# Annex I: Methodology

1. Project Methodology

The information presented below relating to the key methodological steps undertaken to fulfil this study's objectives builds upon the Methodology summary presented in Chapter 2 of the Summary Report. The methodological approach used a combination of quantitative and qualitative research techniques. This culminated in the estimation of the potential impact of the selected FTAs on each agricultural sector under review as well as the overall implications for the Scottish agri-food sector more generally.

1.1 General

Figure I-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 MAGNET CGE model. The results are then analysed in terms of the implications for trade between the UK and each selected country/bloc (partner) and what this means at the farm-level for Scottish agriculture. Chapter 2 of the Summary Report provides an overview of each methodological step. The information presented below supplements the information contained in the Summary Report. As such, additional detail is not provided on each step.

Figure I-1 – Summary of Proposed Methodological Steps
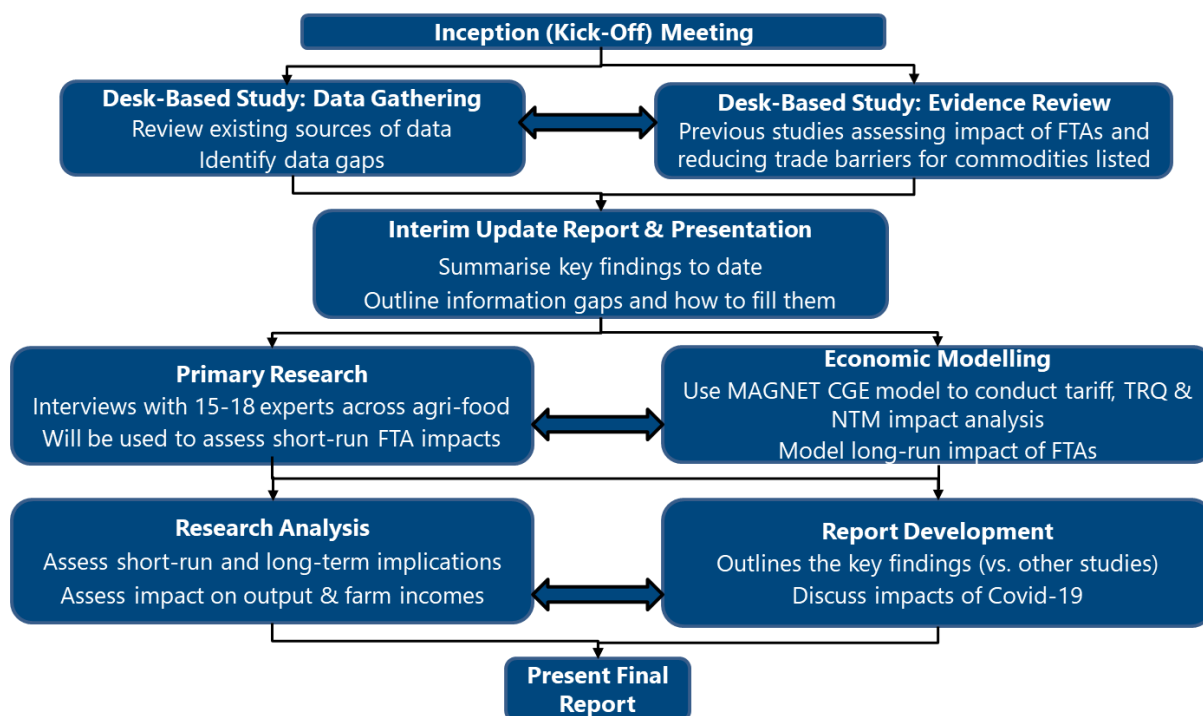
Sources: The Andersons Centre

1.2   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 5 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 5-9 of the main report with supplementary material contained in Annex III. 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.

1.2.1   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 5-9 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 1.2.3 and 1.2.4).

1.2.2   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 traders as some TRQs are open to everyone (i.e. not allocated to specific countries).

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. 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.

1.2.3   Non-Tariff Measures (NTMs) Assessment

Using the insights and data captured from the desk-based research and industry interviews 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 associated sub-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;
* **UK imports from each non-EU partner** – based on the global export price from each non-EU partner during 2018-2020 derived from UN Comtrade (i.e., exports from each partner to all countries).
* **UK exports to each non-EU partner** – based on the global export prices during 2018-2020 from the UK for each product using HMRC data.
* **UK-EU trade** – for both imports and exports using HMRC data during 2018-2020 for UK-EU trade.

