imported intermediate product will be classified as the same product category — for example, the automotive industry's most important imported input is classified as 'motor vehicles'.

We then document how imports of intermediate goods have changed for each UK industry. For each sector, we present the top ten imported inputs and how their imports have changed post-TCA for the EU compared to non-EU countries. We outline the full details of the methodology in the Technical Appendix.

Imports from the EU, relative to imports from non-EU countries, have fallen for goods used in many UK supply chains. These changes are likely to have made UK firms less efficient in production. Previous research suggests that changes in intermediate imports due to the depreciation of sterling reduced wages in affected sectors and reduced training, which highlights the importance of the intermediate imports channel in international trade for worker outcomes.

There is evidence that some sectors began to reorganise their supply chains away from EU countries pre-TCA. Among these were agriculture, fish products, and the automotive industry. These sectors may have anticipated high barriers to trade in the imported inputs regardless of the outcome of the Brexit negotiations.

In other sectors, such as vegetable and animal oils and fats, the divergence between imports from the EU and non-EU for key inputs only occurred post-TCA.

Some sectors experienced a clear rise in imports from non-EU countries of their inputs to production, suggesting that their supply chains adjusted. These included agriculture, fish industry, animal and vegetable oils, and the automotive industry. It is noteworthy that if firms initially chose to source their inputs from the EU, then it is likely to have been their most efficient option, so this reallocation is likely to represent a fall in efficiency. It would also have been possible that imports from the EU fell with no obvious rise in imports from outside the EU — for example if producers switched to domestically sourced inputs, changed their production techniques, or reduced the overall scale of their operations. We do not see clear evidence of this at the broad industry level examined in this report.

There is evidence of stockpiling of imported intermediate products pre-TCA for some sectors such as agriculture, fish industry, pharmaceuticals, and the automotive industry. Industries that were able to stockpile their inputs may have been able to ease the initial frictions of the TCA entering into force.

We illustrate the changes by focusing on six case studies of production sectors which have sizeable adjustment patterns that are representative of trends observed in many other products. These are agricultural products, fish, two manufactured food products (oils and fats and animal feeds), pharmaceuticals, and motor vehicles. Each sector has a different structure of imported inputs used in its production, and each of these imported inputs has a different trend, explaining the patterns observed in the supply chains.

2.2 AGRICULTURAL PRODUCTS

Given promises of a 'Green Brexit', the agricultural sector played an import role in the negotiations between the UK and the EU.

Table 2.1 shows the imported inputs for the agricultural sector in order of monetary value. Products that are more important to the sector will have greater weight in measuring the exposure of the agriculture supply chain to post-TCA import changes. It also gives the percentage change in imports from the EU relative to from non-EU countries post-TCA relative to before the TCA. This is defined as the average difference between UK imports from the EU and non-EU post-TCA less the average difference between the EU and non-EU before the TCA.

Agricultural products themselves top the list and account for 4.15% of total production costs, where production costs include all imported inputs, domestic inputs, and labour costs. The difference between UK imports from the EU and

non-EU post-TCA was 9% lower than the difference between them before the TCA. The second input — coke and refined petroleum — had an imported input share of 3.13% and an average EU versus non-EU change of -13%. Although the input share of prepared animal feeds was smaller at 1.40%, it had a relatively large divergence between imports from the EU and non-EU post-TCA of -44%, meaning that it contributed significantly to the relative fall in imports from the EU in the agricultural sector.

Table 2.1: Imports of all key inputs to the agricultural sector fell by more in the EU than the non-EU after the TCA implementation relative to before

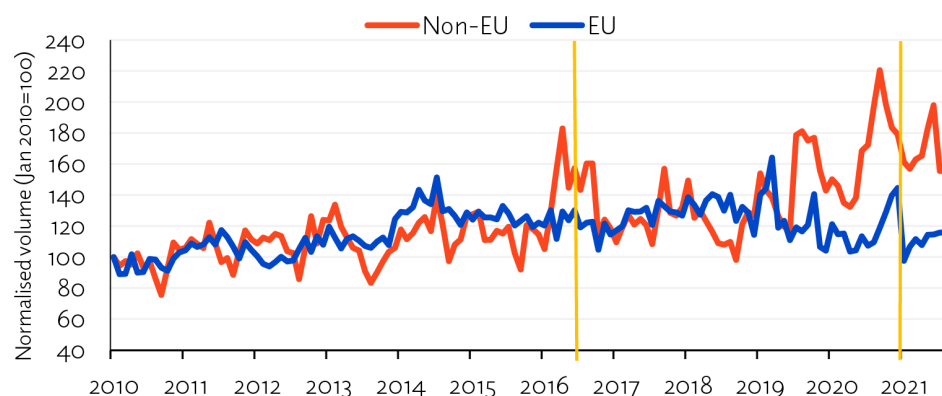| Rank	Input Product	Imported Input Share	Relative % Change (EU vs non-EU & pre-TCA vs post-TCA)
1	Products of agriculture, hunting and related services	4.15%	-9%
2	Coke and refined petroleum products	3.13%	-13%
3	Dyestuffs, agrichemicals	1.48%	-11%
4	Prepared animal feeds	1.40%	-44%
5	Basic pharmaceutical products and pharmaceutical preparations	1.27%	-14%
6	Industrial gases, inorganics and fertilisers (all inorganic chemicals)	0.81%	-17%
7	Other basic metals and casting	0.53%	-21%
8	Other manufactured goods	0.45%	-5%
9	Financial services, except insurance and pension funding	0.39%	N/A
10	Land transport services and transport services via pipelines, excluding rail transport	0.35%	N/A

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. The imported input share is the value of imported inputs of each product in the total production costs (imported inputs plus domestic inputs plus labour costs) for production of products of agriculture, hunting, and related services. The percentage change of imports from the EU versus non-EU after the TCA implementation relative to this same difference before the TCA. Note that we do not have data to estimate the change in services trade after Brexit so these are implicitly assumed to be unchanged.

