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**Estimating the Economic Impact on  
the UK of  
a Transatlantic Trade and Investment  
Partnership (TTIP) Agreement between  
the  
European Union and the United States**

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**Final Project Report**

**March 2013**

**Centre for Economic Policy Research, London**

Reference P2BIS120020

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# Colophon

Estimating the Economic Impact on the UK of a Transatlantic Trade and Investment Partnership Agreement between the European Union and the United States

Report prepared by the CEPR.

**Date:**

March 2013

**Client:**

The Department for Business, Innovation and Skills (BIS)

Reference P2BIS120020

**Contact:**

Centre for Economic Policy Research  
3rd Floor, 77 Bastwick Street  
London EC1V 3PZ

UK Tel: +44 (0) 20 7183 8801

Email: [cepr@cepr.org](mailto:cepr@cepr.org)

Web: [www.cepr.org](http://www.cepr.org)



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## 1 Executive summary

This report employs a CGE model to assess quantitatively the likely impact of a trade and investment agreement between the EU and the US (TTIP or Transatlantic Trade and Investment Partnership) on the UK economy. This includes modelling tariff reductions and liberalization of non-tariff barriers (NTBs). In relative terms, the level of NTBs affecting trans-Atlantic trade is far more important than tariff barriers. For the UK, tariffs are roughly 0.5 percent of the value of exports to the US, while NTBs are roughly 8.5 percent of the value of exports to the US.

A potential TTIP is estimated to yield an increase in UK national income of between £4-10 billion annually, or up to £100 billion over a ten-year period (which corresponds to a 0.14-0.35 per cent increase in GDP levels.) This means a sustained increase in the level of GDP over baseline levels without an agreement. The actual impact depends on the scenario. Most of the national income gains are attributable to lowering of NTBs in goods. Aggregate exports (to all countries) are expected to increase by 1.2 and 2.9 per cent, and imports by 1.0 and 2.5 per cent. The sector most strongly affected is motor vehicles, where output increases by as much as 7.3 percent (or as little as 1.7 percent).

While the results indicate that the effects of a TTIP for the UK are positive, the current overall level of barriers is lower between the UK and US as opposed to EU and US. This reflects a greater importance for services to the US-UK relationship than to the EU as a whole. In addition, an FTA will not just involve the UK, but the other EU Member States as well. Because the EU accounts for half of UK exports, there is likely to be some trade diversion effects driving the overall pattern of results. The greatest direct gains are from NTB reductions for goods. At the same time, there is some offset from the gains from NTB reductions for goods, linked to the same NTB reductions applied to US trade with the other 26 Members of the EU. Such effects are explicitly included in the estimates reported here, and the GDP effects are therefore net, inclusive of such effects.

This report highlights the crucial importance of NTBs. Most of the gains stemming from a potential agreement for the UK are attributable to estimated reductions in NTBs. Reducing non-tariff barriers implies reductions in costs for producers and traders and so increasing productivity. This leads to potential investment and worker income gains. On the other hand, if the FTA is limited to tariffs alone, gains for the UK would be much more limited.

## 2 Background and Context

The Department for Business, Innovation and Skills (BIS) commissioned this study. The aim of the study is to estimate the economic impacts on the UK of a possible EU-US initiative to boost trade and investment, using a Computable General Equilibrium model.

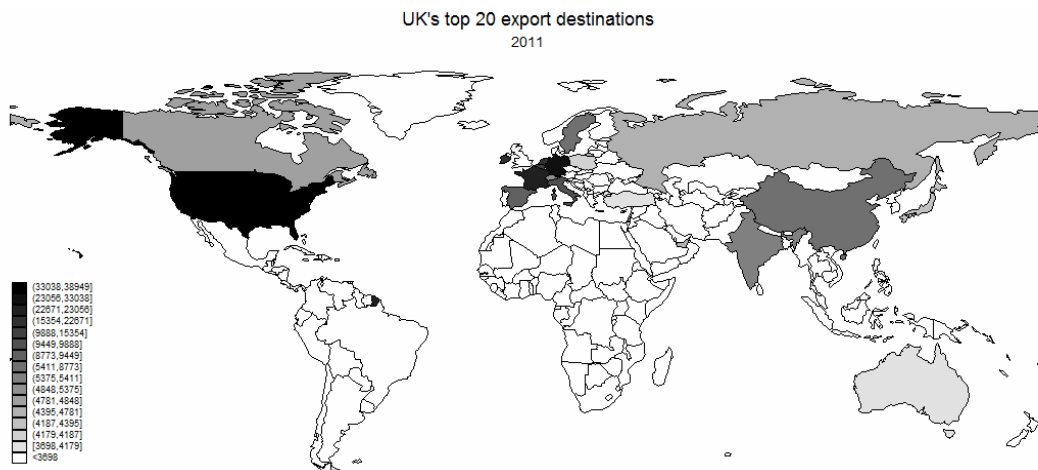
The report is structured as follows. In this Chapter we focus on patterns of trade and protection. The impact of a EU-US FTA on the UK hinges on underlying patterns of trade and investment. In this chapter we focus on those patterns. This provides background for the economic assessment, giving a short description of current patterns of trade, FDI, and tariffs. Chapter 2 contains an overview of the modelling tools, the data used, and the experiment definitions. The overall economic results of the modelling are presented and discussed in Chapter 3. Chapter 4 offers some concluding comments.

### 2.1 TRADE PATTERNS

The US is one of the most important trading partners for the UK. [Figure 1](#) depicts the top 20 export destination in 2011, while [Figure 2](#) shows the exact figures for both the top 20 export and import partners. While the US is the most important export destination for the UK, the UK trades more with the EU as a region than with the US. This last fact will prove important when we examine the impact of an FTA. This is because the direct benefits of liberalization will be tempered by trade diversion (erosion of market access conditions) with respect to the EU, because US firms will gain better access to the EU26.



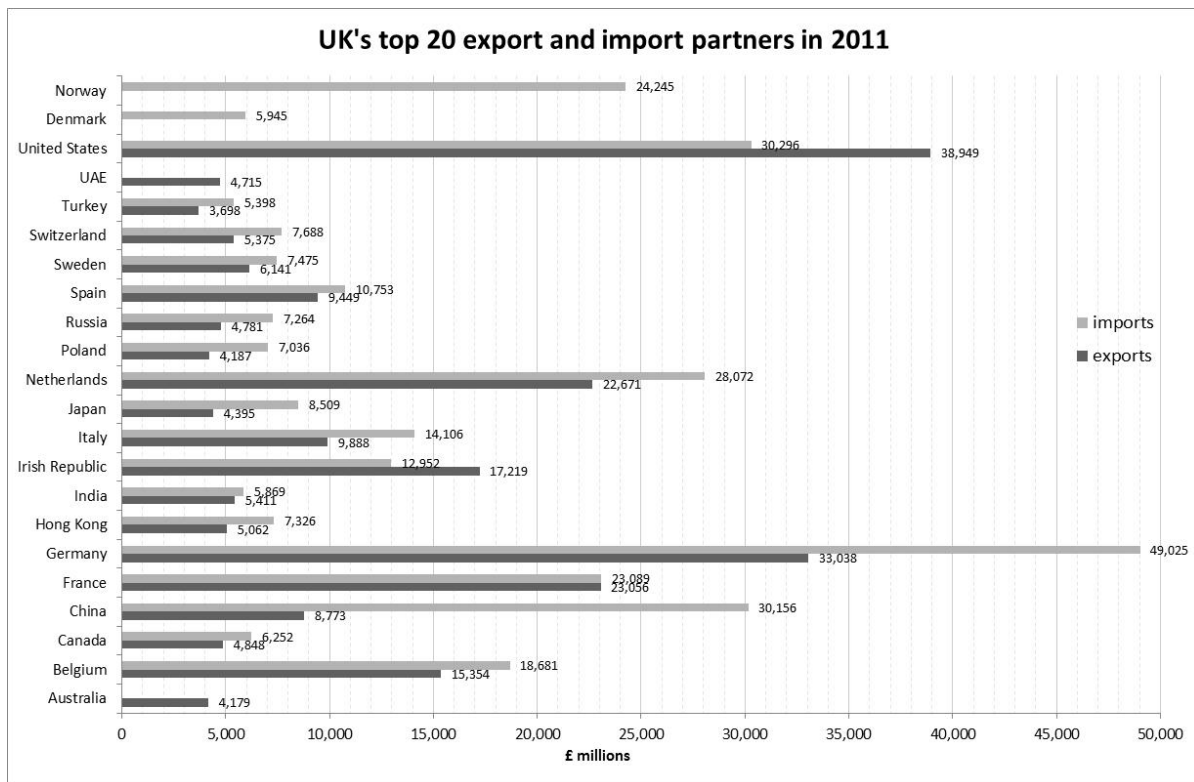
**Figure 1 UK's top 20 export destinations in 2011, £ million**



Source: UK HM Revenue and Customs and own calculations

UK imports from the US in 2011 amounted to £30 billion, while exports were £39 billion. Compared to this, the UK imports about £ 10 billion more from Germany, while exporting about £6 billion less. So, while the US is the most important export destination, Germany is the most important import source for the UK. Nevertheless, trade with the EU as a whole is much more important than trade with the US. Within the top 20 trade partners there are several EU partner countries, amounting to several times more trade together than trade with the US. In 2011, for example, the UK's total imports from the EU were about £200 billion, which is more than six times higher than imports from the US.

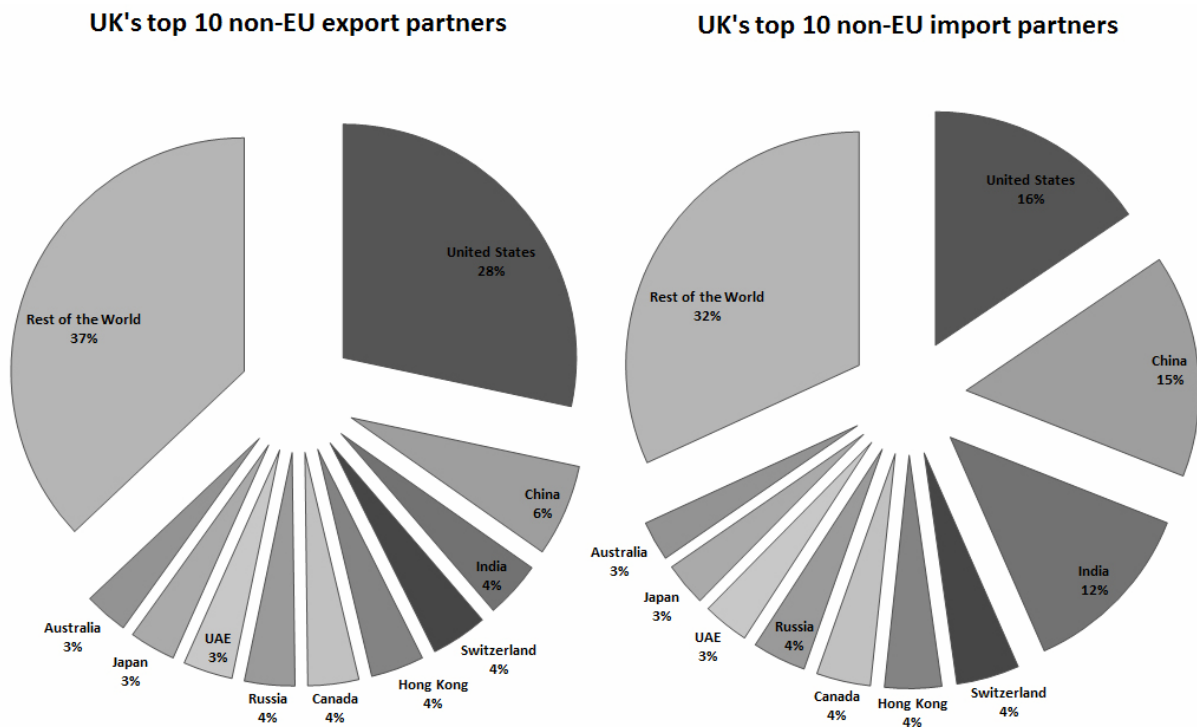
**Figure 2 UK's top 20 export and import partners in 2011, £ million**



Source: UK HM Revenue and Customs and own calculations

When looking at only non-EU trade partners, the share of exports going to the US in total non-EU exports is 28 per cent (see Figure 3). The US is, by far, the most important export destination outside the EU, with the second most important export partner being China, with only 5 per cent of total extra-EU exports. On the import side however, China's significance is much more pronounced. While in 2011, imports from the US amounted to 16 per cent of total extra-EU imports. Imports from China were 15 per cent. India was the third most significant import partner outside the EU, with 12 per cent of total imports from outside EU.

**Figure 3 UK's top 10 non-EU trade partners, 2011**

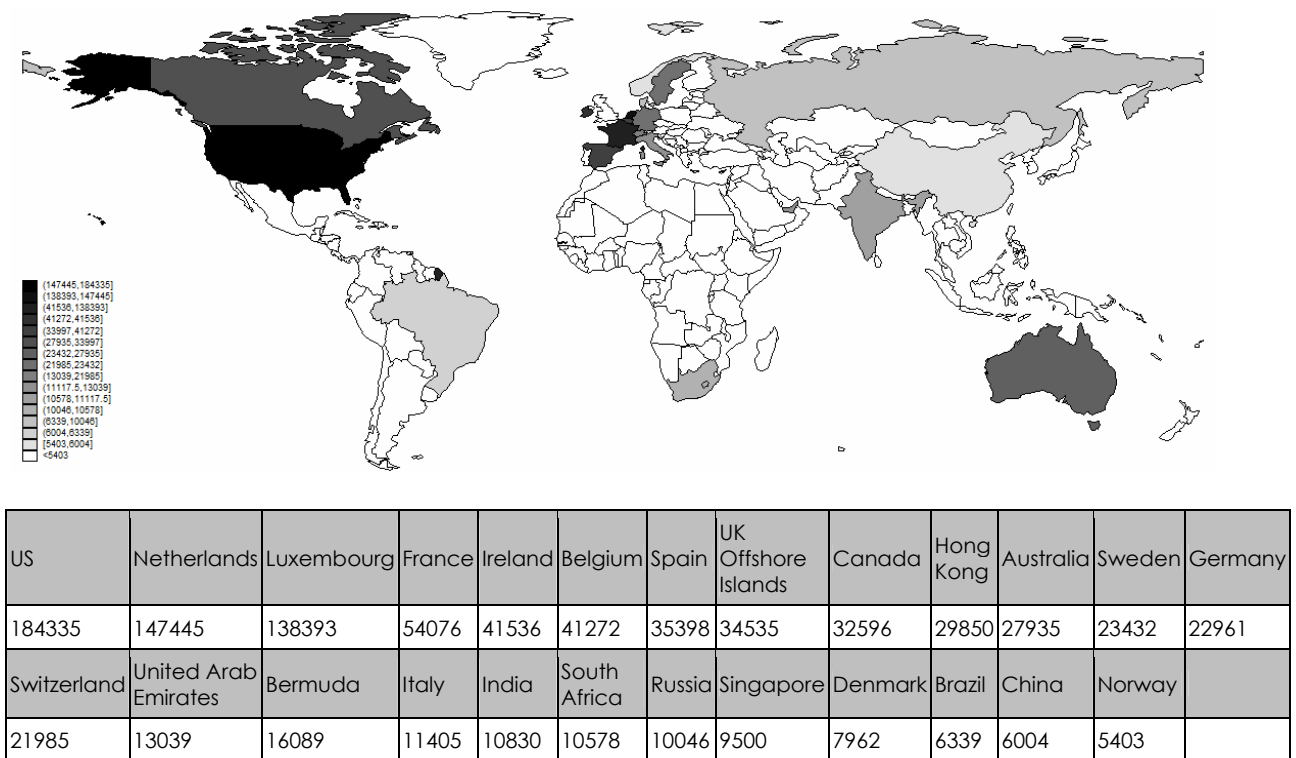


Source: UK HM Revenue and Customs and own calculations

## 2.2 FDI PATTERNS

Many of the most important trade partners of the UK are also the most important destination and source countries of foreign direct investment. Figure 4 depicts the UK's top 25 outward FDI stock destinations in 2010. The most important outward stock destination in 2010 was the US, with £184 billion. Among these top 25 destination countries there are many EU countries, with Netherlands being the second most important destination, and Luxembourg placing third.

