

REPORT ANNEX I: METHODOLOGY
ANALYSIS OF BREXIT SCENARIO IMPACTS ON
SCOTTISH AGRICULTURAL SECTORS

FOR



BY

ANDERSONS

WITH SUPPORT FROM



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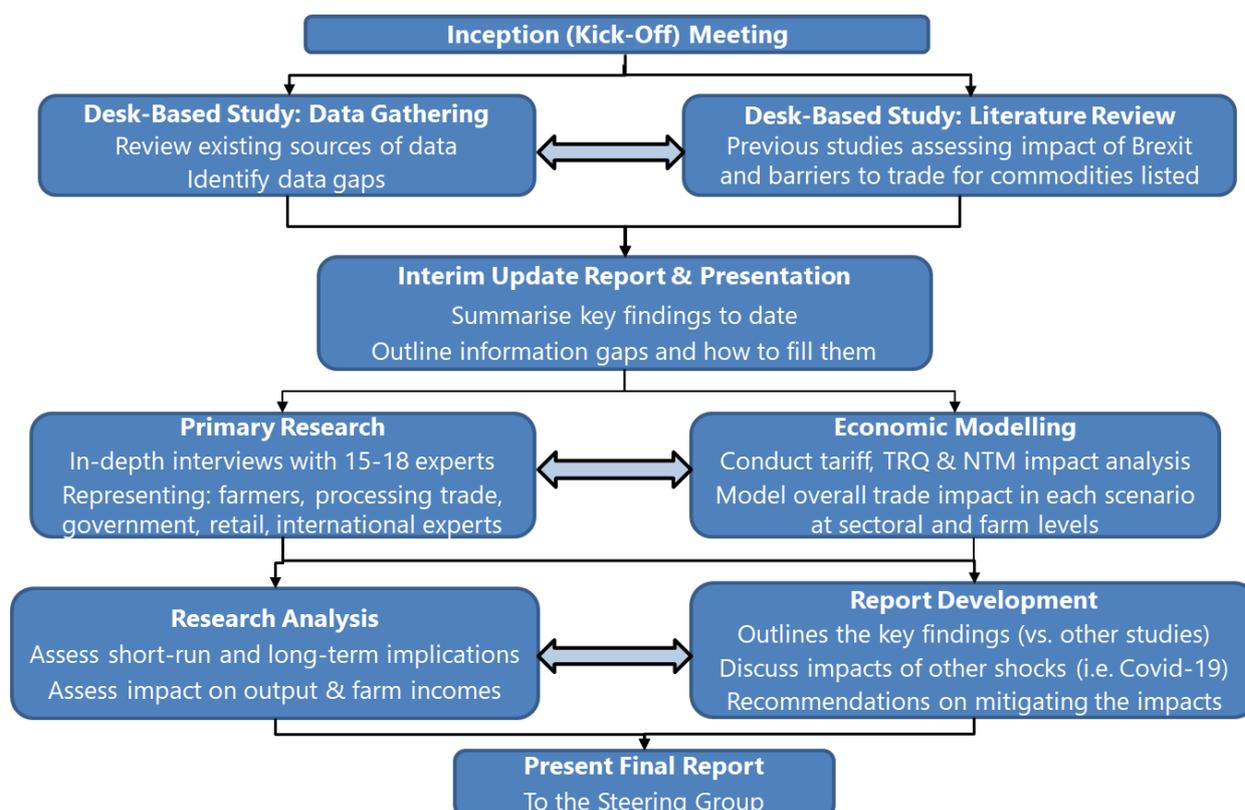
1. PROJECT METHODOLOGY

Below is an overview of the key methodological steps undertaken to fulfil this study's objectives which builds upon the top-level summary of the Methodology presented in Chapter 1. The methodological approach used a combination of quantitative and qualitative research techniques. This culminated in the estimation of the potential impact of Brexit on each agricultural sector under review as well as the overall implications for the Scottish agri-food sector more generally.

1.1 GENERAL

Figure 1 outlines the key methodological steps undertaken for this study which consist of a combination of desk-based and primary research followed by economic modelling using a combination of Excel-based analysis and the Agmemod partial-equilibrium model which represents the agricultural sector of the UK and the EU-27 at MS level. The results are then analysed in terms of the implications for trade between the UK and the EU and what this means at the farm-level for Scottish agriculture. The Sections below explain the methodological steps in more detail.

Figure 1 – Summary of Proposed Methodological Steps



Sources: The Andersons Centre

1.2 DESK-BASED RESEARCH AND LITERATURE REVIEW

The literature review introduces the study, summarising recent studies on the topic with the intention of preventing repetition of effort and resources whilst providing ideas and new contacts for the research.

The review encompassed a detailed examination of over 80 studies that had previously investigated the issue of trade barriers and Brexit in the agri-food sector in the UK and elsewhere. These primarily focused on current UK to EU trade and on exporting into the EU28 (including the UK as a Member State) from

third countries. Where appropriate, consideration was also given to assessments of trade barriers in agri-food trade conducted elsewhere to determine if any additional insights could be gained.

It had multiple aims including;

- Introduce readers to key studies on estimating trade barriers to agri-food trade
- Elaborate further on the key scenarios introduced in Chapter 1 of the main report.
- Provide an overview of the key barriers ('frictions') which impinge upon agri-food trade
- Set-out the framework for assessing the impact of Brexit, including tariffs, tariff rate quotas, NTMs (and NTBs) and other impacts (e.g. Labour), based on previous work.
- To scope-out data sources that could be deployed in the modelling component of the project (some of these are referenced elsewhere in this report).

Annex II accompanying this document contains the detailed Literature Review findings whilst Chapter 3 of the Summary Report outlines the key findings with respect to previous studies at the UK-level, Scottish-specific studies and other issues such as tariffs, TRQs, NTMs, labour and other regulatory issues of relevance to the study.

