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Brexit Trade Impacts: Alternative Scenarios

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Abstract: This note develops four alternative estimates of the trade-related impacts of the United Kingdom seceding from the European Union. We contrast two basic scenarios: an exit that re-sets the UK's relationship with the rest of the EU to a WTO-rules most favoured nation basis ("Brexit"), versus a negotiated change in the UK's status that largely preserves the UK's integration with the rest of the EU at a level similar to that of the European Free Trade Association ("Brefta"). A third scenario introduces a "single market" effect that reflects EU27 "home bias" (EU27 preference for EU27 products). A fourth scenario introduces a UK-US free trade agreement in a context in which the TTIP not going ahead due to the widening gulf between EU and US positions on social and environmental issues under the Trump Administration.

Keywords: United Kingdom, European Union, Brexit, Brefta, TTIP, single market, exit, CGE

JEL Codes: F13, F14

1. Introduction

The United Kingdom's withdrawal from the European Union was set in motion by the triggering of Article 50 by UK Prime Minister Theresa May on 29 March 2017, setting the clock ticking towards a formal UK exit in 2019. The terms of exit are very much up in the air. Both sides have indicated they are seeking a mutually beneficial economic partnership, with the rights of EU citizens living in Britain protected and vice versa, and soft land borders in contiguous regions. The latter include the border between Northern Ireland and the Republic of Ireland, between Gibraltar and Spain (and possibly between Scotland and England if the Scexit shoe falls pursuant to a referendum that Scottish First Minister Nicola Sturgeon says will be held once the terms of Brexit become clear).

In this study, we evaluate the trade-related impacts of an exit by the UK from the EU under alternative scenarios regarding what would replace the current single-market relationship, and weigh the costs against the potential benefits available to the UK from obtaining a free trade agreement with the United States in a context where the Transatlantic Trade and Investment Partnership (TTIP) does not go ahead due to the widening gulf between EU and US positions on social and environmental issues.

We consider two basic alternative exit outcomes: one that resets UK relations with the remaining 27 members ("EU27") on a default World Trade Organization (WTO)-rules basis ("Brexit") and a negotiated exit, which preserves a level of integration equivalent to that under the EU's arrangements with the European Free Trade Association (EFTA) (i.e., a "Brefta"). These scenarios build on the Ciuriak et al. (2015) study for Open Europe, and take into account the impact of Brexit on uncertainty of services market access, following Lysenko and Ciuriak (2016), who develop composite non-tariff barrier estimates for services market access that reflect changes to both applied measures and changes to the gap between applied and bound positions under the General Agreement on Trade in Services (GATS) – i.e., "water in the GATS" (Miroudot and Pertel, 2015). Under the Brefta scenario, this "unbinding" effect of a Brexit is not present.

A third scenario introduces a "single market" effect that takes into account EU27 preference for EU27 products. As a consequence of modelling Brexit and Brefta with the EU27 disaggregated, trade between the EU27 regions substitutes against third party trade at the higher Armington elasticity in the Global Trade Analysis Project (GTAP) database, which does not capture any "home bias" within the EU27 for production in other EU Member States based on, for example, confidence in the EU regulatory framework. By aggregating the EU27 into one region and assigning all intra-EU27 trade to domestic sales, we mimic an effect where there is home bias within the EU27.

Finally, a fourth scenario introduces a UK free trade agreement with the United States in the context of the TTIP not going ahead. This reflects the emerging political economy of trans-Atlantic trade relations where US policy under the Trump Administration is diverging sharply from positions that would be tenable for the EU, but which the UK might accept to offset the trade losses implied by Brexit.

We consider the following factors in the quantification of the impacts of the Brexit and Brefta scenarios:

— The emergence of a tariff wall between the UK and the EU27 under Brexit;
— The emergence of a new hard border for trade between the UK and the EU27, under alternative assumptions concerning the nature of that border under Brexit versus under Brefta;
— The introduction of new administrative requirements to track rules of origin (ROOs) for purposes of UK-EU27 trade under a preferential trade agreement in the Brefta scenario;
— The emergence of new non-tariff barriers (NTBs) to goods trade, reflecting the "drift" of UK regulations away from the EU's absent the requirement to implement Commission directives; and

— The emergence of new barriers to cross-border services trade and foreign direct investment (FDI), under alternative assumptions concerning the terms of the UK's exit from the single market; in the Brexit scenarios, this includes the removal of the binding effect EU policies on UK policies relative to WTO commitments.

The major caveats concern the many factors that cannot be quantified in the current analytical setting:

— The one-time costs of establishing the new border between the UK and the EU27, including potentially the construction of a customs border between Northern Ireland and the Republic of Ireland, between Gibraltar and Spain (and possibly between Scotland and England in a post-Scexit scenario, although the early discussion of new hard borders indicates all efforts would be made to avoid these.
— The implications for cross-channel value chains – particularly in cases where UK suppliers provide a relatively small share of the overall value-added in EU27 products (and vice versa), given that the value-added content in bilateral exports would bear the full weight of the additional border costs;
— Sector-specific impacts, in particular the City of London's access to EU27 internal financial market transactions, and UK-based air carriers' ability to offer intra-EU flight services;
— Interim frictions for the UK firms in terms of access to international certification which currently runs through EU participation in international agreements.
— The extent to which (and with what effect) exit from the single market would open domestic economic policy options to the UK (and to the EU27) that are not available to either under the single market;
— The economic implications of the cessation of UK net contributions to the EU budget and of EU funding of activities in the UK;
— The implications for multinational firms' investment decisions due to the new uncertainty about future market access in bilateral UK-EU27 trade (e.g., a range of contingent-protection measures would be deployable in bilateral UK-EU27 trade outside the single market framework, including anti-dumping and countervailing duties and border carbon offsets for climate change-related measures);
— Labour market effects such as skill mis-matches due to reduced labour movement (press reports indicate that employers in the UK are facing difficulty in filling vacancies after a drop for more in the number of available candidates; Allen, 2017).
— The impact of financial market reactions on the dynamic path that the UK and EU27 would take to reach the new equilibrium implied by the policy changes under UK withdrawal;
— The implications for investment decisions (including both of establishing commercial presence and incurring sunk costs to establish an export market presence) of UK withdrawal from the EU single market and institutions on the parties' political risk profile; and
— The economic consequences of possible knock-on political contingencies, including Scotland seceding from the UK in order to remain within the single market or Ireland withdrawing from the single market to avoid the costs of a hard border with Northern Ireland, etc.

This note is organized as follows. Section 2 sets out the empirical approach to generating the quantitative assessments in the present study. Section 3 sets out the results of the simulations. Section 4 concludes. Annex 1 describes the construction of the various policy shocks and the supporting evidence for the assumptions made.

2. Empirical Approach

2.1. Model

We use a recursive dynamic version of the GTAP computable general equilibrium (CGE) model that incorporates FDI by building in a foreign-invested representative firm in each GTAP region-sector, as described in Ciuriak and Xiao (2014) with an extension to the goods sector. In our model, labour responds to changes in the wage rate with a long-run elasticity of unity and capital supply responds to changes in the rate of return on capital; the investment response is based on the Monash capital model (Dixon and Rimmer, 1998).

Labour and capital are mobile across all sectors within a country. Capital is also mobile internationally in our model, which incorporates a foreign-owned representative firm in each GTAP sector; FDI flows respond to changes in restrictions on FDI, which are modelled as "phantom taxes" that influence behaviour, but do not generate government tax revenue. Labour is not, however, mobile internationally and we cannot directly take into account Brexit-induced changes to the labour supply through existing mechanisms in the model.

2.2. Implementation

We use the 57-product group level of disaggregation permitted by the GTAP database and a regional aggregation featuring 28 economies, including, inter alia, the UK and 16 EU27 countries/regions. We aggregate several of the smaller EU economies into groups: Bellux (Belgium and Luxembourg), Baltics (Estonia, Latvia, and Lithuania), Iberia (Spain and Portugal), Adriatics (Croatia and Slovenia), Central and Eastern European Countries or CEECs (Bulgaria, Czech Republic, Hungary, Romania, and Slovakia), and Mediterraneans (Cyprus, Greece, and Malta). Other economies represented include the non-EU G8 economies and China.

To simulate our various scenarios, we first develop a simulation of the GTAP database to 2030, using GTAP dynamic database tools, which draw on available macroeconomic data (Fouré et al., 2012). According to this macroeconomic projection for the world economy, global growth averages about 3.06% per annum over the period 2016-2030. The UK grows at 2.12% over this period, the EU27 by 1.56%, and the US by 1.53%. China's growth slows to 5.38% over this period; accordingly, it is a fairly conservative view of global growth prospects.

For convenience, we assume the UK's exit occurs as of 1 January 2020. For convenience in comparing options, we adopt the same date for the hard Brexit and the soft Brefta exits, and for the UK's independent entry into a TTIP-type FTA with the US. The individual elements of the shocks are simulated sequentially in order to show the relative contributions of each element.

2.3. Model Closures

For microeconomic closures, modellers have an option of fixing the quantity of labour and capital available for production and allowing wages and returns to capital to adjust; or fixing the returns to capital or to labour and allowing the quantity of the production factors to adjust. Each of these closure rules makes an extreme assumption about the supply of labour and/or capital: it is either perfectly elastic or perfectly inelastic. The reality is likely to be somewhere in between. In the GTAP-FDI model, investment adjusts to changes in the rate of return; similarly, we allow labour supply to adjust to changes in wages. As a result, the policy shocks that we simulate generate "endowment" effects: that is, the amount of labour and capital in an economy changes based on changes in returns to labour and capital.

As regards macroeconomic closures, two approaches are available. First, the current account can be fixed. This assumes that the external balance is determined entirely by domestic investment-savings dynamics. When trade policy shocks result in unbalanced changes in imports and exports, the original trade balance is restored by implicit

exchange rate adjustments. Alternatively, the current account can be allowed to adjust to the trade shock. The change in the current account then must be offset by equivalent changes in capital flows. In reality, unbalanced trade impacts are likely to have both effects: induce subsequent exchange rate adjustments and offset capital flows. Given the active role of FDI in our model, we necessarily adopt the closure where the current account adjusts.

2.4. Scenario Design

We focus on changes to the bilateral UK-EU27 trade regime. However, Brexit affects trade relationships with third parties. We assume that the UK and EU27 maintain EU28 WTO and existing FTA commitments vis-à-vis third parties. This limits the impacts to those that arise from changes to bilateral UK-EU27 trade. This outcome could be achieved by all parties agreeing to maintain status-quo market access on a provisional basis, pending formal restructuring of the EU28 commitments into separate UK and EU27 commitments. This obviously slides over some potentially thorny issues such as access to quotas.

Honouring outstanding commitments by third parties includes continuing to allow cross-cumulation of UK and EU27 value-added for access to preferences available to UK and EU27 exporters under the rules of origin (ROOs) in the EU's existing FTAs. There are precedents for this – for example, the Euro-Med origin regime allows for cumulation with two or more free trade partners of the EU, provided that they have concluded FTAs with one another and apply the Euro-Med origin protocol. There are additional costs: in addition to the existing proofs of origin (MC EUR.1 and invoice declaration), in certain cases, additional certification is required. The need for such cross-cumulation when FTAs are struck with partners that have deep integration with third parties (e.g., Canada and the United States) has been recognized in EU negotiations of trans-Atlantic agreements – e.g., the ROOs derogations under the Canada-EU Comprehensive Economic and Trade Partnership (CETA) for the auto sector, which contemplate allowing auto parts originating in the United States to count as originating for a vehicle produced in the EU or in Canada. Again, the assumption that suitable regimes would be put in place seamlessly slides over a potentially complex and thorny set of issues (consider for example areas where ROOs are typically restrictive such as the EU's "fabric forward" rules for apparel trade).

A ROOs issue would also arise under the WTO's General System of Preferences (GSP): currently, the bilateral cumulation provisions under the EU's GSP regime provide for diagonal cumulation, under which UK content exported for processing to some 150 developing countries is eligible for GSP preferences when these goods are exported back to other EU Member States (and vice versa). Under the EU's post-Cotonou Economic Partnership Agreements (EPAs) with African, Caribbean, and Pacific (ACP) countries, diagonal cumulation could continue under regionalized ROOs. We assume such a device would be used to cover this to avoid additional tightening of market access for ACP countries to both the EU27 and UK markets. In simulations not reported here, we estimate that abrogation of the UK's FTAs with third parties upon a hard Brexit would result in a significant negative impact on the UK of about -0.2% in terms of lowered real GDP and a welfare reduction of about USD 6.5 billion.