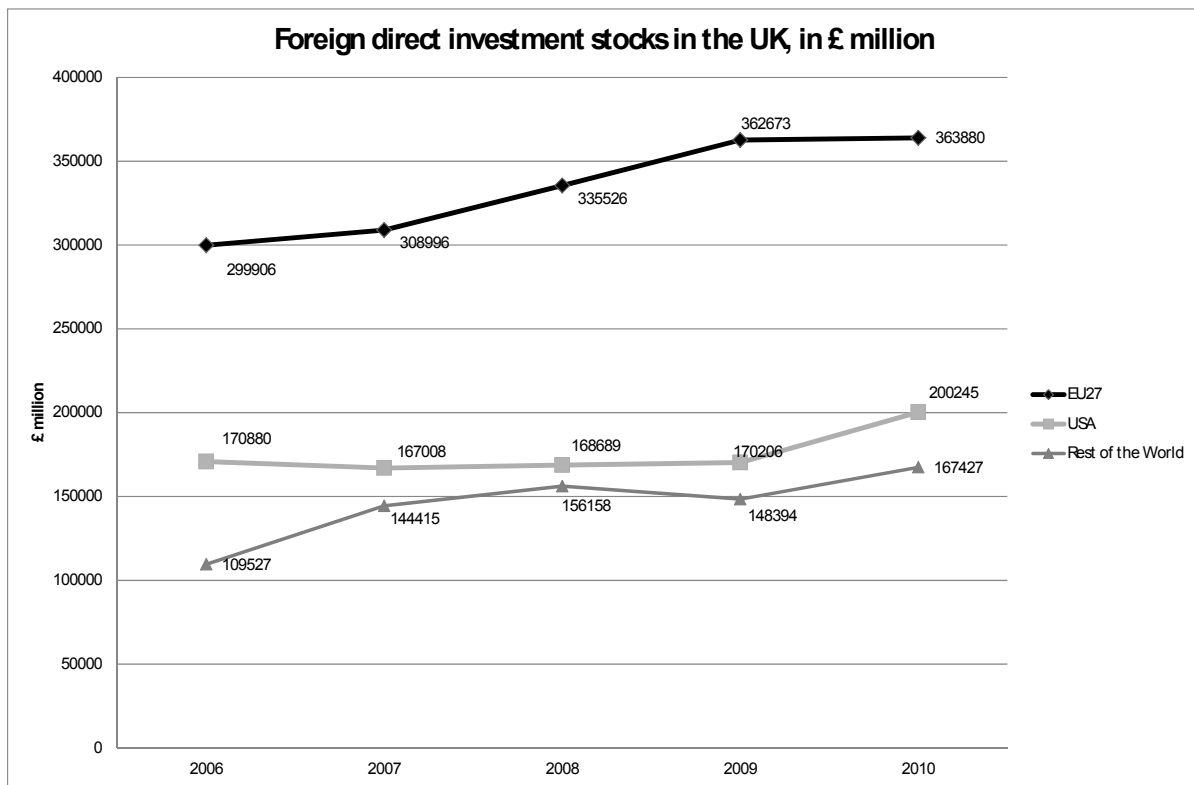
**Figure 4 UK's top 25 outward FDI stock destination in 2010, £ million**



Source: UK HM Revenue and Customs and own calculations. UK FDI stocks to Bermuda, Hong Kong, Singapore, and UK Offshore Islands are not depicted on the map.

Figure 5 depicts the evolution of inward FDI stock in the UK over the period between 2006 and 2010. As can be seen from the figure, most FDI stock originates from other EU countries. Nevertheless, the US is a very important source of FDI. In 2010, while about £364 billion FDI came from other EU countries, FDI from the US amounted to about £200 billion. In the same year, FDI from all other third countries were £167 billion highlighting the importance of the US as one of the most important investors in the UK.

**Figure 5 UK Inward FDI stock**

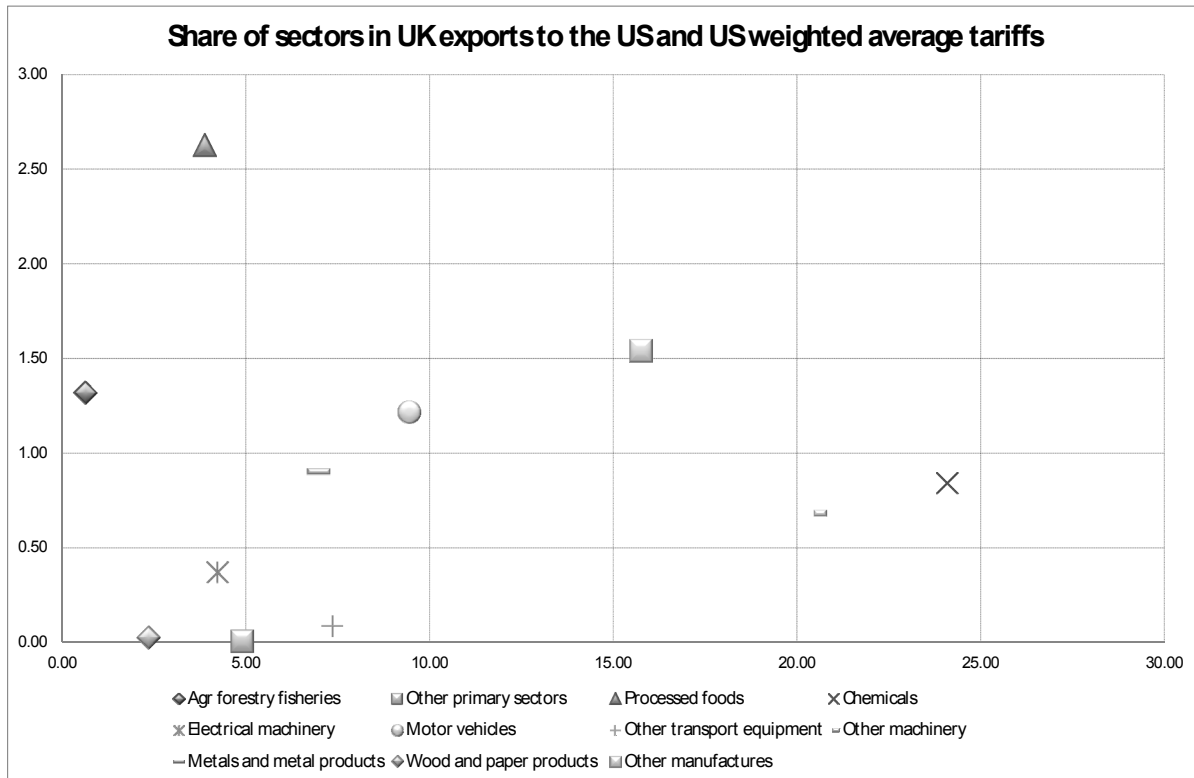


Source: OECD and own calculations

### 2.3 PATTERNS OF IMPORT PROTECTION

Current tariffs on US imports from the UK trade are presented in [Table 1](#) and [Figure 6](#) below. From [Figure 6](#), it can be seen that the tariffs that UK exporters are facing when trading with the US are relatively very low. At the level of aggregation in the table, tariffs are below 3 per cent. In sectors with the highest share of exports destined to the US market tariffs are between 0.5 and 1.5 per cent. The sector with the highest tariffs is processed foods, but the share of these goods in UK exports to the US is less than 5 per cent. In sum, the figure highlights that the potential gains from an FTA that is limited to liberalizing tariffs only is likely to be relatively small.

**Figure 6 Share of sectors in UK goods exports to the US and US weighted average tariffs**



Source: GTAP 8

Table 1 provides further details, and compares the UK exports and tariffs faced by UK firms to those facing firms from the rest of the EU when trading with the US. As shown in the second and fourth columns of Table 1, the tariffs on manufactured goods exported to the US are generally very low. The average tariff on goods exported from the UK to the US is 0.53 per cent, while the corresponding figure for EU exports is 1.09 per cent. Although this figure is still low, it is more than twice as high as for exports from the UK. Thus, removing these tariff barriers is likely to have a bigger impact on the rest of the EU than on the UK. Within manufactured goods, the pattern of exports is similar for the UK and EU, with chemicals and other machinery as the most important sectors, followed by other manufactures and motor vehicles.

**Table 1: Composition of Exports from EU and UK to the US and US tariffs.**

	United Kingdom		Rest of EU	
	export share	tariffs per cent	export share	tariffs per cent
Agr forestry fisheries	0.37	1.32	0.43	4.35
Other primary sectors	2.90	0.01	0.22	0.17
Processed foods	2.30	2.63	4.17	3.41
Chemicals	14.30	0.84	15.61	1.26
Electrical machinery	2.51	0.37	2.47	0.27
Motor vehicles	5.60	1.22	10.64	1.19
Other transport equipment	4.36	0.09	4.13	0.16
Other machinery	12.16	0.68	18.22	0.84
Metals and metal products	4.14	0.90	4.71	1.40
Wood and paper products	1.39	0.03	2.38	0.25
Other manufactures	9.35	1.54	10.17	3.59
<i>total goods</i>	<i>59.37</i>	<i>0.90</i>	<i>73.16</i>	<i>1.49</i>
<i>total services</i>	<i>40.63</i>		<i>26.84</i>	
<i>total all exports to US</i>	<i>100.00</i>	<i>0.53</i>	<i>100.00</i>	<i>1.09</i>

Source: GTAP 8.

Elimination of tariffs is expected to lead to positive economic effects, by providing savings for the exporters and consumers in the importing countries. Furthermore, it is expected to not only be beneficial for those exporters who are already supplying the partner countries' markets, but to also provide new possibilities for those producers who are still out of those markets given higher tariffs. However, the lower levels of a priori tariffs on UK-US trade indicates that the overall gains from lowering tariffs will be smaller than when liberalising EU-US trade in goods. In addition, it is worth noting that tariffs are lower on goods exported from the UK than from the rest of the EU. This reflects a greater specialization by the UK in low tariff goods. This means that tariff reductions are going to benefit firms in the UK less than exporters in the remaining EU Member States.

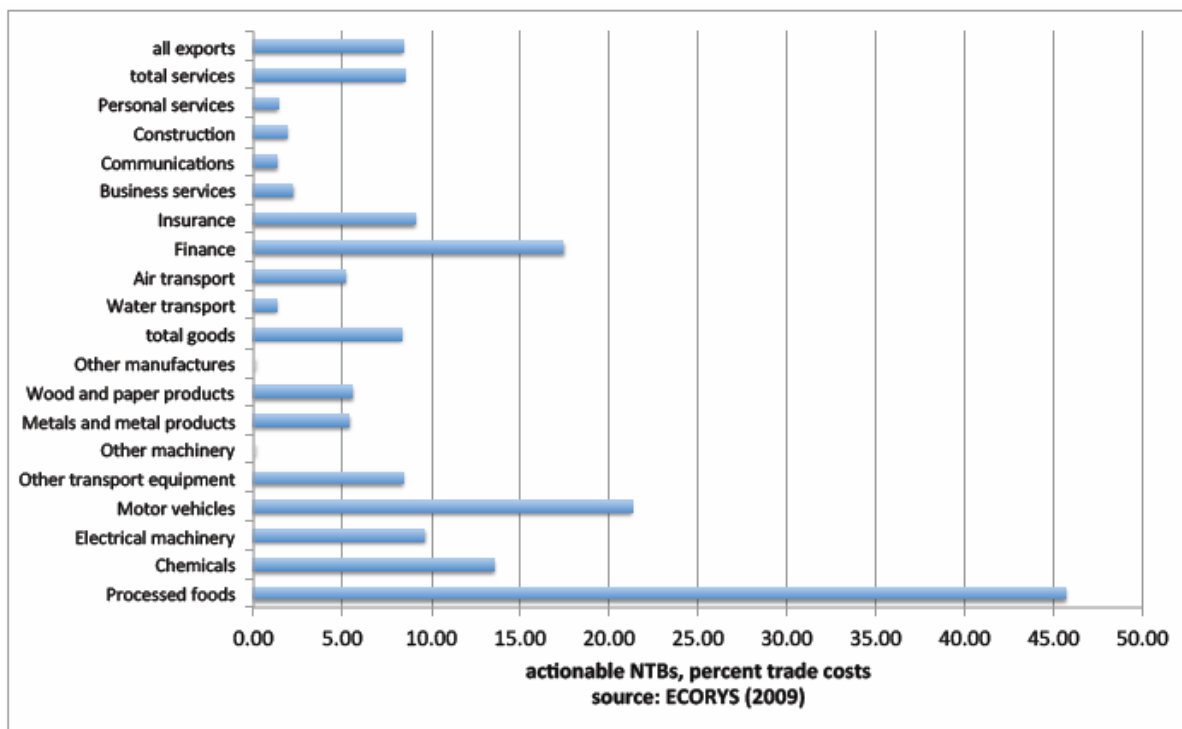
**Figure 7 Level of actionable NTBS, percent trade cost**

Figure 7 above presents the level of NTBs facing UK exports to the US. The costs in the figure represent the per cent of delivered price that is a result of regulatory barriers, both deliberate and incidental, against UK exports. Many of these costs actually follow from differences in regulatory approaches (regulatory divergence). In contrast to tariffs, data on NTBs are not readily available. The estimates employed here originate from the ECORYS (2009) study. The Ecorys estimates NTB costs are based on a mix of surveys with firms, and econometric analysis of firm rankings of trade costs. In the original ECORYS study, barriers were classified into those that can be reduced through negotiation (“actionable” barriers) and those that cannot<sup>1</sup>. Figure 7 presents those that can be reduced.