1.3 PRIMARY RESEARCH INTERVIEWS

During the study, interview discussions were held with 17 industry participants from across the key Scottish agricultural sectors being examined in detail in this study. This input built upon knowledge gained during previous studies, which involved in-depth interviews with scores of industry participants spanning the red-meat, dairy, cereals and horticultural sectors to assess various aspects of Brexit, spanning both tariff and non-tariff issues. Table 1 summarises the interviews undertaken for this specific study. Each discussion, generally took 30-45 minutes to undertake but a number of conversations lasted significantly longer than this. The interviews were based on a questionnaire developed at the outset of the study in conjunction with the Project Steering Group. Additional shorter discussions on specific points were also held with several industry participants, partly based on the recommendations of interviewees. Some participants also provided supplementary information which helped to further expand the data gathered over the course of the study.

Following each interview, the feedback was analysed and key points meriting further exploration were identified and examined further. Key data points were also captured and were inputted as preliminary estimates into the NTMs model.

Table 1 – Summary of Primary Research Interviews Undertaken

Key Assumptions	No. of Interviews	Stakeholder Type
Beef and Sheep	5	Includes 2 processors and 3 trade/farming associations
Dairy	3	1 processor, 1 farming organisation and 1 trade association
Cereals & Cereal Products	4	1 trade association, 1 inputs supplier, 1 grain trader and 1 malting company
Horticulture	4	3 growers/suppliers and 1 trade association
Other / General	1	Trade association specialising in logistics
Total	17	

Source: Andersons

1.4 MODEL DEVELOPMENT SUMMARY

The model development approach undertaken for this study involved multiple stages. It firstly focused on developing a Non-Tariff Measures (NTMs) model to assess projected non-tariff impacts on key commodities. This analysis was based on a methodology which Andersons has developed from previous studies over the past 3-4 years to construct Andersons' NTMs Model. In conjunction with the NTMs modelling, initial analyses of the tariff and TRQ impacts were also developed. The key findings are summarised in Chapters 5-8 of the main report with supplementary material contained in Annexes III and IV. From there, the Agmemod partial equilibrium economic model was deployed incorporating estimates obtained from the NTMs, Tariff and TRQ modelling. This was undertaken at a UK-EU level. The results were then applied to a Scottish agricultural context for provide estimates of the farm-level impact. The methodology employed for each model development stage is outlined below.

1.4.1 Tariff Impact Modelling

Tariffs are relatively straightforward to model as they have defined costs. During this study, an analysis of tariffs that would be applicable under a No Deal scenario was undertaken with respect to UK exports to the EU and the imposition of the UK's proposed tariffs on imports from the EU27 and non-EU countries. When compiling these estimates the UK Global Tariff schedule was applied to UK imports and exports to the EU27 were subject to the EU's Common External Tariff (CET). These impacts are summarised Chapters 5-8 of the Summary Report with additional information in Annex III. As the impact of tariffs are quite well understood, the influence of NTMs are less clear. Accordingly, and bearing in mind the time constraints of this study, the most focus of the modelling and research was on quantifying the impact of NTMs (see sections 1.4.3 and 1.4.4).

1.4.2 Tariff Rate Quota (TRQ) Impacts

For each commodity examined in detail in this study, the projected impact of the reallocation of existing EU28 TRQs based on historic import trade between third countries with the UK and the EU27 was assessed. This was based on a December 2018 agreement between the UK and the EU. This exercise firstly involved splitting each TRQ (relating to WTO MFN commitments only and not TRQs applied as a result of bilateral Free-Trade Agreements (FTAs) such as the EU's CETA accord with Canada). This involved an examination of TRQ volumes which would be potentially available for the UK exporters post-Brexit as some TRQs are open to everyone (i.e. not allocated to specific countries). A similar exercise was also conducted for EU27 exports seeking markets in the UK.

Furthermore, given that the UK had previously announced in March 2019, the intention to introduce a new 230Kt TRQ in the event of a No Deal Brexit (it was subsequently withdrawn), it was decided to examine the impact if the UK introduced a new TRQ for beef based on its net imports. Taking 2017-19 averages, it was estimated that the UK imported 196Kt of beef on a net basis. This became the assumed TRQ for a No Deal scenario sensitivity analysis and would be available on an Erga Omnes basis (i.e. to everyone), provided such imports could meet the UK's regulatory standards. To give an additional level of sensitivity analysis, a reduced TRQ of 98Kt (50% of 196Kt) was also examined. Added to this, consideration was also given to the impact of the new 230Kt beef TRQ that the UK proposed to make available to imports from all countries in a No Deal scenario, provided they could meet the UK's regulatory standards.

With respect to the impact of the TRQs a conservative position has been assumed, where following Van Berkum et al (2016)¹, it has been assumed that the current TRQ filling rates will prevail, except for the new UK TRQ of 196Kt (or 98Kt) where a 100 percent filling rate has been assumed. As no information

was available about the distribution of the TRQ quota rents between buyers and sellers it has been assumed that the entering prices would be close to the world market price plus the within-quota rate. However, when a higher share of the rent would be captured by the sellers, the effective entry price could be higher and closer to the actual price level prevailing in the UK. The economic gain from having access to products under TRQ schemes would then be lower than has currently been assumed.

1.4.3 Non-Tariff Measures (NTMs) Assessment

Using the insights and data captured from the industry interviews process in conjunction with the knowledge obtained from previous studies, a bottom-up NTMs model was deployed to quantify the impact of non-tariff measures for the six commodities (and some associated products) selected for a detailed examination during this study. These products were assessed on a per load basis for both 'checked loads' (subject to the full range of regulatory checks, sampling and accompanying NTMs that were applicable) and on 'probability-based' considerations reflecting the differing check rates (e.g. physical checks ranging from 1% to 15% for red meat) that are potentially applicable. These probability-based estimates calculated the AVE impact of NTMs when averaged out over 100 loads.

For each product under examination, the model sought to estimate the cost of each NTM at the production and processing (plant level), during the cross-border journey (at the border) and at the destination of the shipment. The resultant AVE estimates were then incorporated into the economic modelling stages of the study.

