Implications of a UK exit from the EU for British agriculture

Study for the National Farmers' Union (NFU), Warwickshire, UK

S. van Berkum, R.A. Jongeneel, H.C.J. Vrolijk, M.G.A. van Leeuwen and J.H. Jager

LEI
WAGENINGEN UR

Implications of a UK exit from the EU for British agriculture

Study for the National Farmers' Union (NFU), Warwickshire, UK

S. van Berkum, R.A. Jongeneel, H.C.J. Vrolijk, M.G.A. van Leeuwen and J.H. Jager

This study was carried out by LEI Wageningen UR and was commissioned and financed by the National Farmers' Union of England and Wales (NFU)

LEI Wageningen UR
Wageningen, April 2016

REPORT
LEI 2016-046
ISBN 978-94-6257-773-2

LEI
WAGENINGEN UR

Berkum, S. van, R.A. Jongeneel, H.C.J. Vrolijk, M.G.A. van Leeuwen and J.H. Jager, 2016. *Implications of a UK exit from the EU for British agriculture; Study for the National Farmers' Union (NFU), Warwickshire, UK.* Wageningen, LEI Wageningen UR (University & Research centre), LEI Report 2016-046. 52 pp.; 14 fig.; 12 tab.; 9 ref.

This report offers quantification of effects of possible trade and agricultural support scenarios on the UK agricultural production, trade, farm gate prices and farmers' income levels in case of the UK leaving the EU. The results of each scenario show that for most sectors the biggest driver of UK farm income changes is the level of public support payments available. The positive price impacts on farm incomes seen through both the FTA and WTO default scenario are offset by the loss of direct support payments. A reduction of direct payments, or their complete elimination, would exacerbate the negative impact seen under the UK Trade Liberalisation scenario.

Dit rapport biedt een schatting van de effecten van mogelijke handels- en landbouwsteunscenario's voor de productie, handel, prijzen en inkomens in de Britse landbouwsector in geval van een Brexit. De resultaten laten zien dat voor de meeste agrarische sectoren de belangrijkste inkomensgevolgen voortkomen uit veranderingen in de beschikbare directe inkomenssteun. De positieve prijseffecten op landbouwinkomens in zowel het FTA- als het WTO-scenario worden teniet gedaan als de Britse overheid tegelijkertijd directe inkomenssteun aan de sector verlaagt. Een vermindering of totale afbouw van directe inkomenssteun zal de negatieve inkomenseffecten van een Brits liberalisatiescenario verder verslechteren.

Key words: Brexit, UK, agricultural production and trade, farmers income, scenarios

This report can be downloaded for free at http://dx.doi.org/10.18174/377860 or at www.wageningenUR.nl/en/lei (under LEI publications).

P.O. Box 29703, 2502 LS The Hague, The Netherlands, T +31 (0)70 335 83 30,
E informatie.lei@wur.nl, www.wageningenUR.nl/en/lei. LEI is part of Wageningen UR (University & Research centre).

LEI is ISO 9001:2008 certified.

LEI 2016-046 | Project code 2282500133

Cover photo: Shutterstock

Contents

Preface 5

Executive summary 5

1 Introduction 9

2 Prelude: UK's trade relations with the EU 10

3 UK's agricultural trade policy after Brexit 12

3.1 Introduction 12
3.2 Impacts of applying the EU's MFN tariffs after Brexit 12
3.3 Losing the preferences of import Tariff-rate quotas and of imports under other preferential trade agreements in case the UK applies EU MFN tariffs after Brexit 13
3.4 Next steps 14

4 Scenarios, key assumptions and implications for modelling and analysis 15

4.1 Introduction 15
4.2 Scenarios 15
4.2.1 Key features of trade scenarios 15
4.2.2 Agricultural policy scenarios 17
4.2.3 Initial hypotheses on impacts of scenarios 17
4.3 Impacts on UK agricultural markets when Brexit means imports under TRQ regimes are lost 18
4.3.1 A conceptual presentation of how a TRQ works 18
4.3.2 Empirical elaboration of UK domestic price effects of losing the EU preferential import arrangements after Brexit 20
4.4 Features of the sector and farm model used 21
4.4.1 Sector analysis 21
4.4.2 Farm-level analysis 22
4.5 Limitations of the analysis 23

5 Results of Brexit scenarios by sector 25

5.1 Introduction 25
5.2 Impacts of the FTA scenario 26
5.2.1 Impacts of the lamb meat export TRQ on UK prices 27
5.2.2 Results of the FTA scenario 28
5.3 Impacts of the WTO default scenario 29
5.4 Impact of a trade liberalisation scenario 30
5.5 Budget 31
5.6 Concluding remarks 32

6 Farm income impacts from Brexit scenarios 34

6.1 Introduction 34
6.2 Approach to estimate farm income effects of the scenarios 34
6.3 Structure of UK farming sector 36
6.4 Impact of Brexit on average farm incomes 37
6.5 Impact of Brexit on the development of farm incomes and farm viability at farm level 39
6.6 Concluding remarks 42

7 Major findings summarised 43

7.1 Sector results 43
7.2 Farm income results 44

References and websites 45

Appendix 1 UK exports to and imports from the rest of the EU 46

Appendix 2 Features of the AGMEMOD model 47

Appendix 3 Net export and net import positions of the UK, per scenario 49

Appendix 4 Labour and interest rates 50

Preface

The UK will hold a referendum on 23 June 2016 to decide if it will stay in or leave the European Union. The referendum follows a promise made by Prime Minister Cameron in 2013 that if the Conservative party would be re-elected in May 2015, the UK's EU membership would be renegotiated and an in-out referendum would be held by 2017. Prime minister Cameron agreed a package of changes to the UK's membership of the EU in February 2016 and subsequently announced that the UK should go to the polls to vote for a future in or outside the EU before summer.

Leaving the EU is likely to have significant implications for the agricultural sector in the UK. As a member of the EU the policies that affect UK farming and its food supply chain are determined by the EU through the Common Agricultural Policy (CAP) and indirectly by the World Trade Organisation (WTO). The conditions governing international trade in agricultural products and public support payments for farmers are two critical elements in the EU referendum debate.

After a Brexit the UK will have to form a set of trading and institutional relationships with the EU and with other third countries. The uncertainty is over what these would be and how long they might take to negotiate. This report estimates the effects on the UK's agricultural production, trade and farm income of a number of trade and agricultural support scenarios after a Brexit. The scope of these scenarios is broad, both in terms of trade relations with the EU (free trade versus import tariffs) and agricultural support (CAP levels versus no support). In addition to indicating the overall effects of a scenario, this allows drawing from the results the relative impact of changing trade conditions in comparison to reducing agricultural support to UK farming.

This report has been commissioned and funded by the National Farmers' Union. The authors acknowledge and thank Gail Soutar, Lucia Zitti and Martin Haworth of the NFU and Krijn Poppe of LEI Wageningen UR for their valuable comments on earlier drafts of this report. The responsibility for errors and matters of judgement remain with the authors.

Prof.dr.ir. J.A.G.J. van der Vorst
General Director Social Sciences Group - Wageningen UR

Executive summary

Leaving the European Union would imply that the UK has to redefine its trade relationship with the EU and that it has to decide what agricultural policy it wishes to pursue after the Brexit. This report investigates the trade and farm income effects of 1) a UK-EU Free Trade Arrangement (FTA); 2) a WTO default position; and, 3) a UK Trade Liberalisation (TL) scenario. In each of these scenarios the effects of three different levels of agricultural support are estimated: status quo, i.e. a continuation of all direct payments, 50% reduction of direct payments and no direct payments (see Table ES.1). It is assumed there is no change in the level of environmental (Pillar II) payments to farmers.

The results of each scenario show that for most sectors the biggest driver of UK farm incomes change is the level of public support payments available. The positive price impacts seen through both the FTA and WTO default scenario are offset by the loss of direct support payments. A reduction of direct payments, or a complete elimination, would exacerbate the negative impact on farm incomes seen under the UK TL scenario.

Table ES.1
Overview of scenarios

Name / label of scenarios	Agricultural policy assumptions		
	No changes in Rural Development Policy plus ...		
	100% Direct payments (DP)	50% Direct payments	No Direct payments
Baseline	Benchmark (existing CAP applies)	Not considered	Not considered
FTA between UK and EU	FTA+100%DP	FTA+50% DP	FTA+0%DP
WTO default position	WTO+100%DP	WTO+50%DP	WTO+0%DP
UK Trade Liberalisation	UK TL+100% DP	UK TL+50%DP	UK TL+0%DP

Sector results

Under the FTA and WTO scenarios, UK domestic prices increase, mainly driven by trade facilitation costs. Moreover, under the WTO scenario, those increases are intensified by the fact that UK imports of certain commodities no longer benefit from the EU's TRQ import concessions. Higher farm gate prices will have a positive impact on domestic production, but domestic use will decline in most cases. The net result of this is an improvement of the UK's trade balance due to increasing exports of some products but mainly due to declining imports.

A UK TL scenario implies a lowering of the UK's external import tariffs by 50%. This scenario has significant impacts on UK meat and dairy prices as current import rates are higher for these products. Consequently, the overall effect of the TL scenario is a price decline for animal products which leads to a reduction in meat and milk production in the UK. Due to lower levels of production in the livestock sector, less feed use will lead to an increase in the UK's net export position on barley and an improvement of UK's net-import position on (soft) wheat. Due to less production and higher domestic use, the UK's net imports will increase for beef, poultry, butter and milk powder, whereas the trade balance for sheep meat will turn from positive into negative. The deterioration of the UK's net trade position is largely due to higher imports of a number of livestock products mainly coming from outside the EU due to the significant price difference between the EU and the UK. As a matter of fact, UK prices for these products will tend to be lower than in the EU, making it difficult for the EU to be a competitive exporter to the UK.

Farm income results

Under the FTA and WTO default scenarios, the impact on farm incomes due to changes in prices and production only (hence under the scenarios with 100% direct payments (DP)) are positive across all sectors. However, under the UK TL scenario the impact on farm income is positive only for field crops farms when 100% DP is applied. The positive results of price changes in the FTA scenario range from almost zero to above €10,000 per farm in field crops, dairy and mixed farms, while for horticulture and poultry farms these income effects are around €30,000 (Figure ES.1). The income effects are more positive in the WTO default scenario than in the FTA scenario. This is mainly due to the higher trade facilitation costs, which induce higher prices for the UK's agricultural products. In the scenarios with a full abolition of direct payments the positive effects of an increase in output and prices are more than offset by a decrease in subsidies. In case the UK government maintains a level of direct payments equivalent to 50% of the current EU subsidies, the results in these two scenarios are more diverse. Some types of farming would benefit on average, others would show a decrease in income under the FTA or WTO default scenario (see Figure ES-1).

The UK TL scenario has a significant negative impact on farm incomes across all sectors, except for field crops when 100% direct payments is retained. In particular, the grazing livestock (dairy, sheep and cattle) and the pigs and poultry are strongly affected by the price decreases under this scenario. A 50% reduction or complete elimination of the direct payments further decreases farm incomes in those sectors under this scenario. For example, negative impacts may add up to €50,000 per poultry farm. The impact on the non-livestock farm types such as field crops is less pronounced but still significant as declining production in livestock results in less feed use. The impact of the UK TL scenario on the horticultural farms compared to the WTO default scenario is rather limited, with income expected to increase in the horticulture sector no matter the level of direct support.

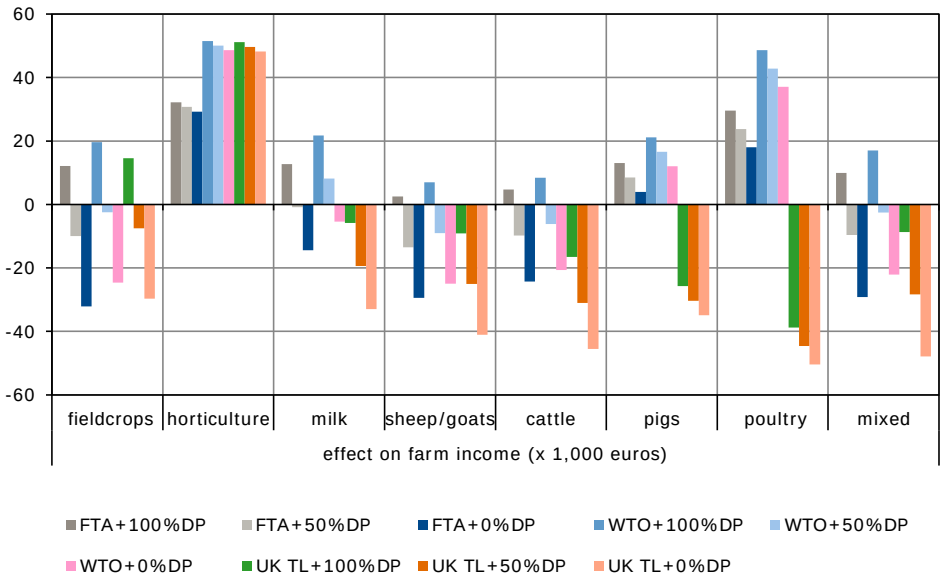


Figure ES.1 *Income effects per farm type, per scenario, changes compared to the 2012/2013 average income (in 1,000 euros)*

In case of the abolition of direct payments a large share of farms will experience negative income effects. Consequently, the viability of a substantial proportion (15-25%, depending on the scenarios) of farms will be negatively affected by this policy change.

The livestock farms in particular are heavily dependent on direct income payments: 2012/2013 FADN data indicate that without these payments their income would be negative. Also mixed farms and field crop farms greatly rely on direct payments. Overall, two-thirds of the UK's farm income relies on direct payment support.

All UK regions would show on average a decline in farm incomes in case the UK government fully abolished the decoupled payments. A 50% reduction of subsidies shows more diverse results with better results under the WTO default scenario than under the FTA scenario. Again the UK TL scenario shows the most significant changes. Farm incomes decline in all regions, except for England-East where half of the horticultural farms are located and which are little affected by the reduction of direct income payments. Farm incomes are most severely affected in Scotland under the UK TL Scenario.

1 Introduction

The UK's relationship with the European Union (EU) is under intense scrutiny ahead of the referendum on whether the UK should remain a part of it or not – the so-called Brexit-scenario. To have an informed base for discussing its stance in this process, the National Farmers' Union (NFU) has asked LEI Wageningen UR to assess different scenarios in the event of a Brexit that show the impacts on the UK agricultural sector.

In this report LEI Wageningen UR elaborates three scenarios in which the UK's relationship with the EU is defined. In each of these scenarios the effects of three different levels of agricultural support are estimated: status quo, 50% reduction in direct payments and no direct payments. This allows for analysing the relative impact of changing tariffs in comparison to reducing direct payments on UK farming. The scenario analysis is conducted by using an economic sector model and a farm-level model. Key variables to look at are the changes in production, use and trade levels, farm gate prices and farmers' income levels. Income effects are reported for a number of farm types and also regional farm income impacts are presented.

The report has the following structure. To indicate the extent the UK is integrated in the EU's agricultural markets, Chapter 2 presents an overview of UK's trade relations with the EU. Leaving the EU would imply the UK is no longer part of the EU's trade commitments to third countries. Chapter 3 highlights the possible implications for UK's agricultural import tariffs and of losing benefits the country currently enjoys of the EU's preferential trade agreements in case of a Brexit. Chapter 4 continues by defining three trade and agricultural policy scenarios after a Brexit. The results at sector level of each of the scenarios are presented in Chapter 5, followed by farm-level income effects in Chapter 6. Chapter 7 concludes by summarising the major findings.

2 Prelude: UK's trade relations with the EU

With a total export value of €26bn and an import value of €57bn, the UK is a net-importer of agricultural products (WTO definition – see Appendix 1.1 for products included). The EU27 (EU28-UK) is the UK's major trading partner: agricultural exports to the rest of the Union amounted to €16bn and imports valued €40bn in 2014 (see Appendix 1.1 for detailed 2014 trade figures with the EU).Trends in the UK-EU trade relations in agricultural products are presented in Figure 2.1 below, showing that the UK's exports to other EU member states accounted, in recent years, for 60-65% of its total agricultural exports, and that around 70% of the UK's imports originates from other EU countries. These numbers indicate the UK's strong integration in the EU's agricultural markets.[1]

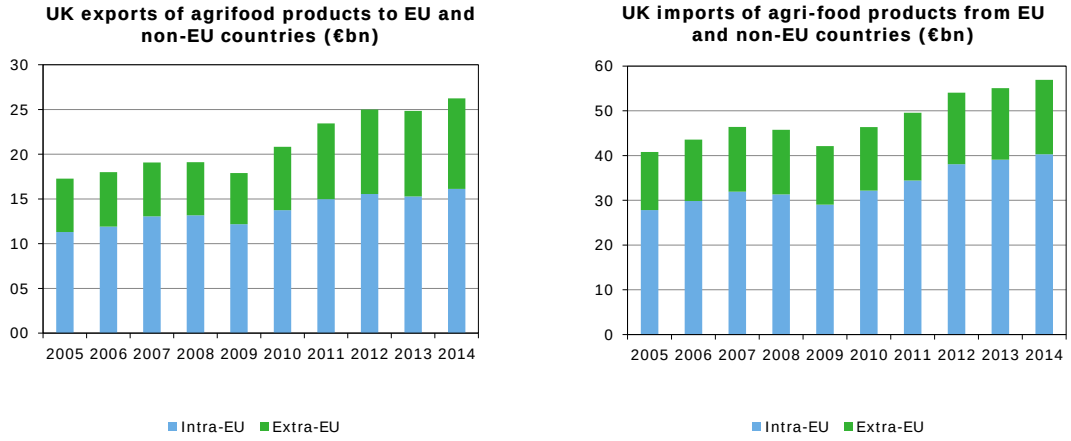


Figure 2.1 *UK exports to and imports from EU and non-EU countries*
Source: Eurostat

The UK's major exported products are (unprocessed) meat, dairy and beverages. Except for beverages, these products are mainly exported to the EU (see Appendix 1.1). In addition to meat and dairy, the EU is the UK's major market for the product categories of fats and oils, meat preparations, sugar/confectionary and animal feed.[2] Major EU export markets of the UK's agrifood sector are Ireland, France, the Netherlands and Germany (see Figure 2.2, left panel).

