Final Report

The impact on Northern Ireland arising from the UK's exit from the EU: Partial Equilibrium Modelling

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Abstract

In this report we provide an initial assessment of the impact of the UK's departure from the EU on Northern Ireland. The methodology employed is that of multi-regional partial equilibrium modelling, where we allow for imperfect competition between firms. The model is run for 116 sectors which includes agriculture, manufacturing and services. A unique feature of the PE model used is that we also include changes in intermediate input costs on the basis of the change in prices driven by Brexit in each sector. The modelling and the results highlight the complexity of the impact of Brexit on Northern Ireland, which arises from the changes in trade costs not just between NI and its trading partners, but also between the UK, Ireland and the rest of the EU. Our results suggest that the impact of Brexit on NI is a decline in economic welfare of the order of -2.4% of base expenditure, accompanied by an average increase in output of 2.2%. Out of the 116 industries modelled 63 see output rise, while 53 see output decline. The unweighted average rise in prices is 4.3%. These results underline the complex impact of the Trade and Cooperation Agreement and the Northern Ireland protocol on industries, firms, and people as workers and consumers.

Report submitted by InterAnalysis.

Contents

Executive Summary

1. In this report we provide an initial assessment of the possible impact on Northern Ireland of the exit of the UK from the EU. We do so using a state of the art partial equilibrium model which allows for imperfect competition between firms, as well as the Brexit induced changes in intermediate input costs. The model is applied to 116 sectors of the economy which includes agriculture, manufacturing, and services.

2. The simulations in this report are not forecasts or predictions. They are simulations which help to identify the direction of possible changes, the relative orders of magnitude of those changes, and the mechanisms driving those changes.

3. A substantial challenge in this work was assembling a coherent and compatible dataset which separates out Northern Ireland from Great Britain, with appropriate information on sales between NI and GB as well as with Ireland, the rest of the EU and the rest of the World. We describe how this has been achieved in a detailed data appendix.

4. We model three types of experiments: No Deal, NI only, and Deal.
    a. The No Deal experiment is a fairly standard interpretation of what the trade costs might have been in the event of No Deal between the UK and the EU, but with the application of the Northern Ireland protocol. While events have moved on, and the Trade and Cooperation Agreement (TCA) was signed on the 30the December 2020, it is nevertheless useful to compare the results of that Deal with what may have occurred in the event of No Deal.
    b. The NI only experiment is highly artificial in which we introduce the increases in trade costs as a result of Brexit as they apply to NI, but we do not change any trade costs between the UK and the EU. The purpose of this experiment is that it is a useful heuristic device for understanding and disentangling the impact on NI of the TCA Deal.
    c. The Deal experiment is intended to simulate as closely as possible the TCA and the application of the NI protocol.

5. In terms of the underlying economic relationship, for GB and the EU a much higher share of output is sold domestically (74.2% and 80.9%) respectively, than is the case for Northern Ireland (59%), or Ireland (39.5%). The data show that NI is very highly integrated with GB in terms of sales and purchases. Nearly 22% of all production in Northern Ireland is sold in GB, whereas in comparison only 6% goes to Ireland and a further 4.5% to the rest of the EU. Over 31% of purchases in Northern Ireland come from GB, and if we exclude domestic sales, nearly 70% of NI's imports come from GB. These close links are then important in understanding the impact both of direct changes in trade barriers between NI and GB, but also the indirect impacts on NI of higher barriers between the EU and GB which change relative competitiveness (see point 7 below).

6. Across all of the experiments there is an overall welfare loss for Northern Ireland, as well as for GB, the EU and Ireland. In our preferred experiments with the changes in intermediate input costs the welfare loss to NI from the UK's exit from the EU is -2.4% (of base expenditure).

7. While there is a welfare loss aggregate output in NI rises. With the TCA deal the rise in output is 2.2%. This is a very standard result in models of international trade which show how protection can increase domestic production but at the expense of total welfare.

8. There are two reasons why the combination of the TCA and the Northern Ireland Protocol results in output in NI rising. First there is the ***direct effect*** of Brexit which results in higher barriers on trade from GB to NI. This serves to 'protect' the domestic industry in NI and induces a rise in domestic production. The second reason derives from the ***increased relative competitiveness*** of Northern Ireland in the EU and in Great Britain. The TCA results in a rise in barriers to trade bilaterally between GB and the EU. This gives Northern Ireland improved access (relative to GB) in the EU market, and (relative to the EU) in the GB market. This increases exports and hence output. It is worth noting that the modelling does not seek to assess the impacts of any grace period, and effectively should be seen as modelling the longer term outcomes without the temporary easements.

9. This distinction between the two effects can be seen from the inclusion of our stylised and hypothetical NI only experiment. In this experiment we do not change any of the trade costs between GB and EU which takes away the relative competitiveness effects. We see that the change in NI output in this case

is a decline of output of -0.6%, whereas once we introduce the full 'Deal' experiment output rises by 2.2%. This shows how the net effects on NI are a combination of the direct effects from changes in barriers between GB and NI, and indirect effects from the changes in barriers between GB and the EU.

10. In terms of broader sectoral changes we find that the implications of the TCA deal for NI are an increase in agricultural output of 9.4%, and increase in manufacturing output of 4.1%, and a decline in service of 2%. These changes are driven by the changes in trade costs both between GB and NI, but also between NI and the EU (for services), and as discussed earlier between GB and the EU.

11. When we disaggregate these results further we find that output increases for 63 industries in NI, and decreases for 53 industries. On average for those industries that see output rise the increase in output is 11.7%; and for those industries that see their output decline the average decline is -4.5%.

12. The three industries out of the top 10 that appear to be most negatively affected by a deal are all services sector industries: architecture and engineering, motion picture and sound recording, and computer programming. This is no doubt driven the exit of NI from the EU Single Market for services. Other sectors include manufacture of cordage and rope, manufacture of bicycles, and tanning and dressing of leather and fur.

13. If we take the top 10 ten industries that see an increase in output, four of these are in food processing, and the remainder are across a range of sectors including basic chemical, precious and other metals, printing services, and non-metallic minerals.

14. If we consider the top 10 industries by value of production in Northern Ireland in the model, than of these sectors 3 see a decline in output from the TCA Deal, and 7 see a rise in output. This underlies again the differential impact of Brexit across sectors.

15. The disaggregated results all show that the impact of Brexit for consumers in Northern Ireland is likely to be negative arising from the increases in prices that will occur. The average increases in prices in NI is 4.3%. This is in turn what is driving the aggregate negative welfare effects discussed earlier.

16. Overall, the modelling and the results highlight the complexity of the impact of Brexit on Northern Ireland. The complexity arise from the changes in trade costs not just between NI and its trading partners, but also between the UK, Ireland and the rest of the EU. Given the close economic relationship between NI and GB any increase in trade barriers has potentially significant impacts. These will have differential effects across society in NI. Some industries may benefit from increased 'protection', others, will see negative impacts. Consumers in general will lose out from the increases in prices.

Introduction

Following the Brexit referendum in June 2016, on the 30th January 2020 the UK left the EU, with a transition period lasting until the end of 2020. The legal terms of the exit of the UK were dealt with by the Withdrawal Agreement between the UK and the EU which had been agreed on October 17th 2019. The terms of the future relationship between the UK and the EU were finally determined on the 24th December 2020, with the conclusion of the Trade and Cooperation Agreement between the UK and the EU (TCA). Since January 1st 2021 therefore the UK has been trading with the EU under the terms of the TCA. An important element of the Withdrawal Agreement was the Protocol on Ireland/Northern Ireland. A key aim of the Protocol was the avoidance of any border controls on the island of Ireland, in other words between Northern Ireland and the Republic of Ireland. The Protocol has also been applied since January 1st 2021, and sets out the rules governing trading relations between Northern Ireland and Great Britain.

On the departure of the UK from the EU it was agreed that Northern Ireland would remain in the UK's customs territory. However, for trade between Northern Ireland and the EU (and therefore the Republic of Ireland) the EU's Union Customs Code would apply, with no tariffs or other restrictions. Northern Ireland will also remain within the EU's single market for agriculture and manufactured goods, but not for services. In terms of possible future tariff and non-tariff barriers facing Northern Ireland the protocol therefore implied the following:

- *Between Northern Ireland and the Republic of Ireland:* no tariffs or regulatory checks in either direction

- *Between Northern Ireland (NI) and GB:* On sales from GB to NI, EU tariffs will be applied if the good is 'at risk' of being moved into the EU. The definition of which goods are 'at risk' was determined by the Joint (UK and EU) Committee under Decision No 4/2020.

  Goods moving from GB to NI are considered not 'at risk' if the applicable EU tariff is zero or if the goods are for sale to, or final use by, end consumers located in the UK and are brought into NI by an authorised trader under the UK Trader Scheme.[1] Goods which are brought into NI for processing will be subject to additional criteria to be considered not 'at risk'. Under the terms of the TCA the applicable tariff is zero for goods which originate in the UK, and where proof of origin can be provided by the importer.[2] Goods which are not UK domestic goods will be treated as movements from the rest of the world into NI, and where the EU tariff is more than 3 percentage points higher than the UK tariff then such goods will be deemed at risk. Where the EU tariff is levied, and if it can be subsequently proven that the good has not entered the EU, customs duties can be reimbursed, but reimbursements are subject to EU state aid limits.

  However, this does not mean there will be no checks or controls at the border as the EU will want to be assured that the correct declarations are being made. For example, all goods moved from GB to NI will require both an entry safety and security declaration (ENS) and an import declaration. A record of the movement will also need to be made on the Goods Vehicle Movement Service (GVMS), where the port is operating the pre-lodgement model. All goods will also be subject to EU regulatory standards.

- *On sales from NI to GB:* The protocol calls for "unfettered access" - so in principle, there are no tariffs or customs checks and with regard to regulatory checks, the Government's impact assessment states that the "Protocol contains no requirement for additional regulatory checks on goods moving from Northern Ireland to Great Britain." However, in practice export declaration forms may be necessary in certain circumstances.[3]

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[1] See: https://www.gov.uk/guidance/trading-and-moving-goods-in-and-out-of-northern-ireland

[2] In this case authorization under the UK Trade Scheme is not required. See: https://www.gov.uk/guidance/claiming-preferential-rates-of-duty-between-the-uk-and-eu

[3] See: https://www.gov.uk/government/publications/customs-declaration-completion-requirements-for-the-northern-ireland-protocol/part-1-tariff-supplement-for-cds-volume-3-for-the-northern-ireland-protocol

Between Northern Ireland and the Rest of the World (RoW): On imports from the rest of the world: EU tariffs will be applied if the good is at risk of being moved into the EU. Goods are considered not 'at risk' if the applicable EU tariff is less than 3 percentage points higher than the applicable UK tariff or if the goods are for sale to, or final use by, end consumers located in Northern Ireland and are brought into Northern Ireland by a trader authorised under the UK Trader Scheme.[4] Otherwise the EU tariff applies. On exports to the rest of the world, there may be import tariffs levied by the destination country, but as Northern Ireland is part of the UK's customs territory, these will be the same as those levied on any other UK exports.

As can be seen from the preceding these are complex changes which in turn are likely to have a range of impacts on the economy of Northern Ireland. The aim of this work is to provide a modelling assessment of the scale of the possible impacts and the range of impacts across different sectors. In order to do so we model the impact on Northern Ireland of two core scenarios – first what would have been the impact of no-deal between the UK and the EU; and secondly the impact on Northern Ireland given the signing of the TCA between the UK and the EU. We include both sets of experiments as it helps in understanding the impact of different levels of trade costs on outcomes. For each experiment we also consider two variants of the PE model. The first variant, involves running the model as a standard PE model where each of the modelled industries / sectors is treated entirely independently. In the second variant of the model we provide some inter-industry linkages through the use of input-output tables which allows us to feed in the changes in intermediate input costs in each sector based on the changes in prices driven by the changes in the trade costs.

The report contains five sections. In the first we provide some background information on the nature and extent of economic integration and trade between Northern Ireland and its principal trading 'partners' – Great Britain, the Republic of Ireland (hereafter referred to as Ireland), and the rest of the EU. In the second section we provide the core details of the partial equilibrium model and the data used to derive the results. In the third section we outline the changes in tariffs and non-tariff barriers that are assumed in the simulations underpinning the results. The fourth section provides the results, and the final section concludes.

1. Trade and Production of Northern Ireland

Section 1 of this report provides detailed information on the data used in our modelling, and that same data is presented below in summary form and which characterizes the structure of the NI economy in the model and the pattern of trade between NI and its principal partners. The data in our model broadly encompasses all sectors of the economy – agriculture, manufacturing and services – however due to data limitations not all sub-sectors are necessarily covered.

Consider first Table 1, which focusses on sales. In the top panel we consider the distribution of sales across all markets and in the bottom panel we just consider the importance of different export markets. In each case the share sums to 100% going down the columns. Countries in rows are destination markets while countries in column headers are origin markets. For the sake of convenience in discussing the data we consider NI and GB as separate market hence, Northern Ireland we use the term exports for NI sales to Ireland (IRL), the EU and the Rest of the World as well as to GB. In the table below EU, represents the EU excluding the UK, and excluding Ireland.

Table 1: Distribution of Sales

Origin / Destination	Share in Sales			
	GB	NI	EU	IRL
GB	74.19%	21.73%	2.35%	4.47%

[4] See: https://www.gov.uk/guidance/check-if-you-can-declare-goods-you-bring-into-northern-ireland-not-at-risk-of-moving-to-the-eu#check-if-you-can-declare-goods-you-bring-into-northern-ireland-directly-from-a-country-outside-of-the-eu-and-the-uk-as-not-at-risk

	GB	NI	EU	IRL
NI	0.82%	59.08%	0.02%	0.64%
EU	9.06%	4.47%	80.89%	18.50%
IRL	0.89%	5.97%	0.35%	39.46%
ROW	15.03%	8.76%	16.39%	36.92%

Share in Exports				
Origin / Destination	GB	NI	EU	IRL
GB		53.09%	12.31%	7.39%
NI	3.18%		0.11%	1.06%
EU	35.10%	10.92%		30.56%
IRL	3.47%	14.58%	1.81%	
ROW	58.25%	21.42%	85.77%	60.99%

There are several features of this data that are interesting. First, we see that for GB and the EU a much higher share of output is sold domestically (74.2% and 80.9%) respectively, than is the case for Northern Ireland (59%), or Ireland (39.5%). Secondly, we see the relative importance of GB to Northern Ireland. Nearly 22% of all production in Northern Ireland is sold in GB, whereas in comparison only 6% goes to Ireland and a further 4.5% to the rest of the EU. In contrast for GB there is a much higher share of both production (over 9%), and exports (over 35%) going to the EU.

Table 2 presents a set of analogous information, but this time we focus on the source of domestic consumption (purchases), where once again the share sum to 100% going down the columns.

Table 2: Distribution of Purchases

Share in Consumption				
Origin / Destination	GB	NI	EU	IRL
GB	73.02%	31.37%	1.54%	6.29%
NI	0.52%	54.64%	0.02%	1.01%
EU	14.15%	5.06%	84.21%	14.84%
IRL	0.82%	4.58%	0.59%	51.62%
ROW	11.50%	4.34%	13.64%	26.23%

Share in Imports				
Origin / Destination	GB	NI	EU	IRL
GB		69.18%	9.78%	12.99%
NI	1.92%		0.12%	2.10%
EU	52.43%	11.16%		30.68%
IRL	3.04%	10.09%	3.72%	
ROW	42.62%	9.57%	86.39%	54.23%

As with the preceding table the close economic connections between NI and GB are apparent. Over 31% of purchases in Northern Ireland come from GB, and if we exclude domestic sales, nearly 70% of NI's imports come from GB. In contrast both GB and Ireland are much more reliant on the EU as a supplier.

