



Impacts of Alternative Post-Brexit Trade Agreements on UK Agriculture: Sector Analyses using the FAPRI-UK Model

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Executive Summary

Brexit will have important implications on UK agricultural commodity markets due to potentially significant changes to trade flows. The analysis in this paper quantifies the sectoral impacts on UK agriculture of alternative trade agreements following Brexit using a partial equilibrium modelling framework; the FAPRI-UK model in combination with the FAPRI-EU model (GOLD). The modelling system captures the impacts on commodity markets as a result of changes in trade flows with the EU and the rest of the world. It has been substantially updated to account for the fact that in the case of Brexit the UK and EU markets would no longer be fully integrated. In this study we examine three Brexit trade scenarios:

- Bespoke Free Trade Agreement (FTA) with the EU;
- World Trade Organisation (WTO) default Most Favoured Nation (MFN) tariffs; and
- Unilateral Trade Liberalisation.

In order to isolate the impacts of these policy changes the projections based on these alternative Brexit trade scenarios are compared against a Baseline in which the UK is fully integrated within the Single Market. In comparison with the Baseline, the three scenarios differ only with regard to trade policy. Thus, within the scenario analysis, domestic support and underlying macroeconomic assumptions, e.g. exchange rates, are unaltered compared to the Baseline. It is also implicitly assumed that labour supply and the regulatory framework for farm businesses are unchanged. The outputs from the partial equilibrium modelling system provide projected changes at the sector level, including producer commodity prices, livestock numbers, production, consumption, imports and exports.

The scenarios are designed to be illustrative of a broad range of potential trade arrangements, rather than speculating on the final outcome of the Brexit trade negotiations. In practice the trade arrangements finally adopted by the UK are likely to be some hybrid of these scenarios and may vary by sector.

Considerable efforts have been made to ensure the modelling system is robust, however we acknowledge that all models, of necessity, are abstractions of reality. We have assumed that trade facilitation costs associated with different trade agreements are caused by the associated additional administration rather than wider non-tariff barriers. Consistent with other partial equilibrium models, commodities are modelled at the aggregate level and thus it is necessary to impose a single tariff for each commodity rather than multiple tariff lines. Our import/export data source excludes processed meat and we note that disruptions to trade in processed meat may have knock-on impacts on the pig and poultry sectors in particular. Also, the magnitude of the changes under each scenario is influenced by the evolution of world markets and exchange rates within the Baseline. There is some uncertainty concerning the extent to which imports from the rest of the world may displace produce from the EU-27 and the domestic market under the 'Unilateral Trade Liberalisation' scenario. In addition, some of the projected price changes within the scenario analysis go beyond the range of variation experienced historically, upon which our partial equilibrium model is calibrated. Thus, there is some

added uncertainty associated with our projections of the extent to which production, consumption and trade might react under such circumstances. Nevertheless, the results indicate the broad directions of change in UK agricultural commodity sectors within each trade scenario.

A summary of the results for the three alternative trade scenarios is provided in the following table.

Executive Summary Table: Percentage Change in UK Commodity Prices, Production and Value of Output under Three Alternative Trade Scenarios Compared to the Baseline at the End of the Projection Period (2025)

	Bespoke Free Trade Agreement with the EU	WTO Default	Unilateral Trade Liberalisation
Scenario definitions:	<ul style="list-style-type: none"> UK retains tariff and quota free access to the EU and EU retains tariff and quota free access to the UK UK maintains EU tariff structure to rest of the world 5% trade facilitation costs on UK-EU27 trade 	<ul style="list-style-type: none"> MFN¹ tariffs applied to imports from the EU TRQs² from 3rd countries retained MFN tariffs applied to UK exports destined for the EU No change in tariff structure for exports to the rest of the world 8% trade facilitation costs on UK-EU27 trade 	<ul style="list-style-type: none"> Zero tariffs applied on imports to the UK from both the EU and the rest of the world MFN tariffs applied to UK exports destined for the EU No change in tariff structure for exports to the rest of the world 8% trade facilitation costs on UK-EU27 trade
Commodity			
Beef:			
Price	+3%	+17%	-45%
Production	0%	+10%	-10%
Output Value	+3%	+29%	-50%
Sheep:			
Price	-1%	-30%	-29%
Production	0%	-11%	-11%
Output Value	-1%	-38%	-36%
Pigs:			
Price	0%	+18%	-12%
Production	+1%	+22%	-6%
Output Value	+1%	+44%	-17%
Poultry:			
Price	0%	+15%	-9%
Production	0%	+11%	-3%
Output Value	0%	+28%	-12%
Milk & Dairy:			
Price	+1%	+30%	-10%
Production	0%	+7%	-2%
Output Value	+2%	+37%	-12%
Wheat:			
Price	-1%	-4%	-5%
Production	0%	-1%	-1%
Output Value	-1%	-4%	-6%
Barley:			
Price	-1%	-5%	-7%
Production	0%	-1%	-2%
Output Value	-2%	-6%	-8%

Notes:

¹Most Favoured Nation

²Tariff Rate Quotas

Bespoke FTA with the EU

This scenario is in line with the goals for an ambitious and comprehensive Free Trade Agreement (FTA) and a new customs agreement within the Brexit White Paper, with tariff and quota free access for UK exports to the EU and vice-versa tariff and quota free access for imports into the UK from the EU. However, additional trade facilitation costs are incorporated for cross border administration paperwork (checking rules of origin for example), sanitary and phytosanitary inspections and delays at ports.

The results indicate that producer prices within the UK domestic market increase slightly for commodities in which the UK is a net importer, e.g. beef and cheese, but decrease a little for commodities in which it is a net exporter, e.g. barley. While the directional impact on producer prices varies, across all commodities the projected changes in prices are relatively small due to limited disruption to trade. Given the modest price changes, it is projected that changes in production and value of output are marginal.

WTO default

In the absence of an FTA between the UK and the EU, the UK would fall back to WTO default MFN tariffs, at least in the short-run. Under this scenario, MFN tariffs are applied on UK exports to the EU and likewise imports from the EU to the UK.

The default MFN tariffs are in the main very high and hence, the imposition of these tariffs leads to significant adjustments in trade between the UK and EU-27. It is projected that the changes in trade have significant impacts on domestic markets, with the direction of impact again depending on whether the UK is a net importer or a net exporter of the relevant commodity. Thus, in the dairy, beef, pig and poultry sectors producer prices and output values are projected to increase significantly. The imposition of high tariffs adds a wedge to EU prices and greatly reduces the competitiveness and thus the volumes of EU imports. Within the Baseline, imports to the UK from the EU in these sectors are considerable, and hence the reduction in available supplies in this scenario exerts an upward impact on UK prices. While higher producer prices benefit producers, there would also be knock-on consequences in the form of higher consumer prices. Within these sectors, higher prices have positive impacts on production.

The positive production impact in the pigs sector exceeds that in the beef sector, partly because the life-cycle dynamics of this sector mean that it is able to respond quickly to price changes. In line with the price and production projections, the pig sector exhibits the largest increase in value of output.

Within the dairy sector, the positive producer milk price response is higher in England, Wales and Scotland compared to Northern Ireland due to the much higher reliance on the powder market in the latter. The analysis assumed that world prices limit the extent to which powder prices fall (the UK is a net exporter of powders). Hence, in Northern Ireland the projected rise of cheese and butter prices have a smaller impact on the producer milk price.

In contrast, lower producer prices are projected in the sheep, wheat and barley sectors. Here, the introduction of MFN tariffs diminishes the competitiveness and thus the volumes of UK exports to the EU, which leads to increases in available supplies within the domestic market. The negative price impact is particularly marked in the sheep sector due to the large quantity of sheepmeat currently exported to the EU from the UK. The projected fall in price has a depressing impact on UK sheepmeat production and thus on the value of output. The reductions in prices and output values in the wheat and barley sectors are more modest.

Unilateral Trade Liberalisation

In order to avoid applying the high WTO default MFN import tariffs the UK could potentially opt for unilateral trade liberalisation, where tariffs on imports from the EU and the rest of the world are reduced. Under this scenario, we examine a radical version of unilateral trade liberalisation in which the UK sets zero tariffs on imports to the UK from both the EU and the rest of the world, while exports from the UK face trading partners MFN tariffs.

The results indicate that the elimination of tariff barriers under this scenario has a depressing impact on UK prices and output values across all commodities. However, the extent varies across sectors depending on the closeness of UK prices to their world price counterparts in the Baseline.

The downward impacts on prices and output values are particularly acute in the beef and sheep sectors since producers in other parts of the world are very competitive in these sectors. It is projected that radical unilateral trade liberalisation with zero tariffs leads to a large increase in imports in these sectors from the rest of the world, which exerts downward pressures on prices in the UK. The reduction in producer prices would also have a depressing impact on consumer prices, but would impose great pressures on producers within the beef and sheep sectors. It is projected that there are significant reductions in production in these sectors. However, the reductions may not be fully captured by the end of the projection period due to the life cycle dynamics in the beef and sheep sectors; the decline in cow and ewe numbers are even greater. In addition, there is an associated impact and uncertainty regarding the profitability of the progeny from the dairy herd entering the beef herd in response to such a significant decline in the beef price.

Scotland experiences a larger decline in beef production compared to the rest of the UK. This reflects the lower proportion of beef sourced from the dairy herd in Scotland where it is projected that ‘Unilateral Trade Liberalisation’ has a substantial negative impact on beef cow numbers, but a relatively modest negative impact on dairy cow numbers.

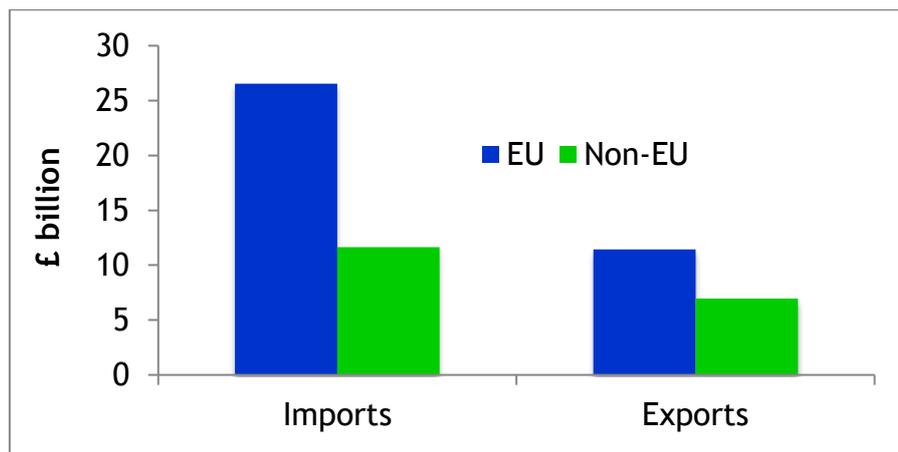
All sectors exhibit a negative change in the value of output under the ‘Unilateral Trade Liberalisation’ scenario, but the impacts are most pronounced in the beef and sheep sectors.