We also do not factor in the one-time costs of erecting a customs border control between Ireland and Northern Ireland, nor the one-time administrative costs on British and EU27 firms. For example, VAT would no longer be charged on UK-EU27 shipments, so firms would have to put in place the paperwork to modify their VAT collection and reporting systems. Membership of UK firms in EU internal organizations would lapse, requiring repatriation of representatives, etc. Websites, letterheads, advertising, etc. would all have to be modified. We could not find a basis to calibrate these latter costs and so do not include them, although they are likely to be non-negligible when cumulated across businesses.[1]

[1] For example, a study conducted by the Centre for International Economics Canberra & Sydney (2008) estimated that the cost of one-off label changes was around 1.1% of product costs.

Finally, one issue which is important for cross-border flows which we do not incorporate is the cessation of the net fiscal transfer from the UK to the EU27. For the EU28, the welfare calculation of the cessation of the transfer would be essentially neutral, as the EU27 would suffer a net loss equivalent to the UK's net gain. The extent of the impact on the EU27 and the UK depends on the basis of measurement.[2]

2.4.1. Brexit

The Brexit scenario incorporates the following effects:

— UK-EU27 trade shifts to an MFN tariff basis. We build an MFN tariff wall between the UK and the EU27. The construction of the Brexit tariff shock is described in the Technical Annex.
— Brexit would raise issues regarding the managed agricultural trade regime under the EU's Common Agricultural Policy (CAP). Over the years and the course of numerous General Agreement on Tariffs and Trade (GATT)/WTO negotiations, the EU has accommodated the agricultural export interests of third parties with tariff rate quotas on sensitive products. But no such agreements have been put in place for UK exports to the EU27 – or, conversely, for EU27 exporters in the UK. Following Ciuriak et al. (2015), where a move to MFN tariffs would shut down trade entirely in some agricultural sectors, we assume that the UK and the EU27 pragmatically limit the increase in bilateral protection to enable market access at levels between the EU and the United States.
— We introduce customs clearance costs for UK-EU27 trade. These are based on estimates drawn from the literature on the increased time costs for customs clearance and additional paperwork.
— We assume that UK economic regulation would be identical to EU27 regulation out of the exit gate. Nonetheless, NTBs would gradually emerge as UK and EU27 rules drift apart under independent reforms and differing legal determinations by their respective courts. We phase in NTB costs equivalent to those faced by EU firms in Canada, which we consider to be a good proxy for a liberal, efficient trade environment tailored for access to both EU and US markets.
— We evaluate the Brexit shock based on changes to the UK and EU27 scores on the OECD's Services Trade Restrictiveness Index (STRI) and Foreign Direct Investment Restrictiveness (FDIR) index. Since the OECD has not calculated the level of intra-EU STRI and FDIR values, we estimate Community internal standards as equivalent to the least restrictive regime maintained by any EU Member State. Further, we assume that the EU membership effectively binds such market access at the applied level, meaning there was no "water" in the bilateral services and investment market access commitments under the EU single market. Brexit will not only revert applied practice to the EU's MFN applied level, but will also remove the certainty of market access generated by EU membership as the EU and UK would be free to revert to bound levels of market access. We incorporate estimates of the effective trade costs of higher uncertainty from the creation of water in the EU27 and UK services commitments. The construction of the new

[2] There are alternative estimates for the UK fiscal offset. On the basis of the Operating Budgetary Balance, the UK average net contribution over the 2007-2013 budget cycle was GBP 3.8 billion, or 0.25% of UK GDP (see European Commission in the UK, 3 November 2014). The UK government provides a calculation of the net transfer for the same period of GBP 6.66 billion, or 0.44% of UK GDP (HM Treasury, 2013 and 2014, Tables 3.A). Ottaviano et al. (2014) incorporate an offset of 0.53% of GDP, based on the HM Treasury figure for the 2013 outturn. The HM Treasury estimates for the 2014-2019 period, compared to our forward projections of UK GDP, average out at about 0.45% of GDP. Caution should be used in combining such a figure, where the fiscal transfer is expressed as a percent of GDP, with estimated impacts of other policy changes on GDP, as these are not directly comparable calculations. To put the fiscal offset into a directly comparable form, one would have to model the fiscal shock in the UK (in the form of reduced taxes or increased expenditure or some combination of the two) which would have tax and fiscal multiplier effects, as well as the fiscal shock to the EU27 of a similar amount, compounded by corresponding tax and fiscal multipliers. The UK would experience a positive fiscal shock and a negative external demand shock; the effect on UK GDP would be the net of these effects; how close this would be to offset as calculated above is an empirical question not addressed here.

composite non-tariff barrier that integrates the increase in applied market access restrictions and increased uncertainty is described in the Technical Annex.

— Finally, we assume that Mode 4 (commercial presence) services trade is grandfathered for expatriates currently employed, and Brexit only impacts on future workers, or those without jobs. This implies no initial discontinuous rise in labour costs due to labour market disruptions.

2.4.2. Brefta

This scenario evaluates the less disruptive outcome under a negotiated exit that grandfathers existing bilateral trade positions and erects only the minimum of new barriers implied by the shift from a single market environment to one in which a border re-appears. In particular, NTBs in goods markets do not emerge since we assume an EFTA-type relationship agreement requires the UK to largely implement EU rules and standards. By the same token, the UK shares in future deepening of the EU single market and, thus, does not face the costs of drift hypothesized in Ottaviano et al. (2014) and reflected in the Brexit scenario.

While the Brefta is as close to being inside the single market as can be obtained for a party that does not assume the obligations of the single market, it still might have sufficient impact to disrupt particular sectors such as the City of London. We do not take into account the risk of additional NTBs emerging that might affect the ability of UK firms to access EU services markets on a cross-border basis in specific sectors (e.g., the City of London).

Similarly, we do not take into account the possibility of the unravelling of value chains in which the UK provides a relatively small share of the value added, which would bear the full cost of the additional border frictions as goods enter and exit within the value chain. Finally, introducing ROOs into UK-EU27 trade generates issues with third-party FTAs. We assume these would be managed by regionalizing the respective FTAs by providing for regional cumulation of value added, thus preserving the current EU FTAs undisturbed in this regard.

On this basis, the Brefta features the following shocks:

— While no new tariffs are imposed on UK-EU27 trade, a ROOs compliance cost would emerge. We assume this to be equal to 1% of the value of trade (we effectively assume 100% utilization of the EFTA-type preferences), which is at the bottom end of the range of ROOs cost estimates in the literature, and reflects the likely desire of both parties to implement a low-cost border regime.

— We introduce new border costs. For the Brefta border, we retain the estimates of the administrative costs of the Brexit border, but assume that a negotiated exit would feature a state-of-the-art border in terms of minimizing time costs to minimize the disruption to UK-EU27 bilateral trade. Where the Brexit border resembles the Canada-US border in terms of costs, the Brefta border resembles the EU-Swiss border.

— We assume a modest increase in barriers to cross-border services trade and FDI based on less flexible provisions for movement of personnel. The OECD's STRI, which we use to code the services and FDI shocks, has a line for "other" restrictions related to movement of persons. We shock this element to increase services trade restrictions under a Brefta, with the interpretation that it would reflect measures related to the issue of "benefit tourism", which was a point of friction for the UK.

2.4.3. Brexit with Single Market Effects

This scenario uses the same shock files and assumptions as the first Brexit scenario but modifies substitution elasticities from CES to CRESH for intra-EU27 trade to capture the effect of the single market in generating home bias in favour of goods subject to full EU regulation and of EU-brand loyalty of EU27 consumers.

2.4.4. UK-US FTA

One of the issues raised in the Brexit debate concerns the possibility that the UK could pursue a more effective trade policy by negotiating FTAs more quickly and reaching deeper liberalization commitments alone, rather than as part of the EU. We simulate the implications of the UK securing an FTA with the United States while the TTIP lapses due to widening gaps between the EU and US positions on social and environmental issues.

3. Results

This section reports the results of the four scenarios described above. We report the impacts for the UK, the EU27 as a whole, the larger individual EU Member States, regional aggregations of the small EU Member States, the US, other major global economies, and the rest of the world. We report the value figures in USD at 2011 prices, the base year for the GTAP 9.0 database. The reported values can be converted to current USD by factoring in the approximately 10% of inflation in the US (as measured by the GDP deflator) between 2011 and 2017. For a European readership, the figures in USD at 2011 prices can be read as equivalent to 2017 EUR (since the 1.10 anticipated USD/EUR exchange rate offsets the approximately 10% inflation in the USD between 2011 and 2017).

3.1. Brexit Impacts

Table 1 summarizes the macroeconomic impacts of the Brexit scenario on the UK, the EU27 and other parties. The EU member states are ranked by % change in real GDP in 2030.

Table 1: GDP and Welfare Impacts of Brexit, Relative to Baseline, by Region

	Real GDP (% change)		Welfare (USD billions)	
	2020	2030	2020	2030
EU28	**-0.308**	**-0.649**	**-78.58**	**-173.46**
UK	**-1.349**	**-2.540**	**-50.09**	**-101.63**
EU27	**-0.126**	**-0.237**	**-28.49**	**-71.83**
Ireland	-1.042	-2.760	-3.00	-8.95
Bellux	-0.420	-0.881	-3.90	-7.56
Netherlands	-0.191	-0.388	-2.67	-5.92
Baltics	-0.095	-0.354	-0.23	-0.98
Denmark	-0.159	-0.344	-0.94	-2.07
Mediterranean	-0.129	-0.319	-0.69	-1.91
Iberia	-0.110	-0.251	-3.28	-8.34
Germany	-0.097	-0.253	-4.79	-11.77
Poland	-0.094	-0.236	-1.02	-3.15
CEECs	-0.084	-0.230	-1.07	-3.63
Sweden	-0.121	-0.245	-0.74	-1.95
France	-0.106	-0.210	-4.05	-9.85
Italy	-0.051	-0.146	-1.58	-4.09
Finland	-0.077	-0.157	-0.26	-0.66
Austria	-0.041	-0.118	-0.19	-0.76
Adriatic	-0.054	-0.121	-0.08	-0.23
G8 & China				
Canada	0.010	0.035	0.56	1.86
Japan	0.009	0.036	1.49	4.76
Russia	0.014	0.033	1.27	3.74
USA	0.006	0.023	3.05	8.32
China	0.011	0.027	2.82	15.94
World Total	-0.059	-0.091	-58.75	-90.74

Source: Calculations by the authors.

Exit by the UK from the EU under the Brexit assumptions generates significant negative impacts for the UK, the EU27 and the global economy as a whole:

— UK real GDP declines by -2.54%, and economic welfare declines by just over USD 100 billion in 2030, measured at 2011 prices;
— The decline in real GDP for the EU27 is much smaller at only -0.24%, however, the decline in economic welfare of USD 72 billion is closer to the impact observed for the UK;
— For the EU28, these impacts add up to -0.65% decline in real GDP and just over USD 173 billion reduction in economic welfare;
— For the global economy as a whole, the corresponding figures are -0.09% and USD 91 billion.

There are, however, beneficiaries from Brexit as the erosion of mutual preferences in the UK and EU27 markets provides windfall gains to third parties in terms of market share gains in both the UK and EU27 markets, notwithstanding negative income effects. Brexit also generates relative competitiveness gains for third parties. For the major G8 economies and China, the net effect is positive, both in terms of real GDP and economic welfare. China is the biggest beneficiary in aggregate economic welfare terms, gaining almost USD 16 billion, as it supplants the UK and the EU27 in each of these region's trade. Japan is the biggest beneficiary in terms of real GDP growth. Thus, as the EU27 and UK lose preferences in each other's markets, third parties gain a competitive edge against both.

Within the EU27, the impacts differ based on the intensity of exposure to bilateral trade with the UK. The average real GDP decline across EU27 Member States is -0.44%. Ireland is the biggest loser from a Brexit, as its GDP declines by -2.8% and economic welfare falls by USD 9 billion by 2030. The Bellux group, along with the Netherlands, are the next most affected with real GDP declines of -0.88% and -0.39% respectively. The impact to Ireland and the Bellux group is such that they are the only Member States with above average declines. Excluding these two regions, the average decline in real GDP for the balance of the Member States is about -0.24%, just over half the overall average rate. The least affected are Austria and the Adriatic states (Croatia and Slovenia) with real GDP declines of -0.118, and -0.121 respectively. The Adriatic states also had the smallest decline in economic welfare at USD 0.23 billion. Geography and trade exposure are, thus, key factors in Brexit's impact on the EU27 Member States. By the same token, most EU member states will feel comparatively little pressure to accommodate UK interests in the Brexit negotiations.

The effects build up over time due to two factors: the gradual build-up of NTBs between the UK and the EU27 and the gradual response of investment to the changes in rates of return induced by the Brexit shock. This latter effect reflects the lead-time for investment decisions. On average, the long-run impacts are roughly two and a half times the size of the initial first-year impacts, although the extent of build up varies somewhat across individual regions. In this regard, it is important to distinguish the build-up in the equilibrium impact and short-term dynamics. The initial impact of Brexit could be much greater than portrayed here because of market reactions that are then dampened over time. However, while the market sensitivities are likely to die out over time, the equilibrium impact will continue to build.