<sup>1</sup> More specifically, in order to estimate the ad-valorem NTBs and to quantify to what extent those are removable between the two economies, the Ecorys (2009) study undertook a survey as a first step. The survey was conducted on EU and US firms, in which they were asked *if* they were facing NTBs. If NTBs were identified,



Comparison of [Figure 7](#) and [Table 1](#) makes clear that NTB reduction will be far more important than tariff reduction when we examine the overall impact of an FTA. For the UK, given tariff levels, NTB reductions are even more important than tariffs, relative to the general interests of the EU.

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companies were asked about the importance of such barriers. The survey answers were then calculated on a 0 to 100 scale, with 0 indicating that there was no regulatory divergence or any type of non-tariff measure and 100 meaning there were prohibitively high NTBs and levels of regulatory divergence. The business survey restrictiveness indicators were then cross-checked against OECD (2007) restrictiveness indicators and against the Product Market Regulation (PMR) indexes. For the service sectors the combination of the OECD restrictiveness indicators and the survey results were used. The acquired survey data, was then used on a gravity model to estimate the corresponding ad-valorem equivalents of NTBs. On that basis Ecorys (2009) reached cost estimates of existing NTBs for traders in percentage, which can be interpreted similarly to ad-valorem tariffs. These estimates are reported above and used as basis for this study.

### 3 The Model and the Set-up of the Experiments

The following sub-chapter provides a short presentation of the computable general equilibrium model (CGE) model applied in the analysis, while more details are available in the Annex. Later in this chapter, we present the specifics, i.e. e. the data, the baselines and experiments employed in the analysis. In order to make an economic assessment of the impact of the FTA between the EU and the US on the UK, we employ a CGE model of global world trade. CGE models help answering *what-if* questions by simulating the price, income and substitution effects in equilibrium on markets under different assumptions. Here, the economic outcomes of the "baseline" scenario, with no policy effects, are compared to the different scenarios with changes in trade policy. The "baseline" for the model is the equilibrium before the policy change, and the 'scenario' is the equilibrium after the policy change. The effect of the policy change can then be quantified as the difference between the two.

#### 3.1 THE CGE MODEL

The CGE model employed is based on the widely used GTAP model (Hertel, 1997), with added features from the Francois, van Meijl, and van Tongeren (2005) model. More technical details of the model are provided in the annex.

The most important aspects of the model can be summarised as follows:

- it covers global world trade and production
- it allows for scale economies and imperfect competition
- it includes intermediate linkages between sectors
- it allows for trade to impact on capital stocks through investment effects which allows to obtain longer-run impact on the economy

### Box 1. Key features of the model

Model simulations are based on a multi-region global CGE model. Sectors are linked through intermediate input coefficients (based on national social accounts data) as well as competition in primary factor markets. The model includes imperfect competition, short-run and long-run macroeconomic closure options, as well as the standard static, perfect competition, Armington-type of model as a subset. It also allows alternative labour market closures. On the policy side, it offers the option to implement tariff reductions, export tax and subsidy reduction, trade quota expansion, input subsidies, output subsidies, and reductions in trade costs. International trade costs include shipping and logistic services (the source of fob-cif margins) but can also be modelled as Samuelson-type deadweight costs. This can be used to capture higher costs when producing for export markets, due to regulatory barriers or NTBs that do not generate rents (or where the rents are dissipated through rent-seeking).

In the model, there is a single representative composite household in each region, with expenditures allocated over personal consumption and savings. The composite household owns endowments of the factors of production and receives income by selling these factors to firms. It also receives income from tariff revenue and rents accruing from import/export quota licenses. Part of the income is distributed as subsidy payments to some sectors, primarily in agriculture.

Taxes are included at several levels in the modelling. Production taxes are placed on intermediate or primary inputs, or on output. Tariffs are levied at the border. Additional internal taxes are placed on domestic or imported intermediate inputs, and may be applied at differential rates that discriminate against imports. Where relevant, taxes are also placed on exports, and on primary factor income. Finally, where relevant (as indicated by social accounting data) taxes are placed on final consumption, and can be applied differentially to consumption of domestic and imported goods.

On the production side, in all sectors, firms employ domestic production factors (capital, labour and land) and intermediate inputs from domestic and foreign sources to produce outputs in the most cost-efficient way that

technology allow. Perfect competition is assumed in all sectors except heavy manufacturing sectors. In sectors where perfect competition is assumed, products from different regions are assumed to be imperfect substitutes.

Heavy manufacturing sectors are modelled with imperfect or monopolistic competition. Monopolistic competition involves scale economies that are internal to each firm, depending on its own production level. An important property of the monopolistic competition model is that increased specialisation at intermediate stages of production yields returns due to specialisation, where the sector as a whole becomes more productive the broader the range of specialised inputs. These gains spill over through two-way trade in specialised intermediate goods. With these 'spill-overs', trade liberalisation can lead to global scale effects related to specialisation. Similar gains follow from consumer good specialisation.

In the standard GTAP model, tariffs and tariff revenues are explicit in the GTAP database, and therefore in the core model. However, NTBs affecting goods and services trade, as well as cost savings linked to trade facilitation, are not explicit in the database and hence a technical coefficient must be introduced to capture these effects. For this, we instead model NTBs as a mix of dead weight or iceberg costs<sup>2</sup>, and rents generated by NTBs. In formal terms, dead-weights costs capture the impact of non-tariff measures on the price of imports from a particular exporter due to destination-specific changes in costs for production and delivery.

The model incorporates GTAP v8 data. The GTAP data are benchmarked to the year 2007, but this is projected to the base year 2027. (See [Table 2](#) for a list

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<sup>2</sup> We will follow the standard approach to modelling iceberg or dead-weight trade costs in the GTAP framework, originally developed by Francois (1999, 2001) with support from the EC to study the Millennium Round (now known as the Doha Round). This approach has grown from an extension in early applications to a now standard feature of the GTAP model, following Hertel, Walmsley and Itakura (2001). It has featured in the joint EC-Canadian government study on an EU-Canada FTA, as well as the 2009 Ecorys study on EU-US non-tariff barriers.

of regions and sectors). Tariffs reflect the most recent applied rates, as discussed above.

While the GTAP database has 57 sectors and 130 different regions are available, for the purpose of this study we have aggregated sectors and regions to allow us to concentrate on the key results. The sector, and regional aggregations for reporting are presented in [Table 2](#) below.

**Table 2: Sectors and Regions used in the Model.**

Sectors	Regions
Agr forestry fisheries	UK
Other primary sectors	European Union
Processed foods	United States
Chemicals	Other OECD, high income
Electrical machinery	East Europe
Motor vehicles	Mediterranean
Other transport equipment	China
Other machinery	India
Metals and metal products	ASEAN
Wood and paper products	MERCOSUR
Other manufactures	Low Income
Water transport	Rest of World
Air transport	
Finance	
Insurance	

The GTAP8 database includes 134 countries and regions and 57 sectors. In the current aggregation, low income is based on World Bank definitions, and is comprised of much of sub-Saharan Africa, as well as Bangladesh, Laos, and parts of South Asia.

[Table 3](#) below summarises other important data used in the modelling. Here, we present the current MFN rates and current and projected trade shares. Data on the levels of NTBs in place are not readily available, nor are there any absolute measures on how much of them could or should be removed. The aim of the Ecorys (2009) study was to both quantify the ad-valorem NTBs and to quantify to what extent those are removable between the EU and US. Those measures are incorporated in this study, and summarised in the third and fourth column of [Table 3](#).

**Table 3: Underlying applied (MFN) tariff rates, NTBS.**

	Tariffs		ECORYS (2009) estimates of actionable NTBs, per cent trade costs	
	EU	US	EU	US
Agr forestry fisheries	3.7	3.7		
Other primary sectors	0.0	0.0		
Processed foods	14.6	3.3	30.3	45.6
Chemicals	2.3	1.2	9.1	13.5
Electrical machinery	0.6	0.3	8.1	9.6
Motor vehicles	8.0	1.2	17.2	21.3
Other transport equipment	1.3	0.2	5.6	8.4
Other machinery	1.3	0.8	†	†
Metals and metal products	1.6	1.3	5.2	5.4
Wood and paper products	0.5	0.2	8.4	5.6
Other manufactures	2.4	3.2	†	†
Water transport			4.5	5.2
Air transport			1.1	1.3
Finance			7.0	17.4
Insurance			5.6	9.1
Business services			4.3	2.2
Communications			8.2	1.3
Construction			2.6	1.9
Personal services			2.5	1.4
Other (public) services			**	**

Source: GTAP 8 and WTO, CEPII, UNCTAD as mapped to GTAP 8.

† While the ECORYS study covered other machinery, not significant barriers were identified. At the same time "other manufactures" include a diverse basket of products not covered in the original study.

\*\* Not covered by the ECORYS estimates. This sector includes education and health care services.

As can be seen from the first two columns, the MFN tariffs are much higher than bilateral tariffs (see Table 1 above). The EU's MFN rates tend to be higher for several sectors than the US's. This is especially the case for processed foods and motor vehicles, where MFN rates are 15 and 8 per cent respectively.

The ECORYS (2009) estimates of actionable NTBS -as percentage trade costs- are higher than MFN tariff rates. Some sectors have higher NTBs in the EU than in the US, and vice versa. Two sectors in particular exhibit the highest levels of

NTBs for both economies: Processed foods (30 and 46 per cent respectively) and motor vehicles (17 and 21 per cent). These are also the sectors with the highest MFN rates, which points to these sectors having the highest barriers to trade overall.

### 3.2 SCENARIOS

We next turn to the scenarios assumed for the CGE model applied in the analysis. The experiments are set up around a baseline and stylised modelling scenarios. The purpose of the baseline is to examine the impact of the FTA relative to the expected position of the economy if the policy was not implemented.

Contrasting to the idea of removing tariffs, it is not realistic to assume that all NTBs can be removed due to the underlying differences in the nature of these measures. As a result, when modelling the liberalisation of NTBs, we take into account the degree to which explicit NTBs or trade costs from regulatory divergence can realistically be reduced (via various means and techniques). Following ECORYS (2009), approximately 50 per cent of all NTBs indeed are removable. The approximation is based on expert opinions, crosschecks with regulators, legislators and businesses supported by the business survey from the Ecorys (2009) study. Nevertheless, this estimate should be seen as a somewhat rough estimate and thus should be interpreted with some caution.

The estimates reported below are set up around two basic scenarios, differing with respect to the levels of ambition with regards to liberalisation: an ambitious scenario; and a modest scenario. These scenarios are then modified to allow for greater liberalisation of NTBs in certain sectors. The underlying assumptions in the modelling scenarios are summarised in [Table 4](#) below.

**Table 4 Overview Scenario Definitions**

<b>Scenario/ Liberalisation Measures</b>	<b>Tariff Removal</b>	<b>Reduction of NTBs</b>
Basic ambitious scenario	100 %	50 % of actionable NTBs
Basic modest scenario	100%, except limited reductions for processed food	25% of actionable NTBs
Modified ambitious scenario	100%	50% of actionable NTBs, except 75% NTBs in chemicals, motor vehicles, business/ICT services
Modified modest scenario:	100% tariffs, except limited reductions for processed foods.	25% of actionable NTBs, except 50% NTBs in chemicals, motor vehicles, business/ICT services.

The basis for the modest scenarios is the assumption of 98 per cent tariff removal (there are limited reductions for processed food) and a reduction of actionable NTBs of 25 per cent (i.e a 25 percent reduction of the Ecorys NTM estimates presented above). In the modified version, the levels of NTM reductions are higher in chemicals, motor vehicles and business/ICT sectors (modelled as 50% reductions). The ambitious scenarios assume 100 per cent removal of tariffs in goods and a 50 per cent overall reduction of actionable NTBs. Here, in the modified version NTB reductions are 75% for the chemicals, motor vehicles and business/ICT sectors. In the modest scenario, processed food liberalization is limited because these are the sectors that stand out in terms of protection and political sensitivity, and so are candidates for treatment as “highly sensitive” sectors. Chemicals, motor vehicles, and Business/ICT services are emphasized in the modified scenarios because of their importance to overall UK exports (See [Table 1](#) and



Table 6.)

Policy changes in general, and the lowering of NTBs in particular, will take time to implement and take effect. To allow time for these changes, the baseline has been projected into 2027. In order to take this into account in the modelling, the UK, the EU and the US economies have been projected to grow as presented in Table 5 below.<sup>3</sup> The projection includes a number of agreed FTAs (EU-Korea, Central America, and MERCOSUR, and US-Korea, US-Central America).

**Table 5: Assumed Growth Rates in Projections, 2007-2027**

	2007-2016	2017-2027	2007-2027
United Kingdom	0.863	2.056	1.489
EU26	0.749	1.731	1.265
United States	1.662	2.595	2.151

Source: IMF and model baseline values.

### 3.3 BENCHMARKING EXPECTATIONS

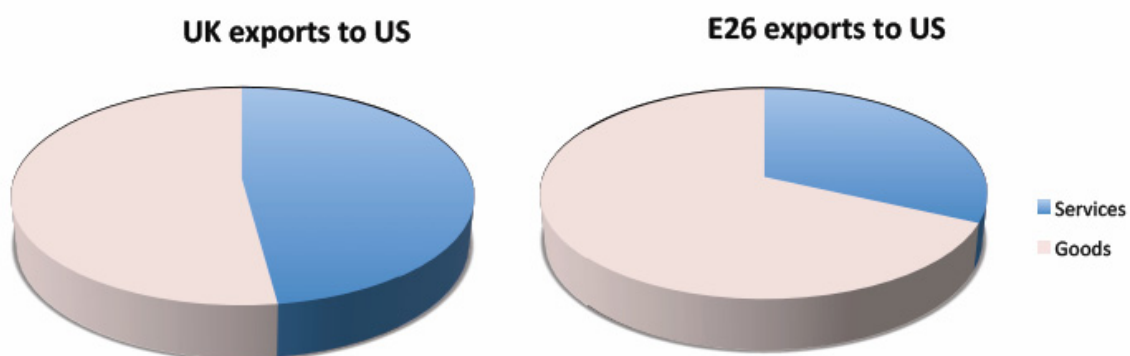
So far in this section we have spelled out trade flows, tariffs, and non-tariff barriers. We have also mapped these into our basic experiment structure. In what follows we will focus in detail on the estimated impacts of the FTA on the UK economy. Before doing so, it is useful to revisit the structure of production, trade, and protection in the context of the experiments outlined above. Our goal in doing so is to basically benchmark expectations about likely effects. In other words, before we turn to modelling results, we want to provide a non-model based ranking of some important sources of likely effects. This will provide some intuition as we wade into the results of our CGE estimates in the next section.

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<sup>3</sup> Historic and projected growth post 2007 is based on IMF estimates, combined with an assumption of only a gradual return toward pre-recession rates. More rapid recovery would imply greater absolute effects, but very similar relative effects.