During the research estimates were sought in relation to the following trade flows;

- **Third country to UK trade** – relates to imports from Non-EU countries.
- **EU to UK trade** – concerns imports from the EU27.
- **UK to EU trade** – focusing on exports to the EU27.

Further information on the processes used to compile the NTM estimates as well as the key assumptions is provided below.

Terminology

The focus of this section is on the types of NTMs that affect the agri-food sector and their impacts on trade. However, it recognises that many of the studies cited below often use the terms NTB and NTM interchangeably.

For the purposes of this study, NTMs are defined as; ***“government-imposed trade regulations, faced by trading businesses, which are unrelated to tariffs or quotas and which place non-price and non-quantity restrictions on cross-border red meat trade.”***

The definition of NTMs used here excludes restrictions placed on cross-border trade by the private sector (e.g. private standards). These can be particularly difficult to identify, measure and predict with certainty.

While trade tariffs have progressively reduced globally since 1948 to facilitate trade, evidence suggests that the same does not hold for NTMs, and in many instances they have become more burdensome. Currently, as part of the Single Market, the UK faces few NTMs when exporting to the EU and are not subject to sanitary or phytosanitary measures (SPS), technical barriers to trade (TBT) or rules of origin (RoO) checks which are implemented where Free-Trade Agreements (FTAs) apply.

Types of NTMs

In 2009, the United Nations Conference on Trade and Development (UNCTAD) in conjunction with the ITC proposed an updated classification of NTMs using 16 categories (see UNCTAD (2010))². These are

set out in Table 2 and serve as the basis for the classifications used by the UNCTAD TRAINS database³. This is widely cited as being the most complete publicly available dataset on NTMs as it provides information on by Harmonised System (HS) tariff line which distinguish six core categories of NTMs.

Table 2 – Non-Tariff Measure Classification by Chapter (UNCTAD, 2012)

Trade		Chapter	NTM description
Imports	Technical Measures	A	Sanitary & Phytosanitary Measures (SPS)
		B	Technical Barriers to Trade (TBT)
		C	Pre-shipment inspection and other formalities
	Non-technical Measures	D	Contingent trade-protective measures
		E	Non-automatic licensing, quotas, prohibitions and quantity control measures other than SPS and TBT reasons.
		F	Price control measures including additional taxes and charges
		G	Finance measures
		H	Measures affecting competition
		I	Trade-related investment measures
		J	Distribution restrictions
		K	Restrictions on post-sales services
		L	Subsidies (excluding export subsidies)
		M	Government procurement restrictions
		N	Intellectual property
		O	Rules of origin
Exports	P	Export-related measures	

Source: UNCTAD (2012)¹

The various classifications of NTM can be physically differentiated into;

- those that affect the production of the good, for example the use of 'threshold' ingredients including veterinarian drugs or additives,
- those that affect the product composition meeting the definition of the good in question
- those associated with the administration of the trade, such as SPS inspections. These cannot be detected in the good, so relevant certification is required.

Of the NTM categories listed above, 'Sanitary and Phytosanitary' (SPS) measures are the most significant for agri-food, particularly in terms of the difficulty in gaining access to the EU market for products of animal origin and plant products. Given that UK and EU will have the same standards in place immediately post Brexit, and assuming relevant recognition of such standards is in place, then the impact of these NTMs should be relatively low; however, official controls at the border will still have to be applied. The authors have used this standards' harmonisation (between the UK and the EU27) as the basis for the analyses presented in this report. It should, however, be acknowledged that future costs are likely to increase if standards diverge.

Issues around Rules of Origin (RoO) requirements are also worthy of comment at this point. The RoOs determine in which country a product and its components have to be produced to benefit from

¹ https://unctad.org/en/PublicationsLibrary/ditctab20122_en.pdf?user=46

preferential tariffs (i.e. an FTA). It is conceivable that even if the EU and the UK reach a trade agreement, many UK exports to the EU would not be eligible anymore to preferential access (if value chains remain unchanged) because not enough value added is being produced in the UK.