While the EU's applied MFN tariffs are generally low, the combination of the insertion of a tariff wall between the UK and the EU27 and the imposition of the new time and out-of-pocket costs of cross-border trade results in a non-negligible impact on bilateral trade, with commensurate consequences for GDP and welfare.

For both the UK and EU27, border costs have the largest impact on GDP followed by tariffs, goods NTBs, services NTBs and lastly FDI NTBs. Border costs also constitute the largest source of changes in real GDP for most other markets, with the exception of Ireland, Bellux, Netherlands, Baltics, Denmark and Japan, for which tariffs have the bigger impact.

As regards impacts on individual third parties, with the exception of FDI NTBs, Ireland's declines in GDP resulting from Brexit's tariffs, border costs and both goods and services NTBs are the largest in the EU27 for each source of impact. Denmark has the largest decline in real GDP attributable to rising NTBs on FDI.

Table 2: Source of Impacts on Real GDP and Welfare, 2030

	Tariffs	Border Costs	Goods NTBs	Services NTBs	FDI NTBs	Tariffs	Border Costs	Goods NTBs	Services NTBs	FDI NTBs
	Real GDP (% change)					Welfare (USD billions)				
EU28	**-0.223**	**-0.289**	**-0.122**	**-0.011**	**-0.004**	**-56.25**	**-78.85**	**-34.73**	**-2.85**	**-0.79**
UK	**-0.899**	**-1.160**	**-0.437**	**-0.043**	**-0.001**	**-30.09**	**-49.93**	**-19.80**	**-1.80**	**-0.01**
EU27	**-0.098**	**-0.128**	**-0.064**	**-0.005**	**-0.004**	**-26.15**	**-28.92**	**-14.93**	**-1.05**	**-0.78**
Ireland	-1.071	-1.060	-0.569	-0.058	-0.002	-3.61	-3.34	-1.81	-0.17	-0.01
Bellux	-0.356	-0.329	-0.184	-0.007	-0.004	-3.43	-2.64	-1.41	-0.05	-0.03
Netherlands	-0.163	-0.142	-0.070	-0.012	-0.001	-2.68	-1.90	-1.21	-0.13	-0.01
Baltics	-0.142	-0.140	-0.069	-0.001	-0.002	-0.44	-0.36	-0.18	0.00	0.00
Denmark	-0.121	-0.116	-0.044	-0.008	-0.056	-0.83	-0.63	-0.33	-0.03	-0.25
Mediterranean	-0.079	-0.154	-0.079	-0.007	0.000	-0.50	-0.90	-0.47	-0.05	0.01
Iberia	-0.085	-0.109	-0.049	-0.004	-0.003	-3.28	-3.30	-1.57	-0.12	-0.07
Germany	-0.061	-0.119	-0.067	-0.003	-0.002	-3.32	-5.26	-2.96	-0.14	-0.09
Poland	-0.073	-0.116	-0.045	-0.002	0.000	-1.16	-1.37	-0.60	-0.02	0.00
CEECs	-0.084	-0.104	-0.039	-0.002	-0.001	-1.52	-1.47	-0.61	-0.02	-0.01
Sweden	-0.057	-0.120	-0.047	-0.005	-0.016	-0.45	-1.01	-0.38	-0.03	-0.07
France	-0.062	-0.095	-0.047	-0.003	-0.001	-3.24	-4.29	-2.15	-0.12	-0.05
Italy	-0.047	-0.063	-0.028	-0.005	-0.002	-1.42	-1.66	-0.83	-0.13	-0.05
Finland	-0.025	-0.081	-0.040	-0.009	-0.003	-0.09	-0.35	-0.18	-0.03	-0.01
Austria	-0.024	-0.049	-0.021	-0.001	-0.023	-0.17	-0.31	-0.15	0.00	-0.12
Adriatic	-0.012	-0.065	-0.040	-0.003	-0.001	-0.03	-0.12	-0.08	0.00	0.00
G8 & China										
Canada	0.012	0.018	0.004	0.001	-0.001	0.39	1.06	0.40	0.04	-0.03
Japan	0.023	0.014	-0.001	0.000	-0.001	3.07	1.95	-0.26	0.06	-0.05
Russia	0.012	0.014	0.006	0.002	-0.001	0.24	2.01	1.46	0.09	-0.05
USA	0.011	0.012	0.000	0.000	0.000	3.74	4.23	0.31	0.14	-0.09
China	0.014	0.015	-0.002	0.000	-0.001	8.29	8.28	-0.56	0.15	-0.22
World Total	-0.026	-0.040	-0.022	-0.001	-0.001	-20.77	-40.31	-26.36	-1.52	-1.78

Source: Calculations by the authors.

3.2. Brefta Impacts

The main factor under Brefta is the imposition of the new time and out-of-pocket costs of cross-border trade through the imposition of a new hard border. Because of the need to enforce the EFTA-type FTA between the UK and the EU27, which characterizes the Brefta, there is an additional cost of demonstrating ROOs compliance. Thus, while Brefta is tariff-free, it is not cost-free in this sense. Our assumption that the four freedoms of movement remain in place for the most part results in only a modest increment to NTBs between the UK and EU27.

Table 3 summarizes the macroeconomic impacts of the Brefta scenario on the UK, the EU27 and other parties. Under the less disruptive exit assumed in the Brefta scenario, the UK's exit from the EU results in a decline in real GDP for the UK of about -1.0% and a loss of economic welfare of about USD 42 billion. For the EU27, the corresponding figures are about -0.1% and USD 24 billion. As in the Brexit scenario, Ireland takes by far the largest hit among the other individual Member States at -0.95%, with the Bellux group also absorbing a larger-than-EU27-average decline in GDP. Just as with the Brexit scenario, excluding these two regions results in a much smaller average decline in real GDP (-0.09%) for the balance of the Member States compared to the average rate (-0.16%) under Brexit. As in the Brexit scenario, Austria and the Adriatic states are the least affected in terms of GDP impacts. There are a few shifts in ranking under the Brefta scenario vs Brexit – the Mediterranean economies move into 3rd place from 6th, the Baltics move from 4th to 6th place and Sweden moves from 9th to 7th place in terms of the most significant.

For third parties, the Brefta generates similar patterns of both positive trade diversion and negative income effects; however, just as for the UK and EU27 the effects are much more muted. There are some changes in the ranking of the third parties; Canada now makes the biggest gain in terms of real GDP at 0.015% – vs Japan in the Brexit scenario. China, at USD 7 billion, continues to make the largest aggregate gain in economic welfare. The global economy as a whole is worse off, with real GDP 0.03% lower than the baseline – but this compares favourably to the 0.09% reduction in the Brexit scenario.

Because of the dynamic nature of the model, the full impact of the Brefta shock is realized only gradually and the effects, thus, build up over time. Brefta features less of build-up of impacts over time since there is no regulatory drift to widen the negative impact on bilateral trade over time. The effects in 2030 on real GDP are on average about half again as high as in 2020, compared to the approximate doubling of impacts under Brexit.

Table 3: GDP and Welfare Impacts of Brefta, Relative to Baseline, by Region

	Real GDP (% change)		Welfare (USD billions)	
	2020	2030	2020	2030
EU28	**-0.153**	**-0.243**	**-39.06**	**-65.87**
UK	**-0.646**	**-0.967**	**-25.56**	**-41.60**
EU27	**-0.067**	**-0.109**	**-13.50**	**-24.27**
Ireland	-0.510	-0.945	-1.29	-2.94
Bellux	-0.204	-0.298	-1.57	-2.36
Netherlands	-0.088	-0.125	-0.98	-1.62
Baltics	-0.058	-0.113	-0.12	-0.29
Denmark	-0.082	-0.120	-0.37	-0.61
Mediterranean	-0.081	-0.135	-0.43	-0.80
Iberia	-0.058	-0.094	-1.48	-2.86
Germany	-0.057	-0.095	-2.56	-4.16
Poland	-0.051	-0.093	-0.49	-1.09
CEECs	-0.047	-0.087	-0.52	-1.21
Sweden	-0.068	-0.096	-0.45	-0.79
France	-0.057	-0.077	-2.05	-3.44
Italy	-0.031	-0.056	-0.86	-1.45
Finland	-0.046	-0.066	-0.17	-0.28
Austria	-0.026	-0.043	-0.13	-0.27
Adriatic	-0.039	-0.052	-0.06	-0.09
G8 & China				
Canada	0.005	0.015	0.37	0.87
Japan	0.002	0.012	0.29	1.62
Russia	0.007	0.013	0.84	1.57
USA	0.002	0.010	1.27	3.75
China	0.004	0.012	0.89	6.81
World Total	-0.030	-0.033	-30.34	-33.21

Source: Calculations by the authors.

Across the board, border costs have the largest impact on GDP followed by ROOs, and services NTBs. The, FDI NTBs were generally fourth in terms of impact – with the exception of Austria where the FDI NTBs ranked third, followed by services NTBs.

With the exception of FDI NTBs, Ireland's declines in GDP resulting from Brexit's ROOs, border costs and services NTBs were the largest in the EU27 for each source. Denmark had the largest decline in real GDP attributable to FDI NTBs.

Table 4: Source of Impacts on Real GDP and Welfare, 2030

	ROOs	Border Costs	Goods NTBs	Services NTBs	FDI NTBs	ROOs	Border Costs	Goods NTBs	Services NTBs	FDI NTBs
	Real GDP (% change)					Welfare (USD billions)				
EU28	**-0.097**	**-0.123**	**0.000**	**-0.022**	**-0.001**	**-26.35**	**-33.58**	**0.00**	**-5.78**	**-0.16**
UK	**-0.390**	**-0.497**	**0.000**	**-0.079**	**-0.001**	**-16.81**	**-21.35**	**0.00**	**-3.40**	**-0.04**
EU27	**-0.042**	**-0.054**	**0.000**	**-0.012**	**-0.001**	**-9.54**	**-12.22**	**0.00**	**-2.39**	**-0.12**
Ireland	-0.356	-0.459	0.000	-0.130	-0.001	-1.12	-1.45	0.00	-0.37	0.00
Bellux	-0.112	-0.142	0.000	-0.042	-0.002	-0.90	-1.15	0.00	-0.29	-0.01
Netherlands	-0.048	-0.061	0.000	-0.016	0.000	-0.64	-0.82	0.00	-0.16	0.00
Baltics	-0.047	-0.060	0.000	-0.005	0.000	-0.12	-0.15	0.00	-0.01	0.00
Denmark	-0.039	-0.050	0.000	-0.022	-0.009	-0.22	-0.27	0.00	-0.08	-0.04
Mediterranean	-0.051	-0.065	0.000	-0.019	0.000	-0.30	-0.38	0.00	-0.13	0.00
Iberia	-0.036	-0.046	0.000	-0.012	0.000	-1.09	-1.40	0.00	-0.37	0.00
Germany	-0.038	-0.049	0.000	-0.007	0.000	-1.69	-2.16	0.00	-0.30	-0.01
Poland	-0.038	-0.049	0.000	-0.006	0.000	-0.45	-0.58	0.00	-0.06	0.00
CEECs	-0.035	-0.045	0.000	-0.007	0.000	-0.50	-0.64	0.00	-0.07	0.00
Sweden	-0.039	-0.050	0.000	-0.006	-0.001	-0.32	-0.42	0.00	-0.04	-0.01
France	-0.031	-0.040	0.000	-0.006	0.000	-1.39	-1.78	0.00	-0.25	-0.02
Italy	-0.021	-0.027	0.000	-0.008	0.000	-0.55	-0.71	0.00	-0.19	0.00
Finland	-0.026	-0.033	0.000	-0.006	0.000	-0.11	-0.15	0.00	-0.02	0.00
Austria	-0.016	-0.020	0.000	-0.003	-0.004	-0.10	-0.13	0.00	-0.02	-0.02
Adriatic	-0.021	-0.027	0.000	-0.005	0.000	-0.04	-0.05	0.00	-0.01	0.00
G8 & China										
Canada	0.006	0.008	0.000	0.001	0.000	0.35	0.45	0.00	0.07	0.00
Japan	0.005	0.006	0.000	0.001	0.000	0.67	0.86	0.00	0.09	0.00
Russia	0.005	0.006	0.000	0.003	0.000	0.65	0.83	0.00	0.10	-0.01
USA	0.004	0.005	0.000	0.001	0.000	1.45	1.84	0.00	0.47	-0.01
China	0.005	0.007	0.000	0.000	0.000	2.93	3.72	0.00	0.19	-0.02
World Total	-0.013	-0.017	0.000	-0.003	0.000	-13.17	-16.80	0.00	-2.97	-0.27

Source: Calculations by the authors.

