THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

Vulnerabilities of Supply Chains Post-Brexit

Report

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Preamble

Arla Foods UK has commissioned LSE Consulting's Trade Policy Hub to deliver a study on the vulnerabilities of the United Kingdom and European Union food industry supply chains after the end of the transition period on 31st December 2020.

This study provides a follow up to the report LSE Consulting delivered in July 2018 on the impact of Brexit on the dairy sector in the UK. The aim of that project was to conduct a critical analysis of the "realistic" scenario for Brexit and to consider the wider implications for product costs and availability in the dairy sector.

This report takes a broader look at the food and beverage sector rather than dairy specifically and considers a wider range of potential disruptions and mitigation measures in no deal and FTA scenarios.

Arla Foods UK has been an active contributor to policy discussions surrounding the potential impact brought about by UK's decision to withdraw from the European Union as well as the effect that Covid-19 has had on the food sector. Earlier this year, it commissioned research on "How to best protect shoppers during the Brexit transition". This report highlighted a few crucial points on what shoppers in the UK value most and the divergence between consumer expectations and the potential disruptions at the end of the transition period.

Our report shows that consumers in the UK are highly dependent on products originating in the EU where 40 percent of all consumption of food products in the UK comes from EU countries, suggesting that UK consumers are highly exposed to changes in the future trading relationship. We also expect that consumers in the EU may also notice increased prices and reduced availability of products from the UK, especially for products for which the UK is an important producer.

In order to be able to properly assess the consequences of higher trade barriers from Brexit on food products, we first document the linkages between the UK and the EU on the aggregate level before zooming into specific products and countries that are particularly vulnerable or important. To this end, we combine quantitative analysis of trade flows between the UK and the EU and forecast tariff and non-tariff measures in the two scenarios with qualitative assessment of the effects on the food and beverage labour market, and disruptions across four dimensions: price and availability of products; quality and food standards; local production; and other disruptions. The latter relies on literature review of existing studies and semi-structured interviews with stakeholders in the UK and the EU.

Our work shows that the food and beverage sector will be one of the worst affected by additional trade barriers and tariffs. Disruptions across the supply chains will be particularly severe in a no deal Brexit scenario due to high tariff rates. The effects are particularly striking vis-à-vis trade flows: both scenarios will result in reduced product availability of EU products, reduced traded volumes across the UK and the EU, and higher prices for all types of products (branded, unbranded, and specialty). The study also highlights the difference between the short-term impacts which operators (farmers, importers, logistic companies) are already risk managing as best as they can but there are no perfect solutions; versus long term effects which will alter substantially trade flows and supply chains. In both scenarios issue will remain, and there will be challenges with dealing with non-tariff barriers, customs, and system preparedness in any event.

As we look ahead to the end of the transition period, it is clear that a Free Trade Agreement (FTA) will go a long way to minimise disruption and the impact in the food sector and on consumers. However, even in the case of an FTA, significant barriers to trade will be imposed through non-tariff barriers which will still negatively affect the sector. But our report also shows that there are urgent and specific actions that both the UK and the EU need to take to ensure the industry is supported in the short and longer term.

1. Executive Summary

The Food supply chain in the UK and the EU

- Supply chains between the UK and the EU are closely interlinked with intermediary and final products and inputs, relying on tariff-free, barrier-free flow between the two parties.
- No deal Brexit will cause disruptions to supply chains both in the UK and the EU, transforming trade flows substantially in the long-term.
- 40% of agricultural and food products consumed by households and businesses in the UK are imported from the EU.
- The food manufacturing sector imports 9% and the agricultural sector 11% of its intermediate inputs from the EU.
- Over 15% of dairy inputs used in the UK food industry are imported and, of those, 99% come from the EU, highlighting that consumers will be affected by the future trading relationship.
- For certain products, the UK and the EU rely heavily on each other:
    - 85% of Danish and 53% of Dutch exports of certain meat products go to the UK.
    - The UK imports 69% of certain aluminium products, 65% of certain pharmaceutical goods and 51% of certain fertilizers from Germany, all of which are key inputs to the agriculture and food industry.
    - More than 75% of UK's imports of cut flowers, bulbs and related products come from the Netherlands, representing over £500 million of imports per year.

The Impact of Brexit on Trade Cost

- The impact of no deal Brexit will disproportionately affect the food and beverage sector, particularly fresh produce.
- While the potential tariffs represent the highest cost for operators from both the UK and the EU, the cost at the border and increased administrative and regulatory burden will significantly affect companies and as a result the consumer. Non-tariff barriers will apply whether there is a deal over tariffs or not.
- Estimates of the cost of compliance with rules of origin checks, when importing into the EU, are found to be in the range of 8% of the value of the underlying good, with a significant portion of this cost (85%) being a result of extra paperwork.
- Import declarations alone could cost traders from both the UK and EU approximately £4 billion a year.
- Chemicals – which are a crucial input to agriculture - face increased regulatory costs from Brexit. The cost of registering each chemical with the new UK regulator will be at a minimum £5,000, but can be in the hundreds of thousands of pounds for some chemicals, that require additional data access.
- The average tariff when exporting food and beverage products from the EU to the UK will rise from 0% to 17.7% when accounting for charges per weight, volume, and concentration and weighting by the value of imports of each product.

- The average tariff when exporting food and beverage products from the UK to the EU will rise from 0% to 21.7% when accounting for charges per weight, volume, and concentration and weighting by the value of imports of each product.

- The average tariff for the food and beverage sector in the UK is more than 4 times larger than all other sectors, while for EU tariffs it is more than 6 times larger. The difference is mainly due to additional charges on weight, volume and concentration which are far more prevalent in food industries and translate to large tariff rates.

The Impact on Trade, Prices and Product Availability

- The predicted changes in trade flows in this section refer to long-run changes and to changes in bilateral trade between the EU and the UK. Some of the reduction in trade between the UK and EU will be offset by increased trade with other countries and/or domestic production. Trade flows are expected to reduce much less in the short run as many businesses are expected to continue operating within existing supply chains for some time, absorbing the cost of tariff and non-tariff barriers.

- The predicted changes in price discussed in this section refer to changes in prices only of those specific products bilaterally traded between the UK and EU. Price increases however are expected to materialise in the short run.

- Operators have begun increasing stock in preparation for a no deal Brexit but the timing of the end of the transition period, which coincides with the Christmas peak period, will strengthen the negative impact of the introduction of tariffs. The lack of clarity of the Border Operating Model and the absence of functioning Good Vehicle Management System and Smart Freight Software further amplify the disruption in both scenarios.

- While consumers expect that local production will be readily available to replace imported items, stakeholders highlight the inability of current producers to cope with increased volume demand.

- Similarly, EU producers are considering options for moving production to the UK to avoid tariffs, but in many cases increasing capacity of current facilities is not possible and greenfield investment takes 2-3 years' time at the least as well as substantial investment. Thus, it cannot be a solution for short term disruptions. These measures are being considered especially in a no deal scenario, where long-term production will be moving out of the EU.

- Under a no deal scenario 17% of product categories in the food and beverage sector will stop being exported entirely from the EU to the UK, and 20% will stop being exported from the UK to the EU. For 85% of products, the volume of trade will fall.

- The average reduction in UK food exports to the EU is 63.2% in a no deal scenario and 22.5% under a Free Trade Agreement. The average reduction in EU food exports to the UK is 61.7% in a no deal scenario and 22.6% under a Free Trade Agreement.

- Dairy exports from the EU to the UK are estimated to fall by 18% under a Free Trade Agreement and by 94% under a no deal scenario. Under a no deal scenario a number of product lines including yoghurt, buttermilk, dairy spreads, milk and cream are likely to cease being imported into the UK from the EU. Stakeholders highlighted that in the case of a no deal scenario there will be an immediate impact on butter, spreadable cheese and mozzarella for pizza.

- Spain, Netherlands, Belgium, Denmark, France, Italy and Greece are all estimated to see a fall in food exports of over 5% in a no deal scenario, while Cyprus is estimated to see a fall of approximately 16%, holding other factors constant. Ireland is likely to be most negatively affected, but modelling the

changes is made difficult by the complexity of the Withdrawal Agreement on Northern Ireland given the interconnectedness between Ireland and Northern Ireland. At the time of writing, this is made more complicated by UK Government policy relating to the Withdrawal Agreement.

- Consumers will feel the effect of price increases across all types of products:
    - In the UK, the average price increase for branded and speciality products imported from the EU under an FTA is estimated to be 9.9% and to be 26.5% under a no deal.
    - In the UK, the average price increase for unbranded and more substitutable products imported from the EU under an FTA is estimated to be 4.7% and under a no deal to be 12.5%.
    - In the EU, the average price increase for branded and speciality products imported from the UK under an FTA is estimated to be 8.5% and under a no deal to be 27.9%.
    - In the EU, the average price increase for unbranded and more substitutable products imported from the UK under an FTA is estimated to be 4.0% and under a no deal to be 13.2%.
- In the UK, speciality cheeses like Halloumi, Gorgonzola, Feta and Roquefort are estimated to experience price increases of 55% under a no deal scenario.
- Speciality prosciutto and bratwurst could see increases of 31% in the UK.
- Estimates driven by NTBs should be seen as a lower bound given the difficulty of modelling an increase in trade barriers that is historically unique. Uncertainties surrounding the impact of port waiting times, checks on POAO, firms navigating the new border system & Rules of Origin, and the smooth running of the new declaration system could lead to far higher costs than those modelled in this analysis. Thus, even in the event of a “shallow” FTA primarily focused on tariff reduction, significant impacts on trade and prices can still be expected.

Brexit and the Food and Beverage Labour Market

- The end of the transition period will signify significant disruption in labour availability in the food and beverage sector, which is highly reliant on EU migrants, particularly on the produce side (fruits and vegetables).
- Current estimates suggest that net migration from the EU to the UK has fallen by more than 50% since 2016.
- Approximately 25% of workers in the manufacture of food products industry are from the EU, compared to 7% on average, which makes it the sector most reliant on workers from the EU.
- The majority of EU workers in the food and beverage industry are low skilled and unlikely to meet the earnings requirements of the new points-based immigration system.
- Warehousing and support for transport is the second most exposed industry with a share of approximately 19% and is an important downstream industry for the distribution of food and beverages.
- The adverse effects due to the reduction in migration on the food supply chain are likely to be muted initially due to the current state of the labour market following the COVID pandemic.

Policy recommendation

- **Tariffs** present the highest potential cost for operators and tariff-free trade is crucial to avoid the most negative effects of Brexit on the food supply chain and consumer choice.
- **Tariffs** are very high on average in the food and beverage sector. Tariff-free trade between the UK and EU must be maintained which, due to World Trade Organisation rules, is only possible if a trade agreement is secured. A no deal Brexit would be devastating for the UK food sector: it would leave the UK with a decision of whether to either (i) maintain high tariffs at the expense of consumers facing significantly increased prices or (ii) reduce tariffs and expose UK producers to intense competition from all across the world which is likely to significantly undermine the UK food and drink industry.
- Vis-à-vis **custom procedures and non-tariff barriers**, the key recommendation is for full recognition of food safety systems and veterinary certifications and avoiding the creation of new non-tariff trade barriers in customs and border requirements, as well as confirming Great Britain's SPS regime as soon as possible. A no deal Brexit must be avoided, but in both the no deal and Brexit scenarios the following recommendations could alleviate some of the disruption in the sector. These will need to apply to all countries with which the UK trades on MFN terms:
    - Clarifying the UK's Border Operating Model and providing clear guidelines on the eligibility and procedure for simpler customs clearance and payment of customs duty.
    - Possibility for phasing-in further the custom clearance and customs duty requirements after 30 June 2021 due to the lack of preparedness for border checks.
    - Ensuring that the Goods Vehicles Management System and Smart Freight Service are tested and functional before the end of the year.
- In the food and beverage sector, the end of the transition period coincides with the **Christmas peak season**, which increases the risks of shortages due to depleted stocks.
    - Scheme for support towards increasing stock since Christmas is peak time and stocks run low.
    - Considering modifications to the UK's Border Operating Model to preview a longer phase-in period for pre-notifications and customs checks on perishable goods.
- The COVID-19 crisis highlighted that one of the main disruptions to supply chains is **panic-buying.** Policymakers should consider the introduction of:
    - Communication campaigns around the availability of products;
    - Ensuring systems in place to avoid panic buying;
    - Discussions with retailers based on experience with the pandemic .
- Due to the **effect on the labour market**, certain F&B low skilled occupations such as Food and Drink Process Operatives (SOC10: 8111), Packers, Bottlers, Canners and Fillers (SOC10: 9134) and Farm Workers (SOC10: 9111), should be included on the shortage occupation list, with an annual salary in line with the Living Wage Foundations' recommended hourly rate.

2. The Food Supply Chain in the UK & EU

In our interconnected world, supply chains are highly integrated across countries. Firms source inputs for production from multiple origins and supply various markets from different locations, taking advantage of increasingly small transportation and communication costs. The European Union is a particularly integrated economic region where trade barriers have reduced significantly over the last decades of continuous economic integration. As a result, production has become more and more fragmented across European countries and hence supply chains routinely cross-country borders multiple times before reaching the final consumer.

Having highly integrated supply chains across countries allows countries and businesses to specialise in specific parts of the production process, leading to efficiency gains and lower prices for consumers. While fragmentation and just-in-time production processes promote efficiency they can suffer from a lack of resilience and can serve as propagation mechanism for local economic shocks to other countries and industries. The multiple border crossings of goods and services also mean that modern supply chains are particularly vulnerable to changes in trade barriers, as has become salient during the recent COVID-19 pandemic. Brexit is another example where the cost of border crossings is likely to increase between the UK and the EU. These trade barriers will apply to any product that crosses the UK-EU border – both intermediate and final products. The highly integrated nature of modern supply chains therefore is an important amplification mechanism for the effects of any trade barriers.

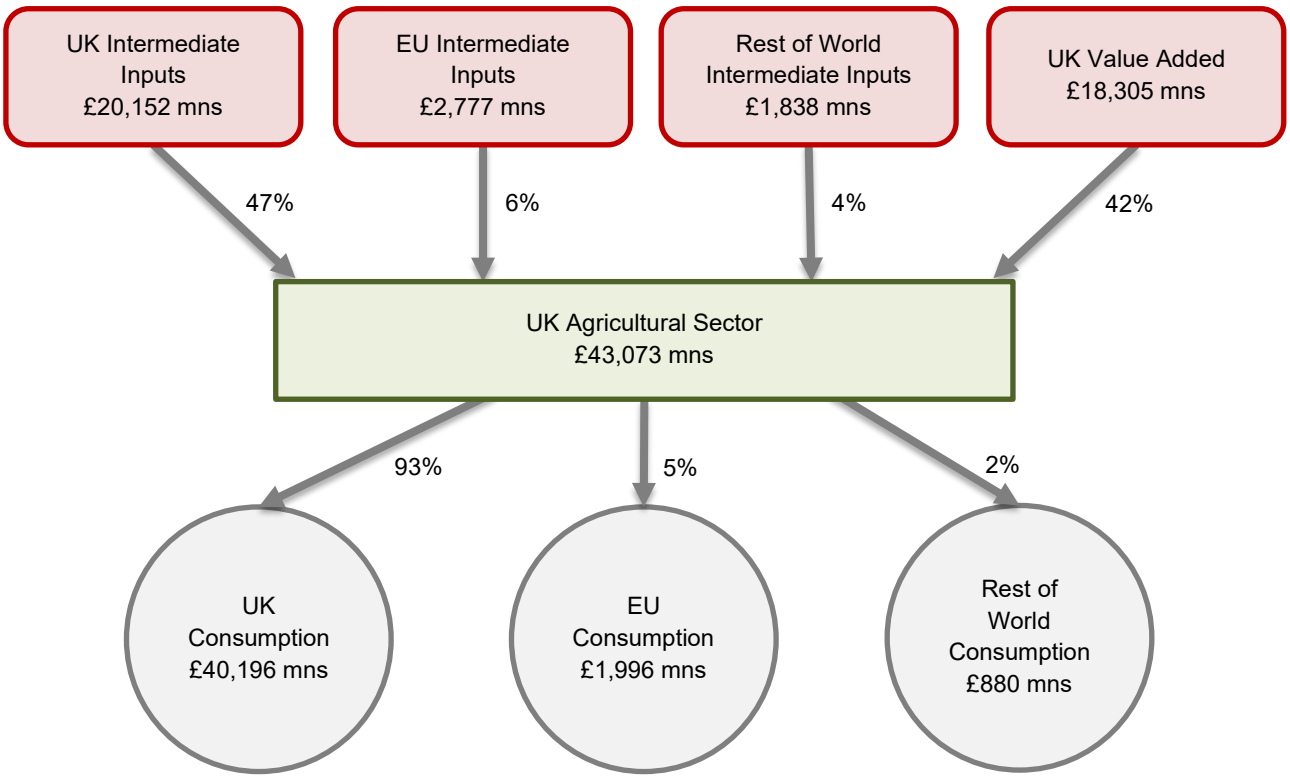
In order to be able to properly assess the consequences of higher trade barriers from Brexit on food products it is therefore important to have a detailed picture of the geography of the food supply chain. To paint this picture, we first document the linkages between the UK and the EU on the aggregate level before zooming into specific products and countries that are particularly vulnerable or important.

The EU economy is more than six times larger than that of the UK and nearly 50 percent of UK exports go to the EU. In contrast, just 6.2 percent of EU exports go to the UK. Given this large difference in size it is not surprising that the EU play a more important role in UK supply chain than vice versa.

Figure 1 summarises the UK agriculture industry supply chain. Overall, 6 percent of the total value of inputs into the UK agriculture sector come from the EU, compared with 4 percent from the rest of the world. The remaining 90 percent is from UK intermediate sectors and value added, which includes the costs of labour, land and capital. In terms of the output of the sector, most is consumed in the UK – either by other sectors as inputs to production or by households – with 5 percent going to the EU and just 2 percent going to other countries around the world.

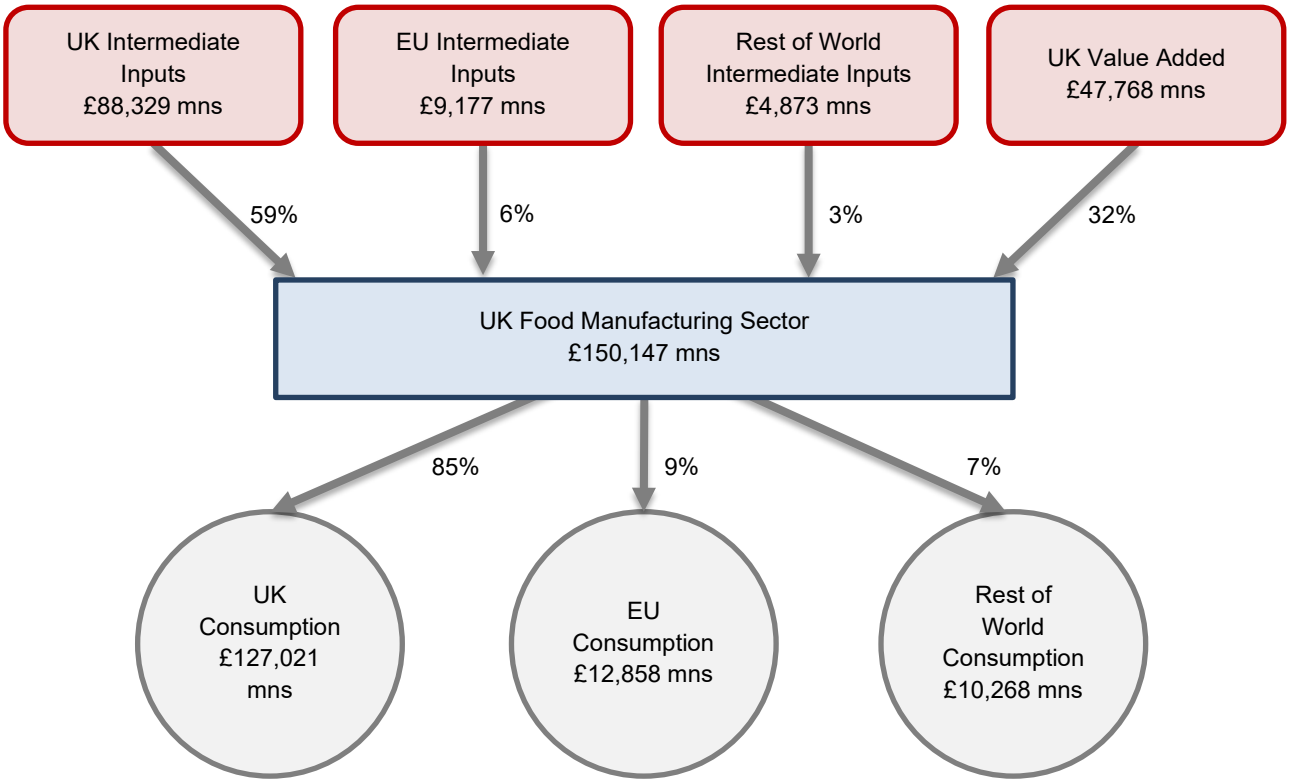
The food manufacturing industry presents a relatively similar picture. 6 percent of inputs come from the EU and 9 percent of output goes to the EU, as shown in Figure 2. Intermediate inputs are more important in the food manufacturing industry relative than in agriculture, and exports make up a greater proportion of total output. These percentages may appear to be relatively small, especially when accounting for value added, but the values are far from trivial: the data suggests that £2.77 billion of imports from the EU are used in the agriculture industry. For the food manufacturing industry, imports from the EU are as high as £9.17 billion.