Impacts of Alternative Post-Brexit Trade Agreements on UK Agriculture: Sector Analyses using the FAPRI-UK Model

1. Introduction

UK agri-food, feed and drink trade is deeply embedded in EU markets (Figure 1). The UK has an annual trade deficit in these products of around £20bn; £15bn of which is with the rest of the EU (Swinbank, 2016). Brexit will clearly have implications on trade flows for agricultural commodities between the UK, the EU and the rest of the world. Depending on the type of trade policy that is implemented after Brexit, changes in trade flows will have important consequences on UK commodity prices and production and in turn future domestic agricultural policies. The analysis in this paper quantifies the impact of alternative trade agreements on UK agricultural commodity markets¹. A glossary of the main technical terms is provided in Appendix A.

Figure 1: UK Agri-food trade: deeply embedded in EU markets



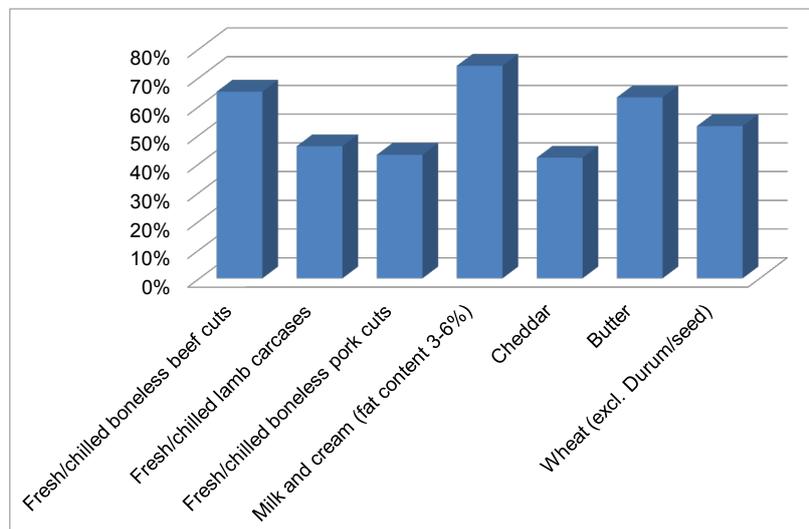
The UK Government set out goals for an ambitious and comprehensive Free Trade Agreement (FTA) and a new customs agreement within the Brexit White Paper (UK Government (2017); Davis (2017)). This would be the least disruptive arrangement in terms of UK-EU27 (EU28 minus the UK) trade as it would most likely entail zero or minimal tariffs for most products. However, there would be additional trade facilitation costs for cross border inspections *etc.*

In the absence of an FTA between the UK and the EU, the UK would fall back to World Trade Organisation (WTO) default Most Favoured Nation (MFN) tariffs, at least in the

¹ The research described in this report was undertaken as part of the FAPRI-UK project. Financial support from the Department for Environment Food and Rural Affairs, the Department of Agriculture, Environment and Rural Affairs in Northern Ireland, the Welsh Government and the Scottish Government is gratefully acknowledged. We also wish to acknowledge the valuable comments of an external reviewer on this project.

short-run. The bound MFN tariffs are in the main very high², reflecting the fact that these are an unreformed legacy of the Common Agricultural Policy (Swinbank, 2017); see examples of bound MFN tariffs in Figure 2. Applying these bound MFN tariffs on UK exports to the EU and likewise imports from the EU to the UK could significantly disrupt trade flows between these markets. The UK could seek FTA deals with third countries but these negotiations could be lengthy, not least because trading partners will require some clarity regarding the details of the new relationship between the UK and EU-27 (Swinbank, 2017). A further trade arrangement is unilateral trade liberalisation, where the UK reduces tariffs on imports from the EU and the rest of the world. This could have large impacts on certain UK agricultural commodity markets due to the highly competitive position of some third countries.

Figure 2: Effective Ad Valorem MFN Tariffs for UK exports to the EU based on 2015 Prices (Calculations AHDB (2016)) in the absence of a UK-EU27 FTA



In this study we examine the impact of the following three illustrative Brexit trade scenarios:

- Bespoke FTA with the EU;
- World Trade Organisation default MFN tariffs; and
- Unilateral Trade Liberalisation.

The analysis is undertaken using the FAPRI-UK partial equilibrium model, which estimates impacts on the key agricultural sectors in England, Wales, Scotland and Northern Ireland. The UK model is run in conjunction with an EU modelling system (FAPRI-GOLD model), which includes a reduced form world model. The analysis captures the impacts on commodity production and prices as a result of changes in trade with the EU and the rest of the world. The modelling system has been substantially updated to

² The bound tariffs refer to the maximum tariff rates agreed by WTO member governments. It is feasible for WTO members to apply duties below the bound tariff (applied tariffs), but they cannot apply duties that exceed the bound rate. Within this study, it is assumed that the UK ‘inherits’ and then applies the EU’s bound rates.

account for the fact that in the case of Brexit the UK and EU markets would no longer be fully integrated.

The negotiations concerning the UK's exit from the EU are in the early stages and it is not feasible to predict the final outcome of this process. In practice the trade agreements finally adopted by the UK are likely to be some hybrid of the above scenarios. The analysis provided in this report demonstrates in a broad sense the potential market impacts of three very different alternative trade scenarios.

2. Methodology

The FAPRI-UK model (created and maintained by staff in AFBI-Economics) captures the dynamic interrelationships among the variables affecting supply and demand in the main agricultural sectors of England, Wales, Scotland and Northern Ireland, with submodels covering the dairy, beef, sheep, pigs, poultry, wheat, barley, oats, rapeseed and biofuel sectors. The UK model is fully incorporated within the EU grain, oilseed, livestock and dairy (GOLD) model run by FAPRI at the University of Missouri.

Historically, the specified price determination process within this combined modelling system was determined at the EU-28 level, reflecting the UK's full integration within the Single Market of the European Union. The commodity submodels are solved at the European level by ensuring EU-28 excess supply equals EU-28 excess demand in all markets (Hanrahan, 2001). The key price in each model was adjusted until equilibrium was attained (net EU-28 excess supply equalled net EU-28 excess demand). Changes in the key prices lead to adjustments not only in supply and utilisation in the key country, but via price linkage equations, to changes in the supply and utilisation totals in all the other markets modelled. The iterative equilibrating process continued until all product markets in all years were in equilibrium. Thus, within this traditional modelling system projected UK commodity prices were determined by equilibrium at the EU-28 level and tracked continental EU prices closely. The UK model was closed with a net trade identity.

In order to undertake scenario analysis of the impact of the UK's exit from the EU, the modelling system has been modified to account for the fact that the UK would no longer be fully integrated within the EU. In particular, a separate price determination process for the UK has been specified so that prices clear the UK market. These domestic UK prices may potentially diverge from those in the EU, depending on border policies and the extent to which trade flows change. At the same time, a market clearing price is determined at the EU-27 level.

An important aspect of the new price determination process for the UK, is newly specified equations for imports/exports that replace the net trade identity:

- (i) Imports from the EU to the UK
- (ii) Imports from rest of the world to the UK;
- (iii) Exports from the UK to the EU; and
- (iv) Exports from the UK to the rest of the world.

These import/export equations are specified as a function of relative price changes (UK/EU relative price within the EU equations and UK/World Price within the rest of the world equations) and an availability term. Wherever applicable, tariffs and transaction costs associated with cross-border trade are incorporated within the relative price terms. This procedure captures the impact of trade policy arrangements on the domestic market. For example, if the world price of a particular commodity is 80% of the comparable UK price, then the application of a zero tariff will result in the inflow of large quantities of imports from the rest of the world and drive down the UK price close to world levels. In this example, a tariff equal to 20% or more should prevent this from happening. Such changes in trade policy arrangements are implemented using specified relative price thresholds, wherein the elasticity of imports/exports with respect to the relative price term is amplified if the value of this term goes beyond these thresholds. In the case of applying zero tariffs, it is likely that these thresholds would be triggered, which would make demand for imports/exports relatively elastic and prevent the UK price diverging too far from EU or world prices. The thresholds are specified using historical relative price ratios.

Note, the model uses Agriculture in the UK data for imports/exports, which only covers raw meat trade; *i.e.* the data for UK imports/exports excludes processed meat. Processed trade is significant within the poultry and pigmeat sectors and hence disruptions to this trade may have knock-on market impacts on the agricultural sector. The potential implications of this issue on the scenario analysis are discussed further within the results section.

The modelling system is firstly simulated to generate Baseline projections based on the assumptions that current policies remain in place, specific macroeconomic projections hold³ and average weather conditions apply. The Baseline used in this analysis covers the projection period 2016 to 2025, wherein it is assumed that the UK is fully integrated within the EU's Single Market and the Customs Union. In addition, post-2013 CAP reforms (including the phased introduction of flat rate payments, greening measures and the provision of coupled payments within some countries) remain in place for the duration of the entire projection period within the Baseline⁴.

These Baseline projections provide a benchmark against which projections derived from policy scenarios can be compared and interpreted. Within this study, the modelling system is further simulated to incorporate changes to trade policies based on alternative Brexit scenarios. The projections for the alternative Brexit trade scenarios results are compared against the Baseline to isolate the impact of these policy changes. It should be borne in mind that the magnitude of the estimated policy changes is dependent on the evolution of world markets and exchange rates. Note, we do not cover certain agriculture sectors such as sugar or examine the implications of Brexit on food products. Welfare estimates based on the analysis in this report will be provided at a later stage.

³ Projections of macroeconomic variables (including exchange rates, GDP growth rates, inflation and the oil price) are based on mid-2016 projections by IHS Global Insight; see Appendix B for key macroeconomic assumptions.

⁴ Although the Basic Payment Scheme payments are decoupled from production in an administrative sense, it is assumed that these payments exert a partial influence on production (30 per cent production stimulating impact compared with the old coupled payments).

3. Scenarios

Each Brexit scenario representing possible outcomes of different trade agreements is described below.

Scenario 1: Bespoke Free Trade Agreement with the EU

This scenario is in line with the ambitions of the UK Government White paper, with the UK forming a new customs arrangement with the EU, which involves tariff and quota free access for UK exports to the EU and vice-versa tariff and quota free access for imports into the UK from the EU. Tariffs and other trade arrangements for UK imports and exports with the rest of the world countries are unchanged compared to the Baseline.

Trade facilitation costs on UK-EU27 trade are incorporated within this scenario to reflect additional trade costs associated with exporting and importing, e.g. border administration paperwork, sanitary and phytosanitary inspections and delays at ports (Matthews, 2016). Note, these costs do not include wider non-tariff barriers. Within the model, the trade facilitation costs are incorporated as a tariff to exports/imports to and from the EU. They are borne by the exporter as they increase the expense of imports from the buyer's perspective. Trade facilitation costs equal to 5% of the commodity price are implemented in this scenario based on analysis undertaken by Abreau (2013).