Consider first the basic pattern of trade. This is shown in **Figure 8** below for the GTAP reference year (2007). The same picture applies if we focus on the projected benchmark flows (2027). The point of the figure is that, for the UK, services are far more important as a share of total exports than they are for the EU as a whole. They are roughly one-third of EU26 exports, but close to half of UK exports on a gross value basis. On this basis, services liberalization matters more in relative terms for the UK than for the EU as a whole. Critically, our estimates of NTB levels and scope for reduction, limited in part by actionability, are lower for services than for merchandise. On top of this, tariff reductions apply of course to goods but not services. As such, the heavier focus on services for the UK means slightly less overall NTB reductions as a share of total value of exports to the US. The simple average NTB level from **Table 3** for goods is 14.3, while for services it is 4.9. With a rough 50:50 goods:services split for the UK and a 70:30 split for the EU26, this implies an approximate 9.5 percent reduction in trade costs for UK exports and an 11.5 percent trade cost reduction for the EU26.

**Figure 8: Export composition to the US**



We consider next a more detailed decomposition of UK exports, mapped to protection levels. This involves the data summarized in

Table 7 below. In the Table, column A summarizes the total value of tariffs and actionable NTBs (as defined by Ecorys) applied by the US against UK exports. The next column summarizes the importance of each sector to total UK exports to the US. Column B is based on the value added contained in exports.<sup>4</sup> In column B, we see that chemicals are 12.98 percent of exports on a value added basis, less than the gross value (See Table 1). As a crude first pass at possible effects, column D provides an impact-ranking index. This is based on the value added contained in exports by sector (B), the scope for liberalization (A), and the price elasticity of demand for imports (C). Together, these provide a rough estimate of increased exports, on a value added basis, following from improved market access to the US for EU firms. For example, of the total value added contained in EU exports to the US, column D says that full liberalization in chemicals could yield a 5.66 percent increase in total exports to the US on a value added basis. As it is value added that translates into GDP, the index also provides a crude ranking of overall GDP impacts of sector-specific changes in market access.

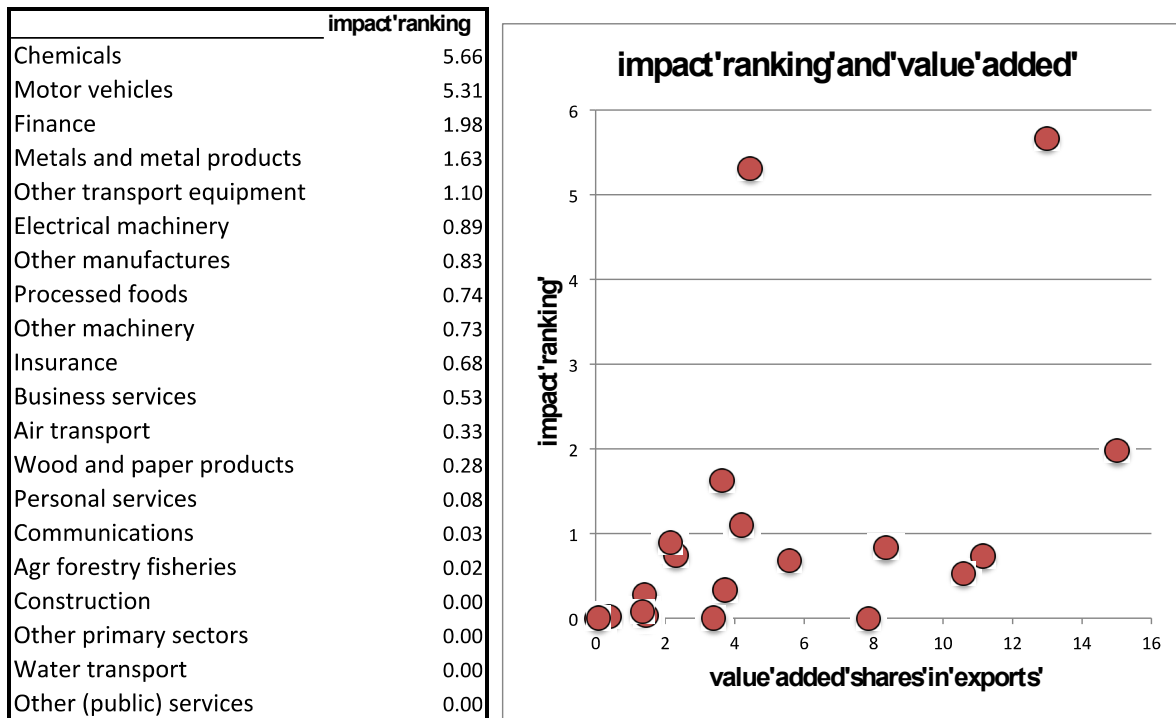
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<sup>4</sup> See Francois, Manchin, and Tomberger (2012) for explanation of the value added calculations, which are based on our CGE model database

**Table 6 NTB reduction impact indexes**

	A	B	C	D=AxBxCx.01
	Combined trade cost, tariff reduction	Export value added share	Price elasticity	Percent impact on total export value added
Agr forestry fisheries	1.30	0.36	4.77	0.02
Other primary sectors	0.01	3.39	12.13	0.00
Processed foods	13.12	2.31	2.46	0.74
Chemicals	8.57	12.98	5.09	5.66
Electrical machinery	4.33	2.14	9.65	0.89
Motor vehicles	11.95	4.44	10.00	5.31
Other transport equipment	3.68	4.20	7.14	1.10
Other machinery	0.68	11.15	9.71	0.73
Metals and metal products	3.22	3.63	13.91	1.63
Wood and paper products	2.52	1.41	7.99	0.28
Other manufactures	1.52	8.36	6.56	0.83
Water transport	0.63	0.03	3.80	0.00
Air transport	2.35	3.72	3.80	0.33
Finance	6.46	15.01	2.04	1.98
Insurance	3.84	5.58	3.18	0.68
Business services	1.58	10.58	3.18	0.53
Communications	0.65	1.45	3.18	0.03
Construction	0.90	0.07	4.21	0.00
Personal services	0.66	1.35	8.71	0.08
Other (public) services	0.00	7.85	3.92	0.00

**Table 7: Impact ranking indexes** **Figure 9 Impact rankings & value added in exports**



Source: own calculations.

These are of course partial equilibrium. They miss cross-sector effects, including labour market interaction and intermediate linkages. They also miss consumer benefits from access to more goods and services. Even so, they provide a clear ranking of likely effects. This ranking carries through the estimates in the next chapter, and so it is worth discussing the pattern for the impact indexes briefly. In Table 7 and Figure 9 above we have mapped value added against impacts. From the table and figure, we can see that for motor vehicle, though it is not dominant on a value added basis, the combination of high elasticities and high trade barriers means that, overall, this sector is likely to dominate in terms of impact. By the same logic, despite the fact that “other machinery” is a major sector on a value added basis, the low level of barriers means it does not rank highly in terms of expected benefits from

improved market access. On the basis of these rankings, the manufacturing sectors are likely to have the greatest impact by far overall on the UK economy. This includes motor vehicles, chemicals, processed foods, and other transport equipment. In contrast, while value added shares are comparable for the services sectors, only financial services are in the top 5. Indeed, while financial services are more important on a value added basis than either chemicals or motor vehicles, they rank below both of these for expected impact. The combination of elasticities, barriers levels, and value added shares means that, overall, we expect the greatest impact of market access on exports and GDP to be from liberalization on good sectors, and especially chemicals and machinery (vehicles and other transport equipment). This pattern is confirmed when we report CGE estimates in the next chapter. Manufacturing liberalization is the primary driver of benefits from improved trade-related market access.

## 4 Modelling results

### 4.1 OVERVIEW OF THE ECONOMIC EFFECTS FOR THE UK, US AND EU

In this chapter, we report the economic impacts resulting from the CGE simulation of the EU- US FTA. First, we report the aggregated results for the US, the EU and the UK. We then take a closer look at the results by examining the effects on a more disaggregate level. The overall economic effects for the four different scenarios are presented in [Table 8](#) and [Table 9](#) with the effects decomposed into tariffs and NTBs.

Removing barriers to trade between the EU and US is expected to lead to an increase in GDP for the EU, UK and US across all scenarios. For the UK, GDP is expected to increase by between £4 and £10 billion, which amounts to a maximum 0.35 per cent increase in GDP. The corresponding figures for the EU and US are £51-114 Billion and £27-64 billion respectively. Given the scope of liberalization, the gains are smaller in the modest scenarios and greater in the ambitious ones.

In relative terms, i.e. as shares of GDP, the effects for the US and UK economies are similar (increases ranging from 0.15 to 0.37 per cent of GDP), while for EU27, the relative gains are about twice as big (increases are estimated to be between 0.4 and 0.8 per cent of GDP). The difference in the magnitude of the impact of a potential FTA on the UK and the EU is partly due to the difference in the initial level of openness between the UK and the US, and the EU and the US, respectively. It is also due to trade diversion, because the EU is a major partner of the UK (more so than the US). Trade diversion is discussed with respect to [Figure 10](#) below. The EU as a whole is expected to benefit more from liberalization since the removable barriers are higher. [Table 1](#) above provided details on the weighted average tariffs faced by UK and EU exporters to the US. The tariffs on total exports are about twice as large for



the EU as a whole (excluding the UK) than for UK traders. Thus once these barriers are removed, the gains are likely to be somewhat higher for the traders facing higher barriers currently.

**Table 8: Macroeconomic effects on the UK, EU 26 and US, Modest Scenarios, 2027 Baseline**

	Basic Modest Scenario			Modified Modest		
	Total	Tariffs	NTBs	Total	Tariffs	NTBs
<b>GDP, per cent change</b>						
United Kingdom	0.14	0.03	0.11	0.17	0.03	0.14
EU26	0.37	0.17	0.20	0.45	0.17	0.27
United States	0.16	0.04	0.13	0.20	0.04	0.17
<b>GDP, million pounds</b>						
United Kingdom	4,086	946	3,140	5,056	975	4,081
EU26	51,148	23,577	27,571	62,271	24,116	38,155
United States	26,644	6,096	20,549	33,412	6,243	27,169
<b>Exports, per cent</b>						
United Kingdom	1.22	0.42	0.80	1.49	0.43	1.06
EU26	1.18	0.53	0.65	1.47	0.54	0.93
United States	3.57	1.90	1.66	4.32	1.99	2.33
<b>Exports, million pounds</b>						
United Kingdom	7,736	2,647	5,089	9,425	2,710	6,715
EU26	61,209	27,265	33,944	76,300	28,066	48,234
United States	62,451	33,343	29,108	75,689	34,851	40,837
<b>Imports, per cent</b>						
United Kingdom	1.03	0.35	0.68	1.26	0.36	0.90
EU26	1.18	0.52	0.65	1.47	0.54	0.93
United States	2.32	1.24	1.08	2.81	1.29	1.52
<b>Imports, million pounds</b>						
United Kingdom	8,305	2,841	5,463	10,118	2,909	7,209
EU26	64,793	28,778	36,015	80,823	29,628	51,195
United States	64,115	34,230	29,885	77,707	35,779	41,928

**Table 9: Macroeconomic Effects on the UK, EU 26 & US, Ambitious Scenarios  
2027 Baseline**

Scenario:	Basic Ambitious			Modified Ambitious		
	Total	Tariffs	NTBs	Total	Tariffs	NTBs
<i>GDP, per cent change</i>						
United Kingdom	0.27	0.04	0.23	0.35	0.04	0.31
EU26	0.61	0.18	0.43	0.82	0.19	0.63
United States	0.31	0.04	0.27	0.39	0.04	0.35
<i>GDP, million pounds</i>						
United Kingdom	7,804	1,052	6,752	10,139	1,128	9,011
EU26	84,820	25,226	59,594	114,460	26,540	87,920
United States	50,995	6,260	44,735	63,563	6,342	57,222
<i>Exports, per cent</i>						
United Kingdom	2.21	0.45	1.76	2.90	0.47	2.43
EU26	2.02	0.57	1.45	2.79	0.60	2.18
United States	5.84	2.11	3.73	7.45	2.28	5.17
<i>Exports, million pounds</i>						
United Kingdom	13,998	2,852	11,146	18,379	2,999	15,380
EU26	104,596	29,431	75,165	144,551	31,282	113,269
United States	102,222	36,960	65,262	130,497	39,969	90,528
<i>Imports, per cent</i>						
United Kingdom	1.87	0.38	1.49	2.46	0.40	2.06
EU26	2.01	0.56	1.45	2.78	0.60	2.18
United States	3.79	1.37	2.42	4.84	1.48	3.36
<i>Imports, million pounds</i>						
United Kingdom	15,028	3,062	11,966	19,732	3,219	16,512
EU26	110,843	31,080	79,763	153,289	33,048	120,241
United States	104,950	37,946	67,004	133,977	41,034	92,943

Source: CGE modelling.

Looking at the gains attributable to removing tariffs as opposed to lowering NTBs, it is obvious that the majority of the increase is attributable to the lowering of NTBs. For the UK and US, this is particularly true. Here, the reduction of NTBs is accountable for up to 90 per cent of the increase in GDP. The lower share of gains from the removal of tariffs for the UK and US, as well as the lower aggregated effect is due to the lower *a priori* levels of tariffs between the US and UK, than between the US and EU.

The relative importance of lowering NTBs is also made obvious when comparing the gains from the ambitious liberalization scenarios as opposed to the modest set up.

Exports from both the EU and UK are estimated to increase by 1.2 to close to 3 per cent across the different liberalization scenarios. US exports, on the other hand are expected to increase by up to 7.5 per cent, or £ 130 Billion in the modified ambitious scenario. Three quarters of this increase is attributable to the lowering of NTBs. Thus, these results again highlight the importance of NTBs for the potential FTA.

In value terms, the corresponding increase in imports is very similar to the estimated increase in exports. For the EU and UK, the percentage increase also corresponds closely to the export figures. However, in relative (percentage) terms, the increase in US imports is smaller than in the case of exports. Here, the estimated increase in imports ranges from 2.3 to 4.8 per cent.