Imports of products used in the agricultural sector from the EU began to fall relative to imports from non-EU countries pre-TCA. This divergence has not reversed since, as shown in Figure 2.1.

Additional Brexit controls are expected on meat and dairy products coming in to the UK from July 1st 2022. Industry leaders are concerned that this will yet lead to further delays at the border and complicate imports from EU partners.

Figure 2.1: Imported inputs for agricultural production from non-EU countries began to rise in 2019

Imports from the EU and non-EU of products used in production of agricultural products.

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. Data weighted by their imported input share of total production costs in 2015. The plots are seasonally adjusted and normalied to 100 in January 2010.

2.3 FISH-RELATED PRODUCTS

Tables 2.2 and 2.3 for fish-related products follows the same structure as for agriculture. Unsurprisingly, the most important input is fish — a product which experienced a large fall in imports from the EU relative to non-EU post-TCA of 30%. The remaining imported intermediate inputs used for fresh fish products, and those used for preserved fish products, are quite different, explaining why the import patterns of their supply chains look somewhat different. The second most imported input for fish products is petroleum products, whereas the second most important input for preserved fish is agricultural products.

Table 2.2: The most important input to production for domestic UK fresh fish production is imported fish

Rank	Input Product	Imported Input Share	Relative % Change (EU vs non-EU & pre-TCA vs post-TCA)
1	Fish and other fishing products, aquaculture products, support services to fishing	5.63%	-30%
2	Coke and refined petroleum products	4.68%	-13%
3	Computer, electronic, and optical products	0.81%	-28%
4	Prepared animal feeds	0.75%	-44%
5	Water transport services	0.75%	
6	Rubber and plastic products	0.75%	-19%
7	Textiles	0.41%	-18%
8	Other manufactured goods	0.34%	-5%

9	Waste collection, treatment and disposal services; materials recovery services	0.34%	3%
10	Machinery and equipment n.e.c.*	0.27%	2%

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. The imported input share is the value of imported inputs of each product in the total production costs (imported inputs plus domestic inputs plus labour costs) for production of fish and other fishing products. The percent change of imports from the EU versus non-EU after the TCA implementation relative to this same difference before the TCA. Note that we do not have data to estimate the change in services trade after Brexit so these are implicitly assumed to be unchanged.

*Not elsewhere classified

Table 2.3: UK imports of fish from the EU relative to non-EU fell after the TCA implementation relative to before, affecting the manufactured fish product supply chain for processed and preserved fish products

Rank	Input Product	Imported Input Share	Relative % Change (EU vs non-EU & pre-TCA vs post-TCA)
1	Fish and other fishing products, aquaculture products, support services to fishing	2.76%	–30%
2	Products of agriculture, hunting, and related services	1.10%	–9%
3	Rubber and plastic products	0.60%	–19%
4	Vegetable and animal oils and fats	0.57%	–59%
5	Paper and paper products	0.47%	–9%
6	Processed and preserved fish, crustaceans, molluscs, fruit and vegetables	0.37%	–17%
7	Other food products	0.33%	–29%
8	Machinery and equipment n.e.c.*	0.28%	2%
9	Land transport services and transport services via pipelines, excluding rail transport	0.25%	N/A
10	Basic pharmaceutical products and pharmaceutical preparations	0.23%	–14%

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. The imported input share is the value of imported inputs of each product in the total production costs (imported inputs plus domestic inputs plus labour costs) for production of processed and preserved fish and seafood. The percent change of imports from the EU versus non-EU after the TCA implementation relative to this same difference before the TCA. Note that we do not have data to estimate the change in services trade after Brexit so these are implicitly assumed to be unchanged.

*Not elsewhere classified

The industry producing fish-related products — which includes fish and other seafood, both fresh and preserved — has seen a huge divergence in their key imports between the EU and non-EU. For fresh fish, this divergence emerged pre-TCA and was exaggerated post-TCA (Figure 2.2). For preserved fish, the divergence began post-referendum and again became more pronounced post-TCA (Figure 2.3).

Figure 2.2: UK imports of intermediate inputs used in fish production switched from EU to non-EU countries

Imports from the EU and non-EU of products used in production of fish and other fishing products.
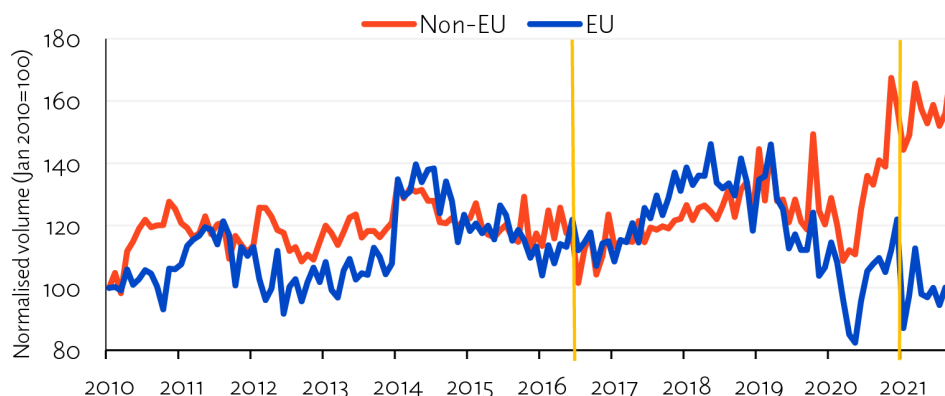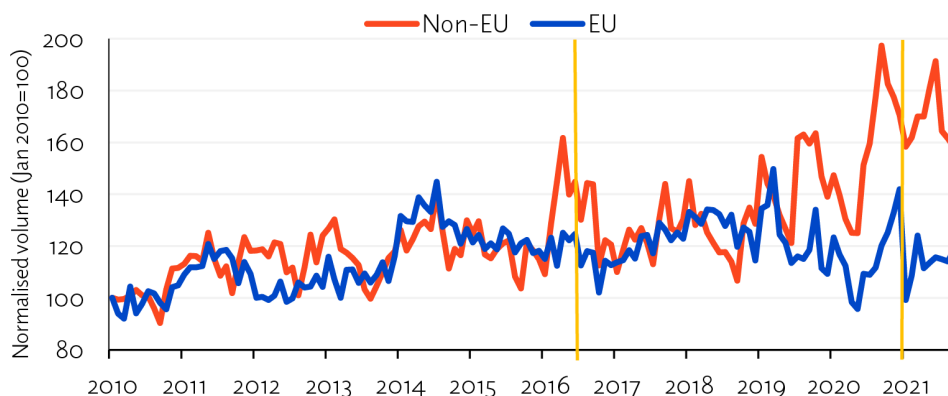