Figure 1: The UK Agriculture Supply Chain



Source: World Input-Output Database

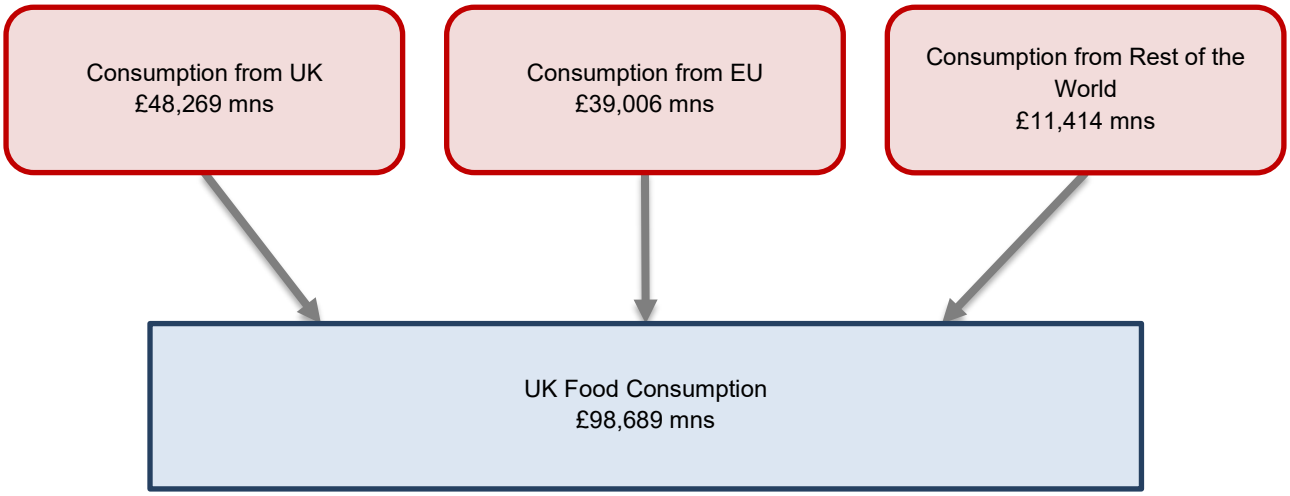
Figure 2: The UK Food Manufacturing Supply Chain



Source: World Input-Output Database

In aggregate, the EU is an important supplier of inputs to the UK food industry, in addition to being a sizeable export market. These linkages do not only exist on the production side but consumers in the UK are also highly dependent on products originating in the EU. Figure 3 shows that 40 percent of all consumption of food products in the UK comes from EU countries, suggesting that UK consumers are highly exposed to changes in the future trading relationship.

Figure 3: UK Consumption of Food Products



Source: World Input-Output Database

Supply chains are not only intertwined across countries but also across industries. Table 1 and Table 2 show the most important input industries to the UK agriculture and food manufacturing industries, respectively. The right column of the tables shows the value of inputs from each of the top input industries. Unsurprisingly, for both the agriculture and food manufacturing sectors, the top two inputs are the agriculture and food manufacturing industries themselves. Other key sectors in both cases are chemicals, paper, rubber and plastics, metals, services and energy sectors.[1]

The main advantage of the data used in these tables – which is obtained from the World Input-Output Database – is that it shows linkages between industry-country pairs. This means that for the UK agriculture or food manufacturing sector we can see which countries provide the inputs of each industry. This is an advantage over standard domestic input-output or supply and use databases such as those produced by the Office for National Statistics (ONS) for the UK. We utilise this information in the middle three columns of Table 1 and Table 2, which show where each input comes from for the UK agriculture and food manufacturing sectors, respectively.

Among the important upstream industries for the agricultural sector (Table 1), some sectors rely far more heavily on EU imports than others. For example, 35 percent of inputs of chemicals and chemical products to UK agriculture are imported from the EU. Therefore, the UK agriculture sector could be particularly vulnerable to increased barriers to trade in the chemicals industry through these upstream supply linkages. The miscellaneous category “Other Industries” – which are not presented separately because their individual input shares are small but together are relatively large – are also reliant on 16 percent of inputs coming from the EU. This suggests that the agriculture industry is broadly exposed to trade barriers through a variety of upstream sector linkages.

[1] *Energy and services are typically less traded inputs or are can be more easily substituted across trading partners so are generally of less importance when analysing the potential impact of Brexit on the food supply chain.*

Among the inputs to the food manufacturing industry (Table 2), more than 20% of inputs supplied by manufacturing of paper products, and of rubber and plastics are imported from EU countries. Throughout the remainder of the analysis in this report, we consider these two sectors as key inputs to the UK food industry, in addition to chemicals and metal products.

Table 1: Key inputs to the UK agriculture industry

Industry	Domestic Share	EU Import Share	Non-EU Import Share	Total Input Value (£millions)
Crop and animal production, hunting and related service activities	86%	11%	3%	5,056
Manufacture of food products, beverages and tobacco products	93%	5%	3%	5,047
Manufacture of coke and refined petroleum products	31%	26%	43%	1,617
Financial service activities, except insurance and pension funding	94%	4%	2%	1,556
Wholesale and retail trade and repair of motor vehicles and motorcycles	99%	1%	0%	1,538
Wholesale trade, except of motor vehicles and motorcycles	88%	11%	1%	1,347
Manufacture of chemicals and chemical products	48%	35%	17%	1,186
Construction	99%	1%	0%	1,066
Electricity, gas, steam and air conditioning supply	99%	1%	0%	791
Other Industries	73%	16%	11%	5,565
Total Intermediate Inputs	**81%**	**11%**	**7%**	**24,769**

Source: World Input-Output Database

Table 2: Key inputs to the UK food manufacturing industry

Industry	Domestic Share	EU Import Share	Non-EU Import Share	Total Input Value (£millions)
Manufacture of food products, beverages and tobacco products	93%	5%	3%	32,709
Crop and animal production, hunting and related service activities	86%	11%	3%	19,713
Electricity, gas, steam and air conditioning supply	99%	0%	0%	4,485
Wholesale trade, except of motor vehicles and motorcycles	88%	11%	1%	4,440
Land transport and transport via pipelines	94%	3%	3%	4,136
Manufacture of paper and paper products	68%	25%	7%	3,832
Manufacture of rubber and plastic products	70%	21%	10%	3,590
Financial service activities, except insurance and pension funding	94%	4%	2%	3,121
Manufacture of fabricated metal products, except machinery and equipment	84%	10%	6%	2,505
Other Industries	78%	11%	10%	23,848
Total Intermediate Inputs	**86%**	**9%**	**5%**	**102,379**

Source: World Input-Output Database

This brief overview shows just how integrated the UK and EU are when it comes to production, sales, and consumption of food-related products. Increased trade barriers therefore have the potential to affect the sector through numerous mechanisms, and the linkages between different sectors show that it is not only barriers in the food industry itself that will play a role. Trade barriers will affect prices of products used as inputs to the industry – the upstream sectors – which will propagate through the supply chain to consumer prices and the availability of different products on the shelves of shops. Products imported from the EU directly for consumption will also face the increased trade barriers. The output of UK food producers who export to the EU will also face barriers, causing reduced demand for UK products. As a consequence, we can expect that consumers in the EU may also notice increased prices and reduced availability of products from the UK, especially for products for which the UK is an important producer.

To investigate the extent to which these effects are likely to materialise, we utilise more detailed data to document the supply chain further and identify key areas of vulnerability. For data on inputs to food industries, we use the ONS supply and use tables for 2015.[2] These have the advantage that they contain more accurate information on inputs to each industry as well as total production of the sectors. The disadvantage is that they only show the total amount of imported products used by a sector – i.e. they do not show the breakdown of imports by sector or by country. We therefore supplement this data with highly detailed information on trade flows of goods between countries from the BACI database maintained by the Centre d'études prospectives et d'informations internationales (CEPII).[3]

Table 3 shows the most important inputs to the UK food industry (agriculture and all elements of food manufacturing).[4] A similar pattern emerges in terms of the key input sectors – they are mainly other food products, paper, rubber, plastics and fabricated metals. For each input, the table also presents the share of the input that is imported from abroad. For these slightly more disaggregated input sectors, some of the inputs have a high reliance on imports from abroad. For example, 25 percent of grain mill inputs to the UK food sector are imported, while for fish it is 34 percent and for vegetable and animal oils and fats as many as 72 percent of inputs are from abroad.

The remainder of the columns in Table 3 show, for each product, the share of UK imports from a selection of key trading partners in the EU as well as the share of imports from other EU countries and the rest of the world.[5] For some of the products identified as key input sectors to the UK food industry, the reliance on imports from particular countries can be relatively high. Focusing on the key input sector – agricultural products – 18 percent of the UK's imports are from the Netherlands. Looking at manufactured products, Germany is an important source of UK imports, providing 17 percent of paper products, 18 percent of fabricated metals and 20 percent of rubber and plastics. The dairy sector is of particular note because as much as 98 percent of the UK's imports of dairy come from the EU, with 20 percent coming from France and 7 percent coming from Denmark, a proportion that is large relative to the size of the Danish economy. These imports make up almost 16% of the UK's dairy consumption.

[2] More information is available at: https://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables#:~:text=Balances%20showing%20the%20relationship%20between,data%20underlying%20Gross%20Domestic%20Product.

[3] More information is available at: http://www.cepii.fr/cepii/en/bdd_modele/presentation.asp?id=37

[4] *We aggregate the energy and services sectors and focus on tradable goods industries. All other products not in the top 10 input sectors are aggregated to "Other Products".*

[5] *Note that for these more detailed sectors, the trade shares are for all UK imports of these products and not only imports that are used in the food sector (in contrast to the shares in Tables 1 and 2 above).*

Table 3: Most important inputs to the UK food industry

Input Product		Share of Total Inputs	Share of Inputs Imported	Share of UK Imports from Germany	Share of UK Imports from Denmark	Share of UK Imports from France	Share of UK Imports from Netherlands	Share of UK Imports from Other EU	Share of UK Imports from Rest of World
Agricultural products		21%	16%	4%	1%	5%	18%	28%	44%
Preserved meat and meat products		7%	8%	10%	7%	3%	17%	42%	21%
Other food products		6%	19%	15%	5%	10%	13%	39%	19%
Prepared animal feeds		4%	10%	12%	1%	20%	15%	37%	15%
Paper and paper products		4%	13%	17%	1%	7%	6%	45%	25%
Grain mill, starches and starch products		4%	25%	16%	1%	14%	10%	32%	26%
Rubber and plastic products		3%	32%	20%	1%	7%	5%	27%	40%
Processed and preserved fish, fruit and vegetables		3%	5%	7%	3%	4%	11%	30%	44%
Dairy products		3%	15%	13%	7%	20%	9%	50%	1%
Vegetable and animal oils and fats		2%	72%	6%	1%	7%	25%	21%	41%
Fishing		1%	34%	1%	0%	1%	1%	10%	88%
Fabricated metal products, excl. machinery and equipment		1%	10%	18%	1%	5%	5%	27%	44%
Services		27%	7%	NA	NA	NA	NA	NA	NA
Energy		7%	19%	10%	1%	3%	8%	30%	48%
Other Products		7%	47%	16%	1%	6%	6%	23%	47%
Total Output (£ millions, 2015)	87,112								
Total Inputs (Domestic and Imported, £ millions, 2015)	58,226								
Imported Inputs (£ millions, 2015)	9,755								

Source: UK Input-Output Tables and BACI Trade Data

In Table 4 we focus on the inputs to the UK food industry which rely most heavily on imports from abroad. At the top of the list is pharmaceuticals, where 98 percent of the inputs to UK food are imported from abroad and a high share of UK imports of pharmaceuticals come from the EU. A contrasting example is fishing, where 88 percent of the UK's imports come from outside the EU. This suggests that the food industry supply chain disruption caused by Brexit through the fishing inputs may be small relative to other sectors.

Table 4: Most important imported inputs to the UK food industry

Input Product		Share of Total Inputs	Share of Inputs Imported	Share of UK Imports from Germany	Share of UK Imports from Denmark	Share of UK Imports from France	Share of UK Imports from Netherlands	Share of UK Imports from Other EU	Share of UK Imports from Rest of World
Pharmaceutical products		1%	98%	22%	2%	5%	10%	33%	28%
Vegetable and animal oils and fats		2%	72%	6%	1%	7%	25%	21%	41%
Industrial gases, inorganics and fertilisers		1%	52%	20%	0%	11%	12%	24%	33%
Dyestuffs and agro-chemicals		1%	50%	19%	1%	22%	7%	26%	25%
Other machinery and equipment		1%	49%	23%	2%	6%	6%	25%	38%
Fishing		1%	34%	1%	0%	1%	1%	10%	88%
Rubber and plastic products		3%	32%	20%	1%	7%	5%	27%	40%
Grain mill, starches and starch products		4%	25%	16%	1%	14%	10%	32%	26%
Other food products		6%	19%	15%	5%	10%	13%	39%	19%
Agricultural products		21%	16%	4%	1%	5%	18%	28%	44%
Dairy products		3%	15%	13%	7%	20%	9%	50%	1%
Paper and paper products		4%	13%	17%	1%	7%	6%	45%	25%
Services		27%	7%	NA	NA	NA	NA	NA	NA
Energy		7%	19%	10%	1%	3%	8%	30%	48%
Other Products		20%	15%	15%	1%	6%	6%	23%	49%
Total Output (£ millions, 2015)	87,112								
Total Inputs (Domestic and Imported, £ millions, 2015)	58,226								
Imported Inputs (£ millions, 2015)	9,755								

Source: UK Input-Output Tables and BACI Trade Data

The analysis in this section has so far utilised supply chain data – either from ONS or the World Input-Output Database – which has the advantage of directly showing linkages between industries in the UK economy but at the cost of hiding some level of detail in terms of sector categories. While the ONS supply chain data splits the economy into 100 product categories, the trade allows us to distinguish more than 1000 products, which is crucial to identify specific products, which are highly exposed to trade barriers and might act as bottlenecks in production.[6]

Table 5 uses the detailed trade data to identify products for which the UK is particularly reliant on imports from major EU economies. We restrict to trade flows in the food industry or that have been identified as key to the food supply chain, and that had a value of over £10 million. We then present the products with the highest import shares from each country. Some striking patterns emerge. For example, over 50 percent of the UK's imports of mineral and chemical fertilizers come from Germany. The Netherlands is a crucial supplier of flowers and bulbs to the UK, with the table showing that over 70 percent of UK imports are sourced there. France is a crucial supplier of some dairy products and corn, while Denmark provides a large chunk of certain meat products to the UK. Note that these trade relationships are not only large in percentage terms but also in terms of values. For example, the UK imported £661 million of cut flowers, of which 76.4% - over £500 million - came from the Netherlands.

Table 5: Top UK imports from key EU countries

Country	Product	Total Imports (£millions)	Share of UK Imports
Denmark	Meat and edible meat offal: salted, in brine, dried or smoked: edible flours and meals of meat or meat offal	662.0	26.5%
Denmark	Fats of bovine animals, sheep or goats: other than those of heading no. 1503	14.8	25.3%
Denmark	Meat of swine: fresh, chilled or frozen	646.3	22.0%
France	Buttermilk, curdled milk and cream, yoghurt, kephir, fermented or acidified milk or cream, whether or not concentrated, containing added sugar, sweetening matter, flavoured or added fruit or cocoa	345.3	43.1%
France	Maize (corn)	257.4	41.7%
France	Vegetables, fruit, nuts, fruit-peel and other parts of plants, preserved by sugar (drained, glace or crystallised)	22.4	35.6%
Germany	Aluminium oxide (including artificial corundum): aluminium hydroxide	24.6	69.3%
Germany	Pharmaceutical goods	101.1	65.5%
Germany	Fertilizers: mineral or chemical, potassic	44.4	51.4%
Netherlands	Bulbs, tubers, tuberous roots, corms, crowns and rhizomes: dormant, in growth or in flower: chicory plants and roots other than roots of heading no. 1212	80.9	76.7%
Netherlands	Flowers: cut flowers and flower buds of a kind suitable for bouquets or for ornamental purposes, fresh, dried, dyed, bleached, impregnated or otherwise prepared	661.2	76.4%
Netherlands	Composite paper and paperboard, (made by sticking layers together with an adhesive), not surface-coated or impregnated, whether or not internally reinforced, in rolls or sheets	39.4	75.9%

Notes: Products are four digit HS 2007 classifications. The table is restricted to products for which total UK exports are greater than 1 million GBP.

Source: BACI Trade Data

[6] *A disadvantage of the trade data is that it simply records cross-border transactions and does not necessarily capture trade in value added. For example, a near-finished good may be imported from China to Germany, finished, and then resold to the UK. It would then show up as both trade flows from China to Germany and from Germany to the UK. Therefore, some of the values picked up in the trade data may be somewhat distorted by distribution and the integration of supply chains.*

A similar picture emerges for UK exports Table 6: some EU countries are key consumers of specific UK exports. Of the UK's £299 million of sheep exports, over 50 percent went to France. Over 80 percent of the UK's exports of lard products went to the Netherlands, while 50 percent of ammonia went to Germany.[7]

Table 6: Top UK exports to key EU countries

Country	Product	Total Imports (£millions)	Share of UK Imports
Denmark	Cocoa beans: whole or broken, raw or roasted	39.4	15.7%
Denmark	Ginger, saffron, turmeric (curcuma), thyme, bay leaves, curry and other spices	28.4	14.5%
Denmark	Crustaceans, molluscs and other aquatic invertebrates, prepared or preserved	64.3	8.5%
France	Meat of sheep or goats: fresh, chilled or frozen	298.8	52.5%
France	Cocoa: paste: whether or not defatted	10.7	43.7%
France	Sunflower seed, safflower or cotton-seed oil and their fractions: whether or not refined, but not chemically modified	21.2	34.1%
Germany	Ammonia: anhydrous or in aqueous solution	78.8	50.3%
Germany	Skins and other parts of birds with feathers, down: feathers, down and parts thereof: not further worked than cleaned, disinfected, treated for preservation: powder, waste and parts of feathers	11.8	35.3%
Germany	Rape or colza seeds: whether or not broken	131.3	28.7%
Netherlands	Lard stearin, lard oil, oleostearin, oleo-oil and tallow oil: not emulsified or mixed or otherwise prepared	10.9	84.2%
Netherlands	Linoleum, whether or not cut to shape: floor coverings consisting of a coating or covering applied on a textile backing, whether or not cut to shape	17.3	49.6%
Netherlands	Flowers: cut flowers and flower buds of a kind suitable for bouquets or for ornamental purposes, fresh, dried, dyed, bleached, impregnated or otherwise prepared	19.3	49.0%

Notes: Products are four digit HS 2007 classifications. The table is restricted to products for which total UK exports are greater than 1 million GBP.