2. The PE model and data

2.1 The PE model:

Our analysis is based on a partial equilibrium model of the impact of the UK leaving the EU on prices, exports, imports and output in 116 different sectors/industries: 1 combined agricultural sector, 102 manufacturing industries, and 13 service industries. These are based on the 4-digit classes of ISIC Revision 4. The model has a multi-market structure, and in this application has eleven markets: Great Britain, Northern Ireland, the EU (which excludes the UK and Ireland), Ireland, the USA, China, Australia, New Zealand, all the countries that the EU has a free trade agreement with and with whom the UK has agreed a continuity free trade agreements with which we call (FTA), all the countries that the EU has a free trade agreement and the UK has not managed to sign a continuity agreement with (these are the non-continuity countries) and the rest of the world.[5]

There are two variants of the model. The core model (referred to as ICF below) is based on Krugman's (1979, 1980, 1981) model of trade under imperfect competition, and our partial equilibrium application builds on the work of Smith and Venables (1988). The model assumes each industry produces differentiated products under conditions of increasing returns to scale. Modelling of demand follows Dixit and Stiglitz (1977), with constant elasticity demand functions for individual products. This means consumers have a 'love of variety' in any one product: wine drinkers like wine from different Spanish producers, and also wine from different Australian producers; and demand for an individual variety depends on its price relative to an aggregate product price index. Demand for the aggregate product is a function of the aggregate price index. The imperfect substitutability of different firms' varieties gives rise to imperfect competition, in which firms have market power and set prices above marginal cost. Increasing returns mean that growth in a firm's sales in one market reduces its cost of production and leads to expansion in other markets too. Markets are segmented and firms act as Bertrand competitors, setting prices in each market to maximise profits taking competitors' prices as given. The number of firms in each country are constant. Moreover, this model is augmented to include intermediate inputs. While we do not model the demand for intermediates, we allow for their prices to change in response to trade policy. These price changes are driven by the changes in prices arising from the changes in trade costs for each of the modelled sectors/industries in the model. We refer to this version of the model as ICF-I and this provides a significant step forward in partial equilibrium modelling as it allows for both much greater sectoral disaggregation, but while taking into account changes in intermediate input costs.

A second version of the model which we use for sensitivity analysis (referred to as ARM) applies the standard Armington assumption on the demand side (Armington, 1969). This means that products are differentiated only by place of production (consumers treat all Spanish wine as homogenous but different from all Australian wine), so that the product varieties produced in different countries are imperfect substitutes for each other. In this variant of the model we assume perfect competition so individual firms do not have market power, and supply behaviour is described by a standard upward sloping supply function. We do not report on the results for these simulations but they are available on request.

Because we use partial equilibrium analysis, our results should not be seen as making 'predictions' about the precise sectoral effects of the UK leaving the EU. The actual effects will depend in good part on the changes in policy which we model, but in addition on structural factors which are not captured by the model, on the second-order adjustments in factor markets and markets for intermediates, on other policy changes and shocks which cannot be predicted, as well as on longer run changes in investment. Our modelling aims to provide a consistent framework for evaluating orders of magnitude of the direct effects on manufacturing from different possible scenarios. This enables comparison across industries and sectors and across scenarios of the extent to which the different industries and sectors are vulnerable to the changes in trade costs implied by the UK leaving the EU.

2.2 Data and experiments

Our model requires data on production, bilateral trade flows and trade costs, where production and trade

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[5] For a full list of countries in each of the groupings please refer Appendix 2.

data are combined to capture domestic absorption (domestic consumption of domestic production). The model requires these data to be broken down by industry and by country (i.e. market). Data are collected for 2018 where possible. Note that there is a fundamental difference between the two sets of data: production data are collected on an activity basis while trade data are collected on a commodity basis. For this particular model the challenge is even greater as there is an absence of data on 'trade' between Northern Ireland, and GB which is needed here. There is some data on this from the NI input-output tables, from HMRC/ONS trade data, and from the innovative BESES dataset. The precise way which we combined all this data to derive the final data set is described in Appendix 2. For other countries in the model reconciliation of the trade and production data also needs to be undertaken. This can be partially (and imperfectly) reconciled using concordance tables, but in sectors where the reconciliation was problematic, we used secondary sources of information on the share of production exported by each industry from the latest release of the World Input-Output Database (WIOD) (Timmer et al., 2015, Timmer et al., 2016) in order to adjust the underlying production data.

To account for the costs of trade between countries, we also need information on tariffs and non-tariff measures (NTMs). These are discussed below:

2.3 Tariffs on goods

Base tariffs
Bilateral tariff data was sourced from UNCTAD's TRAINS database, accessed through WITS. The model requires percentage, ad-valorem, tariffs, which is the legal form of the majority of tariffs. However, in some cases tariffs are defined as specific duties. WITS converts specific duties to ad-valorem equivalents using the average prices of imports. We use 2018 tariffs where these are available; however where 2018 tariffs are missing we use tariff data from earlier years (2017-2012) in order to fill the gaps as far as possible. If tariff rates are missing over the period 2018-2012 we treat them as zero.

For the purpose of the modelling, we use import-weighted average tariffs. To weight GB's tariffs we have used UK imports from UN Comtrade. To weight NI's tariffs we have used NI's imports from HMRCs Overseas Trade Statistics (OTS) data. In the base, tariffs are zero between NI-GB-EU. Where third countries face MFN tariffs, the EU CET is applied for NI's, GB's and EU's imports from these countries. Table 3 below summarises the structure of the base tariffs (note that USA, CHN, AUS and NZL have all been grouped in 'ROW')

Table 3: Base tariffs

Exporter -->	GB	NI	EU26	IRL	FTA	Noncont	ROW
GB	0	0	0	0	Pref	Pref	MFN
NI	0	0	0	0	Pref	Pref	MFN
EU26	0	0	0	0	Pref	Pref	MFN
IRL	0	0	0	0	Pref	Pref	MFN
FTA	Pref	Pref	Pref	Pref	MFN	MFN	MFN
Noncont	Pref	Pref	Pref	Pref	MFN	MFN	MFN
ROW	MFN	MFN	MFN	MFN	MFN	MFN	MFN

Simulation tariffs
The dataset contains a number of different simulation tariffs to allow us to run various experiments. These are outlined below.

Simulation Tariffs UK Global Tariff: This set of tariffs only changes the GB/NI tariffs from the EU CET to the UKGT. All other tariffs remain unchanged.

Simulation Tariffs No Deal: Simulation tariffs for modelling the no deal scenario. This contains a

number of changes compared to the base:
- GB imports from EU26 and Ireland face the UK Global Tariff.
- EU26 and Ireland's imports from GB face the EU CET
- Imports from GB or NI into the 'Non-continuity' group will face MFN tariffs
- Imports by GP or NI from the 'Non-continuity' group will face the UK Global Tariff when imported into GB.
- Tariffs are applied on 'exports' from GB to NI. The amount of trade facing tariffs will be dependent on the definition of goods 'at risk' under the Northern Ireland Protocol. In light of this, we have constructed two versions of tariffs on GB-NI trade, a 'liberal' approach and a 'strict' approach.

    The 'liberal' approach assumes that:
    (a) any goods defined as intermediates according to the BEC classification will be deemed at risk, and will therefore face EU MFN tariffs at the GB-NI border, and
    (b) any goods which face an EU MFN tariff of 3% of more will be considered at risk. This reflects the incentive to smuggle the product through the GB-NI crossing in order to avoid paying the EU MFN tariff.

    The 'strict' approach assumes that:
    (a) any goods defined as intermediates according to the BEC classification will be deemed at risk, and will therefore face EU MFN tariffs at the GB-NI border
    (b) any goods which face a positive EU MFN tariff will be considered at risk.

- Finally, imports from ROW countries (e.g. USA, China, Australia etc.) into NI will face the UK Global Tariff if they are considered not at risk. If they are considered at risk, they will face the EU MFN tariff at the NI border. We have used the following criteria to define goods at risk here:

    (a) any goods defined as intermediates according to the BEC classification will be deemed at risk, and will therefore face EU MFN tariffs at the NI border
    (b) any goods which face a tariff differential (EU MFN-UKGT) of 3 percentage points or more will be considered at risk, as there will be an incentive to smuggle the product through the NI crossing into EU in order to avoid paying the EU MFN tariff.

Table 4: Simulation tariffs − No deal

Exporter -->	GB	NI	EU26	IRL	Noncont	FTA	ROW
GB	0	0	UKGT	UKGT	UKGT	Pref	UKGT
NI	Protocol (1)*	0	0	0	Pref	Pref	Protocol (2)*
EU26	MFN	0	0	0	Pref	Pref	MFN
IRL	MFN	0	0	0	Pref	Pref	MFN
FTA	Pref	Pref	Pref	Pref	MFN	MFN	MFN
Noncont	MFN	MFN	Pref	Pref	MFN	MFN	MFN
ROW	MFN	MFN	MFN	MFN	MFN	MFN	MFN

* Protocol (1) Goods going from GB to NI (NO DEAL)

"Liberal' assumption:

EU MFN tariffs levied on:

- Intermediate goods

- non-intermediate goods which have an EU MFN tariff of 3% or higher

'Strict' assumption

EU MFN tariffs levied on:

- Intermediate goods

- non-intermediate goods which have a non-zero EU MFN tariff

*Protocol (2) Goods coming into NI from USA, CHN, AUS, NZL, ROW

EU MFN tariffs levied on:

- Intermediate goods
- non-intermediates that have a tariff differential (UKGT-EU MFN) of at least 3 percentage points

<u>**Simulation Tariffs Deal**</u>:

The simulation tariffs for a 'deal' scenario. Following the UK-EU Trade and Cooperation Agreement, we have assumed a fully comprehensive tariff liberalisation, such that there are no tariffs on GB-EU trade. This also means that no goods which can prove that they are originating in GB would be considered at risk when sent to NI. However, there may still be incentive for transhipment from ROW countries using the GB-NI-EU route where the UKGT<EU CET. For example, assume that the UKGT is lower than the EU MFN tariff on a given product. USA exports the item to GB under the lower tariffs and then sends it to the EU via NI, thereby avoid the higher EU CET. Such products would be identified through Rules of Origin checks at GB-NI border. If the good would be considered at risk of moving from NI to EU then we assume that the EU CET tariff would be paid at GB-NI border. Under the 'deal' scenario we have therefore assumed that products are at risk if:

(a) they are intermediates
(b) they have a tariff differential (EU CET-UKGT) of 3 percentage points or more.

Table 5: Simulation tariffs – Deal

Exporter -->	GB	NI	EU26	IRL	FTA	Noncont	ROW
GB	0	0	0	0	Pref	UKGT	UKGT
NI	Protocol (3)*	0	0	0	Pref	Pref	Protocol (2)*
EU26	0	0	0	0	Pref	Pref	MFN
IRL	0	0	0	0	Pref	Pref	MFN
FTA	Pref	Pref	Pref	Pref	MFN	MFN	MFN
Noncont	MFN	MFN	Pref	Pref	MFN	MFN	MFN
ROW	MFN	MFN	MFN	MFN	MFN	MFN	MFN

*Protocol (3) Goods going from GB to NI (DEAL)
 EU MFN tariffs levied on:
- Intermediate goods
- non-intermediate goods which have a tariff differential of 3 percentage points or higher

Note: For some sectors eg. agri-food the imposition of a tariff wherever the tariff differential is 3% points or higher may result in an exaggeration of the extent to which tariffs will be levied. Rest of the World goods moving from GB to NI may well prove either to be ROO compliant, or will not be at risk if the goods are being sold in NI. The alternative would be not to model any tariff increases on certain sectors such as agri-food, but conversely such an assumption is likely to underestimate the degree of tariff imposition. It is also hard to know for which sectors such an assumption should be made. Where tariffs are not imposed there is a higher burden on firms, and hence higher costs on firms to establish that a tariff should not be levied. So, to some extent, our inclusion of the tariff can be seen alternatively as capturing these higher costs.

* Protocol (2) Goods coming into NI from USA, CHN, AUS, NZL, ROW
EU MFN tariffs levied on:
- Intermediate goods
- non-intermediates that have a tariff differential (UKGT-EU MFN) of at least 3 percentage points

2.4 Non-Tariff Measures:

Goods trade

Alongside tariffs, non-tariff measures (NTMs) also impact on trade costs. The ad-valorem equivalents of NTMs used for goods trade are based on estimates from Cadot and Gourdon (2016), who compute these for sanitary and phytosanitary and technical-barriers-to-trade (SPS and TBT respectively) for 21 sections of the HS classification. Using concordance tables, these can be linked with a fair degree of precision to the industry groups covering manufacturing.

Cadot and Gourdon provide two sets of estimates according to whether the trading partners are linked by trade agreements or not. Where a trade agreement is in place, NTMs between the parties to the agreement are considered low. In all other cases, NTMs are considered high. The tables below summarise the NTMs used for goods trade under the different simulation scenarios.

Table 6: Base NTMs

Exporter -->	GB	NI	EU26	IRL	FTA	Noncont	ROW
GB	0	0	0	0	Low	Low	High
NI	0	0	0	0	Low	Low	High
EU26	0	0	0	0	Low	Low	High
IRL	0	0	0	0	Low	Low	High
FTA	Low	Low	Low	Low	High	High	High
Noncont	Low	Low	Low	Low	High	High	High
ROW	High	High	High	High	High	High	High

Table 7: Simulation NTMs - No deal

Exporter -->	GB	NI	EU26	IRL	Noncont	FTA	ROW
GB	0	0	High	High	High	Low	High
NI	Low	0	0	0	Low	Low	High
EU26	High	0	0	0	Low	Low	High
IRL	High	0	0	0	Low	Low	High
FTA	Low	Low	Low	Low	High	High	High
Noncont	High	High	Low	Low	High	High	High
ROW	High	High	High	High	High	High	High

Table 8: Simulation NTMs - Deal

Exporter -->	GB	NI	EU26	IRL	FTA	Noncont	ROW
GB	0	0	Low	Low	Low	High	High
NI	Low	0	0	0	Low	Low	High
EU26	Low	0	0	0	Low	Low	High
IRL	Low	0	0	0	Low	Low	High
FTA	Low	Low	Low	Low	High	High	High
Noncont	High	High	Low	Low	High	High	High
ROW	High	High	High	High	High	High	High

For the services sectors, we have computed our own NTM estimates using an underlying gravity model. The full details of the procedure we employed can be found in Appendix 3. As both GB and NI have left the Single Markt for services we have introduced the same level of trade barriers in both cases with the EU. In practice it may be that

the impact across sectors between GB and NI may be different, and one reason for that could be related to the ongoing free movement of workers between NI and Ireland. In some sectors there may be strong complementarity between Mode 1 services trade (the cross border supply of services) and Mode 4 (movement of workers). However, as we do not have an evidence base for this, any such changes are not modelled here.

3. Scenarios and Results

We model the impact of the UK leaving the EU on 116 industries under several different scenarios. The two core scenarios distinguish between No Deal and Deal. The full details are described above but it is useful to summarise the main elements below as they apply to Northern Ireland trade with both Great Britain and with the EU.

Table 9: Summary of experiments applied to Northern Ireland

NO DEAL			DEAL		
Flow	Tariffs	NTMs	Flow	Tariffs	NTMs
GB → NI			**GB → NI**		
Goods	At risk	Low	Goods	At risk	Low
Services		None	Services		None
NI → GB			**NI → GB**		
Goods	None	a) None b) Border costs	Goods	None	None
Services		None	Services		None
EU → NI			**EU → NI**		
Goods	None	None	Goods	None	None
Services		High	Services		Low
NI → EU			**NI → EU**		
Goods	None	a) None b) Border costs	Goods	None	None
Services		High	Services		Low

The results with regard to welfare, outputs, exports and imports are given in the charts below for four different experiments. We report on two variants of No Deal, the results of the TCA Deal, and a very hypothetical experiment in which we do not change the trade costs (tariffs or NTMs) between GB and the EU):

No Deal (A): This is the No Deal experiment as given in the table above. We also introduce additional border costs on trade between GB and the EU, but no such additional border costs on trade from NI to GB, GB to NI, or from NI to the EU.

No Deal (B): This is the same as No Deal (A), except in this case we have introduced modest border costs (2%) costs on trade from GB to NI, and from also NI to GB and NI to the EU. The rationale for each of these is the following. On flows from GB to NI, this captures the additional bureaucracy from administering the Northern Ireland protocol. On flows from NI to GB, even if there is 'unfettered access' and hence no bureaucracy at all on flow from NI to GB, the presence of increased bureaucratic costs from GB to NI, will also increase the costs from NI to GB. This is because in planning freight transport companies take into account the costs in both directions. Additionally, there may well be export declarations to fill in depending on the final outcomes. On flows from NI to the EU, a large proportion of these flows go through GB. Hence if there are border costs between GB and the EU, then these will also apply to a substantial portion of trade from NI to the EU. We do not introduce any increase in trade costs

however between NI and Ireland.

NI only: This is a purely hypothetical experiment in which we introduce the No Deal trade barriers as they affect Northern Ireland, and notably between GB and NI but we do not NI, introduce any trade barriers between GB and the EU, nor NI and the EU. The purpose of this experiment is to be able to isolate the impact on Northern Ireland from Brexit and from the introduction of barriers with GB. This experiment is useful then in interpreting the results from the other experiments.