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. As part of the Single Market, the UK faced few NTMs when exporting to the EU and British traders were 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. Since January 2021, this has changed for exports to the EU, but UK border controls are not fully operational and are unlikely to be so until the end of 2023. This means that exports from the EU to the UK face far fewer trade barriers than trade in the opposite direction.

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 I-1 and serve as the basis for the classifications used by the UNCTAD TRAINS database[3]. 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 I-1 – 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 had the same standards in place immediately following the Transition Period ending, the authors have used this standards' harmonisation (between the UK and the EU27) as the basis for the analyses on UK-EU trade presented in this report. It should, however, be acknowledged that future costs are likely to increase as and when standards diverge.

SPS issues are also a major consideration in trade with non-EU countries, particularly those that do not have a veterinary agreement in place with the UK (e.g., Australia).

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 preferential tariffs (i.e. an FTA). As a result of the provisions of the UK-EU Trade and Cooperation Agreement (TCA), some UK exports to the EU would not be eligible anymore to preferential access because not enough value added is being produced in the UK. This has also been an issue for imports into the UK from the EU.

For the purposes of the commodities and products assessed in this study, it is assumed that the loads are compliant with UK-EU TCA RoO provisions. This assumption has also been made for UK trade with selected non-EU partners, although provision has been made for the costs of a Country of Origin certificate.

NTMs Model Framework and Structure

Numerous forms of inputs were considered in the compilation of the NTMs model. These are summarised in Figure I-2. The modelling process focused on a few key transport modes deemed to be of particular importance for each commodity and each trade flow. For UK-EU trade, this analysis has included a combination of Lift-on, Lift-off (LoLo), Roll-on, Roll-off (RoRo – driver-accompanied only) and bulk shipments (for grain trade). For UK trade with non-EU countries, LoLo shipments are primarily used for most commodities, given the distances involved, with the exception of grain where bulk shipments are again used.

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 Figures I-2 and I-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 was previously documented by the EU Commission, but

the UK Government now operates separate approved lists. These are not detailed here, as they are not considered to be an NTM as such, but is a prerequisite for traders. In addition, for companies undertaking processing activities, individual plants also have to be approved for export to the EU and to each non-EU partner. This also needs consideration by traders when importing into the UK from non-EU countries.

As the UK Border Operating Model for imports from the EU has not yet been implemented, and is unlikely to be so until the end of 2023, the NTM AVEs over the next year or so are likely to be lower than the long-term estimates provided in Chapter 5 of the Summary Report and in Annex III. That said, as the focus of this study is primarily on the long-term impact of the selected FTAs, the NTM estimates provided are chiefly analysed on the basis of the full application of NTMs at the UK border for imports. Similarly, for UK exports to each selected partner, the NTM estimates are based on the full application of regulatory controls by each country/bloc.