Source: BACI Trade Data

Table 7 and Table 8 present the reciprocal analysis; they show, for each EU key country, the top products that rely in imports to the EU and the top products that rely on exporting to the UK. A similar pattern emerges. Table 7 shows that 40 percent of Germany's imports of mineral or chemical potassic fertilizers come from the UK, while over 50 percent of France's imports of live horses are from the UK.

Turning to Table 8, we see that for some products the UK is a hugely important export market. A huge 85 percent of Denmark's £205 million exports of meat offal products are exported to the UK. For the same product, the UK is also a crucial export market for the Netherlands. The table also shows cases where the UK constitutes a high share of French exports, such as some nuts and preserved fruit and vegetables, and for Germany, such as pharmaceuticals and sausages.

[7] *Denmark is a smaller economy than the UK and other economies in the examples shown and therefore has smaller top shares as a UK export destination. Nevertheless, it remains an important market for UK exporters.*

Table 7: Top key EU Country Imports from the UK

Country	Product	Total Imports (£millions)	Share of UK Imports
Germany	Fertilizers: mineral or chemical, potassic	41.3	40.5%
Germany	Colour lakes: preparations based on colour lakes as specified in note 3 to this chapter	10.5	19.6%
Germany	Sulphuric acid: oleum	12.2	17.6%
Denmark	Ginger, saffron, turmeric (curcuma), thyme, bay leaves, curry and other spices	19.4	21.3%
Denmark	Nuts, edible: coconuts, Brazil nuts and cashew nuts, fresh or dried, whether or not shelled or peeled	11.1	16.1%
Denmark	Prepared foods obtained by swelling or roasting cereals or cereal products (egg corn flakes): cereals (other than maize (corn)) in grain form or in the form of flakes or other worked grains (not flour and meal), pre-cooked or otherwise prepared, n.e.c.	43.8	15.3%
France	Horses, asses, mules and hinnies: live	66.8	54.9%
France	Meat of sheep or goats: fresh, chilled or frozen	372.9	42.1%
France	Chemical wood pulp, sulphite, other than dissolving grades	19.9	35.3%
Netherlands	Lard stearin, lard oil, oleostearin, oleo-oil and tallow oil: not emulsified or mixed or otherwise prepared	12.4	74.5%
Netherlands	Linoleum, whether or not cut to shape: floor coverings consisting of a coating or covering applied on a textile backing, whether or not cut to shape	13.2	64.9%
Netherlands	Wadding of textile materials and articles thereof: textile fibres, not exceeding 5 mm in length (flock), textile dust and mill neps	21.9	31.5%

Notes: Products are four digit HS 2007 classifications. The table is restricted to products for which total UK exports are greater than 1 million GBP.

Source: BACI Trade Data

Table 8: Top key EU Country Exports to the UK

Country	Product	Total Imports (£millions)	Share of UK Imports
Germany	Pharmaceutical goods	163.0	40.6%
Germany	Meat and edible meat offal: salted, in brine, dried or smoked: edible flours and meals of meat or meat offal	302.2	27.5%
Germany	Sausages and similar products of meat, meat offal or blood: food preparations based on these products	442.5	24.8%
Denmark	Meat and edible meat offal: salted, in brine, dried or smoked: edible flours and meals of meat or meat offal	205.5	85.3%
Denmark	Food preparations not elsewhere specified or included	729.7	35.5%
Denmark	Paper and paperboard, coated one or both sides with kaolin (china clay) or organic substances, with or without binder, no other coating, surface coloured or not, surface decorated or printed, in rolls or rectangular (including square) sheets, of any size	19.1	32.0%
France	Vegetables, fruit, nuts, fruit-peel and other parts of plants, preserved by sugar (drained, glace or crystallised)	17.7	45.3%
France	Nuts, edible: coconuts, Brazil nuts and cashew nuts, fresh or dried, whether or not shelled or peeled	13.2	41.7%
France	Soya-bean oil and its fractions: whether or not refined, but not chemically modified	50.0	38.9%

Netherlands	Meat and edible meat offal: salted, in brine, dried or smoked: edible flours and meals of meat or meat offal	335.1	53.6%
Netherlands	Tomatoes: prepared or preserved otherwise than by vinegar or acetic acid	22.4	39.6%
Netherlands	Salts of inorganic acids or peroxoacids, excluding azides, n.e.c.	63.9	35.9%
Notes: Products are four digit HS 2007 classifications. The table is restricted to products for which total UK exports are greater than 1 million GBP.			

Source: BACI Trade Data

In summary, this section has demonstrated the importance of integration between the UK and EU for the food sector. This is not limited to trade in final goods; crucial inputs to the food sector are also heavily traded between the UK and the EU. This means that the effects of potential trade barriers – which are documented in the following section – could be amplified through the supply chains, affecting consumers and producers in all EU countries and in the UK.

3. The Impact of Brexit on Trade Costs

Brexit will affect the food supply chain in a variety of ways, but the largest impact Brexit will have on the UK and EU food and beverage industry stems from its effect on trade costs. The changes in trade costs will likely affect consumers through two channels. Firstly, a direct effect, where finished products imported from the trade partner become more costly or less available due to the increased trade costs. Secondly, an indirect effect where intermediate inputs required to produce final consumption goods become more costly for domestic food and beverage manufacturers, potentially increasing the cost of the domestically produced consumption good.

The change in trade costs can be broken down into three separate areas. Firstly, tariffs which are usually just an ad-valorem tax levied at the border. Secondly, barriers at the border such as border checks and declarations, and lastly, barriers behind the border such as conformity regulations. Barriers at the border are likely to have broadly similar impacts across consumption goods and intermediate inputs, though with some exceptions (such as Products of Animal Origin), while barriers behind the border tend to be product specific.

The size of the change in trade costs is likely to be heterogeneous across different industries and even across different product groups within the same industry. In the following section we document some of the barriers that are likely to arise for both final consumption goods and key intermediate inputs, and where possible assess quantitatively how these barriers translate into changes in trade costs.

3.1. Barriers at the Border

3.1.1. Rules of Origin

In the absence of a proper customs arrangement (such as membership of the customs union), which is currently not part of the policy discussions, firms trading between Great Britain (GB) and the EU will need to adhere to Rules of Origin (RoO) requirements if they are hoping to exploit a preferential import tariff due to a Free Trade Agreements (FTA). RoO are used by customs authorities, such as HMRC, to determine where an internationally traded good has originally come from, so that the appropriate import tariffs may be applied. RoO administrative work is necessary to establish that the good being traded has predominantly originated within the free trade area. If it is deemed that it hasn't, then appropriate tariffs may be applied.

Estimates of the cost of compliance to these checks, when importing into the EU, are found to be in the range of 8% of the value of the underlying good (Carrere et al., 2011), with a significant portion of this cost (85%) being a result of extra paperwork. Additional evidence suggests that in cases when costs of compliance are particularly high, for example when production requires complex supply chains, firms simply give up on preferential import tariffs and pay the MFN tariff despite the presence of preferential rates (CEPR, 2013).

As the EU has one set of rules of origin which applies to both single market members outside the CU and to those with FTAs, the current situation of Norway provides a useful benchmark to assess the possible impact that the additional bureaucracy could have on trade.

A survey by the Swedish National Board of Trade (Kommerskollegium, 2011) of almost 1000 businesses, predominantly involved with foreign trade, found that Norway ranked top as both the country to improve trading relations with and the most problematic trading partner (along with Russia). Seven out of ten of those companies who stated trade with Norway was problematic pointed to "incredibly cumbersome" customs handling and rules.

RoO requirements are likely to have varying impacts across different products in the food and beverage industry. For raw materials and agricultural inputs such as wheat, milk and meat traded within a free trade area, the process would be very simple as the point of origin for the whole product is easily determined. For example, for the dairy industry the RoO are very straightforward – all materials used must be wholly produced within the free trade area, and the weight of sugar used must not exceed 40% of the final weight. However, the moment processed foods are considered the process becomes considerably more complex.

The Food and Drink federation's report on RoO provided a variety of case studies highlighting several issues. For example, a branded wholemeal loaf of bread manufactured in the UK but using a blend of grains from the US, UK and Canada would currently not pass requirements under RoO requirements laid out in CETA or the pan-Euro-Mediterranean (PEM) Convention origin protocol.[8] Another example in the report concerned a branded chocolate bar manufactured in the UK utilising cocoa solids and butter from Ghana and Cote d'Ivoire, sugar sourced from Brazilian sugarcane and European sugar-beet. To qualify for being sourced within the FTA under both CETA and PEM, amongst other factors, the value of the non-originating sugar would need to stay below a threshold of 30% of the value of the final product.

The above demonstrates how RoO paperwork would be constantly evolving, and dependent on global input prices, such as sugar. Such administrative work would not be as simple as producing a single origin document for every production batch. Furthermore, it demonstrates the non-linearities in production optimisation faced by GB based producers, which in turn would create further complications.

3.1.2. Safety and Security Declarations

Customs declarations are not required for EU members when trading between member states (except in exceptional circumstances), however they will be required for trade between the UK and the EU gradually from 1st January 2021, with all measures in place from 1st July 2021. In particular, the UK government (and correspondingly EU states' governments) will collect more information on goods moving across borders, such as who is moving the goods, how often, what they are transporting and why.

The UK government outlined the necessary steps for a GB based company to comply with Safety and Security declarations in their July 2020 "The Border with The European Union" publication. In particular, firms will need to:

- Apply for a GB EORI number
    - This is required for all businesses importing to, or exporting from GB with the EU (or Northern Ireland?)
- Get a Customs Intermediary
    - As customs declarations can be complicated and require specific computer software, it is recommended for firms to use customs agents such as Freight Forwarders or Fast Parcel Operators to help guide them through the process. Agents' fees can range between a few pounds to beyond £25 per sea container (Grainger, 2016). If businesses decide to make declarations themselves, they will need to get access to HMRC systems and purchase software.
- Ensure drivers have correct International Driving Permits
    - Hauliers will need to ensure drivers have the correct documentation, for example International Driving Permits (IDPs).

[8] *The PEM relates to a number of EU FTAs with countries in North Africa and around the Mediterranean basin.*

Companies who previously have had little trade outside of the EU are unlikely to have the internal workforce to carry out declaration-related tasks, and thus will see an initial increase in administrative costs, in particular for training and related software. Estimates from the Institute of Government suggest that import declarations alone could cost traders approximately £4 billion a year (Institute for Government, 2017).

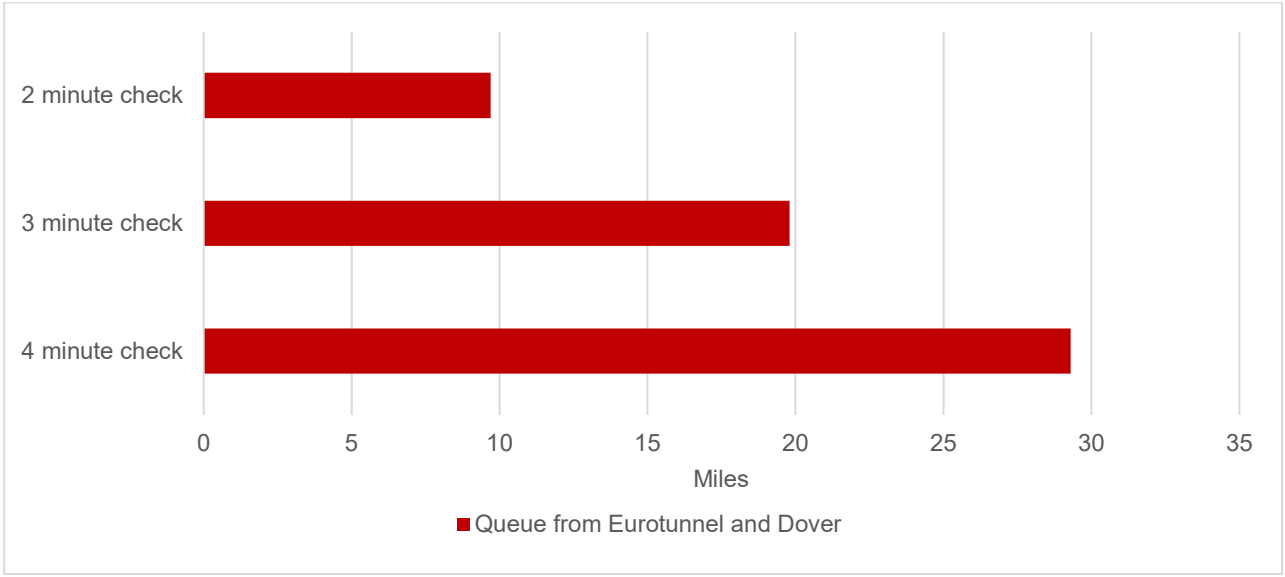
3.1.3. Check Times

Unlike under EU membership, at a port of exit port authorities will now perform a risk assessment based on the contained information and decide whether an inspection is necessary. A similar process exists at the port of entry. These checks can be related to several different areas including safety, security, consumer protection, environment, health and quotas. Such checks are currently necessary for non-EU trade.

Ports which are primarily geared towards EU trade (e.g. Dover and Holyhead) are likely to face significant challenges from the introduction of these checks, which will increase travel times. 99% of Dover's trade is with the EU, which in turn means they could experience up to a 100-fold increase in the number of inspections which need to be carried out. Importantly, it would mean all goods moving through the port would now be treated as those currently going to non-EU destinations.

The impact of these checks on travel times are documented in two key studies on port delays. Government-commissioned research carried out by academics at the University College London estimated that if delays to each vehicle increase by just 70 seconds, trucks would face six-day queues to board ferries at Dover. When pushed to 80 seconds, the outcome would be "no recovery", effectively permanent gridlock. Conversely, checks of just 40 seconds per vehicle were estimated to have no impact on the queuing time of outward journeys. The estimates demonstrate the non-linear response to very marginal changes in check times, and the importance of quick and consistent check times. Research from Imperial College London, however, suggests a more locally linear response. They estimate that every extra minute required for checks per vehicle will add around an extra 10 miles of peak-time traffic queue (see Figure 4), which translates to approximately 1.4 hours of waiting time (Han et al., 2017) at peak times. Currently the 1% of freight going through Dover destined for non-EU locations take approximately 20 minutes to clear customs (Dover, 2017). As a contingency plan, the UK government will utilise the disused Manston Airport, as a car park for 6,000 trucks, to ease traffic congestion on roads in and around Dover.

Figure 4: Estimated queue times by check time duration



Source: Imperial College London

These additional waiting times will have an immediate effect on the wages costs associated with exporting. According to data from the quarterly labour force survey (QLFS), the mean hourly wage for a large goods vehicle (LGV) driver is £12.02. Based on the UCL research an extra 70 seconds delay causing 6 days of waiting could increase transportation costs by more than £1000 per container in terms of labour costs, especially when accounting for impact over overnight waits, while a longer delay of 7 minutes, under the Imperial College estimates would imply an increase in labour costs closer to £120.

Costs induced by increased labour requirements for LGV drivers however is only part of the issue. A significant portion of trade related to the food and beverage industry is related to fresh produce and produce with risk of spoilage. Increased check times would disproportionately affect time-sensitive food and beverage products, such as fresh meat, fruits, vegetables, and dairy products. In some cases, shelf-life at the supermarket would be limited, and risk of spoilage during transportation would rise, while in a few extreme cases some products may no longer be available. For example, the European Livestock and Meat Trades Union (UECBV) note that certain regulatory conditions, such as the need to produce fresh minced beef from a carcass within six days of slaughter, may mean that trade in fresh beef would become infeasible and limited to frozen beef thereby limiting consumer choice. In addition, fresh and frozen produce often requires refrigeration during transportation which compounds costs. The UECBV calculate that a refrigerated truck stuck at the border would cost €550 per day (UECBV, 2017).

3.1.4.Products of Animal Origin

Goods classified as Products of Animal Origin (POAO) face tighter checks at the border when traded with a third country due to Sanitary and Phytosanitary (SPS) requirements. This will be the case for trade with the EU as outlined by the UK government (HM Government, 2020). In particular, by July 2021 POAO will require:

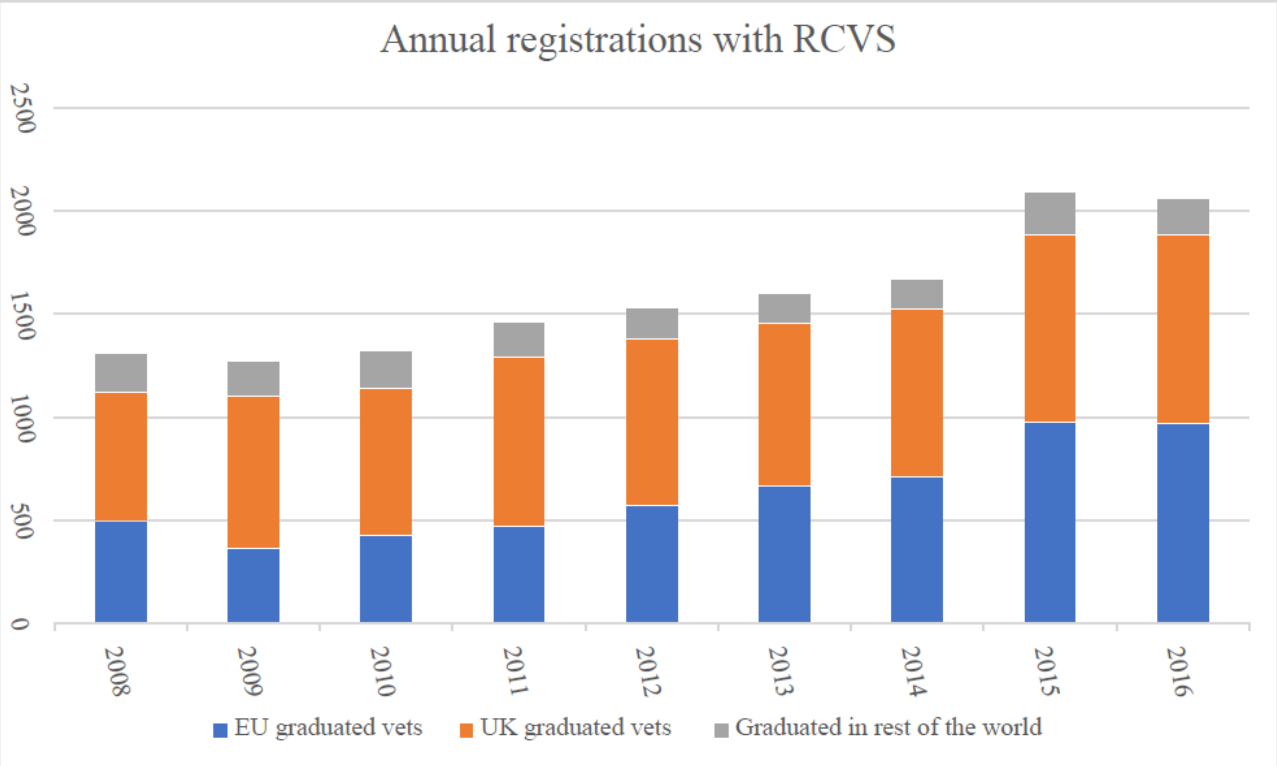
- Registration as a third country company that is authorised to trade in animal products with the UK/EU.
- Apply for relevant import licenses along with documentary proof of the product's country of origin.
- Acquire health certification for each product and/or species within a consignment from a registered Official Veterinarian.
- Notify the relevant Border Control Post (BCP) in advance of the arrival of the goods.
- Arrive at the first point of entry into the UK/EU via a Border Control Post.
- Submit the goods for relevant checks at the border. These include:
    - Documentary checks of certificates, attestations and other commercial paperwork.
    - Visual inspection of the consignment to verify its contents and its labelling.
    - Physical checks to ensure compliance with SPS requirements for the import country. This includes testing of samples, temperature, packaging and labelling.

The above set of rules could have a number of direct and indirect effects for the food and beverage industry. Goods requiring POAO checks include meat, egg and milk products, and all composite products containing the above.

Direct effects include the cost of complying with the above processes such as increased transportation costs due to diversion of logistical routes through designated BCPs, increased administrative costs and costs of veterinary certification. Harmonised charges exist for veterinary control checks at BCPs. For example, the BCP currently at Felixstowe charges £50.60 per consignment up to 6 tonnes and an additional £8.28 per tonne up to a maximum charge of £386.28 per consignment. Other relevant port certifications exist such as organic certification which costs £45 per consignment. The UECBV estimate that direct costs of port clearance for a consignment of meat would cost €635 per consignment.