Deal: In this experiment we simulate the impact of there being a deal between the UK and the EU. However, as explained earlier even if there is a deal there is the possibility that goods will be imported by Great Britain from non-EU third countries, and where the UK tariff is lower than the EU's there may be an incentive to ship the goods to the EU via Northern Ireland. We therefore we apply a tariff on exports from GB to Northern Ireland for those goods where the UKGT is lower than the EU CET. Moreover, we consider a 2% border cost between GB and NI (both ways) and for NI exports to the EU. For UK-EU trade we this border cost is assumed higher at 3.5%.

3.1 Aggregate Results:

For each of the experiments we report on the results of the standard PE model with imperfect competition (ICF), and also the variant where we allow for intermediate input costs to change (ICF-I).

Consider first tables 10 and 11 which give the results for aggregate welfare and output for GB, NI, the EU and Ireland for both variants of the experiment. Welfare here is defined as the sum of the changes in welfare for consumers (equivalent variation), producers (producer surplus under the Armington assumption; or change in profits under imperfect competition), and any changes in tariff revenue. The output we report on here is the quantity as opposed to the value of output, and this is in order to ensure we are capturing changes in real activity. Figures 1 and 2 below, then present the results for Northern Ireland for both variants of each experiment.

Table 10: Changes in Welfare

		GB	NI	EU26	IRL
No deal (A)	no int	-2.95	-0.52	-0.39	-1.45
	with Int	-4.27	-2.05	-0.66	-2.16
No deal (B)	no int	-2.96	-1.19	-0.39	-1.45
	with Int	-4.28	-2.72	-0.66	-2.16
NI only	no int	-0.06	-1.88	0.00	-0.01
	with Int	-1.40	-3.39	-0.23	-0.70
Deal	no int	-2.31	-1.38	-0.27	-0.99
	with Int	-3.07	-2.40	-0.42	-1.37

Table 11: Changes in Output

		GB	NI	EU26	IRL
No deal (A)	no int	-3.15	7.83	-0.59	-1.87
	with Int	-6.16	5.38	-0.92	-3.51
No deal (B)	no int	-3.16	6.13	-0.59	-1.84
	with Int	-6.18	3.71	-0.92	-3.48
NI only	no int	-0.27	1.68	0.01	0.16
	with Int	-3.73	-0.57	-0.18	-1.42
Deal	no int	-2.63	4.09	-0.40	-1.22

	with Int	-4.43	2.16	-0.58	-2.04

Fig 1: % Change in welfare for Northern Ireland

	No deal (A)	No deal (B)	NI only	Deal
No Int	-0.5	-1.2	-1.9	-1.4
With Int	-2.0	-2.7	-3.4	-2.4

Fig 2: % Change in output for Northern Ireland

	No deal (A)	No deal (B)	NI only	Deal
No Int	7.8	6.1	1.7	4.1
With Int	5.4	3.7	-0.6	2.2
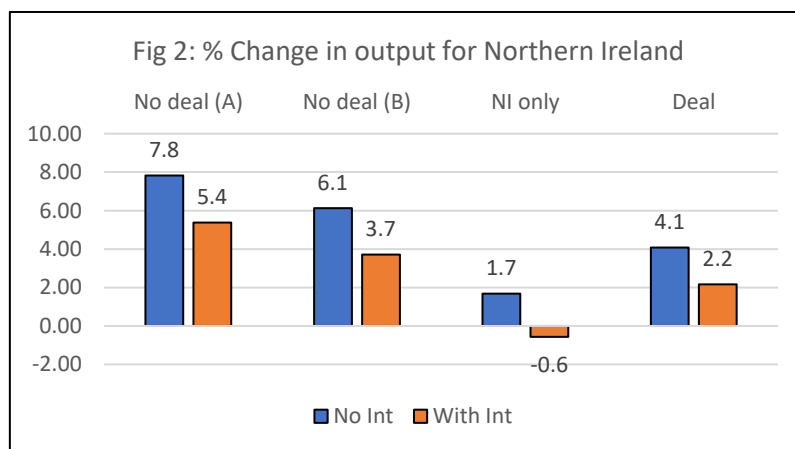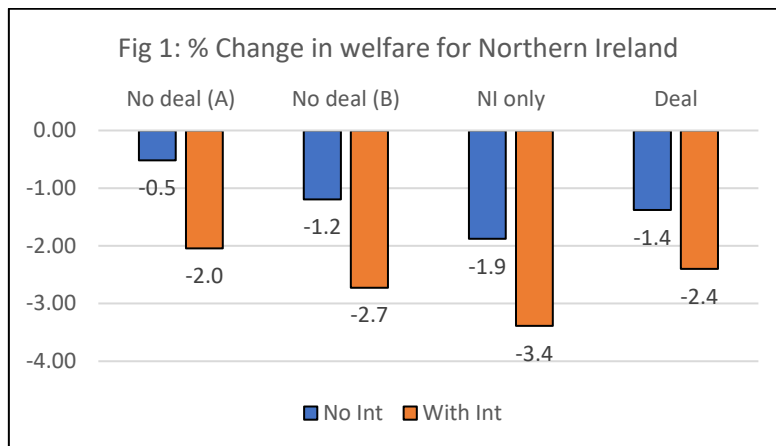
There are a number of important messages which emerge from these results:

- In all the experiment and across both variants there is an overall welfare loss for Northern Ireland, as well as for GB, the EU and Ireland.

- Across all but one of the experiments and variants output rises in Northern Ireland, but the importance of the modelling of the changes in intermediate input costs can be seen by the difference in results in the experiments with these costs and those without. Allowing for changes in intermediate input costs results in smaller increases in output. This is because the increases in trade barriers arising from Brexit, impacts on intermediate input costs which lowers NI firms' competitiveness and thus reduces the positive impact on output arising from greater 'protection' of the NI market from the increased barriers.

- Focussing on the results with the changes in intermediate inputs costs we see that the biggest rise in output occurs in the event of a No Deal (A) with the EU (5.4%), and that with the actual TCA deal and NI protocol the rise in output is a more modest (2.2%).
  - The difference between No Deal (A) and No Deal (B), is that in the latter case we have allowed for an increase in border costs from NI to the EU, and from NI to GB. It is of course very difficult to have any precision on the extent of these barriers. However, the interesting message that emerges is that without including these barriers NI output rises by 5.4%, and if we include a very low level of these barriers (2%) output increase by less (3.7%). This underlines the importance of low trade costs and good trading links with both the EU and GB for Northern Ireland.

- The rise in output in NI is primarily driven by two factors:

i.   Brexit results in higher barriers on trade from GB to NI. This rise in barriers to imports from GB serves to 'protect' the domestic industry in NI and causes the rise in domestic production. This is particularly the case because, as we saw earlier, 31% of domestic consumption in NI is sourced from Britain, and nearly 70% of imports. With the TCA the rise in barriers is less than in the event of No Deal, hence, less protection of NI industry and hence the rise in output is attenuated. It is important to underline however, that while output in aggregate may rise, this is accompanied by a decline in overall welfare. This is a very standard result in models of international trade which show how protection can increase domestic production but at the expense of total welfare.

ii. There is a second reason for the rise in output, which derives from the **increased relative competitiveness** of Northern Ireland in the EU and in Great Britain. The TCA results in a rise in barriers to trade bilaterally between GB and the EU. This gives Northern Ireland improved access (relative to GB) in the EU market, and (relative to the EU) in the GB market. This increases exports and hence output. Figures 3 and 4 below give the changes in exports and imports for Northern Ireland across the experiments.

This distinction between the two effects can be seen from the inclusion of our stylised and hypothetical NI only experiment. In this experiment we capture solely the effect of Brexit on NI, and do not change any of the trade costs between GB and EU, precisely to assume away these relative competitiveness effects. We see that the increase in NI output in this case is 1.7% with no intermediate input costs changes, and a decline of output of -0.6% with these cost changes. With the No Deal experiment we see NI's exports increase, while in the NI only experiment they decrease, where the difference between these two experiments is whether or not we include the change in costs and barriers to trade between GB and the EU. Not surprisingly then the results for the Deal experiment lie between the No Deal, and the NI only experiments as this experiment raises trade costs between the UK and the EU to a lesser extent. This discussion indicates how the net effects on NI are a combination of the direct effects from changes in barriers between GB and NI, and indirect effects from the changes in barriers between GB and the EU.

Fig. 3: % change in exports for Northern Ireland

Fig: 4: % change in imports for Northern Ireland
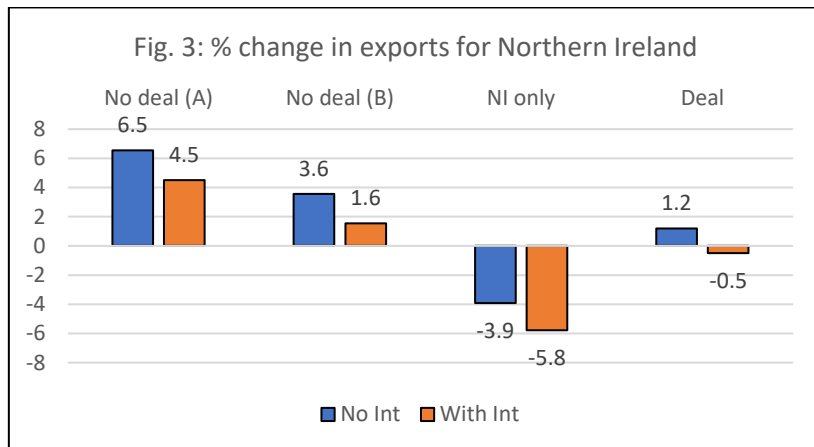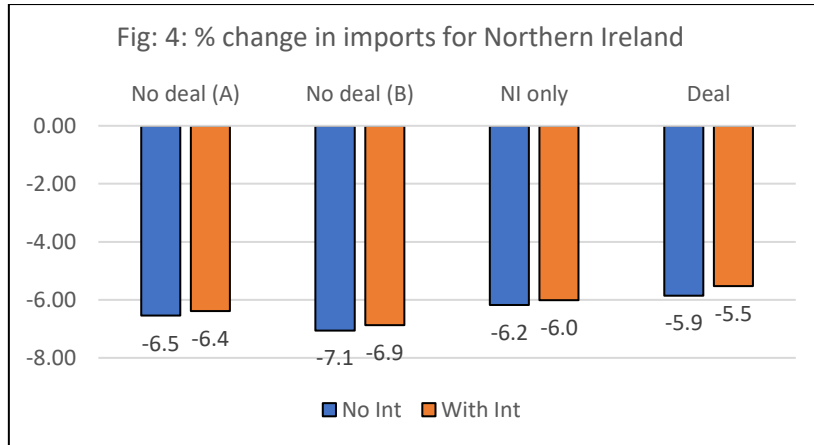
- We also observe that while output rises in all cases in Northern Ireland, conversely it falls in all cases for GB and for Ireland. In the event of No Deal (B), output in GB declines by 3.16% and in Ireland by 1.84% with no intermediate input cost changes, which rises to -6.18% and -3.48% with the intermediate cost changes. With the modelling of the TCA the decline in output for the UK and Ireland respectively, when we allow for the intermediate input costs changes is -4.43% and -2.04% respectively. The larger effects with intermediate input costs is driven by the impact those cost changes have on the competitiveness of firms in both domestic markets and abroad.

- All the experiments result in a decrease in NI 'imports' – where imports here include flow from GB to NI. This is driven primarily by the increase in GB-NI barriers. The rise in barriers between GB and NI which reduces GB sales to NI, will be partly offset by an increase in imports from third countries (be this the EU, Ireland or the ROW), and partly by increased domestic production.

3.2 Broad Sectoral Results:

We now turn to disaggregating the results across broad sectors of the economy – Agriculture, Manufacturing and Services. For this we report on two of the preceding experiment which are No Deal (B) and the strict interpretation of a Deal allowing intermediate prices to change using the ICF-I version of the model. Figures 5 and 6 below give the changes in output respectively for Northern Ireland and GB.

Fig 5: % Change in Sectoral Output NI

Fig 6: % change in sectoral output GB
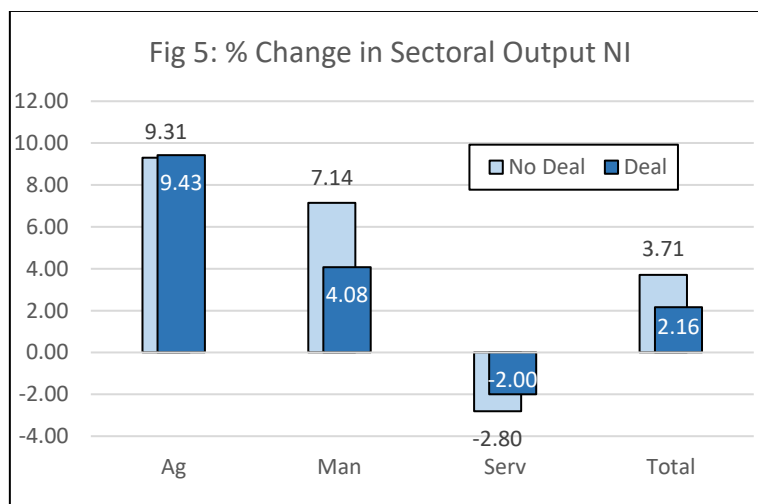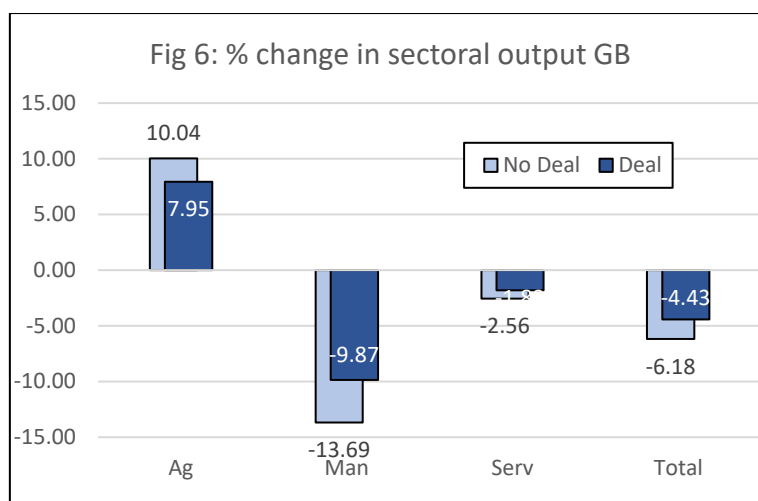
If we consider first the impact of no deal we see a mixed picture across the sectors and which varies between NI and GB. For NI, in the case of the No Deal experiment the biggest rise in output occurs in agriculture (10.04%) with output in manufacturing increasing by 7.14%. In contrast the services sector contracts by 2.8%, with a combined aggregate rise in output of 3.7% as seen earlier in Table 11. The decline in services output is driven by the increase in regulatory barriers between NI and the EU arising from NI no longer being in the single market for services. The pattern of results is very similar for the modelling of the TCA deal though with a much smaller expansion of manufacturing.

For GB we see output in agriculture increasing by 10.04% (from increased protection), and declining in manufacturing by nearly 14% and in services by 2.56%. It is interesting to note that with the TCA deal manufacturing output still declines by 9.9% for GB, and this highlight the important role of non-tariff barriers (regulatory barriers) to trade.

3.3 Detailed industry level results:

In this section we present a summary of the disaggregated industry-level results for the No Deal (B) and the Deal scenarios with intermediate inputs. Table 12 reports the count of sectors that see a positive/negative output changes together with their average percentage change for the Deal and the No Deal (B) scenarios. Under the Deal scenario, Norther Ireland sees an increase in output in 63 out of the 116 sectors with an average increase in output of 11.7%, while 53 sectors see a decline in output (-4.5% on average). Under the No Deal scenario, the count measures do not change dramatically. In this case 70 industries see a positive change while 46 a negative one. The average percentage change for the sectors that see an increase in production is 14.3%, while for the negatively impacted sectors the average change is -5.4%. Results for the EU26, Ireland and GB are quite similar across the two experiments in terms of count, and the average magnitude of changes is larger in the No Deal (B) scenario.

These results underline the highly differential and complex impact of Brexit, and the TCA deal on sectors within both NI and GB, as well as for Ireland and the rest of the EU.