Under this scenario, products can flow freely between the UK and EU-27 since no tariffs are applied and trade is quota free. As a result, if trade from the rest of the world with either the UK or the EU-27 exerts a significant impact on price on one side, arbitrage between the UK and the EU-27 will cause prices on the other side to closely converge. Therefore, the specific allocation of the EU's existing TRQ commitments between the EU-27 and the UK is of no consequence in terms of quantifying the market price impacts within this scenario. A similar line of reasoning was followed by van Berkum *et al.* (2016).

Scenario 2: World Trade Organisation Default

Under this scenario it is assumed that having left the EU in the absence of a trade agreement, the UK falls back to the WTO-default position, with default MFN tariffs applied to imports from the EU. Default MFN tariffs are applied to imports from rest of the world beyond Tariff Rate Quotas (TRQs)⁵. In addition, the EU applies its MFN tariffs to imports from the UK. The MFN tariffs applied in this scenario are equivalent to the bound EU MFN tariffs. Similar to other partial equilibrium models, commodities are modelled at the aggregate level and thus it is necessary to impose a single tariff for each commodity, rather than multiple tariff lines. In the case of meats for example the relevant carcass MFN tariffs are used as representative of all meat products in that category. The MFN tariffs implemented in this scenario are shown in Table 1. In terms of exports from the UK to the rest of the world, it is assumed that the UK inherits the EU's tariff structure to 3rd

⁵ This assumption is (implicitly) held in the Baseline and Scenario 1. A distinctive aspect of Scenario 2 is that additional assumption regarding the division of the TRQ between the UK and the EU-27 has to be made, which is discussed below.

countries⁶; *i.e.* tariffs applied to exports from the UK to the rest of the world remain unchanged under Scenario 2 compared to the Baseline.

It is assumed that TRQs utilised by the UK from 3rd countries are retained. The assumed level of TRQs for the UK is based on the average level of imports from the rest of the world in the last five years. Sensitivity analysis is undertaken using a different assumption regarding TRQs where it is considered that this assumption may unduly affect the results. In particular, under a sensitivity version of this scenario the UK sheepmeat TRQ for imports from 3rd countries is reduced by 50%.

In addition to the MFN tariffs, trade facilitation costs equal to 8% are applied to exports/imports to/from the EU in this scenario to capture additional costs associated with less integrated trade arrangements.

Table 1: MFN Tariffs Implemented in Scenario 2⁷

	MFN Tariff
Beef Carcass	12.8% plus €176.8/100kg
Sheep Carcass	12.8% plus €171.3/100kg
Pig Carcass	€53.6/100kg
Chicken Carcass	€32.5/100kg
Cheese (Cheddar)	€167.1/100kg
Butter	€189.6/100kg
Wheat [#]	€95/tonne
Barley	€93/tonne

[#]: Refers to the tariff for low and medium quality wheat, which encompasses the categories of wheat mainly exported from the UK to the EU. Although the EU does operate a TRQ for these wheats, the UK's export volumes are likely to exceed the erga omnes quantities allowed, and so face the EU's full MFN tariff of €95 per tonne. This tariff does not apply to high quality wheat but the UK does not export this category of wheat.

Scenario 3: Unilateral Trade Liberalisation

Under this scenario, it is assumed that the UK pursues radical unilateral trade liberalisation through setting zero tariffs on imports to the UK from both the EU and the rest of the world. Unilateral trade liberalisation implies that exports from the UK face trading partners MFN tariffs. As in the previous scenario, MFN tariffs are applied to UK exports destined for the EU, while the specification of the relative price term within the exports to the rest of the world equation remains unchanged. Similar to Scenario 2, trade

⁶ This implies exports face trading partners MFN tariffs, except where a current EU FTA specifies a lower tariff. The EU currently has 53 FTAs with different partners. It is unclear how these would be inherited post-Brexit. Rather than model each of the FTAs, it is assumed that current export trading arrangements are not disrupted; *i.e.* the relative price term within the 'UK exports to the rest of the world' equation does not include a specific tariff rate and this remains unchanged under Scenario 2 compared to the Baseline. It should be noted that in general UK exports to 3rd countries are small.

⁷ Note, the value of these tariffs in *ad valorem* terms depends on the price used for calculation purposes.

facilitation costs equal to 8% are applied to exports/imports to/from the EU to capture in the form of a tariff⁸.

In reality it is unlikely that all import tariffs on agri-food products would be reduced to zero, particularly for products where the UK has a significant production interest. This is an extreme version of trade liberalisation, designed to provide an indication of which sectors would be particularly sensitive to such changes in tariffs.

Under each of the scenarios the changes to trade policy are implemented from 2019 to 2025. A summary of the main scenarios is provided in Table 2. Under all the scenarios, domestic support is unaltered compared to the Baseline; *i.e.* it is assumed direct payments to UK farmers following Brexit are equivalent to existing CAP payments. In addition, no changes have been made to the underlying macroeconomic assumptions, *e.g.* exchange rates, within the scenario analysis. Although, the UK’s exit may have important implications on the macroeconomic environment it is difficult to quantify these changes in advance and project how they may vary under the alternative trade agreements. In addition, incorporating changes to the macroeconomic environment would make it more difficult to make inferences regarding the impact of variables of particular interest to the policy debate, *e.g.* tariff levels. It should also be noted that the modelling system does not include any variables relating to labour supply and thus we have not made any assumptions about this component within the scenario analysis.

Table 2: Summary of Trade Scenarios

Bespoke Free Trade Agreement with the EU	WTO Default	Unilateral Trade Liberalisation
<ul style="list-style-type: none"> • UK retains tariff and quota free access to the EU and EU retains tariff and quota free access to the UK • UK maintains EU tariff structure to rest of the world • 5% trade facilitation costs on UK-EU27 trade 	<ul style="list-style-type: none"> • MFN tariffs applied to imports from the EU • TRQs from 3rd countries retained • MFN tariffs applied to UK exports destined for the EU • No change in tariff structure for exports to the rest of the world • 8% trade facilitation costs on UK-EU27 trade 	<ul style="list-style-type: none"> • Zero tariffs applied on imports to the UK from both the EU and the rest of the world • MFN tariffs applied to UK exports destined for the EU • No change in tariff structure for exports to the rest of the world • 8% trade facilitation costs on UK-EU27 trade

⁸ In practice trade facilitation costs may be asymmetric, with lower costs for EU27 to UK trade since under this scenario the UK is no longer applying tariffs, checking rules of origin, *etc.*

4. Results

The results of the Brexit trade scenarios are discussed below. Summary tables with percentage changes between each scenario and the Baseline for key variables at the UK-level and the individual country level (England, Wales, Scotland and Northern Ireland) are provided in Appendix C. The following discussion focuses primarily on results at the UK-level since prices within individual countries in the UK follow the same trend⁹. Impacts at the sub-UK level are only discussed where there are notable differential impacts.

Scenario 1: Bespoke Free Trade Agreement with the EU

Projected changes in UK commodity prices under Scenario 1 compared to the Baseline at the end of the projection period (2025) are shown in Figure 3. The prices in this figure, and discussed elsewhere within this report, refer to UK producer prices for beef, sheepmeat, pigmeat, poultry, wheat & barley; and wholesale prices for cheddar cheese and butter. Changes in the producer price of milk are provided in the Appendix C.

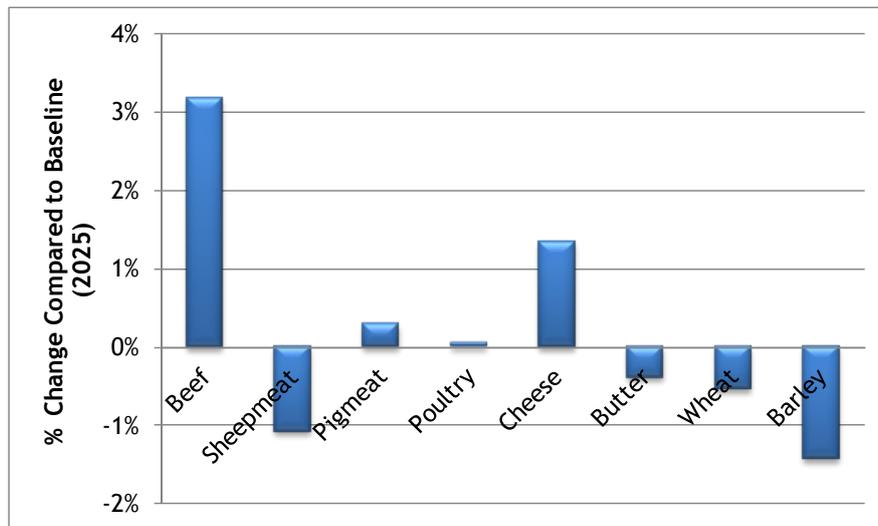
Under this scenario, it is assumed that the FTA between the UK and EU-27 entails no tariff barriers and thus the main factor driving these changes is the increased trade transaction costs. These transaction costs are borne by the exporter based on the reasoning that the transaction costs make the exported commodities more expensive. In other words, the transaction costs affect the competitiveness of the exporting country within the individual import/export equations. Thus, within the ‘Imports from the EU to the UK’ equation EU countries bear the transaction costs of exporting from the EU to the UK, which exerts a downward impact on available supplies in the UK. On the other hand, within the ‘Exports from the UK to the EU’ equation the UK bears the transaction costs of exports from the UK to the EU, which has a positive impact on domestic available supplies. The overall impact on the UK price depends on how these two effects offset each other.

In general, it is projected that the UK price increases for commodities in which it is a net importer; e.g. beef and cheese. In contrast, the UK barley price falls, as the UK is a net exporter. The sheepmeat price also falls, which reflects the fact that UK exports to the EU significantly exceed imports from the EU. While the directional impact varies, across all commodities the projected changes in prices are relatively small.

Given the modest price changes, it is projected that changes in production and value of output are marginal.

⁹ While price differentials are apparent within the UK, based on annual data commodities generally follow the same price path due to the integrated nature of the UK market.

Figure 3: Percentage Change in UK Commodity Prices under Scenario 1 compared to the Baseline (2025)



Scenario 2: World Trade Organisation Default

Scenario 2: Beef Sector

The introduction of high MFN tariffs in this scenario significantly affects beef trade flows between the UK and EU-27. In particular, beef imports from the EU to the UK fall markedly due to the wedge added to the EU price by the tariff that reduces the competitiveness of imports from the EU (Figure 4a). Exports from the UK to the EU also decrease, but since the UK is a large net importer of beef in the Baseline the import effect outweighs the export effect and available supplies within the domestic market decline. As a result, it is projected that the UK beef price increases sharply in 2019 (28% higher compared to the baseline). It should be noted that this price impact diminishes to some extent overtime as the positive price stimulates an increase in UK beef production (Figure 4b)¹⁰. By the end of the projection period (2025), the UK beef price is 17% higher under Scenario 2 compared to the Baseline (Table 3), while UK beef production is 10% higher. Underlying this change in production, UK suckler cow numbers are 18% higher in 2025.