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. Data weighted by their imported input share of total production costs in 2015. The plots are seasonally adjusted and normalied to 100 in January 2010.

Figure 2.3: A large gap between imports from the EU and non-EU has emerged for inputs to preserved fish

Imports from the EU and non-EU of products used in production of processed and preserved fish and seafood.

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. Data weighted by their imported input share of total production costs in 2015. The plots are seasonally adjusted and normalied to 100 in January 2010.

2.4 VEGETABLE AND ANIMAL OILS AND FATS

Imports of vegetable and animal oils and fats themselves, which is by far the most imported input to the sector, accounts for 26.4% of total production costs and drives trends in this sector. Imports from the EU fell by 59% compared to imports from non-EU countries and post-TCA relative to before the TCA.

Table 2.4: A quarter of total production costs in the sector are from imported vegetable and animal oils and fats for which EU imports fell sharply after the TCA relative to non-EU imports

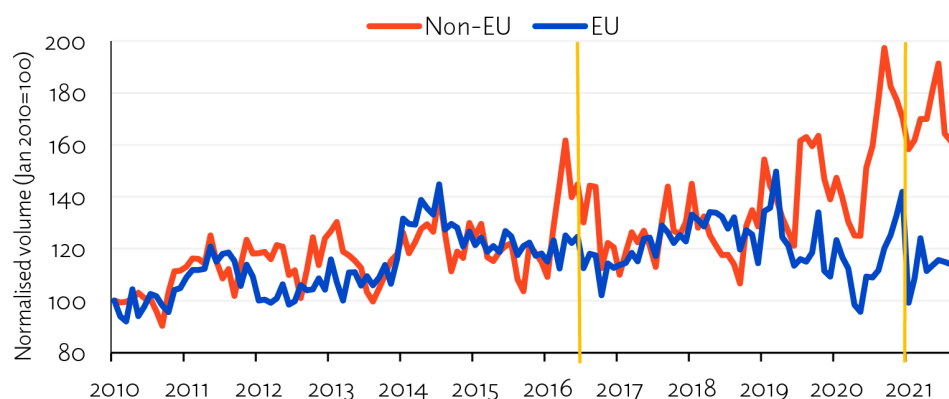| Rank	Input Product	Imported Input Share	Relative % Change (EU vs non-EU & pre-TCA vs post-TCA)
1	Vegetable and animal oils and fats	26.35%	-59%
2	Products of agriculture, hunting, and related services	1.50%	-9%
3	Rubber and plastic products	0.81%	-19%
4	Grain mill products, starches and starch products	0.78%	-36%
5	Paper and paper products	0.77%	-9%
6	Basic pharmaceutical products and pharmaceutical preparations	0.71%	-14%
7	Coke and refined petroleum products	0.57%	-13%
8	Preserved meat and meat products	0.57%	-36%
9	Machinery and equipment n.e.c.*	0.46%	2%
10	Dairy products	0.37%	-39%

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. The imported input share is the value of imported inputs of each product in the total production costs (imported inputs plus domestic inputs plus labour costs) for production of vegetable and animal oils and fats. The percent change of imports from the EU versus non-EU after the TCA implementation relative to this same difference before the TCA. Note that we do not have data to estimate the change in services trade after Brexit so these are implicitly assumed to be unchanged.

*Not elsewhere classified

The supply chain of vegetable oils and animal fats saw a notable fall in imports from the EU relative to from non-EU countries post-TCA. There was a sharp relative fall in imports of input products to the sector from the EU post-TCA, which coincided with a relative rise in imports from non-EU countries, suggesting that supply chains may have been diverted to outside the EU.

Figure 2.4: Imports from the EU of inputs to vegetable and animal oils and fats decline in 2021 relative to non-EU imports

Imports from the EU and non-EU of products used in production of vegetable and animal oils and fats.

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. Data weighted by their imported input share of total production costs in 2015. The plots are seasonally adjusted and normalied to 100 in January 2010.

2.5 PREPARED ANIMAL FEEDS

The production of animal feeds uses a variety of imported inputs. The most important imported input to the sector is pharmaceuticals, which account for 10.5% of total production costs. Vegetable and animal oils and fats, chemical products, prepared animal feeds, and grain-mill products all account for smaller shares of production but saw large relative falls in imports from the EU versus non-EU post-TCA compared to before.