Table 12: Disaggregated sectoral results, output changes

	Count		Average change, %	
	positive	negative	positive	negative
Deal				
GB	18	98	4.3	-12.6
NI	63	53	11.7	-4.5

EU26	4	112	0.6	-0.9
IRL	22	94	3.3	-6
No Deal (B)				
GB	16	100	6.9	-17.5
NI	70	46	14.3	-5.4
EU26	3	113	1.1	-1.4
IRL	18	98	4.8	-9.6

Table 13 reports the same statistics on count and average changes for exports. Under both scenarios, the EU26 and GB see negative changes in exports for all sectors. In terms of average percentage changes, under the No Deal (B) scenario changes for both GB and the EU26 increase approximately by a factor of 1.5. For Ireland Republic few sectors see an increase in exports (similarly across the two scenarios), while Norther Ireland see a positive change in most of the sector, in line with the aggregate results.

Table 13: Disaggregated sectoral results, export changes

	Count		Average change, %	
	positive	negative	positive	negative
Deal				
GB	0	116		-18.2
NI	48	68	8.5	-4.2
EU26	0	116		-2.6
IRL	11	105	2.7	-6.6
No Deal (B)				
GB	0	116		-26
NI	63	53	11.3	-5.9
EU26	0	116		-4.1
IRL	8	108	3.3	-10.6

Table 14 reports on the top and bottom 10 sectors for Northern Ireland under the No Deal (B) ranked in terms of output changes with intermediate inputs. The table shows the percentage changes in prices, output, exports and imports. Three services sectors are among the bottom 10 sectors in terms of output, with Architectural & engineering and Motion picture falling by 12.7% and 14.7%, respectively, followed by Computer services (-10.4%).[6]

Table 14: Top & bottom 10 sectors for NI (No Deal) with intermediates, output changes

ISICr4	ISICr4 description	Percentage changes			
Bottom 10		Prices	Output	Exports	Imports
2391	Man. of refractory products	4.0	-16.7	-15.1	0.2
1394	Man. of cordage, rope etc.	4.2	-16.5	-15.2	0.6
2732-2733	Man. of other electronics	5.0	-15.8	-15.1	1.3
2740	Man. of electric lighting eq.	5.1	-14.9	-14.1	0.6
J59_J60	Motion picture and sound recording	2.3	-14.7	-17.7	1.1
1511	Tanning & dressing of leather & fur	2.7	-14.3	-12.3	0.2

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[6] Appendix 4 reports the bottom 10 sectors excluding services.

			Prices	Output	Exports	Imports
	M71	Architectural and engineering	1.6	-12.7	-13.8	0.3
	1311	Prep. and spinning of textile fibres	4.4	-11.2	-10.3	-0.2
	J62_J63	Computer programming	1.8	-10.4	-10.8	-0.4
	2811	Man. of engines and turbines	3.6	-7.1	-5.0	0.0

Top 10

	2011	Man. of basic chemicals	5.0	33.7	21.6	-13.8
	2013	Man. of plastics and synthetic rubber	4.5	34.7	32.0	-34.0
	2392	Man. of clay building materials	4.9	34.9	21.3	-4.7
	1072-1073	Man. of sugar, cocoa, etc	14.6	37.7	34.4	-0.1
	2420	Man. of basic precious & other metals	6.4	38.7	18.6	-10.4
	2399	Man. of non-metallic minerals n.e.c.	4.7	39.2	18.5	-6.6
	1061-1062	Man. of grain mill products	21.0	44.2	36.1	-12.8
	1030	Processing and pres. of fruit & vegs	9.1	49.8	42.4	-10.3
	1910-1920	Man. of coke oven & refined petroleum	6.9	63.4	22.9	-15.7
	1074-1079	Man. of macaroni, noodles, etc.	8.2	74.7	62.8	-16.6

On the other hand, food processing industries occupy four of the top 10 positions. The rest of the top 10 is composed of manufacturing sectors in the chemicals industry (ISIC 20), manufacture of mineral products (ISIC 23), non-ferrous metals (ISIC 24) and coke and petroleum products (ISIC 19).

Table 15 reports the top and bottom 10 industries by output changes under the Deal scenario. In this case we report results both with and without intermediate inputs. Sectors are ranked by the change in output under the Deal scenario without intermediate inputs. The sectors in the top/bottom for the Deal scenario are almost the same to those under the No Deal (B) scenario. The most negatively affected sectors are services, reflecting the lack of coverage for services in the UK-EU agreement, while the top ten is occupied by four food-processing industries and other manufacturing industries.

Table 15: Top and bottom 10 sectors for NI under Deal, output changes

ISICr4	ISICr4 description	Without Intermediates				With Intermediates			
Bottom 10		Prices	Output	Exports	Imports	Prices	Output	Exports	Imports
M71	Architectural and engineering	0.7	-8.9	-9.1	0.3	1.1	-8.9	-9.2	0.2
J59_J60	Motion picture and sound recording	0.7	-8.4	-10.3	0.4	1.5	-10.2	-12.0	0.8
J62_J63	Computer programming	0.7	-7.4	-7.3	0.2	1.2	-7.4	-7.2	-0.1
1394	Man. of cordage, rope etc.	3.3	-6.5	-6.9	0.4	3.7	-14.1	-13.3	0.5
3092-3099	Man. of bicycles & other transport	11.7	-4.9	-2.0	2.7	12.3	-7.0	-3.5	2.9
1511	Tanning & dressing of leather & fur	2.0	-4.5	-4.4	0.1	2.2	-12.0	-10.7	0.2
2732-2733	Man. of other electronics	3.8	-4.4	-5.5	1.0	4.5	-14.1	-13.7	1.1
2740	Man. of electric lighting eq.	3.7	-4.1	-5.0	0.5	4.4	-14.3	-13.6	0.5
M69_M70	Legal and accounting	1.1	-3.7	-8.9	-1.4	1.5	-3.6	-8.6	-1.7
2740	Man. of electric lighting eq.	2.8	-3.4	-3.9	0.1	3.4	-13.6	-12.5	0.2

Top 10

1030	Processing & pres. of fruit and vegs	5.4	29.7	23.4	-6.7	6.2	19.9	16.2	-5.5
1072-1073	Man. of sugar, cocoa, etc	11.2	30.0	19.5	-0.2	12.0	26.4	17.5	-0.1
2011	Man. of basic chemicals	3.2	32.0	16.0	-12.8	4.4	28.8	13.0	-12.4
1061-1062	Man. of grain mill products	16.0	32.0	19.5	-10.4	17.0	28.3	17.4	-10.1

ISIC4Code	ISIC4Name	Prices	Output	Exports	Imports	Prices	Output	Exports	Imports
2420	Man. of basic precious & other metals	4.2	35.5	18.8	-8.9	5.5	34.0	14.6	-9.2
1812	Printing services	2.8	35.7	16.6	-16.4	3.8	31.7	10.8	-15.3
2399	Man. of non-metallic minerals n.e.c.	3.1	41.6	22.7	-6.6	4.0	37.7	18.1	-6.2
2392	Man. of clay building materials	3.8	44.8	26.6	-5.7	4.5	37.0	19.7	-5.0
1910-1920	Man. of coke oven & refined petroleum	4.8	54.1	22.3	-13.0	5.8	56.8	20.6	-13.9
1074-1079	Man. of macaroni, noodles, etc.	4.9	57.1	46.4	-12.3	6.2	47.9	38.5	-11.4

Table 16 reports on the results for the two experiments No Deal (B) and Deal for the top 10 industries in terms of their base production value in Northern Ireland.[7] Hence these are the industries with the largest shares in output for NI.

The table reports results for experiments with and without intermediates. The largest sector is ISIC construction (ISIC section F), which sees a decrease in output by 0.4% under No Deal (B), and a reduction in output by -0.1% in the Deal scenario. Agriculture (section A) sees an increase in output by around 9% under No Deal (B), and similarly under the Deal scenario. This result appears to be driven mainly by the sharp reduction in imports under the No Deal (B) scenario as tariffs on agricultural products, which would apply to NI imports from GB, are high. A similar rationale applies to 'Processing and preserving of meat' and the 'Man. of prepared animal feeds' sectors, where tariffs are generally high. Both Financial and Administrative and support services see a reduction both under the No Deal (B) and the Deal (liberal) scenarios. While trade of Financial services is modestly affected, exports of Administrative and support services see a much stronger reduction in both scenarios.

Table 16 : Top 10 sectors by base production value, Northern Ireland

ISIC4Code	ISIC4Name	Without Intermediates				With Intermediates				share
No Deal (B)		Prices	Output	Exports	Imports	Prices	Output	Exports	Imports	
F	Construction	0.5	-0.4	-0.1	-0.5	0.7	-0.4	0.4	-1.2	14.6
1010	Processing and pres. of meat	5.5	0.1	2.0	-3.7	11.7	9.0	10.3	-9.4	5.8
A	Crop and animal prod., hunting	2.3	9.4	-0.1	-27.1	3.0	9.3	1.3	-28.0	4.7
2100	Man. of pharmaceuticals	1.7	1.1	1.3	-9.3	2.1	1.2	2.1	-9.7	4.1
N	Admin & support service	1.7	-2.6	-11.8	-1.6	2.9	-3.9	-18.3	-2.4	4.0
1080	Man. of prepared animal feeds	2.3	5.9	2.3	-48.9	2.8	7.9	9.6	-52.5	3.2
H49	Land transport	1.0	0.1	0.0	-7.1	1.6	0.1	0.1	-11.5	3.2
K	Financial and Insurance	1.2	-2.0	-1.5	-0.5	2.0	-3.2	-2.5	-0.9	3.1
2824	Man. of machinery for mining	3.0	-0.7	-0.2	-5.8	3.6	-0.9	0.0	-6.1	3.1
1050	Man. of dairy products	3.7	7.5	-1.3	-27.5	5.0	14.8	5.0	-40.0	2.9
Deal										
F	Construction	0.0	-0.1	-0.2	-0.4	0.5	-0.4	-0.1	-0.5	14.6
1010	Processing and pres. of meat	4.5	2.8	3.5	-4.0	5.5	0.1	2.0	-3.7	5.8
A	Crop and animal prod., hunting	1.0	12.4	5.1	-30.2	2.3	9.4	-0.1	-27.1	4.7
2100	Man. of pharmaceuticals	0.9	2.2	2.6	-9.6	1.7	1.1	1.3	-9.3	4.1
N	Admin & support service	0.9	-1.9	-11.3	-1.5	1.7	-2.6	-11.8	-1.6	4.0
1080	Man. of prepared animal feeds	1.0	8.5	5.9	-50.3	2.3	5.9	2.3	-48.9	3.2
H49	Land transport	0.4	0.7	0.2	-7.5	1.0	0.1	0.0	-7.1	3.2
K	Financial and Insurance	0.5	-1.3	-1.2	-0.6	1.2	-2.0	-1.5	-0.5	3.1
2824	Man. of machinery for mining	1.8	1.9	2.0	-6.7	3.0	-0.7	-0.2	-5.8	3.1

[7] See Appendix 4 for tables on manufacturing only activities.

| 1050 | Man. of dairy products | | 2.3 | 12.4 | 4.4 | -29.0 | 3.7 | 7.5 | -1.3 | -27.5 | 2.9 |

4. Conclusions

This report has provided a preliminary assessment of the impact on Northern Ireland arising from the UK's exit from the EU, the Trade and Cooperation Agreement, and the Northern Ireland Protocol.

Overall, the modelling and the results highlight the complexity of the impact of Brexit on Northern Ireland. The complexity arises from the changes in trade costs not just between NI and its trading partners, but also between the UK, Ireland and the rest of the EU. Given the close economic relationship between NI and GB any increase in trade barriers has potentially significant impacts.

Brexit will have differential effects across society in NI. Some industries, and firms within those industries, and consequently workers in those industries may benefit from the increase in import barriers (GB to NI). This will depend on the extent to which they can expand production and sales and replace GB suppliers. It will also depend on the extent to which higher barriers to trade between GB and the EU offer more export opportunities for NI firms. Others sectors, firms within those sectors, and workers in those firms, will see negative effects because of the impact on their costs and sales and ultimately production. Consumers in general will lose out from the increases in prices.

And finally a caveat. The simulations in this report are not forecasts or predictions. They are simulations which help to identify the direction of possible changes, the relative orders of magnitude of those changes, and the mechanisms driving those changes.

Appendix 1: Modelling demand for and supply of differentiated products

The three models used in the projections in this paper use variants of a two-stage Dixit-Stiglitz constant elasticity of substitution demand system for differentiated products. As is noted in the paper, the model is a partial equilibrium model in which each of the sectors is treated as independent of the others.

Overall demand for the sector's product in a particular national market is represented by the output index X, which is assumed to be a constant elasticity of substitution (CES) function of the sales of different varieties of the product, x_i:

$$X = (\sum_{i=1}^{n} a_i^{\frac{1}{\sigma}} x_i^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$$

(1)

where the individual x_i represent the quantities of the different varieties of the good, the a_i are parameters which sum to 1, and X is the quantity index that aggregates the different varieties.

If variety i is sold at price p_i, it can be shown that the demand functions for individual varieties are given by

$$\frac{x_i}{X} = a_i (\frac{p_i}{P})^{-\sigma}$$

(2)

where P is the price index for the product given by the CES function

$$P = (\sum_{i=1}^{n} a_i p_i^{1-\sigma})^{\frac{1}{1-\sigma}}$$

(3)

which measures the aggregate cost of the goods which constitute X, so the value of total spending in this market is

$$\sum_{i=1}^{n} p_i x_i = PX$$

(4)

If it is assumed that overall demand X is a constant elasticity function of the price index P with elasticity $-\mu$, then the own-price and cross-price elasticities of demand can be derived from (2) and (3) as

$$\epsilon_{ii} = -\sigma + (\sigma - \eta)s_i$$

(5)

$$\epsilon_{ji} = (\sigma - \eta)s_i$$

(6)

where $s_i = p_i x_i / PX$ is the share of variety i in sales of the product in this market, noting that, because cross-price effects enter only through the price index, the cross-price elasticity depends on the market share of the variety whose price is changing, not on the characteristics of the product whose demand is changing as a result.

B.1. The Armington model

In the first model using this structure, we suppose that goods are differentiated only by country of origin and are sold in perfectly competitive markets. With four countries in our model there are four varieties of the product sold in each of the four national markets. Price is equal to marginal cost, and we assume that there are decreasing returns on a market-by-market basis: marginal cost in each market rises with sales in that market but is unaffected by sales in other markets. The decreasing returns are at a mild rate: the assumed elasticity of supply is high. In each country market, (5) relates the elasticity of demand for imports from each country source (and for the home-produced variety) to the underlying elasticities and to market shares. It is easily seen that the same equation gives the overall elasticity of import demand, i.e. the response to an equiproportionate increase in all import prices is given by (5) where the share is the market share of all imports.

B.2.   Imperfect competition

In this version of the model, products are differentiated by producing firm, so firms have some market power. Now (5) determines the elasticity which enters firms' pricing decisions. However, the relationship needs careful interpretation. Even though we are working with a somewhat disaggregated classification of manufactures, from the perspective of competition between product varieties the classification is too aggregate: a typical sector should be thought of as consisting of several sub-sectors each of which produces a distinct set of product varieties.

Applying the partial equilibrium approach at the sub-sector level, the market share relevant to the firm's elasticity of demand is the firm's market share in the relevant sub-sector. If the sub-sectors are symmetric, then s_i, the share of firms from country i will be the same for each subsector, but from the perspective of the individual firm, the it is its market share in the subsector that is relevant to its pricing decision, so in (5) s_i is replaced by s_i/n_i, where n_i is the number of (equal-sized) firms operating in the subsector.

(i)   In one version of the imperfect competition model, we assume that firms have constant marginal cost, so the only source of economies of scale comes from the spreading of fixed cost over a larger output.

(ii)   In the second version, the one used to generate the main results in the paper, we assume that firms' marginal cost decreases with output, so there is a second source of scale economies. This gives rise to a multi-market linkage: if a firm expands its sales in one market, its marginal cost falls and therefore in all other markets its price falls and its sales expand.