The projected magnitude of the price impact is smaller than the tariff in ad valorem terms. This is attributable to the limiting effect of the world price in combination with the MFN tariff. As the UK price reaches the 'World Price + MFN Tariff' imports from the rest of the world increase markedly (plus 94% in 2025) and thereby curb the increase in the domestic UK price.

¹⁰ Beef production initially falls relative to the Baseline due to the retention of heifers as the beef herd expands.

The projected higher beef price exerts a downward impact on beef consumption. Overall, it is projected that beef consumption is 3% lower under Scenario 2 compared to the Baseline in 2025.

Figure 4: Projected Changes in the Beef Sector under Scenario 2

4.a UK Imports and Exports (2025)

4.b UK Beef Price and Production

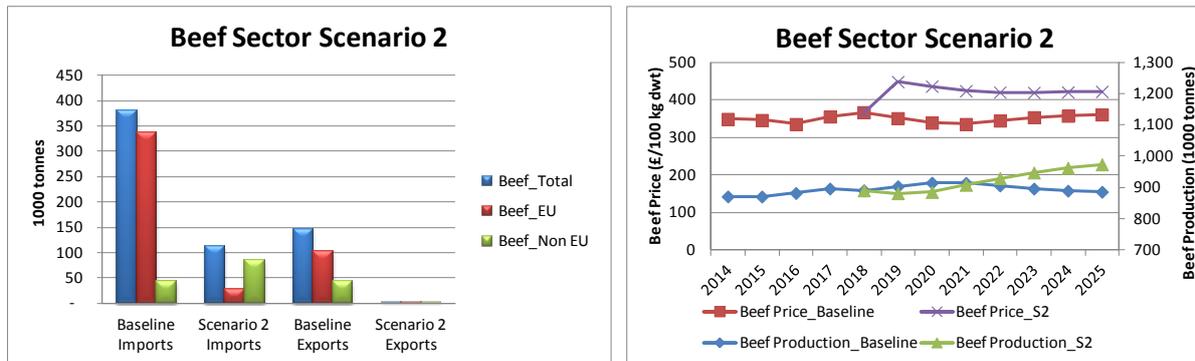


Table 3: Projected Changes in UK Commodity Prices under Scenario 2 compared to the Baseline (2025)

Beef	Sheepmeat	Pigmeat	Poultry	Cheese	Butter	Wheat	Barley
+17%	-30%	+18%	+15%	+29%	+43%	-4%	-5%

Scenario 2: Sheep Sector

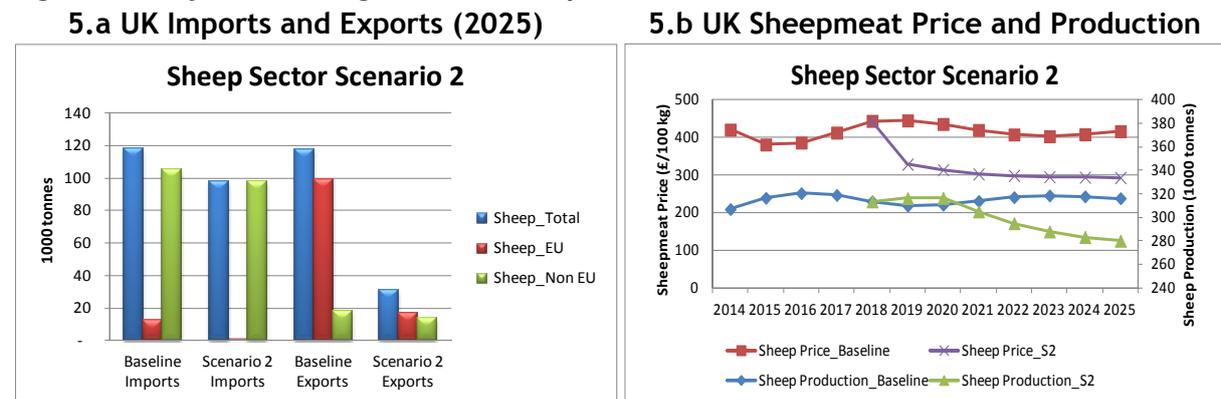
In contrast to the beef sector, it is projected that the introduction of MFN tariffs has a downward impact on domestic prices in the sheep sector. By the end of the projection period, the UK sheepmeat price is 30% lower under Scenario 2 compared to the Baseline (Table 3). The MFN tariffs greatly diminish the competitiveness of UK sheepmeat exports to the EU and consequently, produce that was previously exported onto EU market is rechanneled to the domestic market (Figure 5a). Imports from the EU to the UK also fall, but from a small base. Overall, available supplies within the UK domestic market increase, resulting in a negative price impact.

The projected fall in price, has a depressing impact on production (Figure 5b). As a result, UK sheepmeat production is 11% lower in 2025 under Scenario 2 compared to the Baseline. In contrast, consumption rises in response to the price decrease (9% higher in 2025).

Within the above version of the scenario, imports to the UK from the rest of the world only exhibit a small decline (Figure 5a). Although the UK price falls sharply, imports from the rest of the world within the TRQ remain competitive and hence the projected change is limited. Here it is assumed that the UK’s share of the EU’s TRQ is equal to the average level of imports from the rest of the world in the last five years. However, there is uncertainty regarding how the TRQ will be divided. It is also questionable whether 3rd

countries would continue to supply this TRQ if prices are more rewarding elsewhere. In light of this uncertainty, we also simulate a *sensitivity version of this scenario* in which the UK sheepmeat TRQ for imports from 3rd countries is reduced by 50%. Under this *sensitivity scenario*, the UK sheepmeat price displays a less marked decline (13% lower under the sensitivity scenario compared to the Baseline in 2025).

Figure 5: Projected Changes in the Sheep Sector under Scenario 2



Scenario 2: Pigmeat and Poultry Sectors

Similar to the beef sector, the pigmeat and poultry sectors experience price increases following the introduction of MFN tariffs and other changes implemented in the WTO default scenario. As the UK is a net importer of these meats, the reduction in competitiveness of EU imports results in lower available supplies and exerts an upward impact on UK prices. In particular, the pigmeat and poultry prices increase by 31% and 20% respectively compared to the Baseline in 2019. Again, this initial price response has a positive impact on production and the price effect diminishes slightly over time (Figure 6b and 7b). By 2025, the pigmeat and poultry prices are 18% and 15% higher compared to the Baseline (Table 3). The life cycle dynamics of these sectors mean that production responds relatively quickly to the projected price changes.

Similar to the beef sector, the ‘World Price + MFN Tariff’ imposes a ceiling on the rise in the poultry price. This is not applicable in the pig sector since EU prices are closer to world levels and hence, there is more room for the UK price to rise once the tariffs are introduced.

Carcass balance is a key issue for the poultry sector, with UK consumers generally showing a preference for breast meat compared to thighs and wings. As a result, the latter cuts have a relatively low value in the UK and existing exports from the UK predominantly consist of these cuts. Under this scenario, exports from the UK to the EU collapse due to the imposition of the high tariff. Since these cuts are valued more highly elsewhere, it is assumed that the UK is able to find markets for these cuts in the rest of the world and total export levels are maintained at the Baseline level.

As noted in Section 2, the data for UK imports/exports excludes processed meat. Processed trade is considerable within the poultry and pigmeat sectors and thus the model results do not capture the market impacts of disruption to this trade. In particular, a significant volume of processed poultry meat is imported from 3rd countries, while the volume of imports of raw poultry meat from 3rd countries is small. However, processed poultry meat imports from 3rd countries are sourced through TRQs, which are largely filled (the out of quota tariff is very high - €1,024 per 1000kg). Thus, if the TRQ and out-of-quota tariff is retained the scope for increasing processed poultry imports to fill the supply-demand gap within this scenario is small. In terms of pigmeat, almost all imported meat is from other EU member states. The MFN tariffs for different categories of processed pigmeat are high (e.g. €747 per 1000kg for uncooked sausages) and hence the application of these tariffs to imports from the EU would likely reduce available supplies further. This would result in a somewhat larger UK price increase than shown in this analysis.

Figure 6: Projected Changes in the Pigmeat Sector under Scenario 2

6.a UK Imports and Exports (2025)

6.b UK Pigmeat Price and Production

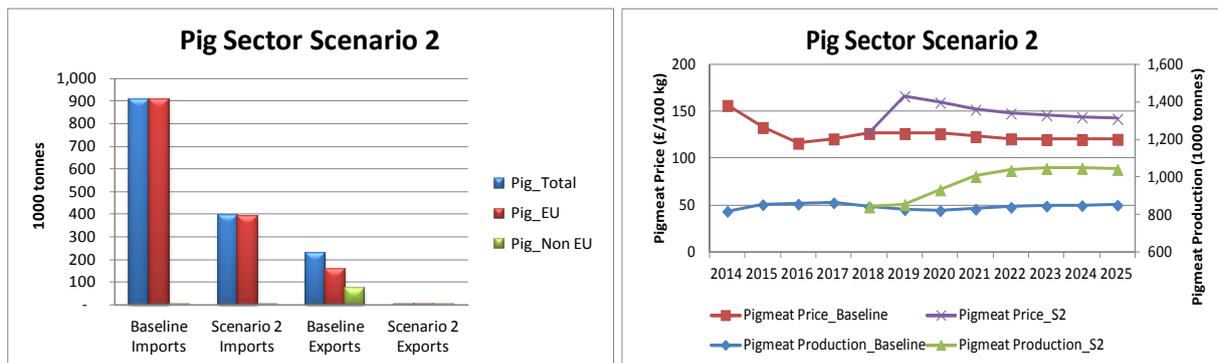
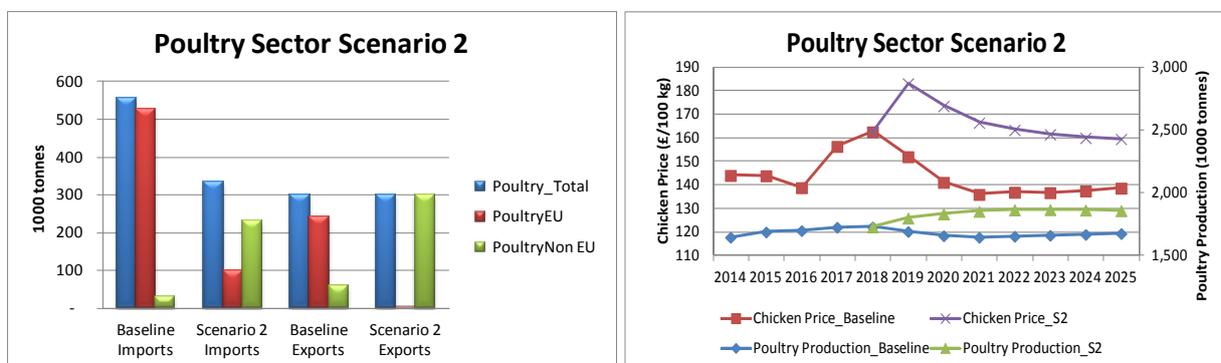


Figure 7: Projected Changes in the Poultry Sector under Scenario 2

7.a UK Imports and Exports (2025)

7.b UK Poultry Price and Production



Scenario 2: Dairy Sector

The projected changes in cheese and butter imports under the WTO default scenario are shown in Figure 8. The reduction in competitiveness of EU imports due to the application of MFN tariffs results in a significant decline in imports from these markets. UK cheese imports from the EU decline from 516 thousand tonnes under the Baseline to 234 thousand tonnes under Scenario 2 in 2025. While substantial, it is notable that cheese imports from the EU do not fall to zero, reflecting the heterogeneity of cheese and the demand for speciality cheeses. In contrast, it is projected that butter imports from the EU collapse to zero. This partly reflects the higher responsiveness of butter imports to changes in prices/tariffs since butter is less heterogeneous compared to cheese. In addition, the MFN tariff for butter is particularly large and hence, prohibits imports.