Table 2.5: The largest imported input for prepared animal feeds is pharmaceuticals

Rank	Input Product	Imported Input Share	Relative % Change (EU vs non-EU & pre-TCA vs post-TCA)
1	Basic pharmaceutical products and pharmaceutical preparations	10.49%	-14%
2	Vegetable and animal oils and fats	3.30%	-59%
3	Processed and preserved fish, crustaceans, molluscs, fruit and vegetables	1.98%	-17%
4	Other chemical products	1.83%	-72%
5	Products of agriculture, hunting and related services	1.53%	-9%
6	Prepared animal feeds	1.04%	-44%
7	Grain mill products, starches and starch products	0.94%	-36%
8	Alcoholic beverages & Tobacco products	0.79%	-7%

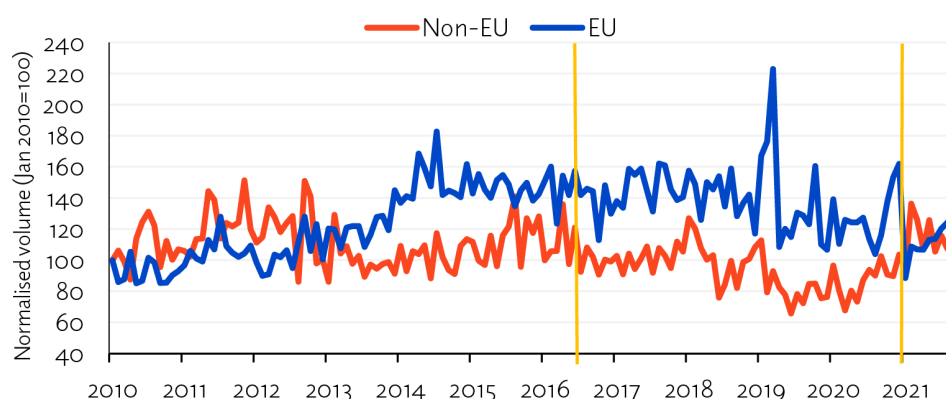| 9	Other food products	0.75%	−29%
10	Rubber and plastic products	0.46%	−19%

Notes: Authors' calculations using data from UN Comtrade and ONS Input–Output tables. The imported input share is the value of imported inputs of each product in the total production costs (imported inputs plus domestic inputs plus labour costs) for production of prepared animal feeds. The percent change of imports from the EU versus non-EU after the TCA implementation relative to this same difference before the TCA. Note that we do not have data to estimate the change in services trade after Brexit so these are implicitly assumed to be unchanged.

Before the implementation of the TCA, imports of these intermediate products from non-EU countries began to rise, whereas imports from the EU remained quite stable until just before its implementation when there is clear evidence of stockpiling. Post-TCA, the diversion of imports from EU to non-EU of inputs to the sector has continued (see Figure 2.5).

Figure 2.5: Imports of inputs for prepared animal feeds from non-EU countries have risen

Imports from the EU and non-EU of products used in production of prepared animal feeds.

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. Data weighted by their imported input share of total production costs in 2015. The plots are seasonally adjusted and normalied to 100 in January 2010.

2.6 BASIC PHARMACEUTICAL PRODUCTS

Pharmaceuticals require large amounts of imported intermediate pharmaceutical products, accounting for 30.7% of all production costs (see Table 2.6). Changes in imports of all intermediate inputs in the pharmaceuticals sector suggest clear evidence of stockpiling from the EU pre-TCA (see Figure 2.6). There is some evidence of the supply chain diverting from EU to non-EU countries.

Table 2.6: Imported pharmaceuticals account for nearly a third of total production costs for UK pharmaceutical production
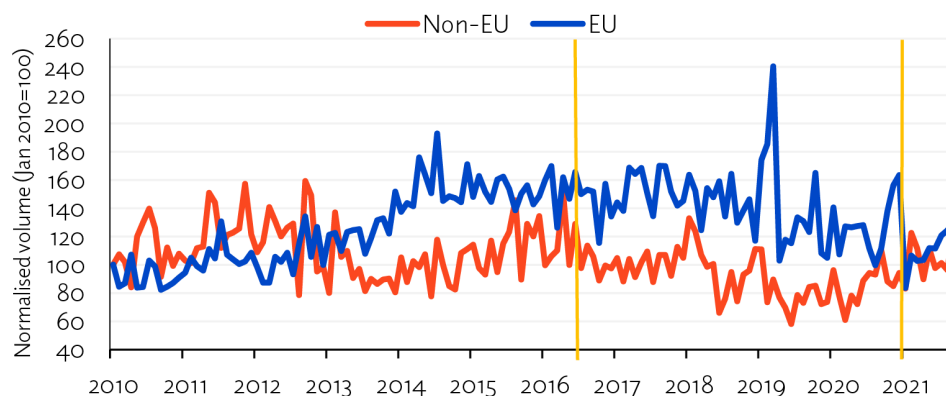
Rank	Input Product	Imported Input Share	Relative % Change (EU vs non-EU & pre-TCA vs post-TCA)
1	Basic pharmaceutical products and pharmaceutical preparations	30.68%	-14%
2	Petrochemicals	1.32%	4%
3	Rubber and plastic products	0.71%	-19%
4	Financial services, except insurance and pension funding	0.49%	N/A
5	Industrial gases, inorganics and fertilisers (all inorganic chemicals)	0.49%	-17%
6	Computer, electronic and optical products	0.37%	-28%
7	Land transport services and transport services via pipelines, excluding rail transport	0.35%	N/A
8	Office administrative, office support and other business support services	0.30%	N/A
9	Other basic metals and casting	0.29%	-21%
10	Paper and paper products	0.28%	-9%

Notes: Authors' calculations using date from UN Comtrade and ONS Input–Output tables. The imported input share is the value of imported inputs of each product in the total production costs (imported inputs plus domestic inputs plus labour costs) for production of basic pharmaceutical products and pharmaceutical preparations. The percentage change of imports from the EU versus non-EU after the TCA implementation relative to this same difference before the TCA. Note that we do not have data to estimate the change in services trade after Brexit so these are implicitly assumed to be unchanged.