Appendix 2: Northern Ireland Partial Equilibrium Dataset

Summary of dataset:

Country coverage:
- Great Britain (GB)
- Northern Ireland (NI)
- Republic of Ireland (IRL)
- EU26
- USA
- China (CHN)
- Australia (AUS)
- New Zealand (NZL)
- Continuity countries (FTA)
- Non-continuity countries (Noncont)
- Rest of World (ROW)

Year: 2018 (or as recent as possible)

Sectors:
- 1 agricultural sector
- 102 manufacturing sectors
- 13 services sectors

Producing the NI PE dataset

The dataset for the Northern Ireland Partial Equilibrium model has been generated in two stages. First, a 'main' dataset has been put together covering all regions in the dataset but without separating the UK into GB and NI. Second, data on the Northern Irish economy has been incorporated in order to generate individual NI and GB regions. This note first outlines how the 'main' dataset was generated, and then how the NI and GB components were produced.

Producing the main dataset

The main dataset contains 6 individual countries: UK, Ireland, USA, China, Australia and New Zealand. In addition it contains four regional groups: EU26, 'FTA', 'Non-continuity', and the Rest of World ('ROW'). The 'FTA' group contains the group of countries with trade agreements in place with the EU and which have agreed continuity agreements with the UK. The "non-continuity" group is the group of countries with trade agreements in place with the EU but which have not agreed continuity agreements with the UK. The exact list of countries included in each of these groups is listed at the end of this document.

The dataset covers three areas: agriculture, manufacturing and services. To put together the dataset detailed information is needed on each country's trade with the other partners in the dataset, and the value of domestic consumption of domestic production (DCDP). Each of the three components (agriculture, manufacturing, services) have been put together using different data and slightly different methodologies which are discussed in turn below.

Goods sectors: Trade data

Trade data for both manufacturing and agriculture comes from UN COMTRADE, for year 2018

downloaded at the HS 6-digit level (HS2012) from WITS. At the time of producing the dataset, 2018 was the most recent year for which data was available for all reporters in the dataset. The data was converted into 4-digit sectors of the ISIC rev. 4 nomenclature using use the OECD Bilateral Trade in Goods by Industry and End-use conversion key. As one way of dealing with missing observations and to correct for bilateral asymmetries in trade data we use an average of imports and mirror export flows.

Goods sectors: Production data

Production data for manufacturing has been collected from two different sources, both reporting output at the 4-digit level of ISIC rev. 4. For OECD countries the primary source is the OECD Structural and Demographic Business Statistics (SDBS) Database. The OECD SDBS gross output data is reported in national currency units, and we convert this into US dollars using the period-average bilateral exchange rates from the OECD. Where OECD production data does not exist, we use output data from the UNIDO INDSTAT4 database (2019 release), reported in US dollars. At the time of collecting the data, the most recent year available in OECD's SDBS database is 2017, whereas UNIDO's 2019 dataset reports up until 2016.

Since our trade data is for 2018, we gross up the most recent production data available for each country (i) and sector (x) by the growth in the respective country's exports in that sector (assuming a constant production-to-export ratio):

$$Production_{i,x,t} = Production_{i,x,t-1} * \frac{Total\ exports_{i,x,t}}{Total\ exports_{i,x,t-1}}$$

For agriculture, we rely on production data from the Food and Agriculture Organization of the United Nations (FAO). We collect data on production quantities and export quantities for all countries in the world, between 2008 and 2016, where the most recent year for which data is available is used to calculate the export intensity ratio, which is then applied to the trade data from UN COMTRADE. Similar to manufacturing, where 2016 data is not available we gross up data for the most recent year using the growth in the country's exports (if production data is missing) or production (if export data is missing).

Domestic Consumption of Domestic Production

The model requires information on the size of domestic consumption of domestic production (DCDP). As a first stage this is obtained by taking total domestic production minus total exports. However, due to inconsistencies in how production data and trade data are generated, this calculation sometimes generates negative values. In these cases, we derive domestic absorption using input-output tables (IOTs). From the IOTs we calculate the share of production that is consumed in the domestic market and the share that is exported, and apply the domestic share to total production for the given sector and country.

$$DCDP_{i,x,t} = Output_{i,x,t} * Domestic\ share\ (IOT)_{i,x,t}$$

For the majority of countries in the dataset we use the World Input-Output Database (WIOD) 2016 release, with the exception of the UK where we use ONS input-output table for 2015, and New Zealand (which is not covered in WIOD) where we instead use the OECD Inter-Country Input-Output (ICIO) Tables, 2018 edition.

Further, unfortunately we do not observe production data for all countries for each of the 122 manufacturing sectors included in the dataset. Table 1 lists the number of sectors (out of 122) that are missing production data for each reporter (note that in the final dataset EU countries are aggregated into one reporter 'EU26'). As can be seen, while UK, China and USA have good coverage across the 122 sectors, production data for Ireland, Australia and New Zealand is missing for 26, 49 and 64 sectors respectively. In addition, coverage at the EU level varies considerably. Some small Member States such as Luxembourg, Malta and Cyprus have poor coverage, as do some larger Member States such as the Netherlands. In contrast, other large Member States such as Germany, France Italy and Spain have very good coverage.

To achieve a consistent dataset over the 122 sectors for all reporters we interpolate production for each country (i) and sector (x) where this is missing. To do this, we once again use IOTs to estimate the share

of production that is consumed domestically and the share that is exported, and apply this to the country's total exports. This serves an approximation given that the IOTs are only available at a more aggregated level than the rest of the data.

$$Production_{i,x} = \frac{total\ exports_{i,x}}{Export\ share_{IOT,i,x}}$$

Further, we do not have production data for all the countries included in the large country groups in our dataset (ROW, "FTA" and "non-continuity"). For this reason we entirely rely on interpolating production using shares from input-output tables for these groups.

Table A2.1: Number of manufacturing sectors missing output data (out of 122)

Country	Number of missing sectors
UK	2
USA	5
China	2
Ireland	26
Australia	49
New Zealand	64
Austria	11
Belgium	5
Bulgaria	9
Croatia	8
Cyprus	57
Czech Republic	15
Denmark	29
Estonia	19
Finland	8
France	1
Germany	7
Greece	1
Hungary	1
Italy	0
Latvia	28
Lithuania	15
Luxembourg	102
Malta	94
Netherlands	65
Poland	4
Portugal	6
Romania	1
Slovak Republic	12
Slovenia	10
Spain	0
Sweden	17

Services: Trade & Production

The data for the services sectors of the dataset comes from WIOD for every country except for New Zealand, the 'FTA' and the 'Non-continuity' groups. For these reporters, data from the OECD ICIO tables have been used. The reason for this is that New Zealand is not included in WIOD, and the country coverage for the 'FTA' and 'Non-continuity' groups is better in the OECD ICIO than in WIOD, particularly for the

Non-continuity group where WIOD only includes 3 countries (Norway, Switzerland and Korea) whereas the OECD ICIO covers 11 countries (Chile, Colombia, Costa Rica, Iceland, Israel, Morocco, Norway, Peru, South Africa, Switzerland, Tunisia and Korea).

Both OECD ICIO and WIOD are available at the ISIC rev.4 nomenclature, but OECD data is more aggregated than WIOD. To disaggregate the New Zealand data in OECD ICIO into the more detailed WIOD sectors, we have used the distribution of Australia's trade across the WIOD sectors and assumed that the same distribution apply also to New Zealand's trade. To disaggregate the 'FTA' and 'Non-continuity' groups from the OECD ICIO structure to the WIOD structure we have used the distribution of these groups' trade in WIOD and applied this to the data in the OECD ICIO.

From the Input-Output tables we can estimate directly the value of Domestic Consumption of Domestic Production (DCDP) for each country and sector.

Producing the dataset incorporating GB and NI

Manufacturing
To incorporate Northern Ireland into the dataset we need information on NI's imports and exports with each of the partners in the dataset, as well as NI's DCDP. Unfortunately, and as will be discussed in more detail below, there is no single dataset that is perfect for our purposes. For this reason two different methods have been used to produce the manufacturing dataset, the "BESES" method and the "SUT" method.

BESES method
This method relies predominantly on data from BESES. The BESES is an annual measure of local businesses' sales and purchases within and outside Northern Ireland. The dataset covers internal sales and purchases (i.e. sales by NI firms to NI, and purchases by NI firms from NI), as well as NI's sales and purchases with GB, IRL, EU26 and certain non-EU partners. From NISRA we have been given access to this data at the SIC 4-digit level of aggregation, which is closely related to ISIC 4-digit and therefore straight forward to convert. This level of sectoral detail is a big benefit of the BESES dataset. There are, however, also some drawbacks:

1. Data does not exist for all non-EU countries individually. The sales data reports data separately for some non-EU countries, e.g. USA and China, but smaller non-EU countries have been combined into regional groups. The purchases data does not separate between any non-EU countries but instead just includes one "ROW" partner. This means that we have to rely on a different source in order to disaggregate the data into ROW partners.

2. The data in BESES is on an industry basis rather than a product basis. This means that the values reported for each SIC 4-digit sector are the purchases made by firms within that industry and the sales by firms within that industry. There is no guarantee that the products that these firms buy and sell also belong in that same industry. For example, firms in the aircraft industry may not buy very many actual aircrafts, but instead their purchases may predominantly be products from other industries going into producing aircrafts (e.g. engines, seats, tyres etc.) This is in contrast to the trade data used for all other countries in the dataset (UN Comtrade) which is defined on a product basis, e.g. purchases in the aircraft sector are purchases of actual aircraft.

3. The sales data in BESES captures total sales by NI firms, irrespective of whether these sales are to other NI businesses or directly to end consumers. However, the purchases data in BESES only captures purchases made by NI businesses, it does not capture purchases made by end consumers.

The issues in (2) and (3) cause inconsistencies with the trade data used for all other countries in the dataset. These issues are likely to be particularly problematic for the purchases/imports data. The sales data in BESES is likely to be more closely related to the actual products being sold (e.g. the sales of the aircraft manufacturing industry are likely to be predominantly aircraft). For this reason, the BESES sales data and

the trade data from UN Comtrade are likely to be relatively aligned. However, this is less certain for the purchases data. Take, for example, ISIC sector 1102 (manufacture of wines). Under this industry, BESES records any purchases made by firms within the wine manufacturing industry in Northern Ireland. However, if there is no, or very little, Northern Irish wine production, then very few purchases would be recorded within this industry. In contrast, the trade data for this sector records imports of wine. Clearly, Northern Ireland will be purchasing (importing) wine even if its own production is very limited, but this would not be captured under the wine manufacturing industry in BESES, leading to a potentially significant discrepancy between the purchases/import data in BESES and the other trade data in the dataset. For this reason, we also use a different method, the "SUT" method explained below to put together an alternative dataset which we believe is more consistent with the trade data.

To address (1) we use data from HMRC's Overseas Trade Statistics (OTS) dataset. This gives data by UK port of entry and exit, meaning that one can get data on the trade that has come in through or has left from a Northern Irish port. There are five Northern Irish ports in the HMRC OTS data: Belfast Harbour, Belfast Airport, Belfast City Airport, Londonderry and Warrenpoint. The OTS details trade with each non-EU partner at the CN 8-digit level, which has been converted into ISIC 4-digit sectors to calculate the shares of Northern Ireland's exports and imports that each of the non-EU partners (USA, CHN, AUS, NZL, FTA, Noncont, ROW) account for in each ISIC sector. These shares are then applied to the total value for ROW in the relevant ISIC 4-dig industry in BESES in order to obtain BESES data for each ROW partner. Here again there is an issue of consistency given that the HMRC dataset is on a product basis but BESES is on an industry basis. However, the HMRC OTS is the only data source which is available at a detailed enough level to make these calculations.

A final point to note is that BESES separates between each industry's sales/purchases of goods and of services. As such, a manufacturing industry often has both goods transactions and services transactions. To match the Comtrade data as closely as possible, only the goods transactions have been included from BESES.

SUT method

The alternative method relies on data from the Northern Irish Supply and Use Tables. The SUTs cover 62 different sectors, defined at the UK SIC 2-digit level (although some sectors combine several SIC 2-dig sectors). The SUTs detail Northern Irish internal sales and purchases, as well as Northern Ireland's sales and purchases with GB, IRL and ROW. Unlike BESES it does not separate between EU26 and ROW.

The SUTs are on a product-by-industry basis. This is a key advantage over the BESES data because it means the data in the SUTs is more consistent with the Comtrade data used for all other partners in the dataset. Further, the SUT data captures both intermediate sales and purchases (i.e. sales and purchases between businesses) and also sales and purchases to final end consumers. For purchases the coverage is therefore better in the SUT than it is in BESES.

A major limitation to the SUT data is its sectoral disaggregation, it is only available at a much more aggregated level than BESES. This poses a problem given the sectoral detail needed for the PE model. Another downside to the SUT data is that the latest year available is 2016 whereas we use 2018 data for all other countries in the dataset.

Table 1 has a short extract of the 2016 NI supply table. This gives total domestic supply by all NI industries of each product (column (A)) in basic prices. It also gives Northern Ireland's imports of each product. Once trading margins and taxes have been added, column (H) gives total supply at purchases prices. Deducting total imports from total supply gives an estimate of total NI output of each product at purchases prices.

Table A2.2: NI Supply table (extract)

Product	Description	Domestic Supply (A)	Imports IE (B)	Imports GB (C)	Imports ROW	Imports TOT (E)	Distributors' Trading Margin	Taxes (less subsidies)	Total Supply	Total NI output (calcul

					(D)		**s (F)**	**on produ cts (G)**	**(H)**	*ated from (H)- (E)) (I)*
10	Food products	3 678	685	1 306	502	2493	1 423	209	7803	*5310*
11-12	Beverages, tobacco products	776	129	395	148	671	779	976	3202	*2531*
13	Textiles	262	18	58	120	196	281	45	784	*588*
14-15	Wearing apparel, leather products	142	113	233	386	732	834	194	1903	*1171*

The Use table (see extract below) is all in purchases prices and gives the use of each product by NI industries, as well as the use by final NI demand (i.e. purchases made by final consumers or government bodies etc.) and the exports of each product. It does not separate the use between NI produced goods or imports, meaning that part of the demand is filled by imports. From this table we get estimates of total exports to IE, GB and ROW of each product. This exports data incorporates the use of some imports. We have not adjusted the exports for the use of imports, since the data from UN Comtrade used for all other countries in the dataset is not adjusted for the use of imports. This approach ensures consistency with all other countries in the dataset.

Table A2.3: NI Use table (extract)

Product	Description	Total Intermediate Use	Total final use	Exports IE	External GB	Exports ROW	Total Exports	Total Use
10	Food products	1869	2415	638	2,438	443	3519	7803
11-Dec	Beverages and tobacco products	212	1485	136	831	538	1505	3202
13	Textiles	283	287	32	89	92	213	784
14-15	Wearing apparel and leather products	183	1479	55	143	42	241	1903

From the SUT we thus get estimates for Northern Ireland's imports, and total output (from Supply table) and NI's exports (from Use table). From this we can estimate NI's DCDP, by calculating, for each sector (x) and country (i):

$$NI\ DCDP_{i,x} = Total\ Output\ (Supply\ table)_{i,x} - Total\ Exports\ (Use\ table)_{i,x}$$

Because exports sometimes use imports in their production, there are 3 occasions (sectors 28, 63 and 46) where this calculation generates negative DCDP values. To correct this, we use the Northern Ireland Input-Output Table to calculate, for each industry, the share of output that is consumed domestically and the share that is exported. We apply the domestic share to the value of total output (from the Supply table). This mirrors the approach taken for all other countries in the dataset.

$$NI\ DCDP\ (corrected)_{i,x} = Total\ Output\ (supply\ table)_{i,x} * Domestic\ shr\ (IOT)_{i,x}$$

The next step is to disaggregate the SUT data into ISIC 4-digit sectors. For sales/exports, where we believe the BESES data is relatively consistent with the trade data, we use data from BESES to calculate, for each ISIC 4-digit sector, its share in the wider ISIC2 (equivalent to SIC 2) sector by partner (NI, GB, IRL, ROW). These shares are then used to disaggregate the SUT data into ISIC4-digit sectors. BESES data is further used to disaggregate the exports data between the EU26 and ROW (since the SUT does not make this distinction). The data from BESES is also used to calculate the growth in sales and exports from 2016 to 2018 for each industry and partner country, which is then applied to the SUT data in order to obtain estimated export values for 2018. This last step addresses any potential changes in the data over the years, for example as a result of large businesses ceasing operation between 2016 and 2018. The final step is to

disaggregate the ROW partner into individual countries (e.g. USA, China, Australia, "FTA" group etc.). For this, we use HMRC OTS data as detailed in the "BESES method" above.