Cheese and butter exports from the UK to the EU also collapse, but from a smaller base compared to imports. As a result of these changes in trade flows, it is projected that the commodity prices for these commodities increase significantly, particularly butter (the UK cheese and butter prices are respectively 29% and 43% higher under Scenario 2 compared to the Baseline in 2025; Table 3). In the case of the latter, the tariff is so high that there is plenty of room for the domestic price to rise before imported goods bearing tariffs become competitive.

Due to data availability issues it has not been possible to model UK market clearing prices for SMP and WMP. Thus, changes to the trading arrangements for these commodities have not been explicitly incorporated within this scenario analysis. Nevertheless, it is expected that the price changes for these commodities under a WTO default scenario would be small since the UK is a net exporter of powders and the domestic prices are close to world levels; *i.e.* world prices would limit the extent to which UK powder prices can fall. Implicitly it is assumed within this analysis that the changes in UK SMP and WMP powder prices are negligible.

The changes in commodity prices result in differential producer milk price paths at a country level within the UK due to differences in the commodity mix (Figure 9a). In particular, producer milk prices within GB increase to a greater extent compared to NI: *e.g.* the English producer milk price is 30% higher under Scenario 2 compared to the Baseline in 2025; while the NI price is 18% higher due to its greater dependence on the powder market. By the end of the projection period, the price differential between the English and NI producer milk price is 6.5 ppl. This differential could potentially lead to supplies of raw milk being drawn from NI to GB. In this case, the price differential would be narrower. It is projected that UK milk production increases over time (plus 7% in 2025; Figure 9b) in response to the positive producer price impact. The majority of this increase is for manufacturing purposes.

Note, underlying these projected changes it is assumed that the tariffs for imports of raw milk across the Irish border are prohibitive, with milk that was previously exported rechanneled for processing within the source countries; mainly NI. This would require an expansion in processing capacity in NI, which may not occur instantaneously in reality, and there are also question marks regarding to what extent the commodity mix would change; *i.e.* would there continue to be a focus on powder production?

Figure 8: Projected Changes in UK Cheese and Butter Imports and Exports under Scenario 2 (2025)

8.a Cheese

8.b Butter

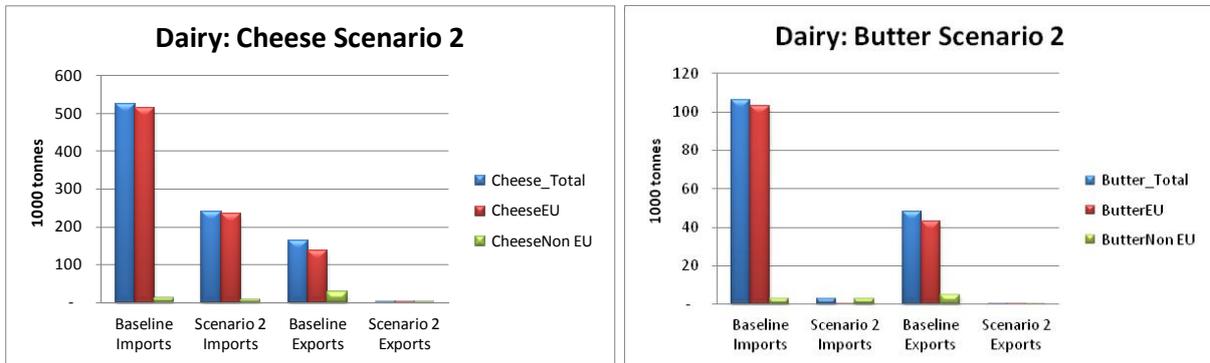
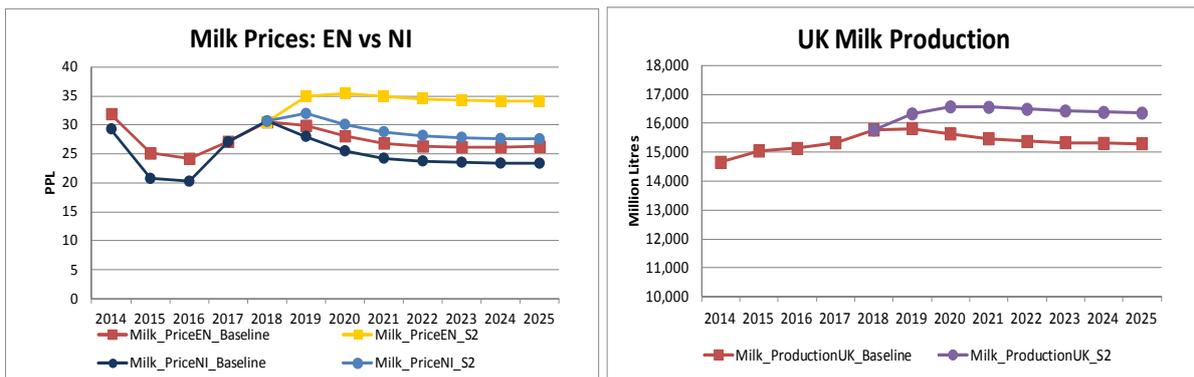


Figure 9: Projected Changes in Producer Milk Prices and Milk Production under Scenario 2

9.a Producer Milk Price

9.b Milk Production



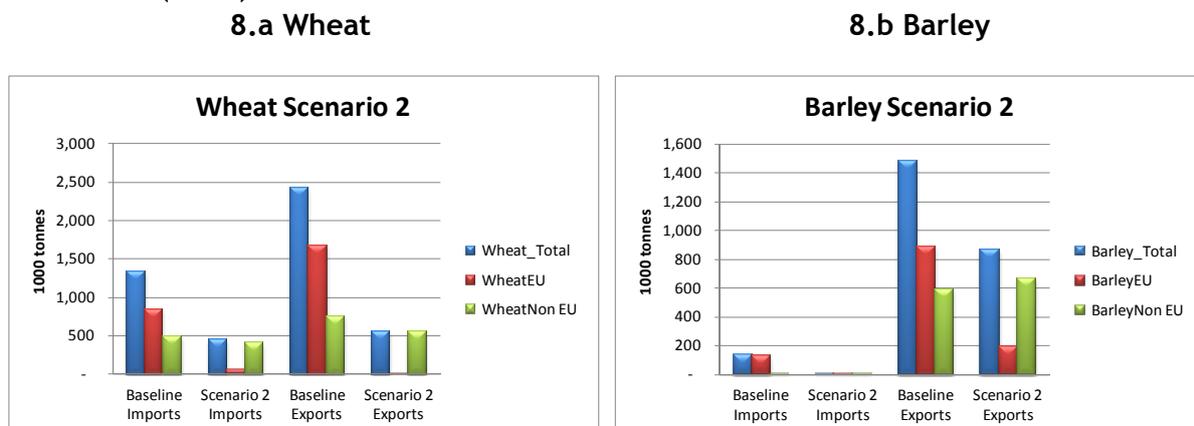
Scenario 2: Crop Sector

Within the Baseline the UK is a net exporter of wheat and barley. However, following the introduction of the MFN tariffs in the WTO default scenario it is projected that trade with the EU in these commodities is significantly disrupted. In particular there is a marked fall in UK exports to the EU, with wheat exports collapsing entirely and barley exports falling by 78%¹¹. Produce that was previously exported increases available supplies within the domestic market and exerts a downward impact on wheat and barley prices (minus 4% and 5% respectively in 2025). The negative price impact is moderate since UK prices are close to world levels in the Baseline, which limits the extent to which UK prices can fall. Despite the lower domestic price, it is not projected that UK exports of wheat to the world market increase due to a reduction in the available surplus. This reflects a projected slight fall in production, combined with an increase in the demand for feed.

The above analysis is based on the application of the full bound MFN tariff. With regards to wheat, the level of applied tariff may vary in practice but this depends on quality. UK exports of wheat to the EU are mainly of a medium or low quality. Although the EU does operate a TRQ for these wheat categories, the UK’s export volumes are likely to exceed the erga omnes quantities allowed, and so face the EU’s full MFN tariff of €95 per tonne. Exports for high quality wheats, however, face a different MFN regime. In order to reflect this uncertainty, we simulate a sensitivity version of the WTO default scenario in which no wheat tariff is applied to exports from the UK to the EU.

Under this *sensitivity version of the scenario*, UK exports to the EU remain largely unchanged compared to the Baseline. In contrast to the main analysis, the UK wheat price rises under this sensitivity analysis due to the projected expansion in the livestock sector, which exerts an upward impact on feed demand. By the end of the projection period, the UK wheat price is 6% higher under this *sensitivity* analysis compared to the Baseline.