Indirect effects are harder to quantify, but no less important. Waiting times at BCPs could increase drastically due to the aforementioned procedures which are carried out on 100% of consignments from third countries. Currently no research studies exist for impacts on waiting times at BCPs for POAO. Additionally, the British Veterinary Association (BVA) has estimated that post-Brexit the volume of goods requiring veterinary checks will increase by 325% (BVA, 2017). Compounding this immense increase in demand is the potential negative labour supply shock that the UK veterinary labour market could face, which has been highly dependent on EU graduate veterinarians. Indeed, in both 2015 and 2016 more EU graduated vets registered with the Royal College of veterinary surgeons than UK graduates (see Figure 5). Both effects could result in a large excess of demand for veterinary services, either pushing up prices or waiting times, or both.

Figure 5: RCVS registrations by area of graduation



Source: RCVS

3.2. Barriers Behind the Border

3.2.1. Products with Protected Status

A number of traded goods produced within the UK and EU have some degree of protected status, whereby they have to originate or be produced within a specific geographical area or are produced using a specific method. Countries signed up to the WTO's Trade-Related Aspects of Intellectual Property Rights (TRIPS) are required to have processes in place allowing producers to apply for protected food names. The UK has already laid out the blueprint for these processes which shall take effect from 1st January 2021. The new rules make clear that products with protected status (in the UK, and from the EU) will be able to maintain their status going forward, but the process for new applications will need to be made separately for the two areas.

Products afforded protected status are of particular interest within the context of Brexit and trade costs as they are not domestically substitutable. While it may be the case that increases in trade costs for some imported goods, such as milk, will lead to an increase in domestic production and a substitution away from imports to

domestically produced goods, thus avoiding the full increase in trade costs, this is not possible when it comes to goods with protected status. Such goods are thus the most exposed to changes in trade costs, and consumers of these goods are likely to face some of the highest increases in cost, while producers will be more protected from competition in the importing country.

The group of products with protected status is made up entirely of food and beverage products. There are 84 UK products in total, including Scotch beef, Welsh lamb, Stilton, Cornish clotted cream, Scotch whiskey, and Cornish pasties. Thus, EU consumers with a strong preference for these products will have to continue to import them. Conversely, there are 1,713 EU products with protected status, including speciality cheeses such as Roquefort, Gorgonzola, Halloumi and Feta, meat such as Bratwurst and varieties of Prosciutto, and drinks such as Cognac and Grappa.

3.2.2. Animal Feed

A key input for products of animal origin is animal feed. Estimates from the Milk Cost of Production Survey (Old Mill, 2019) suggest that 33% of the cost of production of dairy is from animal feed, while in beef and lamb production feed makes up 22% and 30% of total costs (Meat Promotion Wales, 2019).

A large portion of manufactured feeds are regulated products within the EU, and will continue to be in the UK from 1st January 2021, to ensure that certain quality and safety standards are met. As a result, from 2021 onwards third country businesses, including those in EU or EEA states will need to comply with a new set of regulations.

Firms wishing to import products into the UK will need to have a UK based representative, and this will similarly the case for UK firms wishing to import into the EU. Detailed information will then be requested from the representative by the state regulatory body for each manufacturing establishment. Information required will include:

- Names and addresses of the establishment
- Details of the activity exercised in the establishment
- Details of the products to be exported, including product data sheets and ingredient labels.
- Provision of compliance certification, such as feed hygiene certificates
- Submission of evidence that the applying representative ensures compliance within the manufacturing establishment, for example inspection of premises reports.

It is inevitable that compliance with such a process will incur costs, and given that in 2015 £894 million worth of animal feed is imported into the UKit may have non-negligible impacts downstream, in particular on the cost of dairy and meat production.

3.2.3. Veterinary Medicines

Veterinary medicines are comparably a smaller input in the production of dairy and meat. Estimates from The Dairy Group (The Diary Group, 2017) suggests that veterinary and medicinal costs make up approximately 4% of total costs in dairy production, whereas in beef and lamb production they are 6% (Meat Promotion Wales, 2019).

Veterinary medicines are less exposed to issues at the border, in particular waiting times which could affect short-life products (e.g. vaccines). This is because veterinary medicines have been listed as a Category 1 good in terms of trade, this means it is labelled as a “Critical Good for Government-Secured Freight Capacity”, implying the government would intervene in international trade of the product in the case of disruptions. Additionally, veterinary medicines imported from the EU that are already authorised for use in the UK will not

be subject to any additional import requirements at the border, expect in the case where veterinary medicines contain controlled drugs.

However, there may be an increase in costs of regulatory compliance in the manufacturing of veterinary medicines. Currently, a Qualified Person (QP) must certify that each manufactured batch of product complies with state regulation and currently a product that has passed batch testing in the UK can be sold in the EU and vice versa. Current government guidance is unclear as to what will happen with regards to batch testing, however a previous publication by the Department for Environment & Rural Affairs (DEFRA) stated that in the case of a no deal Brexit mutual recognition of batch testing of veterinary medicines between the UK and EU/EEA would cease at the end of the transition agreement (BVA, 2019). This would not only effect products from the EU, but also products from Australia, Canada and New Zealand with whom the EU has mutual recognition agreements. In effect this would double the amount of necessary batch testing for products traded between the UK and EU.

Animal products for human consumption within the EU must adhere to maximum residue limits (MRLs), which are scientifically determined maximum levels of pharmacologically active substances allowed in food produce. Effected food products include lean meat, fat, skin, milk eggs and honey. In the event of a no deal Brexit existing MRLs would become UK law and thus in the short run trade would be unaffected. However, in the longer run the UK could modify domestic MRLs, or not update them in line with the EU MRLs. The former of these may occur for example if the UK pursues an FTA with the USA which aligns UK and US food standards, as US MRLs are different in many dimensions to the EUs. In this event trade in animal products between the UK and EU would be disrupted, as there would likely be a need for cumbersome testing of residue levels at the border, or pre-shipment certification for the alternative regimes.

3.2.4. Chemical Inputs

Chemical inputs are key for a variety of other industries including automotive, defence, food processing, agriculture, metal manufacturing, universities, research and electronics. Manufacture of chemicals and chemical products is important to the agricultural industry and has a total input value of over £1 billion (see Table 1), and 35% of those inputs are sourced from the EU. Important products in this category include pesticides, herbicides, disinfectants, detergents and cleaners.

Similarly the food manufacturing industry uses a large amount of rubber and plastic products as inputs (approximately £3.5 billion worth of inputs per year) which is heavily dependent on the chemical engineering industry, and 21% of these products are currently sourced from the EU.

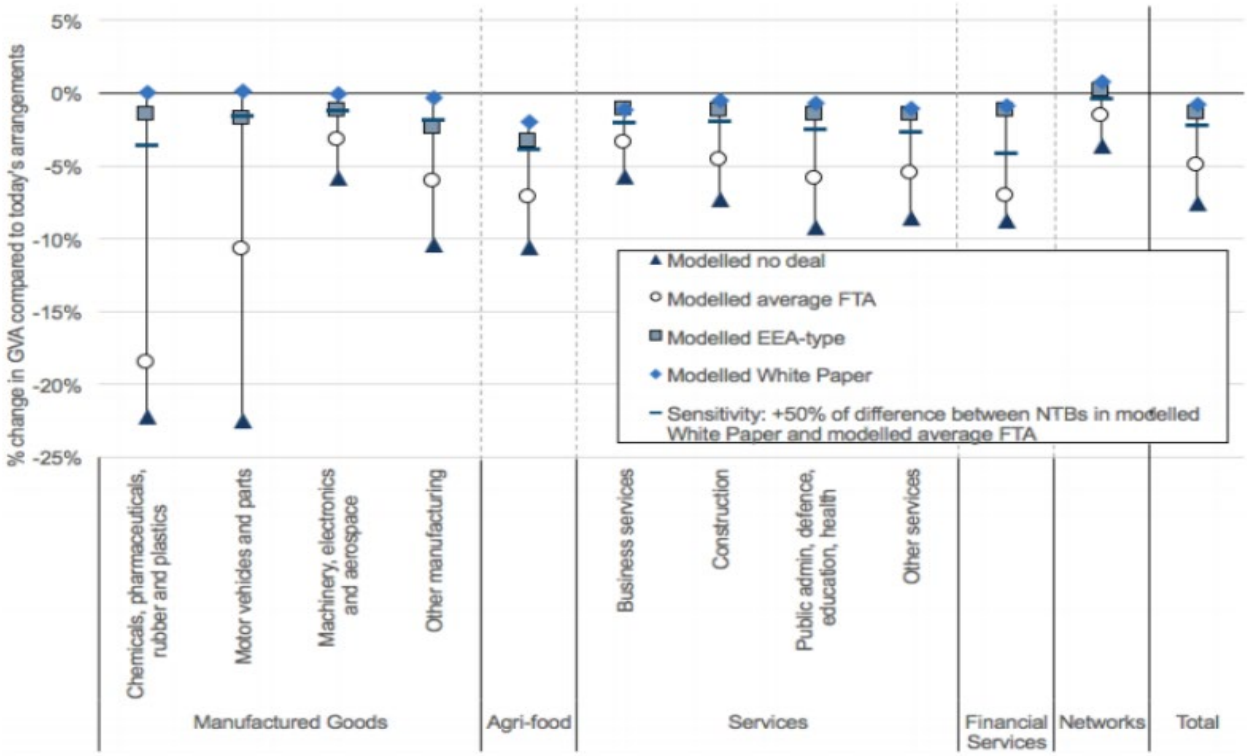
The chemical manufacturing industry is likely to face some new costs, and this will likely be more pronounced for imported inputs, but will also affect domestically produced chemicals. Chemicals manufactured and used within the EU currently fall under the “Registration, Evaluation, Authorisation & Restriction of Chemicals Regulation” (REACH), which addresses the potential impacts of chemical manufacturing and use of chemicals on human health and the environment. The technical and administrative aspects of the implementation of REACH are managed by the European Chemicals Agency (ECHA) which is based in Helsinki. As of 1st January 2020, chemical safety regulations in the UK will fall under the newly established UK-REACH, and managed by a UK equivalent of the ECHA. This decision made by the current government, which breaks with earlier policies of the government under Theresa May, was to ensure a “clean break” from the ECJ.

Existing registrations held by UK companies will automatically be copied over from to the UK system at no fee, however companies would need to submit the necessary registration data within a set transition period. In particular, within 120 days UK companies with EU registrations would have to provide basic data such as company name, company details, substances registered, quantities produced and evidence of their ECHA registration. Within two years companies will need to submit full information such as information and data on the properties of the substances and its safety, which usually includes testing evidence. A similar time frame

exists for imported chemicals from the EU. While submitting such data may seem simple to industry outsiders, there exist several costly barriers. Costs include administrative costs, fees for new commercial data sharing agreements and costs for further sharing if data cannot be shared. Survey estimates suggest that three-quarters of companies don't own all the data for their EU registrations (Chemical Business Association, 2019), implying the aforementioned costs are likely to occur for most companies. Calculating a precise cost for the above is difficult, but estimates from industry insiders suggest that the cost of registering each chemical will be at a minimum £5,000. Those chemicals requiring access to necessary additional data could require "letters of access" costing up to hundreds of thousands of pounds. (Foster, 2020). Currently there are 22,000 substances registered with the ECHA. Imported products will need to have the additional burden of having a UK based representative, as was the case with animal feed, and vice versa for products exported to the EU from the UK.

The UK governments sector-specific estimates of the impact of Brexit onto Gross Value Added (GVA) from both a no deal, and an "average FTA", (i.e. weaker than remaining in the single market) suggested that "Chemicals, pharmaceuticals, rubber and plastics" would be the most severely hit industry, as can be seen in Figure 6. In particular, the industry was estimated to suffer a loss of almost 25% in GVA in the long run from a no deal, compared to remaining in the EU. These estimates only consider the impact of trade disruption, but not migration or regulatory flexibility effects. Thus, given the above discussion, the impact onto the industry may be even more severe. The knock-on effect onto the food and beverage sector is difficult to pin down. It is unclear how the chemical industry would adjust to the additional costs, though it is reasonable that output prices may well be affected.

Figure 6: UK Government trade model predictions by sector



Central estimates only.[157]
This does not include migration or regulatory flexibility effects.
Other sectoral modelling suggests economic output in the agriculture sector could increase in a no deal scenario with EU MFN tariffs, although this is at the expense of consumers who face higher costs (see box on Agri-food additional modelling).
The benefits of new trade deals with countries outside of the EU are captured.
Sectoral GVA excludes tariff revenue.

Source: UK Government Analysis

3.3. Tariffs

The EU Customs Union ensures that all goods that cross borders within the EU are not subject to tariffs. Furthermore, all countries in the EU charge common tariffs to extra-EU goods imported to the bloc. When the Transition Period ends, the UK will leave the Customs Union and it may choose its own tariff schedule. Crucially, the World Trade Organisation (WTO) imposes that each member – which includes the UK – must impose the same tariff rate to all countries for each good. These are termed Most Favoured Nation (MFN) tariffs. The exception to this is if countries form a Preferential Trade Agreement then they can bilaterally negotiate tariff schedules, so long as liberalisation applies to almost all goods.[9] The upshot of this is that, unless the UK and EU can reach an agreement on the future relationship that sees tariffs fall to zero, the UK must impose its MFN tariffs on all goods from the EU and exporters in the UK would also face the EU's MFN tariff to ship its goods into the bloc.

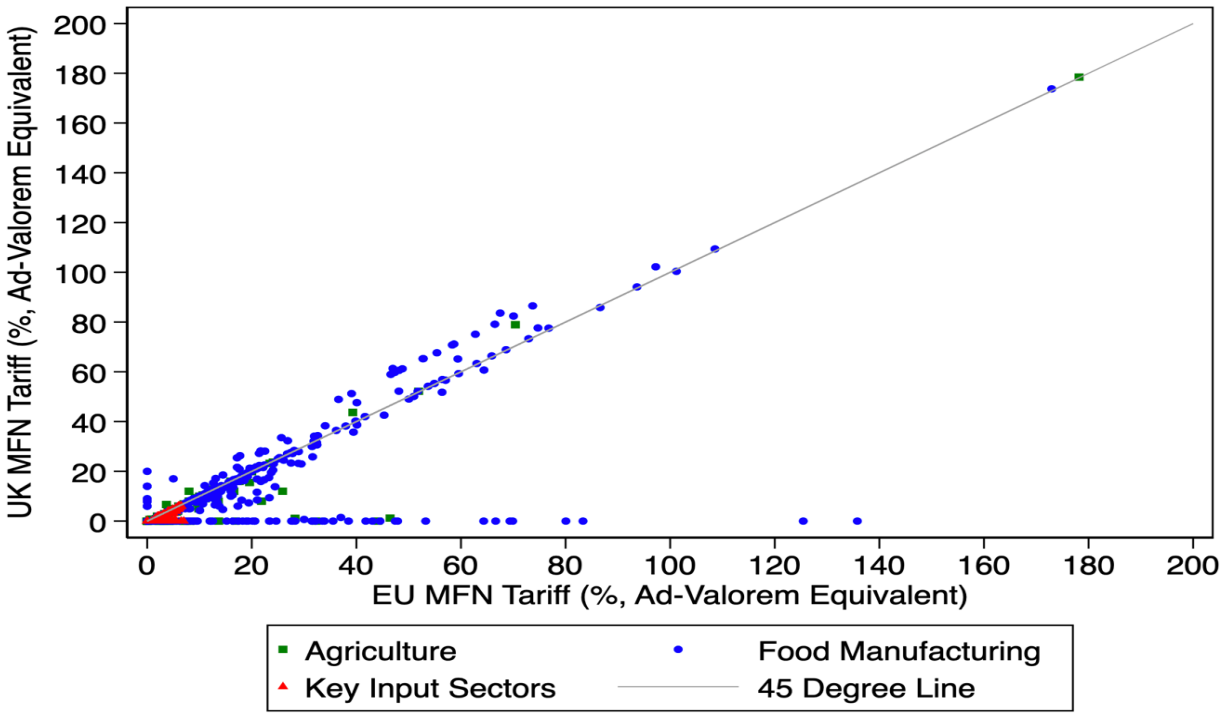
The UK recently published its own MFN tariff schedule that will come into place when the Transition Period ends.[10] Figure 7 shows how the current EU tariff rate compares to the UK rate for all products in the agriculture, food manufacturing and key input sectors to the food industry. The tariffs include an ad-valorem (percentage) equivalent of charges per weight, volume and concentration. Appendix A provides a description of the methodology used to impute these for the UK, which is based on equivalents produced by the EU.

The Figure shows that, in the majority of cases, the UK has either maintained the current MFN tariff rate or reduced the tariff rate. This means that goods entering the UK from outside the EU (and for which there is no trade agreement in place) after Brexit will generally be subject to similar tariffs to now.

However, the crucial point is that currently UK imports from the EU are not subject to any tariffs so, in the event of no deal, all goods for which the UK will impose tariffs on would then be subject to these tariffs. The same would be true for goods entering the EU from the UK. Figure 15 and Figure 16 in Appendix II show the values of UK and EU imports and exports against their potential future tariffs. In some cases, products that are heavily traded face large future tariffs.

[9] *That is, countries are not supposed to "pick and choose" which sectors to liberalise.*
[10] Available at: https://www.gov.uk/guidance/uk-tariffs-from-1-january-2021

Figure 7: UK and EU Most Favoured Nation tariff schedules (including ad-valorem equivalents of charges per weight/volume/concentration)



Source: UK Government and Eurostat

UK MFN tariffs for the agriculture and food manufacturing sector are on average 17.7%, which is considerably higher than the average trade weighted tariff for all other industries UK which stands at 3.6%.[11] As can be seen in Figure 7, tariffs for products in the food manufacturing sector are often non-zero, and in some cases can be quite high. Tariffs for products in key input sectors on the other hand are generally low, with a large portion having no tariffs, and the remainder all having tariffs at less than 10%. For EU MFN tariffs, the average weighted tariff in the agriculture and food manufacturing sectors is 21.7% and in all other sectors it is just 3.3%.

[11] *This is the tariff rate at the HS6 digit classification weighted by the volume of trade between the UK and EU in 2015 to account for differences in exposure. When unweighted, the UK tariffs are 11.9% for food and 2.5% for all other industries, while for the EU they are 15.0% for food and 3.8% for all other industries.*

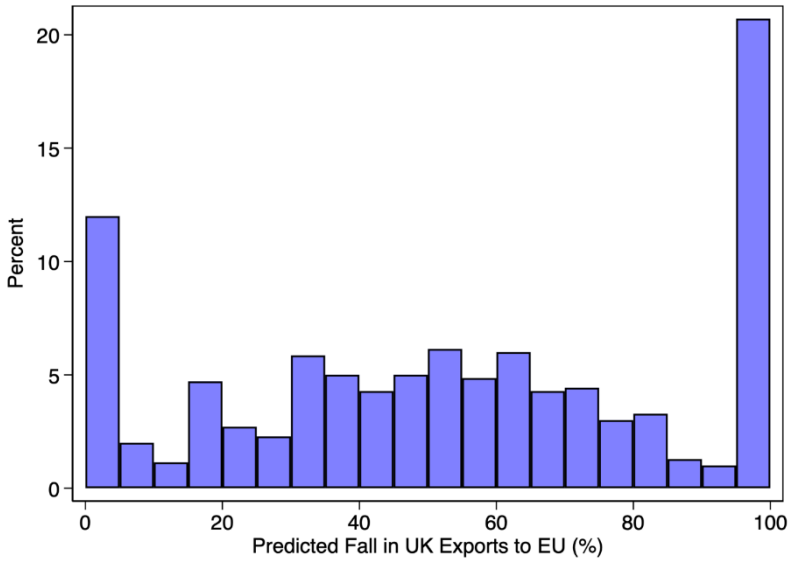
4. The Impact on Trade, Prices & Product Availability

In the following section we examine the impact of tariffs and non-tariff barriers on trade, prices and product availability. We examine two scenarios, a no deal scenario where UK-EU trade faces both MFN tariffs and NTBs, and a basic trade agreement where tariffs are eliminated and only NTBs remain. Ad-valorem tariffs used are those described in the previous section. The modelling of NTBs is slightly more complicated due to sector-specific regulations and the difficulty to estimate the impacts at the border. We therefore use estimates of ad-valorem equivalents (AVEs) of NTBs from the World Bank at the GTAP product level.[12] These are then combined with sector specific estimates of trade elasticities[13] and estimates of tariff to consumer price pass through from the existing literature to examine the impact on trade, prices and availability.[14] When examining the impact on prices we consider differential impacts across branded and specialised products in comparison to unbranded and more homogenous products.

