Quantifying Brexit: From Ex Post to Ex Ante Using Structural Gravity*

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Abstract

Exploiting changes in the geography of economic integration in Europe, this paper uses detailed bilateral trade data for 50 sectors to carry out an econometric ex post evaluation of the trade cost effects of the United Kingdom's various arrangements with the European Union. The analysis reveals important heterogeneity across agreements, sectors, and within pairs. In particular, the EU's eastward enlargement or the EU-Korea trade agreement have lowered the UK's outward trade costs only relatively modestly. These asymmetries matter for the size and distribution of the welfare effects of Brexit – the withdrawal of the UK from EU agreements resulting into a return of trade costs to the situation quo ante. We make this point with the help of a modern multi-sector trade model that is able to capture inter- and intranational production networks. In line with other papers, the welfare costs of Brexit are higher in the UK than in most other EU countries. However, the considered asymmetries tend to attenuate overall costs while giving rise to substantial heterogeneity between EU27 members and sectors.

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1 Introduction

The relationship between the European Union (EU) and the United Kingdom (UK) has always been fraught with complexity for reasons related to history, culture and geography. Differences over the long term goal of the EU integration process – whether the objective is a political union or just the establishment of a common market – date back at least to 1983 when the term "ever closer union" was coined.[1] The creation of the European Monetary Union – from which the UK opted out – and even more so the emergence of deficiencies in the construction of the Eurozone made the necessity of further political integration apparent, and widened the gap between the UK and the continent. At the same time, the relative importance of Europe as a trade partner for the UK fell from about 65% in the early 1990s to less than 45% in 2016, presumably because trade costs with third countries dropped by more than costs of intra-EU trade.[2] This fact, together with rising net budgetary contribution to the EU, seems to imply that the relative costs of a withdrawal from the EU are lower today than what they would have been 25 years ago.

In this paper, we ask: What if, in 2014, the UK had not been part of the EU? What would counterfactual real consumption, trade volumes, or sectoral value added statistics have looked like? This provides us with an estimate of UK benefits from EU membership, which – in turn – we take as a proxy of what the costs of leaving the EU would be. We answer this question in two steps. First, we conduct a state-of-the-art ex post evaluation of the effects of EU membership of the UK on sector-level trade costs. Second, we run ex ante simulations of the effects from reversing those trade cost savings in a quantitative Ricardian trade model. We focus on the trade effects and do so in great detail, distinguishing 22 goods and 28 services industries and 44 countries representing more than 90% of world GDP.

We are not the first to study the potential economic consequences of UK's withdrawal from the EU but we believe we offer the most detailed and most data-driven analysis of the trade-related effects of Brexit. Our key contribution is to embed a careful ex post evaluation of British EU membership into an ex ante analysis of its dissociation from the EU. First, unlike Dhingra et al. (2017), we do not use external information on how Brexit could increase non-tariff trade barriers (NTBs) between the UK and Europe based on estimates for other time periods and countries.[3] Rather, we estimate the (potentially asymmetric) trade effects of

[1]The term first appeared in European Council (1983), "A Solemn Declaration on European Union" at the Council Meeting in Stuttgart, Germany. The document prepared the creation of the Single Market, a central request of Margaret Thatcher, but also led to the granting of annual budget rebates to the UK in 1984.

[2]Exports of goods and services; see Ward (2017).

[3]Sampson (2017) provides an excellent overview of trade and other issues related to Brexit.

EU membership or of EU trade agreements with third countries (such as with Korea) and allow these to differ across industries.[4] Reversing them, we carry out our comparative statics exercise in the year 2014, for which we have real data, rather than for a baseline projected into the future.[5] This allows us to put special emphasis on sectoral heterogeneity.

Second, we estimate the crucial trade elasticities on exactly the same data that we calibrate our model with and which also defines the baseline that we compare our counterfactual equilibrium with. This is in the spirit of structural gravity modeling (see Yotov et al. (2016) for an excellent survey and Mayer et al. (2018) for an application to the costs of non-Europe) and allows for a tight connection between theory, estimation and calibration. Moreover, the econometric exercise supplies us with the necessary information to simulate confidence intervals for all of our endogenous variables. By quantifying uncertainty, we also go beyond Dhingra et al. (2017).

Third, when evaluating the possible effects of new bilateral trade agreements of the UK with third parties, we do not make educated guesses about the size and distribution of sectoral changes in NTBs. Rather, we estimate the (potentially asymmetric) sectoral trade effects of the EU-Korea trade agreement for the UK and assume that new agreements could implement what has proven feasible in that agreement. The EU-Korea deal has been in force since 2011 and is one of the most ambitious (and successful) FTAs of the EU (Lakatos and Nilsson, 2017).

We use a computable general equilibrium (CGE) framework of the type that Costinot and Rodriguez-Clare (2014) have recently reviewed. A common feature of these models is that they give rise to a theoretical foundation of the gravity equation of international trade and that they can be solved in changes, a feature referred to as "exact hat algebra" in the literature (Dekle et al., 2008). This has obvious computational advantages but also helps with calibration as unknown constants drop out. More specifically, our modeling framework is based on Caliendo and Parro (2015)'s multi-sector input-output version of the Ricardian trade model by Eaton and Kortum (2002). We extend this setup to include services trade, non-tariff barriers and heterogeneity of trade agreements. Our parameter estimation and the calibration of the model are based on data provided by the World Input-Output Database (WIOD) as described by Timmer et al. (2015). Importantly, the model features a detailed account of international input-output linkages. Recent work by Vandenbussche et al. (2017) highlights the importance of such networks in the context of Brexit.

[4]Baier et al. (2016) show that asymmetries in trade agreements occur particularly within pairs and play an important role for their exports and imports.

[5]Dhingra et al. (2017) use estimates of NTBs by Berden et al. (2013) for the US-EU relationship dating from the year 2007 and assume a uniform increase by 25% across all sectors. Moreover, they also assume that the UK would not be able to participate in future reductions in NTBs.

We consider three scenarios: (i) a WTO scenario (hard Brexit) in which the UK loses preferential access to EU27 countries and to third countries with which the EU currently maintains free trade agreements; most favored nations (MFN) tariffs apply and non-tariff barriers (NTBs) are reintroduced; (ii) a scenario with a modern and ambitious trade agreement between the EU27 and the UK, comprising tariffs and NTBs, and modeled after the EU-Korea free trade agreement (FTA); and (iii) a global Britain scenario, with tariffs and NTBs as defined in the WTO scenario, but bilateral FTAs between the UK with NAFTA countries, Asian countries and non-European members of the Commonwealth.