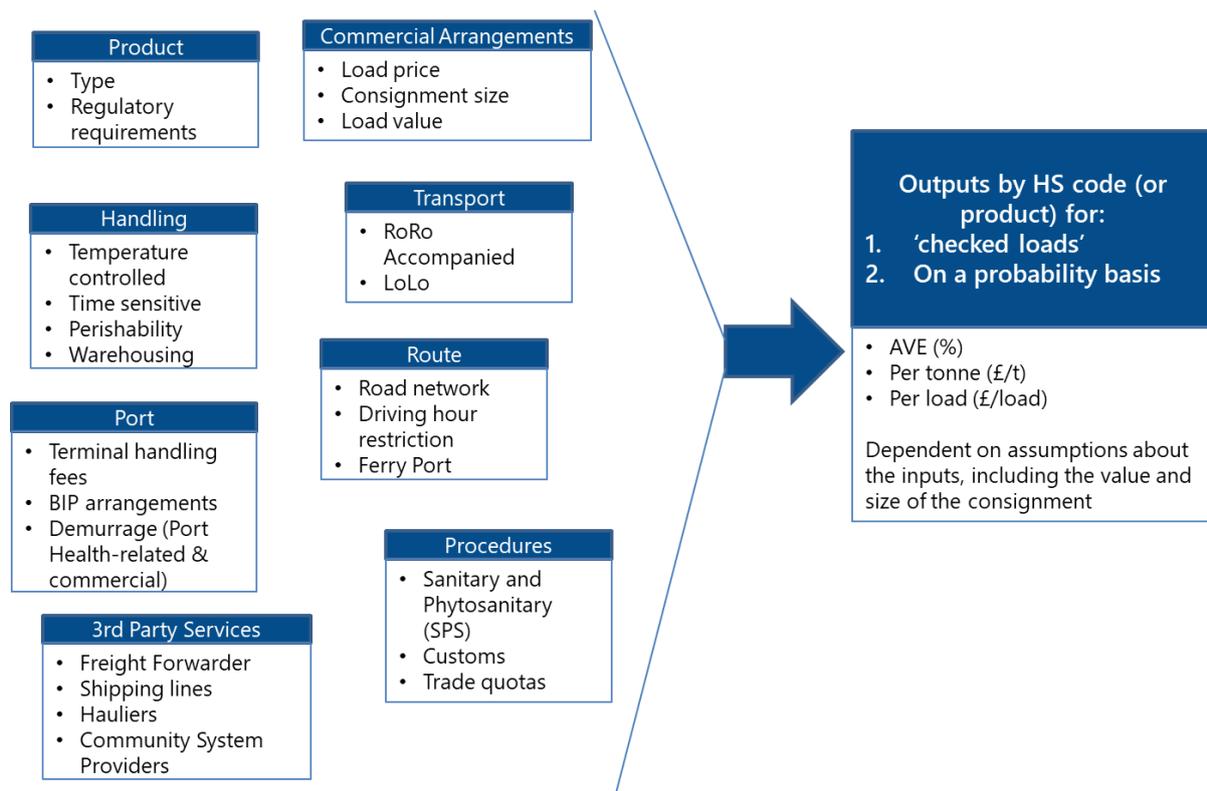
NTMs Model Framework and Structure

Numerous forms of inputs were considered in the compilation of the NTMs model. These are summarised in Figure 2. The modelling process focused on a few key transport modes deemed to be of particular importance to the beef and sheepmeat sectors. In view of this and due to the limited data available for some transport modes, estimates have been compiled for Lift-on, Lift-off (LoLo) and Roll-on, Roll-off (RoRo – driver-accompanied only).

The model development process also led to some NTM considerations such as the administration concerning trade (and tariff rate) quotas and the compilation of official documentation to accompany loads being grouped together under an '*administrative processing time*' parameter in the model. This eventually resulted in the development of the NTMs Model based around the inputs and cost categories summarised in Figure 2 and Figure 3 respectively.

Traders cannot simply import agri-food products, particularly those of animal origin, from any country in the world. First, the country has to be an approved exporter. This list of approved countries is documented by the EU Commission. It is not detailed here, not being an NTM, but is a consideration of traders. In addition, for companies undertaking processing activities, individual plants also have to be approved for export to the EU. This also needs consideration by traders when importing from non-EU countries. Based on the UK's Border Operating Model, the UK will have a similar approvals process both for imports from the EU and from non-EU countries once the Transition Period ends. Although some regulatory checks might be delayed by a few months, from July 2021, it is envisaged that the full range of regulatory checks will be implemented. As the focus of this study looks at the imposition of NTMs from 6 months onwards, estimates have been provided based on the full application of NTMs at the UK border.

Figure 2 – Summary of the Inputs Considered in the Construction of the NTM Model



Sources: Trade Facilitation Consulting Ltd. and The Andersons Centre (2019)

Figure 3 summarises the main NTM cost categories examined during this study and sets-out whether each category has been;

- **Directly quantified:** that there are specific costs applicable to that category which have been applied in the model without any additional modelling or imputation.
- **Indirectly quantified:** the NTM costs have been derived using additional imputation or modelling. For example, administration and training time costs have used shipping clerk payment rates (i.e. £13.50/hour) in order to approximate the costs involved.
- **Not Quantifiable:** despite best-efforts, there are additional NTMs which are highly variable (e.g. depending on the size of business) or speculative in nature (e.g. impact of exceptional delays etc.) that it was not possible to quantify with a robust degree of accuracy during the time and resource confines of this study. Where possible, further commentary is provided on their potential impact in the results section below.
- **General costs:** this category of costs is generically applied all stages of the supply-chain and principally relates to the opportunity cost of tied-up capital associated with the imposition of NTMs which businesses should take into consideration when quantifying costs.

Figure 3 – Summary of NTM Model Quantified and Unquantified Costs

Stage	Directly Quantified	Indirectly Quantified	Not Quantified
At Origin	Customs declarations Country of origin certs Export health certs Official controls costs Transportation certs – vehicles Transportation certs – drivers Organic certification (where applicable)	Training time Administrative processing time (incl. EUR1, TRACES, CHIEFS, etc.) Security / Licensing fees & interest Labelling cost increases Import licensing (where applicable) Packaging & content requirements	New IT systems (additional modules) Cost of non-conformance Cost of future divergence (UK-EU) Re-registering seed varieties in EU (where currently on UK National List only) Farm-level NTMs (e.g. inputs)
At Border	Port health fees encompassing; - Documentary checks - Identity checks - Physical (seal) check Sampling (Basic & Advanced) Infrastructure and associated charges (DTI and UCN fees)	Haulage delays (RoRo) Demurrage delays (LoLo) Doc/ID check times Physical check times Miscellaneous queuing NTM-related terminal handling fees	IT systems (e.g. Customs, UK TRACES) Government resourcing (port health, customs officials etc.) Exceptional delays (incl. initial No Deal upheavals)
At Destination		Value deterioration Waste disposal (in Extremes only) Warehouse storage Training time (UK importers)	Additional IT systems Exceptional delays (incl. initial No Deal upheavals)
General Costs	Opportunity cost of tied-up capital (Applicable to both direct and indirectly quantified costs)		

Source: The Andersons Centre (2019)

1.4.4 Key NTMs Modelling Assumptions

Building upon the framework presented in the previous section, the key modelling assumptions underpinning the NTM estimates are set out below. These include Generic assumptions, of relevance to all supply-chain stages, and probability-based assumptions.

1.4.4.1 Generic Assumptions – Applicable to All Supply-Chain Stages

- **Opportunity cost of capital:** all of the NTM costs for each load are assumed to necessitate additional capital being tied-up which could be used elsewhere. Accordingly, an opportunity cost of capital (3.5% applicable in all scenarios) has been applied. This seeks to capture the preference for value now (i.e. disposable capital) as opposed to being available later (i.e. tied-up in NTMs). This estimate is based on UK Civil Service Green Book (STPR) - Social Time Preference Rate².