Figure 2.6: Imports of inputs to pharmaceuticals have risen from non-EU countries

UK IN A
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EUROPE

Imports from the EU and non-EU of products used in production of pharmaceuticals

Notes: Authors' calculations using data from UN Comtrade and ONS Input-Output tables. Data weighted by their imported input share of total production costs in 2015. The plots are seasonally adjusted and normalied to 100 in January 2010.

2.7 AUTOMOTIVE PRODUCTS

Table 2.7 shows the most important imported inputs into the automotive sector. On number one are direct imports of motor vehicles, trailers, and semi-trailers. As illustrated in column 4, EU imports for these products seem to have been substituted by non-EU imports after the implementation of the TCA. The average difference between UK imports for motor vehicles, trailers, and semi-trailers from the EU vs non-EU pre-TCA vs post-TCA decreased by 34%.

The import of products in the supply chain of the automotive sector had begun to decline from the EU relative to non-EU countries during the transition period (Figure 2.7). Clearly, the Covid-19 pandemic and consequent lockdowns had a major impact on imports for the sector and, following this, we see evidence of stockpiling pre-TCA. Post-TCA, the gap between imports of intermediate products from the EU and non-EU has continued to widen, suggesting that automotive supply chains have been disrupted by Brexit.

Table 2.7: Imports of intermediate inputs to the automotive sector fell substantially from the EU relative to non-EU after the TCA
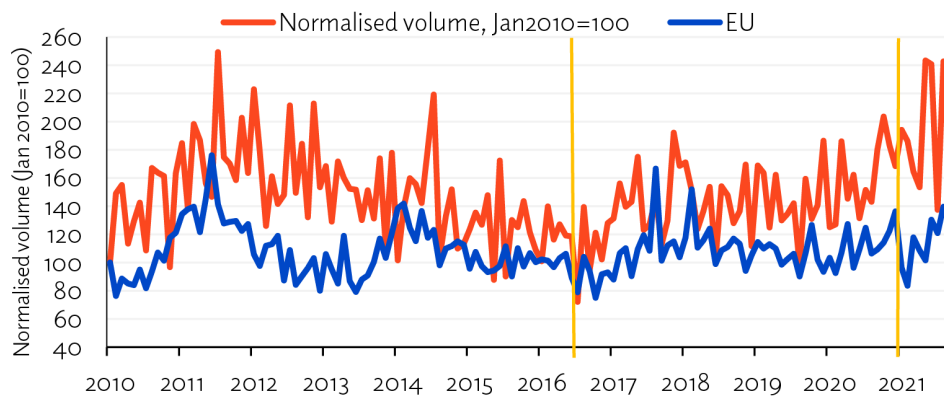
Rank	Input Product	Imported Input Share	Relative % Change (EU vs non-EU & pre-TCA vs post-TCA)
1	Motor vehicles, trailers and semi-trailers	19.21%	–34%
2	Machinery and equipment n.e.c.*	3.39%	2%
3	Other basic metals and casting	2.70%	–21%
4	Electrical equipment	2.11%	0%
5	Fabricated metal products, excl. machinery, equipment, and weapons and ammunition	2.03%	–5%
6	Rubber and plastic products	1.88%	–19%
7	Computer, electronic, and optical products	1.78%	–28%
8	Petrochemicals	1.39%	4%
9	Basic iron and steel	1.22%	4%
10	Other manufactured goods	0.73%	–5%

Notes: Authors' calculations using date from UN Comtrade and ONS Input–Output tables. The imported input share is the value of imported inputs of each product in the total production costs (imported inputs plus domestic inputs plus labour costs) for production of motor vehicles, trailers and semi-trailers. The percentage change of imports from the EU versus non-EU after the TCA implementation relative to this same difference before the TCA. Note that we do not have data to estimate the change in services trade after Brexit so these are implicitly assumed to be unchanged.

*Not elsewhere classified

Figure 2.7: There has been a clear shift in the origin of imports for manufacturing inputs to the automotive sector

Imports from the EU and non-EU of products used in production of motor vehicles, trailers and semi-trailers

Notes: *Authors' calculations using data from UN Comtrade and ONS Input-Output tables. Data weighted by their imported input share of total production costs in 2015. The plots are seasonally adjusted and normalied to 100 in January 2010.*

3. THE IMPACT OF BREXIT ON CONSUMER PRICES

3.1 INTRODUCTION

The UK is experiencing the largest increase in the cost of living for a generation. In February 2022, the yearly CPI inflation rate stood at 6.2%. There are a number of factors contributing to this including increases in global energy prices, staff shortages, and increases in consumer demand following the lifting of Covid restrictions. A possible factor unique to the UK is the increase in trade barriers with the EU, its biggest trading partner.

This section presents evidence that Brexit has led to increases in food prices. In particular, we show that products more reliant on imports from the EU saw larger increases in prices than those less reliant on the EU both immediately after the 2019 election and the implementation of the TCA. We use a "differences in differences" technique to calculate the relationship between EU import penetration and price increases and apply the resulting estimates to calculate the overall impact of Brexit on food prices. Our estimates suggest that, over the two years to the end of 2021, Brexit increased food prices by approximately 6% overall. Products with high EU import shares such as fresh pork, tomatoes, and jams were more affected than those with low EU import shares such as tuna and exotic fruits like pineapple.