**Figure 10 Decomposition, modified ambitious scenario**

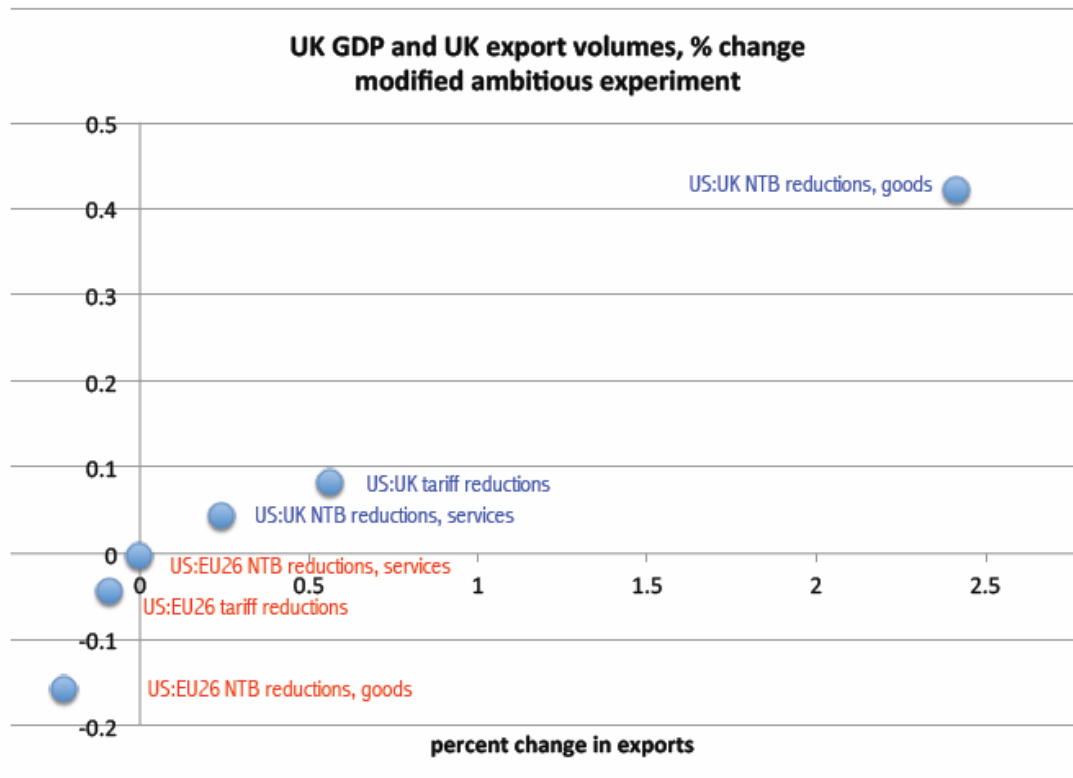


Figure 10 presents a decomposition of the relative contribution of tariff reductions and NTB reductions on UK GDP and exports. These are further broken down into effects from direct US: UK liberalization and into effects from US: EU liberalization. The first set of effects captures the positive effects of direct liberalization and the second capture negative effects from trade diversion away from the UK. The greatest gains are from NTB reductions for goods. At the same time, there is an offset from the gains from goods NTB reductions linked to the same NTB reductions applied to US trade with the other 26 Members of the EU. In particular, GDP increases .43 percent from US: UK liberalization of goods NTBs, and falls 0.16 percent with US: EU26 liberalization. In total, bilateral US: UK liberalization leads to a gain of 0.55 percent in UK GDP, but this is offset by a -0.21 percent effect related to trade diversion (liberalization between the US and EU26). While the total effect is positive and substantial, it is smaller than a pure bilateral assessment would suggest.



## 4.2 DETAILED UK IMPACTS

In this section, the effects on the UK economy are discussed in greater detail. The estimated effects on a number of macroeconomic variables are summarized for the different scenarios in [Table 10](#) and [Table 11](#) below.

**Table 10: Macroeconomic Effects on UK, Modest Scenarios, 2027 baseline**

	Basic Modest Scenario			Modified Modest		
	Total	Tariffs	NTBs	Total	Tariffs	NTBs
GDP, per cent change	0.14	0.03	0.11	0.17	0.03	0.14
GDP, million pounds	4,086	946	3,140	5,056	975	4,081
National income, million pounds	3,870	718	3,152	4,880	741	4,139
Real national income, per cent	0.13	0.02	0.11	0.17	0.03	0.14
Total exports, per cent	1.22	0.42	0.80	1.49	0.43	1.06
Total imports, per cent	1.03	0.35	0.68	1.26	0.36	0.90
Terms of trade	0.09	0.01	0.07	0.11	0.01	0.10
Real wages less skilled, per cent	0.21	0.07	0.15	0.27	0.07	0.20
Real wages more skilled, per cent	0.21	0.07	0.15	0.26	0.07	0.19

Source: CGE modelling.

**Table 11: Macroeconomic Effects on UK, Ambitious Scenarios, 2027 baseline**

	Basic Ambitious Scenario			Modified Ambitious		
	Total	Tariffs	NTBs	Total	Tariffs	NTBs
GDP, per cent change	0.27	0.04	0.23	0.35	0.04	0.31
GDP, million pounds	7,804	1,052	6,752	10,139	1,128	9,011
National income, million pounds	7,613	803	6,811	10,121	864	9,257
Real national income, per cent	0.26	0.03	0.23	0.35	0.03	0.32
Total exports, per cent	2.21	0.45	1.76	2.90	0.47	2.43
Total imports, per cent	1.87	0.38	1.49	2.46	0.40	2.06
Terms of trade	0.18	0.01	0.16	0.25	0.02	0.23
Real wages less skilled, per cent	0.39	0.07	0.32	0.53	0.08	0.45
Real wages more skilled, per cent	0.38	0.07	0.31	0.50	0.08	0.42

Source: CGE modelling.

The third row of the tables shows the corresponding effect on national income. The estimated effect on national income, as opposed to changes in

GDP (which is based on quantities, measuring output changes at fixed prices) also takes into account changes in consumer prices and wages. National income effects technically are equivalent variations measuring the difference between the expenditure required to obtain the new (post-simulation) level of utility at initial prices. Changes in national income correspond closely to the changes in GDP, with the highest gains of about 10 billion pounds expected to take place under the modified ambitious scenario. The crucial importance of liberalizing non-tariff barriers is again highlighted by the results. Of these £10 billion, more than £9 billion is attributable to reducing NTBs while less than 10 per cent of the national income gains follow from tariff liberalization.

A country's terms of trade reflects how much its exports worth in terms of imports. Thus, an improvement (or a positive change) in a country's terms of trade will imply that it can afford to buy more imports for every unit of its exports sold. The corresponding changes in terms of trade are summarized on the seventh rows in [Table 10](#) and [Table 11](#). The estimated effects on terms of trade are quite small, ranging from 0.1 to 0.3 per cent. These also point to primary gains from NTBs rather than tariffs.

The last two rows of [Table 10](#) and [Table 11](#) show the expected effects on real wages for less and more skilled workers. For all workers, increased trade is shown to lead to increased wages between 0.2 to 0.5 per cent with the changes being very similar for more and less skilled workers.

#### 4.2.1 SECTOR SPECIFIC EFFECTS

We next turn to changes on a more disaggregate, sector specific level. First, we look at the changes in sector specific output and then we move on to the estimated changes in trade. The estimated changes in sector specific output for the UK are summarized in [Table 12](#) below. Except for motor vehicles, changes are relatively small across all scenarios, and the pattern is consistent across all scenarios.

**Table 12: Change in UK Output by sector, per cent, Total, 2027 base line**

<b>Sector/Scenario</b>	<b>Basic Ambitious</b>	<b>Basic Modest</b>	<b>Modified Ambitious</b>	<b>Modified Modest</b>
Agr forestry fisheries	0.00	0.02	-0.03	0.01
Other primary sectors	-0.02	0.00	-0.02	-0.01
Processed foods	0.50	0.25	0.55	0.28
Chemicals	0.45	-0.25	1.65	-0.13
Electrical machinery	0.93	0.87	-0.36	0.57
Motor vehicles	4.09	1.65	7.29	2.84
Other transport equipment	-0.44	-0.31	-0.88	-0.44
Other machinery	0.01	0.34	-0.51	0.23
Metals and metal products	-1.48	-0.71	-1.87	-0.80
Wood and paper products	-0.14	-0.01	-0.21	-0.02
Other manufactures	-0.50	-0.20	-0.73	-0.28
Water transport	0.12	0.12	0.05	0.10
Air transport	-0.09	0.01	-0.23	-0.03
Finance	1.13	0.61	1.14	0.63
Insurance	0.69	0.37	0.71	0.39
Business services	0.14	0.09	0.15	0.10
Communications	0.15	0.10	0.17	0.12
Construction	0.40	0.22	0.50	0.27
Personal services	-0.14	-0.03	-0.23	-0.05
Other services	0.13	0.07	0.17	0.08

Source: CGE modelling.

Output in primary sectors is largely unaffected, while output in the services sectors expands. However these changes are small, less than 0.5 per cent, with the exception of the finance sector, which is estimated to increase by a little over 1 per cent in the ambitious scenarios. This is a sector with relatively large NTBs (See [Figure 7](#)).

In the manufacturing sectors, the estimated changes are generally higher. The most notable change is in the motor vehicles sector, which in the modified ambitious scenario (where a 75 per cent reduction of NTBs in this sector is assumed) is expected to increase by over 7.3 per cent. Of this, 7.6 per cent of the increase is attributable to the lowering of NTBs for goods.

Chemicals, where an increase of 1.65 per cent in output is estimated to take place under the modified ambitious scenario, and Business Services, with a



0.15 per cent increase. In both of these sectors NTBs are lowered by 75% under the modified ambitious scenario. Thus, this again points to the fact that the level of NTB reductions is very closely related to the magnitude of the effects. In a few sectors the sign of the impact on output varies between the different scenarios. For example in chemicals in the modest scenarios the UK's output falls marginally, whilst in the ambitious scenarios it rises marginally. This is because there is an interaction of effects taking place. While some sectors expand for example more, those sectors require more workforce thus attracting workers from other sectors. This in turn results in contraction of some other sectors. Thus some scenarios can also have an indirect impact on sector output.

The estimated changes in trade follow the changes in output. We see an increase in exports in most sectors (see [Table 13](#)). Most striking is the export of motor vehicles, which is estimated to increase by as much 15 and 26 per cent, in the ambitious scenarios. Exports of metals and metal products, processed foods and insurance are all expected to increase by between 2 and 5 per cent. Again, mainly lowering of NTBs drives these changes.

Turning to imports, the changes are largest for vehicles, other transport equipment and metals (see [Table 14](#)). The motor vehicle and transport equipment pattern fits with greater two-way trade in parts and components and a general rise on integration of the industry in the UK with the North American industry.

**Table 13: Change in total UK exports by sector, per cent 2027 baseline**

<b>Sector/Scenario</b>	<b>Basic Ambitious</b>	<b>Basic Modest</b>	<b>Modified Ambitious</b>	<b>Modified Modest</b>
Agr forestry fisheries	0.06	0.34	-0.01	0.31
Other primary sectors	0.38	0.21	0.53	0.27
Processed foods	4.52	2.52	4.73	2.60
Chemicals	3.83	1.55	6.76	2.44
Electrical machinery	2.77	1.74	1.24	1.35
Motor vehicles	15.18	6.89	25.62	10.84
Other transport equipment	3.35	1.74	2.80	1.58
Other machinery	0.60	1.12	-0.16	0.94
Metals and metal products	5.30	3.16	4.69	2.99
Wood and paper products	1.63	0.98	1.49	0.97
Other manufactures	0.46	0.88	0.10	0.75
Water transport	0.46	0.27	0.54	0.30
Air transport	0.11	0.11	-0.02	0.08
Finance	3.12	1.62	3.21	1.68
Insurance	3.68	1.96	3.67	2.00
Business services	0.41	0.28	0.54	0.36
Communications	0.55	0.38	0.68	0.43
Construction	-0.19	-0.04	-0.32	-0.08
Personal services	-0.80	-0.25	-1.40	-0.43
Other services	-0.10	0.03	-0.22	0.00

Source: CGE modelling.

**Table 14: Change in total UK imports by sector, per cent 2027 baseline**

	<b>Basic Ambitious</b>	<b>Basic Modest</b>	<b>Modified Ambitious</b>	<b>Modified Modest</b>
Agr forestry fisheries	1.07	0.73	1.25	0.79
Other primary sectors	0.05	0.11	0.05	0.12
Processed foods	1.66	1.05	1.88	1.12
Chemicals	2.44	1.57	3.16	2.05
Electrical machinery	0.74	0.35	1.04	0.44
Motor vehicles	3.31	1.76	5.00	2.41
Other transport equipment	4.69	2.74	5.09	2.86
Other machinery	1.25	0.71	1.82	0.88
Metals and metal products	4.60	2.56	5.37	2.84
Wood and paper products	2.16	1.00	2.58	1.13
Other manufactures	1.46	0.84	1.97	1.00
Water transport	0.61	0.32	0.81	0.39
Air transport	0.73	0.34	0.99	0.42
Finance	1.74	0.84	2.00	0.92
Insurance	1.39	0.59	1.64	0.66
Business services	1.21	0.56	1.76	0.75
Communications	1.68	0.78	2.02	0.88
Construction	1.30	0.59	1.70	0.71
Personal services	2.97	1.25	3.69	1.45
Other services	0.93	0.38	1.36	0.50

Source: CGE modelling.

Next, we turn to the resulting effects for labour [Table 15](#) and [Table 16](#) present the estimated effects on employment and displacement. The closure of the model is such that total employment is kept constant. Therefore the different scenarios result in labour moving between sectors.

**Table 15: Total Change in UK Less Skilled Employment by Sector, per cent 2027 baseline**

	<b>Basic Ambitious</b>	<b>Basic Modest</b>	<b>Modified Ambitious</b>	<b>Modified Modest</b>
Agr forestry fisheries	-0.03	0.02	-0.08	0.00
Other primary sectors	-0.11	-0.05	-0.16	-0.06
Processed foods	0.31	0.15	0.31	0.16
Chemicals	0.29	-0.31	1.37	-0.22
Electrical machinery	0.71	0.72	-0.57	0.42
Motor vehicles	3.86	1.55	6.93	2.69
Other transport equipment	-0.54	-0.36	-1.00	-0.50
Other machinery	-0.11	0.26	-0.66	0.13
Metals and metal products	-1.52	-0.73	-1.93	-0.83
Wood and paper products	-0.28	-0.08	-0.39	-0.11
Other manufactures	-0.61	-0.26	-0.87	-0.35
Water transport	-0.03	0.03	-0.15	0.00
Air transport	-0.36	-0.14	-0.57	-0.21
Finance	0.87	0.47	0.81	0.46
Insurance	0.50	0.27	0.47	0.27
Business services	-0.15	-0.07	-0.22	-0.09
Communications	-0.07	-0.02	-0.12	-0.03
Construction	0.11	0.07	0.11	0.07
Personal services	-0.33	-0.14	-0.48	-0.18
Other services	-0.02	-0.01	-0.04	-0.02
<i>Displacement Index</i>	0.58	0.26	0.99	0.39

N.B.: Displacement index is the weighted mean deviation (square root of the weighted mean squared variation). Source: CGE Modelling.

The changes in employment of less skilled labour are relatively small, and naturally follow the presented effects in output ([Table 12](#)). The sector where somewhat outsized employment changes are estimated to take place is the motor vehicles sector. This is due to the expansion of the sector. As output is estimated to increase, employment also increases in this sector, with an

expected 6.9 per cent increase in less skilled employment under the modified ambitious scenario. Looking at the displacement index (an indicator of the share of the workforce that is shifted between sectors), up to one per cent of the UK labour force is shown to move between sectors as a result of increased trade with the US.