The main results of our econometric ex post evaluation of EU integration steps between 2000 and 2014 are that the EU has been very successful in reducing trade costs and boosting trade between its members on average. While, in the partial equilibrium, EU integration has boosted goods exports of the UK to the other EU countries by about 24%, it has increased other EU members' exports to the UK by as much as 76%. In services trade, we find that UK exports to EU27 countries are by 64% higher due to EU membership, while bilateral services exports of other EU27 countries to the UK have almost doubled. Ignoring these important asymmetries, one could easily overestimate the costs of Brexit to the UK and underestimate it for the rest of the EU. At the finer sectoral level, a lot of heterogeneity exists, but the general picture remains. For example, EU membership has increased exports of the UK to the EU in the air transport sector substantially, while it has not affected exports in its postal and courier sector. The opposite pattern holds for the UK's imports in these sectors. Also, the results suggest that the EU-Korea FTA from 2011 has not had any positive effects on UK overall exports of goods.

We use these partial equilibrium estimates to define trade cost shocks for the counterfactual general equilibrium analysis. It turns out that equilibrium effects depend importantly on treatment heterogeneity. We first show that considering sectoral heterogeneity, the EUs' various agreements and taking asymmetries in trade cost changes into account matters for macroeconomic outcomes. Ignoring heterogeneity, the costs of Brexit can be inflated by as much as 25%. In a next step, fully accounting for asymmetries, we simulate three Brexit scenarios and assess the general equilibrium effects on real consumption, trade, and sectoral value added for 44 countries. We find substantial heterogeneity among EU27 members. A hard Brexit reduces real consumption more in Ireland, Luxembourg and Malta than in the UK, where the 90% confidence interval is [-3.32%,-2.19%]. The core EU economies France, Germany, and Italy face losses lying in the intervals [-0.66%,-0.38%],[-0.84%,-0.59%], and [-0.50%,-0.31%], respectively. The conclusion of a modern FTA, drafted after the existing EU-Korea FTA, compared to the hard Brexit scenario, allows avoiding three quarters of the loss from Brexit in the EU27 countries and two thirds in the UK. Finally, in the global

Britain scenario, where the UK concludes FTAs with many countries but not with the EU27, the change in real consumption is contained in the 90% interval [-2.10%,-0.76%] for the UK. Due to trade diversion effects, losses in EU countries would be higher than in the hard Brexit scenario. For third countries, real consumption changes are not statistically different from zero in most cases. An exception is Switzerland who could slightly benefit from a hard Brexit and a subsequent relocation of financial services.

With a hard Brexit, almost all sectors lose value added, except for crops & animals in the UK and mining & quarrying in the EU27. In the UK, basic metals, fishing & aquaculture, electrical equipment, mining & quarrying, and machinery & equipment are most strongly affected; wholesale trade, aux. transport services, and business services suffer the largest losses from Brexit. For the EU27, electronics & optical, motor vehicles, and food, beverages & tobacco, as well as insurance, postal and courier, publishing, and financial services are most negatively affected.

The remainder of this paper is organized as follows. Section 2 presents the methodological framework. Section 3 discusses the main data sources, explains the empirical estimation method, and discusses gravity results. Based on the defined Brexit scenarios, we examine general equilibrium consistent results on trade and welfare in section 4. The final chapter concludes.

2 Model

The model follows Caliendo and Parro (2015), who provide a multi-sector version of the Eaton and Kortum (2002) gravity model with input-output linkages.

2.1 Setup

There are N countries indexed by i and n, as well as J sectors indexed by j and k. Sectoral goods are either used as inputs in production or consumed, with the representative consumer having Cobb-Douglas preferences over consumption C_n^j of sectoral final goods with expenditure shares $\alpha_n^j \in (0,1)$ and $\sum_j \alpha_n^j = 1$.

Labor is the only production factor and labor markets clear. The labor force L_n is mobile across sectors such that $L_n = \sum_{j=1}^{J} L_n^j$, but not between countries. In each sector j, there is a continuum of intermediate goods producers indexed $\omega^j \in [0,1]$ who combine labor and composite intermediate input and who differ with respect to their productivity $z_i^j(\omega^j)$. Intermediate goods are aggregated into sectoral composites using CES production functions

with elasticity η^j. On all markets, there is perfect competition.

A firm in country i can supply its output at price

$$p_{in}^j(\omega^j) = \kappa_{in}^j \frac{c_i^j}{z_i^j(\omega^j)} \text{ with } c_i^j = \Upsilon_i^j \, {w_i}^{\beta_i^j} \left[\prod_{k=1}^{J} {p_i^k}^{\gamma_i^{k,j}} \right]^{(1-\beta_i^j)}. \tag{1}$$

The minimum cost of an input bundle is c_i^j, where Υ_i^j is a constant, w_i is the wage rate in country i, p_i^k is the price of a composite intermediate good from sector k, $\beta_i^j \geq 0$ is the value added share in sector j in country i and $\gamma_i^{k,j}$ denotes the cost share of source sector k in sector j's intermediate costs, with $\sum_{k=1}^{J} \gamma_i^{k,j} = 1$. κ_{in}^j denotes trade costs of delivering sector j goods from country i to country n such that

$$\kappa_{in}^j = (1 + t_{in}^j) D_{in}^{\rho^j} e^{\delta^j \mathbf{Z}_{in}}, \tag{2}$$

where $t_{in}^j \geq 0$ denotes ad-valorem tariffs, D_{in} is bilateral distance, and $\mathbf{Z}_{in}$ is a vector collecting trade cost shifters (such as FTAs or other trade policies).

Productivity of intermediate goods producers follows a Fréchet distribution with a location parameter $\lambda_n^j \geq 0$ that varies by country and sector (a measure of absolute advantage) and shape parameter θ^j that varies by sector (and captures comparative advantage).[6]

Producers of sectoral composites in country n search for the supplier with the lowest cost such that

$$p_n^j = \min_i \left\{ p_{in}^j(\omega^j); i = 1, \ldots, N \right\}. \tag{3}$$

Caliendo and Parro (2015) show that it is possible to derive a closed form solution of composite intermediate goods price

$$p_n^j = A^j \left(\sum_{i=1}^{N} \lambda_i^j \left(c_i^j \kappa_{in}^j \right)^{\frac{-1}{\theta^j}} \right)^{-\theta^j}, \tag{4}$$

where $A^j = \Gamma\left[1 + \theta^j(1 - \eta^j)\right]^{\frac{1}{1-\eta^j}}$ is a constant.

Similarly, a country n's expenditure share π_{in}^j for source country i's goods in sector j is

$$\pi_{in}^j = \frac{\lambda_i^j \left[c_i^j \kappa_{in}^j \right]^{\frac{-1}{\theta^j}}}{\sum_{i=1}^{N} \lambda_i^j \left[c_i^j \kappa_{in}^j \right]^{\frac{-1}{\theta^j}}}, \tag{5}$$

[6] Convergence requires $1 + \theta^j > \eta^j$.

which forms the core of a gravity equation.