To identify these impacts, we use the share of imports that came from the EU for each product before the Brexit referendum. We then show that products with higher initial shares — as a measure of their reliance on the EU — increased in price by more than those for which reliance on imports from the EU was lower. Note that we do not use the contemporaneous value or quantity of imports as changes in these are related to consumer prices for other reasons than Brexit (econometrically speaking, it is an endogenous variable).

The timing of the most notable price rise for EU-exposed products coincides with the implementation of the TCA. However, there is also evidence of anticipation effects that occur in late 2019, after the UK election in December 2019 and the ratification of the Withdrawal Agreement in January 2020, events that implied that Brexit was indeed certain and increased the likelihood of a hard Brexit with stricter trading relationships.

The observation that these price changes for products more reliant on the EU occur exactly in line with Brexit events suggests that Brexit is indeed the cause

of the price increases for food products. Notably, there is no observable correlation with events relating to the Covid-19 pandemic, and we control for economy-wide macro-impacts such as national lockdowns.

Although we see a strong impact of Brexit on food prices, we do not detect impacts when examining all products together. Impacts are likely more visible on food prices given the nature of the products. In particular, food products tend to be more perishable, so they are more vulnerable to border delays such as those experienced since the implementation of the TCA at the UK border. Furthermore, food products are close to being finished products in the sense that they do not require many intermediate inputs or labour costs, which could make it more difficult to detect a price effect from Brexit. Furthermore, they are among the most exposed product categories to Brexit-related non-tariff trade barriers such as SPS measures.

The reason for these price increases is straightforward: additional barriers at the border such as checks, increased waiting times, and additional paperwork are costly for producers. Firms could change the partner countries from which they are importing, or purchase domestically, but assuming they were operating in the most efficient manner initially, any change is going to incur extra costs. These costs may then be passed on to consumers, increasing consumer prices.

Given differences in production there would undoubtedly be heterogeneity in price increases across products. The factors which determine the consumer price exposure of a product to Brexit are the reliance on imports from the EU, the amount of domestic labour and value added, and the degree to which trade barriers increase for that specific product. Goods which are close to finished when imported, such as fresh foods that only require domestic packaging and transportation, will be far more exposed than products reliant on imports from the EU for a relatively small intermediate input.

3.2 DATA AND METHOD

To examine the impact of Brexit on consumer prices we combine the UN Comtrade dataset with ONS micro-data on prices — the same data that underpins the CPI index — and exploit a novel match of the two datasets.

The Comtrade data contains country-by-country trade flows measured in values ($) and quantities (kg) at the monthly level for highly granular product categories as precise as 'Honey; natural' and 'Margarine; excluding liquid margarine'. This allows us to construct exposure measures to Brexit for specific items by calculating the EU import share of each product.

Each month the ONS collects approximately 100,000 price observations for 1,300 items, which are then used to calculate the inflation rate. These

observations are all included in the ONS price dataset, and can be matched to the Comtrade data based on the item descriptions. This gives us a dataset that maps trade and import exposure to consumer prices.

To estimate the impact of Brexit on prices, we examine the relationship between price changes of goods and EU import exposure, while controlling for aggregate shocks that affect the economy each month. In essence, we exploit the fact that some products were more exposed to Brexit than others before the referendum because they were more reliant on trade with the EU and consider how this difference is related to changes in prices over time. We carry out this exercise both for food products — which are generally perishable, have fewer domestic inputs and were more exposed to Brexit-related trade barriers — and for all products.

Our main estimating equation is:

Equation 1

$$
\begin{aligned}
log\big(Price_{pt}\big) = \ &\beta_1 log\left(\frac{EU\ Imports_{p,2015}}{Total\ Imports_{p,2015}}\right) \times Post_{Election,t} \\
&+ \beta_2 log\left(\frac{EU\ Imports_{p,2015}}{Total\ Imports_{p,2015}}\right) \times Post_{TCA,t} + \gamma_p + \lambda_t + \epsilon_{pt}
\end{aligned}
$$

Where subscript p refers to a product category, subscript t to a year-month, $Post_{Election,t}$ is an indicator variable which equals 1 for year-months after December 2019 and before January 2021 and 0 otherwise, $Post_{TCA,t}$ is an indicator variable which equals 1 for year-month including and after January 2021 and 0 otherwise, γ_p are product fixed effects and λ_t are time fixed effects.

This estimator is akin to a continuous treatment difference-in-difference estimator, where the treatment variable is the pre-referendum level of exposure to imports from the EU for a product, and where we split treatment times into two separate periods — after the 2019 election and after the introduction of the TCA.

As this estimator controls for economy-wide changes in prices through the time fixed effects, we control for macro-level shocks, such as the impact of Covid-19. We additionally run a version of specification (Equation 1) where we control for product-month fixed effects (i.e., γ_{pm}) to ensure that seasonal price effects of products (particularly fresh foods) are not biasing our results.

The estimator is unable to control for product specific differences in time trends and therefore relies on the key assumption of parallel time trends. This means it assumes that, in the absence of Brexit, prices for products with higher EU import share exposure would have changed in a similar fashion to those with a lower EU

import share. To test this assumption, we perform the event study equivalent to Equation 1, which allows us to check whether there are any differences in the time trends of products more and less exposed to Brexit before the key events we have highlighted. The estimating equation for this is:

Equation 2

$$log(Price_{pt}) = \sum_{k \neq May,2016} \beta_3^k \, log\left(\frac{EU\;Imports_{p,2015}}{Total\;Imports_{p,2015}}\right) \times \mathbb{I}[t = k] + \gamma_p + \lambda_t + \epsilon_{pt}$$

Where the estimates of β_3^k represent the differences at time k by import exposure, relative to the month before the Brexit referendum. For graphical representation we then aggregate monthly estimated impacts k to quarters q according to:

Equation 3

$$\hat{\beta}_3^q = \sum_{k \in q} \frac{1}{3} \hat{\beta}_3^k$$

3.3 RESULTS

Table 3.1 shows the results for Equation 1 estimated on food products in our matched dataset. Column 1 reports the main specification and column 2 controlling for product specific seasonal effects. Both sets of estimates point to a sizeable impact of the two Brexit events on consumer food prices, and that this effect grows over the two periods.