3.3. Brexit with Single Market Effect

One issue with modelling trade scenarios involving the EU consists of the treatment for the single market. In this simulation, we treat intra-EU trade as enjoying a home bias. To do this, for each EU27 Member State, we treat imports from other EU Member States as domestic sales – that is, we set the substitution elasticity between imports from EU Member States and non-EU parties (including the UK in the Brexit scenario) at the level that applies for substitution between domestic production and imports. This has several implications. Most importantly, just as trade diversion effects reduce the gains from trade in a liberalization scenario, so they intensify losses in a scenario in which trade barriers are erected. Reducing the amount of trade diversion from intra-EU trade due to Brexit amplifies the costs for the EU27. This may also be considered as capturing the variety effect: as shown by Ossa (2012), applying the model developed by Arkolakis et al. (2012), as the substitution elasticity falls, the welfare gains from trade rise (and conversely, the welfare losses from reduction of trade increase). Tables 5 and 6 report the results.

Under this modelling approach, the UK figures are little changed: real GDP declines by 2.49% (vs -2.54% without the single market effect), and economic welfare loss is USD 99 billion vs a USD 101 billion loss under Brexit. For the EU27 Member States, however, the impact is significantly larger. The GDP decline is -0.32% vs -0.24%. The welfare effect for this scenario is a decline of USD 108 billion which is a 50% increase over the decline of USD 72 billion under the Brexit scenario. Treating the EU as a single market increases the negative impact of Brexit on the global economy as a whole, from USD 91 billion to USD 96 billion.

Table 5: GDP and Welfare Impacts of Brexit with Single Market Effect, Relative to Baseline, by Region

	Real GDP (% change)		Welfare (USD billions)	
	2020	2030	2020	2030
EU28	**-0.340**	**-0.723**	**-97.16**	**-206.86**
UK	**-1.325**	**-2.495**	**-48.79**	**-99.10**
EU27	**-0.169**	**-0.318**	**-48.36**	**-107.76**
Ireland	-1.163	-3.167	-3.89	-10.72
Bellux	-0.592	-1.171	-6.74	-11.43
Netherlands	-0.262	-0.529	-4.34	-8.77
Baltics	-0.154	-0.588	-0.47	-1.76
Denmark	-0.218	-0.434	-1.52	-2.95
Mediterranean	-0.150	-0.380	-0.98	-2.47
Iberia	-0.151	-0.347	-5.41	-12.70
Germany	-0.125	-0.314	-8.08	-17.14
Poland	-0.142	-0.389	-2.00	-5.59
CEECs	-0.140	-0.388	-2.54	-7.01
Sweden	-0.168	-0.338	-1.50	-3.29
France	-0.142	-0.274	-6.73	-14.64
Italy	-0.067	-0.186	-2.79	-6.15
Finland	-0.110	-0.216	-0.50	-1.08
Austria	-0.080	-0.197	-0.67	-1.59
Adriatic	-0.093	-0.197	-0.20	-0.47
G8 & China				
Canada	0.014	0.051	0.67	2.50
Japan	0.012	0.054	1.97	6.59
Russia	0.022	0.061	1.53	5.01
USA	0.009	0.035	4.25	11.39
China	0.015	0.043	3.61	21.13
World Total	-0.063	-0.089	-71.40	-96.01

Source: Calculations by the authors.

Table 6: Source of Impacts on Real GDP and Welfare, 2030

	ROOs	Border Costs	Goods NTBs	Services NTBs	FDI NTBs	ROOs	Border Costs	Goods NTBs	Services NTBs	FDI NTBs
	Real GDP (% change)					Welfare (USD billions)				
EU28	**-0.262**	**-0.314**	**-0.131**	**-0.013**	**-0.004**	**-73.22**	**-89.97**	**-39.49**	**-3.44**	**-0.73**
UK	**-0.882**	**-1.139**	**-0.431**	**-0.043**	**-0.001**	**-29.09**	**-48.75**	**-19.45**	**-1.79**	**-0.01**
EU27	**-0.147**	**-0.162**	**-0.075**	**-0.007**	**-0.004**	**-44.13**	**-41.22**	**-20.04**	**-1.66**	**-0.71**
Ireland	-1.280	-1.183	-0.630	-0.072	-0.002	-4.50	-3.88	-2.11	-0.23	-0.01
Bellux	-0.511	-0.425	-0.220	-0.011	-0.004	-5.44	-3.86	-2.01	-0.10	-0.02
Netherlands	-0.239	-0.184	-0.090	-0.016	-0.001	-4.19	-2.72	-1.66	-0.19	-0.01
Baltics	-0.280	-0.206	-0.099	-0.003	-0.001	-0.90	-0.57	-0.28	-0.01	0.00
Denmark	-0.176	-0.145	-0.050	-0.010	-0.053	-1.27	-0.92	-0.48	-0.05	-0.23
Mediterranean	-0.107	-0.178	-0.085	-0.010	0.000	-0.75	-1.10	-0.55	-0.08	0.01
Iberia	-0.136	-0.141	-0.060	-0.006	-0.003	-5.56	-4.72	-2.15	-0.19	-0.07
Germany	-0.091	-0.142	-0.074	-0.005	-0.002	-5.93	-7.23	-3.68	-0.22	-0.08
Poland	-0.150	-0.173	-0.061	-0.004	-0.001	-2.39	-2.26	-0.90	-0.05	0.00
CEECs	-0.166	-0.163	-0.054	-0.004	-0.001	-3.25	-2.70	-1.00	-0.06	-0.01
Sweden	-0.096	-0.159	-0.061	-0.006	-0.015	-1.01	-1.55	-0.61	-0.05	-0.06
France	-0.093	-0.119	-0.057	-0.004	-0.001	-5.50	-6.01	-2.89	-0.19	-0.05
Italy	-0.068	-0.076	-0.033	-0.007	-0.002	-2.47	-2.35	-1.10	-0.18	-0.05
Finland	-0.049	-0.107	-0.048	-0.010	-0.003	-0.26	-0.53	-0.24	-0.04	-0.01
Austria	-0.064	-0.080	-0.030	-0.002	-0.022	-0.58	-0.63	-0.25	-0.02	-0.11
Adriatic	-0.047	-0.095	-0.049	-0.005	-0.001	-0.13	-0.21	-0.11	-0.01	0.00

	ROOs	Border Costs	Goods NTBs	Services NTBs	FDI NTBs	ROOs	Border Costs	Goods NTBs	Services NTBs	FDI NTBs
	Real GDP (% change)					**Welfare (USD billions)**				
G8 & China										
Canada	0.021	0.024	0.006	0.001	-0.001	0.72	1.29	0.46	0.06	-0.03
Japan	0.033	0.021	0.000	0.001	-0.001	4.06	2.59	-0.09	0.08	-0.05
Russia	0.027	0.024	0.009	0.003	-0.001	0.87	2.47	1.61	0.12	-0.06
USA	0.018	0.016	0.001	0.001	0.000	5.23	5.37	0.67	0.20	-0.09
China	0.022	0.021	0.000	0.001	-0.001	10.98	10.23	-0.08	0.23	-0.23
World Total	-0.025	-0.039	-0.022	-0.001	-0.001	-23.14	-41.35	-28.17	-1.56	-1.78

Source: Calculations by the authors.

3.4. Brexit with a UK-US FTA

One possible offset for the UK to the costs of withdrawal from the single market is an opportunity to pursue a more aggressive FTA agenda, in particular with the United States. With the radical turn of events in the United States on social and environmental fronts, an EU-US TTIP might be difficult to conclude in the politically relevant coming decade, given the sustainability hurdles that an EU FTA must pass to obtain ratification. The UK would seem to face lower hurdles to proceed with an FTA with the United States, although it must be acknowledged that political signals are open to multiple interpretations. We simulate Brexit with an add-on of a UK-US FTA, provisionally implemented in 2020 to avoid the question of how long such an agreement might actually take to negotiate. This FTA is modelled on CETA-level tariff and NTB commitments for the UK and TPP-level tariff and NTB commitments for the United States. The simulation is run with the model incorporating the single market effect for the EU. Tables 7 and 8 provide the results.

Under this scenario, the negative impact to the UK is about 6% smaller than in the Brexit scenario. Real GDP declines by 2.39% (vs by about 2.5% for Brexit without a UK-US FTA add-on) and the economic welfare loss falls to USD 95 billion from USD 101 billion. For the EU27 Member States, the UK-US FTA raises the cost of Brexit: significantly in terms of real GDP, the negative impact rises 70% from -0.237% to -0.403%; and in terms of welfare there is a 50% increase from USD 72 billion to USD 110 billion.

Ireland continues to take the largest hit, followed by the Bellux group. As in the Brexit with Single Market Effect scenario, Italy has the smallest change in GDP, followed by Austria and the Adriatic states. A few countries shift in the rankings, with the biggest shift being for Poland, Germany and CEECs, which move from 7th, 10th and 11th rank under Brexit to 11th, 6th and 7th in this scenario, respectively. For third parties, Russia retains is first place ranking in terms of real GDP gain as in the Brexit with Single Market Effect scenario and as with all the other scenarios China continues to have largest aggregate gain in economic welfare. The global economy as a whole remains worse off – the UK-US FTA does not compensate for Brexit. The offset is relatively small, lowering the real GDP loss to 0.087% from about 0.091% in the Brexit scenarios and the welfare loss to USD 96 billion from USD 100 billion in the Brexit scenario. ROOs and border costs account for the largest impact on GDP both in the EU27 and outside the EU28.

The figures that really jump off the page in this scenario, however, are the impacts of the UK-US FTA for the United States. For the United States, the bilateral trade agreement with the UK generates very small gains of 0.056% in real GDP with USD 18 billion in welfare gains. In the three earlier scenarios, the US welfare gain was about half that generated for China. In this scenario, the welfare gain is about 90% of China's welfare gain. One of the major issues for the UK will be to get policy attention in foreign capitals mobilized to address the impacts of the Trump Administration policies on the global trading order as well as the policy attention of the Trump Administration itself.

Table 7: GDP and Welfare Impacts of Brexit + UK-US FTA, Relative to Baseline, by Region

	Real GDP (% change)		Welfare (USD billions)	
	2020	2030	2020	2030
EU28	**-0.334**	**-0.713**	**-96.17**	**-205.13**
UK	**-1.261**	**-2.387**	**-46.26**	**-94.86**
EU27	**-0.172**	**-0.403**	**-49.91**	**-110.28**
Ireland	-1.179	-3.218	-4.01	-10.96
Bellux	-0.605	-1.190	-6.93	-11.65
Netherlands	-0.268	-0.541	-4.48	-8.97
Baltics	-0.156	-0.594	-0.47	-1.78
Denmark	-0.223	-0.442	-1.56	-3.01
Mediterranean	-0.152	-0.383	-0.99	-2.50
Iberia	-0.154	-0.352	-5.53	-12.92
Germany	-0.129	-0.321	-8.42	-17.61
Poland	-0.145	-0.399	-2.07	-5.75
CEECs	-0.142	-0.393	-2.59	-7.13
Sweden	-0.171	-0.345	-1.55	-3.38
France	-0.145	-0.281	-6.97	-15.07
Italy	-0.069	-0.192	-2.91	-6.32
Finland	-0.112	-0.220	-0.52	-1.10
Austria	-0.082	-0.203	-0.70	-1.63
Adriatic	-0.096	-0.201	-0.21	-0.48
G8 & China				
Canada	0.007	0.036	0.27	1.77
Japan	0.011	0.050	1.76	6.02
Russia	0.021	0.057	1.49	4.71
USA	0.018	0.056	7.61	18.27
China	0.014	0.041	3.36	19.72
World Total	-0.060	-0.087	-69.26	-95.82

Source: Calculations by the authors.