**Table 16: Total Change in UK More Skilled Employment by Sector, per cent 2027 baseline**

Sector/scenario	Basic Ambitious	Basic Modest	Modified Ambitious	Modified Modest
Agr forestry fisheries	-0.02	0.02	-0.07	0.01
Other primary sectors	-0.11	-0.05	-0.15	-0.06
Processed foods	0.32	0.16	0.34	0.16
Chemicals	0.30	-0.31	1.40	-0.21
Electrical machinery	0.72	0.73	-0.54	0.43
Motor vehicles	3.88	1.55	6.96	2.70
Other transport equipment	-0.52	-0.36	-0.98	-0.49
Other machinery	-0.10	0.27	-0.63	0.14
Metals and metal products	-1.51	-0.73	-1.90	-0.82
Wood and paper products	-0.26	-0.08	-0.36	-0.10
Other manufactures	-0.59	-0.25	-0.85	-0.34
Water transport	-0.02	0.04	-0.11	0.01
Air transport	-0.35	-0.14	-0.54	-0.20
Finance	0.88	0.47	0.84	0.47
Insurance	0.51	0.28	0.50	0.28
Business services	-0.13	-0.06	-0.19	-0.08
Communications	-0.05	-0.01	-0.09	-0.02
Construction	0.12	0.07	0.15	0.08
Personal services	-0.32	-0.13	-0.45	-0.17
Other services	-0.01	-0.01	-0.01	-0.01
Displacement Index	0.44	0.20	0.74	0.29

N.B.: Displacement index is the weighted mean deviation (square root of the weighted mean squared variation). Source: CGE Modelling.

The resulting changes in employment of more skilled labour are similar, albeit smaller in magnitude in most of the sectors relative to the estimated changes in less skilled labour employment. Again, we see outsized effects in the motor vehicles sector for more skilled workers. The displacement index for more skilled workers ranges between 0.2 and 0.7 per cent, implying that less than

one percent of jobs is shifted between sectors for skilled workers. This means there is more relocation of less skilled than more skilled employment. From [Table 10](#) and [Table 11](#), this is accompanied by increased labour demand and higher wages.

#### 4.2.2 STATIC VS DYNAMIC EFFECTS

The CGE scenarios include long-run capital accumulation (investment effects). This is a response to changes in general productivity with policy changes under the FTA. In order to better understand the contribution of these long-run dynamic effects to the total impact of the FTA, the results presented in [Table 10](#) and [Table 11](#) are disaggregated according to static vs. dynamic effects in [Table 17](#) and [Table 18](#)

Our short-run or static estimates correspond to the impact of an agreement as observed in 2027, if the agreement were fully introduced and implemented in 2027. The longer-term (dynamic) estimates provide an overview of the observed impact assuming that the agreement already has been in place for several years, such that investment effects are fully realized. Hence, the estimates with capital accumulation provide a sense of the eventual outcome from dynamic gains linked to the agreement. On the other hand, short-run estimates do not incorporate investment effects. These estimates reflect the impact of changes in prices resulting from trade liberalization on trading patterns, which spills into changes in output leading to changes in wages.

From [Table 17](#) and [Table 18](#), the static changes account for about one third of the increases in GDP and national income, while dynamic effects account for the remaining two thirds. However, larger changes take place in the short-run in trade and real wages, than over the long run.

**Table 17: Comparison of static and dynamic effects on macro economic variables, modest scenarios, 2027 baseline**

	Basic Modest Scenario			Modified Modest		
	Total	Static	Dynamic	Total	Static	Dynamic
GDP, per cent change	0.14	0.04	0.10	0.17	0.06	0.11
GDP, million pounds	4,086	1,289	2,798	5,056	1,731	3,325
National income, million pounds	3,870	1,233	2,636	4,880	1,793	3,088
Real national income, per cent	0.13	0.04	0.09	0.17	0.06	0.11
Total exports, per cent	1.22	1.09	0.14	1.49	1.32	0.16
Total imports, per cent	1.03	0.92	0.11	1.26	1.12	0.14
Terms of trade	0.09	0.06	0.02	0.11	0.08	0.03
Real wages less skilled, per cent	0.21	0.12	0.09	0.27	0.15	0.11
Real wages more skilled, per cent	0.21	0.12	0.09	0.26	0.16	0.10

Source: CGE modelling.

**Table 18: Comparison of static and dynamic effects on macroeconomic variables for ambitious scenarios, 2027 baseline**

	Basic Ambitious Scenario			Modified Ambitious		
	Total	Static	Dynamic	Total	Static	Dynamic
GDP, per cent change	0.27	0.09	0.17	0.35	0.13	0.22
GDP, million pounds	7,804	2,721	5,082	10,139	3,814	6,325
National income, million pounds	7,613	2,771	4,842	10,121	4,294	5,827
Real national income, per cent	0.26	0.09	0.17	0.35	0.15	0.20
Total exports, per cent	2.21	1.98	0.23	2.90	2.60	0.30
Total imports, per cent	1.87	1.67	0.20	2.46	2.20	0.26
Terms of trade	0.18	0.14	0.04	0.25	0.19	0.06
Real wages less skilled, per cent	0.39	0.22	0.17	0.53	0.30	0.23
Real wages more skilled, per cent	0.38	0.23	0.15	0.50	0.32	0.18

Source: CGE modelling.

## 5 Conclusions

This study provides estimates of the impact on the UK of a potential EU-US preferential trade agreement incorporating both reductions in tariff and non-tariff barriers. NTB estimates are combined with tariffs to estimate the total impact of an US-EU FTA on the UK economy, covering both tariffs and NTBs.

Four main scenarios are covered in the report. These involve between 98 and 100 percent tariff elimination, combined with variations in NTB reductions. Under all scenarios, the results indicate positive and significant gains for the UK. For the UK, national income and GDP are expected to increase by between £4 and £10 billion annually, depending on the scenarios, with the highest increase taking place under the most ambitious scenario, which incorporates the highest reductions in NTBs. The gains from removing tariffs are much higher in the case of rest of the EU than in the case of the UK due to the initial barriers, which are lower for the UK.

The primary message is that NTBs are critical to UK gains. Indeed, tariffs matter less for the UK than for the EU as a whole, while NTBs matter more. In terms of sector benefits, the motor vehicle sector stands out in terms of output and employment gains when NTBs are reduced. In the service sector, financial services also stands out. Overall, the scope for benefits for the UK hinges on the level of ambition. A more ambitious agreement yields greater gains in terms of output, wages, and investment.



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## Appendix I      **MAPPING OF MODEL SECTORS**

**Table 19: Mapping of Model Sectors to GTAP**

No.	GTAP Sector	Model Sector	No.	GTAP Sector	Model Sector
1	pdr	1 Agr forestry fisheries	30	lum	10 Wood and paper products
2	wht	1 Agr forestry fisheries	31	ppp	10 Wood and paper products
3	gro	1 Agr forestry fisheries	32	p_c	4 Chemicals
4	v_f	1 Agr forestry fisheries	33	crp	4 Chemicals
5	osd	1 Agr forestry fisheries	34	nmm	11 Other manufactures
6	c_b	1 Agr forestry fisheries	35	i_s	9 Metals and metal products
7	pfb	1 Agr forestry fisheries	36	nfm	9 Metals and metal products
8	ocr	1 Agr forestry fisheries	37	fmp	9 Metals and metal products
9	ctl	1 Agr forestry fisheries	38	mvh	6 Motor vehicles
10	oap	1 Agr forestry fisheries	39	otn	7 Other transport equipment
11	rmk	1 Agr forestry fisheries	40	ele	5 Electrical machinery
12	wol	1 Agr forestry fisheries	41	ome	8 Other machinery
13	frs	1 Agr forestry fisheries	42	omf	11 Other manufactures
14	fsh	1 Agr forestry fisheries	43	ely	20 Other services
15	coa	2 Other primary sectors	44	gdt	20 Other services
16	oil	2 Other primary sectors	45	wtr	20 Other services
17	gas	2 Other primary sectors	46	cns	18 Construction
18	omn	2 Other primary sectors	47	trd	20 Other services
19	cmt	3 Processed foods	48	otp	20 Other services
20	omt	3 Processed foods	49	wtp	12 Water Transport
21	vol	3 Processed foods	50	atp	13 Air Transport
22	mil	3 Processed foods	51	cmn	17 Communications
23	pcr	3 Processed foods	52	ofi	14 Finance
24	sgr	3 Processed foods	53	isr	15 Insurance
25	ofd	3 Processed foods	54	obs	16 Business services
26	b_t	3 Processed foods	55	ros	19 Personal services
27	tex	11 Other manufactures	56	osg	20 Other services
28	wap	11 Other manufactures	57	dwe	20 Other services
29	lea	11 Other manufactures			

**Table 20: Mapping of Model Sectors to ISIC rev 3.1**

<b>Model Sector</b>	<b>ISIC Sectors</b>
1 Agr forestry fisheries	ISIC 01-05
2 Other primary sectors	ISIC 10-14
3 Processed foods	ISIC 15-16
4 Chemicals	ISIC 24-25
5 Electrical machinery	ISIC 30-32
6 Motor vehicles	ISIC 34
7 Other transport equipment	ISIC 35
8 Other machinery	ISIC 29,31,33
9 Metals and metal products	ISIC 27-28
10 Wood and paper products	ISIC 20-22
11 Other manufacturing	ISIC 15-37, all remaining
12 Water transport	ISIC 61
13 Air transport	ISIC 62
14 Finance	ISIC 65,67
15 Insurance	ISIC 66
16 Business services	ISIC 70-74
17 Communications	ISIC 64
18 Construction	ISIC 45
19 Personal services	ISIC 91-93
20 Other services	ISIC 40,41,50,51,52,63,75,80,85,90

## Appendix II ELASTICITIES IN THE MODEL

**Table 21: Sectors and Model Elasticities employed in the modelling**

	trade substitution elasticity	substitution in value added	UK value added share 2007	UK value added share 2027
Agr forestry fisheries	4.77	0.24	0.007	0.015
Other primary sectors	12.13	0.2	0.017	0.035
Processed foods	2.46	1.12	0.028	0.029
Chemicals	5.09	1.26	0.023	0.019
Electrical machinery	9.65	1.26	0.006	0.003
Motor vehicles	10	1.26	0.011	0.009
Other transport equipment	7.14	1.26	0.009	0.010
Other machinery	9.71	1.26	0.029	0.025
Metals and metal products	13.91	1.26	0.018	0.012
Wood and paper products	7.99	1.26	0.021	0.022
Other manufactures	6.56	1.26	0.023	0.014
Water transport	3.8	1.68	0.004	0.006
Air transport	3.8	1.68	0.004	0.003
Finance	2.04	1.26	0.020	0.021
Insurance	3.18	1.26	0.011	0.012
Business services	3.18	1.26	0.239	0.226
Communications	3.18	1.26	0.029	0.027
Construction	4.21	1.4	0.065	0.065
Personal services	8.71	1.26	0.034	0.037
Other (public) services	3.92	1.41	0.403	0.411

## Appendix III CGE MODEL TECHNICAL OVERVIEW

In the computational model, the "whole" economy, for the relevant aggregation of economic agents, is modelled simultaneously. This means that the entire economy is classified into production and consumption sectors. These sectors are then modelled collectively. Production sectors are explicitly linked together in value-added chains from primary goods, through higher stages of processing, to the final assembly of consumption goods for households and governments. These links span borders as well as industries. The link between sectors is both direct, such as the input of steel into the production of transport equipment, and also indirect, as with the link between chemicals and agriculture through the production of fertilizers and pesticides. Sectors are also linked through their competition for resources in primary factor markets (capital, labour, and land). The data structure of the model follows the GTAP database structure, and basic models of this class are implemented in either GEMPACK or GAMS (Hertel et al 1997, Rutherford and Paltsev 2000). We work here with a GEMPACK implementation.

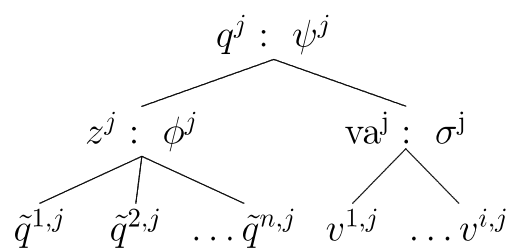
### *Production*

We start here with a representative production technology using a basic, constant returns to scale specification. Where we have scale economies, this serves as the cost structure for composite input bundles. Assume that output  $q^j$  in sector  $j$  can be produced with a combination of intermediate inputs  $z^j$  and value added services (capital, labour, land, etc.)  $va^j$ . This is formalized in equation 1. Assuming homothetic cost functions and separability, we can define the cost of a representative bundle of intermediate inputs  $z^j$  for the firm producing  $q^j$  and similarly the cost of a representative bundle  $va^j$  of value

added services. These are shown in equations 2 and 3. They depend on the vector of composite goods prices  $\tilde{P}$  and primary factor prices  $\omega$ . Unit costs for  $q$  then depend on the mix of technology and prices embodied in equations 1,2,3. We represent this in equation 4, which defines unit cost  $\zeta^j$ . In the absence of taxes, in competitive sectors  $\zeta^j$  represents both marginal cost and price. On the other hand, with imperfect competition on the output side (discussed explicitly later)  $\zeta^j$  can be viewed as measuring the marginal cost side of the optimal markup equation, with mark-ups driving a wedge between  $\zeta^j$  and  $P^j$ .

To combine production technologies with data, we need to move from general to specific functional forms. We employ a nested CES function, with a CES representation of value added activities  $va^j$ , a CES representation of a composite intermediate  $z^j$  made up of intermediate inputs, and an upper CES nest that then combines these to yield the final good  $q^j$ . Our set-up is illustrated in Figure 2 below, on the assumption we have  $i$  primary factors  $v$ , as well as  $n$  production sectors that can be represented in terms of composite goods  $\tilde{q}$  as defined below.

Figure 3: representative nested production technology



These composites may (or may not, depending on the goods involved) be used as intermediate inputs. In Figure 2, we have also shown the CES substitution elasticity for intermediate inputs  $\phi$ , the substitution elasticity for value added  $\sigma$ , and the substitution elasticity for our "upper nest" aggregation of value added

and intermediates,  $\psi$ . In the absence of taxes, total value added  $Y$  will be the sum of primary factor income, as in equation 5.

Given our assumption of CES technologies, we can represent value added in sector  $j$  as a function of primary inputs and the elasticity of substitution in value added  $\sigma^j$ . This yields equation 6, and its associated CES price index shown in equation 7. Similarly, we can specify the CES price index for composite intermediates, as in equation 7. This gives us equation 8, where the coefficient  $\phi^j$  is the elasticity of substitution between intermediate inputs. This is assumed to be Leontief (i.e.  $\phi^j = 0$ ). Finally, following Figure 2, we will also specify an aggregation function for value added and intermediate inputs, in terms of its CES price index. This is shown as equation 9. From the first order conditions for minimizing the cost of production, we can map the allocation of primary factors to the level of value added across sectors. This is formalized in equation 10. We can also specify the total demand for composite intermediate goods across sectors  $\tilde{q}^{\text{int},i}$  as a function of the producer price of composite input price  $P_{z^j}$  in each sector, the scale of intermediate demand across sectors  $z^j$ , and prices of composite goods  $\tilde{P}_i$ . This is shown in equation 11. With the upper nest CES for goods we can also map value added  $\text{va}^j$  and intermediate demand  $z^j$  in terms of equations 7 and 8, output  $q^j$  and the elasticity of substitution  $\psi^j$  between inputs and value added. This yields equations 12 and 13, where the terms  $\gamma$  are the CES weights (similar to those in equation 6) while  $\psi^j$  is the upper nest elasticity of substitution in the production function.