For purchases and imports data we do not believe it is appropriate to use BESES, for reasons of inconsistency with the trade data as discussed above. However, there is no obvious alternative source. We explored the potential to use HMRC data to disaggregate the SUT imports data, but for the reasons outlined below they were not found to be a workable alternatives:

1. HMRC OTS data: This data is available at sufficient detail, however it only covers NI trade with non-EU countries. This means that we cannot use this data to disaggregate NI's trade with Ireland or EU26.

2. HMRC Regional Trade Statistics: This is an alternative HMRC trade dataset which reports NI's trade with all countries in the world, including Ireland and the rest of the EU. This data is, however, only reported at the 2-digit level of the SITC nomenclature. This is considerably more aggregated than the ISIC rev. 4, and for this reason we cannot use the HMRC RTS as a reliable source to disaggregate the SUT into ISIC rev. 4 sectors.

In the end, we concluded that the best alternative was to use UK's trade as reported in Comtrade as a proxy for NI's imports. We use UK's imports from Ireland, EU26 and ROW as a proxy for NI's imports from these partners. Further, we use UK's exports to Ireland as a proxy for Northern Ireland's imports from GB. As a first step, we used this data to disaggregate the SUT imports data from ISIC 2-dig sectors into ISIC 4-digit sectors, using the distribution of UK's trade across the detailed 4-dig sectors as a proxy for NI's distribution. We also used the distribution of UK's trade across EU26 and ROW as a proxy for the distribution of NI's trade across these regions in order to separate the ROW partner in the SUT into EU26 and ROW. Further, we generated 2018 import values by applying the growth rate of UK imports between 2016 to 2018 to NI's imports in 2016. Finally, we disaggregated the ROW partner into individual countries using HMRC OTS data (same approach as for the sales/exports data)

Incorporating Great Britain

The final step in constructing the manufacturing dataset is to generate a GB reporter and partner. This is done by deducting the trade values for Northern Ireland from the UK total in the original dataset. For example, GB's imports of sector (x) from country (i) is equal to UK's imports from country (i) of sector(x) minus NI's imports from country (i) of sector (x).

GB domestic consumption of domestic production is then calculated as follows:

$$DCDP_{GB,x} = DCDP_{UK,x} - (Imp_{NI,GB,x} + Exp_{NI,GB,x} + DCDP_{NI,x})$$

In other words, UK DCDP is made up of four components: GB DCDP of sector x, NI DCDP of sector x, NI imports from GB and NI exports to GB of the sector. Subtracting the latter three from total UK DCDP gives GB DCDCP.

Due to the inconsistencies in the data discussed earlier, these calculations sometimes yield negative results for GB. In the BESES method, this affects 9 observations (out of a total of 1342 observations). In the SUT method this affects 24 observations in total. The reason why there are more negative observations using the SUT method is because the values in the SUT data are larger on the whole, given that they capture both intermediate and final goods consumption which BESES does not. To correct for these negative values we use data from the HMRC RTS database.

This database gives information on Northern Ireland and GB's trade with all external (non-UK) partner countries. This makes it preferable to the HMRS OTS dataset which only has information on trade with non-EU countries. However, the downside to the RTS is that it is only available at the SITC 2-dig level which is more aggregated than the ISIC 4-dig level. Nevertheless, this has been converted into ISIC 4-digit sectors by first converting from SITC to CPC rev.2, and from CPC rev.2 to ISIC rev.4. Given that the SITC 2dig is less detailed than the ISIC rev4 this conversion is not precise and requires a large amount of

apportioning across industries, but in the end it does give a rough estimate of NI and GB's exports and imports by ISIC sector. This enables us to calculate the share of total UK trade, with each partner country and by ISIC sector, that is accounted for by NI and GB respectively.

The example below illustrates how this data is used to correct for the negative values. In the original calculation a negative value has been generated for Ireland' imports from GB, because Ireland's imports from NI>Irelands imports from the UK. From the RTS we have calculated the share of UK's exports to Ireland in this sector that comes from GB (60%) and NI (40%) respectively. These shares are then applied to Ireland's total imports from the UK.

$$IRL\ imp_{GB,sector\ X} = IRL\ imp_{UK,sector\ X} * GB\ expshr_{IRL,sector\ X}$$
$$IRL\ imp_{NI,sector\ X} = IRL\ imp_{UK,sector\ X} * NI\ expshr_{IRL,sector\ X}$$

Table A2.4: Correcting for negative values

ISIC4	Reporter	Original data			Corrected data			Export shares	
		Imp from UK	Imp from GB	Imp from NI	Imp from UK	Imp from GB	Imp from NI	*GB exp shr*	*NI exp shr*
XXXX	IRL	50	-25	75	50	30.0	20.0	*60%*	*40%*

These calculations correct the majority of negative values. However, they cannot correct negative values for GB DCDP. This happens where NI DCDP is relatively large, or where NI's imports from GB or exports to GB are sufficiently large so that the calculations for GB DCDP become negative. There is one such case in the BESES data, and 11 cases in the SUT data. Where the calculations for GB DCDP generate a negative value, we have corrected this by setting GB DCDP equal to UK DCDP. We believe this is justified given that for each of these sectors, NI output represents only a small share of total UK output, as can be seen in the table below which gives, for each affected sector, the share of NI's output in total UK output (calculated from the NI IOT and the UK IOT (ONS)).

Table A2.5: Sectors with negative GB DCDP

ISIC4	SIC sector (NI IOT)	NI output/UK output
1410	14-15	2.1%
1430	14-15	2.1%
1512	14-15	2.1%
1520	14-15	2.1%
2029	19-20	0.9%
2420	24	0.6%
2652	26	3.4%
2710	27	6.4%
3092	30	4.5%
3220	32	1.6%
3230	32	1.6%

Agricultural trade

For agriculture only one method is used, the SUT method, because BESES does not cover agriculture. The NI SUT only includes one agricultural sector, which is why the final dataset only has one sector for agriculture.

The ROW partner in the SUT data (combining EU26 and all non-EU countries) needs to be disaggregated into individual partners. Since there is no BESES data, we cannot use the same method as for manufacturing. Instead, to disaggregate the ROW partners into individual countries, shares from HMRC RTS have been used. The RTS dataset has been used here rather than the OTS because the SUT does not distinguish between EU26 and non-EU countries (both are included in the group 'ROW') and since HMRC OTS does not cover trade with the EU this cannot be used to separate the partners into individual regions.

Further, the RTS data is better suited for this analysis than in the manufacturing data because the agriculture sector is defined at a more aggregated level (2-digit level of ISIC) which means that less apportioning is needed to convert the RTS data to match the ISIC data.

Services data
The original services dataset (with the UK as a reporter) uses data from WIOD to capture services trade between the partners in the dataset. To incorporate NI's services trade, a similar approach to the above has been used – one version using the "BESES" method and another version using the "SUT" method.

BESES method
The BESES method uses services trade data directly from BESES. Only the purchases and sales of services are included, purchases and sales of goods by services industries are not included. In contrast to the manufacturing dataset, HMRC OTS data cannot be used to disaggregate trade by ROW partner, since HMRC only covers goods trade. Instead, UK's trade shares in WIOD have been used. For a given services sector, we have calculated the share of UK's total exports that went to each ROW country according to the WIOD data. These shares are then applied to NI's services trade in BESES in order to estimate the amount of exports going to each partner. The same procedure applies to imports. This assumes that the distribution of services trade with non-EU countries in NI is identical to that of the UK, which is clearly a simplification.

However, in the absence of suitable NI data it's the best approximation we can make. The one exception to this is for financial services which is not covered in BESES. To incorporate this sector, the "SUT" approach as outlined below has been used.

SUT method
The SUT method is very similar to that outlined for manufacturing above, although it is simplified by the fact that the services section of the dataset is reported at the 2-digit (and sometimes more aggregate) level of ISIC rev.4. This means that we do not have to disaggregate the SUT data into ISIC 4-digit categories as we did for manufacturing. Rather, the only disaggregation that is necessary is to split the 'ROW' partner into EU26 and each individual ROW region. To do this we use the UK's WIOD shares as described above.

Generating GB services trade
To generate GB services trade, the same approach as for manufacturing has been used whereby the values for NI's services trade have been deducted from UK's services trade in order to create GB trade flows. Similar to the manufacturing case this sometimes generates negative values. Using the BESES approach there are 4 observations (out of 154) which are negative. Using the SUT approach there are 6 observations which yield negative values. These are all corrected using data from the ONS on services exports and imports by broad industries and by NUTS1 regions, for year 2017. This dataset breaks down services trade into 11 different services categories, and separates between trade with the EU and non-EU. However, in the case of Northern Ireland the EU/non-EU values are often suppressed to avoid disclosure and instead only total values are reported.

From this dataset it is possible to calculate the share of UK services exports and services imports in each broad sector that have been generated by NI and GB respectively. These shares are then used to correct for the negative values in a similar way as was done for manufacturing. Because there are no negative GB domestic absorption rates in the services data all the negative values have been corrected using this approach.

Intermediate flows matrix
The PE model also includes intermediate inputs. To account for intermediate input costs we need information on the share of intermediates in production for each of the sectors in the dataset and also on the share of imported intermediates from each of the countries in the model. For the main dataset we use WIOD data for this whereby each of the ISIC sectors is modelled as purchasing intermediates from the 56 WIOD intermediate input sectors. The process entails matching our ISIC 4-digit sectors to the WIOD input-output industries. We then use the WIOD data to generate supplier-share coefficients. For each country and industry, these coefficients tell us the share of intermediates being bought from each industry

and country.

Further, the model includes intermediate shares which are computed as:

$$\frac{Total\ intermediate\ consumption}{Output\ basic\ prices}$$

For the main dataset this is also calculated from WIOD, apart from New Zealand where data from OECD ICIO table is used. The OECD ICIO table does not have a row called "Total intermediate consumption" as WIOD, but this is just the sum of all intermediate consumption for a given column. Similar to the services data, we use Australia's shares to disaggregate the OECD ICIO data into WIOD sectors

Incorporating NI and GB to intermediate flows matrix

The original matrix with intermediate flows is based on data from WIOD, including a UK reporter. To incorporate Northern Ireland and Great Britain, the UK reporter needs to be split by GB and NI.
There are two components to the matrix. The first is the supplier shares matrix. This breaks down the supply to each reporter and industry by supplier country, and by supplying industry within the supplying country. The table below gives an example, where supply industries are in columns and use industries in rows. From the top row it can be seen that industry 1 in GB sources 16% of its total use from itself (industry 1 in GB), 5% from industry 2 in GB, 2% from industry 1 in Northern Ireland and so on. Similarly, Industry 1 in Northern Ireland (row 4) sources 15% of its total use from industry 1 in GB, 1% from industry 2 in GB and so on. The rows all sum to 100%.

Table A2.6: Extract of supplier shares matrix

ISIC sector	Reporter Name	Share_GB1	Share_GB2	(…)	Share_NI1	Share_NI 2	(…)	Share_EU 261	Share_EU 26 2	(…)	Sum
1	GB	0.16	0.05		0.02	0.07		0.01	0.04		1
2	GB	0	0.3		0	0.02		0.07	0.01		1
(…)											
1	NI	0.15	0.01		0.2	0.04		0.1	0		1
2	NI	0	0.05		0	0.3		0.07	0.01		1
(…)											
1	EU26	0.05	0.01		0	0.01		0.3	0.05		1
2	EU26	0.07	0.02		0.01	0.05		0.1	0.25		1
(…)											

To put this data together for NI one therefore needs the following information

1. The amount supplied to Northern Ireland by NI use industry and by each supplying industry within each supplying partner.
2. The amount supplied by each industry in Northern Ireland to each partner, by each partner country's use industries

The Northern Ireland Economic Accounts contains an Input-Output table which details, for 63 supplier industries and 63 use industries, the interrelationships between supply and use industries within the Northern Ireland economy. This IOT does not, however, give the same detail for Northern Ireland's imports and exports. Instead, the IOT simply gives, by use industry, the total amount imported (from all supplier countries and all supplier industries), and by supplier industry, the total amount exported (to all countries and all external use industries). This data therefore needs to be broken down (a) by importer/exporter country and (b) by supply/use industries within each of those partners.

For (a) exports and imports data was first disaggregated into GB, IRL and ROW using shares from the Supply and Use tables. The next step is to disaggregate ROW into EU26, USA, CHN, AUS, FTA, Non-continuity etc. We cannot use shares from BESES for this since BESES does not split ROW into sufficient detail in order to separate out the relevant partner groups. One option could have been to use HMRC OTS

data however this would only apply to goods and a different method would need to be found for services.

Instead, to be consistent across all the sectors in the supplier matrix, shares from WIOD have been used. From WIOD, it is possible to estimate the shares of UK's exports that go to USA, CHN, AUS etc. and the shares of UK's imports that come from USA, CHN, AUS etc. These shares have been calculated for each of UK's supply and use industry, and then applied to Northern Ireland's supply and use industries. This approach assumes that the distribution of Northern Ireland's supply to and use from the EU26 and ROW is identical to the UK's distribution.

The next step is to disaggregate Northern Ireland's supply and use with each partner by the partner's industries. Again, shares from WIOD have been used for this, in all cases except NI-NI flows where the NI IOT has sufficient data. For example, take industry 1 in Northern Ireland. The steps above have estimated industry 1's total imports from, say, China using UK's shares in WIOD. From WIOD we also know the distribution of UK's imports from China across each Chinese supplier industry. Applying these shares to NI's imports from China means that we can disaggregate China's supply to NI industry 1 by Chinese supply industry. The same is done for all partners in the dataset. For NI-GB flows, the distribution of UK's internal flows according to WIOD has been used. Take industry 1 in Northern Ireland again. From the steps above we know this industry's total imports from GB. To disaggregate this into GB supplier industries we use the distribution of UK supply industries to UK use industry 1 according to WIOD.

Finally, to generate GB values the values for NI have been deducted from the UK total for each supply and use industry. This again generate some negative values within the calculations. In total 288 observations have negative values as a result of these calculations, out of just under 900,000 observations in total. Given the small number of affected observations, these negative values have been set to zero. Once data exists for all partners, the final supplier shares have been calculated.

The second component to the intermediate matrix is the intermediate shares. For this we can use data directly from the NI IOT as it does not require bilateral information but only needs data, by industry, on the total intermediate consumption and total output. For each industry, total intermediate consumption is obtained by summing 'Total domestic use' and 'Total Use of Imports' from the NI IOT. For some sectors (sector 'Aother', sector 19-20, sector 'E' and sector 72-73 in the NI IOT), the WIOD sectoral disaggregation is more detailed than the NI IOT. To disaggregate these sectors, we have again used UK shares from WIOD.

Other parameters

The model depends on a set of parameters, which include the elasticity of demand, the elasticity of substitution and the elasticity of supply. On the supply side, the elasticity of supply is set at 6 for domestic suppliers to domestic markets (i.e. UK suppliers to UK market, Korean suppliers to the Korean market, etc.), and set at 15 for other suppliers. There is a limited empirical evidence on the 'correct' value of these elasticities, but we believe our estimates are reasonable. The supply elasticity is higher for export markets than for the domestic one because invariably producers have a substantially larger share of their domestic market than for any individual export market.

On the demand side, we source demand elasticities from Ghodsi et al. (2016), who compute import demand elasticities for 167 countries and 5,124 commodities at the 6-digit level of the HS1996, for the period 1996-2014. We converted these to 4-digit divisions of ISIC Revision 4.

Substitution elasticities are based on whether the sector is considered homogenous or differentiated. Homogenous sectors have a substitution elasticity of 6 and differentiated sectors have a substitution elasticity of 3.

Dataset versions

There is a full dataset which covers 122 manufacturing sectors, one agricultural sector and 14 services sectors (137 sectors in total). However, for a number of sectors NI's trade is zero. There are therefore an additional datasets which creates groups combining the zero NI sectors with a non-zero sector. This ensures that there is no loss of coverage in terms of the overall economy, but we limit the number of zero-trade flow sectors for NI. The restricted version contains 102 individual manufacturing sectors, one agricultural sector and 13 services sectors. For full details of the sectoral coverage see the tables at the end of this document.