² See:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

- **Exchange rates:** are based on the European Central Bank (ECB) rates and as 2017-2018 is the base period, the following Euro-Sterling exchange rates have been used in the NTMs modelling;
 - €1 = £0.84808
 - £1 = €1.17914

1.4.4.2 Probability-Based Assumptions

For some of the cost categories listed above and particularly those associated with regulatory checks, it is important to note that not all loads are subject to the full array of checks that could take place. Accordingly, check rates are applied and vary by scenario. The following cost categories are most directly associated with varying check rates;

- **Physical (seal) checks:** vary in accordance with EU Official Controls as well as regulatory agreements currently in place with other third countries. For example, New Zealand lamb has a reduced physical check rate of 1% according to industry experts consulted during this study whilst imports of Canadian beef are subject to 10% physical check rates based on the provisions of the CETA agreement³. These reduced check rates are significantly lower than the default 15% for red meat which it is understood that the EU will apply to third country imports from the UK⁴. For agri-food products assessed in this study, the FTA scenario tends to have check rates associated with a comprehensive free trade deal (e.g. 10% for red meat) whilst the High scenario assumes a default check rate (e.g. 15% for red meat, 30% for dairy products for human consumption). In some instances, where reduced checks are not applicable assumed check rates across scenarios can be the same (e.g. for seeds, a 5% check rate is assumed in both the Best Estimate and High scenarios).
- **Physical checks (HMRC related):** as noted above, these are separate to physical (seal) checks administered under the auspices of PHAs. Across all product categories, these are assumed to range from 2.5% to 5% with a Brexit Deal check rate of 3% assumed.
- **Sampling:** are assumed to apply to a subset of the physically (seal) checked loads above. In a Low scenario, 1% of physically checked loads are assumed to be sampled whilst for the Brexit Deal and No Deal scenarios, the rates rise (e.g. to 5% or 10% depending on the product). In the FTA scenario, the sampling rate (as a proportion of all loads) is usually below 1% (e.g. 0.5% for fresh/chilled boneless beef). In the No Deal scenario, it can rise to 3% (of all loads) in some instances (e.g. dairy).
- **Onward impacts of probability assumptions:** primarily affect two areas namely;
 - **Value deterioration:** when probability is applied the impact of value deterioration tends to reduce considerably and primarily affects the proportion of loads subject to sampling.
 - **Terminal handling fees associated with NTMs:** for RoRo, these are reduced by the proportion of loads subject to sampling as drivers no longer accompany loads. For LoLo loads, terminal handling fees are assumed to apply to all loads as it is anticipated that for most ports some form of shunting is required to move containers for regulatory checks.

³ See: [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:22017A0114\(01\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:22017A0114(01)&from=EN)

⁴ See: <http://apha.defra.gov.uk/documents/ov/Briefing-Note-3219-pp.pdf>

1.4.4.3 Presentation of NTMs Results

The results are based on two sets of estimates;

1. **Checked Loads:** this could be thought of as the “unlucky load” that is subject to the full range of regulatory checks as well as sampling. Accordingly, the NTM estimates become substantial, especially in the “No Deal” scenario.
2. **Probability-Based:** these estimates project the NTM costs averaged out over 100 loads. Therefore, they are much lower than the checked loads and could be taken as a more realistic assessment of what NTMs are likely to be at a national level. It is these estimates which are used for the economic modelling in this study.

1.4.4.4 Key Caveats

Although the assumptions outlined above give a good overview of the points meriting consideration when reviewing the NTM estimates, additional caveats also need to be highlighted. These include;

1. **Dynamic nature of estimating NTMs:** the research undertaken is based on engagement with key stakeholders who volunteered their time to participate, and the authors’ understanding of possible scenarios for UK-EU trade after the UK’s decision to exit from the EU. Inevitably, the subject is dynamic in nature and can change significantly, particularly if delays under a No Deal scenario become more/less pronounced over time.
2. **Industry participation:** whilst every effort was made to include as many industry participants as possible, it was not possible to include stakeholders representing every part of the agri-food sectors under examination in this study.
3. **Using probability-based estimates to gauge impact on SMEs:** probability-based estimates are assumed to apply to the national level. As many SMEs ship significantly less than 100 loads of a given product per annum, some will be subject to regulatory checks (and sampling) and are therefore likely to be subject to much higher levels of NTMs. These would be more akin to the checked loads’ NTM estimates. As such, it is arguable that NTMs would affect SMEs disproportionately, especially when they are less favourably positioned to avail of special economic authorisations such as AEO status.
4. **Influence of load values and sizes on NTM estimates:** for many products, load price and size, and therefore load values, are heavily reliant on the prices derived from trade statistics data. For some products (e.g. chilled boneless beef) only very high-value products tend to be imported into the UK. This results in load values much larger than if a standard beef price were applied. This has the effect of reducing the size of the NTMs when assessed on an AVE basis. Accordingly, caution needs to be adopted when reviewing the NTM estimates provided and a combination of AVE, cost per tonne and cost per load considerations should be used, particularly if readers are applying the estimates provided to individual business contexts.
5. **Standards equivalence:** whilst efforts were made during the primary research to reflect the impact of varying product equivalence (e.g. differences between third country and EU standards) and their contribution to NTM costs, it quickly became apparent that using the methodology employed by this study, it would not be possible to get sufficiently reliable input for such estimates. This is partly due to a reluctance amongst some businesses to provide details of cost differences due to commercial sensitivities. Furthermore, as most of the research interviewees were UK-based, many were not in a position to offer detailed insights on how production costs differed according to varying product standards. In view of this and the fact

that UK and EU standards will start off being essentially the same post-Brexit, it was decided to compile the estimates on the basis of standards equivalence.

When comparing the results presented below with previous studies, this standards equivalence assumption is one of the key reasons for the differences in estimated NTM costs, particularly for third countries trading with the EU. Where possible, additional input has been provided based on discussions with third country participants and this is an area where further research is advised, particularly as the UK seeks to build new overseas markets.