We also model some sectors as being characterized by large group monopolistic competition. In reduced form, this can be represented by an industry level scale economy that reflects variety effects. We define the price of output at industry level as in equation 14. In this case,  $\zeta^j$  is defined by equation 9 and represents the price of a bundle of inputs, and equation 14 follows directly from average cost pricing, homothetic cost functions, and Dixit-Stiglitz type monopolistic competition. (See Francois and Roland-Holst 1997, Francois 1998, and Francois, van Meijl, and van Tongeren 2005 for explicit derivations.)

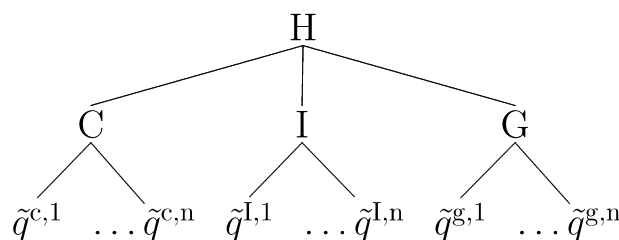


Together, equations 1 through 14 map out the production side of the economy. For an open economy, given resources, technology (represented by technical coefficients in the CES functional forms), and prices for foreign and domestic goods and services, we can determine factor incomes, national income, and the structure of production. We close this system by discussion of the demand side of the economy, and basic open economy aspects, in the next sections.

*Final Demand*

In the system we have spelled out so far, we have mapped the basic, national structure of production. We close the system with a demand specification for a representative household. This involves allocation of regional income by the household to composite consumption  $H$ , which is separated over private consumption  $C$ , public consumption  $G$ , and investment  $I$ . Each of these components of  $H$  involves consumption of composite goods and services  $\tilde{q}$  indexed by sector  $j$ . This is illustrated in Figure 3 below. Where we assume fixed expenditure shares (i.e. with  $H$  taking a Cobb-Douglas functional form), then we also have a fixed savings rate. Otherwise, given the equilibrium allocation of household income to consumption and investment, we will denote these expenditure shares by  $\theta$ . We maintain a fixed-share allocation between public and private consumption.

Figure 4: representative household demand



We assume a well-defined CES utility function for personal consumption defined over goods  $\tilde{q}$ . From the first order conditions for utility maximization, we can then

derive the price of utility from private consumption  $P_U$  as a function of prices  $\tilde{P}$ , as in equation 15. The corresponding expenditure function is then  $U = U^c P_U$  where  $U^c$  is the level of utility from private consumption. Taking national income as our budget constraint, then combining equation 5 with the expenditure function yields equation 16. From 16, we can define  $U^c$  from the expenditure function and income, as in equation 17. Consumption quantities, in terms of composite goods, can be recovered from equation 17, as shown in equation 18. Like private consumption, the public sector is also modelled with a CES demand function over public sector consumption. This implies equations 19-22. For investment demand, in the short run, we assume a fixed savings rate. In the long-run, the model can alternatively incorporate a fixed savings rate, or a rate that adjusts to meet steady state conditions in a basic Ramsey structure with constant relative risk aversion (CRRA) preferences. We employ the CRRA version here. (Francois, McDonald and Nordstrom 1996). With fixed savings, and assuming a Leontief composite of investment goods that make up the regional investment good, investment demand is defined by equation 23. With CRRA preferences, steady-state conditions implies equation 24 as well, related to the price of capital  $\omega_k$ . Where 24 holds, the additional equation allows us to make the savings rate coefficient  $\theta^l$  endogenous. In equation 24  $\rho$  is the rate of time discount and  $\delta$  is the rate of depreciation. With a short-run or static closure, investment demand means we apply equation 23. With a long-run closure, we also apply equation 25. When we impose CRRA preferences in the long-run, we then employ all three equations on the model 23-25, and savings rates are endogenous. With a fixed savings rate, we drop equation 24 and make  $\theta^l$  exogenous.

#### *Cross-border linkages and taxes*

Finally, individual countries, as described by equations 1-25 above, are linked through cross border trade and investment flows. With either monopolistic competition or Armington preferences, we can define a CES composite good  $\tilde{q}$  in terms of foreign and domestic goods. The price index for this composite good

is defined by equation 26. Given equation 26 and the envelope theorem, we can define domestic absorption  $D$  as in equation 27, where  $h$  indexes home prices and quantities. The difference between production  $q_j$  and domestic absorption  $D_j$  in equilibrium will be imports (where a negative value denotes exports), as in equation 28. Across all countries indexed by  $r$ , we also have a global balanced trade requirement, shown in equation 29. Similarly, balancing the global capital account also requires equations 30 and 31 (where we now index source  $r$  and home destination  $h$ ).

Trading costs are modelled as in ECORYS (2009), and benchmark values for NTBs come from this source. Information on the extent to which policies affect prices and costs is important for accurate modelling of policy reforms, including whether policies create "rents" as opposed to being resource-using (generating "waste"), and the identity (ownership) of the entities and groups to whom any rents accrue. This is a well-known issue that can have a major bearing on the magnitude of the welfare impacts of policies and policy reforms. For example, if a policy generates rents for domestic groups and liberalization results in a share of these rents accruing to foreign entrants, the result may be lower national welfare. Recent work supported by the EC (ECORYS 2009, Copenhagen Economics 2009) has been focused explicitly on this distinction, and the results of this analysis feed into the estimates reported in this study. In the estimates below, we distinguish between cost and rent generation under NTBs on the basis of ECORYS (2009), assuming 2/3 of rents accrue to importer interests, and 1/3 to exporter interests. Rents are modelled, in effect, like export and import taxes. For cost-raising barriers, we follow the now standard approach to modelling iceberg or dead-weight trade costs in the GTAP framework, originally developed by Francois (1999, 2001) with support from the EC to study the Millennium Round (now known as the Doha Round). This approach has grown from an extension in early applications to a now standard feature of the GTAP model, following Hertel, Walmsley and Itakura (2001). It has featured in the joint EC-Canadian government study on a EU-Canada FTA, as well as the 2009 ECORYS study on EU-US non-tariff barriers. In formal terms, changes in the value of this technical

coefficient capture the impact of non-tariff measures on the price of imports from a particular exporter due to destination-specific reduced costs for production and delivery.

The basic system outlined above provides the core production and demand structure of each region, as well as the basic requirements for bilateral import demand, global market clearing for traded goods and services, and global capital account balancing. Within this basic structure, we also introduce taxes, transport services, iceberg (deadweight) non-tariff barriers, and rent-generating non-tariff barriers. These drive a wedge between the ex-factory price originating in country  $r$  and the landed prices in country  $h$  inclusive of duties and transport costs. Taxes and rent-generating trade costs mean that  $Y$  is also inclusive of tax revenues and rents. In the short-run we fix  $B$ , while in the long-run this is endogenous (such that the distribution of relative global returns is maintained). All of this adds additional complexity to the system outlined above, but the core structure remains the same.

Finally, in the main body of the report we, when discussing labour displacement, in addition to shifts in employment at sector level, we have also reported a summary statistic – a labour displacement index. This is the “across displacement” index, based on Francois (2004) and Francois, Jansen, and Peters (2012). In formal terms, the index is defined as follows:

$$S_{L, \text{across}} = \sqrt{\sum_{j=1}^n \lambda_j (\bar{i}_j - \bar{m}_L)^2}$$

Following the notation of Francois, Jansen, and Peters (2012),  $\lambda_j$  is the sector  $j$  share of employment,  $\bar{i}_j$  is the per cent change in sector  $j$  employment, and  $\bar{m}_L$  is total per cent change in employment. The index  $S_{L, \text{across}}$  gives us a measure of variation of employment across sectors and thus a measure of the actual number of workers that change jobs by moving across sectors. The

index provides a useful indication for the adjustments taking place in labour markets following trade reform, in terms of labour moving across sectors.<sup>5</sup>

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<sup>5</sup> The index is a lower bound on labour displacement, as it is likely to underestimate the actual amount of job churning that occurs. Workers who change jobs but do not change sectors are not captured by the above measure. In order to capture those workers, it would be necessary to have information on employment changes at the firm level.

$$\begin{aligned}
 (1) \quad q^j &= f^j(z^j, \text{va}^j) \\
 (2) \quad P_z &= g(\tilde{P}) \\
 (3) \quad P_{\text{va}} &= h(\omega) \\
 (4) \quad \zeta_j &= c(P_z, P_{\text{va}}) \\
 (5) \quad Y &= \sum_i \omega_i v_i \\
 (6) \quad \text{va}_j &= \left[ \sum_i \alpha_{ij} v_{ij}^{\frac{\sigma^j-1}{\sigma^j}} \right]^{\frac{1}{\sigma^j-1}} \\
 (7) \quad P_{vj} &= \left[ \sum_i \alpha_{ij}^{\sigma^j} \omega_i^{1-\sigma^j} \right]^{\frac{1}{1-\sigma^j}} \\
 (8) \quad P_{zj} &= \left[ \sum_i \beta_{ij}^{\phi_j} \tilde{P}_i^{1-\phi_j} \right]^{\frac{1}{1-\phi_j}} \\
 (9) \quad P_j &= \left( \gamma_{vj}^{\psi_j} P_{\text{va}j}^{1-\psi_j} + \gamma_{zj}^{\psi_j} P_{zj}^{1-\psi_j} \right)^{\frac{1}{1-\psi_j}} \\
 (10) \quad v_i &\geq \sum_j \text{va}^j \left( \frac{\alpha_{vj}}{\omega_i} \right)^{\sigma^j} P_{\text{va}j} \\
 (11) \quad \tilde{q}^{\text{int},i} &= \sum_j z^j \left( \frac{\beta_{ij}}{\tilde{P}_i} \right)^{\phi_j} P_{zj} \\
 (12) \quad \text{va}^j &= q^j \left( \frac{\gamma_{vi}}{P_{vj}} \right)^{\psi_j} P_j \\
 (13) \quad \tilde{z}^j &= q^j \left( \frac{\gamma_{zi}}{P_{zj}} \right)^{\psi_j} P_j \\
 (14) \quad P_j &= q_j^{\psi_j} \left( \gamma_{vj}^{\psi_j} P_{\text{va}j}^{1-\psi_j} + \gamma_{zj}^{\psi_j} P_{zj}^{1-\psi_j} \right)^{\frac{1}{1-\psi_j}} \\
 &\text{where } 1 > \psi > 0 \\
 (15) \quad P_{U^c} &= \left( \sum_{i=1}^n \alpha_{c,i}^{\eta^c} \tilde{P}_i^{1-\eta^c} \right)^{\frac{1}{1-\eta^c}} \\
 &\text{where } 0 < \frac{\eta^c - 1}{\eta^c} < 1 \\
 (16) \quad U^c &= \left( \sum_{i=1}^n \alpha_{c,i}^{\eta^c} \tilde{P}_i^{1-\eta^c} \right)^{\frac{1}{1-\eta^c}} = Y \theta^c \\
 (17) \quad U^c &= \left( \sum_{i=1}^n \alpha_{c,i}^{\eta^c} \tilde{P}_i^{1-\eta^c} \right)^{\frac{1}{\eta^c-1}} Y \theta^c \\
 (18) \quad \tilde{q}^{c,i} &= U^c P_{U^c}^{\eta^c} \alpha_{c,i}^{\eta^c} \tilde{P}_i^{-\eta^c} \\
 (19) \quad P_{U^g} &= \left( \sum_{i=1}^n \alpha_{g,i}^{\eta^g} \tilde{P}_i^{1-\eta^g} \right)^{\frac{1}{1-\eta^g}} \\
 &\text{where } 0 < \frac{\eta^g - 1}{\eta^g} < 1 \\
 (20) \quad U^g &= \left( \sum_{i=1}^n \alpha_{g,i}^{\eta^g} \tilde{P}_i^{1-\eta^g} \right)^{\frac{1}{1-\eta^g}} = Y \theta^g \\
 (21) \quad U^g &= \left( \sum_{i=1}^n \alpha_{g,i}^{\eta^g} \tilde{P}_i^{1-\eta^g} \right)^{\frac{1}{\eta^g-1}} Y \theta^g \\
 (22) \quad \tilde{q}^{g,i} &= U^c P_{U^c}^{\eta^g} \alpha_{g,i}^{\eta^g} \tilde{P}_i^{-\eta^g} \\
 (23) \quad \left( \sum_{j=1}^n \alpha_{I,j} \tilde{P}_j \right) &= Y \theta^I \\
 (24) \quad \omega_k &= P^c(\rho + \delta) \\
 (25) \quad dK/K &= dI/I \\
 (26) \quad \tilde{P}_j &= \left( \sum_{r=1}^R b_{r,j}^{s_j} P_{r,j}^{1-s_j} \right)^{\frac{1}{1-s_j}} \\
 &\text{where } 0 < \frac{s_j - 1}{s_j} < 1 \\
 (27) \quad D_j &= (\tilde{q}^{c,j} + \tilde{q}^{l,j} + \tilde{q}^{g,j} + \tilde{q}^{\text{int},i}) \tilde{P}_j^s b_{h,j}^s P_{h,j}^{-s} \\
 (28) \quad M_j &= D_j - q_j \\
 (29) \quad \left( \sum_{r=1}^{rr} M_{r,j} \right) &= 0 \\
 (30) \quad \left( \sum_j \sum_{r \neq h} P_{r,j} M_{r,h,j} \right) &= B_h \\
 (31) \quad \left( \sum_r B_r \right) &= 0
 \end{aligned}$$

## Appendix IV **DETAILED RESULTS**



**Table 22: Change in total UK exports by sector, per cent, 2027 baseline**

	Basic Ambitious Scenario			Basic Modest Scenario			Modified Ambitious			Modified Modest		
	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs
Agr forestry fisheries	0.06	0.58	-0.52	0.34	0.58	-0.24	-0.01	0.58	-0.59	0.31	0.58	-0.27
Other primary sectors	0.38	0.06	0.33	0.21	0.06	0.16	0.53	0.06	0.47	0.27	0.06	0.22
Processed foods	4.52	0.81	3.71	2.52	0.75	1.77	4.73	0.82	3.91	2.60	0.75	1.85
Chemicals	3.83	-0.42	4.25	1.55	-0.43	1.98	6.76	-0.41	7.17	2.44	-0.44	2.88
Electrical machinery	2.77	0.65	2.12	1.74	0.68	1.07	1.24	0.57	0.67	1.35	0.65	0.69
Motor vehicles	15.18	1.28	13.90	6.89	1.04	5.85	25.62	1.58	24.04	10.84	1.16	9.68
Other transport equipment	3.35	0.26	3.09	1.74	0.23	1.51	2.80	0.27	2.53	1.58	0.24	1.34
Other machinery	0.60	1.65	-1.05	1.12	1.61	-0.48	-0.16	1.66	-1.81	0.94	1.62	-0.69
Metals and metal products	5.30	1.65	3.64	3.16	1.50	1.66	4.69	1.65	3.04	2.99	1.51	1.48
Wood and paper products	1.63	0.41	1.22	0.98	0.38	0.60	1.49	0.44	1.06	0.97	0.39	0.58
Other manufactures	0.46	1.29	-0.83	0.88	1.28	-0.40	0.10	1.30	-1.20	0.75	1.29	-0.53
Water transport	0.46	0.14	0.31	0.27	0.13	0.14	0.54	0.16	0.38	0.30	0.14	0.16
Air transport	0.11	0.12	-0.01	0.11	0.11	0.00	-0.02	0.13	-0.15	0.08	0.11	-0.04
Finance	3.12	0.22	2.90	1.62	0.20	1.42	3.21	0.23	2.98	1.68	0.21	1.47
Insurance	3.68	0.34	3.35	1.96	0.30	1.65	3.67	0.36	3.31	2.00	0.32	1.68
Business services	0.41	0.18	0.23	0.28	0.17	0.11	0.54	0.20	0.35	0.36	0.18	0.19
Communications	0.55	0.25	0.30	0.38	0.24	0.14	0.68	0.26	0.41	0.43	0.24	0.19
Construction	-0.19	0.10	-0.28	-0.04	0.09	-0.13	-0.32	0.11	-0.42	-0.08	0.10	-0.17
Personal services	-0.80	0.24	-1.04	-0.25	0.22	-0.47	-1.40	0.26	-1.66	-0.43	0.23	-0.66
Other services	-0.10	0.17	-0.27	0.03	0.16	-0.13	-0.22	0.18	-0.40	0.00	0.16	-0.16

Source: CGE modelling.