Table 8: Source of Impacts on Real GDP and Welfare, 2030

	ROOs+ Border costs	Goods NTBs	Services NTBs	FDI NTBs	ROOs+ border costs	Goods NTBs	Services NTBs	FDI NTBs
	Real GDP (% change)				Welfare (USD billions)			
EU28	**-0.716**	**0.002**	**0.000**	**0.000**	**-205.94**	**0.71**	**0.10**	**0.00**
UK	**-2.413**	**0.024**	**0.003**	**0.000**	**-96.17**	**1.16**	**0.15**	**0.00**
EU27	**-0.401**	**-0.002**	**0.000**	**0.000**	**-109.77**	**-0.45**	**-0.06**	**0.00**
Ireland	-3.198	-0.019	-0.001	0.000	-10.87	-0.08	-0.01	0.00
Bellux	-1.186	-0.004	0.000	0.000	-11.60	-0.05	0.00	0.00
Netherlands	-0.538	-0.002	0.000	0.000	-8.93	-0.04	0.00	0.00
Baltics	-0.593	-0.001	0.000	0.000	-1.77	0.00	0.00	0.00
Denmark	-0.441	-0.001	0.000	0.000	-3.00	-0.01	0.00	0.00
Mediterranean	-0.383	0.000	0.000	0.000	-2.50	0.00	0.00	0.00
Iberia	-0.351	-0.001	0.000	0.000	-12.88	-0.03	-0.01	0.00
Germany	-0.320	-0.001	0.000	0.000	-17.51	-0.09	-0.01	0.00
Poland	-0.397	-0.001	0.000	0.000	-5.73	-0.02	0.00	0.00
CEECs	-0.392	-0.001	0.000	0.000	-7.12	-0.01	0.00	0.00
Sweden	-0.343	-0.001	0.000	0.000	-3.36	-0.02	0.00	0.00
France	-0.280	-0.001	0.000	0.000	-15.00	-0.07	-0.01	0.00
Italy	-0.191	-0.001	0.000	0.000	-6.29	-0.02	-0.01	0.00
Finland	-0.219	-0.001	0.000	0.000	-1.10	0.00	0.00	0.00
Austria	-0.202	-0.001	0.000	0.000	-1.63	-0.01	0.00	0.00
Adriatic	-0.200	-0.001	0.000	0.000	-0.48	0.00	0.00	0.00

	ROOs+ Border costs	Goods NTBs	Services NTBs	FDI NTBs	ROOs+ border costs	Goods NTBs	Services NTBs	FDI NTBs
	Real GDP (% change)				**Welfare (USD billions)**			
G8 & China								
Canada	0.039	-0.003	0.000	0.000	1.90	-0.12	-0.01	0.01
Japan	0.051	-0.001	0.000	0.000	6.12	-0.10	-0.01	0.00
Russia	0.058	0.000	0.000	0.000	4.74	-0.03	-0.01	0.01
USA	0.051	0.004	0.001	0.001	17.01	0.95	0.10	0.21
China	0.042	0.000	0.000	0.000	19.99	-0.27	-0.02	0.02
World Total	-0.088	0.001	0.000	0.000	-96.58	0.37	0.05	0.34

Source: Calculations by the authors.

3.5. Macro Impacts on the UK and the EU27

Tables 9 and 10 summarize the main indicators under the four scenarios for the UK and the EU27 respectively in 2030 when all the impacts of the scenarios will have worked their way through the economy.

Table 9: Summary of Macroeconomic Impacts on the UK, 2030

	Brexit	Brefta	Brexit – Single Market	Brexit - Single Market + UK-US FTA
Major aggregates				
Economic Welfare USD billions	-101.6	-41.6	-99.1	-94.9
Economic Welfare % change	-2.75	-1.08	-2.69	-2.58
GDP value USD billions	-114.0	-53.6	-89.7	-85.9
GDP value USD billions % change	-2.89	-1.36	-2.80	-2.68
GDP volume % change	-2.54	-0.97	-2.50	-2.39
GDP deflator % change	-0.35	-0.39	-0.30	-0.29
CPI % change	0.08	-0.24	0.10	0.10
National Accounts Aggregates (real terms)				
Consumption	-3.00	-1.15	-2.93	-2.81
Government Expenditure	-1.93	-0.84	-1.88	-1.80
Investment	-4.38	-1.63	-4.28	-4.06
Total Exports of Goods & Services	-6.75	-1.72	-6.63	-6.24
Total Imports of Goods & Services	-7.53	-2.20	-7.34	-6.93
Trade Impacts (value terms)				
Bilateral exports UK to EU27 USD billions	-100.3	-31.4	-98.2	-98.5
Bilateral Exports % change	-22.86	-6.98	-22.48	-22.57
Bilateral Imports UK from EU27 USD billions	-144.4	-40.0	-141.7	-143.9
Bilateral Imports % change	-31.79	-9.01	-31.42	-31.89
Total Exports USD billions	-81.0	-22.6	-79.1	-74.9
Total Exports % change	-6.75	-1.72	-6.63	-6.24
Total Imports USD billions	-97.1	-28.5	-94.8	-89.8
Total Imports % change	-7.53	-2.20	-7.34	-6.93
Trade balance USD billions	16.1	5.9	15.7	14.9
Terms of Trade % change	-0.50	-0.29	-0.45	-0.43
Factor Markets				
Capital Stock % change	-1.84	-0.75	-1.80	-1.70
Real wage of Unskilled labour % change	-1.70	-0.58	-1.66	-1.58
Real wage of skilled labour % change	-1.80	-0.60	-1.76	-1.68
Real GDP / Total Real Trade	0.36	0.49	0.36	0.36
Labour Productivity / Real Wage	1.45	1.64	1.46	1.46

Source: Calculations by the authors.

Table 10: Summary of Macroeconomic Impacts on the EU27, 2030

	Brexit	Brefta	Brexit – Single Market	Brexit – Single Market + UK-US FTA
Major aggregates				
Economic Welfare USD billions	-71.8	-24.3	-107.8	-110.3
Economic Welfare % change	-0.35	-0.12	-0.52	-0.53
GDP value USD billions	-107.4	-32.3	-122.5	-127.2
GDP value USD billions % change	-0.50	-0.15	-0.67	-0.69
GDP volume % change	-0.30	-0.11	-0.39	-0.40
GDP deflator % change	-0.20	-0.04	-0.28	-0.30
CPI % change	-0.13	-0.03	-0.17	-0.19
National Accounts Aggregates (real terms)				
Consumption	-0.38	-0.13	-0.56	-0.57
Government Expenditure	-0.25	-0.09	-0.37	-0.37
Investment	-0.49	-0.16	-0.68	-0.70
Total Exports of Goods & Services	-0.40	-0.11	-0.59	-0.60
Total Imports of Goods & Services	-0.59	-0.16	-0.97	-0.99
Trade Impacts (value terms)				
Bilateral exports EU27 to UK USD billions	-144.4	-40.0	-141.7	-143.9
Bilateral Exports % change	-31.79	-9.01	-31.42	-31.89
Bilateral Imports EU27 from UK USD billions	-100.3	-31.4	-98.2	-98.5
Bilateral Imports % change	-22.86	-6.98	-22.48	-22.57
Total Exports USD billions	-55.1	-14.2	-79.5	-82.2
Total Exports % change	-0.40	-0.11	-0.59	-0.60
Total Imports USD billions	-56.3	-14.6	-93.0	-95.8
Total Imports % change	-0.59	-0.16	-0.97	-0.99
Trade balance USD billions	1.3	0.4	13.5	13.6
Terms of Trade % change	-0.08	-0.01	-0.11	-0.12
Factor Markets				
Capital Stock % change	-0.19	-0.07	-0.27	-0.27
Real wage of Unskilled labour % change	-0.20	-0.07	-0.29	-0.29
Real wage of skilled labour % change	-0.21	-0.07	-0.30	-0.31
Real GDP / Total Real Trade	0.60	0.81	0.50	0.50
Labour Productivity / Real Wage	1.47	1.66	1.32	1.33

Source: Calculations by the authors.

4. Conclusions

In terms of numbers, Brexit is an expensive proposition for both the UK and the EU27. We evaluate the cost to the UK as equivalent to a permanent reduction of GDP by about 2.54% by 2030. The welfare cost to UK households is equivalent to a loss of about USD 100 billion in total household income. The hypothetical border that we construct for this scenario using available data for the cost of trading across borders for the UK and the EU is the single biggest element of the increased costs. In terms of its costs, our constructed border resembles the Canada-US border based on a range of studies of the cost of the latter.

Under Brefta, where the UK exits the EU with an EFTA-style agreement in place, the cost is substantially reduced. For this scenario, which assumes a carefully negotiated exit that minimizes bilateral trade costs between the UK and the EU27, we reduce the cost of the border to one comparable to the current EU-Swiss border. We do not factor in the one-time costs of constructing the border. Since there is no legacy border to deal with, the UK and the EU27 would be free to construct an optimal border, drawing on state-of-the-art customs procedures, information technology, risk management, and so forth, to largely retain the seamless experience under the single market. However, whereas Brexit does not impose additional ROOs costs on UK-EU27 trade (which is conducted on an MFN basis), Brefta does. We assume a low-cost ROOs regime that minimizes costs for small and medium-sized enterprises.

We consider the implications of Brexit given the existence of a single market effect, which creates lower substitutability of internal EU27 trade for external trade. In this scenario, the welfare costs rise, particularly for the EU27 as lower trade elasticities imply higher welfare losses from the disruption of trade by Brexit.

A UK FTA with the United States softens the blow of Brexit but only compensates for about one-fifth of the welfare losses to the UK from Brexit. The preference erosion for the EU27 in the UK and US markets adds on additional welfare losses for the EU27 although these are relatively modest in the big picture.

Table 11 summarizes the main results across the four scenarios.

The least disruptive scenario is Brefta. Brexit with Single Market Effect generates the best outcome for third parties with the exception of the United States which has the best outcome under the Brexit with a UK-US FTA scenario.

Table 11: Summary of Real GDP and Welfare 2030 – 4 Scenarios

	Real GDP (% change) 2030				Welfare (USD billions) 2030			
	Brexit	Brefta	Brexit with Single Market Effect	Brexit with a UK-US FTA	Brexit	Brefta	Brexit with Single Market Effect	Brexit with a UK-US FTA
UK	-2.54	-0.97	-2.50	-2.39	-101.6	-41.6	-99.1	-94.9
EU27	-0.30	-0.11	-0.40	-0.40	-71.8	-24.3	-107.8	-110.3
Canada	0.03	0.02	0.05	0.04	1.9	0.9	2.5	1.8
Japan	0.04	0.01	0.05	0.05	4.8	1.6	6.6	6.0
Russia	0.03	0.01	0.06	0.06	3.7	1.6	5.0	4.7
USA	0.02	0.01	0.04	0.06	8.3	3.8	11.4	18.3
China	0.03	0.01	0.04	0.04	15.9	6.8	21.1	19.7
World Total	-0.09	-0.03	-0.09	-0.09	-90.7	-33.2	-96.0	-95.8

Source: Calculations by the authors.

Several conclusions can be derived from these results.

First, the economic disruption of a full Brexit generates significant economic costs for both parties – the UK and the EU27. These costs substantially exceed those associated with the UK exiting the EU with an EFTA-like free trade arrangement.

Second, for the UK, an FTA with the United States reduces the negative impact on welfare marginally – with only a USD 6 billion improvement in economic welfare. This reflects the heavy toll that distance exacts on trade: although the United States is larger than the EU27, the distance across the Atlantic is sufficiently greater than that across the English Channel that the trade gains under a UK-US FTA are a steep discount to those available under the Single Market. This reality is compounded by the necessarily shallower degree of liberalization possible with the United States. The incremental USD 10 billion in welfare that is generated from a bilateral UK-US FTA post Brexit may complicate matters for the UK since there is no mistaking the position of US trade policy as considering America first – and an overall gain of USD 18 billion for America may affect the UK's ranking in the US's FTA queue.

Third, from a technical modelling perspective, the welfare loss to the EU27 is greater if we treat all internal EU27 trade as equivalent to domestic shipments. This is consistent with theoretical treatments of the welfare gains from trade as depending on the trade elasticity and also consistent with the increase in economic gains for the EU from trade liberalization when its internal market is treated as a Single Market.

Fourth, the main external beneficiaries of Brexit are geopolitical rivals – USA and China.

The bottom line is that Brexit scenarios put the UK and the EU27 onto lower-output tracks due to economic inefficiencies that persist year-in, year-out. There are many caveats to this conclusion based on factors that are not explicitly incorporated in the modelling: one set is based on potential economic gains that Brexit might afford; the second is based on dynamic effects that could amplify the losses.

A major premise of support for Brexit is that EU regulation impedes UK growth. This can be neither substantiated nor dismissed out of hand since: (a) EU regulation by definition has a "one size fits all" within the Union; and (b) given there are thousands of regulations, it is not possible to parse through these and identify those where the purpose of the regulation is not served by its application in the UK but the cost of compliance is nonetheless borne by UK firms.

Looking first at regulations that address product quality and are required for market access (e.g., documentation of chemical content of products), Brexit is not a solution – the better option to modify regulations is to remain in the Union and influence their making.

Looking next at regulations that address over-riding social or environmental objectives (e.g., labour market or climate change), de-regulation in these areas by the UK might generate cost savings to the UK economy. An Open Europe assessment (conducted pre-Brexit in Spring 2015) suggested GBP 12.8 billion of savings were possible (about USD 20 billion 2011 USD). This, if realizable, would represent a modest offset to the Brexit costs, if it flowed entirely into UK household incomes. If the benefits flowed primarily to multinational firms' bottom lines, UK welfare might be minimally improved, if at all. At the same time, the UK would face constraints from potential anti-dumping/countervailing duty actions if new regulations were construed as generating either social or environmental dumping.

The second set of caveats concerns factors that could worsen outcomes. As we have not attempted to explicitly quantify these, the most that can be said is that the majority of these represent negative impacts for the UK and the EU27 because of additional transactions costs and heightened uncertainty.