Major agricultural products imported by the UK are meat (both processed and unprocessed), dairy, fruits and beverages. Except for fruits, these products are largely imported from the EU. The UK's dependency on EU imports is significantly higher than average (70%, see Appendix 1.1) for meat, dairy, live trees/ornamental plants, vegetables, a number of processed foods categories and beverages. The EU countries from which the UK sources the majority of agrifood imports are the Netherlands, France, Ireland and Germany (see Figure 2.2, right panel). These four countries are also the UK's main export markets in the EU, showing the UK's strong trade links with a small group of neighbouring countries.

[1] Note that the possible impact of trans-shipment from third countries through Rotterdam and other continental ports may overstate the UK's import figures from EU countries (e.g soy meal originating from Argentina imported from the Netherlands).

[2] Meaning: the UK exports to the EU are more than 75% of its total exports of these products.

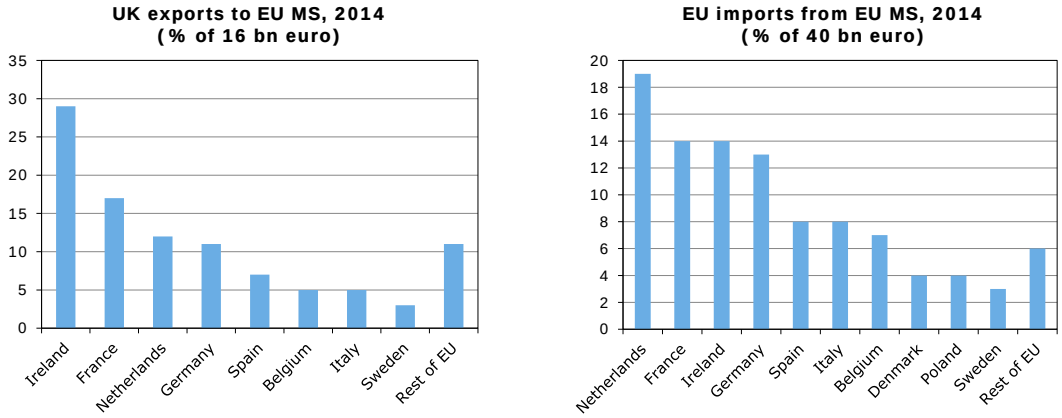


Figure 2.2 *The UKs major trading partners in the EU, 2014*
Source: Eurostat

The UK sources only a small number of agricultural products from outside the EU. These product groups are coffee, tea, and mate products (65% of total UK imports of this product category), sheep meat (90%, mainly from New Zealand); soy beans (95%); palm oil (85%); cane or beet sugar (60%), molasses (85%) and oilcakes (65%). Except for coffee and tea, these imports are subject to an EU country-specific duty-free TRQ regime (sheep meat, sugar/molasses) or a duty-free import regime agreed in WTO.

3 UK's agricultural trade policy after Brexit

3.1 Introduction

Leaving the EU would imply that the UK is no longer part of the EU's trade commitments to third countries. These commitments are laid down in the WTO agreement and in its many bilateral and regional trade agreements (FTAs and RTAs), such as free trade agreements with Canada, Korea and Mexico, and preferential trade agreements with developing countries (General System of Preferences, including the Everything But Arms arrangement, and arrangements with African, Caribbean and Pacific states in Economic Partnership Agreements). Hence, the UK has to decide what agricultural trade policy it wishes to pursue after Brexit. It is very likely the UK will remain a member of the WTO, the most logical fallback position for the country when leaving the EU. Bilateral agreements both with the EU and third countries, though, have to be re-assessed, re-negotiated and ratified, which may be a complex and time-consuming process. Matthews (2016) and Buckwell (2016) discuss the agricultural trade policy dimensions of a UK withdrawal extensively. Below, the possible implications for the UK's agricultural import tariffs and tariff rate quotas (TRQs) are highlighted and further elaborated. Agricultural policy assumptions after Brexit will be discussed in Chapter 4.

3.2 Impacts of applying the EU's MFN tariffs after Brexit

After Brexit, the UK is likely to inherit the EU's bound import tariffs which are similar to the EU's applied Most Favoured-Nation (MFN) tariffs for most tariff lines. Indeed, it is most likely that this will not be controversial in a WTO context, since, compared to the current situation of the UK being part of the EU, third countries would not lose market access to the UK. The UK could of course set its future applied MFN tariffs below this level but it could not exceed them. What it means for import prices and domestic consumers would vary from sector to sector, and product to product as illustrated in Figure 3.1, which compares the EU's average MFN tariff rates (which also include specific tariffs)[3] across over 200 agricultural products with the UK's trade balance with the EU in each. For example, the figure shows that in bilateral UK-EU trade, a tariff of 30-40% would be applied on wine and cheese - two items for which the UK runs a significant deficit with the EU (net-imports of about 2,200 million and 1,250 million euro respectively, see Figure 3.1). In addition, imports of several meat product items would become subject to tariffs that could exceed 30% and might be even close to 70% or 90%, depending on the type of meat. All in all, the UK consumer will face higher prices for many items that are imported, which will only alter, if the UK government negotiates preferential access with the EU when leaving the Union.

[3] The level of MFN tariff rates are estimated in Ad Valorem Equivalents (AVEs), by estimating the specific tariff that is an amount per unit in an 'ad valorem' form, as the percentage of the import unit price, Meat and dairy products are subject to specifc tariffs in the EUs CCT, in particular. The AVEs are estimated for meat (HS02 and H16) and dairy (HS04) products in most detail, using the import volume at 6-digit level as the weighing factor for calculating the AVE rate at 4-digit level as presented in Figure 3.1.

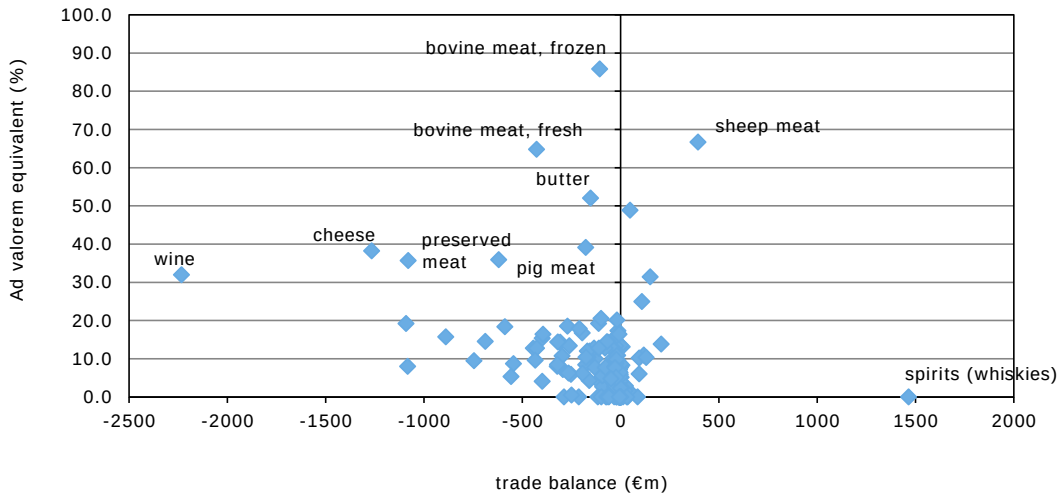


Figure 3.1 *EU MFN tariff as AVE (vertical axis) versus UK-EU trade balance (horizontal axis) for agricultural products (HS 01-24, detailed at 4-digit product categories), 2014 (see footnote on previous page for explaining the Ad Valorem Equivalent calculation)*

3.3 Losing the preferences of import Tariff-rate quotas and of imports under other preferential trade agreements in case the UK applies EU MFN tariffs after Brexit

Tariff-rate quotas (TRQ) are a more difficult case. As part of the WTO and bilateral trade agreements the EU has duty-free TRQ access to partner countries *and* it offers partner countries duty-free TRQs access to the EU's internal market. In case of a Brexit, these TRQs could be apportioned between the UK and EU27 (EU28 minus the UK). However, Matthews (2016) argues that partner countries have no reason to agree with splitting up volumes of duty-free exports to the EU as, by definition, it reduces their market access to the Union: 'A TRQ dividing into binding limits in two markets is less valuable than the same TRQ with the flexibility to switch exports between two markets'. With regard to the EU's TRQ access to partner countries, it is very unlikely the EU would be willing to grant the UK some of these benefits; after all it's the UK who wants to leave the Union. The UK can opt for negotiating its own market access arrangements with partners, but to make these arrangement WTO-compatible would be technically complex and hence a time-consuming process. All in all, a Brexit is expected to lead to a loss of cheap imports and export sales as benefits of in-quota imports and exports will vanish. Also, the UK may lose preferential access to countries with whom the EU has an FTA or any other preferential trade agreement.

As Matthews (2016) rightly points out, the impacts may be most significant for UK sugar imports and its processing industry. For example the UK's Tate and Lyle cane sugar refinery (in 2010 acquired by the American ASR Group) depends on access to duty free sugar imports from ACP states and Least Developed Countries (LDCs) for its viability. Sugar imports from this set of countries do not take place under a TRQ arrangement, but are part of the preferential trade agreement that allows duty-free, quota free imports. The volume of raw sugar imported by the UK is around 700,000 tonnes, which is slightly less than a quarter of the EU imports in 2013/2014. Other highly relevant TRQ import arrangements to the UK's agrifood sector are on butter, cheese and sheep meat, in particular with New Zealand. New Zealand's butter and cheese may enter the EU through WTO country-specific tariff rate quotas of 74,693 tonnes and 11,000 tonnes per annum respectively. In 2014, the UK was the main EU importer of this butter, importing 11,631 tonnes out of EU28 total import of 50,000 tonnes, whereas UK imports amounted to 7,200 tonnes of cheese from New Zealand under this regime (see

Eurostat trade statistics). Total EU imports of cheeses were 76,000 tonnes in 2014, of which 12,000 tonnes were by the UK. Sheep and goat meat from New Zealand enters the EU duty free within a 228,254 tonnes TRQ that was formalised after the conclusion of the Uruguay Round of the GATT in 1993 and updated when the EU enlarged in 2004 and 2007. The UK imports about 40% of the EU's total sheep and goat meat imports from New Zealand (approximately 85,000 tonnes in recent years), which is equal to half of all EU imports of sheep and goat meat. The UK is also importing a significant share of the EU's import of poultry meat (largely under duty-free TRQ regimes used by Brazil and Thailand). Table 3.1 below presents an overview of the EU's import TRQs that are most important to the UK, showing that the UK imports a significant part of the volumes that benefit from the zero-tariff in-quota TRQs. The figures also show that the TRQs of the products listed were not fully filled by the exporting countries, indicating that the out-of-quota tariffs are prohibitive.

Table 3.1

EU tariff quotas allocated to third countries for selected products, UK imports and EU28 total imports (averages of 2013 and 2014, in 1,000 tonnes)

Product and HS codes	TRQ volume	EU28 import	UK imports	TRQ fill rate (%)	UK imports share of total EU imports (%)
Sheep and goat meat (0204)	240	160	85	67	53
Poultry meat (0207, 0210, 1602)	715	700	230	98	33
Butter (0405)	86	50	12	58	24
Cheese (0406)	95	76	12	80	16

Sources: trade figures from Eurostat. TRQ volumes are estimates from various sources. These are Van Horne and Bondt (2013), for poultry; EU DG Agri dashboard: sugar; EU legislation OJ L 170/8, 23.06.206 for butter and cheese; and DG Agri http://ec.europa.eu/agriculture/sheep-goats/presentations/index_en.htm for sheep meat

Consequently, Brexit will make the UK's imports that enter its market under the EU TRQ regime or other preferential trade agreements more expensive in the case that the UK applies the EU's MFN tariffs after Brexit. Given the significant volumes imported under the preferential schemes, more expensive imports of raw sugar, sheep and poultry meat may distort the UK's importing industries processing these products. However, disruption of the industry's supply may be smoothed if UK farmers expand domestic production in response to an upward trend in farm-level prices that follows the decline of cheap imports. To what extent UK farmers will respond to these opportunities will depend on the impact of losing the cheap imports on domestic prices. Section 4.1.5 explains our approach to quantify this price effect.

An assessment of the effects on the UK agrifood sector of a loss of export sales to non-EU countries related to the loss of TRQ access to the EU's partner countries is complicated as it requires an inquiry of each bilateral TRQ (in over 30 bilateral agreements) and how important these are for the UK. This has not been investigated in detail. Effects on the UK's agrifood sector and domestic market, though, could be expected to be small, given the fact that the UK is a significant net-importer of a broad range of agricultural products, and that exports to non-EU countries are relatively small in comparison to the total exports for most of the UK agrifood sectors (except for beverages).

3.4 Next steps

The above are reflections on what a Brexit might imply for trade flows in case the UK chooses to pursue a trade policy that complies with the WTO MFN regime. There are, of course, more options to the country than the WTO MFN trade regime. Moreover, the impacts of such trade policy options on the agricultural sector depend on how the sector responds to estimated price changes that follow from certain trade policy choices made. The next chapter includes efforts to quantify the economic impacts of a set of trade scenarios after Brexit on the British agricultural sector.

4 Scenarios, key assumptions and implications for modelling and analysis

4.1 Introduction

This chapter defines and clarifies the scenarios depicting the UK's assumed trade and agricultural policies following Brexit. As the loss of access to preferential trade regimes is flagged as a potentially important consequence of leaving the EU, Section 2 in this chapter explains how a TRQ works conceptually and elaborates empirically the possible price effects of losing these preferences. The effects of the policy changes assumed are quantified by using a sector model – AGMEMOD – and a farm-level model; both tools are introduced in Section 4.4. The chapter concludes by highlighting some of the major limitations of the study that are important to consider when interpreting the results of the quantitative estimations.

4.2 Scenarios

4.2.1 Key features of trade scenarios

We have identified three trade policy scenarios in the event of a Brexit, some of which stay close to the current situation and some that substantially differ from it. In this study these three scenarios and a baseline (scenario 0) are analysed. Key features of the scenarios, which all have a ten-year, medium-term time frame, are as follows:

Baseline
A baseline scenario describes the continuation of the 'status quo', with the UK remaining a member of the EU (no Brexit). In principle that means that decisions taken for the future are taken into account in this scenario, such as the budget aspects of the CAP reforms (such as the UK's contribution and CAP payments received by the UK). However in some aspects we face practical data problems and have to relax this assumption: at the moment of writing the latest CAP reform is still in the process of being implemented and some details of this reform, such as partitioned payments for greening, re-coupling of payments and changes in the Rural Development Policy do not yet show-up in the data sets. For these aspects we rely on the pre-reform situation, since 2013/2014 is the latest year for which official data on the implementation of policy measures is available (e.g. FADN data on farms, including the direct payments they receive).

A Free Trade Agreement (FTA) between the UK and the EU
The background to this scenario is that the EU, with its positive trade balance (in total agricultural trade) with the UK, would have an interest in concluding an FTA quickly, say within the two years allowed by Article 50 of the Treaty of the European Union. An FTA goes with a number of qualifications, though. First, an FTA is not as advantageous as the free access to the European Single Market that membership of the EU confers. Border arrangements are required to deal with matters like country of origin. For this reason it is assumed that additional transaction costs of trade of 5% would be incurred (see Donner Abreu, World Trade Organisation 2013; Boulanger and Philippides, 2015). Next, agricultural matters are normally the most difficult part of FTA talks and generally the most difficult to resolve. For this reason, it is very implausible that an FTA between the EU and the UK would apply zero tariffs to all products for unlimited volumes of trade. FTAs invariably treat some agricultural products as sensitive, and it is the EU's preferred policy to apply Tariff Rate Quotas to these products. In this scenario we assume a TRQ on UK sheep and lamb meat, meaning the UK would be allowed to export the current (2014/2015) export volume to the EU at zero tariffs, and for it to pay the EU's external tariff for volumes beyond that quota. For commodities other than sheep/lamb meat,

no tariffs will be applied in the UK's bilateral trade with the EU. This effectively implies for those products that the UK and the EU are one internal market where products can freely flow. It also implies that imports into the EU subject to EU's TRQ regimes will remain to have an effect on the UK market, either directly (imports flowing through e.g. from Rotterdam into the UK) or indirectly (imports into the EU have price depressing effects throughout the EU+UK market as these add to the overall supply available; even if 'rules of origin' are specified, there will be some effects from lower priced EU products entering the UK markets. In this scenario we assume that the UK will not face any effect of losing the preferential imports (under TRQ or otherwise) that it currently enjoys as member of the EU. For UK external trade with third countries, the UK continues to adopt the EU Common Customs Tariff (CCT) on extra-EU trade imports.