While this is the best available resource for such an exercise there are some drawbacks. The increase in NTBs that Brexit is likely to induce with the UK's largest trading partner, is unprecedented and therefore the use of estimates of AVEs may not take into account crucial aspects of some barriers. For example, they may not fully account for change in port waiting times as discussed in section 3.1.3, especially where the effects may be non-linear.

Figure 8 and Figure 9 present the distribution of estimated UK-EU trade changes at the product level for goods in the food and beverage sector under a no deal scenario. As can be seen approximately 20% of F&B products traded from the UK to the EU will stop trading entirely, while approximately 17% will cease trading from the EU to the UK. Only for about 15% of product trade volumes are predicted to be unaffected in both cases, while the remainder of products experience effects relatively uniformly across the distribution of changes.

Figure 8: Distribution of predicted fall in UK exports to the EU across products in the no deal scenario

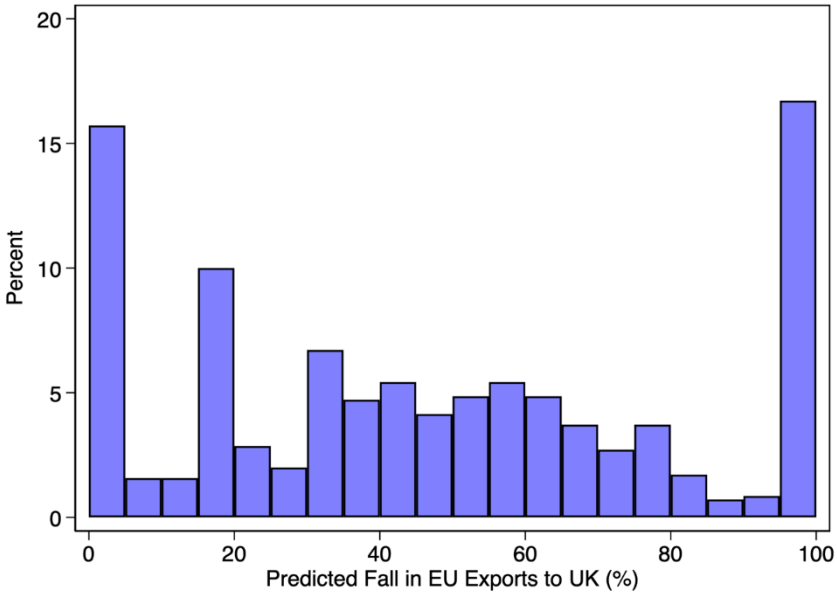


[12] *In particular, we use the NTBs estimated for importing into the EU from Canada, pre-CETA.*

[13] $TradeElasticity = \frac{\%\,\Delta\left(\frac{imports}{domesticdemand}\right)}{\%\,\Delta bilateraltradecost}$

[14] *For a full discussion of the methodology please see the methodology appendix.*

Figure 9: Distribution of predicted fall in EU exports to the UK across products in the no deal scenario



Source: Authors' calculations using UK tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Table 9 shows estimates of the impacts on exports from the UK to the EU at the sector level for changes in trade volume and product availability for F&B products and their key inputs in production. The impacts on the percentage change in trade are sizeable and almost always in double digits. Unsurprisingly, the estimated impacts are larger under a no deal setting than an FTA, though the difference in effect size between these two figures varies. Under an FTA the most affected sectors are Vegetable and Oil Fats (-57%) and Agriculture (-36%), this suggests that these sectors face the highest NTBs. Under a no deal scenario some sectors face almost a complete drop in UK exports to the EU. Both Dairy products and Animal feed are estimated to face drops in trade by more than 90%, while both Meat and Vegetable and animal oils and fats are likely drop by more than three quarters. While these affects are large, the average impacts bear some similarity to other key estimates from the recent literature. The Centre for Economic Performance's main trade model for example estimates a long run reduction in bilateral trade of approximately 40% across all industries under a no deal scenario (Dhingra et al., 2017). Estimates for the F&B industry are likely to be higher due to the fact they face considerably higher barriers as outlined in section 3.

Rubber and plastic products is estimated to the be the least effected industry with UK to EU exports dropping by 5% under an FTA and 13% under a no deal. Sectors do not see a drop in the number of product lines being bilaterally exported under an FTA except for Agriculture and Grain mill products and starch. Under a no deal however almost all food sectors are likely to experience product lines no longer being traded, and this is especially pronounced in the Agriculture, Meat and Grain mill products and starch sectors where, 61, 23 and 21 product lines respectively are estimated to stop being exported from the UK to the EU. Note that these are product lines, such that the number of actual products and brands that will stop being traded will be much larger.

Table 9: Predicted changes in UK exports to EU

Sector	Total UK Exports (£millions)	Share of UK Exports to EU	Number of Product Lines Exported from UK to EU	Predicted Percentage Change in UK Exports to EU		Predicted Number of Products No Longer Exported by UK to EU	
				Free Trade Agreement	No Deal	Free Trade Agreement	No Deal
Agriculture	2,197	65%	212	-36%	-69%	9	61
Meat	1,857	79%	86	-19%	-76%	0	23
Fish, fruit and vegetables	1,336	70%	191	-15%	-44%	0	8
Vegetable and animal oils and fats	375	72%	48	-57%	-76%	0	5
Dairy products	1,111	72%	24	-18%	-96%	0	18
Grain mill products and starch	751	70%	45	-24%	-68%	2	21
Bakery and farinaceous products	838	66%	9	-20%	-56%	0	0
Other food products	3,091	64%	68	-18%	-41%	0	3
Prepared animal feeds	618	69%	3	-20%	-98%	0	1
Paper and paper products	2,204	68%	122	-21%	-23%	0	3
Industrial gases, inorganics and fertilisers	1,866	58%	169	-13%	-27%	0	0
Dyestuffs, agro-chemicals	1,698	58%	48	-13%	-41%	0	0
Rubber and plastic products	6,900	64%	131	-5%	-13%	0	0
Fabricated metal products	4,930	47%	220	-23%	-36%	0	0

Source: Authors' calculations using EU tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Table 10 presents the estimated impacts onto consumer prices for products imported into the EU from the UK, under the two scenarios for both branded and unbranded products. As expected, price changes are higher under a no deal setting and for branded products. Branded and specialised product prices are more sensitive to trade costs for two reasons. Firstly, branded products often have greater consumer loyalty and therefore face a more inelastic demand curve meaning that importers are able to pass on the trade cost rise to consumers. Secondly, specialised products, especially those outlined in section 3.2.1 which have protected status face no competition from producers outside of the designated production area, and therefore are able to pass the trade costs on.

F&B input products such as Dyestuffs and Rubber and plastic products are estimated to face a considerably less severe price change than actual F&B products, and this is far more pronounced under a no deal setting as tariffs are generally higher for food products. We find that under a no deal setting branded Meat, Dairy and Grain mill imports are all estimated to face more than a 40% price raise. Unbranded imports into the EU in the same set of categories are estimated to face more than a 20% price rise.

Under the FTA scenario all price changes drop to single digits for both branded and unbranded products with the exception of Grain mill products and Vegetable and animal oils. In the case of unbranded products all price changes are less than or equal to 3%, with the exception of the previously mentioned two sectors.

Table 10: Predicted changes in EU prices of branded and unbranded products

Sector	Predicted Percentage Change in Consumer Prices: Branded Products		Predicted Percentage Change in Consumer Prices: Unbranded Products	
	Free Trade Agreement	No Deal	Free Trade Agreement	No Deal
Agriculture	1%	9%	1%	4%
Meat	7%	42%	3%	20%
Fish, fruit and vegetables	6%	16%	3%	8%
Vegetable and animal oils and fats	21%	30%	10%	14%
Dairy products	7%	57%	3%	27%
Grain mill products and starch	45%	64%	21%	30%
Bakery and farinaceous products	7%	21%	3%	10%
Other food products	7%	17%	3%	8%
Prepared animal feeds	7%	39%	3%	18%
Paper and paper products	2%	2%	1%	1%
Industrial gases, inorganics and fertilisers	3%	5%	1%	3%
Dyestuffs, agro-chemicals	3%	8%	1%	4%
Rubber and plastic products	3%	7%	1%	4%
Fabricated metal products	5%	8%	2%	4%

Source: Authors' calculations using EU tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Table 11 documents the most affected detailed product categories for UK exports to the EU. In almost all cases all product lines are estimated to no longer be exported from the UK to the EU under a no deal. Meat of sheep or goats (whether fresh, chilled or frozen) is estimated to stop being exported altogether, and the value of this currently stands at £299 million a year. A similar picture exists for other high value export products such as Meat of bovine, live Horses, asses, mules and hinnies, Wheat and meslin, Barley, Milk and cream, and Butter all of which are valued over £100 million a year. Aside from live equines and Wheat and meslin, the

effects are considerably softer under an FTA, with most drops in exports changing from 100% to less than 30%.

Table 11: Most affected changes in UK exports to EU for detailed product categories

Sector	Total UK Exports (£millions)	Share of UK Exports to EU	Number of Product Lines Exported from UK to EU	Predicted Percentage Change in UK Exports to EU		Predicted Number of Products No Longer Exported by UK to EU	
				Free Trade Agreement	No Deal	Free Trade Agreement	No Deal
Meat of sheep or goats: fresh, chilled or frozen	299	95%	9	-30%	-100%	0	9
Meat of bovine animals: fresh or chilled	257	97%	3	-30%	-100%	0	3
Horses, asses, mules and hinnies: live	334	64%	2	-100%	-100%	2	2
Wheat and meslin	250	59%	2	-100%	-100%	2	2
Barley	188	64%	1	0%	-100%	0	0
Milk and cream: concentrated or containing added sugar or other sweetening matter	243	48%	5	-18%	-100%	0	5
Butter and other fats and oils derived from milk: dairy spreads	102	86%	3	-18%	-100%	0	3
Birds' eggs, in shell: fresh, preserved or cooked	90	68%	1	-3%	-100%	0	1
Wheat or meslin flour	57	94%	1	-20%	-100%	0	0
Buttermilk, curdled milk and cream, yoghurt, kephir, fermented or acidified milk or cream, whether or not concentrated, containing added sugar, sweetening matter, flavoured or added fruit or cocoa	58	78%	2	-18%	-100%	0	2
Meat of bovine animals: frozen	59	72%	3	-30%	-100%	0	3
Whey and products consisting of natural milk constituents: whether or not containing added sugar or other sweetening matter, not elsewhere specified or included	44	74%	2	-18%	-100%	0	2
Wadding of textile materials and articles thereof: textile fibres, not exceeding 5 mm in length (flock), textile dust and mill neps	51	62%	3	-79%	-100%	0	1
Bananas, including plantains: fresh or dried	19	100%	1	-34%	-100%	0	1

Source: Authors' calculations using EU tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

The impact on EU exports to the UK paints a similar picture, though with some differences to UK exports to the EU. As seen in Table 12, impacts are considerably worse under a no deal scenario, and in general F&B products are more severely impacted than their input products. In terms of missing product lines, only Agriculture and Grain mill products are affected in the FTA setting, however in the no deal setting all food products are estimated to experience some missing product lines, with the most affected sectors being Agriculture, Meat and Dairy products.

A key difference however between the UK exports to EU, and EU exports to UK estimates is the impact these changes will have for the respective trading areas. As can be seen by the third column in Table 9, the share of UK exports going to the EU for all of the considered sectors is very high. In all cases bar Fabricated metals, the EU buys more than half of UK exports and for the food sectors, the average share of UK exports going to the EU is above two thirds. For some specific product lines, this figure is above 90%, such as Bovine meat, as seen in Table 11. This means that these changes are likely to have a large effect on UK companies that are exporting these products. Conversely, as can be seen by the third column in Table 12, the UK purchases a considerably smaller share of EU exports, in many cases the share is less than 10%.

Table 12: Predicted changes in EU exports to UK

Sector	Total EU Exports (£millions)	Share of EU Exports to UK	Number of Product Lines Exported from EU to UK	Predicted Percentage Change in EU Exports to UK		Predicted Number of Products No Longer Exported by EU to UK	
				Free Trade Agreement	No Deal	Free Trade Agreement	No Deal
Agriculture	73,313	8%	211	-29%	-72%	10	48
Meat	39,132	12%	88	-16%	-59%	0	21
Fish, fruit and vegetables	30,730	10%	188	-18%	-54%	0	5
Vegetable and animal oils and fats	16,838	6%	47	-61%	-77%	0	4
Dairy products	29,685	8%	24	-18%	-94%	0	18
Grain mill products and starch	10,110	9%	44	-28%	-57%	2	7
Bakery and farinaceous products	12,260	13%	9	-20%	-79%	0	1
Other food products	49,262	10%	68	-19%	-40%	0	3
Prepared animal feeds	8,810	8%	3	-20%	-22%	0	0
Paper and paper products	61,657	8%	120	-20%	-20%	0	1
Industrial gases, inorganics and fertilisers	25,778	6%	170	-13%	-26%	0	0
Dyestuffs, agro-chemicals	16,647	5%	48	-13%	-39%	0	0
Rubber and plastic products	100,071	6%	131	-5%	-12%	0	0
Fabricated metal products	94,831	6%	219	-23%	-28%	0	0

Source: Authors' calculations using UK tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Table 13 documents the estimates onto consumer prices at the sector level for goods imported into the UK from the EU. Intermediate inputs for the F&B industry are estimated to experience comparatively low-price increases, and even in the case of a no deal scenario, price changes are in single digits even for branded goods. In the case of an FTA, unbranded intermediate inputs are estimated to only increase by 1%. F&B products imported from the EU on the other hand are estimated to see considerable price increases, especially

under a no deal scenario. Unbranded Meat, Dairy and Grain mill products are estimated to experience 15%, 26% and 56% price increases and their branded counterparts are even higher. For example, speciality cheeses like Halloumi, Gorgonzola, Feta and Roquefort are estimated to experience price increases of 55% under a no deal scenario, while speciality prosciutto and bratwurst could see increases of 31%.

Similar to the issue discussed above, these price changes are likely to have a far more pronounced effect on the UK market, than on the EU market, for a number of reasons. Firstly, there are far more EU products with protected status, than UK products, and therefore the number of speciality products which the UK imports that can't face direct competition is larger than the EU counterpart. Secondly, the share of UK F&B imports coming from the EU is far higher than the share of EU imports coming from the UK.

Table 13: Predicted changes in UK prices of branded and unbranded products

Sector	Predicted Percentage Change in Consumer Prices: Branded Products		Predicted Percentage Change in Consumer Prices: Unbranded Products	
	Free Trade Agreement	No Deal	Free Trade Agreement	No Deal
Agriculture	2%	9%	1%	4%
Meat	6%	31%	3%	15%
Fish, fruit and vegetables	7%	20%	3%	10%
Vegetable and animal oils and fats	23%	32%	11%	15%
Dairy products	7%	55%	3%	26%
Grain mill products and starch	104%	119%	49%	56%
Bakery and farinaceous products	7%	29%	3%	14%
Other food products	7%	16%	3%	8%
Prepared animal feeds	7%	8%	3%	4%
Paper and paper products	2%	2%	1%	1%
Industrial gases, inorganics and fertilisers	3%	5%	1%	2%
Dyestuffs, agro-chemicals	3%	8%	1%	4%
Rubber and plastic products	3%	7%	1%	3%
Fabricated metal products	5%	6%	2%	3%

Source: Authors' calculations using UK tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Table 14 documents some of the most affected EU exports to the UK at a detailed product category level. As can be seen by the third column the share of EU exports to the UK is considerably less than the UK counterparts in Table 11, however they are still sizeable for some products. For example, the value of Bovine meat exported to the UK from the EU is approximately £750m a year. Similar to the case for UK exports to the EU, under a no deal all products are estimated to cease being imported into the UK from the EU. Under an FTA scenario this figure falls to only 4 products.

Table 14: Most affected changes in EU exports to UK for detailed product categories

Sector	Total EU Exports (£millions)	Share of EU Exports to UK	Number of Product Lines Exported from EU to UK	Predicted Percentage Change in EU Exports to UK		Predicted Number of Products No Longer Exported by EU to UK	
				Free Trade Agreement	No Deal	Free Trade Agreement	No Deal
Meat of bovine animals: fresh or chilled	6,242	12%	3	-30%	-100%	0	3
Buttermilk, curdled milk and cream, yoghurt, kephir, fermented or acidified milk or cream, whether or not concentrated, containing added sugar, sweetening matter, flavoured or added fruit or cocoa	1,922	18%	2	-18%	-100%	0	2
Horses, asses, mules and hinnies: live	819	33%	2	-100%	-100%	2	2
Butter and other fats and oils derived from milk: dairy spreads	2,612	8%	3	-18%	-100%	0	3
Olive oil and its fractions: whether or not refined, but not chemically modified	4,010	4%	2	-63%	-100%	0	2
Wheat and meslin	9,074	2%	2	-100%	-100%	2	2
Lettuce (lactuca sativa) and chicory (cichorium spp.) fresh or chilled	1,032	14%	4	-34%	-100%	0	4
Milk and cream: concentrated or containing added sugar or other sweetening matter	4,729	3%	5	-18%	-100%	0	5
Meat of bovine animals: frozen	1,178	11%	3	-30%	-100%	0	3
Apricots, cherries, peaches (including nectarines), plums and sloes, fresh	1,563	8%	4	-34%	-100%	0	4
Cucumbers and gherkins: fresh or chilled	804	14%	1	-34%	-100%	0	1
Whey and products consisting of natural milk constituents: whether or not containing added sugar or other sweetening matter, not elsewhere specified or included	1,664	4%	2	-18%	-100%	0	2
Birds' eggs, in shell: fresh, preserved or cooked	1,498	5%	1	-3%	-100%	0	1
Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots: fresh or chilled	485	9%	2	-34%	-100%	0	2

Source: Authors' calculations using UK tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Table 15 and Table 16 show the EU countries whose food sectors are most likely to be affected under a no deal Brexit. Unsurprisingly, Ireland comes out top in both tables. Ireland is predicted to have a 30% reduction in its *total* food exports, with currently 43% of all of its food exports going to the UK. The predicted fall in Ireland's imports is expected to amount to 33.6% of its current imports. Cyprus is heavily affected in terms of exports. Spain, Netherlands, Belgium, Denmark, France, Italy, Greece and Poland are also expected to have sizable falls in their exports, amounting to around 5% of their total food export value. The import effects are generally smaller than those for export but still represent a fall of around 2% of total imports for France, Netherlands, Denmark, Spain, Sweden and Belgium.

Table 15: EU countries with the greatest predicted fall in exports

Country	Predicted Percentage Fall in Food Exports: Free Trade Agreement	Predicted Percentage Fall in Food Exports: No Deal
Ireland	11.1%	29.9%
Cyprus	4.2%	16.8%
Spain	2.5%	6.7%
Netherlands	2.4%	6.4%
Belgium	1.8%	5.7%
Denmark	1.8%	5.3%
France	1.9%	5.3%
Italy	1.8%	5.1%
Greece	1.7%	5.1%
Poland	1.6%	4.5%

Source: Authors' calculations using UK tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Table 16: EU countries with the greatest predicted fall in imports

Country	Predicted Percentage Fall in Food Imports: Free Trade Agreement	Predicted Percentage Fall in Food Imports: No Deal
Ireland	12.6%	33.6%
Malta	2.4%	6.5%
Cyprus	1.4%	3.8%
France	0.9%	2.5%
Netherlands	0.8%	2.1%
Denmark	0.5%	1.8%
Spain	0.7%	1.7%
Sweden	0.6%	1.6%
Belgium	0.4%	1.5%
Finland	0.5%	1.4%

Source: Authors' calculations using UK tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Table 15 and Table 16 document the estimated impacts on changes to the total value of food imports and exports of EU-UK trade, for the most affected EU countries. Under both scenarios the impacts on EU exports to the UK are considerably higher than the impact on imports from the UK. Aside from Ireland, Cyprus is likely to see the largest fall in food, and in a no deal scenario this effect is in double digits. Spain, Netherlands,

Belgium, Denmark, France, Italy, and Greece are all estimated to see falls in the region of 5%, holding all other things constant.