Figure 10: Projected Changes in UK Wheat and Barley Imports and Exports under Scenario 2 (2025)

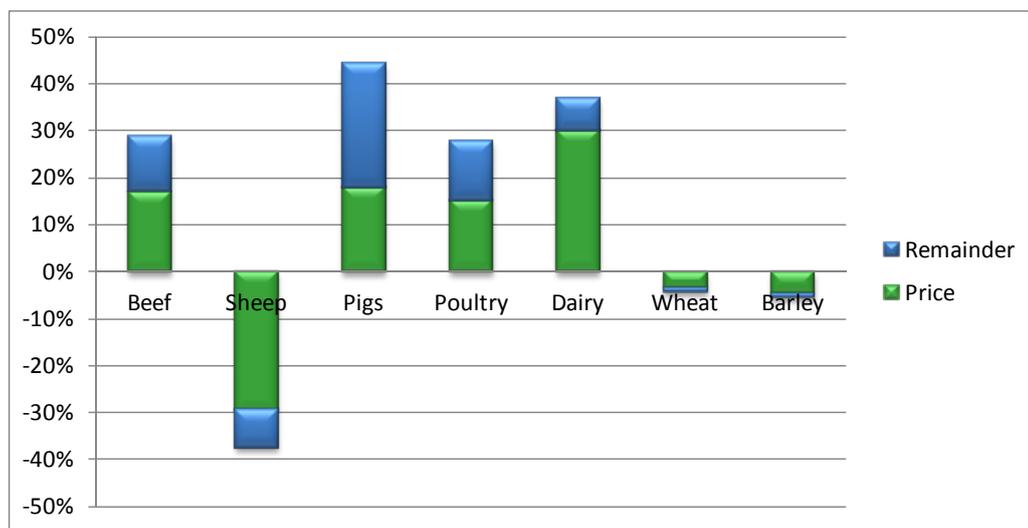


¹¹ Barley exports do not fall to zero since it is assumed that the UK continues to export malting barley to the EU (this assumption is based on the lower end of malting barley exports to the EU in the last ten years).

Scenario 2: Value of Output

Projected changes in UK value of output (producer price multiplied by production) for specific sectors are shown in Figure 11. In order of magnitude, the changes in trade arrangements under the WTO default scenario have a favourable impact on value of output in the pig, dairy, beef and poultry sectors. In contrast, the value of output declines in the sheepmeat, wheat and barley sectors. The variable impact across sectors essentially depends on whether the UK was a net importer or a net exporter. The negative impact is particularly marked in the sheep sector.

Figure 11: Percentage Change in Value of Output by Sector under WTO Default Scenario compared to Baseline in 2025

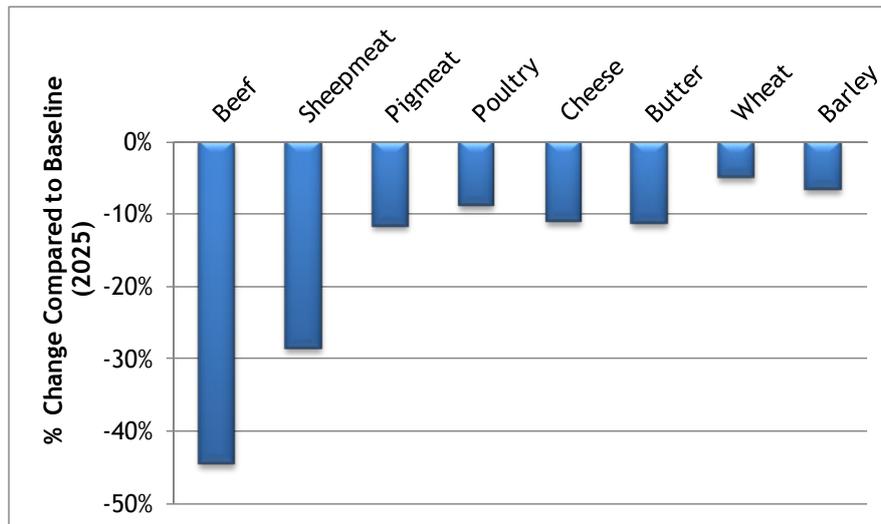


Note: Percentage change in Value of Output is disaggregated into a price component and a remainder component, where the latter is defined as volume change plus volume change multiplied by price change.

Scenario 3: Unilateral Trade Liberalisation

Projected changes in UK commodity prices under Scenario 3 are shown in Figure 12. In general, the elimination of tariff barriers under this scenario has a depressing impact on UK prices across all commodities. However, the extent varies across sectors depending on the closeness of UK prices to their world counterparts in the Baseline.

Figure 12: Percentage Change in UK Commodity Prices under Scenario 3 compared to the Baseline (2025)



Scenario 3: Beef Sector

Within the beef sector, major exporters on the world market such as Australia and Brazil are significantly more competitive compared to the UK and hence, trade liberalisation leads to a large increase of imports from the rest of the world. The projected inflow from the rest of world displaces EU imports, which collapse to zero. In response to these changes in trade flows, the UK beef price falls by 45% by 2025. The beef sector shrinks as a result of the negative price impact, particularly as the decline in feed prices is much less marked (see description of the crop sector below). There is a prolonged response to the price fall, with suckler cow numbers continuing to decline in the latter years of the projection period. By the end of the projection period, UK suckler cow numbers are 42% lower under Scenario 3 compared to the Baseline. The decline in beef production at the end of the projection period is substantial but less marked (minus 10%). This partly reflects dynamics in the beef sector, with suckler cow numbers continuing to decline during the projection period and an interval of approximately two years between the birth of the calf and finished beef production. In addition, the reduction in dairy cow numbers is relatively modest compared to suckler cows and hence, beef production is held up by progeny from the dairy herd in this scenario analysis. Given the marked decline in the projected beef price it may no longer be profitable to finish animals from the dairy herd. In this case, the decline in beef production would be greater than shown here.

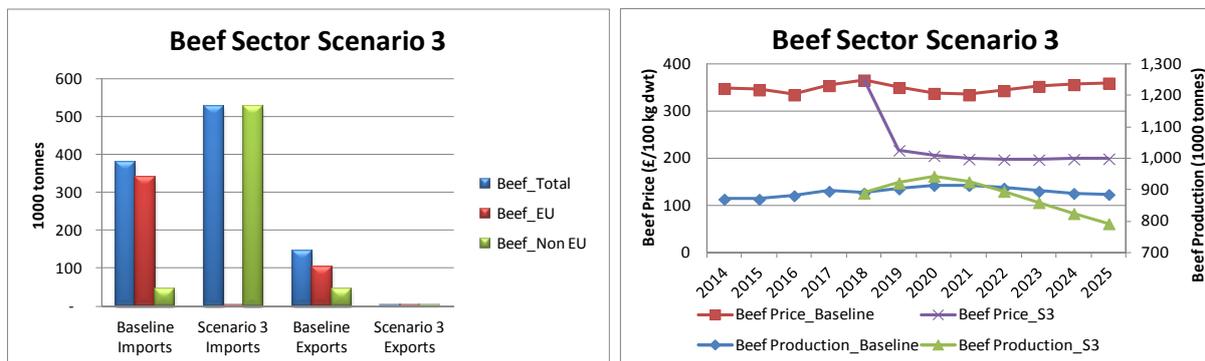
It is notable that the decline in beef production is more marked in Scotland (minus 16% in 2025) compared to elsewhere in the UK (-9 to -11%). This is attributable to differences in the proportion of beef sourced from the dairy herd across the UK, with a higher proportion of beef animals coming from the progeny of the dairy herd in England, Wales and Northern Ireland compared to Scotland. For example, in 2015, dairy cows accounted for 55% to 63% of total cows in England, Wales and Northern Ireland, compared to 30% in Scotland. This variability results in a greater fall in beef production in Scotland in this scenario since it is projected that ‘Unilateral Trade Liberalisation’ has a substantial negative impact on beef cow numbers across the UK, but a modest negative impact on dairy cow numbers.

It should be acknowledged that there is some uncertainty concerning the extent to which imports from the rest of the world may displace produce from the EU-27 and the domestic market. Consumer preferences for local produce, supermarket sourcing policies and beef heterogeneity may dampen the increase in imports from the rest of the world. In this case, the decline in the domestic beef price would be somewhat less marked than shown here.

Figure 13: Projected Changes in the Beef Sector under Scenario 3

13.a UK Imports and Exports (2025)

13.b UK Beef Price and Production



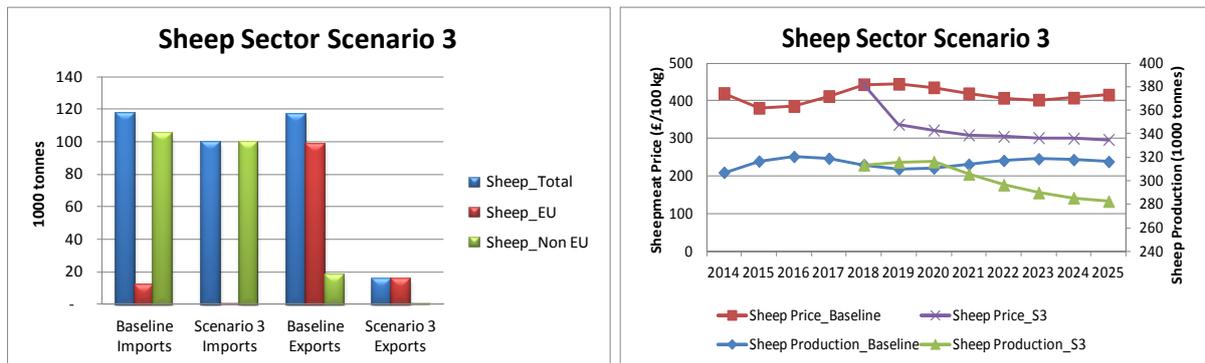
Scenario 3: Sheep Sector

Similar to the beef sector, the domestic UK sheepmeat price declines significantly following unilateral trade liberalisation (minus 29% at the end of the projection period). Again, the negative price impact has a depressing impact on production (Figure 14b). By the end of the projection period, UK sheepmeat production is 11% lower under Scenario 3 compared to the Baseline. At the same time consumption responds positively to the price fall and consequently, the UK is no longer self-sufficient at the end of the projection period. Exports fall to low levels following the imposition of the changes in trade in 2019. This initially reflects the imposition of MFN tariffs on UK exports to the EU, but is reinforced by the lack of self-sufficiency in the latter part of the projection period.

Figure 14: Projected Changes in the Sheep Sector under Scenario 3

14.a UK Imports and Exports (2025)

14.b UK Sheepmeat Price and Production



Scenario 3: Pigmeat and Poultry Sectors

The pig and poultry sectors experience less significant price declines (minus 12% and 9% respectively). This reflects the fact that projected UK prices in the Baseline are closer to world levels compared to the beef and sheep sectors. Within the pig sector there is some displacement of EU-27 imports from the rest of the world, although imports from the former still remain substantial.

Note, the exclusion of processed import/export data does not have a significant bearing on the results within Scenario 3 since the commodity price impact is primarily determined by the world price.

Scenario 3: Meat consumption

Overall, it is projected that there is a significant rise in total meat consumption in response to the large price falls, with particularly sizeable increases in beef and sheep consumption. By the end of the projection period total meat consumption is 7% higher under the Unilateral Trade Liberalisation scenario compared to the Baseline. While this represents a considerable boost to consumption, these levels are not unprecedented with projected per capita total meat consumption levels in 2025 comparable to historic levels in 2005¹².