WTO-default position

In this scenario, the UK leaves the EU and falls back to the WTO-default position, meaning that UK import/export trade falls under the WTO's non discrimination Most Favoured Nation (MFN) rules.[4] Under this scenario the EU applies its CCT (i.e. the MFN applied rates as agreed in WTO agreements) to UK imports, and the UK applies the same rates set by the EU's CCT to EU and 3rd party imports. Note that because the UK imports are no longer subject to the EU's TRQ import concessions regime, the price level in the UK for products that benefitted from that regime is likely to increase since the UK is no longer able to import at zero duty through the EU's TRQ system (see section 4.3 for further details on how a TRQ works). Under this scenario the UK and EU legislation no longer necessarily run parallel, which also implies that mutual recognition of rules and measures becomes more costly. For that reason under this scenario a trade facilitation costs mark-up of 8% (the upper limit of the average transaction costs, as mentioned in Donner Abreu, World Trade Organisation, 2013) is assumed.

UK Trade liberalisation

The UK reduces its tariff rates by 50% across the board in a UK Trade Liberalisation scenario. This scenario is rather similar to the WTO default scenario (including 8% trade facilitation costs), with the only difference that the UK and the EU have different border tariffs: the UK applies 50% of MFN tariffs to all imports including those from the EU, whereas the EU applies its CCT to UK exports to the Union. Such an approach is consistent with the position outlined in the 2005 UK Treasury Defra Vision document where it calls for 'import tariffs for all sectors to be progressively aligned with the much lower level prevailing in other sectors of the economy' (HM Treasury, Defra, 2005:4). No TRQs are assumed.

It should be noted that in case of a Brexit, the UK would most probably seek to negotiate separate FTAs with third countries like New Zealand and Thailand. But this would take time for the UK government to negotiate and is very complex to model. Therefore, it has not been included in this study.

A further scenario was considered but not modelled. This is the European Economic Area (EEA) scenario, sometimes known as the 'Norway model'. This allows a country almost open access to the European single market. There are a number of reasons why it was decided not to model this scenario:

- It is not evident that an EEA model would include agricultural goods. Norway, Iceland and Lichtenstein, the countries that benefit from the EEA, only have limited duty free access to the EU's single market for agriculture and fisheries.
- If it were possible to have an EEA arrangement which included agriculture, it should be noted that Norway is outside the EU Customs Union, which means that all trade is subject to customs procedures including country of origin checks.

[4] Under the WTO agreements, countries cannot normally discriminate between their trading partners. Grant someone a special favour (such as a lower customs duty rate for one of their products) and you have to do the same for all other WTO members. This principle is known as most-favoured-nation (MFN) treatment (see www.wto.org).

- This means that the additional transaction costs would fall somewhere between zero which full access to the single market implies, and which is modelled in the baseline scenario, and 5% in the FTA scenario. Otherwise there would be no change from the baseline scenario (no Brexit).
- If it were possible to construct an EEA arrangement that included agriculture, this would technically be the easiest model to introduce because it involves the least change to existing arrangements and is therefore the least disruptive. However, politically, the EEA scenario appears unlikely and few people who are arguing for the UK to leave the EU are advocating this outcome. This is because it would require the UK to continue to make substantial contributions to the EU budget; accept all relevant EU Regulation without being able to influence it and accept free movement of people throughout the EEA.

4.2.2 Agricultural policy scenarios

It is uncertain how the UK's agricultural policy will look like in a Brexit scenario. According to Matthews (2016, 13) the UK government has always been a strong critic of the CAP, in particular of its income support policy. This is confirmed in the HM Treasury/Defra Vision document of 2005. Assuming this is the case, the UK government would probably be more likely to reduce rather than increase the direct payments that are now made to farmers under the heading of the first Pillar of the CAP (Pillar I). With respect to the second pillar of the CAP (the Rural Development Policy) the UK has a well-developed policy, which address the provision of rural public goods (e.g. landscape and biodiversity services) and socio-economic growth priorities. As this links to societal concerns as well as to market failure, this policy might largely stay in place also in case of a Brexit. To account for the policy uncertainty, each of the scenarios will be undertaken with three different levels of direct support: status quo (100% direct payment), 50% reduction in direct payments and no direct payments. It is further assumed that payments for public goods (Pillar II) will remain the same as in the baseline (no Brexit).

Table 4.1
Overview of scenarios

Name of scenario	Key features of the trade scenario	Agricultural policy assumptions		
		No changes in Rural Development Policy plus ...		
		100% Direct payments (DP)	50% Direct payments	No Direct payments
Baseline	Benchmark (existing trade policies apply)	Benchmark (existing CAP applies	Not considered	Not considered
UK-EU FTA	FTA between the UK and the EU; 5% TF costs; UK export TRQ on sheep/lamb meat; UK still benefits from EU's preferential import regimes	FTA+100%DP	FTA+50%DP	FTA+0%DP
WTO default	UK and EU both apply the CCT; 8% TF costs; UK loses access to EU's preferential import regimes	WTO+100%DP	WTO+50%DP	WTO+0%DP
UK Trade Liberalisation	UK reduces its CCT by 50%, EU applies full CCT; 8% TF costs; UK loses access to EU's preferential import regimes	UK TL+100%DP	UK TL+50% DP	UK TL+0%DP

4.2.3 Initial hypotheses on impacts of scenarios

The UK-EU FTA scenario is expected to be the least disruptive with respect to trade flows, although some impacts are foreseen due to increasing trade costs and the implementation of the TRQ on sheep/lamb meat. Note that in this scenario, relative to the baseline, there are three changes: a) the CAP related budget the UK receives from the EU falls to zero; b) the UK has to finance its own agricultural policy, with expenditure being a function of how this policy will be structured; and c) there

might be some impacts on trade flows due to the increase in trade facilitation costs applying to agro-food trade under this scenario.

In the WTO as default scenario the UK leaves the EU without making arrangements of a prefential trade agreement. As a result, ad valorem and specific tariffs will apply to UK-EU agro-food trade. The WTO's non-discrimination rules mean that it will not be possible for the UK and the EU to make *specific* bilateral agreements opening preferential access for *specific* agricultural products. The EU and the UK would be free to negotiate a comprehensive free trade agreement (as is the case in scenario EU-UK FTA), but this would have to cover 'substantially all products' and could not cover agriculture alone. Moreover, the trade facilitation costs will create a wedge between UK and EU price levels, increasing the farmgate price of a product in the importing country relative to the exporting country. This is a likely outcome of the expected increase in non-tariff barriers as compliance with prevailing regulations of both trading partners will no longer be assured (Matthews, 2016, 9). Moreover, it is assumed in this scenario that the UK chooses to stick to the same (existing) CCT as applied by the EU. With regard to the budgetary aspects that were already mentioned for the UK-EU FTA scenario, this scenario adds that the UK exchequer (as well as the EU) will experience changes in its net tariff revenues associated with the bilateral UK-EU trade.

Note that in the FTA and WTO default scenario the common customs tariff prevails for the EU in the same way that it applies in the current situation (baseline) to third countries. However, in contrast to the UK-EU FTA scenario, UK-EU bilateral trade will be subject to tariffs in the WTO default scenario, and as a result bilateral trade as well as trade for both the EU and the UK with third countries is likely to be affected. Hence, trade and consequently production and consumption effects in the EU and the UK are expected to be more significant in the WTO default scenario than in scenario UK-EU FTA scenario.

In the UK TL scenario, the UK combines leaving the EU with trade liberalisation. In this scenario the UK is assumed to lower its tariff rates by 50% of the CCT across the board. Note that relative to the baseline and the FTA and WTO default scenarios, the level of farmgate prices within the UK will change more significantly (it will go down for all products with a non-zero tariff rate) and as a result production, consumption and trade will be affected. Alongside changes in policy payments (status quo, 50% reduced or zero direct payments), UK farmers will face substantial price changes, which will have an effect on their revenues and ultimately on their income. At the same time the lowered UK tariffs will improve the market access of the UK's trading partners, including the EU, to the UK-market.

The results of the scenarios are compared to a baseline scenario that takes into account recent EU and world market developments.

4.3 Impacts on UK agricultural markets when Brexit means imports under TRQ regimes are lost

4.3.1 A conceptual presentation of how a TRQ works

A tariff rate quota (TRQ) is a two-tiered tariff. In a given period, the lower in-quota tariff is applied to the first Q units of imports and the higher over-quota tariff is applied to all subsequent imports. A tariff rate quota allows the countries making use of this quota to export to a market at a lower (sometimes zero) tariff than the standard (MFN) border tariff. In agricultural trade many of these TRQs exist, four of which are particularly relevant to discuss in the context of a Brexit (see Table 3.1). The EU has TRQs which grant trade concessions to among others New Zealand and a wide number of developing countries, allowing those countries to export sheep meat, poultry meat, butter and cheese to the EU with a competitive advantage. In the cases mentioned these quotas are mainly sold in the UK (implying that it is the UK which imports considerable amounts of these products). In case of a Brexit the TRQs are likely to stay with the EU. This means that after a Brexit the UK can no longer benefit from these imports at low or zero tariffs, except for the UK establishing an FTA with the EU

(see FTA scenario description in Section 4.1.1). To understand the impacts this may have, Figure 4.1 may be helpful.

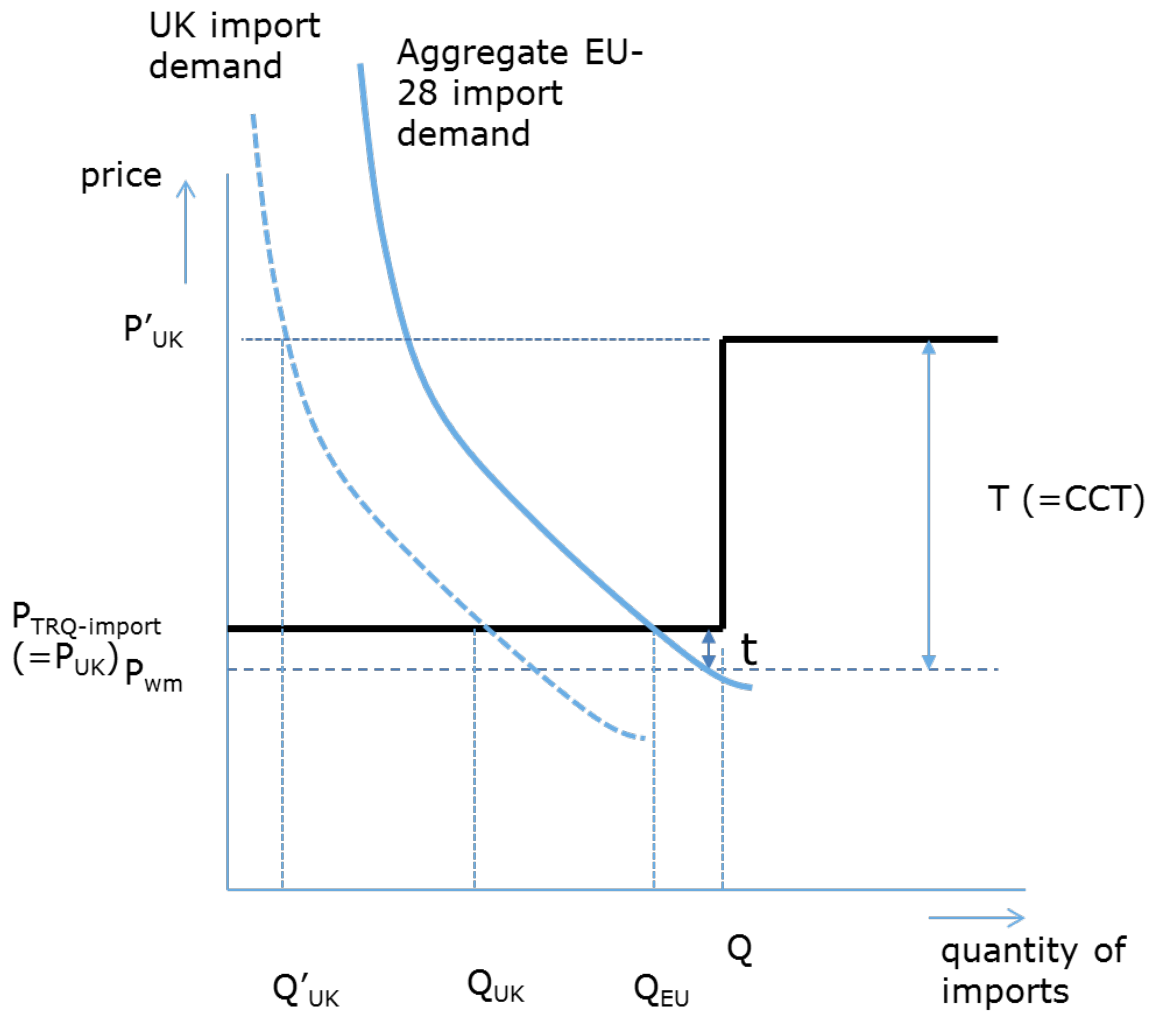


Figure 4.1 *EU import TRQ and UK price level before and after Brexit*

Legend: P_{wm} = world market price; $P_{TRQ\text{-}import}$ = EU import price; t = a within-quota tariff; T = an over-quota tariff (equal to the CCT tariff); Q = TRQ quota volume; P'_{UK} = UK domestic price in case of no TRQ-access.

The black line in Figure 4.1 represents the supply curve of import to the EU, which consists of two horizontal line parts, indicating the within-tariff rate quota supply (up to Q) and the over-quota supply. The level of both import supply curve parts is determined by, respectively, the within-quota tariff t and the over-quota tariff T. The aggregate demand for imports by the EU is represented by the bold downward sloping excess demand curve (part of this demand comes from the UK; see the dotted downward sloping UK import demand curve). In case the TRQ is not fully filled in the outset situation (see the case as drawn in Figure 4.1 with the aggregate import demand curve of the EU crossing the import supply curve at the within-TRQ-part), the import price in the EU will be determined by the within-quota tariff. This is usually set at zero or at a lower tariff relative to the over-quota tariff T, and may lead to a domestic price that is below the level of the domestic market that would occur in case imports do not take place under the preferential TRQ scheme.

Note that by being a member state of the EU, the UK has access to the EU's TRQ-facility, and can import products at the relative low within-quota tariff rate. When leaving the EU, this option ends (unless the UK establishes a preferential agreement, like an FTA, with the EU after Brexit), which implies that the UK's import price will be determined by the over-quota tariff T (which is assumed to

be equal to the EU's CCT). As a consequence of this import price increase (from $P_{TRQ\text{-}import}$ to P'_{UK}), the UK's demand for imports is likely to decline. Whether the overall take up of the EU's import TRQ declines after Brexit is not clear a priori, but depends on the price competitiveness of foreign supply on EU27 market.[5]

In the absence of no separate bilateral agreements over the extension of the EU's TRQs to the UK market, the loss of the EU's TRQ facility will (ceteris paribus) lead to an upward pressure on farmgate prices in the UK. This may induce a positive domestic supply response, but is likely to have a negative impact on consumers and can disrupt supply chains that were originally benefitting from this trade concession facility.

4.3.2 Empirical elaboration of UK domestic price effects of losing the EU preferential import arrangements after Brexit

A numerical elaboration of the most likely impacts of losing the TRQ and other preferential imports on the UK and EU market requires information on import and domestic price levels, and the share of imported volumes in total supply on the domestic market. In this section we explain how we quantify the impact of losing preferential imports on the UK's farm-level prices.

The UK currently imports sheep and goat meat, poultry meat, butter, cheese and sugar under a preferential EU-import regime. Losing this facility because of a Brexit will result in higher import prices and subsequently a decline of imports, as import conditions for these products change from zero to MFN import tariffs (equal to EU's CCT in the FTA and WTO-default scenario). Lower imports are expected to lead to higher UK domestic prices. The impact on the UK farmgate and consumer prices depends on how much (in terms of volume) the total supply on the UK market is imported and at which prices. The larger the imported volume as a share of total domestic supply and the larger the price wedge between the import and the EU price, the more significant price change is expected as the result of losing the import preferences under the EU trade regimes. Theoretically, the price wedge could be as high as the difference between the EU (domestic) market price and world market price. However, the price wedge may be (much) smaller, because exporters exploit the rent; that is exporters (from non-EU countries) sell into the UK market at a price just below the UK domestic market price. If this is the case in reality, not much will change in the UK's import price after Brexit, and consequently there will be little impact on UK's farmgate prices.

Table 4.2 below presents the data we use to assess the impact of losing the preferential imports under EU's trade regimes on UK's domestic farm prices. For each of the relevant product categories (sheep, poultry, butter, cheese and sugar), we measure the volume of imports under preferential trade regimes (column 2) and express these as the share in total domestic supply (production plus net-imports, column 4). We assume that the imported volumes are entering the UK at the world market price (column 5). Domestic production in the UK is valued at an average EU price determined in the AGMEMOD model (see Section 4.2.1 and Appendix 2 for the features of the model) and based on historical (Eurostat) data. Then, we construct a pooled price (column 7) for domestic production and imports together by using the respective shares in total domestic supply as weights and multiply these with the corresponding prices (column 5 and 6). The difference between the pooled price and the domestic price is defined as the price depressing effect of the imports (against world market prices) in the original situation (column 8).

[5] Possible pressures on EU prices that may result from increased TRQ-related imports at EU27 markets due to a Brexit are not considered.