2.2 General Equilibrium

Let Y_n^j denote the value of gross production of varieties in sector j. For each country n and sector j, Y_n^j has to equal the value of demand for sectoral varieties from all countries $i = 1, \ldots, N$.[7] The goods market clearing condition is given by

$$Y_n^j = \sum_{i=1}^{N} \frac{\pi_{ni}^j}{(1+t_{ni}^j)} X_i^j \qquad \text{with} \qquad X_i^j = \sum_{k=1}^{J} \gamma_i^{j,k}(1-\beta_i^k) Y_i^k + \alpha_i^j I_i, \tag{6}$$

where national income consists of labor income, tariff rebates R_i and the (exogenous) trade surplus S_i, i.e. $I_i = w_i L_i + R_i - S_i$ and X_i^j is country i's expenditure on sector j goods. The first term on the right hand side gives demand of sectors k in all countries i for intermediate usage of sector j varieties produced in country n, the second term denotes final demand. Tariff rebates are $R_i = \sum_{j=1}^{J} X_i^j \left(1 - \sum_{n=1}^{N} \frac{\pi_{ni}^j}{(1+t_{ni}^j)}\right)$.[8]

The second equilibrium condition requires that, for each country n, the value of total imports, domestic demand and the trade surplus has to equal the value of total exports including domestic sales, which is equivalent to total output Y_n:

$$\sum_{j=1}^{J}\sum_{i=1}^{N} \frac{\pi_{in}^j}{(1+t_{in}^j)} X_n^j + S_n = \sum_{j=1}^{J}\sum_{i=1}^{N} \frac{\pi_{ni}^j}{(1+t_{ni}^j)} X_i^j = \sum_{j=1}^{J} Y_n^j \equiv Y_n \tag{7}$$

Conditions (6) and (7) close the model.

2.3 Comparative Statics in General Equilibrium

We are interested in the effects of different Brexit scenarios on trade flows, wages, sectoral value added, and real consumption (as our measure of welfare). Hence, we need to quantify the comparative static effects of changes in trade costs (tariffs and non-tariff barriers) κ_{in}^j on endogenous quantities such as trade flows, wages, sectoral value added, production and tariff income. As shown by Dekle et al. (2008), the model can be solved in changes. Let z

[7] Our exposition differs from Caliendo and Parro (2015) in that they use total expenditure on composite goods instead of total production of varieties as endogenous variable. So in Caliendo and Parro (2015) the value of gross production comprises all foreign varieties that are bundled into the composite good without generation of value added.

[8] Instead of the goods market clearing condition, one can also use the expenditure equation $X_i^j = \left(\sum_{k=1}^{J} \gamma_i^{j,k}(1-\beta_i^k)(F_i^k X_i^k + S_i^k) + \alpha_i^j I_i\right)$ as in Caliendo and Parro (2015).

denote the initial level of a variable and z' its counterfactual level. Then, trade cost shocks are given by $\hat{\kappa}_{in}^{j} = \frac{1+t_{in}^{j'}}{1+t_{in}^{j}} e^{\delta^j (Z'_{in} - Z_{in})}$ and the change in real consumption is

$$\hat{W}_n = \frac{\hat{X}_n}{\prod_{j=1}^{J} \left(\hat{p}_n^j\right)^{\alpha_n^j}}. \tag{8}$$

In Appendix A.1, we present the system of equations in changes required to solve the model. An important advantage of solving the model in changes is that certain constant parameters such as the absolute advantage or the elasticity of substitution between input varieties ω drop out and need not be estimated. This reduces the data needs and lowers the scope for measurement error – of course, at the price of functional assumptions.

Our comparative statics exercise refers to the long-run, i.e., to a new equilibrium in which all relevant general equilibrium interactions have already fully taken place. Short-run effects can differ from those long-run predictions. Moreover, we hold technology fixed and abstract from endogenous innovation or technology adoption. Doing this would be interesting but would require leaving the bedrock of a standard and widely accepted modeling framework.

3 Empirical Model, Data, and Parameter Estimates

3.1 Empirical Model

From equations (2) and (5) we derive the following sector-level gravity equations which we use to estimate the parameters θ and δ:

$$\begin{aligned} M_{in,t}^{j} = \exp\Bigg[& -\frac{1}{\theta^j} \ln(1 + t_{in,t}^{j}) + \frac{\delta_1^j}{\theta^j} EU27_{in,t}^{j} + \frac{\delta_2^j}{\theta^j} EU_{UKn,t}^{j} + \frac{\delta_3^j}{\theta^j} EU_{iUK,t}^{j} + \frac{\delta_4^j}{\theta^j} Euro_{in,t}^{j} + \frac{\delta_5^j}{\theta^j} Schengen_{in,t}^{j} \\ & + \frac{\delta_6^j}{\theta^j} EU27KOR_{in,t}^{j} + \frac{\delta_7^j}{\theta^j} UKKOR_{in,t}^{j} + \frac{\delta_8^j}{\theta^j} FTA_{in,t}^{j} + \nu_{in}^{j} + \nu_{i,t}^{j} + \nu_{n,t}^{j} \Bigg] + \varepsilon_{in,t}^{j}. \end{aligned} \tag{9}$$

$M_{in,t}^{j}$ denotes the value of imports of country i to country n in sector j at time t, the ad valorem tariff factor is given by $1 + t_{in,t}^{j}$, and the trade elasticity is $1/\theta^j > 0$. $\nu_{i,t}^{j}$ and $\nu_{n,t}^{j}$ denote importer- and exporter-specific year fixed effects, respectively. ν_{in}^{j} denotes bilateral country-pair fixed effects and $\varepsilon_{in,t}^{j}$ is a random error term. The bilateral fixed effects account for all time-invariant determinants of trade, such as geographical distance, or initial conditions. The time-varying importer and exporter effects control for multilateral resistance. By triangulation, they also account for the effects of exchange rate variation.

For the simulation, we require estimates of δ_k^j/θ^j. Whenever an agreement affects the UK, we allow its effect to differ between the UK and the other 27 EU members (EU27). For example, we impose symmetry in the trade cost effect of EU membership amongst the EU27, but allow the EU membership for the UK to differ from that average; moreover, we also allow UK exports to be affected differently than imports. We deal similarly with the conclusion of the EU-Korea agreement in 2011. Because the UK is neither a member of the Schengenzone nor the Eurozone, we do not further differentiate those effects.[9]

All integration measures are defined as binary variables taking the value one in a year if countries i and j are both members of an agreement. $\text{Schengen}_{in,t}^j$ is different; it systematically treats European countries as heterogeneous, as land-borne trade within Europe from i to n may cross one or up to eight Schengen-internal borders. Aside, even if i and/or n are outsiders to the Schengen area, a pair in may experience lower transit costs. We thus use a variable $\text{Schengen}_{in,t}^j = \{1, \ldots, 8\}$ that counts the number of Schengen-internal borders between a pair in (see Felbermayr et al., 2018).