Table A2.7: Sectoral coverage in full dataset

ISIC4 Name	ISIC4
Crop and animal production, hunting and related service activities	01
Processing and preserving of meat	1010
Processing and preserving of fish, crustaceans and molluscs	1020
Processing and preserving of fruit and vegetables	1030
Manufacture of vegetable and animal oils and fats	1040
Manufacture of dairy products	1050
Manufacture of grain mill products	1061
Manufacture of starches and starch products	1062
Manufacture of bakery products	1071
Manufacture of sugar	1072
Manufacture of cocoa, chocolate and sugar confectionery	1073
Manufacture of macaroni, noodles, couscous and similar farinaceous products	1074
Manufacture of other food products n.e.c.	1079
Manufacture of prepared animal feeds	1080
Distilling, rectifying and blending of spirits	1101
Manufacture of wines	1102
Manufacture of malt liquors and malt	1103
Manufacture of soft drinks; production of mineral waters and other bottled waters	1104
Manufacture of tobacco products	1200
Preparation and spinning of textile fibres	1311
Weaving of textiles	1312
Manufacture of knitted and crocheted fabrics	1391
Manufacture of made-up textile articles, except apparel	1392
Manufacture of carpets and rugs	1393
Manufacture of cordage, rope, twine and netting	1394
Manufacture of other textiles n.e.c.	1399
Manufacture of wearing apparel, except fur apparel	1410
Manufacture of articles of fur	1420
Manufacture of knitted and crocheted apparel	1430
Tanning and dressing of leather; dressing and dyeing of fur	1511
Manufacture of luggage, handbags and the like, saddlery and harness	1512
Manufacture of footwear	1520
Sawmilling and planing of wood	1610
Manufacture of veneer sheets and wood-based panels	1621
Manufacture of builders' carpentry and joinery	1622

Manufacture of wooden containers	1623
Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	1629
Manufacture of pulp, paper and paperboard	1701
Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	1702
Manufacture of other articles of paper and paperboard	1709
Printing	1811
Service activities related to printing	1812
Reproduction of recorded media	1820
Manufacture of coke oven products	1910
Manufacture of refined petroleum products	1920
Manufacture of basic chemicals	2011
Manufacture of fertilizers and nitrogen compounds	2012
Manufacture of plastics and synthetic rubber in primary forms	2013
Manufacture of pesticides and other agrochemical products	2021
Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2022
Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	2023
Manufacture of other chemical products n.e.c.	2029
Manufacture of man-made fibres	2030
Manufacture of pharmaceuticals, medicinal chemical and botanical products	2100
Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	2211
Manufacture of other rubber products	2219
Manufacture of plastics products	2220
Manufacture of glass and glass products	2310
Manufacture of refractory products	2391
Manufacture of clay building materials	2392
Manufacture of other porcelain and ceramic products	2393
Manufacture of cement, lime and plaster	2394
Manufacture of articles of concrete, cement and plaster	2395
Cutting, shaping and finishing of stone	2396
Manufacture of other non-metallic mineral products n.e.c.	2399
Manufacture of basic iron and steel	2410
Manufacture of basic precious and other non-ferrous metals	2420
Casting of iron and steel	2431
Manufacture of structural metal products	2511
Manufacture of tanks, reservoirs and containers of metal	2512
Manufacture of steam generators, except central heating hot water boilers	2513
Manufacture of cutlery, hand tools and general hardware	2593
Manufacture of other fabricated metal products n.e.c.	2599
Manufacture of electronic components and boards	2610
Manufacture of computers and peripheral equipment	2620
Manufacture of communication equipment	2630
Manufacture of consumer electronics	2640
Manufacture of measuring, testing, navigating and control equipment	2651

Manufacture of watches and clocks	2652
Manufacture of irradiation, electromedical and electrotherapeutic equipment	2660
Manufacture of optical instruments and photographic equipment	2670
Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus	2710
Manufacture of batteries and accumulators	2720
Manufacture of fibre optic cables	2731
Manufacture of other electronic and electric wires and cables	2732
Manufacture of wiring devices	2733
Manufacture of electric lighting equipment	2740
Manufacture of domestic appliances	2750
Manufacture of other electrical equipment	2790
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	2811
Manufacture of fluid power equipment	2812
Manufacture of other pumps, compressors, taps and valves	2813
Manufacture of bearings, gears, gearing and driving elements	2814
Manufacture of ovens, furnaces and furnace burners	2815
Manufacture of lifting and handling equipment	2816
Manufacture of office machinery and equipment (except computers and peripheral equipment)	2817
Manufacture of power-driven hand tools	2818
Manufacture of other general-purpose machinery	2819
Manufacture of agricultural and forestry machinery	2821
Manufacture of metal-forming machinery and machine tools	2822
Manufacture of machinery for metallurgy	2823
Manufacture of machinery for mining, quarrying and construction	2824
Manufacture of machinery for food, beverage and tobacco processing	2825
Manufacture of machinery for textile, apparel and leather production	2826
Manufacture of other special-purpose machinery	2829
Manufacture of motor vehicles	2910
Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	2920
Manufacture of parts and accessories for motor vehicles	2930
Building of ships and floating structures	3011
Building of pleasure and sporting boats	3012
Manufacture of railway locomotives and rolling stock	3020
Manufacture of air and spacecraft and related machinery	3030
Manufacture of motorcycles	3091
Manufacture of bicycles and invalid carriages	3092
Manufacture of other transport equipment n.e.c.	3099
Manufacture of furniture	3100
Manufacture of jewellery and related articles	3211
Manufacture of imitation jewellery and related articles	3212
Manufacture of musical instruments	3220
Manufacture of sports goods	3230
Manufacture of games and toys	3240
Manufacture of medical and dental instruments and supplies	3250

Other manufacturing n.e.c.	3290
Construction	27
Wholesale trade, except of motor vehicles and motorcycles	29
Land transport and transport via pipelines	31
Water transport	32
Air transport	33
Warehousing and support activities for transportation	34
Postal and courier activities	35
Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	38
Telecommunications	39
Computer programming, consultancy and related activities; information service activities	40
Financial and Insurance services	41
Legal and accounting activities; activities of head offices; management consultancy activities	45
Architectural and engineering activities; technical testing and analysis	46
Administrative and support service activities	50

Table A2.8: sectoral coverage in 'restricted' version of dataset

ISIC4 Name	ISIC4
Crop and animal production, hunting and related service activities	01
Processing and preserving of meat	1010
Processing and preserving of fish, crustaceans and molluscs	1020
Processing and preserving of fruit and vegetables	1030
Manufacture of vegetable and animal oils and fats	1040
Manufacture of dairy products	1050
Manufacture of grain mill products, starches and starch products	1061-1062
Manufacture of bakery products	1071
Manufacture of sugar, cocoa, chocolate and sugar confectionery	1072-1073
Manufacture of macaroni, noodles, couscous etc. and other food products n.e.c.	1074-1079
Manufacture of prepared animal feeds	1080
Distilling, rectifying and blending of spirits	1101
Manufacture of wines	1102
Manufacture of malt liquors and malt	1103
Manufacture of soft drinks & mineral waters and manufacture of tobacco products	1104-1200
Preparation and spinning of textile fibres	1311
Weaving of textiles	1312
Manufacture of knitted and crocheted fabrics	1391
Manufacture of made-up textile articles, except apparel	1392
Manufacture of carpets and rugs	1393
Manufacture of cordage, rope, twine and netting	1394
Manufacture of other textiles n.e.c.	1399
Manufacture of wearing apparel, incl. fur apparel	1410-1420
Manufacture of knitted and crocheted apparel	1430

Tanning and dressing of leather; dressing and dyeing of fur	1511
Manufacture of luggage, handbags and the like, saddlery and harness	1512
Manufacture of footwear	1520
Sawmilling and planing of wood	1610
Manufacture of veneer sheets and wood-based panels	1621
Manufacture of builders' carpentry and joinery	1622
Manufacture of wooden containers	1623
Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	1629
Manufacture of pulp, paper and paperboard	1701
Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	1702
Manufacture of other articles of paper and paperboard	1709
Printing	1811
Service activities related to printing	1812
Reproduction of recorded media	1820
Manufacture of coke oven products & refined petroleum products	1910-1920
Manufacture of basic chemicals	2011
Manufacture of fertilizers and nitrogen compounds	2012
Manufacture of plastics and synthetic rubber in primary forms	2013
Manufacture of pesticides and other agrochemical products	2021
Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2022
Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	2023
Manufacture of other chemical products n.e.c.	2029
Manufacture of man-made fibres	2030
Manufacture of pharmaceuticals, medicinal chemical and botanical products	2100
Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	2211
Manufacture of other rubber products	2219
Manufacture of plastics products	2220
Manufacture of glass and glass products	2310
Manufacture of refractory products	2391
Manufacture of clay building materials	2392
Manufacture of other porcelain and ceramic products	2393
Manufacture of cement, lime and plaster	2394
Manufacture of articles of concrete, cement and plaster	2395
Cutting, shaping and finishing of stone	2396
Manufacture of other non-metallic mineral products n.e.c.	2399
Manufacture of basic iron and steel	2410
Manufacture of basic precious and other non-ferrous metals	2420
Casting of iron and steel	2431
Manufacture of structural metal products	2511
Manufacture of tanks, reservoirs and containers of metal	2512
Manufacture of steam generators, except central heating hot water boilers	2513
Manufacture of cutlery, hand tools and general hardware	2593
Manufacture of other fabricated metal products n.e.c.	2599

Manufacture of electronic components, boards, computers and peripheral equipment	2610-2620
Manufacture of communication equipment & consumer electronics	2630-2640
Manufacture of measuring, testing, navigating, control equipment & watches and clocks	2651-2652
Manufacture of irradiation, electromedical, electrotherapeutic equipment & optical instruments and photographic equipment	2660-2670
Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus	2710
Manufacture of batteries, accumulators & fibre optic cables	2720-2731
Manufacture of other electronic, electric wires and cables & wiring devices	2732-2733
Manufacture of electric lighting equipment	2740
Manufacture of domestic appliances	2750
Manufacture of other electrical equipment	2790
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	2811
Manufacture of fluid power equipment	2812
Manufacture of other pumps, compressors, taps and valves	2813
Manufacture of bearings, gears, gearing and driving elements	2814
Manufacture of ovens, furnaces and furnace burners	2815
Manufacture of lifting and handling equipment & office machinery and equipment (except computers and peripheral equipment)	2816-2817
Manufacture of power-driven hand tools	2818
Manufacture of other general-purpose machinery	2819
Manufacture of agricultural and forestry machinery & metal-forming machinery and machine tools	2821-2822
Manufacture of machinery for metallurgy	2823
Manufacture of machinery for mining, quarrying and construction	2824
Manufacture of machinery for food, beverage and tobacco processing	2825
Manufacture of machinery for textile, apparel and leather production	2826
Manufacture of other special-purpose machinery	2829
Manufacture of motor vehicles	2910
Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	2920
Manufacture of parts and accessories for motor vehicles	2930
Building of ships, floating structures, pleasure and sporting boats & Manufacture of railway locomotives, rolling stock, air, spacecraft and related machinery	3011-3030
Manufacture of motorcycles	3091
Manufacture of bicycles and invalid carriages & other transport equipment n.e.c.	3092-3099
Manufacture of furniture	3100
Manufacture of jewellery and related articles	3211
Manufacture of imitation jewellery and related articles	3212
Manufacture of musical instruments, sports goods, games and toys	3220-3240
Manufacture of medical and dental instruments and supplies	3250
Other manufacturing n.e.c.	3290
Construction	27
Land transport and transport via pipelines	31
Water transport	32
Air transport	33
Warehousing and support activities for transportation	34
Postal and courier activities	35

Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	38
Telecommunications	39
Computer programming, consultancy and related activities; information service activities	40
Financial and Insurance services	41
Legal and accounting activities; activities of head offices; management consultancy activities	45
Architectural and engineering activities; technical testing and analysis	46
Administrative and support service activities	50

Table A2.9: Country coverage

Individual countries	
Great Britain (GB)	China
Northern Ireland (NI)	Australia
Ireland	New Zealand
USA	
EU26	
Austria	Italy
Belgium	Latvia
Bulgaria	Lithuania
Croatia	Luxembourg
Cyprus	Malta
Czech rep.	Nethlerands
Denmark	Poland
Estonia	Portugal
Finland	Romania
France	Slovakia
Germany	Slovenia
Greece	Spain
Hungary	Sweden
FTA group (continuity)	
Colombia	Madagascar
Ecuador	Mauritius
Peru	Seychelles
Antigua & Barbuda	Zimbabwe
Barbados	Faroe Island
Belize	Georgia
Bahamas	Iceland
Dominica	Norway
Dominican Rep.	Israel
Grenada	Jordan
Guyana	Kosovo
Jamaica	Lebanon
St. Kitts & Nevis	Liechtenstein
St. Lucia	Morocco
St. Vincent and the Grenadines	Fiji
South Korea	Papua New Guinea

Trinidad & Tobago	Palestinian Authority
Suriname	Botswana
Costa Rica	Eswatini
El Salvador	Lesotho
Guatemala	Namibia
Honduras	South Africa
Nicaragua	Mozambique
Panama	Switzerland
Chile	Tunisia
Non-continuity group	
Albania	Moldova
Algeria	Montenegro
Bosnia	North Macedonia
Cameroon	Serbia
Canada	Ukraine
Côte d'Ivoire	Japan
Egypt	Turkey
Ghana	San Marino
Kenya	Andorra
Mexico	

Appendix 3: Methodology for AVE in services

Impediments to services trade are probably larger than those affecting goods trade but give the fragmented and non-standard formats of trade barriers, they are often poorly measured. To overcome this issue, both the World Bank and the OECD started to produce measures of services trade barriers reviewing the regulations affecting services trade and producing a Services Trade Restrictiveness Index (STRI). These two indexes vary between 0 and 1 (0 and 100 for WB), with zero representing no-barriers while 1 is a virtually closed economy. In our exercise we use the OECD STRI as it produces values both for MFN STRI and intra-EEA STRI, which we will use for our counterfactual.

To use these measures of services trade barriers into our PE model, we need to translate trade barriers from STRI points into tariff equivalents. To do that, we rely on the gravity model of international trade and follow the recent work of Benz and Jaax (2020). In the gravity model, trade between an exporter i and an importer j can be expressed as:

$$X_{ij} = \left(\frac{tradecost_{ij}}{\Pi_i P_j}\right)^{-\theta} Y_i Y_j \qquad (1)$$

In equation (1) Y_i and Y_j represent exporter and exporter GDPs. The two terms Π_i and P_j are referred to as "multilateral resistance" terms, and they measures how costly it is for an exporter (importer) to export to (import from) any country in the world. Following the latest development in the gravity literature, we make use of importer-year and exporter-year dummies to control for GDPs and multilateral resistance terms, together with any other unobservable that varies at that level. Finally, $tradecost_{ij}$ are bilateral trade costs affecting trade between i and j. We model such trade costs as:

$$\ln tradecost_{ij} = D'_{ij}\beta + \gamma\left(border_{ij} \times STRI_{jt}\right)$$

Where D_{ij} are observable bilateral trade frictions (distance, contiguity, …). Because the STRI is specific to an importer-year observation, we could not estimate its coefficient using the set of importer-year and exporter-year fixed effects. To overcome this issue, we include national trade in our dataset and interact the STRI with the border dummy. The border dummy $border_{ij}$ takes value of zero for national flows and one for international flows.

We estimate the gravity model with PPML including zero flows. The empirical equation that we estimate is:

$$X_{ij} = \exp\left[\gamma\left(border_{ij} \times STRI_{jt}\right) + D'_{ij}\beta + a_{it} + a_{jt} + \epsilon_{ijt}\right]$$

The variables in the D_{ij} vector are the log of distance and dummies for EIA, contiguity, common language and colonial ties. The STRI variable is the MFN STRI from the OECD apart for intra-EEA flows where we replace it with intra-EEA values of the STRI.

After estimating the gravity equation for each sector individually, we retrieve the $\tilde{\gamma}$ coefficients and compute the ad valorem equivalent (AVE) of increasing the STRI from zero (the minimum) to the MFN level for a given country-sector as:

$$AVE_{jt}^{MFN} = \exp\left(-\frac{STRI_{jt}^{MFN} \times \tilde{\gamma}}{\sigma - 1}\right) - 1$$

Where σ is the elasticity of substitution assumed to be $\sigma = 3$ for each sector. For further detail on the derivation of the AVE see Benz and Jaax (2020). Similarly, we compute the same measure for intra-EEA values:

$$AVE_{jt}^{EEA} = \exp\left(-\frac{STRI_{jt}^{EEA} \times \tilde{\gamma}}{\sigma - 1}\right) - 1$$

Data

For the estimation of the gravity equation we need information on trade flows, gravity variables and STRI. Trade data come from the USITC ITPD-E database (Borchert et al. 2020) which contains information on national and international trade flows for 243 countries and 170 industries. The standard gravity variables and EIA dummies come from the USITC Dynamic Gravity Dataset (Gurevich and Herman 2018). Finally, the STRI is taken from the OECD database.