6. **Exchange rates:** the potential impact of exchange rate swings has not been considered in this study. Whilst it is arguable that potential exchange rate impacts (e.g. brought about by a further weakening of Sterling) could mitigate cost increases in a post-Brexit scenario, these need to be balanced against the potential for increased inflationary pressures on input costs (notably feed) as well as issues surrounding the availability of labour (drivers for RoRo) which could push up prices significantly. Furthermore, it is possible for Sterling to strengthen particularly if a soft-Brexit emerges which results in minimal regulatory change from the status quo. Given the volatile and often speculative nature of exchange rate movements, it was decided to omit such issues from consideration. However, in an attempt to mitigate some of the volatility associated with exchange rates, three-year averages have been used where possible in this study.
7. **Differences between EU Member States:** there were occasional examples cited during the study where the application of NTMs in one EU Member State differed from others. However, such instances were rare and were deemed as being unlikely to exert a major impact.
8. **Extreme circumstances:** an extreme scenario was not formally included in the analysis. That said, references are made to extreme (or exceptional) circumstances in the results. These are anticipated to apply primarily in the short-run (e.g. within the first 6 months following a chaotic post-Transition), although some lingering issues might apply on a longer-term basis. However, over time and once businesses reconfigure their operational practices and commercial arrangements, it is anticipated that the more extreme impacts should dissipate significantly. That said, it was emphasised by some that in an extreme scenario, if they were unable to change their operational practices and commercial arrangements in the short to mid-term (i.e. have an adequate notice period to adapt), their businesses models would quickly become unviable.
9. **Complex special customs procedures:** such as Outward Processing Relief and Inward Processing Relief (IPR and OPR) arrangements, which are used by some businesses to manage customs duty liabilities where goods cross borders multiple times before they are fully processed, were not considered during this study. This is because such administrative arrangements can become highly complex, can be very specialised (i.e. to individual businesses) and would require a substantial degree of conjecture to arrive at an estimate of their national-level impact. Other specific customs arrangements such as the application for a Binding Tariff Information (BTI) to avoid tariff classification challenges at the point of import for products where tariff classification is not straight forward (for example, mixed meat products or meat-based pies), were not explored in detail, other than the fact that there would be costs for a customs consultant to put such procedures in place.

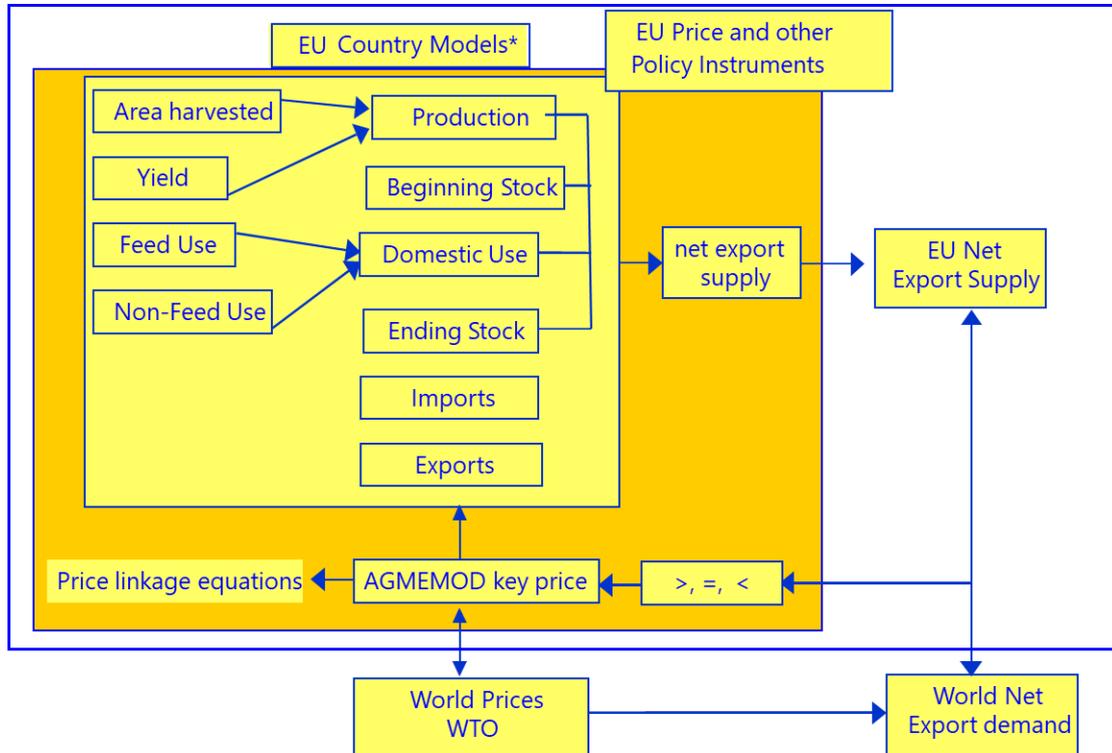
1.4.5 Trade Impact Modelling

1.4.5.1 Agmemod Overview

Agmemod is a partial equilibrium modelling system focusing on the agricultural, food (and fisheries) sectors in the EU and neighbouring countries (e.g. the UK). It encompasses 36 countries in total as well as aggregated EU and Rest of World components. For each country,

it covers key agricultural commodities in detail. Although the scope of the commodity coverage varies between countries reflecting agricultural output in each nation, it captures in detail, the key interactions in each agricultural sector including overseas trade. Figure 4 provides a graphical overview of Agmemod with further explanations provided below.

Figure 4: Conceptual Overview of the Agmemod Model



Sources: Thunen Institut, LEI Wageningen UR.

* Includes UK within the Baseline version of the Model, UK is split-out from EU in Brexit scenarios.

It is used each year by the European Commission to provide a mid-term outlook at MS level. It has also been used to assess potential changes in agricultural policy. On several occasions, Agmemod has been deployed to assess the impacts of Brexit on UK-EU trade and resultant impact on UK agricultural output. As it has detailed coverage of most of the commodities being focused on in this study (i.e. wheat, barley, dairying, beef, sheep and potatoes) and benefits from a collaborative network of research organisations in more than 30 countries, it was selected as the basis of the economic analysis presented in Chapters 5 to 8 of the Summary Report.