Table 4.2

Assessing the price effects on UK markets of losing the preferential import TRQs after Brexit

1	2	3	4	5	6	7	8	9
Sector	UK imports under TRQ or other preferential scheme ('000 tonne)[1]	UK production level ('000 tonne)[2]	Imports as share of total domestic supply (%)	World market prices (euro/tonne)[3]	UK domestic price (euro/tonne)[4]	Pooled price[5] (euro/tonne)	Domestic price de-pressing effect of preferential imports (%)[6]	Price shock applied in the model
Sheep meat	85	295	22	3,175	5,038	4,621	8.3	4.2
Poultry meat	230	1,650	12	1,500	1,577	1,568	0.6	0.3
Butter	12	140	8	2,925	3,653	3,596	1.6	0.8
Cheese	12	360	3	3,035	3,732	3,710	0.6	0.3
Sugar	700	1,200	4	265	335	309	7.7	3.8

Notes: 1) Eurostat COMEXT (see also Table 3.1); 2) from AGMEMOD, average 2013/14; 3) OECD-FAO Agricultural Outlook 2015, average 2013/2014; 4) AGMEMOD, average 2013/14, for sugar: EU threshold price, average 2013/14; 5) pooled price calculated as (price at world market x import share) + (UK domestic price x UK production level); 6) (UK farmgate price minus pooled price)/domestic price.

When the UK loses the preferential conditions of importing the observed volumes, its domestic prices will increase by the percentage changes as indicated in column 8. However, note that when considering import prices against world market prices we assume that all rents accrue to the importers (UK traders and processors). If import prices are higher in practice, the price difference between the domestic and world market price would be less, and hence the calculated price depressing effect. A Brexit would then result in a smaller price shock than indicated by the estimated price depressing effect in Table 4.2. The TRQ filling rates (see Table 3.1) and the share of raw sugar imports in UK's domestic supply are shown to be significant, indicating exporters find these preferential trade regimes attractive. Hence, the distribution of the benefits is likely to be more equal: we assume a 50:50 ratio. That would lead us to implement a price shock that is half the estimated price depressing effect reported in the table above: the simulated price increases for sheep and goat meat, poultry meat, butter, cheese and sugar are +4.2%, +0.3%, +0.3%, +0.8% and +3.8% respectively (column 9). Note also that world market prices may be highly fluctuating within and over the years, underlining that this estimation is subject to many uncertainties.

4.4 Features of the sector and farm model used

4.4.1 Sector analysis

The baseline and scenarios discussed will be analysed using a two step-procedure, consisting of a sector analysis at country/EU level and a farm-level analysis at UK regional and sectoral level. Figure 4.2 shows the way scenarios and the modelling tools, including their interaction, do relate. For the sector analysis the AGMEMOD modelling tool will be used. AGMEMOD is a partial equilibrium model with a detailed representation of agriculture and the policies associated with it (first and second pillar of the CAP, including trade measures such as tariffs and tariff rate quota). The AGMEMOD model is regularly updated, including improvements of Member State or country modules, as well as with respect to the external environment or world market conditions. The tool has been updated with the results from the latest OECD-FAO Agricultural Outlook (dating from July, 2015), and the Medium Term Perspectives of the EU Commission (dating from December 2015). This should guarantee that the ten year horizon with estimates on future price, quantity, and policy developments are up to date and consistent with the latest available information. As regards policy, the model includes the main policy measures, impacting on markets (See Appendix 2 for further details on the AGMEMOD model).

In the analysis it will be assumed that the world market price levels remain as they are projected in the baseline. A Brexit scenario is expected to potentially change trade patterns, but the impacts on

aggregated trade volumes are expected to be small relative to current world trade in agricultural products, with adjustments in prices expected to be negligible.

As regards the financial and budgetary aspects, the assumptions are defined in section 4.2.2. The budgetary effects of a Brexit are not part of the modelling process, but based on a number of additional arguments. All member states have to contribute to the general means of the EU (based on GDP growth, value added tax, and net EU customs returns of products under the common customs tariff). It is assumed that the net effect of Brexit with respect to agriculture is determined by the change in the EU's contribution as far as it is related to financing the CAP. It is assumed that with a Brexit the UK will have to finance its own agricultural policy.

With respect to the rural development policy expenditure the effect of leaving the EU for the UK is that it has to finance this policy for its full amount, whereas previously this policy was partly directly financed (via the co-finance obligations applicable to various rural development policy measures) and partly financed indirectly (via the UK's contribution to the general EU means used to finance the CAP).[6] With respect to the market and price policy (first pillar of the CAP) the UK will have to finance this policy (mainly consisting of direct payments) from its national means, while it saves the indirect contribution to the general means of the EU used to finance the first pillar of the CAP. No market management measures are modelled.

4.4.2 Farm-level analysis

The second step in the two-step procedure is a farm-level impact analysis. This analysis is based on the FADN farm accountancy data. By its construction, this data set creates a representative picture of farm performance in a member state. Whilst this is an accounting system and not a direct simulation model, it does provide a detailed overview of farm income as it is affected by farmer choices and the external conditions farmers face (e.g. market conditions such as prices, regulatory constraints such as those from national environmental legislation or EU CAP's cross compliance and policy incentives, such as subsidies, taxes and income transfers like the direct payments and payments associated with the provisioning of public goods or agro-environmental services). This detailed empirical representation of the farm situation has been used to create a FADN-based farm impact assessment tool.

The farm-level analysis uses a UK FADN farm data-based calculation tool and applies to this potential changes in policy variables, such as the level of direct payments (e.g. 100%, 50% and zero direct payments). Moreover, prices changes that are the result of implementing the trade policy scenarios and estimated by the sector model simulations are feeding into the farm-level model. To transfer these prices changes from the AGMEMOD model to the farm-level analysis, the product groups of AGMEMOD will be linked to the products as recorded in FADN. In the short run no impact on the production quantities are included in the estimations, so the cost structure is assumed to stay the same, with one important exception being the feed input costs. With respect to (purchased) feed input, the impact of price changes will be taken into account (which will thus lead to a potential change in costs). While the FADN-based farm-level analysis can claim to be representative at member state level, the tool also allows the impacts at lower aggregation levels (e.g. sector and regions) to be shown.

A main aim of the farm-level analysis is to determine the impact of different scenarios on the income levels of farmers and the viability of farms. To establish the financial robustness or viability of a farm, farms are categorised by income categories. A distinction is made between including and excluding opportunity costs. The cost of own labour is calculated as the average of paid labour in a specific region, the cost of own assets is calculated as fixed percentage of own equity.

[6] In the UK, co-financing has been strongly reduced by shifting budget from the Pillar I to Pillar II.

The farm-level results based on FADN data will then be aggregated to relevant higher levels (groups of farms and/ or regions). AGMEMOD provides outcomes at national level. Regional impacts for Wales, Scotland, Northern Ireland and England will be estimated by applying the farm-level model.

These analyses will result in the first-order effects of the policy and price changes associated with the different scenarios. The results will not fully take into account possible changes in the behaviour of farms. These first-order impacts are relevant because they describe the direct pressures of a Brexit on farmers. It can be argued that the outcomes represent an upper-bound of the short-run impacts, as behavioural responses, when taking place, will lead to less negative and more positive impacts. (Note that impacts on farm structure and land prices are not included in this analysis; see last paragraph in Section 4.3.)

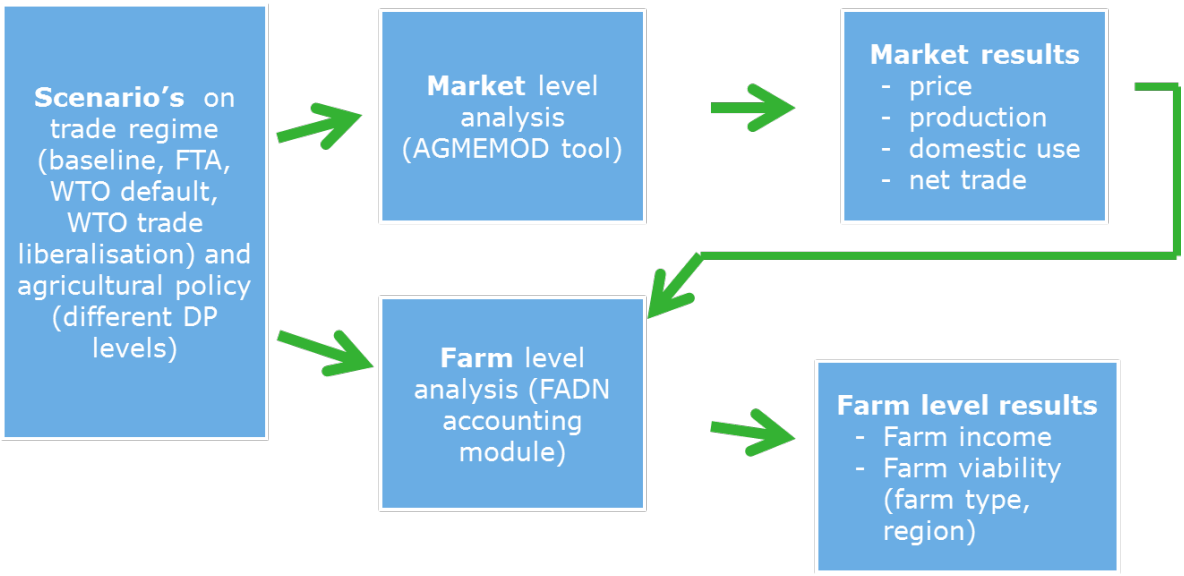


Figure 4.2 *Relations between scenarios and model tools*

4.5 Limitations of the analysis

In the previous section the basic characteristics of the tools and the way they will be used in the analysis have been discussed. In this section some limitations of the analysis are mentioned.

As regards the sector modelling, the AGMEMOD tool has EU intra-trade as net trade. This implies that rather than presenting all bilateral trade flows between the UK and other EU member states it only provides the net trade position of the UK with respect to all other countries (including the EU). As a result, the model provides no detailed information about bilateral trade flows between the UK and other individual EU member states. Moreover, traded goods are interpreted to be perfect substitutes, while in reality goods (e.g. cheese from France and cheese from the Netherlands) may be heterogeneous (have different qualities).

The horticultural sector in the UK is not modelled in detail as the key products in AGMEMOD representing the sector (apples and tomatoes) are not produced in significant quantities in the UK to provide robust data. We therefore do not rely on model results, but rather follow a qualitative argument to estimate price changes for this sector due to Brexit. The UK is a structural net importer of vegetables (Edible vegetables and certain roots and tubers) and fruits (Edible fruit and nuts; peel of citrus fruits or melons), with net import values of 3.0 and 4.3 billion euro (2013/14 averages) respectively. The shares of these imports coming from the EU were 80 and 39 percent respectively. For some products (e.g. apples) the demand and supply responses to prices are known to be very limited, while for other products (e.g. tropical fruits) imports are mostly coming from outside the EU.

There are seasonal impacts on trade flows (e.g. imports of oranges). There is some protection with respect to fruits and vegetables (e.g. seasonal tariffs for third countries with respect to tomatoes, cucumber, citrus and a general tariff with respect to bananas) and ornamentals (seasonal tariff on roses) but their impact is in general estimated to be limited. As such the impacts on the horticultural sector are assumed to mainly be determined by the assumed trade facilitation cost increases with limited impacts on both UK production and demand for these products. As a result also the simulated impacts on net trade are expected to be limited, but they are likely to be different for different products (e.g. demand and supply for ornamental horticulture is likely to be more price sensitive than demand for apples). In estimating farm level income effects, we follow the same line, assuming that trade facilitation costs are determining price effects that are used to calculate income effects in the horticultural sector.

The level of aggregation of goods in the AGMEMOD tool (largely at 4-digit HS codes, see Appendix 2, Table 2) may be such that policy details at refined product-levels (e.g. specific tariffs) can be only taken into account by way of approximation.

The FADN calculation tool is a static tool that does not include the farmers' behavioural response to changes in payments or prices. Whilst it does analyse the pressure on farmers due to the Brexit, it does not estimate the behavioural adjustment of farmers as a response to those pressures. This implies that in case of price increases the positive impacts on farm income and farm viability might be underestimated, as a likely increase in production is not modelled, and might for the future be overestimated as increased production lead to lower prices. The same holds for price declines: in case of projected price declines the negative impact on farm income and farm viability is likely to be underestimated. Neither there is any attention to the fact that part of the change in income will be passed to land owners via the rent for land and the land prices. Because this are second order impacts the approximation-error by following this approach is expected to be limited.

The most recent data published by FADN at the moment of writing this report reflect accounting year 2013. These data does not incorporate the changes to farm income and farm viability due to the 2014-2020 CAP reform.

Neither the AGMEMOD tool nor the FADN farm-level module are able to take into account details with respect to structural change (e.g. farm exit, outflow of family labour) or issues such as the land market (land price). A Brexit is likely to have an impact on these variables, but these effects, which are difficult to project, are ignored in the current analysis.

There are other potential consequences of a Brexit for British agriculture that are beyond the scope of the model, and have not therefore been quantified. These would include the:

- availability of labour, particularly seasonal labour if free movement is restricted
- consequences for the £/€ exchange rate, and changes in interest rates
- changes in input costs including land prices (and machinery costs as a result of changes in import tariffs paid), except for feed costs in the animal sector (these have been taken into account);
- implication for the regulatory burden on farm businesses
- implication for the wider UK food chain, particularly the food manufacturing sector, and therefore the impact on demand for primary products
- impact of uncertainty following a Brexit vote
- implication for product approvals regimes.

Note that as with any model, our models used can only be an approximation of the highly complex real economic relationships. Therefore, the results can only be indicative. The interpretation of the results should centre on their direction (up of down) and broad magnitude (small, medium or large) rather than on the precise point estimates that the model produces.

5 Results of Brexit scenarios by sector

5.1 Introduction

This chapter reports the results of different scenarios with respect to their impact on UK farm gate prices, production, domestic use and trade. The farm-level impacts corresponding to these scenarios are discussed in Chapter 6. The farm-level analysis will especially take into account the findings with respect to the expected price changes presented in this chapter.

The scenarios (UK-EU FTA, WTO default, UK Trade Liberalisation) were introduced and already described in the previous chapter. The scenarios are analysed in a so-called comparative static way. This implies that two 'equilibrium' states are compared (with and without a Brexit scenario). Since the timing and implementation of a Brexit trajectory is highly uncertain, no attempt has been made to make any detailed assumptions here. The focus is thus on end-states and not on the adjustment process.

Under the assumptions outlined above, the comparative static approach means that the model projections of the key variables at the end of the simulation period are compared (in our case we take a ten year horizon to 2025, which we assumed to be of a sufficient length for the impacts to fully materialise), and the extent of the outcome of each of the policy scenarios deviates from the baseline scenario results is reported. In this way, we present the impact of a Brexit in terms of percentage changes of what would have been the market balance in case the UK remains a member of the EU. However, as percentage changes need context in order to tell us how much weight they should be given (a percentage increase of production may look impressive but if the base level is pretty low, the impact on the market balance and on farm income may be minor), Table 5.1. below presents the market balances of the UK's major agricultural commodities, with reference to the average 2013/2014 levels. Note that these are sectoral aggregations according to our AGMEMOD model (see Appendix 2) and that with respect to trade only net trade numbers are presented (as AGMEMOD is essentially a net-trade model). Net-trade numbers can refer to different bilateral trade flows. For example, a net export of soft wheat of -140 thousand tonnes (see Table 5.1) primarily indicates that the UK is a net importer with respect to soft wheat for the indicated year. However, such a number could refer to different underlying bilateral trade flows: it could for example be the result of 1.72 million tonnes of soft wheat imports and 1.58 million tonnes of soft wheat exports (e.g. UK 2012 trade data), or an import of 700 thousand tonnes and an export 560 thousand tonnes soft wheat simultaneously.

Table 5.1

Market balances, 2013/2014 average levels (in 1,000 tonnes)

	Production	Use	Net-export a)
Soft wheat	14,260	14,400	-140
Barley	7,000	5,400	1,600
Rapeseed	2,312	2,118	193
Sugar	1,200	2,318	-1,117
Beef	860	1,053	-190
Pork	847	1,451	-603
Poultry	1,652	1,695	-43
Eggs	406	819	-413
Sheep meat	295	286	8
Raw milk b)	14,258	n.a	n.a
Butter	142	200	-58
Cheese	360	695	-335
SMP	70	57	13
WMP	42	67	-25

a) Net export is the balance between exports and imports and is defined as production minus domestic use. A positive sign indicates that the balance between exports and imports is positive, whilst a negative sign indicates the imports are higher than exports. This number refers to global trade, and is not specified for trade partners (e.g. EU); b) Use and net-exports of milk production are reflected by processed products.

Source: own calculations based on AGMEMOD database

Soft wheat and barley account for most of the UK's cereal production, and rapeseed is the UK's major oilseeds crop. Table 5.1 above shows for 2013/2014 a small net-import position for soft wheat (corresponding to a negative net export number), and a relatively robust net-export position for barley. Recent production levels of these crops, though, have shown considerable fluctuations explained mainly by weather impacts: a bumper crop in 2011 was followed by less abundant harvests in the two following years, but production levels increased again in 2014 and 2015. Consequently the UK's net trade position for wheat swings from positive to negative and back again. Projections, though, show a more consistent trend of an increasing net-import position for wheat, as production falls short of domestic use. Barley and rapeseed production continues to exceed domestic use which leads to a relatively constant positive net-export position for barley and a further improving net-exports position for rapeseeds over the coming decade. On the other hand, sugar production in the UK (based on domestically produced sugar beets), is far below domestic use. According to our baseline simulation, the UK's net imports of raw sugar will gradually increase over the projected period.