It is important to note that estimates for Ireland should be treated with extra caution. A significant proportion of the trade between Ireland and the UK is likely to happen at the Ireland-Northern Ireland border, and with the goods remaining on the island post trade. This trade is likely to be considerably less affected due to the Northern Ireland Protocol, which ensures goods moving between the two countries are not subject to border controls, and those goods for domestic use will not be subject to tariffs. Due to data limitations our modelling treats Northern Ireland as part of the UK and therefore does not take this feature into account. Nor are we able to make any assessment on the impact of trade between Northern Ireland and Great Britain.

In all cases, a Free Trade Agreement would significantly reduce the impacts on each country. These numbers do not account for potential readjustment of exports and imports across countries. Instead, they show how the fall in trade with the UK compares with their total global food exports and imports.

5. Brexit and the Food & Beverage Labour Market

The decision of the United Kingdom to leave the European Union has important implications for the food and beverage industry, from the producer to the final consumer. In this section we will focus on the labour market implications, along the supply chain of the food and beverage industry, with a particular focus on labour supply within the Food and Beverage industry.

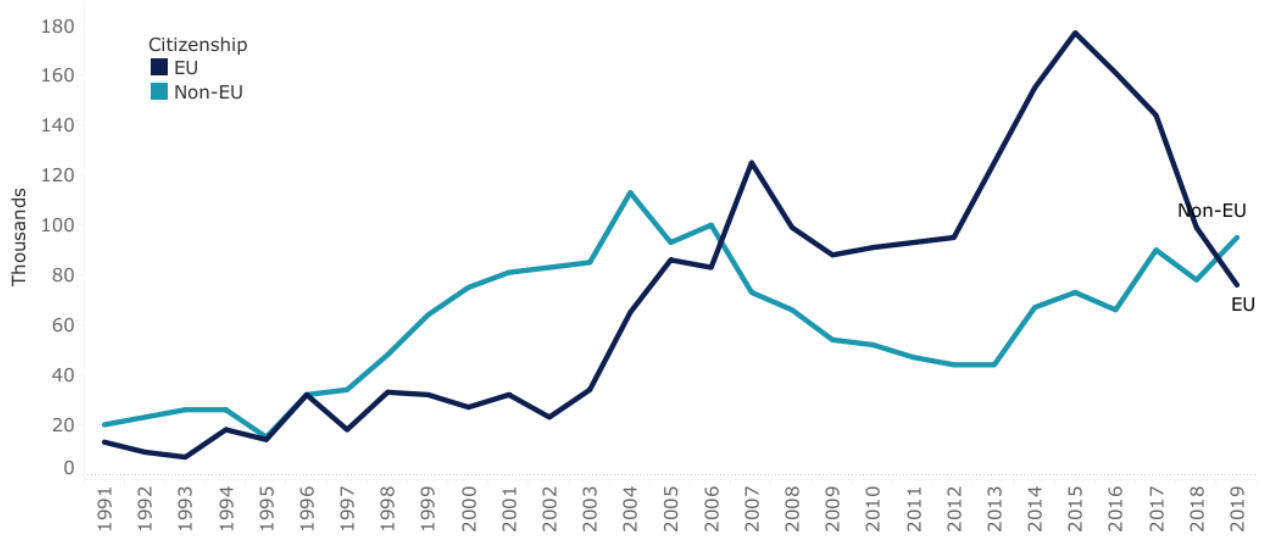
At the time of writing this report the UK labour market is facing its worst crisis in a generation. The impact of the COVID-19 pandemic on the economy has resulted in an increase of 117% in the number of individuals claiming unemployment benefits since March 2020, approximately 7.5 million workers are temporarily away from work (i.e. furloughed) and between the first and second quarter of the year the number of hours worked in the economy dropped by almost 20%. There still exists a great degree of uncertainty concerning the future of the UK labour market, and therefore analysis laid out in this document is subject to those same uncertainties. That said, a loose labour market as a result of the pandemic could mean that filling vacancies which otherwise would have been filled by EU workers may not be as difficult as previously assumed and therefore may soften some of the following impacts.

5.1. The impact of the referendum on aggregate labour supply

Since the referendum, there has been a rapid decrease in net migration from the EU to the UK, with current estimates suggesting it has fallen by more than 50% (Figure 10), putting net migration at its lowest level for 16 years. Statistics from the ONS suggest a large portion of this drop is attributable to those EU migrants coming to the UK to look for a job, rather than those coming with a job offer in hand. In the year following the referendum the number of migrants from the EU looking for a job fell by almost two thirds. However, since 2018, the portion of workers with a job in hand migrating from the EU to the UK has also dropped considerably. High-skilled workers are generally more likely to migrate for a definite job while low-skilled workers tend to migrate first and then look for a job locally. Therefore, the observed drop in migration is most likely predominantly driven by a drop-in net-migration of low-skilled workers, however there will undoubtedly be falls in skilled migrants as well.

Since changes in legislation will not be active until 1st January 2020, the observed drop in migration may continue in the coming years. The observed migration response that has already appeared is likely driven by the following set of factors (Portes 2016). First, the decrease in sterling decreases the effective real wage of migrants that send remittances to their origin countries or plan to spend their savings abroad. Second, the referendum has created uncertainty about the future status of migrants in the UK which decreases the benefits of migration. Third, the focus on migration during the campaigns, as manifested in the increase of hate crimes around the referendum (Home Office 2017), is a psychological factor reducing net migration.

Figure 10: Long-term work migration by citizenship, 1991-2019



Source: ONS, International Passenger Survey table 3.08 (1991-2018) and LTIM Provisional Estimates, year ending December 2019. Note: Figures only include people who say that they intend to move to the UK for at least 12 months; they do not include ONS adjustments for migration between the UK and Ireland, people who change their intended duration of stay, and asylum seekers. Data come from a sample survey with large confidence intervals, so small differences may not be statistically significant. Data from 2001-2011 have not been revised following the results of the 2011 Census, which showed that the IPS had underestimated net migration of EU citizens during this period.

Under the proposed immigration system EU citizens will be treated similarly to workers from the rest of the world and freedom of movement, which has been a feature of the UK-EU labour market since 1992, will come to an end. EU workers wanting to work in the UK will require a work visa and must fulfil several criteria. In particular, they must:

1) Have a job offer from an approved employer where they:
    a. will need skills at least equivalent to A-levels;
    b. will be paid more than £25,600 per annum, or the lower quartile of the average salary, whichever is higher;
    c. or are to work in a shortage occupation or have a relevant PhD in a STEM subject, where the threshold will then be £20,480;
    d. or have a relevant PhD in a non-STEM subject, where the threshold will then be £23,480;
    e. or are to work in the NHS or education sectors, where there will be no salary threshold, assuming the skill equivalent is at least to A-levels.

2) Speak English at the required level.

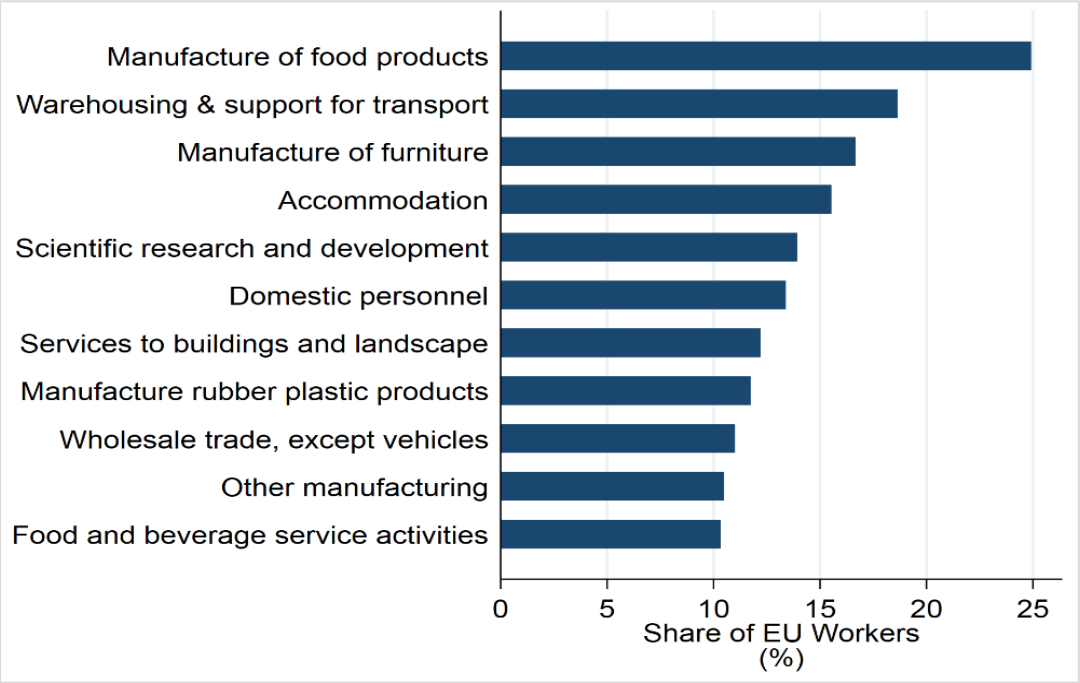
The above represents a significant change when compared to free movement and will likely prevent lower skilled EU migrants from entering the UK. Skilled migrants who meet the necessary criteria will need their prospective employer to apply on their behalf, will incur fees for applying and have fewer rights than is the current case, such as access to the benefit system. It is worth noting however that the new system represents a lowering of barriers for migrants from the rest of the world, which may mean that the change in the inflow of skilled workers into the UK could be on net positive.

Estimates suggested that ending free movement would reduce net migration from the EU to the UK by 90,000-150,000 per year, compared to pre-referendum levels which has mostly already occurred. If further large falls occur, it would require resident EU workers in the UK to leave (Portes, 2020).

5.2. EU workers in the Food & Beverage sector

The food and beverage industry is, by some measures, the most exposed industry to changes in UK-EU labour movement. Figure 11 shows the share of EU workers by industry, for the industries with the highest 11 shares.[15] Manufacture of food products has the highest share of EU workers out of all 89 industries at this level of aggregation, and the proportion is considerably larger even to other highly ranked industries. Approximately 25% of workers in the manufacture of food products industry are from the EU, while the average industry only has a share of approximately 7%. The industry with the second highest share, warehousing and support for transport, has a share of approximately 19% and is an important downstream industry for the distribution of food and beverages. Other important upstream and downstream industries to the food and beverage sector with a high share of EU workers includes manufacture of rubber and plastic products and food and beverage service activities.

Figure 11: Share of EU workers by industry



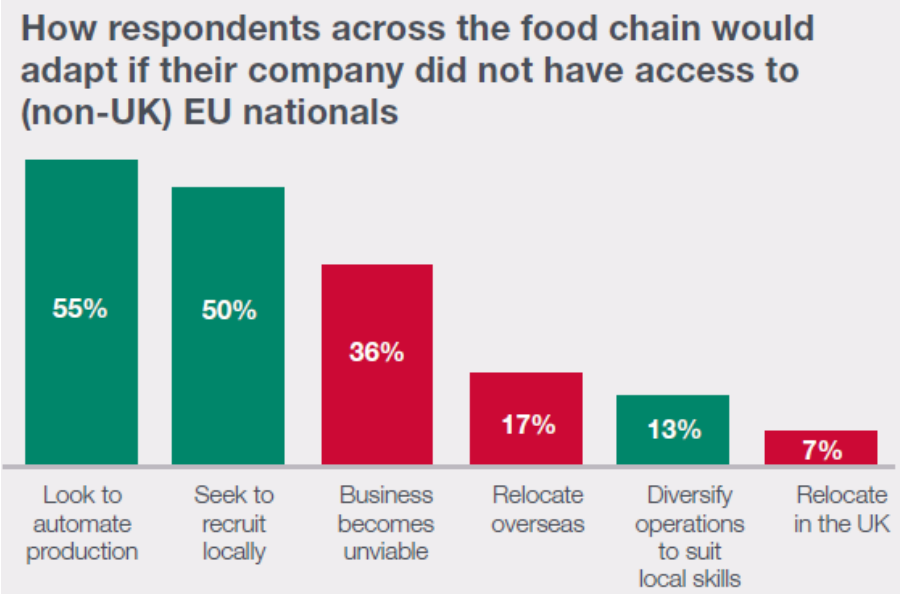
Source: Author's calculations using data from the Labour Force Survey

Evidence from the LFS suggests that the EU workers in the food and beverage industry are predominantly low skilled. Their average wage stands at £9.50 per hour, which is equivalent to an annual salary of approximately £18,500, falling far short of the new threshold. Additionally, three quarters of the workers fall under the occupation groupings of "Elementary Occupations" and "Process, Plant and Machine Operatives" implying they are not working in highly skilled or technical roles.

The above suggests the food and beverage industry is extremely exposed to the new immigration system. A recent survey of producers along the food supply chain suggests that producers who rely more on migrant labour from the EU will react to a decrease in migration from the EU by increasing automation, recruiting locally and in some cases, business may become unviable (see Figure 12).

[15] *Industries are measured at the 2 digit SIC code level.*

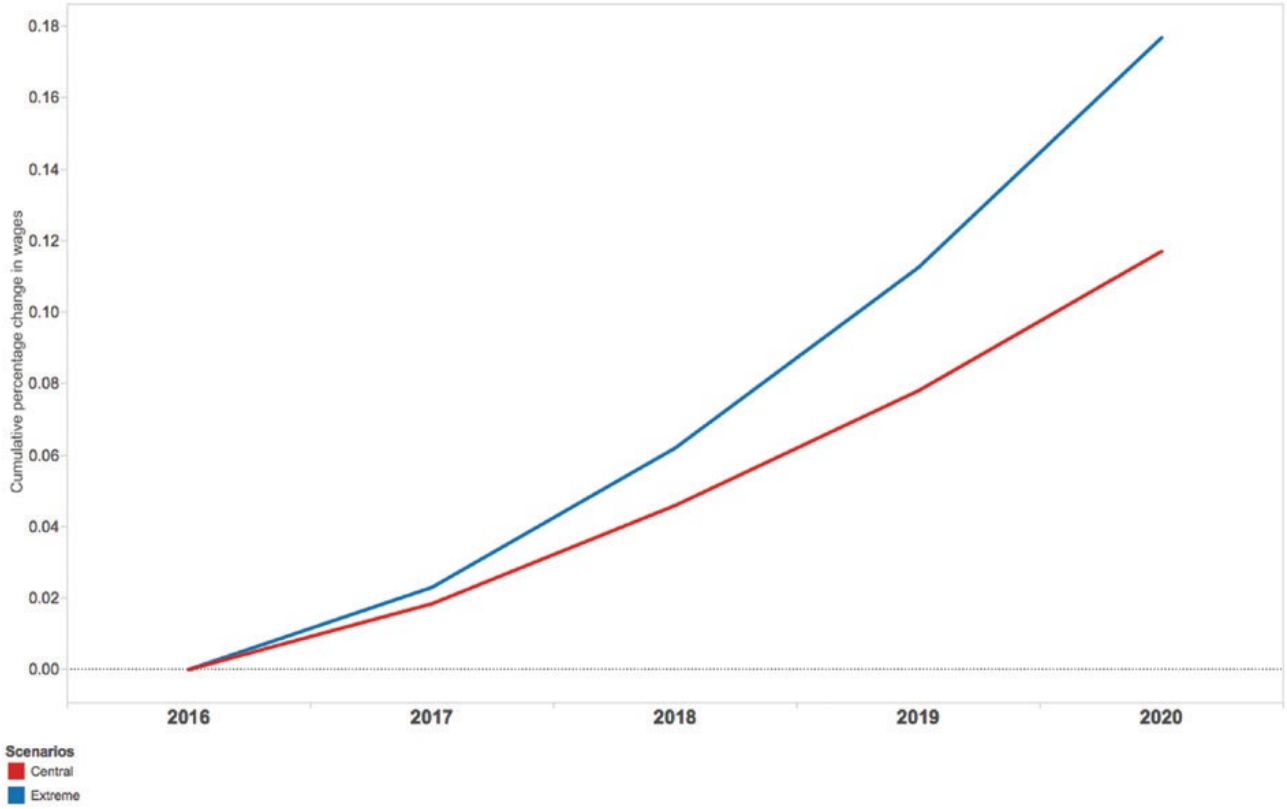
Figure 12: Industry-level strategic responses to a reduction in migration



Source: Food and Drink Federation (2017)

Academic studies on the effect of migration on wages suggest that these effects are likely to be small. Portes and Forte (2017) predict a cumulative increase in wages of 0.12 percent by 2020 and 0.51 percent by 2030 for low- to medium-skilled service sectors, and it's regarded that's an upper bound for the wage effect (see Figure 13).

Figure 13: Predicted cumulative wage effect of reduced migration



Source: Portes and Forte (2017)

However, a source of uncertainty with these estimates is that most studies examining migration effects on wages are based on an increase in migration, since abrupt decreases in migration have been less commonly observed in more recent times. Additionally, they look at mean wage effects across entire skill groups, which may hide heterogeneous impacts across unskilled occupations. During a period with a tight labour market companies seeking to recruit locally, especially for jobs which natives have a lower preference for, may need to increase wages to attract local workers. This in turn could induce a cost shock for the food and beverage industry which would likely result in some margin of adjustment, such as higher consumer prices or lower profit margins. Due to the current state of the labour market this effect may well be muted as it may be easy to fill vacancies due to higher rates of unemployment, or underemployment.

Given the above, concerns of a cost shock induced by drops in unskilled EU migration are unlikely to be a first order concern for the food and beverage industry, and for consumers of their products. However, given the high level of exposure that the industry has it would be reasonable for the government to place unskilled occupations related to the industry on a watchlist to be considered as a shortage occupation, potentially with a lower salary threshold of £18,500.

6. Disruptions and Risk Management

As seen from the previous sections the future relationship between the UK and the EU will affect trade and non-trade costs in a variety of ways. In both the no deal and FTA scenarios farmers, hauliers, brokers, freight forwarders, port authorities and traders will be impacted and this section includes the findings from the literature review and interviews conducted to illustrate some of those disruptions, but the list is not exhaustive.

For producers, traders and logistics businesses, the most important changes and regulations include tariffs, declaration costs, port check times, product of animal origin checks and potentially organic certification, and rules of origin. In the longer term, the cost of inputs and cost from UK divergence are the most problematic. Recently, both Logistics UK and the British International Freight Association (BIFA) have expressed concerns about the preparedness of Great Britain to implement new customs documentation and procedures, which would apply in both the no deal and FTA scenarios.

At the same time, research commissioned by Arla Food UK highlights that consumers expect to continue having access to high quality products at a reasonable price. The report highlights a few crucial points for what shoppers in the UK value most and the potential impacts a future deal may have on them:

1. Shoppers feel **price increases** and change in availability are most likely to occur
2. Shoppers value **product quality** the most and expect food standards to remain to a high standard
3. Shoppers **expect British made products** to be readily available on shelves, and of high quality – with most unwilling to pay a premium but shoppers don't expect disruption to yoghurt, milk and non-specialty cheese to last as long as categories believed to be imported from the EU.

Our research highlights that consumers are highly dependent on products originating in the EU and producers outline potential disruptions, which customers do not expect. We expand on each one below.

- **Price increases** in all categories, especially everyday essential items such as butter, soft cheese and Mozzarella and speciality products like flavoured yogurts, specialty cheeses, and smaller batch brands;
- **Reduced availability** for those products that are not sourced in the UK, where in the long-term smaller brands may stop selling due to high tariffs and low demand;
- **Inability of local production** will not be able to compensate for the reduced availability due to the lack of existing capacity;
- **Disruptions despite preparations: retailers are working with suppliers and hauliers** to avoid short-term disruptions but most operators see those as inevitable without additional measures both in the no deal and FTA scenarios.