In this regard, it is important to distinguish the build-up over time in the equilibrium impact reported in this study and short-term dynamics. The initial impact of Brexit could be much greater in a negative sense than portrayed here because of market reactions that are then dampened over time. Table 12 sets out the present value of the foregone income from Brexit on an equilibrium path. They are large. If the economy takes a low road – i.e., greater short-term disruption than would be felt in the long-run outcome – the present value of the foregone income would be considerably higher. The chances of a high road seem to be small since the reaction of business to the announcement of Brexit is already to make adjustments rather than wait for the actual change in trade relations.

Table 12: Impacts of Brexit Scenario in Present Value Terms

	Brexit	Brefta	Brexit with Single Market Effect	Brexit plus UK-US FTA
EU28	**-832**	**-357**	**-1007**	**-998**
UK	**-503**	**-229**	**-491**	**-468**
EU27	**-329**	**-128**	**-516**	**-530**
Ireland	-38	-14	-47	-48
Bellux	-38	-14	-61	-63
Netherlands	-29	-9	-44	-45
Baltics	-4	-1	-7	-7
Denmark	-11	-3	-16	-16
Mediterraneans	-8	-4	-11	-11
Iberia	-38	-14	-59	-60
Germany	-55	-23	-85	-88
Poland	-13	-5	-24	-25
CEECs	-15	-6	-31	-31
Sweden	-9	-4	-16	-16
France	-45	-19	-71	-73
Italy	-19	-8	-30	-31
Finland	-3	-2	-5	-5
Austria	-3	-1	-8	-8
Adriatics	-1	-1	-2	-2
G8 & China				
Canada	8	4	10	7
Japan	21	7	29	27
Russia	17	8	22	21
USA	38	17	52	87
China	60	25	79	74
World Total	-504	-220	-570	-560

Source: Calculations by the authors.

Finally, there is a general caveat to be noted. The scenarios described here explicitly assume the global trading environment remains as it was in the base year of the GTAP dataset – 2011. That world is now long gone and Brexit and the election of Donald Trump have injected a major dollop of uncertainty into international commerce. A basic premise underpinning Brexit was that there were trade opportunities available to the UK on a timelier or deeper basis than as part of the EU. The most important trade partner for the UK in this regard is the United States. The Trump election casts doubt on what the UK can achieve one-on-one with the United States, especially in light of the uncertainty as to what the United States will ultimately sign on to.

References

Allen, Kate. 2017. "UK firms struggle to find employees – even before Brexit bites." *The Guardian*, 9 May.

Arkolakis, Costas, Arnaud Costinot, and Andréz Rodríguez-Clare. 2012. "New Trade Models, Same Old Gains?" *American Economic Review* 102(1): 94-130.

Boumellassa, Houssein, David Laborde, and Cristina Mitaritonna. 2009. "A Picture of Tariff Protection Across the World in 2004." *IFPRI Discussion Paper* 00903.

Centre for Customs and Excise Studies. 2014. *Review of Accredited Operator Schemes*. Ashfield, NSW: Australian International Trade and Transport Industry Development Fund.

Centre for International Economics Canberra & Sydney. 2008. *Nutrition, health and related claims: A benefit cost analysis*. Canberra: CIE.

Ciuriak, Dan and Derk Bienen. 2014. "Overcoming Low Preference Utilization in PTAs: Presumption of Origin for Small Shipments." Presented at the Workshop of the ESIL Interest Group on International Economic Law, Vienna, Austria, 3 September.

Ciuriak, Dan and Dmitry Lysenko. 2016. "The Effect of Binding Commitments on Services Trade." C.D. Howe Institute Technical Paper for *Better in than Out? Canada and the Trans-Pacific Partnership*. Toronto: C.D. Howe Institute.

Ciuriak, Dan and Hanne Melin. 2014. "Promoting Small Business Utilisation of Market Access under the Mega-Regionals." *E15 Blog*, November. <http://e15initiative.org/blogs/promoting-small-business-utilisation-of-market-access-under-the-mega-regionals/#sthash.0FBHNFBi.dpuf>.

Ciuriak, Dan and Jingliang Xiao. 2014. "The Trans-Pacific Partnership: Evaluating the 'Landing Zone' for Negotiations." Ciuriak Consulting Working Paper.

Ciuriak, Dan and Jingliang Xiao, with Natassia Ciuriak, Ali Dadkhah, Dmitry Lysenko, and Badri Narayanan G. 2015a. "The Trade-related Impact of a UK Exit from the EU Single Market." London: Open Europe.

Ciuriak, Dan, Hanne Melin, and Derk Bienen. 2015b. "Improving Market Access for Small Enterprise: Design Principles for the Mega Regionals." Published as "Como melhorar o acesso a mercado de pequenas empresas nos acordos megarregionais?" *Pontes* 11.1: 10-14 (in Portuguese).

Dixon, Peter B. and Maureen T. Rimmer. 1998. "Forecasting and Policy Analysis with a Dynamic CGE Model of Australia." Centre of Policy Studies/IMPACT Centre Working Papers op-90.

European Commission. 2015a. "Suspension." *Taxation and Customs Union*. <http://ec.europa.eu/taxation_customs/customs/customs_duties/tariff_aspects/suspensions/index_en.htm>.

European Commission. 2015b. "TARIC." *Taxation and Customs Union*. <http://ec.europa.eu/taxation_customs/dds2/taric/taric_consultation.jsp>.

European Commission in the UK. 2014. "The EU budget and UK contributions – the facts, 2013." *Blogs.ec.europa.eu*, 3 November. <http://blogs.ec.europa.eu/ECintheUK/the-eu-budget-and-uk-contributions-the-facts-2013/>.

Fontagné, Lionel, Amélie Guillin, and Cristina Mitaritonna. 2011. "Estimations of Tariff Equivalents for the Services Sectors." CEPII Working Paper 2011-24.

Fouré, Jean, Agnès Bénassy-Quéré, and Lionel Fontagné. 2012. "The Great Shift: Macroeconomic projections for the world economy at the 2050 horizon." CEPII Working Paper 2012-03.

HM Revenue and Customs. 2009. *Impact Assessment of the Introduction of Authorised Economic Operator (AEO) Status*. London: HM Revenue and Customs.

HM Treasury. 2013. *European Union Finances 2013: statement on the 2013 EU Budget and measures to counter fraud and financial mismanagement*. UK: Controller of Her Majesty's Stationery Office.

HM Treasury. 2014. *European Union Finances 2014: statement on the 2013 EU Budget and measures to counter fraud and financial mismanagement*. UK: Controller of Her Majesty's Stationery Office.

Hummels, David and Georg Schaur. 2012. "Time as a Trade Barrier." NBER Working Paper 17758.

International Trade Centre. 2014. *Market Access Map*. <http://www.macmap.org/>.

Jafari, Yaghoob and David G. Tarr. 2014. "Estimates of Ad Valorem Equivalents of Barriers Against Foreign Suppliers of Services in Eleven Services Sectors and 103 Countries." *World Bank Policy Research Paper* WPS7096.

Minsch, Ruedi and Peter Moser. 2006. "Volkswirtschaftliche Kosten der Zollschranken: Ergebnisse einer Unternehmensumfrage." *Die Volkswirtschaft* 3.

Miroudot, Sébastien and Kätlin Pertel. 2015. "Water in the GATS: Methodology and Results." *OECD Trade Policy Papers* 185.

Moens, Alexander and Michael Cust. 2008. *Saving the North American Security and Prosperity Partnership: The Case for a North American Standards and Regulatory Area*. Vancouver: Fraser Institute.

Moens, Alexander and Nachum Gabler. 2012. "The Costs of the Canada-US Border." *Fraser Forum* (January/February): 25-27.

Open Europe. March 2015. "Open Europe Brexit Barometer." *Open Europe*. <http://openeurope.org.uk/today/open-europe-alert/>.

Ossa, Ralph. 2012. "Why Trade Matters After All." NBER Working Paper 18113.

Ottaviano, Gianmarco, Joao Paulo Pessoa, Thomas Sampson, and John Van Reenen. 2014. "The Costs and Benefits of Leaving the EU." Center for Financial Studies Working Paper 472.

Petri, Peter A., Michael G. Plummer, and Fan Zhai. 2011 (updated 2013). "The Trans-Pacific Partnership and Asia-Pacific Integration: A Quantitative Assessment." East-West Center Working Paper 119.

Sinoski, Kelly. 2015. "Canada, U.S. sign border agreement." *The Vancouver Sun*, 16 March. <http://www.vancouversun.com/travel/Canada+sign+border+agreement/10894890/story.html>.

United Nations Statistical Division. 2010. "Complete HS and SITC conversion and correspondence tables along with detailed note on its conversion methodology." *Trade Statistics Branch*. <http://unstats.un.org/unsd/trade/conversions/HS%20Correlation%20and%20Conversion%20tables.htm>.

WITS. N.d. "Product Concordance." *World Integrated Trade Solution*. <http://wits.worldbank.org/product_concordance.html>.

Technical Annex

1. Construction of the Brexit Tariff Shock

The Brexit tariff shock consists of the imposition of WTO MFN levels of protection between the UK and the EU27. To construct this policy shock, we build up weighted average protection levels from the 10-digit tariff-line level to the GTAP product group level. This tariff profile is then imposed upon UK-EU27 trade at the disaggregated EU Member State level.

Since trade within the EU is not distorted by tariffs, we have the unusual luxury of not having to worry about endogeneity bias in applying the tariff shock.[3] Accordingly, we use the weighted average MFN rates that emerge from our calculations. Constructed in this fashion, the tariffs vary by EU27 Member State/region. Notably, while the EU MFN tariff is the same at the tariff-line level, the different composition of imports and exports means that the UK faces a different level of tariffs in the EU27 than the EU27 faces in the UK. Further, as can be seen from Table A1, the changing composition of trade from year to year means that there is no definitive tariff shock for Brexit. The actual tariff shock under Brexit would depend on what trade would have been in the counterfactual where the UK remained in the EU.

For a handful of agricultural products that feature very high MFN tariffs (in all cases, agricultural products are subject to managed trade regimes with tariff rate quotas limiting the extent of market access), we adopt pragmatic "halfway house" assumptions since the Brexit shock would otherwise be excessive; for this purpose, we use US-EU levels of bilateral protection in agriculture to establish the tariff shock. The specific areas where we intervene are the following:

- Beef: UK imports from Ireland, where we lower the effective tariff increase from 75% to 23%;
- Dairy: UK imports from Ireland, where we lower the effective tariff increase from 50% to 30%; and
- Sugar: UK imports from France, where we lower the effective tariff increase from 63% to 8%.

The full set of initial tariffs by GTAP sector is included in the "Brexit Tariff Shock" tab of the Excel data file accompanying this report. We describe the detailed methodology below.

The Brexit tariff shock is based on the EU 2014 MFN schedule and is weighted by imports of the following 17 EU regions: Adriatics (Croatia and Slovenia), Austria, Baltics, Bellux (Belgium and Luxembourg), CEECs (Bulgaria, Czech Republic, Hungary, Romania, and Slovakia), Denmark, Finland, France, Germany, Iberia (Portugal and Spain), Ireland, Italy, Mediterraneans (Cyprus, Greece, and Malta), Netherlands, Poland, Sweden, and the UK.

We construct four separate datasets by weighting the 2014 MFN schedule by 2010, 2011, 2012, and 2013 imports.[4] This provides the basis for assessment of whether any specific year is an outlier. The procedure involves the following steps:

1) The MFN schedule is obtained from the International Trade Centre's (ITC) Market Access Map database.[5] An advantage of using ITC data is that specific tariffs (which are not expressed as a percentage of the value of the dutiable products) in the national tariff schedules are converted by ITC to ad valorem equivalents (i.e., the tariffs are expressed as a percentage of the value of the dutiable products).

[3] See Boumellassa et al. (2009) for a discussion of the endogeneity issue in constructing tariff protection.
[4] 2014 imports were not yet available at the time of construction of the data.
[5] International Trade Centre (2014).

2) The MFN tariffs, which are suspended by the EU, are replaced with MFN tariffs.[6] In some cases, tariffs are suspended only partially and a specific suspended tariff is applied. In these cases, we use ITC data to convert specific suspended tariffs into ad valorem equivalents.[7]
3) Because the 2014 EU tariff schedule follows a classification based on HS2012 and import data for 2010 and 2011 follow HS2007, the tariff lines are matched to corresponding HS2007 6-digit codes. This is required for subsequent aggregation of the tariffs. A conversion table from HS2012 to HS2007 is sourced from the United Nations Statistics Division (2010).
4) Aggregate tariffs at 10-digit tariff-line level up to HS 6-digit level as a simple average. Weighting cannot be performed at this detailed level, because the most disaggregated level at which the appropriate import data is available is HS 6-digit level.[8]
5) We then match 2010 and 2011 HS2007 6-digit imports of a region (by region-source) to 2014 tariffs (converted to HS2007, 6-digit level, at step 3). Similarly, we match 2012 and 2013 HS2012 6-digit imports to 2014 tariffs that also follow HS2012 classification.
6) We then aggregate the import and tariff data to GTAP codes. The mappings between GTAP and HS classifications are provided within the World Integrated Trade Solutions software package developed by the World Bank and the United Nations Conference on Trade and Development (UNCTD).[9] The mapping between GTAP and HS2007 is readily available. In order to create HS2012-GTAP mapping, an HS2012-HS2007 conversion table produced by the United Nations Statistics Division (2010) is used.
7) Aggregate tariffs at the HS 6-digit level up to GTAP code as weighted averages using actual imports as weights.
8) For the UK tariffs facing EU27 member states and the EU27 tariffs facing UK, we take the average MFN rates from 2010 to 2013 as the final protection level. However, for the agricultural products that feature very high MFN tariffs, we adopt the pragmatic "halfway house" assumptions discussed previously.