Figure I-2 – Summary of the Inputs Considered in the Construction of the NTM Model
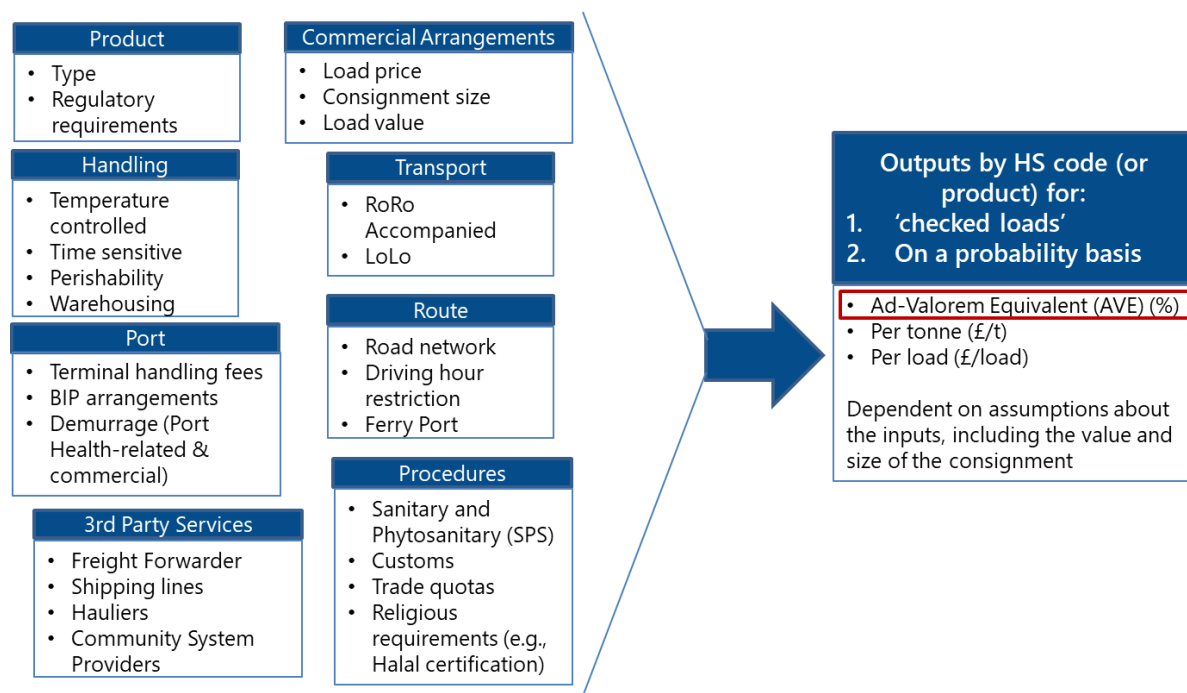
Sources: Trade Facilitation Consulting Ltd. and The Andersons Centre (2019)
Note: Ad-Valorem Equivalent (AVE) is highlighted because the AVE values have been used for the CGE modelling undertaken via MAGNET (see section 1.2.5 below).

Figure I-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 I-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 (e.g. 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 (2022)

1.2.4 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.

1.2.4.1 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 Rate[2].

- **Exchange rates:** are based on the European Central Bank (ECB) rates and as 2018-2020 is the base period. Although the US is not included within scope, being the primary global currency, UN Comtrade data are denominated in US Dollars. Furthermore, the US Dollar is also heavily used in GCC countries. The following exchange rates have been used in the NTMs modelling;

    o **Euro to Sterling:** €1 = £0.8838

    o **Sterling to Euro:** £1 = €1.1315

    o **US Dollar (USD) to Sterling:** US$1 = £0.7710

    o **Sterling to USD:** £1 = US$1.2976

    o **Australian Dollar (AUD) to Sterling:** AU$1 = £0.5475

    o **Sterling to ASD:** £1 = AU$1.8269

    o **New Zealand Dollar (NZD) to Sterling:** NZ$1 = £0.5138

    o **Sterling to NZD:** £1 = NZ$1.9464

    o **Canadian Dollar (CAD) to Sterling:** CA$1 = £0.5836

    o **Sterling to CAD:** £1 = CA$1.7136

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[2] See: The Green Book (publishing.service.gov.uk)

1.2.4.2 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 trading partner. The following cost categories are most directly associated with varying check rates;

- **Physical (seal) checks:** vary in accordance with UK/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% with the UK and the EU according to industry experts consulted during this study. Imports of Canadian beef are subject to 10% physical check rates based on the provisions of the CETA agreement[3] (and the subsequent UK-Canada rollover agreement (CUKTCA)). These reduced check rates are significantly lower than the default 15% for red meat. It is understood that the EU has been applying its default (third country) check rates for imports from the UK[4]. Therefore, the default check rates of 15% for red meat, 30% for dairy products for human consumption are assumed in this study. For other products such as seed potatoes and grain, a 5% check rate is assumed.

  To derive NTM AVEs for exports from the UK to each non-EU partner, the applicable physical check rates of each country (e.g. Canada) have been utilised where possible. In instances where physical checks' data was not possible to obtain (e.g., for GCC), the corresponding check rates for imports into the UK from that partner were assumed to apply.

- **Physical checks (HMRC related):** as noted above, these are separate to physical (seal) checks administered under the auspices of PHAs/agricultural ministries. Across all product categories, these are assumed to range from 2.5% to 5%.

- **Sampling:** are assumed to apply to a subset of the physically (seal) checked loads above. Where veterinary agreements apply, these can be as low as 1% of physically checked loads. In other cases, the sampling rates can be as high as 5-10% of physically checked loads. As a proportion of all loads, the percentage of loads sampled is often below 1% but can rise to 3% (of all loads) in some instances (e.g. dairy).