The UK is a net importer of most meats and dairy products. Note that the UK's sheep meat sector is a significant exporter of lamb meat, whereas the country imports other parts of sheep meat, resulting in a small yet positive net-export position. No big changes are expected in the projected period for the UK meat markets in the baseline scenario. Due to further shifts in consumption trends, the UK's imports of beef and pork are expected to decline, while poultry meat imports will increase. The UK's net-export position for sheep meat is expected to remain positive. The UK's dairy trade position is negative (hence, the UK is a net importer), with increasing imports of butter and cheese projected over the coming years. Import and export quantities of milk powder (both SMP and WMP) are relatively small, resulting in a positive net-export position in recent and coming years.

To estimate the impact of Brexit, model simulations have been conducted according to the trade scenario narratives outlined above in Chapter 4. The results of these simulations in terms of market balances are compared with the outcomes of the baseline scenario. The percentage changes in the key variables are presented below (see Tables 5.2, 5.3 and 5.5).

5.2 Impacts of the FTA scenario

Table 5.2 compares the key output variables of the FTA scenario against the baseline. Numbers show the percentage change of the values according to the two scenarios in 2025. As Table 5.2 shows, UK

farmgate prices tend to increase with an FTA, which is mainly driven by trade facilitation costs of 5% of the value of traded products. An exception is the sheep sector, where a lower price increase (of about 2%) is projected. As discussed in Chapter 4, part of the modelled UK-FTA scenario after Brexit is that the UK and the EU negotiate access for UK sheep meat to the EU market, with a zero tariff up to a limit of 55,000 tonnes. This amount equates roughly to the current UK fresh lamb meat exports to the EU. Were the UK to export more to the EU, the CCT tariff outside the quota would apply. As Figure 3.1 indicates, this could be as high as an AVE of 67%. How this impacts on UK domestic prices is explained in section 5.2.1, while scenario results are presented in Section 5.2.2

5.2.1 Impacts of the lamb meat export TRQ on UK prices

Figure 5.1 helps assess the consequences and clarify the analytical approach that has been chosen to take the UK-EU lamb meat TRQ into account in our modelling analysis. The left panel shows the UK domestic market, whereas the right panel shows the UK trade with the EU, by presenting the UK's excess supply curve ES^0 (which is simply derived from its domestic supply and demand curves for lamb meat, being S^0 and D^0 respectively). The right panel further shows the TRQ amount, which represents the demand for lamb meat from the EU. Note that the agreed TRQ limits the UK's exports of lamb meat to the EU to an amount X^0 (see the vertical TRQ-line).

Based on available market outlook projections, it is expected that in the FTA scenario UK domestic consumption of lamb meat will follow the past trend and show some decline (see shift of demand from D^0 to D^1). Moreover, UK supply of lamb meat is expected to be relatively stable or show a limited increase (see shift in supply from S^0 to S^1). As a consequence of these developments the UK's excess supply curve will shift to the right (see in the right panel the shift from ES^0 to ES^1). As a result, taking into account the high EU price, the UK will want to export X^1 rather than X^0. However, the out of quota tariff rate (67% as indicated in Figure 3.1) set for quantities above 55,000 tonnes fresh lamb meat will limit the UK from doing so.

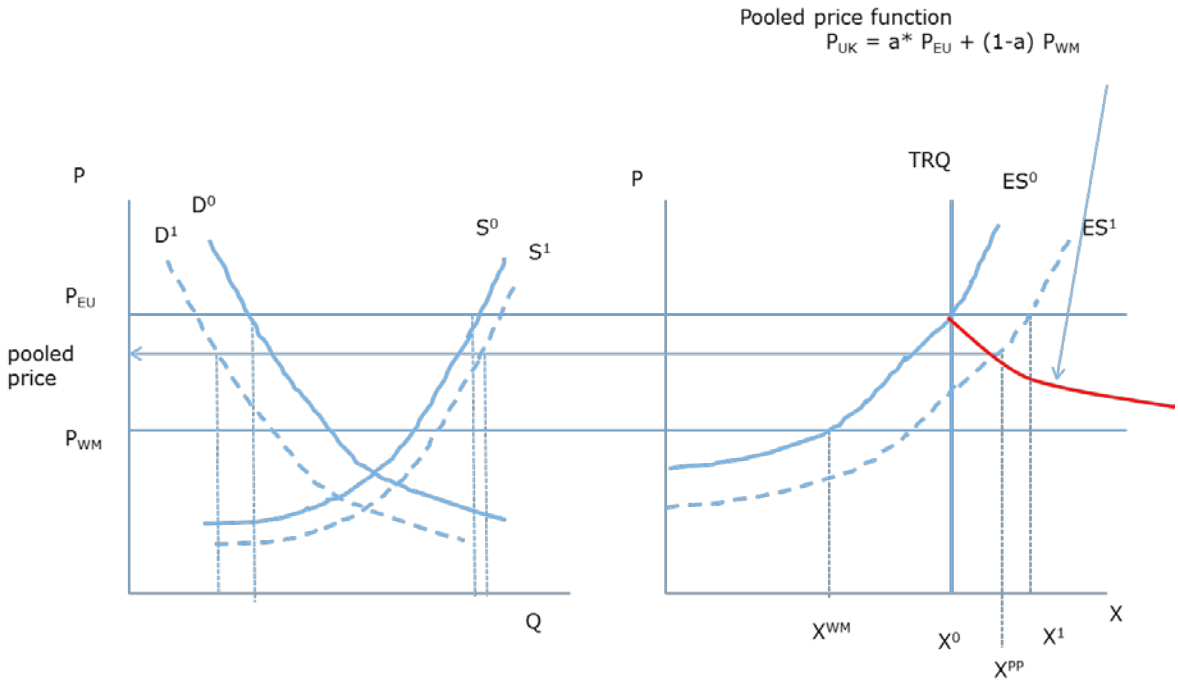


Figure 5.1 *Lamb meat TRQ and Brexit*

From this analysis, a first conclusion is that the UK is likely to fully use this TRQ. As Figure 1 shows at the low world market price, the UK is not likely to be competitive to export lamb meat. When world market price conditions prevail, the UK will be able to export X^{WM}, which is much smaller than X^0 or X^1. Following that reasoning, the TRQ will operate as an effective restriction on UK net exports as well as

on its lamb meat production. According to a less conservative reasoning, it might be assumed that the sector will be able to have some (limited) exports beyond the EU TRQ, which than have to be exported to the rest of the world (world market). In that case, the price is given by the so-called pooled price function. When 100% of the products are exported to the EU, the 'pooled' price will be equal to the EU price. In case more is produced the UK price will be equal to the share of exports to the EU (say *a*) times the EU price plus the share that is exported to the world market (say *1 – a*) times the world market price. In the latter case the market equilibrium will be the one associated with the intersection of the UK's excess supply curve (ES^1) and the pooled price function. UK lamb meat exported to countries other than the EU are then equal to X^{PP}-X^0 that is most likely to be of a temporary situation as the UK is not competitive in price terms at the world market.

Based on market outlook information and the projected shifts in UK demand and supply, the share of over-quota production has been estimated to be in the range of 5-10%. Using projected price data for the UK and the world market for 2015, the pooled price lies then in the range of €508-€515/100kg, which is in between the world market price of €389/100kg and the EU price of €522/100kg. Effectively, this implies a price reduction in the range of 2 to 4% relative to the EU price (which initially is also the UK price). So, in our simulation of the FTA scenario in which we assume 5% trade facilitation costs, we add a negative price wedge of 3%, making the UK price 2% higher than the EU price in the event of a Brexit.

5.2.2 Results of the FTA scenario

The projected price increases (5% on average) lead to changes in behaviour, which are also influenced by the elasticities of demand and supply in the agricultural commodity markets and their interrelationships (cross-elasticities). The behavioural responses result in percentage changes in the key variables that varies among the products presented. Generally, price levels are higher (closely following the trade facilitation cost increase, except for sheep meat) than in the baseline. The higher prices induce positive production responses, as can be read from Table 5.2.

Also domestic consumption is affected by the projected price increases. Depending on the product, domestic use comprises various categories, such as the use for food, seed, feed, changes in stocks, and demand for biofuels. As Table 5.2 shows, in a number of cases domestic use increases albeit less than production. Whereas one would expect the price increase to have a negative impact on consumer (food) demand, the increase in the price of animal products is increasing animal production and the associated demand for feed. The latter aspect contributes to the increased domestic use of feedstuffs like cereals. The increase of the use of sheep meat despite an increase of its price seems counterintuitive too, but can be explained by the fact that due to stronger price increases for other types of meat, consumer preference will shift towards higher demand for sheep meat. Sheep meat consumption is modest in absolute terms, which makes the percentage change considerable.

In general, small changes in domestic production and use may lead to much larger changes in the net trade position, especially when net trade is small relative to domestic supply. This is reflected in Table 5.2 where percentage changes in the UK net-trade positions are significant (partly as a consequence of relatively low absolute numbers) for beef, poultry, sheep meat, SMP and WMP. For instance, the increase of SMP exports is over 1,300%, reflecting an increase from 1,000 tonnes in the baseline scenario to almost 13,000 tonnes under the FTA scenario.[7] On average, the FTA scenario shows a tendency to reduce net imports, which follows from an increase in domestic production and a reduction or modest increase in domestic use (relative to supply) as a response to the increase in prices, or increases the net-export position (as is the case for barley). However, this does not work out in a linear way since the changes in prices also affect relative prices (creating some substituon effects) and there are complex interaction between subsectors (e.g. between crops/feed and animal products).

[7] See Appendix 3 for absolute numbers reflecting the UK's trade balance of selected commodities, per scenario.

Table 5.2

Percentage difference in price, production, consumption and trade in Scenario 1 (FTA, 5% trade facilitation costs and a 3% negative price wedge for sheep meat) a) compared to the baseline scenario, 2025

	Soft wheat	Barley	Rapeseeds	Sugar	beef	pork	Poultry	Eggs	Sheep	Raw milk	Butter	cheese	SMP	WMP
Price	5.0	5.0	5.0	4.9	4.6	4.9	4.9	4.5	2.3	4.3	5.0	5.0	4.9	5.5
Production	1.2	1.2	0.1	1.1	1.1	0.7	1.5	-0.8	1.1	1.1	0.1	0.1	18.9	7.8
Use	1.2	0.4	1.8	0.0	-0.1	-0.4	0.0	-0	2.2		-0.2	-1.1	0.0	0.0
Net exports b)		9.5	-7.4						-48.7				1333	
Net imports b)	1.6			-0.6	-17.9	-2.1	-18.2	0.4			-0.6	-2.5		-62.3

a) See Section 5.2.1 for explanation; b) net exports stands for a positive trade balance. A positive sign means an increase (exports increase) and a negative sign means a decline of the positive trade balance. Net imports stands for a negative trade balance. A positive signs means the negative trade balance becomes more negative, and a negative sign means the negative trade balance becomes less negative (imports decline).

Source: own calculations, based on AGMEMOD

5.3 Impacts of the WTO default scenario

Table 5.3 presents the impacts of a WTO default scenario in case of a Brexit on key output variables relative to the baseline. As Table 5.3 shows, several sectors show a price increase of about 8% (reflecting the assumed 8% increase in trade facilitation costs associated with this scenario), while other sectors deviate from this. These deviations are mainly caused by the UK's loss of being able to benefit from the EU import TRQ concessions and other preferential EU import arrangements that previously applied to the UK. As compared to the FTA scenario discussed in the previous section, the WTO default scenario differs in the fact that the UK has not negotiated a free trade agreement with the EU. Therefore, in this scenario the UK also loses its access to a number of relevant import TRQs the EU has, which are currently also used by the UK (as explained in Section 4.1.3). When the UK loses its access to an import TRQ, this in general creates an upward pressure to the UK price, as it can no longer benefit from importing at a reduced (often zero) tariff for at least part of its imports. To estimate the impact this will have on UK prices, the same price pooling-approach that has been followed for the UK-EU lamb meat TRQ under the FTA scenario has been used (see Section 4.1.5 for a quantification of the price effects of losing the benefits of EU preferential import regimes).

Table 5.3

Percentage difference in price, production, consumption and trade in Scenario 2 (WTO default, 8% trade facilitation costs, UK loses access to the EU's preferential import regimes) compared to the baseline scenario, 2025

	Soft wheat	Barley	Rapeseeds	Sugar	beef	pork	poultry	Eggs	Sheep	Raw milk	Butter	cheese	SMP	WMP
Price	8.0	8.0	8.0	11.5	7.4	7.8	8.1	7.1	8.8	7.2	8.8	8.3	7.8	9.3
Production	2.0	2.0	0.2	2.9	1.5	1.2	2.5	-1.3	6.8	2.0	0.4	-0.2	32.5	13.5
Use	2.1	0.6	2.9	-0.1	-0.1	-0.6	0.2	-0	-0.8		-0.4	-1.9	0.0	0.0
Net exports a)		16.6	-12.4						326				2285	
Net imports a)	2.4			-1.5	-26.4	-3.5	-28.9	0.6			-1.4	-4.1		-107

a) Net exports stands for a positive trade balance. A positive sign means an increase (exports increase) and a negative sign means a decline of the positive trade balance. Net imports stands for a negative trade balance. A positive signs means the negative trade balance becomes more negative, and a negative sign means the negative trade balance becomes less negative (imports decline)

Source: own calculations, based on AGMEMOD.

As Table 5.3 further shows, due to the price increases, production will also increase, but less than proportional (reflecting the inelastic price response of agricultural supply). The supply increases appear to be about 1.5 times larger than the ones in the FTA scenario for most products. In addition to the trade facilitation costs (inducing a 8% price increase), the loss of EU TRQs for the UK leads to larger price and production increase for sugar, poultry, sheep meat and butter. Similar to the FTA scenario, the projected price increases under this scenario have a negative impact on domestic uses, where again the interaction between the crop sector and the animal sector plays a role: production increases in livestock induce an increasing demand for cereals and rapeseed as feed use. Even more so than in the FTA scenario, the WTO scenario will reduce UK net import positions, and improve UK trade balance for products it already has a net-export position, for instance for sheep meat and SMP (again from a low base, as indicated earlier).

5.4 Impact of a trade liberalisation scenario

The third scenario considers a trade-policy scenario in which the UK will lower its external tariff by 50%. The reduction of its border tariff will lead to a UK price level closer to the world market price levels. Table 5.4 provides an overview of the impacts the tariff reduction has on UK prices. The impacts have been calculated by comparing EU prices and world market prices, both measured in euro/tonne (an average price level of 2013 and 2014 is used). It is assumed that the wedge between these prices provide a reasonable approximation of the applied special and ad valorem tariffs (at the aggregation level as it is used in the model and ignoring differences caused by quality differences between imports and exports). As Table 5.4 shows, the impacts on prices differ over the commodities. In general the impact on crop prices (with sugar being an exception) is small, which reflects the fact that current EU prices are already similar to world prices. Sugar and animal products (meats and dairy products) still have a much higher degree of protection. Therefore, halving the import tariffs for these products would lead to substantial price declines for these products, such as 18-19% for beef and sheep meat.

Table 5.4

Estimated percentage price declines for selected agricultural products due to a 50% border tariff reduction (prices in euro/tonne, average 2013/2014)

	Soft wheat	Barley	Rapeseeds	Sugar	Beef	Pork	Poultry	Sheep meat	Milk	Butter	Cheese	SMP	WMP
EU price	188	172	367	512	3,749	1,668	1,972	5,070	347	3,611	3,662	2,871	3,292
World price	184	162	357	344	2,223	1,226	1,496	3,172	292 a)	2,923	3,334	3,067	3,186
Difference between EU and World price	4	10	10	168	1526	442	476	1,898	55	688	328	-196	106
Half of the EU-World price difference	2	5	5	84	763	221	238	949	27	344	164	-98	53
Half the price difference as % of EU price	1	3	1	17	18	11	15	19	7	9	4	0	2

a) World market price = New Zealand Fonterra price reported at www.milkprices.nl.; no tariff changes for eggs assumed.

Sources: EU Commission, 2015 December Outlook for EU and World market prices

It should be noted that the calculated price declines in Table 5.4 reflect the impact of the assumed tariff reduction. In addition, in this scenario (just as in the WTO default scenario) prices are also changing due to the trade facilitation costs (causing an upward impact on prices of 8%), and the impact of the UK's loss of access to the EU import TRQs (also causing price increases for some products, see Section 4.1.5). The net impact on prices consists of the combination of all of these effects. Note that as a result of these three drivers of change, the UK will still see an increase in the

producer prices of its main arable crops (except for sugar) and to a lesser extent also for most dairy products, while the prices of sugar and all types of meat will show a net decline. Table 5.5 reports the net result of the three drivers of change on product prices in the UK.

Table 5.5 provides also an overview of the impact on production, use and trade (net exports and net imports) as they have been simulated under the assumptions of the UK Trade liberalisation scenario. Compared to the previous scenarios, the main difference is that for a number of products the price levels in the UK will decline as compared to the current EU-membership situation. This is in particular impacting the sugar and the different meat sectors. The decline in output prices, together with feed prices showing some increase squeezes the profitability in the livestock sectors; the latter also holds for the milk/dairy sector. The sectors will therefore reduce their production relative to both the levels in the FTA and WTO default scenario. The reduced profitability in animal production also has a spill-over effect on the crop sectors, because the feed demand will increase less than before.