Econometric identification relies on countries joining the EU, the Euro, the Schengenzone or FTAs in the period 2000-2014. Thus, the trade cost effect of the Single Market is identified through the various waves of Eastern enlargement (2004, 2007, 2013). The Eurozone was created in 1999 by 11 EU members; until 2014 seven additional countries joined. Similarly, Schengen was gradually expanded. The EU-Korea FTA entered into force in 2011 (the latest trade agreement of the EU available in our data), as did a number of other FTAs amongst non-EU countries.

The selection of country pairs into trade agreements with many members such as the EU is not random; the same is true for the setting of tariffs. To obtain unbiased estimates of θ^j and δ_k^j we require that the covariances between the error term $\varepsilon_{in,t}^j$ and the integration dummy on the one hand and between $\varepsilon_{in,t}^j$ and the sectoral tariff rate on the other are zero conditional on controls. Note that we include bilateral fixed effects ν_{in}^j to account for all time invariant variables that jointly affect policy variables and bilateral trade flows. Next to potential endogeneity, this also addresses omitted variable bias in integration agreements (see, e.g., Baier and Bergstrand, 2007).

As recommended by Santos Silva and Tenreyro (2006) and Fally (2015), we estimate the model using Poisson Pseudo Maximum Likelihood (PPML) methods. We cluster standard errors at bilateral pairs.

[9]The same approach is taken for FTAs other than the EU-Korea agreement.

3.2 Data Sources

To calibrate the model and to estimate the possible effects of the UK leaving the EU Single Market and Customs Union, we need comprehensive data.

The World Input-Output Database (WIOD) comprises our main data source. It contains information on sectoral production, value added, and bilateral trade in final and intermediate goods in producer and consumer prices detailed by sector. This allows us to extract bilateral input-output tables and expenditure levels. WIOD includes 43 countries and a rest-of-the-world (RoW) aggregate for the years 2000 to 2014. It captures 56 sectors, which we aggregate into 50 industries as some sectors display zero output for some countries (see Table A1 in the Appendix). This aggregation concerns mostly services; we keep the sectoral detail in the manufacturing and agricultural industries.[10]

Data on bilateral preferential and MFN tariffs stem from the World Integrated Trade Solutions (WITS-TRAINS) and the WTO's Integrated Database (IDB).[11] Data on tariffs and on trade from WIOD are used to estimate trade elasticities for the 22 manufacturing sectors – jointly with the ad valorem equivalent changes in NTBs associated with the different steps of European and trade integration in general.[12] We use data on FTA membership from the WTO.[13] Data on membership in the EU, the Eurozone and the successive accession of countries to the Schengen agreement stem from the European Commission. We capture membership in the EU, the Euro or in FTAs by indicator variables. To obtain a geographical measure of Schengen, we follow Felbermayr et al. (2018) and use the count of the number of Schengen borders crossed by truck and ferry when moving from economic centers of i to n in year t.

We use those data to structurally estimate the elasticities θ and coefficients δ. Input-output tables provide us with data on the expenditure shares α, and the cost shares β and γ. Further, data on bilateral trade shares π, countries' total value added $w_n L_n$, and trade surpluses S are calculated from input-output tables.

We take information on net fiscal transfers of EU members to the EU budget from the Eu-

[10] We use the approach outlined in Aichele and Heiland (2018) to account for the fact that WIOD expenditure shares are valued in "basic" (or "producer") prices (net of tariffs), while expenditure shares in the model are defined in "market" prices (including tariffs). Further, we utilize their approach to account for changes in inventory as part of the accounting system of WIOD but do not feature in our model.

[11] As tariffs are not available for every year and every pair within our time frame, we interpolate tariff levels forward and backward.

[12] For services sectors, we borrow an average estimate of the elasticity of services trade with respect to trade cost from Egger et al. (2012). We adapt their method to obtain a trade elasticity of services and apply it to our estimated goods elasticity from our aggregated gravity estimation.

[13] The RTA gateway is accessible via `http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx`.

ropean Commission. Transfer redistribution is calculated based on the operating budgetary balance for the 2010-2014 UK average, relative to each country's gross national income (see Table A2 in the Appendix). The year 2014 is the latest year available in the WIOD data and thus serves as our baseline. Our simulation exercise compares the status quo in 2014 with a hypothetical situation in which the UK would leave the European Union in that year.

3.3 The UK's Europe Exposure in Comparison

Our analysis is based on one important conjecture, namely that inward and outward market access costs of the UK have benefitted differently – possibly by less – from EU membership than other countries, and one key assumption, namely that the analysis of sector-level trade data for the years 2000 to 2014 is informative about the unwinding of integration steps between the UK and continental European countries that happened much earlier. In fact, through Brexit, we assume that trade costs between the EU and the UK go up by the amount that the Eastern enlargement has brought them down. While this is innocuous for trade costs between the UK and the new EU members, it may underestimate the effect of EU membership on trade costs between the UK and old EU member states.

Here, we present very simple facts suggesting that our presumptions are plausible. Consistent with our formal model, we compute a simple index of average inverse trade frictions of the form