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[3] See: COMPREHENSIVE ECONOMIC AND TRADE AGREEMENT (CETA) - between Canada, of the one part, and the European Union and its Member States, of the other part (europa.eu)

[4] See: Briefing-Note-3219-pp.pdf (defra.gov.uk)

- **Onward impacts of probability assumptions:** primarily affect two areas namely;

  o **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.

  o **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.

1.2.4.3 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 for perishable products.

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.

1.2.4.4 Key Caveats

Although the assumptions outlined above give an insightful 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 trading arrangements since the Transition Period ended in January 2021. Inevitably, the subject is dynamic in nature and can change significantly, particularly if sanitary and phytosanitary issues emerge 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 and trade flows 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. Evidence has emerged during both the primary and desk-based research that significant numbers of SMEs have ceased trading between the UK (Scotland) and the EU due to the new regulatory requirements and the significant upfront/overhead costs that these requirements place on businesses.

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 and cost per tonne 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 UK/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 have started off being essentially the same, it was decided to compile the estimates on the basis of standards equivalence for both EU and non-EU partners.

When comparing the results presented in the Summary Report and Annex III 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 UK. Where possible, additional input has been

provided based on discussions with third country participants but further research is advised, particularly as the UK (and Scotland) 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 even more significantly than has been seen since January 2021. Furthermore, it is possible for Sterling to strengthen against the Euro and other currencies in the future. 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 (as noted above).

7. **Differences between EU Member States:** there were occasional examples cited during this study and previous studies 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 rushed introduction of UK border controls), 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.

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.

1.2.5 Trade Impact Modelling

1.2.5.1 MAGNET Model Overview

The Modular Applied GeNeral Equilibrium Tool (MAGNET)[5] is a recursive dynamic, multi-regional, multi-commodity CGE model, covering the entire global economy (Woltjer and Kuiper, 2012). As with other CGE models, MAGNET explicitly represents the economic linkages across the sectors of each regional economy. This is particularly important when analysing policy effects in sectors that are vertically linked with each other, such as fertilisers, agriculture and biofuels. It is built upon the GTAP (Global Trade Analysis Project)[16] model (Hertel, 1997)[4] and has been widely used for policy analysis (Nowicki et al., 2009[5], Woltjer, 2011[6], Doelman et al., 2019, Kuiper and Cui, 2021[7], Latka et al., 2021[8]). The MAGNET model is modular in nature and extends the GTAP model through the addition of a number of policy-relevant modules. The MAGNET model and the underlying GTAP database provide all values in US Dollars (USD) as all data must be consolidated to the same currency.

MAGNET has been used by European Commission, the OECD (2019)[9], IFAD (IFAD, 2021)[10] and others. Recently MAGNET has been applied in a study for the European Parliament to assess the impact of Brexit in Fisheries (Bartelings and Smeets Kristkova, 2022).

For the purpose of this study, individual MAGNET regions were aggregated to 14 blocks, keeping the focus countries – UK, Australia, New Zealand, Canada, GCC countries disaggregated (Figure I-5).

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[5] The MAGNET consortium includes Wageningen Economic Research (lead), the European Commission's Joint Research Centre (JRC) and the Thünen-Institute (TI) MAGNET (magnet-model.eu)