Table 5.5

The impact of a UK Trade liberalisation scenario (50% border tariff reduction and 8% trade facilitation costs), in percentage difference in price, production, consumption and trade compared to the baseline scenario, 2025

	Soft wheat	Barley	Rapeseeds	Sugar	beef	Pork	poultry	Eggs	Sheep	Raw milk	Butter	Cheese	SMP	WMP
Price	7.9	8.0	8.0	-4.6	-14.9	-3.3	-6.6	8.7	-4.7	2.2	-0.6	3.9	8.0	3.8
Production	1.3	1.3	0.5	-1.9	-6.6	-1.9	-2.5	-1.2	-6.6	-0.7	-1.9	0.5	-2.6	-1.7
Use	-2.3	0.4	2.9	0.0	0.6	-1.7	0.1	-0	-1.8		0.1	-0.9	0.0	0.0
Net exports a)		10.8	-10.0						-206				-181	
Net imports a)	-17.2			1.0	106	-1.3	29.0	0.5			2.2	-2.7		13.5

a) Net exports stands for a positive trade balance. A positive sign means an increase (exports increase) and a negative sign means a decline of the positive trade balance. Net imports stands for a negative trade balance. A positive signs means the negative trade balance becomes more negative, and a negative sign means the negative trade balance becomes less negative (imports decline).

Source: own calculations, based on AGMEMOD.

The trade impact of the UK Trade Liberalisation scenario is mixed, as trade balances improve for wheat and barley and deterioriate for most animal products. Due to less production in the livestock sector, less feed use will lead to an increase of the UK's net export position on barley and a decline of UK's net-import position on (soft) wheat. Due to less production and higher domestic use, the UK's net imports will increase for beef, poultry, butter and milk powder, whereas the trade balance for sheep meat will turn from positive into negative. The decline of the UK's net trade position – largely because of more imports of a number of livestock products – is likely to be accompanied by relatively less intensive trade relations with EU countries, since in particular for animal products UK prices will tend to be lower than in the EU (as EU prices are assumed to remain on levels indicated in Table 5.4), making it for the EU difficult to be a competitive exporter to the UK for these products.

5.5 Budget

There are not only costs and benefits of a Brexit for producers and consumers/users of food and biomass but also for the government budget (taxpayers). The impact on the net government budget position is scenario-dependent. The net expenditure position of the UK in the baseline situation involves several components. First, there is the contribution of the UK to the general budget of the EU, amounting about 27.4 bn euro (EU Commission, 2016). Alongside the EU budget contributions based on value added tax (VAT; Member States contribute 0.3% of their harmonised VAT base), and gross national income (GNI; Member States contribute up to a maximum of 1.24% of GNI), this contribution

includes the so-called traditional own resources (TOR) of the EU. These TOR comprise customs, agricultural, sugar and isoglucosis levies (25% of which a Member State may keep as a contribution to cover collection costs). For the UK these TOR payments amount to about €2bn. For the UK a rebate has been applied since 1984 (about €7.2bn) which reduces its EU budget contribution to €20.2bn. The part of the UK's contribution to the EU budget that is related to the financing the CAP is €7.9bn: this estimation is determined as the UK's general (net) contribution times the share (39%) of CAP related expenditures in the EU's total budget).

The support farmers receive from the CAP amounts to about €3.8bn, consisting of €3.2bn First Pillar (market and income support policy) payments,[8] and €0.6bn Second Pillar (rural development policy) payments (see Table 5.6). The net position of the UK with respect to EU related to agricultural policy is €4.1bn (equal to the UK's agricultural policy related EU budget contribution of €7.9bn less the €3.8bn received by farmers).[9]

Table 5.6

UK's agriculture-related net contribution to EU budget and the budget expenditure for different agricultural policy scenario's in case of a Brexit (in €bn)

Agricultural policy	Baseline	Brexit: UK national policy		
	EU, CAP	100% DP, 100% RDP payments	50% DP, 100% RDP payments	no DP, 100% of the RDP payments
UK contribution to EU related to CAP	7.9	0	0	0
Agricultural Policy				
CAP pillar I (market and income support)	3.2	3.2	1.6	0
CAP pillar II (rural development policy)	0.6	0.6	0.6	0.6
Total agricultural policy	3.8	3.8	2.2	0.6
Agricultural net position of UK w.r.t. EU	4.1	-3.8	-2.2	-0.6
Change (relative to baseline)		-7.9	-6.3	-4.7
UK budget expenditure w.r.t. agriculture	7.9	3.8	2.2	0.6
Change (relative to baseline)		-4.1	-5.7	-7.3

Source: own calculations based on European Commission data and Boulanger and Philippides (2015)

Table 5.6 also provides an estimation of the UK budget expenditure on agricultural policy for different policy scenarios (as well as the changes relative to the baseline situation of no Brexit). In case of Brexit the UK would save budget expenditure on agriculture: the declines in budget expenditure vary from 4.1 (-52%) to 7.3 (-93%) bn euro, depending on how the UK's new agricultural policy will look after a Brexit.[10]

5.6 Concluding remarks

Three trade and agricultural policy scenarios on UK agriculture have been designed to estimate possible effects on the UK agricultural sector of a Brexit. Price effects are caused by the introduction of trade facilitation costs, which effectively result in higher farm gate prices as the UK is an net-importing country for most agricultural products. In addition, the UK will lose access to EU's preferential imports which has a similar price increasing effect.

[8] Mainly received by farmers in terms of direct payments that are decoupled from production, as a hectare payment (regional flat rate).

[9] The UK's total net contribution to the EU amounts about 11.2bn euro. See Boulanger and Philippides (2015: 836) for a detailed overview.

[10] Note that in these calculations no corrections have been made for the changes in the net tariff revenues associated with these policies (which are here considered to be more trade policy than agricultural policy-related).

The agricultural product prices are projected to increase in the FTA scenario in the range of 2.3 to 5.5%, and 7.2 to 11.5% in the WTO scenario. These price increases have a positive impact on supply and farm revenue and income, but have a negative impact on domestic use and consumer (or user) expenditure. At the level of the society this implies a loss of consumer welfare.

A UK Trade Liberalisation scenario significantly impacts on UK meat and dairy prices as current import tariff rates are higher for these products. Consequently, the overall effect of the Trade Liberalisation scenario is a price decline for animal products which leads to less meat and milk production in the UK. Due to lower levels of production in the livestock sector, less feed use will lead to an increase in the UK's net export position on barley and an improvement of UK's net-import position on (soft) wheat. Due to less production and higher domestic use, the UK's net imports will increase for beef, poultry, butter and milk powder, whereas the trade balance for sheep meat will turn from positive into negative. The deterioration of the UK's net trade position is largely due to higher imports of a number of livestock products mainly coming from outside the EU due to the significant price difference between the EU and the UK. As a matter of fact, UK prices for these products will tend to be lower than in the EU, making it difficult for the EU to be a competitive exporter to the UK.

The UK currently contributes an estimated €7.9bn to the CAP budget, from which its farmers receive €3.8bn. A Brexit would save the UK budget expenditure on agriculture: the declines in budget expenditure vary from €4.1bn (-52%) to €7.3bn (-93%), depending on whether the UK's new agricultural policy will maintain 100% direct income payment, reduces payments by 50% or abolishes them.

Being member of the EU implies the UK is part of a large EU market on which trade occurs at relatively low transaction costs. A Brexit would cause trade costs to increase. Comparing the impacts on trade of the different scenarios simulated in this research the FTA and WTO scenarios show a kind of anti-trade bias, as they add to transaction costs in trade, and - in case of the WTO scenario - imply a loss of benefits from cheap imports under the EU's preferential trade arrangements. In the Trade Liberalisation scenario, the reduction in the external import tariff levels assumed leads to declining prices, less production and more imports of a number of products, and as such to more openness to trade.

6 Farm income impacts from Brexit scenarios

6.1 Introduction

In this chapter the results at sector level of each of the scenarios are used to estimate farm-level income effects, as the second step of the Brexit impact analysis. As explained in Section 4.4. price changes that are the result of implementing the trade policy scenarios and estimated by the sector model simulations are feeding into our farm-level model. As indicated earlier, the analysis results in first order effects, and does not include impacts on production quantities or other possible changes in the behaviour of farmers, nor on changes in land prices and rents. The approach is further explained in Section 6.2, specifying the data used and the methodology to calculate costs of farming. Section 6.3 presents the structural and income characteristics per category of farms. Section 6.4 and 6.5 show the impacts of our policy scenario simulations on farm income and on the economic viability of farms in the UK after Brexit.

6.2 Approach to estimate farm income effects of the scenarios

Farm income impacts are estimated by using a farm-level simulation based on FADN data. These farm-level simulations aim at quantifying the direct impacts of the changes in outputs and prices as generated by the AGMEMOD model under the different scenarios, and include the reduction of the direct payments available to the UK farmers (status quo; 50% reduction; abolition of payments).

For each farm in the FADN sample, the farm income before and after the Brexit (under the different scenarios) is estimated (see Figure 6.1, first level). The FADN sample represents the total farm population (above a certain minimum size) and allows the estimation of the impact on the whole farming population.

To describe the impact of the scenario at individual farm level, farms are categorised in two groups considering whether they benefit or are negatively affected by the Brexit scenario in terms of the level of farm income (see Figure 6.1, second level).

Depending on the baseline situation at farm level, the impact of a Brexit could have or not have a substantial impact on the viability of the farm. Farm viability is defined based on the extent to which the farm can cover all costs of the farm, including opportunity costs for their own (unpaid) input of labour, land and capital. A distinction is made between the farms that cover all costs (defined as high viability) and farms that do NOT cover all costs (defined as low viability). A substantial share of farms, will stay in the same viability class despite the fact that they face an improvement or worsening of the farm income. Some farms benefit from Brexit by improving their viability class (bright green in Figure 6.1) and for some farms the Brexit will result in a lower viability class (bright red in Figure 6.1).

FADN farm income (standard variable SE420) is the reward for family owned fixed factors of production (work, land and capital). The farm income is the difference between the net value added and the paid factor costs (wages, rent and interest). Net value added is the total farm receipts (total output plus public support) minus the total intermediate consumption (farm specific costs plus overheads) and depreciation. See http://ec.europa.eu/agriculture/rica/pdf/site_en.pdf for a further definition of these variables.

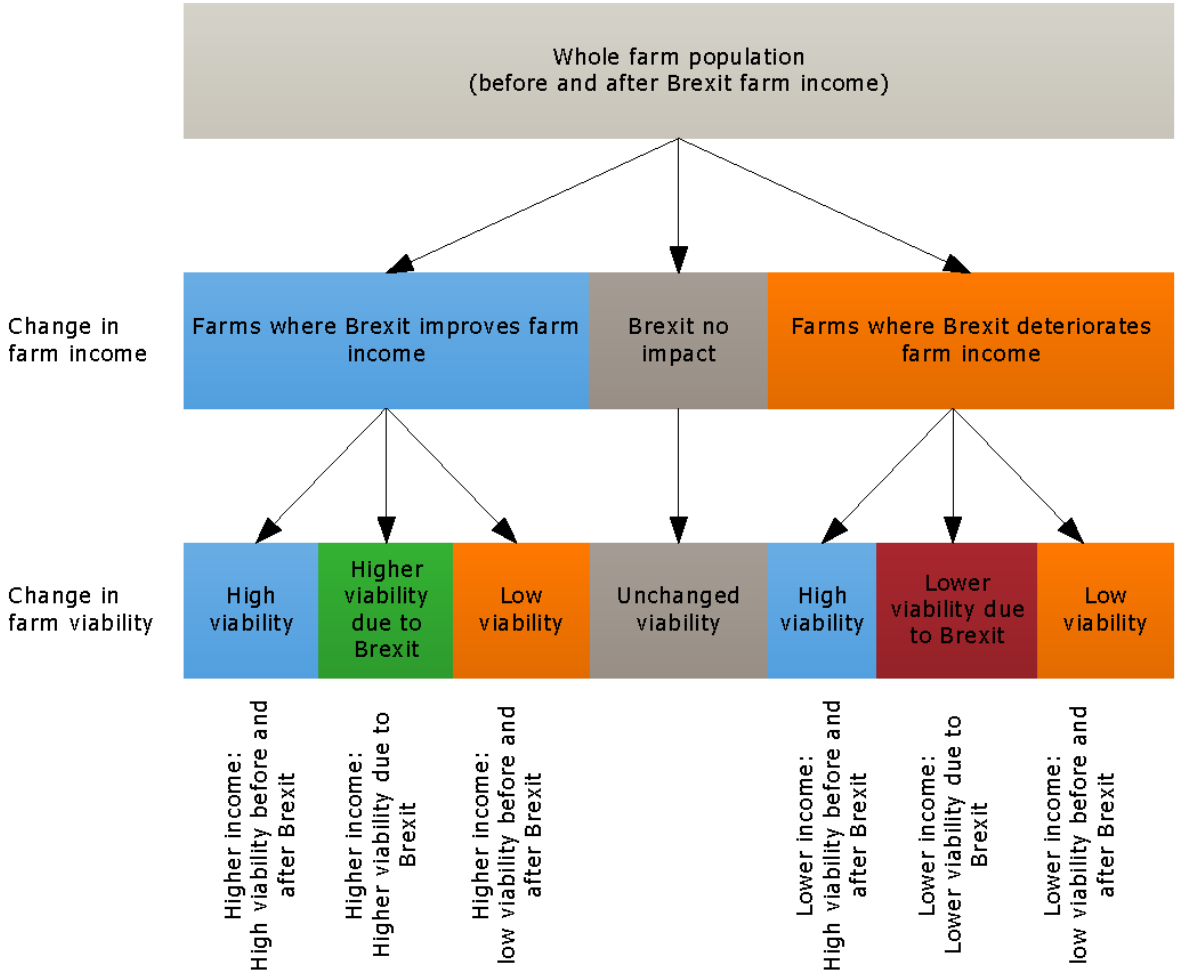


Figure 6.1 *Different levels of impact of a Brexit in the farm-level analyses*

In the standard results, FADN does not consider the costs of own labour, land and assets. In the long run, to be viable, the costs of a farm's own labour, land and assets should be considered. Therefore the opportunity costs of these production factors are estimated in this analysis. This does not imply that a farm will go bankrupt if it does not fully cover the opportunity costs. A farmer can accept a lower level of remuneration of his labour and assets. Furthermore, bankruptcy of the farm depends on many other factors such as the cash flow, farm wealth, the off farm wealth, the off farm income etc.

In the calculation of the opportunity costs the costs of own labour and own assets are included. The opportunity cost of own labour is calculated based on the average value of paid labour at a specific type of farming in a specific region (see Appendix 4). This is considered as an alternative if a farmer decides to quit his own farm, but is likely to be a conservative estimate of the real opportunity costs given the management responsibilities and skills of a farmer.

The opportunity costs for own capital makes use of an imputed cost, where the interest cost are approximated by an interest rate based on the interest rate of state bond to which a 1.5% mark-up is applied to account for the risk level associated with investments in primary agriculture (see Blokland and Van Everdingen, 2008, for the methodological background). The total calculated capital costs take into account the actual financial structure of the farm (both the paid interest on debt and imputed interest on equity). The cost of capital (in %) is calculated for each farm. The cost rate is directly applied to biological and monetary assets. For machines, quota and buildings this rate is adjusted for the inflation rate (value change are reflected in the balance sheet and not in the farm result). For the land the value it is decreased by 2% (long-term difference in development of land values and inflation rate) with a minimum rate of 0.5.

The farm-level results based on FADN data are aggregated to relevant higher levels (groups of farms and/or regions) to present concise pictures of the effects. AGMEMOD provides outcomes only at national level. Regional impacts at the level of the major socio-economic regions (Wales, Scotland, Northern Ireland and England) will therefore be estimated by applying the farm-level model.

6.3 Structure of UK farming sector

Table 6.1 gives a description of the structure of the farm types as used to present the results in the following sections. Agricultural activities within a type of farming and the amount of direct payments (absolute levels and as a share of farm income) are important parameters to understand the outcomes of the different scenarios. The average amount of subsidies varies between €3,000 in horticulture up to around €40,000 for fieldcrop farms and mixed farms. Also the grazing livestock farms (dairy, cattle and sheep/goats) receive about €30,000 of direct payments. The cattle and sheep/goats farms are heavily depend on direct income payments: the data in Table 6.1 indicate that without these payments their income would be negative. Also mixed farms and field crops farming heavily rely on direct payments for their income. Overall, two-thirds of UK's farm income relates to direct payment support. Horticulture covers agricultural holdings producing vegetables (outdoor and under glass), flowers and ornamentals (outdoor and under glass), nurseries and mushrooms. Horticultural farm types do receive only a relatively small percentage of their income as direct income support.