Equation 1 uses a log-log specification. Therefore, the interpretation of the point estimates is that a doubling of the EU import share is associated with a 3.7% increase in consumer prices following the December 2019 election and a 6% increase following the introduction of the TCA. To put this into more transparent terms, as the mean EU import share for food products is 0.75, a back-of-the-envelope calculation implies that a product with full EU import exposure (i.e., all imports for that food product came from the EU) would experience 4.9% faster inflation in 2020 and 8.1% faster inflation over 2020 and 2021 in comparison to a product with no EU import exposure. Given the average food product has an import share of 0.75, this implies Brexit increased average food prices by approximately 3% per year in 2020 and 2021.

Table 3.1 — Impacts of Brexit on Food Prices: Estimates of a difference-in-difference specification

	(1) Log Prices	(2) Log Prices
Log (EU Imports$_{2015}$ / Total Imports$_{2015}$) x Post$_{Election}$	0.0368** (0.0171)	0.0364** (0.0172)
Log (EU Imports$_{2015}$ / Total Imports$_{2015}$) x Post$_{TCA}$	0.0607*** (0.0208)	0.0617*** (0.0211)
Observations	9,036	9,036
Year-Month FE	Yes	Yes
Product FE	Yes	
Product-Month FE		Yes

The table presents estimates of β_1 and β_2 from Equation 1 using a sample of food products. The base period is 2010 to November 2019. EU imports is imports from the EU. Standard errors clustered at the product level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 3.1 shows the results from the main exercise for food products. It shows that in all quarters leading up to the Brexit referendum and in almost all leading up to the 2019 election there was no (statistically significant) difference in price changes between products that were more and less exposed to imports from the EU. These results are reassuring as it demonstrates the parallel-trends assumption is not violated during the "before" periods.

Following the December 2019 election, prices rose for those goods more reliant on imports from the EU. These initial effects are not statistically significant when looking at quarterly effects, however they are significant to a 5% level when aggregating across all four quarters as shown in the results in Table 3.1. Post-TCA this increase in prices became considerably more pronounced and statistically significant even in the individual quarters. When aggregated together they become significant to a 1% level as shown in Table 3.1. The 95% confidence interval for the full two-year effects is 2-10.1%.

The first of these events occurred before the pandemic affected mainland Europe and the UK, and the timing of the second event aligns perfectly with the sharp statistically significant increase in prices. Although the introduction of the TCA coincides with the third national UK lockdown, we find no relationship between the exposure-induced price changes with the timing of the other two lockdowns, nor with the easing of restrictions from the third. Additionally, we see no impacts around the time of the Brexit referendum and the depreciation of sterling. Given that sterling depreciated against all currencies, this is unsurprising as an aggregate effect like this would most likely be controlled for by the time fixed effects.

Figure 3.1: Impacts of Brexit on food prices over time: event study estimates

Event study estimates of effect of log import shares on log prices, by quarter relative to Brexit. Estimate plus upper and lower confidence intervals.
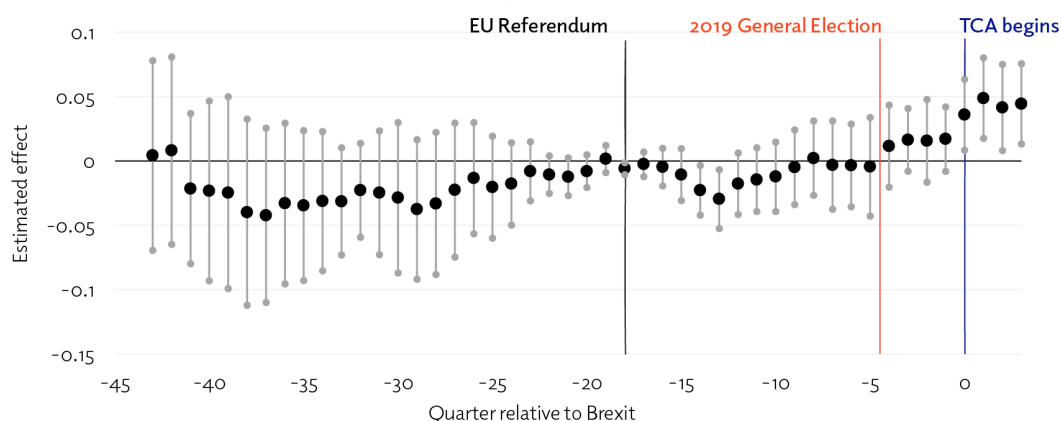
Notes: The figure presents estimates on the relationship between EU import exposure and food prices over time relative to Brexit. Black dots are the estimates of $\hat{\beta}_3^q$ from Equation 3 and grey dots represent 95% confidence intervals.

Table 3.2 and Figure 3.2 present the counterpart estimates using the full sample of products. We find no obvious impact of Brexit across all products. It is unsurprising that there is heterogeneity across product categories, and this is related to the nature of the products and their market structure.