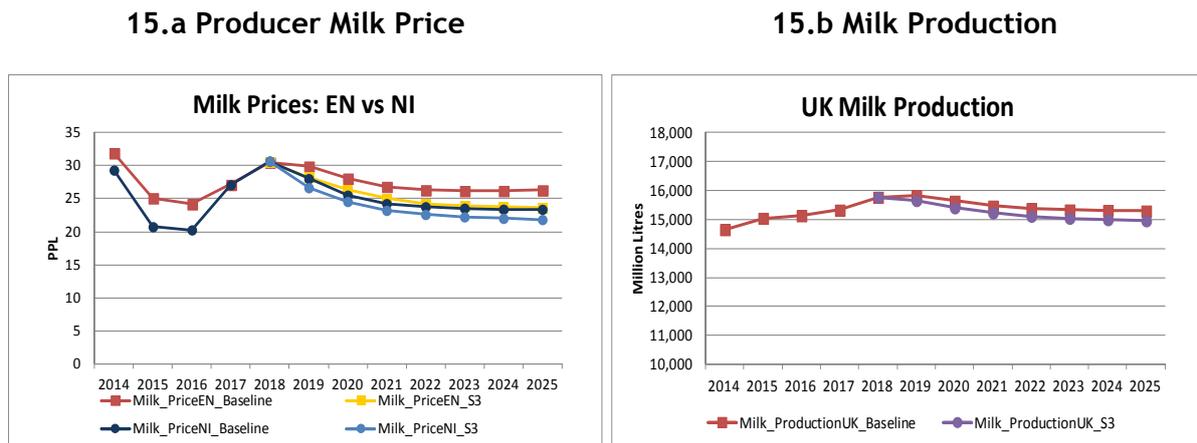
Scenario 3: Dairy Sector

In the dairy sector, cheese and butter prices exhibit moderate price declines following trade liberalisation (both minus 11%). There is some scope for UK cheese and butter prices to fall in this scenario; although the prices for these commodities are close to world levels in the Baseline in the short term, they diverge slightly in the latter part of the projection period in response to an increase in the UK population which has an upward

¹² During the historic period, per capita total meat consumption declined post-2005, partly in response to price rises.

impact on the consumption of these commodities¹³. The projected changes in dairy commodity prices have a depressing impact on producer milk prices, with those in GB falling by around 10% and the NI producer milk price falling by 7% (Figure 15a). The declines in producer milk prices have a depressing impact on UK milk production (Figure 15b) and milk for manufacture in England, Wales and Scotland. However, milk supply for manufacture increases in NI due to tariff barriers for exports of raw milk from NI to RoI.

Figure 15: Projected Changes in Producer Milk Prices and Milk Production under Scenario 3



Scenario 3: Crop Sector

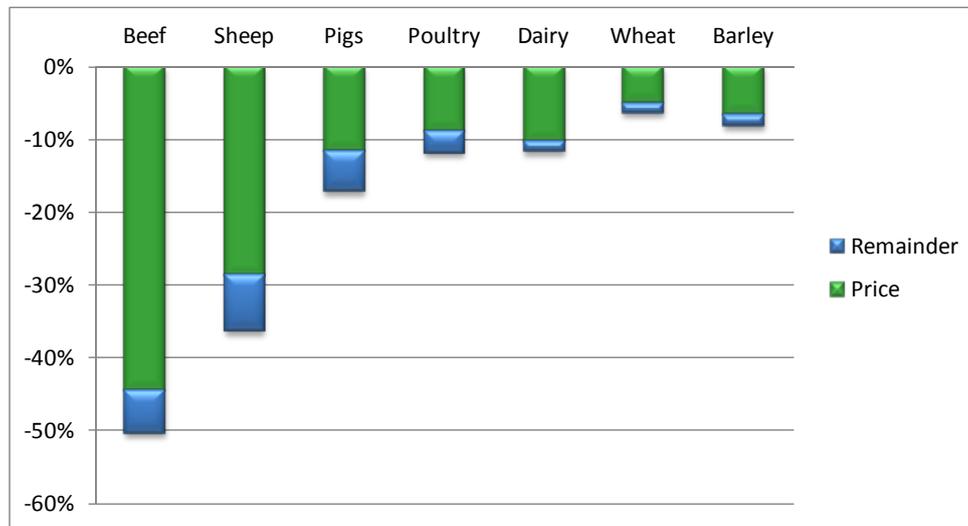
In the crop sector, it is projected that wheat and barley prices decline in response to unilateral trade liberalisation. However, the price reductions are relatively modest (minus 5% and 7% for wheat and barley respectively) since UK prices are fairly close to world levels within the Baseline. The price decline is slightly greater for barley compared to wheat since the surplus supply is greater for the former within the Baseline. In addition, feed demand is a greater component of domestic use for barley and this component falls in response to the decline in livestock numbers.

Scenario 3: Value of Output

As shown in Figure 16, all sectors display a negative change in value of output under the Unilateral Trade Liberalisation scenario. However, the impact is more pronounced in the beef and sheep sectors, which would be particularly exposed to competitive overseas suppliers if tariffs on imports were completely eliminated.

¹³ Again, it was not feasible to explicitly model changes in powder prices, but it is deemed plausible that the impacts are small due to the export orientation of these commodities.

Figure 16: Percentage Change in Value of Output by Sector under Unilateral Trade Liberalisation Scenario compared to Baseline in 2025



Note: Percentage change in Value of Output is disaggregated into a price component and a remainder component, where the latter is defined as volume change plus volume change multiplied by price change.

5. Conclusions

In this study we examine the sectoral impacts on UK agriculture of alternative trade agreements following Brexit using a partial equilibrium modelling framework. In particular, we consider three illustrative Brexit trade scenarios:

- Bespoke FTA with the EU;
- WTO default MFN tariffs; and
- Unilateral Trade Liberalisation.

In interpreting the results of this study it is important to bear in mind the nature of the scenarios underlying this analysis which were agreed with the FAPRI board to demonstrate the impact of illustrative trading arrangements; *e.g.* zero tariffs between the UK and EU-27 under Scenario 1, application of WTO default bounded MFN tariffs in Scenario 2 and complete elimination of tariffs on imports into the UK in Scenario 3. The Brexit negotiations are in their early stages and the final agreement is likely to differ from the policy changes considered here. In practice the trade agreements finally adopted by the UK are likely to be some hybrid of these scenarios and may vary by sector. In addition, the magnitude of the changes is dependent on the evolution of world markets and exchange rates. For example, the relative price of UK beef compared to Brazil and Australia has fluctuated considerably in recent years. Some of the projected price changes within the scenario analysis go beyond the range of variation experienced historically, upon which our partial equilibrium model is calibrated. Thus, there is some added uncertainty associated with our projections of the extent to which production,

consumption and trade might react under such circumstances. Nevertheless, the results indicate the broad directions of change in UK agricultural commodity sectors within each trade scenario.

As expected, the estimated changes are relatively small under the FTA with the EU scenario since this entails minimal disruption to trade. The projected impacts are larger under the other two trade scenarios. The high tariffs imposed under the WTO default scenario lead to significant adjustments in trade between the UK and EU-27. The changes in trade will have important consequences on domestic markets, with the direction of impact depending on whether the UK is a net importer or a net exporter of the relevant commodity. In the dairy, beef, pig and poultry sectors producer prices are projected to increase. Higher producer prices in these sectors would be likely to benefit producers as cereal prices are not projected to increase. However, there would also be knock-on consequences in the form of higher consumer prices, which would squeeze consumer budgets; this would probably have distributional effects due to the disproportionate impacts on the budgets of lower income households. On the other hand, the lower producer prices projected in the sheep sector would have major implications on profitability in this sector and could lead to significant restructuring in the medium to longer term.

All sectors experience price and value of production declines under the Unilateral Trade Liberalisation scenario. The impacts are particularly marked in the beef and sheep sectors. Producers in the rest of the world are very competitive in these sectors and the complete elimination of tariff protection would clearly impose great pressures on those sectors and lead to significant restructuring in the medium to longer term. The results in this scenario strongly indicate that there is a more pressing need to improve domestic productivity and competitiveness under this trade scenario since producers would be much more exposed to direct competition with overseas suppliers.

References

- Abreau, M., 2013. *Preferential Rules of Origin in Regional Trade Agreements*, Staff Working Paper ERSD-2013-05, Geneva, Economic Research and Statistics Division, World Trade Organization.
- AHDB, 2016. *What might Brexit mean for UK trade in agricultural products?* AHDB Horizon Market Intelligence publication, 12 October 2017.
http://www.ahdb.org.uk/documents/Horizon_Brexit_Analysis_Report-Oct2016.pdf
- Davis, J., 2017. *Impact of Brexit on U.K. Agriculture*. Presentation to AFBI Outlook Conference. 28 March 2017.
- Hanrahan, K.F., 2001. *The EU GOLD model 2.1: An introductory manual*. Working Paper, Teagasc, Dublin.
- Matthews, A., 2016. The Potential Implications of a Brexit for Future EU Agri-food Policies. *EuroChoices*, 15(2), pp.17-23.
- Swinbank, A., 2016. Brexit: The Current Status of EU-UK Agri- food Trade. *EuroChoices* 15 (2) 24-25.
- Swinbank, A., 2017. *World trade rules and the policy options for British agriculture post-Brexit*. UK Trade Policy Observatory, Briefing Paper 7, January 2017.
- van Berkum, S., R. A. Jongeneel, H. C. J. Vrolijk, M. G. A. van Leeuwen, and J. H. Jager. *Implications of a UK exit from the EU for British agriculture*. 2016. LEI Wageningen UR, 2016.
- White Paper, 2017. *The United Kingdom's exit from and new partnership with the European Union*. UK Government White Paper, Published 2 February 2017, ISBN 9781474140652.