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[6] Tariff suspensions are total or partial waiver of tariffs that are in force over a specific period of time. See European Commission (2015a) for more information. There are more than 2,000 tariff lines for which tariffs are suspended, out of the almost 15,000 tariff lines in the MFN schedule. Suspensions are extracted from the TARIC database European Commission (2015b).

[7] We do not take into account the airworthiness tariff suspension (suspensions of duties for import of parts and other goods used for aircraft), because they are conditional on the use of product. As a product may have many uses besides aircraft (and the tariff is waived only if the product is used for aircraft), taking into account these suspensions would underestimate the level of protection.

[8] EUROSTAT provides data at Combined Nomenclature 8-digit level, but these data cannot be used for our purposes, because the nomenclature is changed every year and, for practical purposes, it is not possible to match CN8 codes for different years to 2014 tariff lines. In the 2010 and 2011 datasets, tariffs are aggregated up to HS2007 6-digit level and, in the 2012 and 2013 datasets, tariffs are aggregated up to HS2012 6-digit level. A shortcoming of calculating simple average tariffs is that they may be biased, because an equal weight is given to products that are imported in different volumes or even not imported at all. This bias is somewhat mitigated, because we use simple average tariffs to move only between 10-digit tariff line and the still-very-detailed HS 6-digit level. The bias, however, may be somewhat larger in some sectors in the 2010 and 2011 datasets, because in some cases tariff lines are aggregated within a broader HS 6-digit category than in the 2012 and 2013 datasets. This happens, because a 2014-10-digit tariff line necessarily corresponds to a single 6-digit HS2012 code, but it may correspond to several 6-digit HS2007 codes (because a single 6-digit HS2012 code may correspond to several 6-digit HS2007 codes). This is likely to be an issue only for those sectors that experienced substantial revision in HS2012. This also can make comparison of tariffs of a GTAP sector between 2010/2011 and 2012/2013 problematic.

[9] See WITS (n.d.). The mapping excludes GTAP 11 (raw milk) and corresponding 6-digit HS code(s) are matched to GTAP 22 (dairy products).

Table A1: GTAP-level aggregation of Implied MFN tariffs, UK and EU27, 2010-2013

		Tariffs that EU27 faces in UK				Tariffs that UK faces in EU27			
		2010	2011	2012	2013	2010	2011	2012	2013
1	PDR - Paddy rice	12.47	13.50	12.87	12.22	16.14	21.89	25.90	22.48
2	WHT - Wheat	20.04	19.37	19.87	20.49	20.67	20.94	20.04	20.26
3	GRO - Cereal grains n.e.c.	5.72	7.21	8.37	7.40	38.73	39.46	35.51	34.72
4	V_F - Vegetables, fruit, nuts	14.22	13.98	13.71	13.39	10.49	10.23	10.68	10.29
5	OSD - Oil seeds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	C_B - Sugar cane, sugar beet	50.31	50.31	50.31	50.31	50.31	50.31	50.31	50.31
7	PFB - Plant-based fibers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	OCR - Crops n.e.c.	6.90	6.81	6.90	6.89	3.61	4.00	3.84	3.89
9	CTL - Bovine cattle, sheep and goats, horses	4.97	5.10	8.18	5.30	2.06	3.19	3.97	4.18
10	OAP - Animal products n.e.c.	12.93	12.29	13.55	11.92	6.16	5.77	6.68	7.39
12	WOL - Wool, silk-worm cocoons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	FRS - Forestry	1.09	0.71	0.90	0.89	0.25	0.28	0.14	0.11
14	FSH - Fishing	7.33	6.96	8.76	7.08	8.56	8.16	8.15	7.95
15	COA - Coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	OIL - Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	GAS - Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	OMN - Minerals n.e.c.	0.05	0.04	0.05	0.04	0.01	0.01	0.01	0.01
19	CMT - Bovine meat prods	74.12	72.99	72.88	73.26	57.57	58.18	56.72	58.86
20	OMT - Meat products n.e.c.	29.94	31.02	31.45	31.68	32.34	32.80	34.33	35.07
21	VOL - Vegetable oils and fats	12.50	12.92	11.24	11.19	9.05	8.03	7.74	7.61
22	MIL - Dairy products	50.04	50.36	50.76	50.96	51.24	52.96	54.42	55.38
23	PCR - Processed rice	26.01	26.31	26.35	26.38	25.87	26.86	26.49	26.83
24	SGR - Sugar	62.49	62.20	65.12	62.01	67.84	67.98	66.96	64.11
25	OFD - Food products n.e.c.	15.73	15.76	15.51	15.52	14.61	14.86	15.05	14.95
26	B_T - Beverages and tobacco products	10.96	13.42	10.34	9.07	8.22	8.03	7.18	6.60
27	TEX - Textiles	7.85	7.87	7.92	7.99	7.25	7.21	7.26	7.16
28	WAP - Wearing apparel	11.26	11.22	11.20	11.17	11.10	11.10	11.08	11.11
29	LEA - Leather products	8.24	8.28	8.60	8.33	8.26	8.09	8.23	8.18
30	LUM - Wood products	1.65	1.68	1.59	1.58	1.85	2.04	2.18	2.31
31	PPP - Paper products, publishing	0.12	0.15	0.23	0.28	0.12	0.12	0.13	0.09
32	P_C - Petroleum, coal products	2.14	2.01	2.11	2.24	2.06	2.02	2.29	2.28
33	CRP - Chemical, rubber, plastic products	1.97	2.08	1.95	1.88	1.73	1.82	1.83	1.76
34	NMM - Mineral products n.e.c.	3.12	3.09	3.18	3.33	2.55	2.54	2.55	2.54
35	I_S - Ferrous metals	0.22	0.20	0.19	0.22	0.27	0.26	0.32	0.24
36	NFM - Metals n.e.c.	2.03	1.72	1.34	1.60	1.63	1.45	1.43	1.44
37	FMP - Metal products	2.09	2.13	2.13	2.13	2.13	2.06	2.10	2.09
38	MVH - Motor vehicles and parts	8.23	8.24	8.17	8.33	7.86	7.87	7.94	8.09
39	OTN - Transport equipment n.e.c.	1.66	2.03	2.05	2.22	0.88	0.92	0.87	0.90
40	ELE - Electronic equipment	2.04	1.59	1.49	1.38	0.58	0.72	0.66	0.62
41	OME - Machinery and equipment n.e.c.	1.29	1.30	1.30	1.30	1.22	1.25	1.25	1.26
42	OMF - Manufactures n.e.c.	1.35	1.23	1.41	1.52	1.57	1.56	1.74	1.87

Source: Calculations by the authors. Note: MFN tariffs that are suspended by the EU are accordingly replaced with suspended tariffs sourced from the TARIC database.

A recent exercise in constructing a tariff shock for Brexit by Ottaviano et al. (2014) produced similar figures for most sectors, although the HS-based aggregates used in this study are not directly comparable to the GTAP sectors in the present study. In two sectors, the data diverged. This may reflect the different sources of data used (we use ITC Trade Map data, whereas Ottaviano et al., 2014 use WTO data).

Table A2: Comparison of Constructed Tariffs

	Ottaviano et al (2014)		Present Study	
	Tariff in UK	Tariff in EU27	Tariff in UK	Tariff in EU27
Food, Beverages, and Tobacco	7.26%	4.96%	23.38	22.40
Agriculture, Hunting, Forestry, and Fishing	5.90%	5.63%	11.27	8.26

2. Calibrating the Brexit and Brefta Border Costs

To construct the Brexit border, we draw on the time and out-of-pocket cost of border transit in the World Bank's Doing Business surveys for the UK and the EU. The introduction of a customs barrier to UK-EU27 trade would occur in a generally low-cost environment. Doing Business indicates one day to exit and one day to enter, which we assume would be additional time, compared to the relatively seamless procedure under the single market. This is valued at an ad valorem tariff equivalent of 1.3% per day, which is the midpoint of the range identified by Hummels and Schaur (2012) that each day in transit is worth between 0.6% and 2% of the value of the goods being shipped.

In addition, we impose an additional administrative cost equal to US$100 per container to reflect the new requirement of an additional document, the Single Administration Document (SAD) that now accompanies extra-EU exports. Currently, to export a container requires three documents, which cost US$175 to prepare, and to import requires two documents, which cost US$180. We assume the SAD takes up a modestly disproportionate share of the export total and further assume that the additional document preparation time does not add to the time costs of UK-EU27 trade, as such preparation can be done in anticipation of actual transit.

We transform this into an ad valorem equivalent cost by applying it to an estimate of the average value of goods shipped in a standard container (twenty-foot equivalent unit or TEU) between the US and Europe and in the reverse direction. This figure is about 0.33%, which is derived as follows. We rely on a Swiss Re estimate of the value of a container load going in these two directions in 2007 (average value of US$27,452), which we raise to US$30,606 based on the estimated increase in the US GDP deflator between 2007 and 2014. We assume a $100 cost of the SAD, loosely based on the Doing Business documentation costs, which were valid for 2014. This works out to an ad valorem equivalent (AVE) of 0.33%. The combined costs generate a total border cost as an AVE on imports of 3.26%.

Examining the literature, this figure is comparable to estimates for the Canada-US border, cited by Moens and Gabler (2012) and Moens and Cust (2008), albeit at the high end of the range. Several other observations are salient:

— Notably, notwithstanding the very high degree of trust between Canada and the US, the costs of border security have not decreased over time – if anything, the reverse is true.[10] Our assumed costs do not directly take into account additional behind-the-border costs of trading companies to obtaining and maintaining certification under Authorized Economic Operator (AEO) schemes, which are not required for intra-EU trade. These costs are not insignificant: for example, Australia declined, in 2005, to enter into AEO schemes, because the costs were deemed too high for the value, although this position changed under the Abbott government.[11] For the UK, estimates of the cost of AEO certification range from £14,000 for medium-sized firms to £40,000 for larger companies with multiple facilities.[12]

[10] See the report on the latest effort to streamline the Canada-US border by Sinoski (2015).
[11] See Centre for Customs and Excise Studies (2014).
[12] HM Revenue and Customs (2009).

— Even for e-commerce transactions, based on eBay data, when a country joins a single market like the EU, the positive impact on e-commerce surpasses that of FTAs, pointing to the existence of border effects even for this generally micro level of trade (Ciuriak and Melin, 2014; Ciuriak et al., 2015).
— Small businesses, which have been free of borders in the EU environment, will bear the additional costs disproportionately since larger companies are already geared up for extra-EU trade.

Accordingly, the relatively costly Brexit border may be characterized as reflecting a world in which implementation lags vision, where well-intentioned schemes to create efficiencies nonetheless create red tape and inefficiency (the cost of which falls disproportionately on small business), where security trumps trade, and so forth. It is not unrealistic; many such borders exist, even between friendly regimes like Canada and the US – in the latter case despite the fact that more than one border initiative has been launched to streamline processes.

However, the UK and the EU27 are not necessarily condemned to experience such a border in the event of the UK's withdrawal from the single market. Under Brefta, we maintain our assumptions about documentation costs, but reduce our time costs by a quarter, calibrating our overall border costs to what has been estimated prevails for the EU-Swiss border (Minsch and Moser, 2006). Under a Brefta scenario, both the UK and the EU27 would have it in their mutual interest to minimize the disruption of bilateral trade, which would hand the advantage to third parties. The UK and the EU27, moreover, would have the unusual advantage of having no legacy border regime for trade in place. The trade border could be designed de novo, based on state-of-the-art information technology, risk management methods, and so forth. By incorporating features to minimize the costs of the new border to smaller businesses, it would also have a chance to preserve a high share of the existing cross-border integration that has evolved under the single market (see, e.g., the proposal to recast ROOs provisions to facilitate small business utilization of preferences, such as would obtain under Brefta, in Ciuriak and Bienen, 2014).

On this basis we assume the following: one-quarter of the time for customs clearance, the same documentation costs as under Brexit, and a 1% ROOs cost, which is at the lower bound of the range of estimates. This adds up to a total border cost as an AVE on imports of 2.31%.