Table 6.1

Structural and income characteristics per type of farming in the UK (baseline 2012/2013)

	Field crops	Horti-culture	Milk	Sheep/ goats	Cattle	Pigs	Poultry a)	Mixed	Total
Number of farms	24,150	2,090	13,940	19,830	18,800	1,280	1,860	8,100	90,970
Cows	0	0	123	0	2	0	6	5	
Ewes	22	1	26	557	103	21	18	128	
Other sheep	29	1	31	511	115	24	19	151	
Piglets	0	0	1	0	0	849	0	29	
Breeding sows	0	0	0	0	0	198	0	5	
Pigs for fattening	4	0	4	0	1	1,246	0	60	
Table chicken	0	0	0	0	0	15	0	1	
Laying hens	0	0	23	0	3	0	35,156	334	
Hectare	182	21	106	270	110	43	52	161	163
Total labour (awu)	2.0	10.6	2.7	1.6	1.5	2.7	3.6	2.4	2.2
Paid labour (awu)	0.9	9.2	1.0	0.3	0.2	1.5	2.4	1.0	0.9
Direct payments (x 1,000 euros)	44.2	2.9	27.0	31.6	28.1	9.1	11.6	38.8	32.6
Total output (x 1,000 euros)	288.9	695.5	421.8	113.0	123.2	462.3	837.0	270.4	258.3
Farm income (x 1,000 euros)	69.9	73.2	72.3	27.4	21.9	55.7	93.5	49.8	49.2
Direct payment as share of farm income	63	4	37	117	133	16	12	79	67

Note a) Eggs are included in the poultry farm category

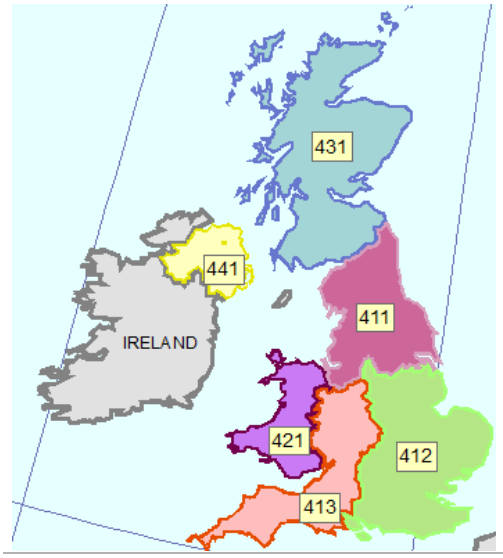
The number of farms in the first row of Table 6.1 gives the number of farms in the UK as represented by FADN. FADN does not cover all agricultural holdings, but only those which are considered to be commercial holdings. Therefore, in each member state a threshold value for the economic size is used. In the UK this threshold is €25,000 SO (standard output) with an exception for Northern Ireland, where this threshold is €15,000.

To understand the regional impacts of Brexit, Table 6.2 provides some structural data of each of the regions analysed in this report (England-West, England-East, England-North, Scotland, Wales and Northern Ireland). For each type of farming within each region the number of farms and the average size of the farm (in terms of average output) is given. The definition of the regions is given in Figure 6.2.

Table 6.2

Number of farms and size of farms (output in 1,000 euros) in the UK regions (baseline 2012/2013)

Average output (in 1,000 euros)	Field crops	Horticulture	Milk	Sheep/ goats	Cattle	Pigs	Poultry	Mixed	Total
England-North	236.2	444.5	450.0	133.2	167.4	503.3	1,042.6	246.2	267.3
England-East	338.5	764.1	529.3	110.4	140.1	487.5	883.1	346.1	365.9
England-West	242.9	713.6	497.6	123.0	118.8	456.8	807.9	238.9	281.0
Wales	112.4	0.0	361.0	119.4	128.5	0.0	0.0	215.9	173.2
Scotland	274.2	0.0	527.5	134.1	164.2	0.0	0.0	281.9	235.8
Northern Ireland	134.4	0.0	275.3	58.0	73.3	169.9	282.1	167.8	127.9
Total	288.9	695.5	421.8	113.0	123.2	462.3	837.0	270.4	258.3
Number of farms	**Field crops**	**Horticulture**	**Milk**	**Sheep/ goats**	**Cattle**	**Pigs**	**Poultry**	**Mixed**	**Total**
England-North	4,150	340	2,500	4,080	2,140	410	400	1,620	15,640
England-East	11,730	1,080	1,070	1,670	1,460	560	760	2,070	20,890
England-West	3,930	670	4,020	2,950	4,340	210	510	2,330	19,320
Wales	400	0	1,960	5,380	1,520	0	0	330	9,590
Scotland	3,540	0	1,090	2,300	3,930	0	0	1,350	12,210
Northern Ireland	390	0	3,310	3,450	5,410	100	180	400	13,320
Total	24,150	2,090	13,940	19,830	18,800	1,280	1,860	8,100	90,970



FADN Regions in the UK
411 England North
412 England East
413 England West
421 Wales
431 Scotland
441 Norther Ireland

Figure 6.2 *Definition of FADN regions in the UK*

6.4 Impact of Brexit on average farm incomes

Figure 6.3 shows the average impact on farm income per type of farming under the different scenarios taking into account the changes in farm gate prices as received (and paid in case of feed) by farmers (per scenario taken from Table 5.2, 5.3 and 5.5 respectively) and the changes in direct payments. The income effects due to changes in prices only (hence the scenarios with 100% DP) are positive in all sector in both the FTA and WTO default scenarios, but only for field crops farms when the UK Trade Liberalisation scenario is applied. The positive results of price changes in the FTA and WTO default scenario, range from almost zero to above €10,000 per farm in fieldcrops, dairy and mixed farms. The income effects are more positive in the WTO default scenario than in the FTA scenario. In the scenarios with a full abolishment of direct payments the positive effects of an increase in output prices are more than offset by a decrease in subsidies. In case the UK government maintains a level of direct payments of 50% of the current EU subsidies, the results in these two scenarios are more diverse.

Some types of farming would benefit on average, others would show a decrease in income under the FTA or WTO default scenario.

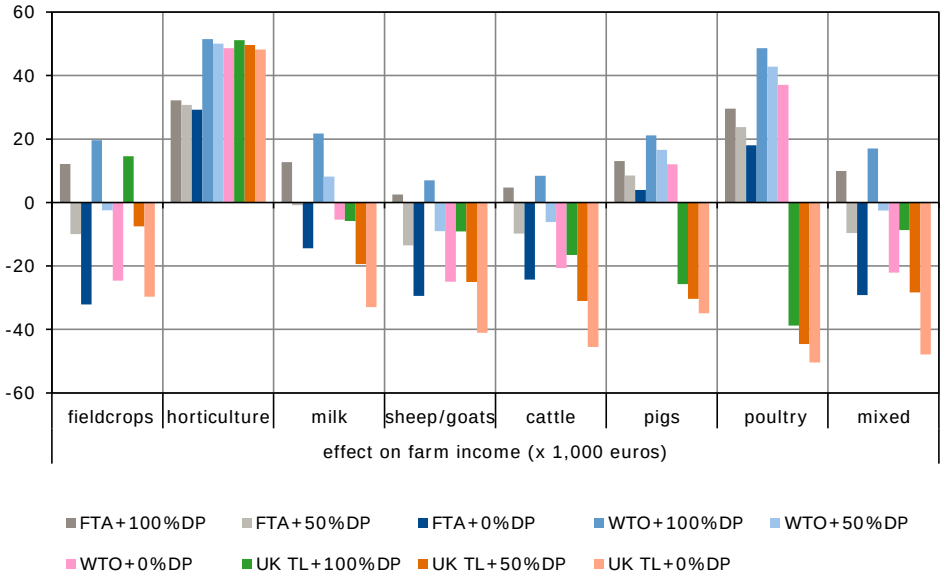


Figure 6.3 *Income effects per farm type, per scenario, changes compared to the 2012/2013 average income (in 1,000 euros)*

As indicated, the UK TL scenario has a significant negative impact on all sectors, except on field crops when 100% DP remain. In particular, the grazing livestock (dairy, sheep and cattle) and the pigs and poultry are strongly affected by the price decreases in this scenario. A 50% reduction or complete elimination of the direct payments further decreases farm incomes in those sectors under this scenario. In the most extreme case, negative impacts may add up to €50,000 per poultry farm. The impact on the non-livestock farm types such as field crops is less pronounced but still significant as declining production in livestock results in less feed use. The impact of the UK TL scenario on the horticultural farms compared to the WTO default scenario is rather limited.

Figure 6.4 shows the income effects per region. The conclusions are consistent with the previous sector wide figure (Figure 6.3). The changes in farm gate prices under the FTA and the WTO-default scenario have a positive impact on farm incomes in all regions. In case in those scenarios the UK government fully abolished the direct payments, all regions would show on average a decline in farm incomes. A 50% reduction of subsidies shows more diverse results with better results under the WTO-default scenario than under the FTA scenario.

Again the UK TL scenario shows the most significant changes. The impacts on farm incomes are all negative in all regions, except for England-East. In this region the share of field-crops and horticultural farms is high; both farm types are little affected by the lower prices in the TL scenarios. In the TL scenario Scotland and Wales are heavily affected due to the higher share of livestock farms.

Figure 6.4 *Regional farm income effects, per scenario, changes compared to the 2012/2013 average income (in 1,000 euros)*

6.5 Impact of Brexit on the development of farm incomes and farm viability at farm level

The previous figure shows the effects on the average income levels. Figure 6.5 shows the share of farms (per type of farming) that will face a negative impact on farm income due to Brexit under the different scenarios. Mixed farms, cattle farms and sheep and goat farms are the categories showing the highest percentage of farms with a negative impact on farm income due to Brexit. This ranges from 0% under the most positive scenario (with a full continuation of direct payments by the UK government) up to 80 to 95% under the more negative FTA and WTO default scenarios with a partial or full abolishment of direct payments and even up to 100% in the TL scenarios.

In case of the Trade Liberalisation scenario a large percentage of farms will be confronted with negative income effects. The decrease in prices leads to substantial losses of revenues and a decrease in incomes. In the grazing livestock and the pig sectors almost all farms are faced with decreasing farm incomes. The impact is very limited in the horticultural sector.

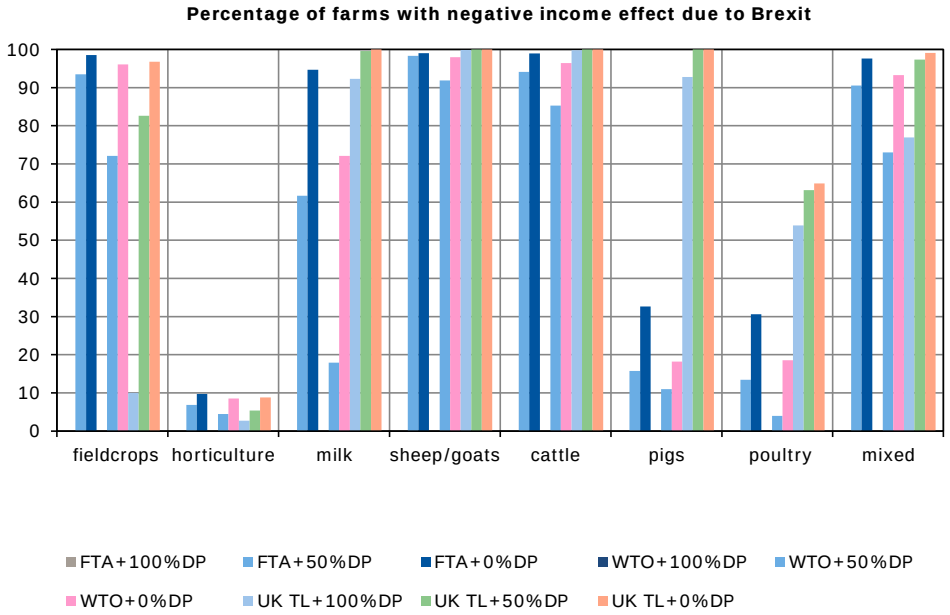


Figure 6.5 *Share of farms with a negative income effect due to Brexit*

Figure 6.6 reports the impact of the scenarios on farm incomes and the viability of individual farms in the category of field crop farmers. The figure shows that among these farms there is a substantial share that faces a deterioration of its viability due to the Brexit (bright red in the figure) in case direct payments are reduced or fully eliminated: under all three scenarios with a full abolition of direct payments between 15% and 20% of the farms would not be able to cover their opportunity costs anymore after Brexit (in addition to those who cannot cover their opportunity costs in the baseline scenario). Under the scenarios with a full continuation of direct payments by the UK government, between 5 and 10% of the farms would improve their viability. In the scenarios with a partial continuation of direct payments there are both winners and losers in terms of viability.

The results in the sheep and goats farms (presented in Figure 6.7) and cattle sector show similar percentages of farms with declining viability as in the field crops farm category under the FTA and WTO scenario, but outcomes are much worse for these animal sectors in the UK TL scenario. Due to the significant decrease in prices in the livestock sector under the TL scenario, up to 25% of the farms are not able to cover their opportunity costs as a direct consequence of Brexit. Even with a full continuation of the direct payments a significant share of farms – about 10% - will show a decrease in viability.

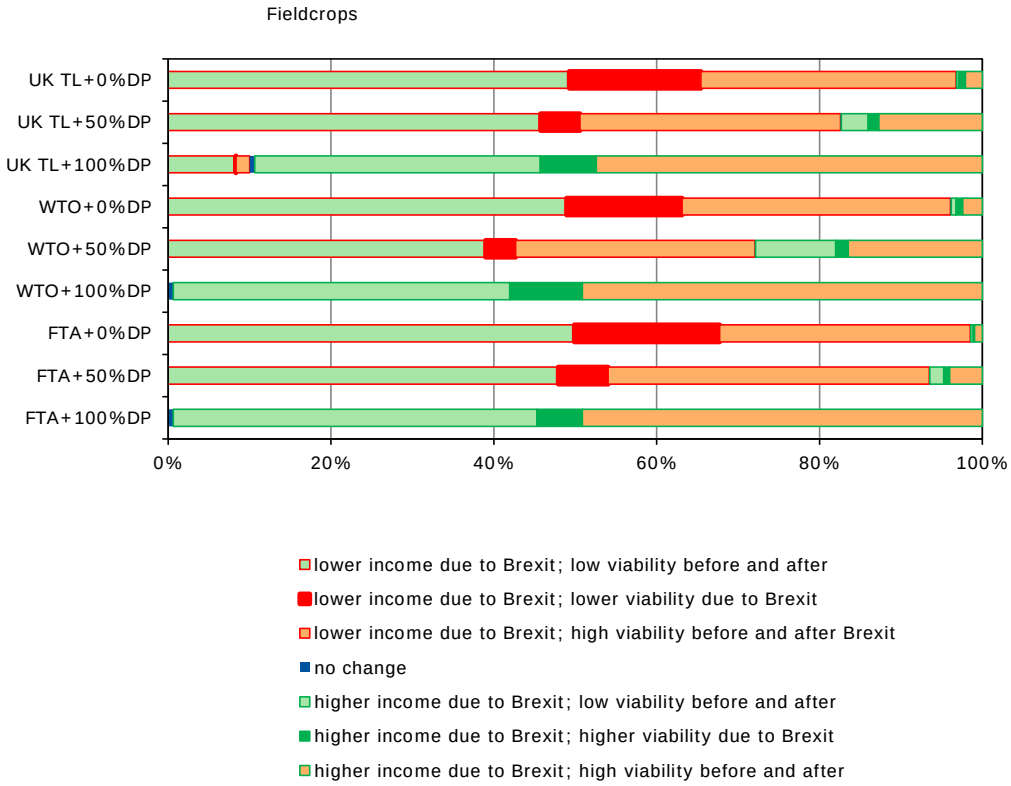


Figure 6.6 *Impact of Brexit on viability at farm level (fieldcrops)*

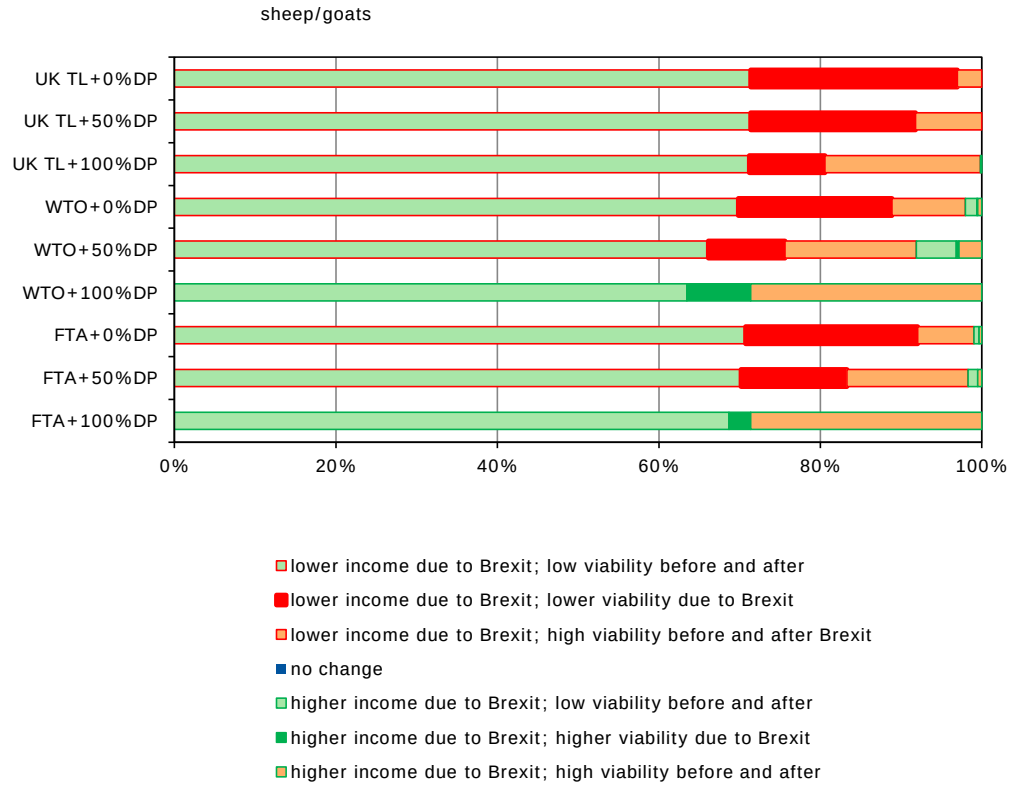


Figure 6.7 *Impact of Brexit on viability at farm level (sheep and goats)*

6.6 Concluding remarks

Price changes due to a Brexit have a positive impact on farm incomes in all sectors under the FTA and WTO-default scenario. In case of a UK Trade Liberalisation scenario, the livestock sector will face price declines, and subsequently its income is negatively affected.