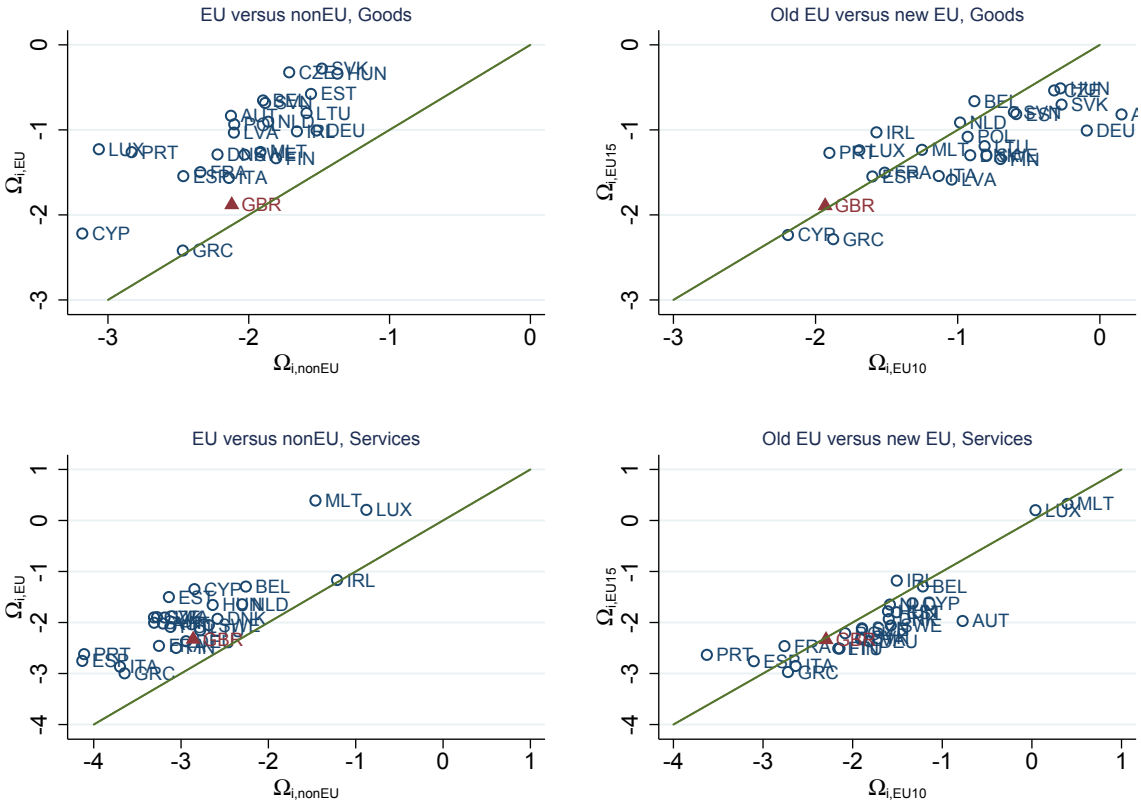
$$\Omega_{in} \equiv \ln[X_{in}^{1/2} X_{ni}^{1/2} Y^w / (Y_i Y_n)], \tag{10}$$

where Y_i and Y_n denote country i's and n's GDPs, $Y^w = \sum_i Y_i$ is world GDP and X_{in} are country i's exports to country n.[14]

Figure 1 plots countries' inverse trade frictions with other EU members and with trade partners outside of the EU. The upper row looks at goods trade; the lower row at services trade. The left column compares inverse trade frictions of countries with EU members and with non-EU members. The right column compares countries' inverse trade frictions with 'old' EU and with 'new' EU members. The pictures suggest that all 25 countries (the 'old' 15 EU members and the ten countries that joined in 2004) have lower frictions amongst themselves than with the rest of the world. This is no surprise and reflects lower geographical

[14] A simple way of writing a model-consistent gravity equation is to posit $X_{in} = (Y_i Y_n / Y^w)\,\tilde{\Omega}_{in}$. Total bilateral trade is characterized by the geometric mean $(X_{in}X_{ni})^{1/2} = (Y_i Y_n / Y^w)\left(\tilde{\Omega}_{in}\tilde{\Omega}_{ni}\right)^{1/2}$. The inverse, undirectional (i.e., average) index of bilateral trade costs $\Omega_{in} \equiv \ln[\left(\tilde{\Omega}_{in}\tilde{\Omega}_{ni}\right)^{1/2}]$ can be calculated by available data. We know that this index is only an approximation; however, we do not calculate the Head-Ries-Index, as this would require trade cost symmetry and our point is that trade costs involving the UK and the EU are indeed asymmetric.

Figure 1: Inverse Trade Frictions with Different Trade Partners, 2014



Note: Data from WIOD 2016. The straight line is the 45-degrees line.

and political trade costs. However, intra-EU goods trade frictions $\Omega_{i,EU}^{-1}$ are nowhere higher than in Greece, Cyprus and the UK, while the latter occupies a middle ground when looking at trade frictions with third parties. Hence, the UK seems less strongly tied to intra-European goods trade than other countries of similar size such as Italy, France, Spain, or Germany. This also implies that it has less to lose should it exit the union. With services trade, the UK's position is slightly better.

The right-hand diagram in Figure 1 plots inverse trade frictions of countries relative to 'old' (EU15) and 'new' (EU10) EU members. Again, the UK lies in the bottom-lower corner, signaling relatively high trade costs with both groups of countries. Importantly, it lies on the 45-degrees line, both for goods and services trade. This suggests that UK exporters and importers face similar situations in both new and old member states. This leaves us confident that, even though our strategy identifies the effects of EU membership using accessions within the period 2000-2014, the estimates are, on average, also sensible with regard to the UK's trade relationship with the old EU15 countries.

3.4 Gravity Analysis of Aggregate Data

Table 1 shows results from regressions on aggregate data. Columns (1) to (6) report the effects on integration arrangements on goods trade; columns (7) to (10) on services trade. It reveals four insights that are of paramount importance for the following quantitative analysis.

First, on average, EU membership is associated with substantial trade creation. Coefficients on goods (column (1)) and on services (column (7)), both statistically significant at the 1% level, imply trade creation of 72% and 95%, respectively.[15] Assuming an elasticity of 3.5 for goods and 1.5 for services,[16] the estimates imply trade cost reductions of 14% and 36%, respectively.[17] FTAs other than the EU create less trade and indicate trade cost reductions of 3.4% and 4.8%, respectively. The Chi2-test clearly rejects equality of EU and FTA effects; for services, FTAs are not even significant.

Second, accounting for other steps of European integration is important to correctly isolate the role of EU membership. Columns (2) and (8) add Eurozone and Schengen membership. It turns out that Schengen matters, both, for goods and services trade; but Eurozone membership is (marginally) not significant statistically. However, controlling for those, the coefficient for the EU membership falls to 0.470 for goods and 0.594 for services, implying a fall in the trade cost reduction relative to columns (1) and (7).

Third, the effect of EU membership on trade may differ between country pairs involving the UK and those involving only EU27 members (excluding UK). For goods, the coefficient in column (3) is smaller for pairs involving the UK than for non-UK pairs; column (4) indicates that estimated trade cost reductions due to EU membership are 13% for EU27-pairs and 11% for pairs involving the UK. Note that the difference is not statistically significant. For services, trade cost reductions in pairs involving the UK are stronger than for EU27 (column (9)). Again, the difference is not statistically different from zero. Importantly, adding tariffs for goods trade in column (4) yields a very plausible estimate of the trade elasticity (3.5), with a variance of 0.92. Accounting for tariffs reduces trade costs of EU membership from 12.5% to 8.1% for EU27 pairs and from 10.7% to 6.4% for EU27-UK pairs. This is crucial, as tariffs imply very different welfare implications than iceberg trade costs (non-tariff barriers, NTBs); mistaking tariffs with NTBs would lead to an overestimate of the welfare damage of Brexit.