**Table 23: Change in total UK imports by sector, per cent, 2027 baseline**

	Basic Ambitious Scenario			Basic Modest Scenario			Modified Ambitious			Modified Modest		
	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs
Agr forestry fisheries	1.07	0.44	0.63	0.73	0.43	0.29	1.25	0.45	0.81	0.79	0.44	0.36
Other primary sectors	0.05	0.17	-0.11	0.11	0.16	-0.05	0.05	0.17	-0.12	0.12	0.16	-0.04
Processed foods	1.66	0.58	1.08	1.05	0.55	0.50	1.88	0.58	1.30	1.12	0.55	0.57
Chemicals	2.44	0.82	1.61	1.57	0.80	0.77	3.16	0.85	2.32	2.05	0.82	1.23
Electrical machinery	0.74	0.08	0.66	0.35	0.06	0.29	1.04	0.09	0.95	0.44	0.06	0.37
Motor vehicles	3.31	0.95	2.37	1.76	0.76	1.00	5.00	1.13	3.87	2.41	0.84	1.57
Other transport equipment	4.69	1.02	3.67	2.74	0.99	1.75	5.09	1.02	4.07	2.86	0.99	1.88
Other machinery	1.25	0.23	1.02	0.71	0.25	0.46	1.82	0.23	1.58	0.88	0.24	0.64
Metals and metal products	4.60	1.00	3.60	2.56	0.93	1.63	5.37	1.00	4.37	2.84	0.92	1.91
Wood and paper products	2.16	0.01	2.15	1.00	0.01	0.99	2.58	0.01	2.57	1.13	0.01	1.12
Other manufactures	1.46	0.29	1.17	0.84	0.30	0.54	1.97	0.29	1.67	1.00	0.29	0.71
Water transport	0.61	0.09	0.52	0.32	0.08	0.24	0.81	0.10	0.71	0.39	0.08	0.30
Air transport	0.73	-0.01	0.74	0.34	-0.01	0.34	0.99	-0.01	1.00	0.42	-0.01	0.43
Finance	1.74	0.00	1.74	0.84	0.00	0.83	2.00	0.00	2.00	0.92	0.00	0.92
Insurance	1.39	-0.15	1.53	0.59	-0.14	0.73	1.64	-0.15	1.80	0.66	-0.14	0.80
Business services	1.21	-0.02	1.23	0.56	-0.02	0.57	1.76	-0.02	1.78	0.75	-0.02	0.77
Communications	1.68	-0.05	1.73	0.78	-0.05	0.82	2.02	-0.05	2.07	0.88	-0.05	0.93
Construction	1.30	-0.04	1.34	0.59	-0.04	0.63	1.70	-0.04	1.74	0.71	-0.04	0.75
Personal services	2.97	-0.30	3.27	1.25	-0.28	1.53	3.69	-0.32	4.01	1.45	-0.29	1.75
Other services	0.93	-0.10	1.03	0.38	-0.10	0.47	1.36	-0.11	1.47	0.50	-0.10	0.60

Source: CGE modelling.

**Table 24: Change in total UK less skilled employment by sector, per cent, 2027 baseline**

	Basic Ambitious Scenario			Basic Modest Scenario			Modified Ambitious			Modified Modest		
	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs
Agr forestry fisheries	-0.03	0.06	-0.08	0.02	0.05	-0.04	-0.08	0.06	-0.13	0.00	0.05	-0.05
Other primary sectors	-0.11	0.01	-0.12	-0.05	0.01	-0.05	-0.16	0.01	-0.16	-0.06	0.01	-0.07
Processed foods	0.31	0.01	0.31	0.15	0.00	0.15	0.31	0.01	0.30	0.16	0.01	0.15
Chemicals	0.29	-0.82	1.11	-0.31	-0.81	0.50	1.37	-0.83	2.20	-0.22	-0.83	0.61
Electrical machinery	0.71	0.41	0.29	0.72	0.47	0.25	-0.57	0.32	-0.89	0.42	0.44	-0.02
Motor vehicles	3.86	-0.30	4.16	1.55	-0.23	1.78	6.93	-0.34	7.26	2.69	-0.26	2.95
Other transport equipment	-0.54	-0.23	-0.31	-0.36	-0.23	-0.13	-1.00	-0.22	-0.78	-0.50	-0.23	-0.27
Other machinery	-0.11	0.63	-0.74	0.26	0.60	-0.34	-0.66	0.64	-1.29	0.13	0.61	-0.48
Metals and metal products	-1.52	-0.06	-1.46	-0.73	-0.06	-0.67	-1.93	-0.06	-1.87	-0.83	-0.05	-0.78
Wood and paper products	-0.28	0.08	-0.35	-0.08	0.07	-0.16	-0.39	0.08	-0.47	-0.11	0.07	-0.19
Other manufactures	-0.61	0.06	-0.66	-0.26	0.05	-0.31	-0.87	0.06	-0.93	-0.35	0.05	-0.41
Water transport	-0.03	0.12	-0.15	0.03	0.11	-0.07	-0.15	0.13	-0.27	0.00	0.11	-0.11
Air transport	-0.36	0.05	-0.41	-0.14	0.04	-0.19	-0.57	0.05	-0.62	-0.21	0.05	-0.26
Finance	0.87	0.08	0.78	0.47	0.08	0.39	0.81	0.09	0.72	0.46	0.08	0.38
Insurance	0.50	0.05	0.45	0.27	0.04	0.23	0.47	0.05	0.41	0.27	0.05	0.22
Business services	-0.15	-0.01	-0.14	-0.07	-0.01	-0.06	-0.22	-0.01	-0.21	-0.09	-0.01	-0.09
Communications	-0.07	0.03	-0.09	-0.02	0.02	-0.04	-0.12	0.03	-0.15	-0.03	0.02	-0.06
Construction	0.11	0.03	0.08	0.07	0.03	0.04	0.11	0.03	0.08	0.07	0.03	0.04
Personal services	-0.33	0.03	-0.36	-0.14	0.03	-0.17	-0.48	0.04	-0.51	-0.18	0.03	-0.21
Other services	-0.02	-0.01	-0.02	-0.01	-0.01	-0.01	-0.04	-0.01	-0.03	-0.02	-0.01	-0.01
Displacement Index	0.58	0.18	0.64	0.26	0.18	0.28	0.99	0.19	1.08	0.39	0.18	0.43

Displacement index is the weighted mean deviation (square root of the weighted mean squared variation).

Source: CGE modelling.

**Table 25: Change in total UK more skilled employment by sector, per cent, 2027 baseline**

	Basic Ambitious Scenario			Basic Modest Scenario			Modified Ambitious			Modified Modest		
	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs
Agr forestry fisheries	-0.02	0.06	-0.08	0.02	0.05	-0.03	-0.07	0.06	-0.13	0.01	0.05	-0.05
Other primary sectors	-0.11	0.01	-0.11	-0.05	0.01	-0.05	-0.15	0.01	-0.16	-0.06	0.01	-0.06
Processed foods	0.32	0.01	0.32	0.16	0.00	0.15	0.34	0.01	0.33	0.16	0.00	0.16
Chemicals	0.30	-0.83	1.12	-0.31	-0.81	0.50	1.40	-0.83	2.23	-0.21	-0.83	0.62
Electrical machinery	0.72	0.41	0.31	0.73	0.47	0.25	-0.54	0.32	-0.86	0.43	0.44	-0.01
Motor vehicles	3.88	-0.30	4.18	1.55	-0.23	1.79	6.96	-0.34	7.30	2.70	-0.26	2.96
Other transport equipment	-0.52	-0.23	-0.29	-0.36	-0.24	-0.12	-0.98	-0.22	-0.75	-0.49	-0.23	-0.26
Other machinery	-0.10	0.63	-0.73	0.27	0.60	-0.34	-0.63	0.63	-1.26	0.14	0.61	-0.47
Metals and metal products	-1.51	-0.06	-1.45	-0.73	-0.06	-0.67	-1.90	-0.06	-1.84	-0.82	-0.05	-0.77
Wood and paper products	-0.26	0.08	-0.34	-0.08	0.07	-0.15	-0.36	0.08	-0.44	-0.10	0.07	-0.18
Other manufactures	-0.59	0.05	-0.65	-0.25	0.05	-0.31	-0.85	0.06	-0.90	-0.34	0.05	-0.40
Water transport	-0.02	0.12	-0.13	0.04	0.10	-0.07	-0.11	0.12	-0.24	0.01	0.11	-0.10
Air transport	-0.35	0.04	-0.39	-0.14	0.04	-0.18	-0.54	0.05	-0.58	-0.20	0.04	-0.24
Finance	0.88	0.08	0.79	0.47	0.08	0.40	0.84	0.09	0.75	0.47	0.08	0.39
Insurance	0.51	0.05	0.47	0.28	0.04	0.23	0.50	0.05	0.44	0.28	0.05	0.23
Business services	-0.13	-0.01	-0.13	-0.06	-0.01	-0.06	-0.19	-0.01	-0.18	-0.08	-0.01	-0.08
Communications	-0.05	0.02	-0.08	-0.01	0.02	-0.04	-0.09	0.03	-0.12	-0.02	0.02	-0.04
Construction	0.12	0.03	0.09	0.07	0.03	0.04	0.15	0.03	0.11	0.08	0.03	0.05
Personal services	-0.32	0.03	-0.35	-0.13	0.03	-0.16	-0.45	0.03	-0.48	-0.17	0.03	-0.20
Other services	-0.01	-0.01	0.00	-0.01	-0.01	0.00	-0.01	-0.01	0.00	-0.01	-0.01	0.00
Displacement Index	0.44	0.16	0.49	0.20	0.16	0.22	0.74	0.16	0.82	0.29	0.16	0.32

Displacement index is the weighted mean deviation (square root of the weighted mean squared variation).

Source: CGE modelling.

**Table 26: Change in total UK output by sector, per cent, 2027 baseline**

	Basic Ambitious Scenario			Basic Modest Scenario			Modified Ambitious			Modified Modest		
	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs	total	tariffs	NTBs
Agr forestry fisheries	0.00	0.03	-0.04	0.02	0.03	-0.02	-0.03	0.03	-0.06	0.01	0.03	-0.02
Other primary sectors	-0.02	0.01	-0.02	0.00	0.01	-0.01	-0.02	0.01	-0.03	-0.01	0.01	-0.01
Processed foods	0.50	0.04	0.46	0.25	0.03	0.22	0.55	0.04	0.51	0.28	0.03	0.24
Chemicals	0.45	-0.84	1.29	-0.25	-0.83	0.58	1.65	-0.85	2.50	-0.13	-0.85	0.72
Electrical machinery	0.93	0.47	0.46	0.87	0.53	0.33	-0.36	0.38	-0.74	0.57	0.50	0.07
Motor vehicles	4.09	-0.29	4.38	1.65	-0.23	1.87	7.29	-0.33	7.62	2.84	-0.25	3.10
Other transport equipment	-0.44	-0.22	-0.22	-0.31	-0.23	-0.09	-0.88	-0.21	-0.67	-0.44	-0.22	-0.22
Other machinery	0.01	0.68	-0.67	0.34	0.65	-0.31	-0.51	0.69	-1.20	0.23	0.66	-0.43
Metals and metal products	-1.48	-0.05	-1.43	-0.71	-0.05	-0.66	-1.87	-0.05	-1.83	-0.80	-0.04	-0.76
Wood and paper products	-0.14	0.11	-0.25	-0.01	0.10	-0.11	-0.21	0.11	-0.32	-0.02	0.10	-0.12
Other manufactures	-0.50	0.08	-0.58	-0.20	0.08	-0.27	-0.73	0.09	-0.82	-0.28	0.08	-0.36
Water transport	0.12	0.15	-0.03	0.12	0.14	-0.02	0.05	0.16	-0.11	0.10	0.14	-0.04
Air transport	-0.09	0.11	-0.20	0.01	0.10	-0.09	-0.23	0.11	-0.34	-0.03	0.10	-0.13
Finance	1.13	0.13	1.00	0.61	0.11	0.50	1.14	0.13	1.01	0.63	0.12	0.51
Insurance	0.69	0.08	0.61	0.37	0.07	0.30	0.71	0.09	0.63	0.39	0.08	0.32
Business services	0.14	0.05	0.09	0.09	0.04	0.04	0.15	0.05	0.11	0.10	0.04	0.06
Communications	0.15	0.07	0.08	0.10	0.06	0.04	0.17	0.07	0.10	0.12	0.06	0.05
Construction	0.40	0.08	0.31	0.22	0.08	0.15	0.50	0.09	0.41	0.27	0.08	0.19
Personal services	-0.14	0.07	-0.22	-0.03	0.07	-0.10	-0.23	0.08	-0.30	-0.05	0.07	-0.12
Other services	0.13	0.02	0.11	0.07	0.02	0.05	0.17	0.02	0.15	0.08	0.02	0.07

Source: CGE modelling.

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