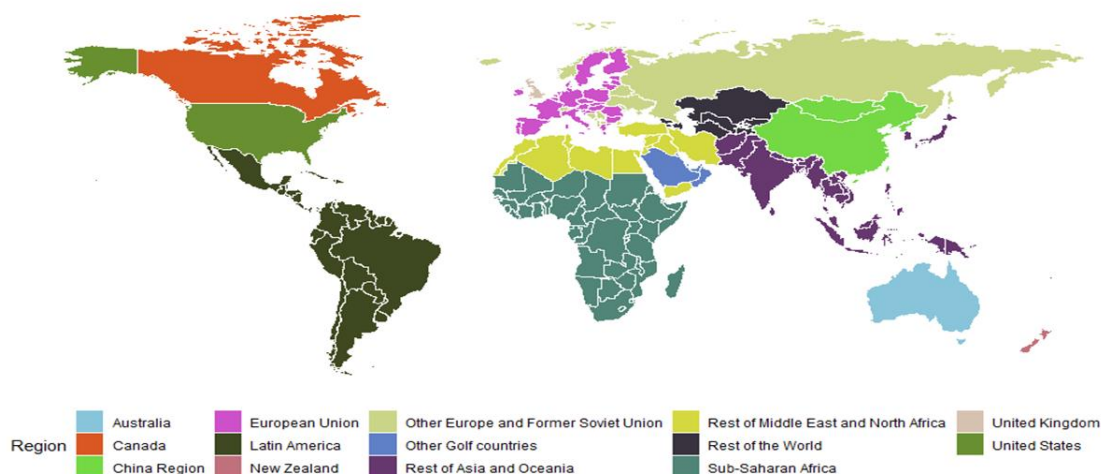[6] The Global Trade Analysis Project (GTAP) is a global network of researchers and policy makers conducting quantitative analysis of international policy issues.

Figure I-4: Conceptual Overview of the MAGNET Model
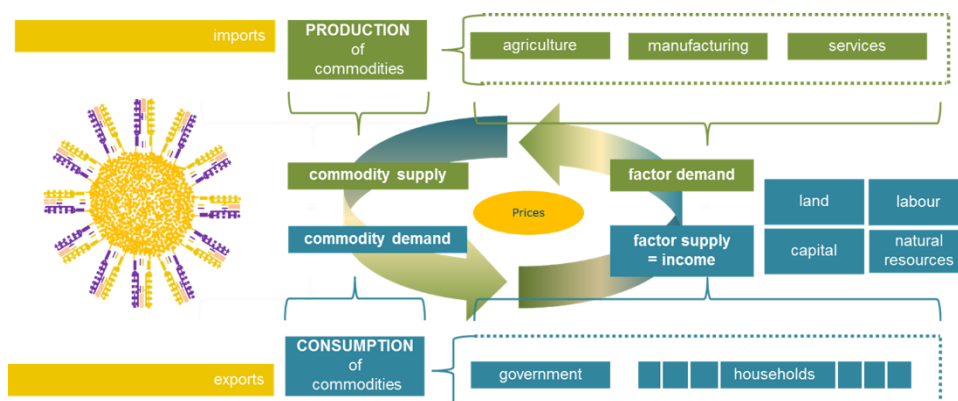
Sources: Thunen Institut, LEI Wageningen UR.

Figure I-5: Regional Aggregation in MAGNET

Concerning the commodity aggregation, there are 18 primary agriculture commodities and 9 food processing commodities as well as a number of other non-agricultural commodities. Table I-2 provides mapping of the MAGNET commodities that are focus of this study to the original GTAP database.

Table I-2 – Mapping of MAGNET Commodities to GTAP

MAGNET category	Mapping to GTAP
Primary Agriculture	
Wheat	wheat, GTAP (wht)
Grain	cereal grains category, GTAP (gro)
Food industry	
Lamb	other cattle meat - separated from GTAP cattle meat (cmt)
Beef	beef meat - separated from GTAP cattle meat (cmt)
Dairy	dairy products, GTAP (mil)
Aggregates	
Agri_Food	Primary and food processing

1.2.5.2 Scenario set-up and assumptions

To reflect the long-term process of trade liberalisation between UK and the focus countries, FTA scenarios are applied on a projected future economy in 2037 that incorporates Brexit. An additional scenario is also calculated using the Alternative Baseline as a reference case (reported for selected indicators). Trade liberalisation scenarios consider both a low-liberalisation option (25% decrease of NTMs for the focus countries and zero import tariffs) and a high-liberalisation option (50% decrease of NTMs for the focus countries and zero import tariffs).

Table I-3 – Description of the MAGNET Scenarios

Scenario Name	Description
Main Baseline (Incorporating Brexit) (2014-2037)	Incorporate Trade measures based on historical evidence (2014-2019) and Incorporate Brexit trade and labour shocks (2019-2037)
Alternative Baseline (No-Brexit) (2014-2037)	Incorporate Trade measures based on historical evidence, but Brexit-related trade and labour shocks are not incorporated.
FTA Low Liberalisation (Low Lib) (Comparative Static 2037)	25% decrease of NTMs for the focus countries, zero import tariffs (FTAs assumption)
FTA High Liberalisation (High Lib) (Comparative Static 2037)	50% decrease of NTMs for the focus countries, zero import tariffs (FTAs assumption)

The baseline scenarios require assumptions to be made on the expected rates of growth of exogenous variables, technological progress, land expansion, productivity improvements in feed sectors, and historical changes in trade and CAP policies that need to be considered (for details, see Table I-4).