Fourth, allowing exports of the UK to EU27 to be affected differently than imports, i.e., turning to directional FTA effects, columns (5), (6) and (10) provide evidence for strong

[15] We apply the formula $100 \times (exp(\beta) - 1)$, where β is the estimated coefficient.

[16] See below for more details.

[17] We apply the formula $100 \times (exp(\delta) - 1)$ where $\delta = \beta \times \theta$.

asymmetries. Columns (5) and (6) show that EU27 goods exports to the UK have increased through EU membership of the UK, but UK exports to EU27 countries have benefited only through the elimination of tariffs but not through NTBs. The difference between UK exports and imports is statistically significantly different from zero at the 1%-level. In the area of services, UK exports seem to have benefited more, but here the difference is not statistically different from zero.

3.5 Gravity Analysis of Sectoral Data

Table 2 reports key results from sector-level gravity regressions which are replica of the equations on aggregate data described in columns (6) and (10) of Table 1. It documents substantial heterogeneity across the 22 goods and 28 services sectors with respect to the trade elasticity, and regarding effects of EU membership or the EU-Korea FTA.[18]

We find reasonable trade elasticities (estimated coefficients on tariffs) for most goods sectors; in sectors where the estimates violate regularity conditions, we report estimates based on tariff adjusted imports and replace elasticities with estimates obtained for aggregate data; see Table 1, column (6). Economic integration arrangements have very different effects on different sectors. Bilateral trade between the EU27 and the UK is shown to increase unambiguously through EU integration in 33 out of 50 sectors (both UK exports and imports go up with at least one effect statistically significant at the 10%-level). In 16 cases (mostly manufacturing), UK imports increase by more than UK exports; in 15 sectors (mostly services) the opposite is true. In the automotive sector (20), UK imports are affected very positively, but UK exports are not. A strong asymmetry exists in the chemicals sector, too, while in basic metals the situation is relatively balanced. In services sectors, postal & courier and financial services stand out, where, against the trend, UK imports have grown by more than UK exports due to EU integration.

[18]To save space, the table drops other covariates included in the model; see Tables A3 and A4 in the Appendix for full detail.

Table 1: The Impact of EU Integration Steps on Bilateral Imports (2000 - 2014)

Dep. var.:	Bilateral Imports									
	Goods						Services			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Both EU	0.542***	0.470***	0.466***	0.294***	0.468***	0.294***	0.667***	0.594***	0.515***	0.512***
	(0.05)	(0.05)	(0.06)	(0.07)	(0.06)	(0.07)	(0.06)	(0.06)	(0.07)	(0.07)
EU27-UK			0.398***	0.232**					0.601***	
			(0.09)	(0.10)					(0.13)	
Exp: EU27, imp: UK					0.564***	0.399***				0.687***
					(0.11)	(0.11)				(0.20)
Exp: UK, imp: EU27					0.213***	0.039				0.497***
					(0.08)	(0.08)				(0.17)
Euro		0.060	0.056	0.058	0.056	0.058		0.152***	0.153***	0.152***
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)		(0.06)	(0.06)	(0.06)
Schengen		0.093***	0.093***	0.090***	0.094***	0.090***		0.076***	0.077***	0.077***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)		(0.02)	(0.02)	(0.02)
EU-KOR			0.370***	0.253***					0.516***	
			(0.05)	(0.06)					(0.08)	
EU27-KOR					0.203***	0.117*				0.378***
					(0.07)	(0.07)				(0.06)
UK-KOR					0.078	−0.007				0.182***
					(0.24)	(0.23)				(0.06)
Other FTAs	0.122***	0.122***	0.108**	0.029	0.110**	0.029	0.073	0.072	−0.007	−0.009
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)
Tariff				−3.443***		−3.471***				
				(0.91)		(0.92)				
Chi2-Test										
Prob > chi2	0.000	0.000	0.403	0.451	0.002	0.002	0.000	0.000	0.486	0.470

Note: ***, **, * denote significance at the 1%, 5%, 10% levels, respectively. All models estimated use Poisson Pseudo Maximum Likelihood (PPML) methods. Robust standard errors (in parentheses) allow for clustering at the country-pair level. Pair as well as year specific importer and exporter fixed effects included but not reported. Specifications (1), (2), (7) and (8) use EU28 and other RTA excluding the EU. All other use EU27, treating the UK separately, and other RTA exclude the EU and the EU - Korea RTA. Number of observations: 27,735. Chi2-Tests compare "Both EU" to "Other RTA" in columns (1), (2), (7) and (8); "Both EU" and "EU-UK, symmetric" in columns (3), (4), and (9); and "EU->UK, asymmetric" with "EU<-UK,asymmetric" in columns (5), (6), and (10).

Table 2: EU Integration Steps and Bilateral Imports (2000 - 2014)