We expand on each one of these areas below and we conclude by setting out the impact on the EU and policy recommendations.

6.1. Price and Availability of Products

Results from multiple studies show that depending on the trade deal scenario, there will be an increase in UK retail prices especially vis-à-vis meat and dairy products. Studies predict that these price increases will result

in a loss of consumer welfare[16]. Operators are particularly concerned about the timing of the end of the transition period, which coincides with the Christmas peak season for the food and beverage industry. While these effects are likely to affect the majority of the sector, we zoom in on dairy as a proxy to some of the changes in the industry.

The recent experience with COVID-19 showed the effects of panic buying but also subtle changes in the industry, which may remain the long term. These included: a move from fresh to filtered products due to longer shelf and fridge life; surge in the use of cream related to increase in home meal preparation; as well as surge in the use of butter, which is particularly associated with consumers who are preparing baked goods at home *(Virtual Interview A, 18 August 2020)*.

The quantitative analysis highlights that under a no deal scenario a number of product lines including yoghurt, buttermilk, dairy spreads, milk and cream are estimated to cease being imported into the UK from the EU. This is confirmed by stakeholders who preview disruptions to both everyday essentials and specialty products. In the first group, worse affected are butter, cream cheese and mozzarella for pizza.[17] Butter will be the top affected product for import in the UK from the EU, where the expected impact is an increase in the price at consumer level. To avoid a price increase, suppliers can use downsizing (smaller pack) as a mitigation strategy to offload some of the tariff impact. In the long term some operators can move production to the UK, but the price hike would have already taken place across the sub-sector.

Products to be most affected include spreadable cheese such as cream cheese which will be subject to a high tariff. In the case of cream cheese, the pricing is transactional and the price increase will be felt by the entire market, moving it upwards. In the case of mozzarella for pizza, where currently the majority is imported, companies to satisfy existing contracts will have to freeze mozzarella in the short term *(Virtual Interview C, 2 September 2020).* Only one producer in the UK has the capacity to increase production and produce locally and price increases are also expected.

On the specialty products, stakeholders highlight that EU specialty cheeses make up approx. 50% of the UK market. These will attract big tariffs and while in the long-term production may shift to the UK for some brands, some of the smaller brands will no longer be available. This is a particular problem on the specialty side since they already attract smaller volumes and they are more vulnerable to price hike and reduced demand. Finally, specialty yogurts that have recently attracted consumers in the UK will also be affected. Companies will either have to accept smaller margins or leave entire brands to die out. Therefore, branded and specialty products experience a higher risk to move out of the UK market, due to reduced volumes, which would make them unprofitable. Retailers are trying to limit risk as much as possible and are demanding information on production and packaging sites and potential disruptions *(Virtual Interview B, 26 August 2020)*.

6.2. Quality and Food Standards

The new UK agriculture subsidy program emphasizes environmental and sustainable practices but so far has not finalised the arrangements for Great Britain's regime for animal and plant health. Most recently, Department for the Environment, Food and Rural Affairs (DEFRA) has confirmed the transposition in UK law of the Official Controls Regulation and Animal Health and Plant Health Regulations but they have notified that they will be doing so with some exceptions. The uncertainty created by the absence of an SPS regime is very problematic for both parties.

While the former Secretary of State at DEFRA promised to uphold EU bans on substandard food imports, the current official has not guaranteed to keep these regulations, leaving room for future international trade deals

[16] European Agriculture after Brexit: Does Anyone Benefit from the Divorce?, Journal of Agricultural Economics, 2020
[17] *Operators also discuss cheddar cheese but to a lesser extent in comparison to the other products.*

to allow food imports of inferior quality[18]. The tension between EU and US approach to certain food processing standards fall outside of the scope of the study, but some operators mentioned their concern in view of a potential US-UK agreement. Stakeholders also question whether the UK will keep the import restrictions on bovine growth hormones and carcase microbial treatments *(Virtual Interview J, 17 September 2020).*

Currently most UK retailers and suppliers have their own schemes and standards and have voiced that they will upkeep them, especially in relation to a potential agreement with the US) *(Virtual Interview D, 8 September 2020)*. One of the biggest concerns to the National Farmers Union at the minute is food standards from outside of the EU in case of trade diversion after the end of the transition period. For example, in early July, the National Farmers Union gathered more than 1,038,900 signatures for a petition to maintain the UK's high food standards. The US has signalled readiness to work with the UK on a swift agreement, but US business are waiting to see the outcome of the EU-UK negotiations.

6.3. Local Production and Other Disruptions

What the two scenarios mean for UK farmers? UK farmers are expecting both a supply impact (feed and fertilisers) and a cost impact (fuel) *(Virtual Interview D, 8 September 2020)*. On the input side, they are very reliant on feed and fertilisers from the EU (direct effect) while currency impacts are to affect the third component – fuel. For example, soy as a main type of feed imported into the UK, there may be potential new suppliers (South America) or looking towards other sources of protein (oilseed rip which can be a direct replacement according to one of the interviewees). Another concern are chemicals and cleaning products, which can be pre-stocked for the next harvesting if farmers are made aware in advance *(Virtual Interview D, 8 September 2020)*. Some farmers in the UK have already started preparing via focus on resilience. Finally, farmers are very reliant on EU labour, which is a particular concern in the produce sector – salad and veggies but also affects other products. This is in line with the academic literature where multiple studies suggest a potential impact on production in the UK due to migrant labour restrictions.

The uncertainty over the impending trade deal has implications for farm managers' planning. Many studies illustrate possible logistical risks relating to transportation delays and disruptions due to increased time for border checks and unclear customs clearance procedures. Much of the literature shows that these disruptions caused by Brexit will affect Ireland's food supply chain most negatively[19]. Interviewers also point out to:

- Need to complete commercial invoices, which are in turn used to make a customs declaration[20] for all exported goods *(Virtual Interview C, 2 September 2020)*
- Need to apply an export health certificate ahead of time *(Virtual Interview C, 2 September 2020)*
- Need to become aware and comply with new systems and hope they will be in place under the Border Operating Model, Goods Vehicles Management System and Smart Freight Software app *(Virtual Interview J, 17 September 2020).*

6.4. Impact on the European Union

All EU-27 countries will be negatively affected by a no deal Brexit, the magnitude of the impact increasing with economic proximity to the UK. Interviewers point to ongoing monitoring of supply demand changes and quick response to market dynamics. The sectors most likely to be impacted, in order of EU to UK export turnover,

[18] *"British farmers fret about losing their protection and their subsidies", The Economist, 2020*
[19] Research for AGRI Committee, EU - UK Agricultural Trade: State of Play and Possible Impacts of Brexit, 2017
[20] See for example, https://www.dsv.com/en/insights/brexit/export-guide.

are: fruit and vegetables, beef meat, pig meat, dairy and wine. However, other agricultural sectors (e.g. flowers, ornamental plants, and rice) will also be affected subsequently *(Virtual Interview F, 9 September 2020)*.

While there is agreement in the literature that agri-trade between the EU and the UK would significantly decline under MFN tariffs scenario, there are opposing projections for the impact of Brexit on local production depending on the member state. On the EU side, many studies that have been conducted to estimate the economic impact of a no deal option project that an increase in UK import prices would cause an increase in domestic EU production[21]. Other papers suggest that local EU production would decrease, particularly in the meat sector, as a result of a reduction in exports to the UK[22]. In both the no deal and FTA scenarios, respondents preview that long-term EU producers will have to relocate production to the UK to avoid tariff and non-tariff barriers. While this will be exacerbated in the no deal case, producers will still find it beneficial to avoid customs, NTBs and the potential uncertainty of future divergence by moving production to the UK at the expense of EU production.

In addition to the linkages described in the quantitative part, one of the main risks for EU operators is the reduced export of final products to the UK resulting into higher cost, loss of trade flow and finally, oversupply in the European Union. This is particularly relevant for the meat sector with products to suffer the most, including beef, pig and sheep meat. In the case of meat products veterinary checks, storage aspects, and just-in time logistics are also relevant. In addition to final products, intermediate products which currently used for input to export to the UK will have to find alternative markets (e.g. fats which go in butter), which will also affect market prices.

Overall, the countries most affected are Ireland, Germany, France, Spain, Belgium, the Netherlands, and Denmark with the Netherlands being deeply impacted *(Virtual Interview F, 9 September 2020)*.

On the input side, pricing and availability depends on regulatory processes to put fertilisers and pesticides on the UK market – plant protection products will suffer from higher administrative burden and higher cost due to tariffs, so there will be consequences for both sides *(Virtual Interview F, 9 September 2020)*.

- EU exporters to the UK will also need to factor in cost at the border, which is still under preparation;
- EU exporters will also suffer from increased competition, particularly food and vegetables;
- Supply chains to third countries will be affected.

Potential mitigation measures include market and product diversification, training new staff, and avoiding unnecessary divergence in SPS standards.

6.5. Mitigation measures

Both the UK and the EU are preparing for Brexit through the issuing of notices, legislative initiatives, and contingency planning. The UK announced the Direct Payments to Farmers Bill that replaces the EU's CAP highlighting the role of environmental sustainability, requirements for multi-annual financial assistance plans from Ministers, food security reports, as well as fertiliser and animal identification regulations[23]. The literature recommends that stronger collaboration efforts between supply chain actors and a post-Brexit trade policy that eliminates import tariffs could help to reduce the increase in agriculture prices[24].

[21] *Brexit's Agri-trade Impacts on the Netherlands, 2018*
[22] *The potential economic impact of Brexit on Denmark, OECD Economics Working Papers, 2019*
[23] Agriculture Bill 2019-21 Commons Research Briefing, House of Commons, 2020
[24] *European Agriculture after Brexit: Does Anyone Benefit from the Divorce?, EuroChoices, 2020*

Operators in the UK are already increasing stock levels as the main strategy to deal with a no deal Brexit, which comes at a cost of other investment. These include:

1. Storing extra produce in existing facilities
2. Renting other facilities for additional storage for products, which have a longer shelf life in the short term
3. Delivering product to supermarkets' depots ahead of time

Traders are also considering to absorb tariffs on key products in Q1 and Q2 and in the meantime increasing the capacity of existing facilities. In the long term, setting local production in the UK for everyday essentials is bound to expand but will require greenfield investment, which would in turn mean that companies will have to redirect resources from other geographies / products *(Virtual Interviews A, B, E).* This is a likely scenario with a 2-3-year lead time and disruptions in the meantime are still possible since it is unlikely that local producers will be able to increase production to compensate (Virtual Interview E). Finally, producers are considering transformations from chilled to frozen products to avoid short shelf lives.

7. Policy Recommendations

Based on the quantitative and qualitative analysis, the following policy recommendations may alleviate the impacts on the food and beverage sector in a no deal Brexit and for some areas, the FTA scenario.

For both parties, **tariffs** present the highest potential cost for operators and tariff-free trade is crucial to avoid the most negative effects of Brexit on the food supply chain and consumer choice.

For the European Union:

- **Tariffs:** All EU-27 countries will be negatively affected by a no deal Brexit, the magnitude of the impact increasing with proximity to the UK, with Ireland, Germany, France, Spain, Belgium, the Netherlands and Denmark most affected. As a priority, the EU should avoid the reintroduction of tariffs on trade in both directions, to minimise the potential for disrupting the supply chains set out above.

- **Custom procedures and non-tariff barriers:** Customs border and other procedures at the border would add a considerable amount of time to journeys between EU27 and UK with significant impact for perishable goods.
    - The EU and the UK should avoid the creation of new non-tariff barriers and custom requirements
    - There should be full recognition of food safety systems and veterinary certifications
    - The EU should continue adhering to a risk-based approach to pesticides and residue levels, in order to avoid disruptions to exports.

- **Local production to the UK:** Stakeholders shared that one of the key expectations in the long term is for production to shift from the EU to the UK both in the no deal and the FTA scenarios, but particularly for the former. This would entail loss of production in the EU.
    - Similarly, some of the brands, which may no longer be available in the UK will lose out due to the time it has taken them to establish themselves.
    - EU producers have already made investments in facilities in the EU and the UK and will take long time to diversify their product portfolios.

- While **market diversification** and **product diversification** are available long-term strategies for EU producers, in the short term, there may be oversupply of certain products, which are exported to the UK.
    - This is particularly relevant for the meat sector with products to suffer the most, including beef, pig and sheep meat.

For the United Kingdom:

- **Tariffs** are very high on average in the food and beverage sector. Tariff-free trade between the UK and EU must be maintained which, due to World Trade Organisation rules, is only possible if a trade agreement is secured. A no deal Brexit would be devastating for the UK food sector: it would leave the UK with a decision of whether to either (i) maintain high tariffs at the expense of consumers facing significantly increased prices or (ii) reduce tariffs and expose UK producers to intense competition from all across the world which is likely to significantly undermine the UK food and drink industry.

- Vis-à-vis **custom procedures and non-tariff barriers**, the key recommendation is for full recognition of food safety systems and veterinary certifications and avoiding the creation of new non-tariff trade barriers in customs and border requirements, as well as confirming Great Britain's smarter rules for safer food (SRSF) package as soon as possible. A no deal Brexit must be avoided, but in both the no

deal and Brexit scenarios the following recommendations could alleviate some of the disruption in the sector. These will need to apply to all countries with which the UK trades on MFN terms:

  - Clarifying the UK's Border Operating Model and providing clear guidelines on the eligibility and procedure for simpler customs clearance and payment of customs duty
  - Possibility for phasing-in further the custom clearance and customs duty requirements after June 2021 due to the lack of preparedness for border checks
  - Ensuring that the Goods Vehicles Management System and Smart Freight Service are tested and functional before the end of the year. It is essential for the Government to ensure that the IT systems and infrastructure can cope with export and import of agricultural products, including the Republic of Ireland.
  - Risk particular to perishable goods increase in lead time of products due to checks in ports. For fresh produce avoiding this disruption would be very difficult, only few hours of delay would be tolerable.

- In the food and beverage sector, the end of the transition period coincides with the **Christmas peak season**, which increases the risks of shortages due to depleted stocks.
  - Scheme for support towards increasing stock since Christmas is peak time and stocks run low.
  - Considering modifications to the UK's Border Operating Model to preview a longer phase-in period for pre-notifications and customs checks on perishable goods.
  - The Groceries Supply Code of Practice (GSCOP) is legislation designed to regulate the relationship between supermarkets and their suppliers. It calls for reasonable notice to vary supply agreements or to make significant changes to supply chain procedures, which is usually 12 weeks' notice. This means that operators need to have sufficient time to assess impact on price and communicate price increases ahead of time.

- **Food standards and animal welfare:** UK producers have a reputation for high animal welfare, environmental and food standards. The future relationship and UK's agricultural policy should not undermine that with cheaper imports, which do not pertain to the same high standards, since this will affect British producers and consumers, as well as relationship with the European Union. Stakeholders expect that the UK will champion even higher animal welfare standards, particularly in the area of animal transport.

- Due to the **effect on the labour market**, certain F&B low skilled occupations such as Food and Drink Process Operatives (SOC10: 8111), Packers, Bottlers, Canners and Fillers (SOC10: 9134) and Farm Workers (SOC10: 9111), should be included on the shortage occupation list, with an annual salary in line with the Living Wage Foundations' recommended hourly rate.

- The COVID-19 crisis highlighted that one of the main disruptions to supply chains is **panic-buying.** Policymakers should consider the introduction of:
  - Communication campaigns around the availability of products;
  - Ensuring systems in place to avoid panic buying;
  - Discussions with retailers based on experience with the pandemic.

8. Appendix I: Methodology

8.1. A: Tariffs

Methodology for construction of ad-valorem equivalents

All tariff rates are constructed at the 6-digit HS 2017 level. For cases where there are multiple product lines per 6-digit product, we take the mean tariff rate. Our analysis uses HS2007 6-digit codes as they can be mapped to the UK input-output table classifications. To get the tariff rates to the 6-digit HS2007 level, we use a mapping from HS2017 to HS2007 and use the number of product lines as frequency weights in cases where the mapping is one to many.

The methodology for constructing ad-valorem equivalents (AVE) for charges per weight, volume and concentration is the following. First, the EU publishes AVE tariff rates both including and not including additional charges. We therefore compute the simple difference between the rate including the additional charges and the MFN tariff rate (which excludes the additional charges). We also have information on the EU's charges per weight/volume/concentration and, in almost all cases, there is only one unit of additional charges per product.[25] We therefore compute a scalar measure of how the weight charge translates to the AVE charge for each product. Then, for each product in the UK tariff schedule, we multiply this measure by the UK's charge per weight to arrive at the AVE tariff schedule for the UK that includes both the MFN rate and additional charges.

8.2. B: Methodology for forecasts

To predict changes in trade flows between the UK and EU, we use the most detailed tariff data available at the HS6 level. We combine this with ad-valorem equivalent values for non-tariff barriers taken from the World Bank data catalogue. These NTB AVE estimates are at a more detailed level of aggregation which we match to 6-digit HS codes. We assume that the level of NTBs between the UK and EU will be equivalently restrictive as those between Canada and the EU. We then use the tariff and NTB AVE to get a percentage measure of the increase in trade costs arising from NTBs only (which we consider as the case of a trade agreement) and NTBs plus tariffs (which we consider as no deal). Note that all changes in trade barriers between the UK and EU will be weakly positive i.e. either 0 or greater than 0.

The second crucial ingredient to predict changes in trade flows is a measure of how trade flows respond to changes in trade cost – this is known as the "trade elasticity". We take trade elasticity estimates by sector from Caliendo and Parro (2015) – see Table 1 of the paper columns title θ^j for the parameter values. The trade elasticity for agriculture is 8.11, which suggests that a 1% increase in trade costs causes an 8.11% decline in the bilateral trade flow. The elasticity for food manufacturing is 2.55% and the average across all sectors is 4.55%. Elasticities vary across sectors for a variety of reasons such as how homogenous the product is – goods that are more homogenous can be more easily imported from other countries so a given rise in trade costs causes a larger fall in trade flows.

Then we can use this combined with our trade cost measures to predict changes in trade flows as:

$$Predicted\ \%\ change\ in\ trade\ flows = Trade\ elasticity \times Change\ in\ trade\ costs$$

[25] *There are 6 cases where dairy products face additional charges per weight and concentration of lactic matter, in which case our method would not work. Here, we note that the charges per lactic matter are almost identical for the UK and EU schedules, so we can ignore the charges per lactic matter in our imputations (as they don't change, the weight variables pick up all of the change).*

For each HS6 product line, we bound this predicted change at 100% and impose that products that are currently non-traded, of which there are very few, receive a 0% predicted change in trade flows. To aggregate the numbers to the broader sector aggregations presented in the paper, we weight each predicted change in trade flows by the value of bilateral imports and exports between the UK and EU in 2015 for each detailed product line. To compute the predicted number of product lines that will cease trading, we simply create a count of the number of product lines predicted to fall by 100 percent.

To estimate predicted changes in prices, we use the same measures of changes in trade costs but instead of a trade elasticity we use measures of expected pass through from trade costs to prices, which differ for branded and unbranded goods.

8.3. C: Methodology for qualitative analysis

The literature review was conducted by first identifying the research questions and then using key word searches to find and select relevant studies, organize the studies based on target group (i.e. farm managers, supply chain managers, logistics companies, and EU exporters and importers), and collect, rate and summarize the main conclusions. A comprehensive search using the key terms including Brexit, UK, EU, supply chain, agri-trade, trade disruption channels, food products, food sector, agriculture, and impact. The number of relevant documents found was 15 published from 2016 to 2020. The review provides a broad range of the literature including academic studies, government reports, and media pieces.

Documents were excluded from this study if they were published before the Brexit referendum in 2016. Sources published in a language other than English were also excluded. This study could be extended to better understand the implications for EU member states.

To triangulate the results from the quantitative analysis and literature review, the team also conducted interviews with thirteen stakeholders in the UK and the EU. They encompassed representatives from Arla Foods UK, other suppliers, logistic companies and farm managers, and cross-cutting associations. The interviewee results were recorded in a confidential manner. Below is the list of conducted interviews and interview guide used for the study.