The positive price impacts on farm incomes in the FTA and WTO default scenario will be offset by the loss of direct payments, in case these trade scenarios are combined with reduced agricultural support. A reduction of direct payments or their complete elimination further aggravates farmers' income effects under the UK Trade Liberalisation scenario.

In case of the abolition of direct payments a large share of farms will have negative income effects. Consequently, the viability of a substantial share (15-25%, depending on the scenario) of farms will be negatively affected by this policy change.

Livestock sectors in particular are heavily dependent on direct income payments: 2012/2013 FADN data indicate that without these payments their income would be negative. Also mixed farms and field crop farms greatly rely on direct payments for their income. Overall, two-third of the UK's farm income relies on direct payment support.

All UK regions would show on average a decline in farm incomes in case the UK government fully abolished the direct payments. A 50% reduction of subsidies shows more diverse results with better results under the WTO default scenario than under the FTA scenario.

Again the UK TL scenario shows the most significant changes. Farm incomes decline in all regions, except for England-East where half of the UK horticultural farms are located and which are little affected by the reduction of direct income payments. Farm incomes are most severely affected in Scotland under a UK TL Scenario.

7 Major findings summarised

The major findings of the sector results (Chapter 5) and the farm income effects (Chapter 6) are concisely summarised in this chapter.

7.1 Sector results

Three trade and agricultural policy scenarios on UK agriculture have been designed to estimate possible effects on the UK agricultural sector of a Brexit. Price effects are caused by the introduction of trade facilitation costs, which effectively result in higher farm gate prices as the UK is an net-importing country for most agricultural products. In addition, the UK will lose access to EU's preferential imports which has a similar price increasing effect.

The agricultural product prices are projected to increase in the FTA and WTO scenarios. These price increases have a positive impact on supply and farm revenue and income, but have a negative impact on domestic use and consumer (or user) expenditure. At the level of the society this implies a loss of consumer welfare.

A UK Trade Liberalisation scenario significantly impacts on UK meat and dairy prices as current import tariff rates are higher for these products. Consequently, the overall effect of the Trade Liberalisation scenario is a price decline for animal products which leads to less meat and milk production in the UK. Due to lower levels of production in the livestock sector, less feed use will lead to an increase in the UK's net export position on barley and an improvement of UK's net-import position on (soft) wheat. Due to less production and higher domestic use, the UK's net imports will increase for beef, poultry, butter and milk powder, whereas the trade balance for sheep meat will turn from positive into negative. The deterioration of the UK's net trade position is largely due to higher imports of a number of livestock products mainly coming from outside the EU due to the significant price difference between the EU and the UK. As a matter of fact, UK prices for these products will tend to be lower than in the EU, making it difficult for the EU to be a competitive exporter to the UK.

The UK currently contributes an estimated €7.9bn to the CAP budget, from which its farmers receive €3.8bn. A Brexit would save the UK budget expenditure on agriculture: the declines in budget expenditure vary from €4.1bn (-52%) to €7.3bn (-93%), depending on whether the UK's new agricultural policy will maintain 100% direct income payment, reduces payments by 50% or abolishes them.

Being member of the EU implies the UK is part of a large EU market on which trade occurs at relatively low transaction costs. A Brexit would cause trade costs to increase. Comparing the impacts on trade of the different scenarios simulated in this research the FTA and WTO scenarios show a kind of anti-trade bias, as they add to transaction costs in trade, and - in case of the WTO scenario - imply a loss of benefits from cheap imports under the EU's preferential trade arrangements. In the Trade Liberalisation scenario, the reduction in the external import tariff levels assumed leads to declining prices, less production and more imports of a number of products, and as such to more openness to trade.

7.2 Farm income results

Price changes due to Brexit have a positive impact on farm incomes in all sectors under the FTA and WTO default scenario. In case of a UK Trade Liberalisation scenario, the livestock sector will face price declines, and subsequently its income is negatively affected.

The positive price impacts on farm incomes in the FTA and WTO default scenario will be offset by the loss of direct payments, in case these trade scenarios are combined with reduced agricultural support. A reduction of direct payments or their complete elimination further aggravates farmers' income effects under the UK Trade Liberalisation scenario.

In case of the abolition of direct payments a large share of farms will have negative income effects. Consequently, the viability of a substantial share (15-25%, depending on the scenario) of farms will be negatively affected by this policy change.

Livestock sectors in particular are heavily dependent on direct income payments: 2012/2013 FADN data indicate that without these payments their income would be negative. Also mixed farms and field crop farms greatly rely on direct payments for their income. Overall, two-third of the UK's farm income relies on direct payment support.

All UK regions would show on average a decline in farm incomes in case the UK government fully abolished the direct payments. A 50% reduction of subsidies shows more diverse results with better results under the WTO default scenario than under the FTA scenario.

Again the UK TL scenario shows the most significant changes. Farm incomes decline in all regions, except for England-East where half of the UK horticultural farms are located and which are little affected by the reduction of direct income payments. Farm incomes are most severely affected in Scotland under a UK TL Scenario.

References and websites

Boulanger, P. and G. Philippidis (2015). The End of a Romance? A Note on the Quantitative Impacts of a 'Brexit' from the EU Journal of Agricultural Economics, Vol. 66, No. 3, 2015, 832–842 doi: 10.1111/1477-9552.12120

Blokland, W.A and W. van Everdingen (2008). How the LEI accounts. Methodological note on Calculated interest. Agrimonitor December 2008. ISSN 1383-6455 - 4 p. http://edepot.wur.nl/68116

Buckwell, A. (2016). Agricultural implications of Brexit. Worshipful Company of Farmers. February 2016.

Donner Abreu, M., (2013). Preferential rules of origin in Regional Trade Agreements. World Trade Organization, Economic Research and Statistics Division. https://www.wto.org/english/res_e/reser_e/ersd201305_e.pdf

European Commission (2016). EU expenditure and revenue 2014-2020. http://ec.europa.eu/budget/figures/interactive/index_en.cfm. Retrieved at 23 March 2016.

European Commission, DG Agriculture and Rural development (2015). EU agricultural Outlook. Medium term prospects for EU agricultural markets and income 2015-2025. Brussels.

HM Treasury and Defra (2005). A Vision for the Common Agricultural Policy, December 2005

OECD/Food and Agriculture Organization of the United Nations (2015), OECD-FAO Agricultural Outlook 2015, OECD Publishing, Paris. http://dx.doi.org/10.1787/agr_outlook-2015-en

Matthews, A. (2016). WTO dimensions of UK 'Brexit' and agricultural trade. Blog Post 5 January 2016. http://capreform.eu/wto-dimensions-of-a-uk-brexit-and-agricultural-trade/

Appendix 1 UK exports to and imports from the rest of the EU

Table A1.1

UK exports to and imports from the (rest of the) EU, agricultural products (WTO definition), in €m 2014

2-digit product categories	Export to EU (€m)	Export to EU as % of total export	Import from EU (€m)	Import from EU as % of total imports
01 - Live animals	332	65	401	85
02 - Meat and edible meat offal	1471	82	4036	83
03 - Fish etc	1149	64	632	29
04 - Dairy produce, etc	1312	75	3271	95
05 - Products of animal origin (nes)	114	81	101	61
06 - Live trees and other plants	65	90	1211	88
07 - Edible vegetables etc	228	58	2599	77
08 - Edible fruit and nuts	199	93	1959	42
09 - Coffee, tea, mate and spices	290	64	416	35
10 – Cereals	396	74	802	56
11 - Products of the milling industry	177	49	329	91
12 - Oil seeds and oleaginous fruits, etc	342	89	343	38
13 – Lacs	54	55	90	52
14 - Vegetable plaiting materials	2	85	4	28
15 - Animal or vegetable fats and oils	541	87	1137	72
16 - Preparations of meat, etc	385	87	2233	59
17 - Sugars and sugar confectionery	370	76	1006	67
18 - Cocoa and cocoa preparations	558	71	1812	86
19 - Preparations of cereals, etc	1241	67	3059	92
20 - Preparations of vegetables, fruit, etc	370	73	2397	85
21 - Miscellaneous edible preparations	1437	71	2480	84
22 - Beverages, spirits and vinegar	3312	40	5299	77
23 - Residues & waste/prep. animal fodder	832	75	1540	61
24 - Tobacco and man. tobacco substitutes	255	70	405	74
29 - Organic chemicals	2	72	29	97
33 - Essential oils and resinoids	188	47	585	76
35 - Albuminous substances	84	54	295	82
38 - Miscellaneous chemical products	94	68	153	73
40 - Rubber and articles thereof	13	67	15	11
41 – Hides, skins and leather	116	47	47	84
43 - Furskins and artificial fur	7	33	12	39
44 - Wood etc	109	82	1554	61
45 - Cork and articles of cork	0	30	2	75
50 – Silk	1	63	0	6
51 - Wool, etc	74	47	20	12
52 – Cotton	1	53	12	53
53 - Other vegetable textile fibres	0	39	1	2
Totals	16121	61	40286	71

Appendix 2 Features of the AGMEMOD model

Scenario analyses on sector level

In order to quantify the possible outcomes of the scenarios identified, LEI will use the AGMEMOD model. AGMEMOD is a dynamic, multi-country, multi-market, partial equilibrium model. It provides significant detail on the main agricultural and its processing sectors for all EU Member States and some EU neighbours. The model has been largely econometrically estimated at the individual Member State level although in some cases, when estimation was either not feasible or meaningful, model parameters have been calibrated (Chantreuil, Hanrahan and van Leeuwen, 2012). The model is extensively used for the analysis of the EU Common Agricultural Policy (CAP) at Member State level (see for example Erjavec *et al.* (2011), Salputra *et al.* (2011) and Bartova, Fellmann and M'barek (2009) as well as for baseline projections (Offermann *et al.*, 2014).

The model has been developed and is currently maintained by the AGMEMOD consortium. It includes the expertise of an extensive network of economists collaborating across the EU. This growing network brought together a level of pan-national expertise that would have been difficult to assemble otherwise. The activities of the experts are supplemented by the assistance of national experts in commodity markets in individual countries, who frequently review the models and projections produced by the national modeling teams (Salamon *et al.*, 2008).

Data requirements for AGMEMOD are high, as time series for the parameter estimations are required to cover not only the supply side of agriculture but also different types of usages as well as processing. Each country model is based on a database of annual time series, covering, when possible, a period from 1973 to the latest available year. AGMEMOD's database includes balance sheets for all primary agricultural commodities and most food processing commodities, generally including prices, production, imports and exports, opening and ending stocks as well as food, feed and other consumption. Country experts collect and validate data from various sources, e.g. national statistics, Eurostat for European Countries and FAO.

The represented agricultural sectors differ across countries depending on their importance in the respective country. For each commodity in each country agricultural production as well as supply, demand, trade, stocks and domestic prices are determined in equations with econometrically estimated or calibrated parameters. One element of the supply and demand balance for each commodity is used as a closure variable to make the balance consistent. The functional forms of the estimated equations differ between countries and commodities. In this way the equations can be adjusted to differences in agricultural systems, policy instruments or data availability. These country models are then integrated into a general model, capturing all represented models as well as the rest of the world. This approach captures the heterogeneity of agricultural systems in the various countries, while simultaneously maintaining analytical consistency across the estimated country models. Projections are possible on a yearly basis up to 2030. These projections are mainly driven by world market prices for represented products, agricultural policies and macroeconomic variables such as GDP and population. Through changes in these drivers – especially the policies – their impact on agricultural markets can be analyzed.

AGMEMOD provides output on annual bases and for each represented country. The main outputs are prices in € or national currencies as well as production, demand, export and import volumes in metric tonnes. AGMEMOD's regional and sectoral representation is presented below in Table 1 and 2. For this assignment, sectoral details are aggregated to report on the following crops: wheat, barley, maize, oilseeds, sugar beets. For livestock sectors, the report will show outcomes for beef, pork, sheep, poultry, milk, butter, SMP, cream and cheese.

Table A2.1

Regional representation in AGMEMOD

European Union	
Austria	Bulgaria
Germany	Czech Republic
Denmark	Croatia
Spain	Hungary
Finland	Estonia
France	Lithuania
Ireland	Latvia
Italy	Romania
Netherlands	Slovenia
Portugal	Slovak Republic
Sweden	Poland
United Kingdom	
Belgium (includes Luxembourg)	
Greece (includes Malta and Cyprus)	

Table A2.2

Sectoral representation in AGMEMOD

Crops		Processed crop products	Livestock	Meat and dairy products
soft wheat	other crops	rape meal	Cattle	Mutton and Lamb
durum	Olives	sun meal	Dairy cows	Beef and veal
barley	protein crop	soya meal	Suckler cows	Pig meat
maize	Potatoes	rape oil	Bovine animals (less than 1 yr)	Chicken Meat/ Broiler
oats	sugar beet	sun oil		Poultry meat
rice	raw tobacco	soya oil	Cows	Other Poultry
rye	cotton	Olive oil, extra virgin	Pigs	Skimmed milk powder
triticale	tomatoes	ethanol	Sheep total	Whole milk powder
other grains	Oranges	biodiesel	Cow's Milk	Emmenthal cheese
rapeseed	Apples	sugar	Other milk	Butter
sunflower	Wine		Eggs	Cream
soya				Other fresh dairy products
other oilseeds				
				Drinking milk
				Casein
				Other dairy products

Appendix 3 Net export and net import positions of the UK, per scenario

Table A3.1

Net export (+) and net imports (-) position of selected commodities, per scenario, end of simulation period (in 1,000 tonnes)

	Soft wheat	Barley	Rape-seeds	Sugar	beef	pork	Poultry	Sheep	Butter	cheese	SMP	WMP
Baseline	-3,225	470	501	-1,556	-65	-530	-150	7.6	-117	-345	0.9	-8.1
FTA	-3,277	514	464	-1,546	-53	-519	-122	3.9	-116	-337	12.5	-3.1
WTO	-3,301	548	439	-1,532	-48	-512	-106	32	-116	-331	21	0.6
UK TL	-2,669	520	451	-1,571	-134	-523	-193	-8.1	-120	-336	-0.7	-9.2

Source : own calculations, based on AGMEMOD

Appendix 4 Labour and interest rates

Table A4.1

Paid labour per awu average 2012/13 (x 1,000 euros)

	Field-crops	Horticulture	Milk	Sheep / goats	Cattle	Pigs	Poultry	Mixed
England-North	24.3	23.4	26.1	23.9	23.7	24.3	23.4	24.9
England-East	28.0	24.9	27.0	21.0	22.9	29.4	23.6	24.7
England-West	26.6	22.3	27.0	24.3	23.2	25.1	25.4	26.0
Wales	22.7		26.9	23.0	26.0			27.1
Scotland	29.0		27.8	26.7	25.3			27.0
Northern Ireland	19.9		22.1	21.6	23.1	21.3	22.0	24.1
Total	27.4	23.7	26.5	23.9	24.1	27.5	23.8	25.3

Table A4.2

Cost of capital in % and solvability, 2012/13

	Field crops	Horticulture	Milk	Sheep / goats	Cattle	Pigs	Poultry	Mixed
interest gov. bounds	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89
paid interest	2.73	1.90	3.03	3.11	3.11	2.75	3.19	2.66
(weighted) average cost of capital	3.32	3.17	3.36	3.38	3.37	3.30	3.26	3.35
Inflation	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
interest land assets	0.50	0.50	0.50	0.50	0.50	0.50	0.59	0.51
interest machinery and building assets	0.71	0.70	0.74	0.75	0.73	0.79	0.86	0.72
Solvability	92	78	85	93	93	80	69	90

LEI Wageningen UR
P.O. Box 29703
2502 LS The Hague
The Netherlands
T +31 (0)70 335 83 30
E publicatie.lei@wur.nl
www.wageningenUR.nl/en/lei

REPORT
LEI 2016-046

LEI Wageningen UR is one of the world's leading independent socio-economic research institutes. LEI's unique data, models and knowledge offer clients insight and integrated advice on policy and decision-making in an innovative manner, and ultimately contribute to a more sustainable world. LEI is part of Wageningen UR (University and Research centre), forming the Social Sciences Group together with the Department of Social Sciences and Wageningen UR Centre for Development Innovation.

The mission of Wageningen UR (University & Research centre) is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment. With approximately 30 locations, 6,000 members of staff and 9,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the various disciplines are at the heart of the unique Wageningen Approach.

To explore the potential of nature to improve the quality of life

LEI Wageningen UR
P.O. Box 29703
2502 LS Den Haag
The Netherlands
E publicatie.lei@wur.nl
www.wageningenUR.nl/lei

REPORT
LEI 2016-046
ISBN 978-94-6257-773-2

LEI Wageningen UR is one of the world's leading independent socio-economic research institutes. LEI's unique data, models and knowledge offer clients insight and integrated advice on policy and decision-making in an innovative manner, and ultimately contribute to a more sustainable world. LEI is part of Wageningen UR (University and Research centre), forming the Social Sciences Group together with the Department of Social Sciences and Wageningen UR Centre for Development Innovation.

The mission of Wageningen UR (University & Research centre) is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment. With approximately 30 locations, 6,000 members of staff and 9,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the various disciplines are at the heart of the unique Wageningen Approach.