Appendix A: Glossary

Ad valorem equivalent (AVE)	A tariff that is expressed as a percentage of the commodity price.
Applied Tariff	Duties that are actually charged on imports. These can be below the bound rates. #
Bound Tariff	Maximum tariff rate agreed by WTO member governments.
Customs Union	Members apply a common external tariff. #
Free Trade Agreement (FTA)	Treaty between two or more countries to establish a free trade area, where trade can be conducted across their common borders, with the elimination of tariffs and other restrictive regulations of commerce on ‘substantially all the trade’ in products originating within the FTA.*
Most Favoured Nation Tariffs	Normal non-discriminatory tariff charged on imports (excludes preferential tariffs under free trade agreements and other schemes or tariffs charged inside quotas).#
Tariff Rate Quota (TRQ)	Quantities inside a quota are charged lower import duty rates, than those outside. #

#: Source WTO Glossary https://www.wto.org/english/thewto_e/glossary_e/mfn_tariff_e.htm

*: Source Swinbank (2017)

Appendix B: Key Macro-Economic Assumptions

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Exchange Rates												
£/\$	0.61	0.65	0.74	0.85	0.87	0.78	0.71	0.66	0.64	0.62	0.61	0.60
£/euro	0.81	0.73	0.82	0.87	0.89	0.86	0.85	0.83	0.82	0.82	0.82	0.82
euro/\$	0.75	0.90	0.90	0.99	0.98	0.90	0.83	0.79	0.77	0.75	0.74	0.73
UK GDP Growth	4.0%	2.9%	2.7%	1.9%	1.8%	2.2%	2.5%	2.9%	3.0%	2.9%	2.8%	2.7%
UK Population	64.33	64.72	65.11	65.51	65.91	66.31	66.70	67.08	67.46	67.82	68.18	68.53

Source: HIS Global Insight

Appendix C: Summary Result Tables for Main Scenarios

Table A1: Projected Changes in the Livestock Sectors in the UK, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Cattle			
Beef cows	1%	18%	-42%
Dairy cows	0%	6%	-2%
Total Cattle	0%	11%	-17%
Beef			
Production	0%	10%	-10%
Domestic use	-1%	-3%	18%
Export	-2%	-100%	-100%
Exports from UK to EU-27	-2%	-100%	-100%
Exports from UK to Non-EU	-2%	-100%	-100%
Import	-3%	-70%	38%
Imports from EU-27 to UK	-3%	-92%	-100%
Imports from Non-EU to UK	-3%	94%	1103%
Cattle price	3%	17%	-45%
Sheep			
Ewes	0%	-13%	-12%
Total Sheep	0%	-12%	-12%
Sheepmeat			
Production	0%	-11%	-11%
Domestic use	0%	9%	16%
Export	0%	-73%	-86%
Exports from UK to EU-27	-1%	-83%	-84%
Exports from UK to Non-EU	0%	-23%	-100%
Import	0%	-17%	-15%
Imports from EU-27 to UK	-1%	-100%	-100%
Imports from Non-EU to UK	0%	-7%	-5%
Sheepmeat price	-1%	-30%	-29%
Pig			
Sows	1%	21%	-8%
Total pigs	1%	23%	-8%
Pigmeat			
Production	1%	22%	-6%
Domestic use	0%	-6%	5%
Export	0%	-100%	-100%
Exports from UK to EU-27	-1%	-100%	-100%
Exports from UK to Non-EU	0%	-100%	-100%
Import	-1%	-56%	-9%
Imports from EU-27 to UK	-1%	-57%	-31%
Imports from Non-EU to UK	0%	0%	7811%
Pigmeat reference price	0%	18%	-12%
Poultry			
Production	0%	11%	-3%
Domestic use	0%	-2%	1%
Export	-2%	0%	-43%
Exports from UK to EU-27	-2%	-100%	-100%
Exports from UK to Non-EU	0%	408%	189%
Import	-1%	-40%	-8%
Imports from EU-27 to UK	-1%	-81%	-100%
Imports from Non-EU to UK	0%	676%	1603%
Chicken price	0%	15%	-9%

Table A2: Projected Changes in the Livestock Sectors in England, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Cattle			
Beef cows	1%	19%	-43%
Dairy cows	0%	5%	-2%
Total Cattle	0%	10%	-14%
Production	0%	8%	-9%
Sheep			
Ewes	0%	-11%	-10%
Total Sheep	0%	-10%	-10%
Production	0%	-11%	-10%
Pig			
Sows	1%	21%	-9%
Total pigs	1%	24%	-8%
Production	1%	24%	-7%
Poultry			
Poultry production (EW)	0%	11%	-3%

Table A3: Projected Changes in the Livestock Sectors in Wales, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Cattle			
Beef cows	1.4%	23.8%	-60.3%
Dairy cows	0.4%	8.1%	-2.6%
Total Cattle	0.6%	14.1%	-21.4%
Production	0.2%	11.6%	-10.9%
Sheep			
Ewes	-0.3%	-19.5%	-18.3%
Total Sheep	-0.2%	-19.3%	-18.1%
Production	0.0%	-15.0%	-13.9%
Pig			
Sows	0.5%	19.8%	-8.2%
Total pigs	0.6%	21.6%	-7.6%
Production	0.8%	27.6%	-7.9%
Poultry			
Poultry production (EW)	0.2%	11.2%	-3.5%

Table A4: Projected Changes in the Livestock Sectors in Scotland, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Cattle			
Beef cows	1.1%	18.0%	-40.7%
Dairy cows	0.4%	8.9%	-2.9%
Total Cattle	0.6%	14.5%	-24.4%
Production	0.1%	14.0%	-16.1%
Sheep			
Ewes	-0.1%	-9.4%	-9.1%
Total Sheep	-0.1%	-8.9%	-8.6%
Production	0.0%	-8.7%	-8.3%
Pig			
Sows	0.6%	22.8%	-9.5%
Total pigs	0.8%	28.4%	-9.8%
Production	0.6%	23.1%	-6.2%
Poultry			
Poultry production	0.2%	14.3%	-4.4%

Table A5: Projected Changes in the Livestock Sectors in Northern Ireland, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Cattle			
Beef cows	0.9%	14.2%	-30.8%
Dairy cows	0.2%	4.6%	-1.5%
Total Cattle	0.4%	8.7%	-12.7%
Production	0.1%	8.4%	-9.2%
Sheep			
Ewes	-0.1%	-9.4%	-8.9%
Total Sheep	-0.1%	-9.3%	-8.8%
Production	0.0%	-7.7%	-7.2%
Pig			
Sows	0.3%	13.2%	-5.5%
Total pigs	0.4%	15.4%	-5.3%
Production	0.4%	13.7%	-3.7%
Poultry			
Poultry production	0.1%	7.2%	-2.2%

Table A6: Projected Changes in the Dairy Sectors in the UK, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Dairy			
Cow's milk Production	0%	7%	-2%
Liquid consumption	0%	-3%	1%
Manufacturing use	1%	18%	-6%
Prices			
Producer milk price	1%	30%	-10%
Cheese price	1%	29%	-11%
Butter price	0%	43%	-11%
WMP price	0%	0%	0%
SMP price	0%	0%	0%
Cheese			
Production	1%	19%	-4%
Domestic use	0%	-4%	2%
Export	-2%	-100%	-88%
Exports from UK to EU-27	-3%	-100%	-100%
Exports from UK to Non-EU	0%	-100%	-27%
Import	-2%	-54%	-20%
Imports from EU-27 to UK	-2%	-55%	-28%
Imports from Non-EU to UK	-13%	-23%	380%
Butter			
Production	0%	25%	-2%
Domestic use	0%	-11%	4%
Export	-4%	-100%	-100%
Exports from UK to EU-27	-5%	-100%	-100%
Exports from UK to Non-EU	1%	-100%	-100%
Import	-2%	-97%	-26%
Imports from EU-27 to UK	-2%	-100%	-100%
Imports from Non-EU to UK	-1%	-7%	2558%

Table A7: Projected Changes in the Dairy Sectors in England, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Milk			
Milk production	0.3%	6.3%	-2.0%
Dairy cows	0.2%	5.0%	-1.6%
Milk yield per cow	0.1%	1.2%	-0.4%
Milk price	1.3%	29.8%	-10.3%

Table A8: Projected Changes in the Dairy Sectors in Wales, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Milk			
Milk production	0.4%	9.4%	-3.0%
Dairy cows	0.4%	8.1%	-2.6%
Milk yield per cow	0.0%	1.1%	-0.4%
Milk price	1.2%	28.3%	-9.8%

Table A9: Projected Changes in the Dairy Sectors in Scotland, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Milk			
Milk production	0.4%	10.1%	-3.3%
Dairy cows	0.4%	8.9%	-2.9%
Milk yield per cow	0.0%	1.2%	-0.4%
Milk price	1.2%	28.2%	-9.8%

Table A10: Projected Changes in the Dairy Sectors in Northern Ireland, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Milk			
Milk production	0.3%	5.3%	-1.7%
Dairy cows	0.2%	4.6%	-1.5%
Milk yield per cow	0.0%	0.6%	-0.2%
Milk price	0.8%	18.1%	-6.6%

Table A11: Projected Changes in the Crop Sectors in the UK, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Wheat			
Production	0%	-1%	-1%
Domestic use	0%	6%	-2%
Export	-3%	-77%	-34%
Exports from UK to EU-27	-4%	-100%	-100%
Exports from UK to Non-EU	-1%	-25%	116%
Import	-1%	-66%	-62%
Imports from EU-27 to UK	-1%	-93%	-96%
Imports from Non-EU to UK	-1%	-20%	-6%
Barley			
Production	0%	-1%	-2%
Domestic use	0%	7%	-2%
Export	-3%	-42%	-8%
Exports from UK to EU-27	-5%	-78%	-78%
Exports from UK to Non-EU	0%	12%	97%
Import	-3%	-100%	-100%
Imports from EU-27 to UK	-3%	-100%	-100%
Imports from Non-EU to UK	-2%	-100%	-100%
Area			
Wheat	0%	-1%	-1%
Barley	0%	-1%	-1%
Prices			
Wheat	-1%	-4%	-5%
Barley	-1%	-5%	-7%

Table A12: Projected Changes in the Crop Sectors in England, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Area			
Wheat	-0.2%	-0.9%	-1.4%
Barley	-0.3%	-1.0%	-1.5%
Yield			
Wheat	0.0%	0.0%	-0.1%
Barley	0.0%	-0.1%	-0.1%
Production			
Wheat	-0.2%	-1.0%	-1.4%
Barley	-0.3%	-1.1%	-1.6%

Table A13: Projected Changes in the Crop Sectors in Wales, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Area			
Wheat	0.0%	-0.4%	-0.5%
Barley	-0.2%	-0.5%	-0.8%
Yield			
Wheat	0.0%	-0.1%	-0.1%
Barley	0.0%	-0.1%	-0.2%
Production			
Wheat	0.0%	-0.4%	-0.6%
Barley	-0.2%	-0.6%	-1.0%

Table A14: Projected Changes in the Crop Sectors in Scotland, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Area			
Wheat	0.0%	-0.5%	-0.7%
Barley	-0.3%	-0.7%	-1.1%
Yield			
Wheat	0.0%	-0.1%	-0.1%
Barley	0.0%	-0.1%	-0.2%
Production			
Wheat	0.0%	-0.6%	-0.8%
Barley	-0.3%	-0.8%	-1.3%

Table A15: Projected Changes in the Crop Sectors in Northern Ireland, Percentage Difference in 2025 Compared to the Baseline

	S1	S2	S3
Area			
Wheat	-0.2%	-0.9%	-1.3%
Barley	-0.3%	-1.0%	-1.5%
Yield			
Wheat	0.0%	-0.1%	-0.1%
Barley	0.0%	-0.1%	-0.1%
Production			
Wheat	-0.2%	-0.9%	-1.4%
Barley	-0.3%	-1.1%	-1.6%