**Table I-4: Summary of the Main Assumptions in the Baseline Scenarios**

Drivers	Description
Macroeconomic	Population growth: SSP2 – Medium Variant, Historical growth from World Bank GDP growth: combination of sources: SSP2, World Bank Indicators Labour supply: based on labour force projections (ILO)
Sectoral Productivity	Land productivity: about 0.5% p.a. based on SSP2 Feed efficiency improvements in livestock sectors (combines drivers of better feed conversion (+) and livestock intensification (-)
Policy Assumptions	Biofuel share (blending targets), CAP budget, Implementing FTA between the EU and Canada
Trade Flows Alignment	Align trade flows in the historical period from COMTRADE
Brexit	Implement NTM costs for trade between EU and UK (-0.1% ~ -10%) Reduce unskilled labour supply (-2%) Align the UK Global Tariff Lines (increase import tariffs) for the key commodities

For projections on the exogenous drivers, it is a common practice in the global economy-wide models to implement the Shared Socioeconomic Pathways (SSPs) (Riahi et al. 2017[11], van Meijl et al., 2020 a,b[12,13], Doelman, et. al, 2019)[14]. SSPs are scenarios of possible socioeconomic futures to explore the implications of climate change. They comprise of five different narratives of the world's future with quantified drivers of population, economic activity, urbanisation, and income inequality (O'Neill et. al, 2017)[15]. The commonly used scenario is the SSP2 – Middle of the Road scenario, which follows a path in which social, economic, and technological trends do not shift markedly from historical patterns.

Figure I-6 shows that developing countries such as Sub-Saharan Africa, but also China are expected to attain the highest GDP growth (up to 5% p.a.). The GCC countries are also on a dynamic growth path (about 3% p.a.), followed by Australia (2.5% p.a.) and New Zealand and Canada (1.9% p.a.). GDP growth in UK is expected

to be higher than in the EU (1.9% vs 1.5% resp.). The developing countries are those with the highest population growth, the highest in Sub-Saharan Africa (above 1% p.a.), while in developed regions the growth is moderate, even negative (China).

Figure I-6: Projected % Growth Rates of GDP and Population Based on SSP2 (2019-2037)
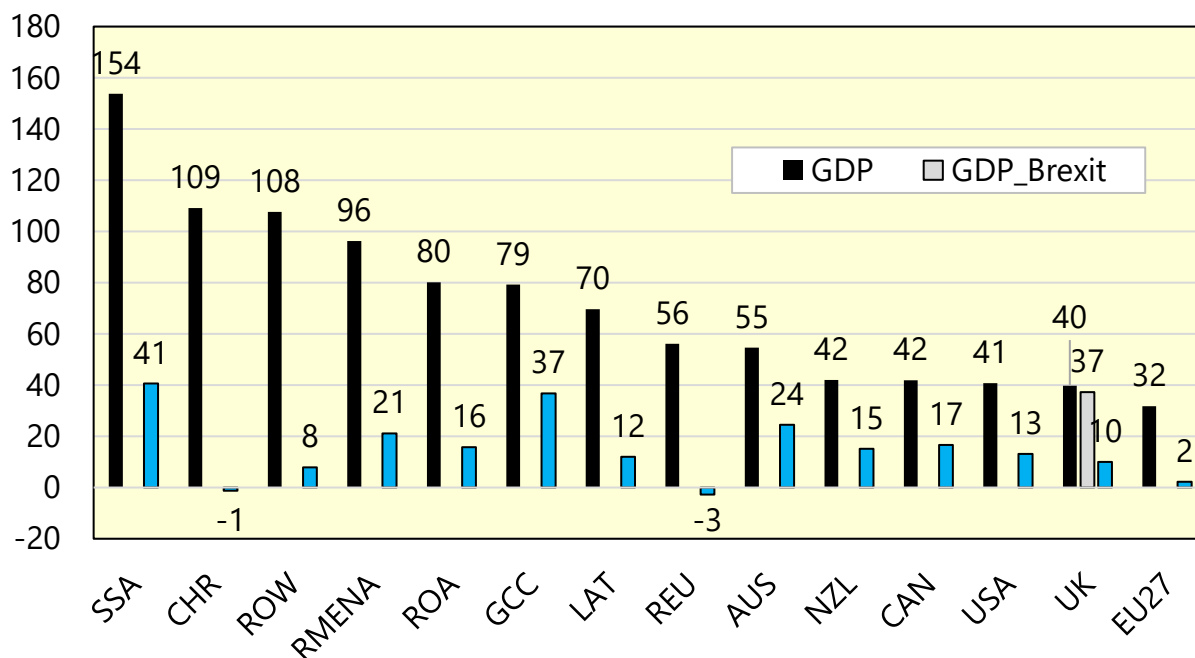
Sources: SSPs (O'Neill et al., 2017), author's elaboration,