Dep. var.:	Bilateral Imports				
Sector Description	exp: EU27 imp: UK	exp: UK imp: EU27	EU27 - KOR	UK - KOR	Tariff
1 Crops & Animals°	1.254***	0.733***	0.327	−0.212	−3.471***
2 Forestry & Logging°	0.194	0.267	0.091	−0.919***	−3.471***
3 Fishing & Aquaculture°	0.003	1.057	−0.174	0.605	−3.471***
4 Mining & Quarrying°	−0.797***	−0.192	1.136***	2.792***	−3.471***
5 Food, Beverages & Tobacco	0.736***	0.555***	0.18	−0.611***	−1.066
6 Textiles, Apparel, Leather°	0.117	0.295	0.345***	−0.414*	−3.471***
7 Wood & Cork°	0.076	−0.109	0.410***	0.479***	−3.471***
8 Paper°	0.369	0.307**	0.341***	−0.167	−3.471***
9 Recorded Media Reproduction	−0.111	−0.011	0.879***	0.174	−1.254
10 Coke, Refined Petroleum	−0.292	−0.029	0.512*	0.372***	−6.020***
11 Chemicals	0.777***	0.253**	0.318***	0.166**	−3.531***
12 Pharmaceuticals	1.098***	0.828***	−0.061	−0.088	−11.390 ***
13 Rubber & Plastics	0.698***	0.448***	0.307***	0.116*	−2.258**
14 Other non-Metallic Mineral	0.265	0.223*	0.029	0.033	−1.366*
15 Basic Metals	0.681**	0.641***	0.308***	0.075	−3.191***
16 Fabricated Metal	0.551***	0.254	0.275***	0.135	−1.543***
17 Electronics & Optical Products	0.694***	−0.208	−0.15	−0.809***	−7.780***
18 Electrical Equipment	0.601***	0.151	0.370***	−0.003	−6.001***
19 Machinery & Equipment	0.568***	0.214*	0.119*	0.180***	−7.873***
20 Motor Vehicles	0.730***	0.364	0.311***	0.144	−4.611***
21 Other Transport Equipment	0.188	−0.303	0.315	0.169	−2.947
22 Furniture & Other Manufacturing	−0.086	−0.149	−0.571***	−1.110***	−3.727***
23 Electricity & Gas	0.895**	1.068**	0.355	−1.653***	−1.446***
24 Water Supply	−0.334	0.001	0.629***	0.623***	−1.446***
25 Sewerage & Waste	1.314***	0.893***	−0.015	−0.015	−1.446***
26 Construction	1.239***	2.154***	0.137	0.234	−1.446***
27 Trade & Repair of Motor Vehicles	1.503**	2.256***	0.736***	1.097***	−1.446***
28 Wholesale Trade	1.515***	2.611***	0.471***	1.299***	−1.446***
29 Retail Trade	1.374***	1.571***	0.425*	0.847***	−1.446***
30 Land Transport	0.333*	1.047***	0.327*	0.384	−1.446***
31 Water Transport	0.679**	0.759**	0.302	−1.020**	−1.446***
32 Air Transport	0.198	0.700***	0.108	−0.859**	−1.446***
33 Aux. Transportation Services	0.24	0.638***	0.04	−0.025	−1.446***
34 Postal & Courier	1.266***	0.245	0.680**	−0.163	−1.446***
35 Accommodation & Food	0.002	−0.018	−0.456***	−1.576***	−1.446***
36 Publishing	0.23	0.542*	−0.191	−0.096	−1.446***
37 Media Services	0.027	0.565**	0.071	0.063	−1.446***
38 Telecommunications	0.466	0.323	0.604***	−0.06	−1.446***
39 Computer & Information Services	1.067***	0.532**	0.848**	−0.221	−1.446***
40 Financial Services	1.809***	0.484	0.899***	−0.366*	−1.446***
41 Insurance	−0.121	−0.609	0.058	−0.147	−1.446***
42 Real Estate	0.832**	1.104***	0.04	0.544	−1.446***
43 Legal & Accounting	0.520**	0.599**	0.16	0.018	−1.446***
44 Business Services	0.999***	0.993***	0.809***	0.413***	−1.446***
45 Research & Development	−0.134	−0.049	−0.138	−1.095***	−1.446***
46 Admin. & Support Services	0.229	−0.097	0.046	−0.509***	−1.446***
47 Public & Social Services	0.438	0.657	0.095	1.085***	−1.446***
48 Education	1.062***	1.503***	0.555	1.065***	−1.446***
49 Human Health & Social Work	0.271	0.959**	0.971***	1.058***	−1.446***
50 Other Services, Households	0.824	0.397	0.023	0.919***	−1.446***

Note: ***, **, * denote significance at the 1%, 5%, 10% levels, respectively. All models estimated use Poisson Pseudo Maximum Likelihood (PPML) methods. Robust standard errors (not reported) allow for clustering at the country-pair level. Pair as well as year specific importer and exporter fixed effects included but not reported. Sectors marked with ° report estimates based on tariff adjusted imports, applying overall trade elasticities for goods trade from Table (1) column (5). For services sectors, we calculate the trade elasticity for services according to Egger et al. (2012). Varying observations between 23,085 and 27,735. Detailed effects for the 22 goods and 28 services sectors can be found in Tables A3 and A4 in the Appendix.

4 General Equilibrium Results

4.1 Counterfactual Scenarios

We have now paved the way to simulate general equilibrium effects of the UK leaving the European Union Single Market and Customs Union. For each sector, the gravity model provides us with estimates of the (inverse) trade elasticity θ and of the NTB effects δ of various integration steps, as well as with estimates of the associated variance-covariance matrices. For services, we have no trade cost shifters such as tariffs. So, we turn to Egger et al. (2012) to infer a trade elasticity of $\hat{1/\theta}_{\text{Services}} = 1.446$.[19]

Assuming that parameters are jointly normally distributed, we draw a value of θ to calibrate the model, and a full set of NTB shifters δ to inform the counterfactual analysis.[20] We repeat this procedure 1,000 times and, thus, obtain a distribution of NTB cost shocks as well as a distribution of changes of endogenous variables. This allows us to construct confidence intervals.[21]

We define the following counterfactual scenarios. Figure 2 illustrates trade cost shocks $\hat{\kappa}$ (equation (2)) and their distribution for each sector.

S1 **WTO Scenario ("Hard Brexit")**: The UK is no longer part of the European Single Market and Customs Union and there is no new FTA substituting for it. The EU27 and the UK apply MFN tariffs as currently granted under WTO rules on imports of third countries.[22] In addition, directional NTBs are reintroduced between the EU27 and the UK according to the sectoral trade costs calculated from the gravity estimations.

[19]Importantly, Egger et al. (2012) state that services trade reacts more elastically to trade liberalization than goods trade. Hence, assuming an elasticity of 5 as in Caliendo and Parro (2015) seems not to be a reasonable choice in our context. This is supported by recent applications of Hobijn and Nechio (2018) using VAT data for the EU25 and Marquez (2006) using price and income data for the US. Both find a range for services elasticities between 1 and 3. More specifically, Egger et al. (2012) estimate a parameter β in their model (which belongs to a related class of new quantitative trade models), which is given by $\beta = \beta_{\text{Goods}} - \beta_{\text{Services}}$. Given their estimate $\hat{\beta} = 2.026$ and our own estimate $\hat{\beta}_{\text{Goods}} = \hat{1/\theta}_{\text{Goods}}$, we can infer $\hat{\beta}_{\text{Services}} = \hat{1/\theta}_{\text{Services}}$, with a variance 0.144.

[20]The choice of normal distribution implies that we will always obtain some draws that violate the model-imposed parameter constraint $1/\theta > 0$. To circumvent this problem we drop the (very few) parameter draws of θ that violate the constraint. This comes at the expense of a small upward bias of the mean parameter estimate and a downward bias of the standard errors.

[21]The underlying normality assumption is not completely innocuous, given that the model outcomes are potentially highly non-linear functions of the parameters. The distribution of model outcomes might be highly asymmetric even if the size of the underlying sample is large enough for the normal approximation to work well for parameter estimation.

[22]Figure 4 in the Appendix shows sectoral trade-weighted MFN tariffs granted at the product-level by the EU to third countries in 2014. These are used for simulation in the WTO scenario.

Figure 2a shows NTB changes for the UK (importer) with EU27 countries; Figure 2b shows respective barriers for EU27 members with the UK (exporter). Moreover, the UK loses all existing tariff and non-tariff preferences that it currently enjoys with third countries with whom the EU has an FTA in force. We apply the heterogeneous UK-Korea agreement effect from the gravity model and effects from further pre-EU accession treaties. Additionally, we consider fiscal transfers by correcting the specific trade balances for fiscal transfers between the EU27 and the UK.