List of conducted interviews

- Virtual Interview A, 18 August 2020.
- Virtual Interview B, 26 August 2020.
- Virtual Interview C, 2 September 2020.
- Virtual Interview D, 8 September 2020.
- Virtual Interview E, 9 September 2020.
- Virtual Interview F, two attendees, 9 September 2020.
- Virtual Interview G, 9 September 2020.
- Virtual Interview H, 15 September 2020.
- Virtual Interview I, 16 September 2020.
- Virtual Interview J, three attendees, 17 September 2020.

Interview Guide

Structure: 15-20 min MS Teams/Zoom semi-structured interview

Draft Questions:

1. Farm managers

1. General: what product categories do you produce?
2. For which final and intermediate products do you rely on non-UK producers?
   2.1. Are there intermediate products that are crucial for the production process and complications because of regulatory issues and border delays might be very disruptive (i.e. intermediates that might act as "bottlenecks")?
   2.2. Are there alternative suppliers in the UK or in third countries who can produce a similar quality at a similar price?
3. How do you expect food standards to be affected?
4. How do you expect product traceability to be affected?
5. What measures are you putting in place to avoid any disruptions?
6. What mitigating measures would you propose?

2. Supply chain manager at a supermarket

1. Which product categories do you see as most affected as a result of Brexit?
   1.1. What about everyday essentials?
   1.2. What about specialty products (specialty cheeses, cured meats, etc.)?
2. Will firms/supermarkets increase inventory or accept that there might be temporary disruptions in the supply of certain products?
   2.1. What measures are you putting in place to avoid any disruptions?
3. Do supermarket managers expect change in availability of certain products?
   3.1. Which EU products and brands do you see as most likely to be affected?
   3.2. Do they see potential replacement with non-EU products?
4. Shoppers expect British made products to be readily available on shelves, to what extent is this feasible?
5. How do they manage food standards across your supply chain?
6. What mitigating measures would you propose?

3. Logistics company

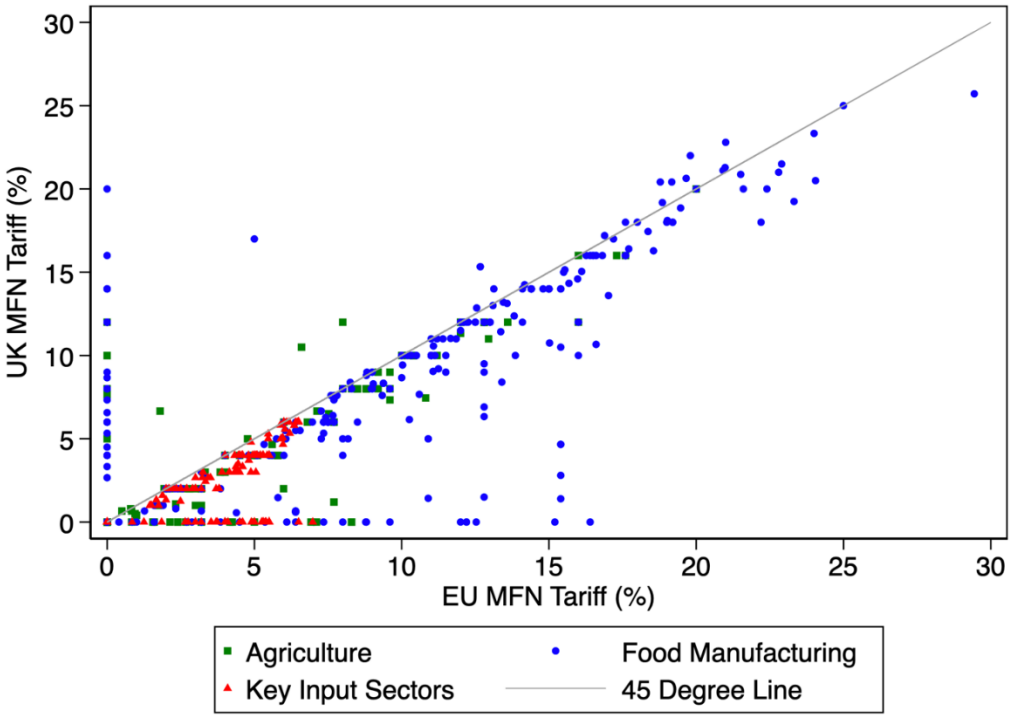
1. Which product categories do they see as most affected as a result of Brexit?
2. Do they expect any disruptions in terms of declaration costs, port check times, product of animal origin checks and potentially organic certification, rules of origin, tariffs and quotas?
3. What measures are you putting in place to avoid any disruptions?
4. What about the changes to rules re product traceability and food transportation standards?
5. Do you expect redirection towards non-EU suppliers?
6. What mitigating measures would you propose?

4. Exporter/importer of food from the EU

1. General: what product categories do you import / export?
2. Do exporters expect to pass on any tariffs etc to their buyers?
3. Do exporters worry to be driven out of the market due to higher tariffs?
4. Will firms move production to the UK?
5. Do you expect ceasing the importation of specific EU brands? Do you expect a redirection towards non-EU products and brands?
6. How easy it is to find a domestic alternative for an important product (i.e. products where the supply chain is not very resilient to a trade disruption)?
7. What measures are you putting in place to avoid any disruptions?
8. What mitigating measures would you propose?

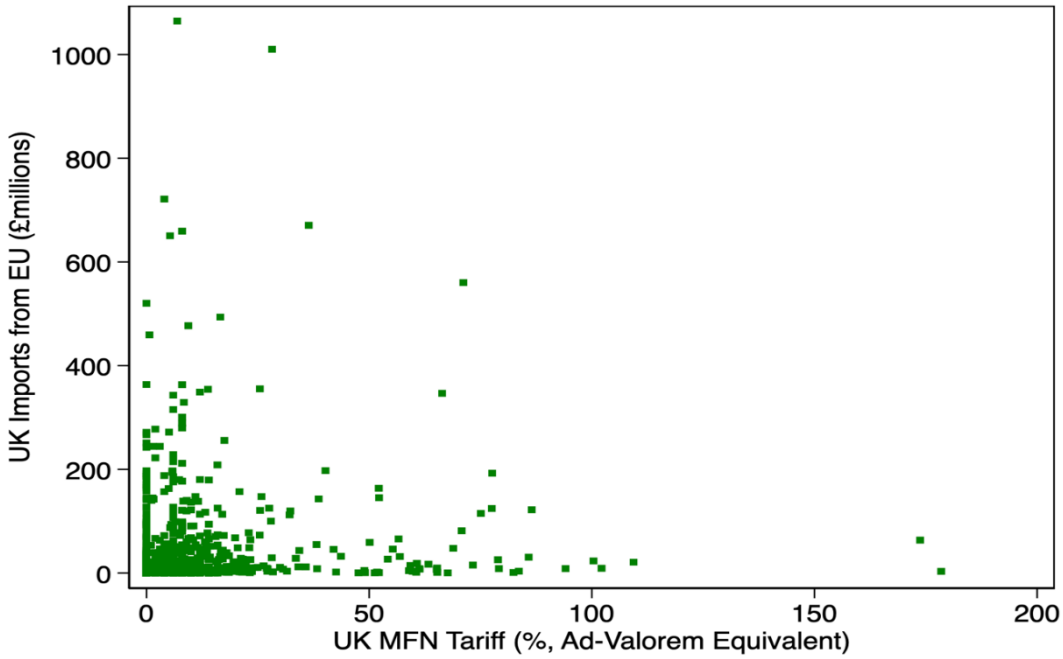
9. Appendix II: Additional figures and tables

Figure 14: UK and EU Most Favoured Nation tariff schedules (excluding ad-valorem equivalents of charges per weight/volume/concentration)



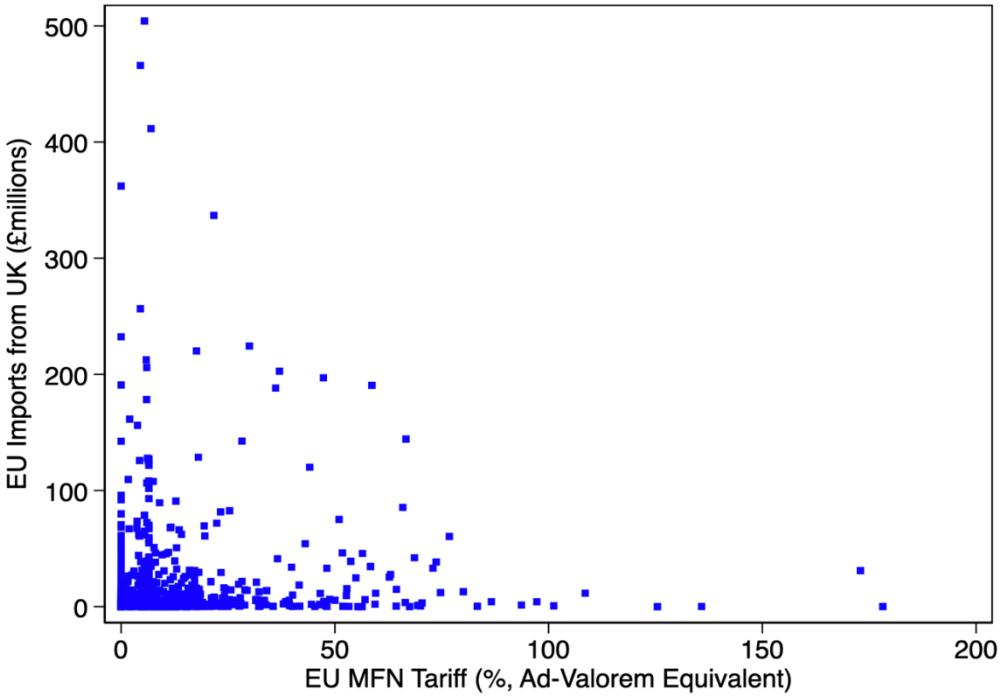
Source: UK Government and Eurostat

Figure 15: UK imports from EU against UK most favoured nation tariffs



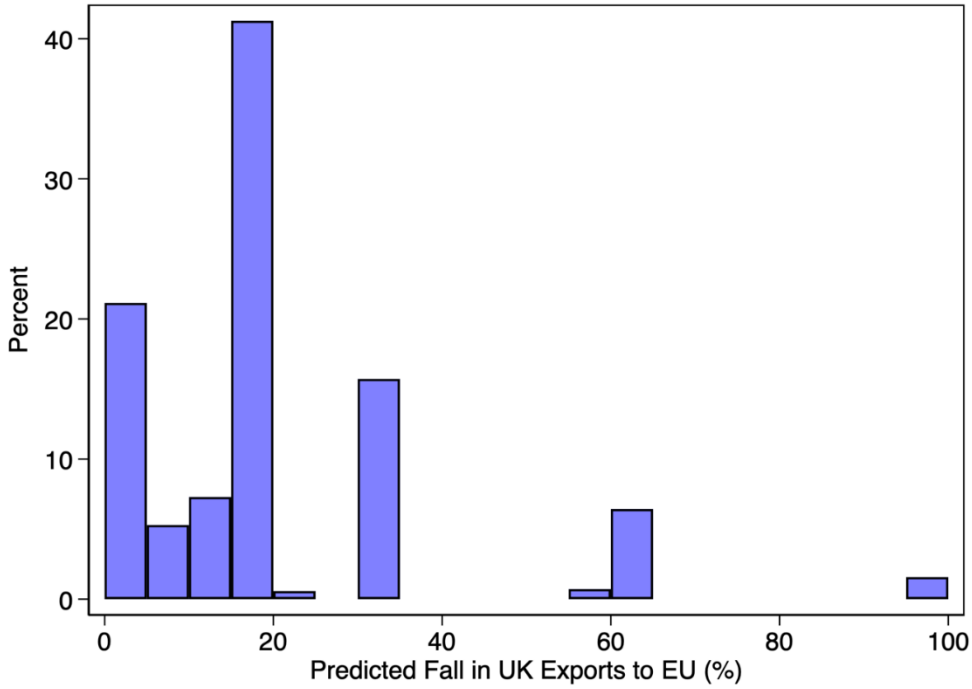
Source: UK Government and BACI Trade Data

Figure 16: UK exports to EU against EU most favoured nation tariff



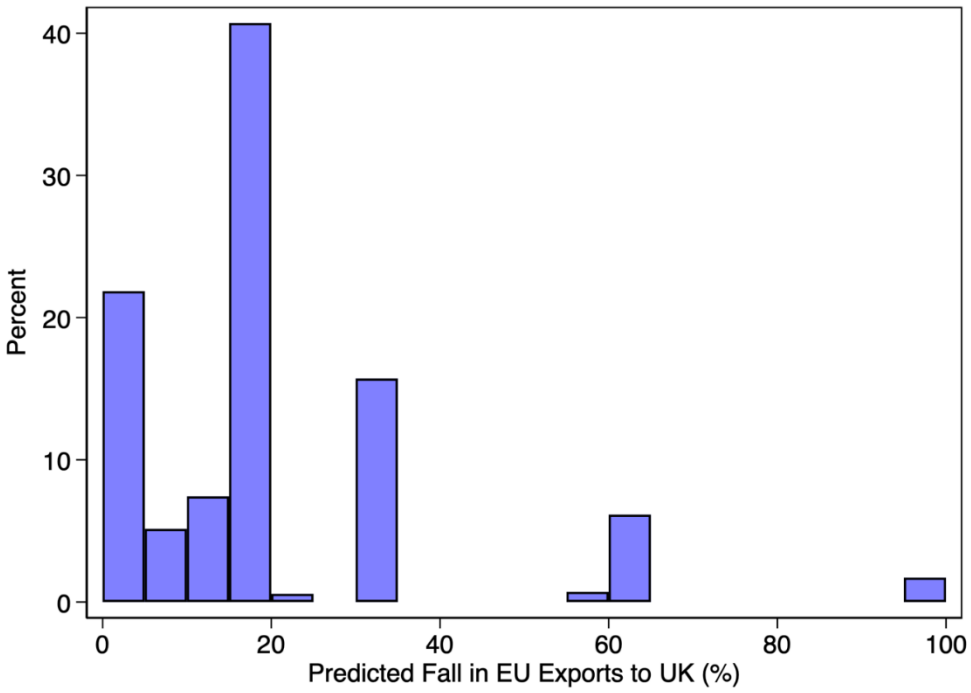
Source: UK Government and Eurostat

Figure 17: Distribution of predicted fall in UK exports to the EU with zero tariffs (only non-tariff barriers)



Source: Authors' calculations using EU tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

Figure 18: Distribution of predicted fall in EU exports to the UK with zero tariffs (only non-tariff barriers)



Source: Authors' calculations using UK tariff data, World Bank non-tariff barrier data and trade elasticities parameters from Caliendo and Parro (2015).

10. Appendix III: Summary table of key studies

Source	Year	Focus	Methodology	Key Finding
Brexit Poses Serious Threats to the Availability and affordability of food in the United Kingdom; Journal of Health	2018	Availability and price of product	Qualitative study	Identifies 5 threats: disruption of import supplies, domestic food production based on migrant labour, prices of food, delays in logistics, and negative impacts on the food supply chain in Ireland
Supermarkets will run out of food and people's health will be at risk; Institute of Economic Affairs	2019	Disruptions	Qualitative study	Despite legal and technical measures being implemented, there is a large risk of delays and logistical disruption that necessitates more support for small and intermediary businesses
Brexit: How might UK Agriculture Thrive or Survive; Newcastle University	2019	Disruptions	Impact assessment using Computable General and Partial Equilibrium (CGE and CPE) Models and survey data	Highlights Brexit implications for farmers, food security and uncertainty that complicates farmers' ability to plan
Brexit's Agri-trade Impacts on the Netherlands	2018	Price of product, local production	AGMEMOD (CPE model)	• Analyses 2 scenarios: 1. EU-UK FTA and 2. Default WTO rules • The analysis compares the differences in price, production, impacts on Dutch trade and UK imports in these two scenarios • Under scenario 2, UK imports become more expensive leading to a decrease in consumption and a potential increase in domestic production • Dutch trade effects are limited in either scenario, under the second scenario; model shows that production values would decline by 2%
The potential economic impact of Brexit on Denmark, OECD Economics Working Papers	2019	Local production	METRO model compatible with CGE approach using the OECD's Trade	• Assumes a "no deal"/WTO rules trade agreement between EU-UK • Agri-food exports to the UK would fall by 24% • Meat production declines more than any other sector

			in Value Added data (TiVA)	
European Agriculture after Brexit: Does Anyone Benefit from the Divorce?, Journal of Agricultural Economics	2020	Availability and price of product, Local production	Common Agricultural Policy Regionalised Impact Modelling System (CAPRI); PE	• Analyses the impact on welfare focusing on the agricultural sector of 4 possible trade deal scenarios between the UK-EU ranging from an EEA relationship to a relationship based on Most Favoured Nation (MFN) status • Conclusions show an increase in UK agricultural prices, particularly meat and dairy • Largest welfare loss is born on UK consumers which outweighs producer and taxpayer gain
Research for AGRI Committee, EU - UK Agricultural Trade: State of Play and Possible Impacts of Brexit	2017	Local Production, Disruptions	MIRAGE model (CGE)	• Analyses agri-trade between the EU-UK after a return to WTO conditions • Shows a likely significant decrease in trade in the meat and dairy sectors but a potential for the EU to boost red meat, cattle and wheat production • Findings show that Brexit will affect Ireland most negatively
Implications of a UK exit from the EU for British agriculture; Study for the National Farmers Union (NFU)	2016	Availability and price of product, Local production	AGMEMOD (CPE model) based on Farm Accountancy Data Network (FADN) data	• Investigates 3 scenarios of impact on trade and farm income (UK-EU FTA, WTO default, UK Trade Liberalisation (TL)) • Positive price impacts from FTA or WTO default scenario are offset by negative effects of direct support payments • A reduction of direct payments would worsen negative effect of farm incomes in UK TL scenario
OECD-FAO Agricultural Outlook 2020-2029	2020	Availability and price of product	Aglink-Cosimo model (CPE model)	• Analyses global food supply chain within context of COVID-19; overview on global agri-trade • Assumes no differences in trade agreements in context of Brexit but briefly mentions potential impacts in production and prices in UK that could affect global dairy and meat markets

The impacts of changes in agricultural policies in the United Kingdom on trade and agriculture - A literature review	2019	Availability and price of product, Local production	Scoping literature review	• Existing literature predicts a reduction in UK's GDP by varying degrees depending on trade deal scenario • Most studies show a larger impact on UK than EU member states besides Ireland • Most studies show negative impact on UK domestic consumption
Research into the checks on goods imported into the European Union; Culture, Tourism, Europe and External Affairs Committee, Scottish Parliament	2020	Disruptions	Qualitative study	• Provides background on logistical procedures that apply to imported goods to the EU that could apply after the transition period for the UK • Procedures depend on border type and serve different purposes including safety and security checks, customs clearance, and standards/regulations checks
Brexit Scenarios: An Impact Assessment; Agriculture & Horticulture Development Board	2017	Local production (UK), availability and price of product	CPE Model	• Models 3 different Brexit scenarios 1) "business as usual", 2) unilateral liberalisation, 3) WTO rules under MFN status • Shows impact on cereal, horticulture, processed potatoes, sheep, beef, pigs and dairy sectors • Under scenario 1, most sectors are unchanged (price increases offset) • Under scenario 2: most Farm Business Income is positive except meat sector • Scenario 3: FBI is negative for cereal and meat sector
Local food supply chain resilience to constitutional change: the Brexit effect; International Journal of Operations & Production Management	2019	Disruptions	Multiple Case Study Analysis	Results emphasize the importance of collaboration between supply chain actors to anticipate and mitigate disruption that is uniquely tied to constitutional change and requires a targeted resilience-building process
Brexit: potential impacts on economic welfare of UK farm households	2020	Local production		Examines various Brexit scenarios showing that the elimination of direct payments to farmers contributes to a farm vulnerability and could impact economic welfare of farmers

Will a No-Deal Brexit Disturb the EU-UK Agrifood Trade?, EuroChoices	2019	Availability and price of product		• Findings show EU exports of meat are most impacted by the No Deal scenario as UK tariffs on meat productions will increase significantly • The EU is a big wine and cheese supplier to the UK but removal of import tariffs on wine could introduce third markets

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