Note: Both Alternative and Brexit baseline have similar assumptions on population growth and GDP, except for UK with Brexit factored in, GDP growth rates are lower (obtained endogenously by the model). For other regions, Brexit GDP growth rates are very similar to Alternative baseline.

An important attention was also paid to the alignment of the trade flows in the MAGNET model with the historical data obtained from COMTRADE and from Andersons (Interim report). Upon several modelling adjustments, the trade flows in 2019 obtained by MAGNET baseline simulation are very close to the historical flows (Table I-5). Therefore it is assured that the starting point for the ex-ante analysis, year 2019, is properly represented in MAGNET.

Table I-5: Comparison of Trade Flows in MAGNET and COMTRADE

Commodity/ Partner	Exports million USD			Imports million USD		
	Andersons*	COMTRADE	MAGNET	Andersons*	COMTRADE	MAGNET
Beef						
Australia	0	0	0	12	17	16
Canada	11	10	10	0	0	0
NZ	0	0	0	3	2	3
GCC	1	7	7	0	0	0
Sheep						
Australia	0	0	0	42	45	44
Canada	1	3	3	0	0	0
NZ	1	1	1	228	284	277
GCC	6	3	3	0	0	0
Dairy						
Australia	16	18	18	0	0	0
Canada	14	19	18	0.299	0.223	0.180
NZ	5	5	5	2	4	4
GCC	49	62	56	0	0	0
Wheat						
Australia	0	0	0	2	3	3
Canada	0	0	0	93	103	82
NZ	0	0	0	0	0	0
GCC	0	0	0	0	0	0

Sources: GTAP, UN COMTRADE, Andersons and WUR

Note: *Andersons data refer to the average of 2018-2020 period, COMTRADE data are obtained for 2019.

The second stage of the Main Baseline construction involved the **implementation of the UK's exit from the EU**. Three elements were considered here;

i. the incorporation of the NTMs for trade between the EU and the UK

ii. increased labour costs due to disruptions on the labour markets, and

iii. adjusting the trade relations to reflect the newest agreements with the focus countries – particularly regarding the Bilateral Trade Quotas.

With respect to the **non-tariff trade measures**, the applied rates are based on the results from the detailed research done by Andersons in this, and previous, studies (for the focus commodities). For the remainder of the commodities (other agri-food, industry and services) rates were based on the recent study of Bartelings and Smeets Kristkova (2022)[16]. For this study, the NTMs were compiled from various sources such as Cadot and Gourdon (2016)[17], Fussachia et al., (2020)[18], Dhingra et al. (2017)[19] and

Freund and Springman (2021)[20]. The overview of the AVEs of the NTMs is presented in Table I-6.

Table I-6: Overview of the NTMs Applied in MAGNET to Simulate Brexit

Sector	EU to UK Trade	UK to EU Trade
Wheat	0.1%	0.1%
Grain	0.1%	0.1%
Dairy	2.0%	2.2%
Beef	1.8%	2.1%
Sheepmeat	2.3%	1.9%
Other agri-food	10.0%	10.0%
Industry	5.0%	5.0%
Services	3.0%	3.0%