To match the ITPD-E sectors and the STRI we rely on the ISIC rev.4 classification and we are able to match seven ITPD-E sectors over the period 2014-16.

Table reports the matching across sectors. Apart for few cases, the match is often one ITPD-E sector to many STRI sectors. In these cases, we take a simple average of the STRI collapsing at the ITPD-E sector level.

Table A3.1: Matching ITPD-E and STRI sectors

ITPD-E Code	ITPD-E description	ISIC4	SEC	SECTOR
156	Transport	H	TRAIR	Air transport
156	Transport	H	CR	Courier
156	Transport	H	LSCAR	Logistics cargo-handling
156	Transport	H	LSSTG	Logistics storage and warehouse
156	Transport	H	LSFGT	Logistics freight forwarding
156	Transport	H	LSCUS	Logistics customs brokerage
156	Transport	H	TRMAR	Maritime transport
156	Transport	H	TRRAI	Rail freight transport
156	Transport	H	TRROF	Road freight transport
158	Construction	F	CO	Construction
159	Insurance and pension services	K	FSINS	Insurance
160	Financial services	K	FSBNK	Commercial banking
162	Telecommunications, computer, and information services	J	ASMOT	Motion pictures
162	Telecommunications, computer, and information services	J	ASSOU	Sound recording
162	Telecommunications, computer, and information services	J	TC	Telecom
162	Telecommunications, computer, and information services	J	ASBRD	Broadcasting
162	Telecommunications, computer, and information services	J	CS	Computer
163	Other business services	M+N	PSARC	Architecture
163	Other business services	M+N	PSENG	Engineering
163	Other business services	M+N	PSLEG	Legal
163	Other business services	M+N	PSACC	Accounting
169	Trade-related services	G	DS	Distribution

Since our PE dataset for services (from WIOD) is more disaggregated than the ITPD-E in terms of sectors, the AVEs are computed for each STRI sector separately, applying the same γ coefficient to multiple sectors when the matching is one-to-many. For instance, we estimate one γ coefficient for "Other business services" and apply this to all four STRI sectors associated with this ITPD-E sector.

Results

Table reports the results of the gravity estimation for the seven ITPD-E sectors. In all cases the coefficient on the interaction of the border dummy with the STRI is negative and significant, and its range across sectors is similar to the one of Benz and Jaax (2020).

Table A3.2: Gravity results

	ITPD-E Sectors						
	156	158	159	160	162	163	169
Border	-2.878***	-6.155***	-4.221***	-1.995***	-3.101***	-3.098***	-5.715***
	[0.159]	[0.607]	[0.343]	[0.368]	[0.192]	[0.202]	[0.345]
Border*STRI	-4.018***	-8.245***	-3.942***	-6.124***	-4.860***	-4.801***	-5.966***
	[0.383]	[1.436]	[0.808]	[0.914]	[0.579]	[0.518]	[0.984]
Ln distance	-0.568***	-0.649***	-0.670***	-0.753***	-0.675***	-0.371***	-0.719***
	[0.0413]	[0.151]	[0.0906]	[0.0766]	[0.0466]	[0.0531]	[0.0978]
EIA	-0.491***	0.151	-0.493**	-1.088***	-0.388***	-0.991***	-0.483**
	[0.0988]	[0.351]	[0.172]	[0.178]	[0.0954]	[0.124]	[0.161]
Contiguity	0.425***	0.445**	0.148	-0.0467	0.122	0.640***	0.440*
	[0.0771]	[0.165]	[0.203]	[0.170]	[0.101]	[0.0949]	[0.185]
Common lang.	0.347***	0.427*	0.664***	0.573***	0.493***	0.0924	0.373***
	[0.0714]	[0.176]	[0.163]	[0.165]	[0.0855]	[0.0797]	[0.106]
Colony of origin ever	0.636**	-1.477**	-0.415	-0.0215	-0.063	-0.348	0.346
	[0.223]	[0.560]	[0.648]	[0.572]	[0.252]	[0.392]	[0.459]
Colony of destination ever	-0.28	-0.568	-2.723***	-0.412	-0.641**	-1.407***	-0.0578
	[0.203]	[0.767]	[0.629]	[0.735]	[0.214]	[0.260]	[0.419]
Exporter-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4029	3302	3393	3483	3879	3754	3209

Robust standard errors in brackets. * p<0.05, ** p<0.01, *** p<0.001.

Table reports the AVEs (both EEA and MFN values) for the EU26, Ireland and the UK across the WIOD sectors used in the simulation model.[8] In the PE model, the AVEs for Northern Ireland are the same as the UK's ones. For the EU26, we computed a weighted average AVEs across countries where weights are given by the GDP shares.

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[8] The concordance between STRI and WIOD is based on ISIC rev. 4 classification.

Table A3.3: AVE values for EU and UK

WIOD	EU26		Ireland		UK	
	EEA	MFN	EEA	MFN	EEA	MFN
F	0.24	1.32	0.11	0.93	0.06	0.71
G46	0.26	0.63	0.23	0.56	0.12	0.43
G47	0.26	0.63	0.23	0.56	0.12	0.43
H49	0.13	0.51	0.09	0.44	0.07	0.39
H50	0.10	0.53	0.06	0.44	0.01	0.44
H51	0.36	1.22	0.32	1.15	0.30	1.19
H52	0.15	0.45	0.05	0.42	0.05	0.37
H53	0.15	0.43	0.10	0.41	0.15	0.44
J59_J60	0.18	0.66	0.09	0.45	0.11	0.48
J61	0.11	0.41	0.11	0.34	0.21	0.51
J62_J63	0.14	0.67	0.00	0.48	0.00	0.48
K64	0.23	0.71	0.12	0.54	0.12	0.68
K65	0.08	0.41	0.01	0.27	0.01	0.32
K66	0.08	0.41	0.01	0.27	0.01	0.32
M69_M70	0.24	1.48	0.19	0.60	0.11	0.69
M71	0.18	0.94	0.05	0.49	0.03	0.45

For FTA partners, we assume that the trade agreement reduces AVEs by one-half of the reduction implied by the EEA agreement.

Appendix 4: Additional results

Table A4.1: Top and bottom 10 manuf. sectors by change in output, No Deal (B) NI

ISICr4	ISICr4 description		Percentage changes		
Bottom 10		Prices	Output	Exports	Imports
2391	Man. of refractory products	4.0	-16.7	-15.1	0.2
1394	Man. of cordage, rope etc.	4.2	-16.5	-15.2	0.6
2732-2733	Man. of other electronics	5.0	-15.8	-15.1	1.3
2740	Man. of electric lighting eq.	5.1	-14.9	-14.1	0.6
1511	Tanning & dressing of leather & fur	2.7	-14.3	-12.3	0.2
1311	Prep. and spinning of textile fibres	4.4	-11.2	-10.3	-0.2
2811	Man. of engines and turbines	3.6	-7.1	-5.0	0.0
2030	Man. of man-made fibres	3.9	-6.9	-4.9	-0.2
2823	Man. of machinery for metallurgy	0.1	-6.8	-4.1	0.0
2513	Man. of steam generators	4.8	-6.5	-4.5	0.2
Top 10					
2011	Man. of basic chemicals	5.0	33.7	21.6	-13.8
2013	Man. of plastics and synthetic rubber	4.5	34.7	32.0	-34.0
2392	Man. of clay building materials	4.9	34.9	21.3	-4.7
1072-1073	Man. of sugar, cocoa, etc	14.6	37.7	34.4	-0.1
2420	Man. of basic precious & other metals	6.4	38.7	18.6	-10.4
2399	Man. of non-metallic minerals n.e.c.	4.7	39.2	18.5	-6.6
1061-1062	Man. of grain mill products	21.0	44.2	36.1	-12.8
1030	Processing and pres. of fruit & vegs	9.1	49.8	42.4	-10.3
1910-1920	Man. of coke oven & refined petroleum	6.9	63.4	22.9	-15.7
1074-1079	Man. of macaroni, noodles, etc.	8.2	74.7	62.8	-16.6

Table A4.2: Top and bottom 10 manuf. sectors by change in output, Deal NI

ISICr4	ISICr4 description	Without Intermediates				With Intermediates			
Bottom 10		Prices	Output	Exports	Imports	Prices	Output	Exports	Imports
1394	Man. of cordage, rope etc.	3.34	-6.50	-6.95	0.45	3.74	-14.10	-13.34	0.50
3092-3099	Man. of bicycles & other transport	11.69	-4.86	-2.03	2.73	12.31	-7.03	-3.46	2.87
1511	Tanning & dressing of leather & fur	1.97	-4.49	-4.39	0.13	2.24	-12.04	-10.69	0.16
2732-2733	Man. of other electronics	3.83	-4.40	-5.45	0.97	4.51	-14.14	-13.67	1.14
2740	Man. of electric lighting eq.	3.71	-4.12	-5.01	0.46	4.37	-14.27	-13.61	0.54
2391	Man. of refractory products	2.79	-3.39	-3.88	0.12	3.40	-13.64	-12.55	0.15
3011-3030	Building of ships, etc.	4.46	-2.62	-1.63	0.73	4.77	-4.86	-3.08	0.85
2811	Man. of engines and turbines	2.53	-2.15	-1.74	0.00	2.87	-6.12	-4.36	0.00
1391	Man. of knitted and crocheted fabrics	2.81	-2.14	-3.74	-5.96	3.65	-8.13	-9.04	-4.59
2030	Man. of man-made fibres	2.65	-2.08	-1.68	-0.17	3.22	-5.93	-4.29	-0.20
Top 10									
1030	Processing & pres. of fruit and vegs	5.4	29.7	23.4	-6.7	6.2	19.9	16.2	-5.5
1072-1073	Man. of sugar, cocoa, etc	11.2	30.0	19.5	-0.2	12.0	26.4	17.5	-0.1
2011	Man. of basic chemicals	3.2	32.0	16.0	-12.8	4.4	28.8	13.0	-12.4
1061-1062	Man. of grain mill products	16.0	32.0	19.5	-10.4	17.0	28.3	17.4	-10.1
2420	Man. of basic precious & other metals	4.2	35.5	18.8	-8.9	5.5	34.0	14.6	-9.2
1812	Printing services	2.8	35.7	16.6	-16.4	3.8	31.7	10.8	-15.3
2399	Man. of non-metallic minerals n.e.c.	3.1	41.6	22.7	-6.6	4.0	37.7	18.1	-6.2
2392	Man. of clay building materials	3.8	44.8	26.6	-5.7	4.5	37.0	19.7	-5.0
1910-1920	Man. of coke oven & refined petroleum	4.8	54.1	22.3	-13.0	5.8	56.8	20.6	-13.9
1074-1079	Man. of macaroni, noodles, etc.	4.9	57.1	46.4	-12.3	6.2	47.9	38.5	-11.4

Table A4.3: Top 10 sectors by base production, No Deal (B) and Deal (liberal) NI

ISIC4Code	ISIC4Name	Without Intermediates				With Intermediates				share
No Deal (B)		Prices	Output	Exports	Imports	Prices	Output	Exports	Imports	
F	Construction	0.5	-0.4	-0.1	-0.5	0.7	-0.4	0.4	-1.2	14.6
1010	Processing and pres. of meat	5.5	0.1	2.0	-3.7	11.7	9.0	10.3	-9.4	5.8
A	Crop and animal prod., hunting	2.3	9.4	-0.1	-27.1	3.0	9.3	1.3	-28.0	4.7
2100	Man. of pharmaceuticals	1.7	1.1	1.3	-9.3	2.1	1.2	2.1	-9.7	4.1
N	Admin & support service	1.7	-2.6	-11.8	-1.6	2.9	-3.9	-18.3	-2.4	4.0
1080	Man. of prepared animal feeds	2.3	5.9	2.3	-48.9	2.8	7.9	9.6	-52.5	3.2
H49	Land transport	1.0	0.1	0.0	-7.1	1.6	0.1	0.1	-11.5	3.2
K	Financial and Insurance	1.2	-2.0	-1.5	-0.5	2.0	-3.2	-2.5	-0.9	3.1
2824	Man. of machinery for mining	3.0	-0.7	-0.2	-5.8	3.6	-0.9	0.0	-6.1	3.1
1050	Man. of dairy products	3.7	7.5	-1.3	-27.5	5.0	14.8	5.0	-40.0	2.9
Deal										
F	Construction	0.0	-0.1	-0.2	-0.4	0.5	-0.4	-0.1	-0.5	14.6
1010	Processing and pres. of meat	4.5	2.8	3.5	-4.0	5.5	0.1	2.0	-3.7	5.8
A	Crop and animal prod., hunting	1.0	12.4	5.1	-30.2	2.3	9.4	-0.1	-27.1	4.7
2100	Man. of pharmaceuticals	0.9	2.2	2.6	-9.6	1.7	1.1	1.3	-9.3	4.1
N	Admin & support service	0.9	-1.9	-11.3	-1.5	1.7	-2.6	-11.8	-1.6	4.0
1080	Man. of prepared animal feeds	1.0	8.5	5.9	-50.3	2.3	5.9	2.3	-48.9	3.2
H49	Land transport	0.4	0.7	0.2	-7.5	1.0	0.1	0.0	-7.1	3.2
K	Financial and Insurance	0.5	-1.3	-1.2	-0.6	1.2	-2.0	-1.5	-0.5	3.1
2824	Man. of machinery for mining	1.8	1.9	2.0	-6.7	3.0	-0.7	-0.2	-5.8	3.1
1050	Man. of dairy products	2.3	12.4	4.4	-29.0	3.7	7.5	-1.3	-27.5	2.9

ISIC4Code	ISIC4Name	Without Intermediates				With Intermediates				share
No Deal (B)		Prices	Output	Exports	Imports	Prices	Output	Exports	Imports	
1010	Processing and pres. of meat	5.5	0.1	2.0	-3.7	11.7	9.0	10.3	-9.4	5.8
A	Crop and animal prod., hunting	2.3	9.4	-0.1	-27.1	3.0	9.3	1.3	-28.0	4.7
2100	Man. of pharmaceuticals	1.7	1.1	1.3	-9.3	2.1	1.2	2.1	-9.7	4.1
1080	Man. of prepared animal feeds	2.3	5.9	2.3	-48.9	2.8	7.9	9.6	-52.5	3.2
2824	Man. of machinery for mining	3.0	-0.7	-0.2	-5.8	3.6	-0.9	0.0	-6.1	3.1
1050	Man. of dairy products	3.7	7.5	-1.3	-27.5	5.0	14.8	5.0	-40.0	2.9
3011-3030	Building of ships, etc	4.8	-4.9	-3.1	0.8	5.2	-5.5	-3.4	0.9	2.8
1104-1200	Man. of soft drinks & tobacco	2.6	2.5	4.6	-13.1	3.9	3.9	8.1	-19.9	2.8
2710	Man. of electric motors	1.6	-2.2	-1.7	-2.4	2.1	-2.2	-1.1	-2.7	2.2
1410-1420	Man. of wearing apparel	2.0	1.4	0.9	-3.7	3.9	5.2	6.3	-8.4	2.0
Deal										
1010	Processing and pres. of meat	4.5	2.8	3.5	-4.0	5.5	0.1	2.0	-3.7	5.8
A	Crop and animal prod., hunting	1.0	12.4	5.1	-30.2	2.3	9.4	-0.1	-27.1	4.7
2100	Man. of pharmaceuticals	0.9	2.2	2.6	-9.6	1.7	1.1	1.3	-9.3	4.1
1080	Man. of prepared animal feeds	1.0	8.5	5.9	-50.3	2.3	5.9	2.3	-48.9	3.2
2824	Man. of machinery for mining	1.8	1.9	2.0	-6.7	3.0	-0.7	-0.2	-5.8	3.1
1050	Man. of dairy products	2.3	12.4	4.4	-29.0	3.7	7.5	-1.3	-27.5	2.9

3011-3030	Building of ships, etc	4.5	-2.6	-1.6	0.7	4.8	-4.9	-3.1	0.8	2.8
1104-1200	Man. of soft drinks & tobacco	1.4	4.0	5.6	-13.9	2.6	2.5	4.6	-13.1	2.8
2710	Man. of electric motors	0.6	-0.1	0.3	-3.5	1.6	-2.2	-1.7	-2.4	2.2
1410-1420	Man. of wearing apparel	1.3	2.8	2.4	-4.3	2.0	1.4	0.9	-3.7	2.0

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