Data requirements for Agmemod are high, as detailed time series data for the parameter estimations are required. This covers not only the supply side of agriculture but also different types of domestic usages, e.g. food, feed, industrial use, etc. Each country model is based on a database of annual time series data, covering, when possible, a period from 1973 to the latest available year. Agmemod's database encompasses 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 consumption⁴. In order to populate the model, country experts collect and validate data from various sources, e.g. national statistics, Eurostat for European Countries and FAO amongst others. The

Andersons Centre is the Agmemod partner for the UK and updated baseline data has been provided for each commodity under focus in this study to 2019.

The agricultural sectors represented within Agmemod differ across each country depending on each commodity's relative importance in the respective country. For each modelled 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, thus "solving" the model at each country level.

The functional forms of the estimated equations differ between countries and commodities. This permits the equations to capture country-specific features, such as differences in agricultural systems, policy instruments, etc.. Subsequently, these country models are then integrated into a general framework, capturing all represented countries as well as the rest of the world.

This approach captures the heterogeneity of agricultural systems within each country, whilst simultaneously maintaining analytical consistency across each country model estimated within Agmemod. Projections are made on an annual basis and for this study run up to 2025. These projections are chiefly driven by world market prices for represented products, agricultural & trade policies and macroeconomic variables such as GDP and population. Through changes in these drivers – especially in policies – their impact on agricultural markets can be analysed.

Agmemod provides indicators on annual bases and for each represented country. The main output variables are prices (€ and £ terms for the UK) as well as production, domestic use, export and import volumes in metric tonnes. For this study, sectoral details are aggregated to report on the following commodities:

- Cereals – wheat and barley
- Potatoes
- Dairy – milk, butter, SMP and cheese.
- Grazing livestock – beef and sheep.

1.4.5.2 Trade Impact Modelling Steps

Additional Excel-based analysis was then used in conjunction with agricultural costings data to quantify the potential Brexit impacts for cauliflower, broccoli and strawberries. This is documented further in Chapter 8.

To carry out the scenario simulation by means of the Agmemod, Andersons was supported by Wageningen University and Research (WUR). It has extensive experience in using Agmemod over 20 years and has completed several Brexit-related studies concerning both the UK⁵ and the Netherlands⁶. Therefore, the economic modelling has built on the collective experience that both Andersons and WUR have obtained during past studies. Several of these have involved both specialist econometric modelling and Excel-based analysis. The Agmemod sectoral level modelling consisted of the following elements:

- a. Baseline data:** used a combination of historical data on UK and EU output and trade contained within Agmemod and data obtained from the data gathering stage. The latter consisted of obtaining both UK level data (e.g. Defra AUK data and HMRC) as well as Scottish specific data (e.g. ERSA and Scottish TIFF⁷) in addition to EU data obtained from

the EU Commission's agri-food data portal⁸ and EUROSTAT. It is against this baseline (Base) that the effects of the trade-related changes were assessed under each scenario.

b. Conduct modelling assessment based on each scenario: drawing upon the estimates on tariffs, TRQs and NTMs, the Agmemod model was deployed to estimate the potential impact of these trade barriers on post-Brexit trade under an FTA and No Deal scenario. This exercise was undertaken in collaboration with Wageningen University and Research (WUR). The Agmemod modelling focused solely on the trade-related aspects of Brexit and kept agricultural policy support payments constant as this is expected to be the situation in Scotland until 2024.

- **Split existing (EU28) TRQs between the UK from the EU27 under both an FTA and No Deal scenario:** the Agmemod model consists of a series of country models which are then combined into an overall model. In addition to EU Member States and the UK, it also contains several other non-EU country-level models (e.g. Ukraine, Turkey) as well as a "Rest of World" model which depicts output and trade parameters for countries not modelled individually. The first step in modelling the Brexit impact was to allocate the old EU28 TRQs between the UK and the EU27. Due to time constraints, it was not possible to make provisions for the application of the Northern Ireland Protocol which de-facto, has Northern Ireland participating in both the UK internal market and the EU Single Market. In the Baseline (Base), the UK continues as an EU Member State.

- **Introduce the UK's Global Tariffs into Agmemod:** was undertaken for each major commodity using the tariff information compiled in the data gathering stage.

- **Introduce "price-shocks" for each Brexit scenario:** on UK-EU27 trade taking account of tariff, TRQ and NTM effects under each scenario. This involved taking the average traded prices for each commodity during the Base period and then adding the effect of trade barriers onto the prices of UK exports to the EU27 and imports into the UK from the EU27. This exercise also examined the proportion of UK supply that was drawn from EU imports and the proportion of UK production that was exported to the EU. A "pooled" price was then compiled which was a weighted average of the UK domestic price and EU traded price (plus the effects of trade barriers). Each price shock was calculated as half the difference between the UK domestic price and the "pooled" price, as it was assumed that the costs of such trade barriers would in-effect be shared 50:50 between importers and exporters.

The price shocks were also informed by a similar exercise which assessed UK domestic prices and world prices for each commodity, and any price depressing effects that might ensue if the UK had to rely more on the world market for procuring imports and selling its exportable surpluses.

These price shocks constituted the 'starting point' for the Agmemod modelling simulation (next step). The price effects applied for each commodity are set out in Chapters 5-8 of the Summary Report.

- **Run Agmemod simulation: for each scenario a model solution was computed,** followed by a comparison of the scenario outcomes against the baseline results terms of output and trade. This process drew upon the insights gained from the Data Gathering step and from the price shocks' exercise outlined in the previous point. Using all the above as scenario inputs, the Agmemod model was run to provide a model solution. Where appropriate, sensitivity analysis was also undertaken to further

explore additional key issues such as exchange rates. These results are reported in the relevant sectoral Chapters (5-8) with additional detail provided in Annex IV.