Sources: The Andersons Centre, WUR

With respect to simulating **increased labour costs**, the recent report on labour impacts of Brexit (Henehan, 2022)[21] concludes that the new migration regime will slow labour force growth and skew the educational and occupational composition of migrants. In particular, while the RoW migrants were significantly more likely than their UK-born counterparts to work in professional occupations, EU workers were much more likely than their UK-born counterparts to work in operative/process and elementary occupations. Under the new migration regime due to Brexit, a large share of EU-born workers would not be eligible for "Skilled Worker Visa" (SWV) (about 50%). Using this assumption together with the data on the percentage share of migrants in the workforce (18% in 2020, out of which 8% come from the EU), the estimated reduction of UK's workforce would be about -2%. Given the dominance of EU-born migrants employed in lower-skilled sectors, we apply this negative labour supply shock to the unskilled labour supply in MAGNET. This produces the expected increase of labour costs (7.5%) compared to the Alternative baseline (without Brexit).

The last element of Brexit considers changes in the **import tariffs**. The Trade and Cooperation Agreement between the EU and the UK guarantees that trade between the EU and the UK will still be realised under zero tariffs. However, the import tariffs between the UK and the other trading partners no longer follow the trading arrangements that the EU has in place with those countries. That said, the UK's Global Tariff lines are quite similar to those applied by the EU, via its Common External Tariff (CET). Therefore, the adjustments in tariffs primarily concentrated on the focus commodities. Table I-7 provides aggregated ad-valorem import tariff rates applied to imports to and from the UK that were implemented in MAGNET. UK rates applied to imports from the partner countries are considerably higher than those

charged on UK exports, with the exception of dairy exported to Canada, which is charged at a 262% tariff.

Table I-7 Ad-Valorem Import Tariff Rates for Key Commodities and Focus Countries

Commodity	To UK				From UK			
	AU %	CA %	GCC %	NZ %	AU %	CA %	GCC %	NZ %
Wheat	40%	43%	11%	23%	0%	77%	0%	0%
Barley	44%	44%	13%	9%	0%	21%	0%	0%
Dairy	52%	41%	55%	49%	10%	262%	6%	0%
Beef	62%	71%	87%	66%	0%	27%	3%	0%
Sheepmeat	16%	32%	84%	41%	0%	0%	2%	0%

Source: Andersons

It is important to realise that agri-food trade balances will change over time as some countries will become more competitive on the world markets compared to others. The **bilateral tariff rate quotas** (BTRQs) can be used a support tool to understand which trade flows would be subject to out-of-quota tariff in the longer-run. Also, for those cases where the indicative tariffs are too excessive (e.g. dairy imports from UK to Canada of 262%), the corresponding weighted applied tariff can be used to replace the indicative tariffs from Table I-7 above.

Although this study focuses predominantly on the trade between the focus countries and key commodities, MAGNET CGE model reflects the relationships between all trading partners and commodities. Since it is out of the scope of this project to implement all detailed BTRQs for the non-focus countries and commodities, the BTRQ information was used mainly as a support information to design an appropriate level of import tariffs but it was not applied directly in the Main Baseline. By this the consistency is maintained between trade instruments for the focus trade flows and the remaining trade flows. The implemented import tariffs are thus largely based on Table I-7. This effectively means increasing level of protection for the key commodities (except for UK import tariffs of sheep which are slightly lower than in the EU) compared to the pre-Brexit situation. It also reflects the asymmetry between the level of tariffs applied to imports into UK compared to exports from UK.

1.2.5.3 Trade Impact Modelling Steps

Additional Excel-based analysis was used in conjunction with costings data to quantify the impacts of the selected FTAs on the potatoes sector. This is documented in Chapter 8 of the Summary Report.

1.2.5.4 Farm-Level Modelling

This was undertaken following the CGE modelling to quantify the impact on Scottish farm-level performance of the changes projected by MAGNET. This was done using the Scottish Farm Business Income dataset[22].

For potatoes, insights from the Scottish Farm Management Handbook and the ABC Book were used to compile an FTA impact analysis. This is because MAGNET does not cover the potatoes' sector in sufficient detail. This analysis was accompanied by a commentary on what the results would mean in practical terms for Scottish agriculture. Here, insights from the primary research (the methodology of which is explained in Chapter 2 of the Summary Report) were also used to ascertain the impact on Scottish agri-food trade.

1.3   Research Analysis and Report Development

These stages are documented in the Summary Report (Section 2.2).

1.4   Report Presentation and Finalisation:

Approximately 2 weeks after the submission of the draft report, Andersons and WUR presented the 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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