3. Calibrating Goods NTBs under Brexit

In the Brexit scenario, we assume that the UK starts with the EU regulatory regime and, thus, there is no shock to NTBs for goods trade immediately upon Brexit. However, over time, we assume some drift between the UK and the continent, in part based on the philosophical differences concerning regulation, which constitute one of the factors giving rise to consideration of Brexit in the first place.

As regards the manner in which the NTBs are introduced into the model, there are two options: an increase in rents or an increase in costs. As we work in a perfect competition modelling framework, which does not include cost mark-ups, we make a virtue of necessity in choosing the increased cost mode of NTBs, on grounds that the main elements of NTBs that would creep into UK-EU27 trade would likely take the form of additional marketing costs, including certification, as UK standards start to drift from continental standards. We use scores for Canadian NTBs of 0.080 for agriculture and 0.013 for manufactures to capture this effect (Petri et al., 2011; 66).

4. Constructing the Services and FDI NTBs

To quantify the services NTBs, this study takes into account both actual reductions of barriers to cross-border services trade and the impact of binding existing market access. The methodology involves combining the reduction in actual barriers and the reduction of "water" (the difference between bound and applied market

access) into a composite NTB (following Ciuriak and Lysenko, 2016). The Brexit impacts on this composite NTB represent a percentage reduction in services market access barriers that reflects both applied restrictions and uncertainty. This percentage reduction in barriers is then applied to estimates of ad valorem trade cost equivalents developed for cross-border trade by Fontagne, Guillin and Mitaritonna (2011).[13]

It is well established that a reduction in uncertainty about market access stimulates trade (see, e.g., Handley and Limão, 2012). It follows that econometric estimates of the height of barriers to services trade (ad valorem equivalents or AVEs) reflect both the effect of actual restrictions and of policy uncertainty.

Ciuriak and Lysenko (2016) use a gravity modelling approach to identify the separate effects on services trade access from applied restrictions and water. They find that services trade responds positively but in-elastically to reductions in services trade barriers, as measured by the STRI, and that the response to actual restrictions is about twice as strong as the response to comparable reductions in "water."

We note that both the STRI and "water" are measured on the basis of the same index and have approximately equal mean values in the Ciuriak and Lysenko dataset. This allows us to combine the effects into a single aggregate NTB, on the basis of the following aggregation formula:

$$\text{Total NTB} = \alpha(\text{STRI} + 0.5*\text{Water})$$

Where α is a coefficient that scales the index-based measure to the measured AVEs. Alternative sets of AVEs have been measured by Jafari & Tarr (2014) for 103 countries and 11 sectors, on the basis of price wedges across countries; and by Fontagné et al. (2011) for 65 countries and 9 sectors, on the basis of gravity modelling which infers the height of barriers by the differences in actual trade versus expected levels, given gravity model relationships.

The STRI database covers the 34 OECD member countries plus Brazil, China, Colombia, India, Indonesia, Latvia, Russia and South Africa – 42 countries in all.

The STRI categorizes each sector under five policy areas:

- Restrictions on foreign ownership and other market entry conditions;
- Restrictions on the movement of people;
- Other discriminatory measures and international standards;
- Barriers to competition and public ownership; and
- Regulatory transparency and administrative requirements.

These individual policy areas are then broken down much more finely to capture the various issues confronted in each sector.

The calculation of Brexit impacts on UK's services restrictions was coded for 18 sectors. These sectors and the mapping to the GTAP study sectors are listed in the table below:

[13] http://www.cepii.fr/PDF_PUB/wp/2011/wp2011-24.pdf

Table A3: Services sector mapping to GTAP sectors

STRI Sector	GTAP	GTAP Sector No.
Construction	Construction	46
Distribution	Trade	47
Air Transport	Air transport	50
Maritime Transport	Sea transport	49
Rail freight transport	Transport nec	48
Road Transport	Transport nec	48
Courier	Transport nec	48
Telecommunications	Communication	51
Commercial Banking	Financial services nec	52
Insurance	Insurance	53
Accounting	Business services nec	54
Architecture	Business services nec	54
Computer	Business services nec	54
Engineering	Business services nec	54
Legal	Business services nec	54

a) Calculating the liberalization shock for UK-US FTA

The reduction to barriers to cross-border services trade is based on the impact of the binding measures in the Korea US FTA (KORUS) as a proxy for UK-US FTA. The approach is straightforward First, we create a template based on the UK-US FTA's commitments. In developing the template, each article of the UK-US FTA is mapped to a measure in the STRI. Second, to calculate the policy shock for UK and US, the template is applied in light of their Schedule of commitments for cross border supply of services and establishment. For UK, we have taken into account the traditional reservations, most of which are mentioned in CETA.

If the template changes the answer to "not restrictive", the contribution of that measure to the restrictiveness of the regime, which is based on its index weight, is removed. The Simulator recalculates the final score of the specific sector for the US or UK as the case may be. The percentage difference is taken as the degree of reduction of the existing barriers to services trade.

This methodology covers both horizontal and sector-specific commitments. The horizontal commitments stipulate conditions and restrictions that apply to all sectors of the economy. These measures include investment screening, limitations on board members and managers of firms, impediments on acquiring land and real estate, and so forth.

The specific commitments apply to a specific sector as indicated in the schedule. For instance, interest rate regulations pertain only to financial services. Some restrictions tend to impact some sectors more than other; for example, restrictions in public procurement have a particularly large impact on the construction sector in light of the importance of government demand for these services.

To measure the liberalization potential under the UK-US for cross-border services trade, we isolate those measures that affect Mode 1 (cross-border) specifically and those that affect all modes. These measures constitute a sub-index that can be referred to as the Cross-Border Services Restrictiveness Index (CBS-RI in our terminology). The corresponding sub-index for bindings is the GATS Cross-Border Services Restrictiveness Index or G-CBS-RI.

b) Calculating the bindings shock

To evaluate the impact of improved bindings under the UK-US, we compare the STRI as calculated based on GATS commitments (GATS Trade Restrictiveness Index or GTRI) and the STRI as bound under the UK-US FTA. The calculation of the binding shock is straightforward: the difference between the GTRI and the STRI

represents "water" in the bindings. The difference between "water" pre- and post- UK-US FTA constitutes the binding shock.

The table below sets out the detailed results of the coding of the impacts of the UK-US FTA on US and US' STRI/GTRI.

Table A4: UK Cross-border Services Shock for the UK-US FTA

UK – Cross-border	Pre-UK-US FTA		Post- UK-US FTA				
	CBS-RI	G-CBS-RI	CBS-RI	G-CBS-RI	NTB Shock	GTAP	GTAP Sector Name
Construction	0.017	0.034	0.017	0.034	0.000	46	Construction
Distribution	0.000	0.009	0.000	0.009	0.000	47	Trade
Courier	0.061	0.072	0.061	0.072	0.000	48	Transport nec
Rail freight transport	0.000	0.096	0.000	0.096	0.000	48	Transport nec
Road Transport	0.053	0.070	0.053	0.070	0.000	48	Transport nec
Maritime Transport	0.056	0.151	0.056	0.133	0.009	49	Sea transport
Air Transport	0.140	0.309	0.140	0.309	0.000	50	Air Transport
Broadcasting	0.000	0.025	0.000	0.025	0.000	51	Communication
Motion Picture	0.013	0.101	0.013	0.101	0.000	51	Communication
Sound Recording	0.020	0.096	0.020	0.096	0.000	51	Communication
Telecommunications	0.052	0.052	0.036	0.036	0.024	51	Communication
Commercial banking	0.041	0.041	0.041	0.041	0.000	52	Financial services nec
Accounting	0.059	0.193	0.059	0.161	0.016	54	Business services nec
Architecture	0.012	0.162	0.012	0.114	0.024	54	Business services nec
Computer	0.120	0.199	0.120	0.199	0.000	54	Business services nec
Engineering	0.011	0.142	0.011	0.105	0.018	54	Business services nec
Legal	0.067	0.239	0.067	0.239	0.000	54	Business services nec

Table A5: US Cross-border Services Shock for the UK-US FTA

US – Cross-border	Pre-UK-US FTA		Post- UK-US FTA				
	CBS-RI	G-CBS-RI	CBS-RI	G-CBS-RI	NTB Shock	GTAP	GTAP Sector Name
Construction	0.073	0.089	0.060	0.076	0.019	46	Construction
Distribution	0.030	0.039	0.030	0.039	0.000	47	Trade
Courier	0.135	0.144	0.135	0.144	0.000	48	Transport nec
Rail freight transport	0.015	0.025	0.015	0.025	0.000	48	Transport nec
Road Transport	0.060	0.077	0.060	0.077	0.000	48	Transport nec
Maritime Transport	0.154	0.178	0.154	0.178	0.000	49	Sea transport
Air Transport	0.166	0.309	0.166	0.309	0.000	50	Air Transport
Broadcasting	0.019	0.019	0.019	0.019	0.000	51	Communication
Motion Picture	0.013	0.039	0.013	0.039	0.000	51	Communication
Sound Recording	0.020	0.060	0.020	0.060	0.000	51	Communication
Telecommunications	0.041	0.041	0.041	0.041	0.000	51	Communication
Commercial banking	0.037	0.037	0.037	0.037	0.000	52	Financial services nec
Accounting	0.066	0.183	0.066	0.152	0.016	54	Business services nec
Architecture	0.078	0.210	0.078	0.144	0.033	54	Business services nec
Computer	0.117	0.217	0.117	0.217	0.000	54	Business services nec
Engineering	0.094	0.189	0.058	0.134	0.064	54	Business services nec
Legal	0.039	0.183	0.039	0.145	0.019	54	Business services nec

Table A6: UK Cross-border FDI Shock for the UK-US FTA

UK – FDI	Pre-UK-US FTA		Post- UK-US FTA				
	FDI-RI	G-FDI-RI	FDI-RI	G-FDI-RI	NTB Shock	GTAP	GTAP Sector Name
Construction	0.000	0.034	0.000	0.000	0.017	46	Construction
Distribution	0.038	0.038	0.022	0.022	0.024	47	Trade
Courier	0.057	0.416	0.057	0.287	0.064	48	Transport nec
Rail freight transport	0.032	0.423	0.032	0.223	0.100	48	Transport nec
Road Transport	0.025	0.025	0.025	0.025	0.000	48	Transport nec
Maritime Transport	0.007	0.490	0.007	0.312	0.089	49	Sea transport
Air Transport	0.222	0.634	0.222	0.634	0.000	50	Air Transport
Broadcasting	0.095	0.718	0.095	0.718	0.000	51	Communication
Motion Picture	0.045	0.502	0.045	0.502	0.000	51	Communication
Sound Recording	0.000	0.301	0.000	0.301	0.000	51	Communication
Telecommunications	0.024	0.028	0.024	0.028	0.000	51	Communication
Commercial banking	0.036	0.063	0.036	0.063	0.000	52	Financial services nec
Accounting	0.036	0.036	0.036	0.036	0.000	54	Business services nec
Architecture	0.013	0.013	0.013	0.013	0.000	54	Business services nec
Computer	0.000	0.000	0.000	0.000	0.000	54	Business services nec
Engineering	0.000	0.000	0.000	0.000	0.000	54	Business services nec
Legal	0.000	0.387	0.000	0.387	0.000	54	Business services nec

Table A7: US Cross-border FDI Shock for the UK-US FTA

US – FDI	Pre-UK-US FTA		Post- UK-US FTA				
	FDI-RI	G-FDI-RI	FDI-RI	G-FDI-RI	NTB Shock	GTAP	GTAP Sector Name
Construction	0.034	0.067	0.034	0.067	0.000	46	Construction
Distribution	0.032	0.063	0.032	0.047	0.008	47	Trade
Courier	0.194	0.194	0.194	0.194	0.000	48	Transport nec
Rail freight transport	0.082	0.082	0.082	0.082	0.000	48	Transport nec
Road Transport	0.049	0.074	0.049	0.049	0.012	48	Transport nec
Maritime Transport	0.178	0.490	0.178	0.490	0.000	49	Sea transport
Air Transport	0.359	0.634	0.359	0.634	0.000	50	Air Transport
Broadcasting	0.263	0.288	0.263	0.288	0.000	51	Communication
Motion Picture	0.018	0.055	0.018	0.055	0.000	51	Communication
Sound Recording	0.000	0.000	0.000	0.000	0.000	51	Communication
Telecommunications	0.068	0.177	0.068	0.110	0.034	51	Communication
Commercial banking	0.081	0.081	0.081	0.081	0.000	52	Financial services nec
Accounting	0.018	0.054	0.018	0.018	0.018	54	Business services nec
Architecture	0.013	0.026	0.013	0.026	0.000	54	Business services nec
Computer	0.034	0.034	0.034	0.034	0.000	54	Business services nec
Engineering	0.013	0.027	0.013	0.027	0.000	54	Business services nec
Legal	0.024	0.024	0.024	0.024	0.000	54	Business services nec