1.4.5.3 Farm-Level Modelling

Quantify impact on Scottish farm-level performance: was undertaken in conjunction with the report development stage, based on the results emanating from the economic modelling. This was done using both the Scottish Farm Business Income dataset⁹ and Andersons' Model Farms. For horticulture (Chapter 8), insights from the Scottish Farm Management Handbook and the ABC Book were used to compile a Brexit impact analysis for cauliflower, broccoli and strawberries. This is because Agmemod only provides projections for potatoes at a UK-level. This was accompanied by a commentary on what the results would mean in practical terms for Scottish agriculture. Here, insights from the primary research were also used to ascertain the impact on Scottish agri-food trade, particularly with the EU27. Consideration was also given to the short-term impact (6-12 months) and the long-term impacts (after 1 year or more) from application of the policy measures.

1.4.5.4 Modelling Limitations

All modelling exercises have their strengths and weaknesses. Whilst the Agmemod simulation undertaken in this study benefits from detailed analysis on agricultural output and trade within each EU Member State, affiliated countries and on the world market which draws upon the expertise of numerous country experts, there are limitations which are briefly outlined below;

- **Net-trade structure of Agmemod:** whilst the broader study has examined both imports and exports between the UK and the EU in detail and considered these within the price shocks analysis, Agmemod models UK-EU trade on a "net-trade" basis (i.e. net trade = exports – imports (for each year)). Accordingly, it does not consider bilateral trade flows between the UK and individual EU Member States. The model is also predicated on a net-trade position with world markets. Therefore, adjustments are needed in sectors such as lamb where the UK is a major exporter in one part of the year and a major importer (e.g. from New Zealand) in another.
- **Commodities as perfect substitutes:** within a product category, e.g. cheese, traded goods such are considered perfect substitutes for one another. In practice, this is not always the case as continental soft-cheeses are quite distinct from cheddar.
- **Horticultural sector:** is not modelled in detail at the UK level using Agmemod. Accordingly, for this study, only potatoes have been considered. For the other horticultural sectors, an alternative approach has been undertaken using costing book information and primary research input.
- **Aggregation of goods:** within Agmemod is generally at the HS 4-digit level. As such detailed policy considerations (e.g. effect of specific tariffs for high-value beef products) can only be assessed by way of approximation. That said, the analysis undertaken in Chapters 5-8 of the Summary Report goes down to HS 8-digit code level in several instances and insights from this exercise are then taken into the Agmemod modelling simulations.
- **UK-EU focus of Agmemod:** as most trade data is collected at a UK-EU level only and Scottish specific data on exports to the rest of the UK and overseas are very limited, it has not been possible to undertake the Agmemod analysis at a Scotland-only level. That said, Scotland is an integral part of the UK Internal Market. As such, it is reasonable to assume that changes at the aggregate UK-EU level will have broadly similar impacts on Scotland. Again, where possible in the report, if Scotland is deemed to have greater exposure, this issue is flagged.

- **Structural change:** neither the Agmemod modelling process nor the farm-level analysis have assessed in detail the potential impacts on structural change within farming. These issues are important over the longer term and where possible the analysis has commented on these. Similarly, although labour has been analysed particularly in the horticultural sector where it is of greatest concern, it has not been possible to model in detail the effects of the ending of Free Movement using Agmemod. Again, the commentary in Chapters 5-8 attempt to provide more detail on this issue.
- **Implications for regulatory burdens on farm businesses:** have not been directly modelled, although the NTMs analysis examined regulatory barriers at the processing level in great detail. Additional regulatory issues are likely to affect the farm-level, particularly if extra certification is required in the horticultural sector (e.g. seed potatoes) on issues such as pesticides' usage.

In light of the above, the results of this analysis are indicative only. The interpretation of the results should centre on the overall direction and broad magnitude (small, medium, or large percentage impacts) rather than the precise point estimates that the modelling produces.

1.5 RESEARCH ANALYSIS:

This was undertaken in conjunction with the report development stage, based on the results emanating from the economic modelling which were assessed in detail. It also encompassed examining the farm-level implications of the economic modelling results with a commentary on what the results would mean in practical terms for Scottish agriculture. Insights from the primary research were also used to provide a commentary on what the results would mean for Scottish agri-food trade, particularly with the EU27. During the analysis stage, consideration was also be given to the short-term impact (6-12 months) and the long-term impacts (after 1 year or more) from application of the policy measures).

1.6 REPORT DEVELOPMENT:

The draft summary report, in conjunction with accompanying Annexes, were developed to outline in detail the key findings from the study. The key assumptions underpinning the analysis, and each scenario, were also set-out as were any additional assumptions underpinning the sensitivity analyses undertaken. The draft report has been peer-reviewed internally by Andersons colleagues not directly involved in the research. Feedback from this peer review has been incorporated into the report which was submitted to the Project Steering Group in the first instance.

1.7 REPORT PRESENTATION AND FINALISATION:

Approximately 1 week after the submission of the draft report, Andersons presented its findings to the Project Steering Group. This consisted of a comprehensive overview of the research findings followed by a Q&A session on the report's conclusions and recommendations. Feedback from the report was then incorporated into the main report, before final report submission.

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² United Nations Conference on Trade and Development (UNCTAD) (2010), Non-tariff Measures: Evidence from Selected Developing Countries and Future Research Agenda, Geneva, UNCTAD.

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³ See: <http://trains.unctad.org/Forms/ProductViewNew.aspx?mode=modify&action=search>

⁴ See: <https://www.nfuonline.com/assets/61142>

⁵ For example, see: <https://www.nfuonline.com/assets/61142>

⁶ For example, see: <https://edepot.wur.nl/441200>

⁷ <https://www.gov.scot/publications/total-income-farming-estimates-scotland-2016-18/pages/1/>

⁸ See: <https://agridata.ec.europa.eu/extensions/DataPortal/trade.html>

⁹ See: <https://www.gov.scot/publications/scottish-farm-business-income-annual-estimates-2018-19/>