## Table 3.2 — Impacts of Brexit on prices of all products: Difference-in-difference estimates

	(1) Log Prices	(2) Log Prices
Log (EU Imports$_{2015}$ / Total Imports$_{2015}$) x Post$_{Election}$	–0.00631 (0.0164)	–0.00615 (0.0165)
Log (EU Imports$_{2015}$ / Total Imports$_{2015}$) x Post$_{Brexit}$	–0.00877 (0.0187)	–0.00876 (0.0188)
Observations	26,304	26,296
Year-Month FE	Yes	Yes
Product FE	Yes	
Product-Month FE		Yes

The table presents estimates of β_1 and β_2 from Equation 1 using a sample of all products. EU imports is imports from the EU. Standard errors clustered at the product level are reported in parentheses.

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

Figure 3.2: Impacts of Brexit on prices of all products over time: event study estimates

Event study estimates of effect of log import shares on log prices, by quarter relative to Brexit. Estimate plus upper and lower confidence intervals.
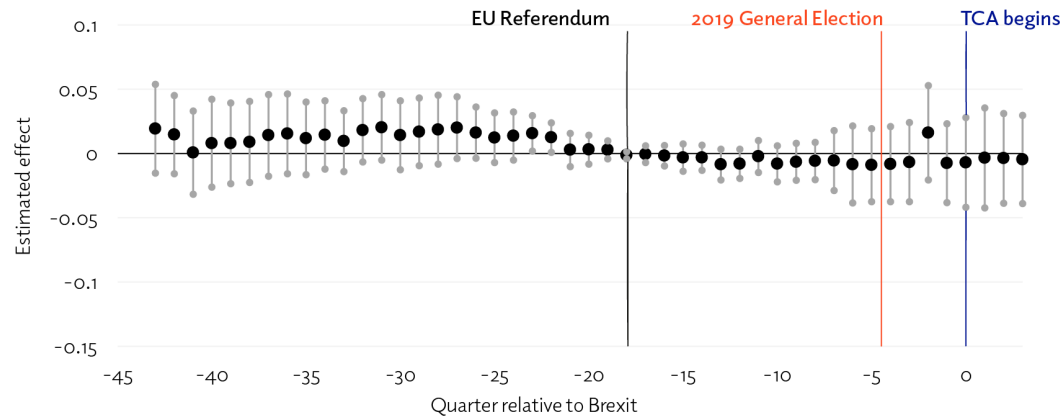
Notes: The figure presents estimates on the relationship between EU import exposure and prices of all products over time relative to Brexit. Black dots are the estimates of $\hat{\beta}_3^q$ from Equation 3 and grey dots represent 95% confidence intervals.

TECHNICAL APPENDIX

We are interested in how imports have changed for the intermediate products used in production for each UK sector. Therefore, we combine data on importing, as used in Section 1, with information on the use of inputs and imports of each input product in each output product from the Office for National Statistics (ONS) input-output (IO) tables. The import share of each input good in the total production costs of each output product can then be used as exposure weights to changes in imports following the TCA implementation. Data on international trade in each section is from Comtrade, and is aggregated to the level of ONS IO table products.

The estimated level of total imported inputs for production product i at time t is:

Equation A

$$TotalImportedInputs_{it}^c = \sum_j \frac{Imports_{ji,2015}}{ProductionCosts_{i,2015}} \times Imports_{jt}^c$$

where j denotes each input product. The equation can be computed for the EU and the non-EU, denoted by c. The first term on the right-hand side gives the importance of imports of input j into output-product i using data from the ONS IO tables. The numerator is the value of imports of product j that go into production of i, whereas the denominator is the total production costs of industry i, defined as total imported inputs plus total domestic inputs, both of which include capital investments, plus wage costs. These are held fixed to 2015 so that any changes over time are entirely driven by changes in national-level imports — the second term on the right-hand side — which can be split out by EU and non-EU. We then normalise each series, for EU and non-EU, to 100 in the first period.

We calculate the industry-level import shares as follows. First, in the ONS IO tables, we only observe the total amount of imports of j that go into i and cannot disaggregate this according to whether the inputs are imported from the EU or non-EU. We therefore have to assume that exposure to future changes in imports from the EU and from outside the EU depend only on total imports of each product into a sector. Second, we make a proportionality assumption on attributing national level changes in imports to subnational industries. That is, that industries' imports respond proportionally to their initial shares.

Changes in total imported inputs are determined by the product of two factors: the importance of imports for each product in production and changes in imports.

To determine the differences between imports from the EU and non-EU after the implementation of the TCA, we can compute Equation A for both imports from the EU and non-EU separately.

We provide a table of the top ten imported input products for each output industry. For each of the input products, we report the share of the imported input value in total production costs, exactly as reported in Equation A. To give an estimate of the extent of divergence between imports from the EU and non-EU after the TCA relative to before, we estimate a difference-in-difference regression for each product j, defined as:

$$Log\ (Imports_{ct}) = \beta\ Post_t \times EU_c + \alpha\ Post_t + \gamma\ EU_c + \epsilon_{ct}$$

where c denotes the country group, EU or non-EU, and t is the year-month. $Post_t$ is a dummy variable that equals 1 for all periods after and including January 2021 and 0 otherwise. EU_c is a dummy variable that equals 1 for imports from the EU and 0 for imports from non-EU. Therefore, the estimated coefficient β estimates the average difference between imports from the EU and non-EU after the TCA implementation relative to before.

Note that this captures averages over the full period after the TCA versus the full period before. In some sectors, there was a divergence whereby imports from the EU fell relative to imports from non-EU countries before the TCA entered into effect. In these cases, the estimated β coefficient will be smaller in magnitude than if we had, for example, defined the pre-period as before the Brexit referendum.

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T 020 7848 2630

E info@UKandEU.ac.uk

UKinaChangingEurope

@UKandEU

www.UKandEU.ac.uk