S2 **FTA Scenario ("Soft Brexit")**: The UK exits the EU Single Market and Customs Union, but the EU27 and the UK negotiate a modern free trade agreement (FTA), which comprises not only tariffs but also affects NTBs on goods and services. We model the FTA scenario as a replication of the EU-Korea agreement of 2011 – the latest and most comprehensive trade agreement of the EU covered in the data. We utilize the estimated trade cost reductions of the EU-Korea FTA from our gravity model as a proxy for a potential NTB effects between the EU27 and the UK (see Figure 2c).

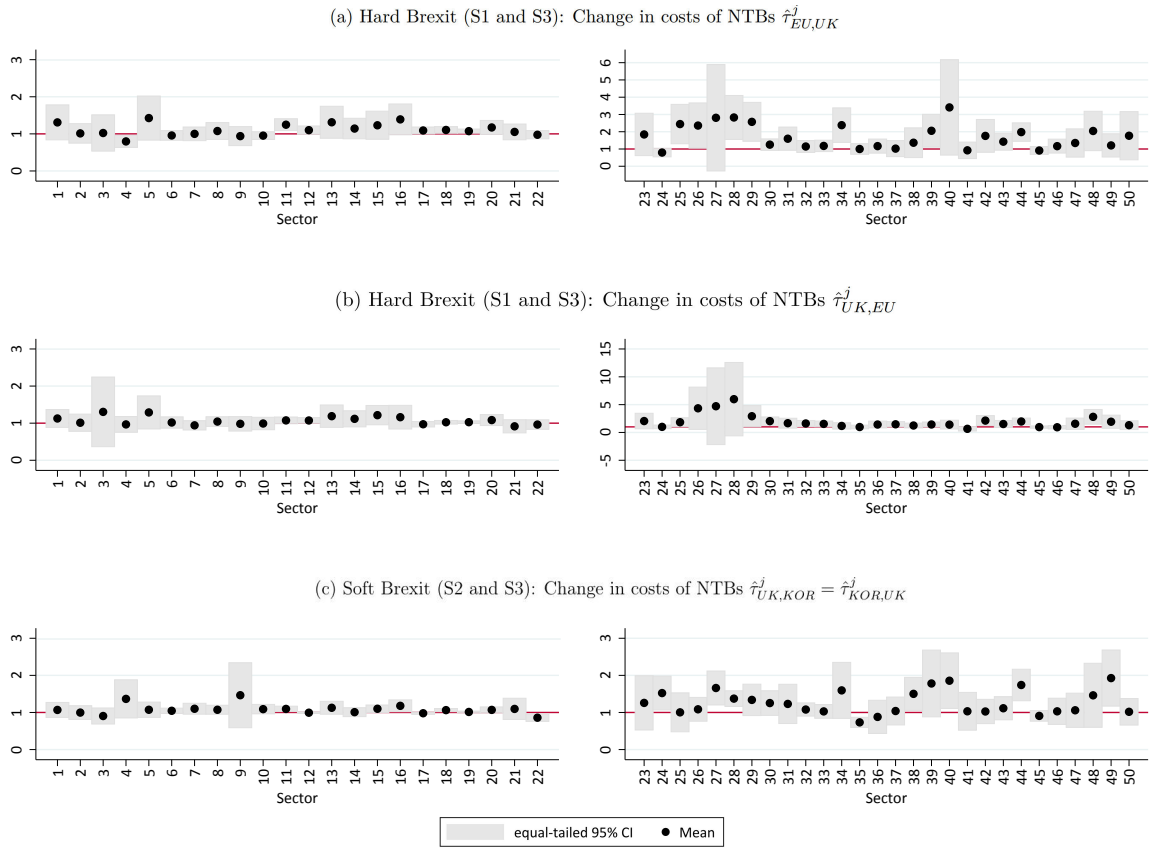
S3 **Global Britain Scenario**: We model the same relationship regarding tariffs and NTBs between the EU27 and the UK as under the WTO scenario, but now the UK unilaterally eliminates tariffs and concludes FTAs with various third countries in order to lower NTBs. The scenario is divided into three stages:

(a) The UK concludes an FTA with the NAFTA countries the US, Mexico, and Canada. NTBs are reduced as under the EU-Korea FTA.

(b) Further, the UK concludes an FTA with selected non-EU Commonwealth countries, namely Australia and India.

(c) Finally, we assume that the UK also concludes additional FTAs with selected Asian countries (JPN, KOR, CHN).

Figure 2: Change in Non-Tariff Barriers, in %



Note: Dots depict percentage changes of non-tariff barriers. Bars show 90%-confidence bounds, which are based on 1,000 replications and approximate normal distribution. Sector 1 to 4 are agricultural and natural resources sectors, 5 to 22 are manufacturing sectors, and 23 to 50 are services sectors.

4.2 The Role of Treatment Heterogeneity

Before turning to the detailed general equilibrium analysis, we compare various model specifications under a hard Brexit scenario. We show that heterogeneity in trade cost shocks matters for quantitative results. In Table 3, we illustrate this by simulating the real wage effects of the hard Brexit scenario (S1).[23] Panel A uses the broad sector specification of (Table 1), while Panel B allows for heterogeneity of treatment effects and elasticities across the 50 sectors in our data (Table 2).

Panel A reveals that moving from a very simplistic treatment of EU membership with the

[23]We focus on real wages as these are less strongly affected by whether trade cost shocks are modeled as affecting tariffs or iceberg trade costs, a distinction that is lost when lumping together different steps of European integration.

help of a single dummy variable (row [1]) to a more subtle measurement allowing for variable geometry, asymmetry between the effects on EU27 pairs and pairs involving the UK, and directionality in the EU27-UK effects gradually reduces the real wage losses due to Brexit from 0.57% in row [1] to 0.41% in row [4] for the EU27 and from 3.20% to 2.53% for the UK. The simplistic approach overestimates the damage from Brexit by about 40% for the EU27 average and 25% for the UK.

Table 3: Average Real Wage Changes in a Hard Brexit Scenario, in %, Based on Different NTB Estimations

	EU27	UK	RoW
Panel A: Broad sectoral disaggregation (estimates from Table 1)			
[1] Single EU dummy (col. (1) and (7))	-0.57	-3.20	-0.01
[2] Variable geometry (col. (2) and (8))	-0.51	-2.88	-0.01
[3] UK and EU treated differently (col. (3) and (9))	-0.49	-2.76	-0.01
[4] Allowing for directionality (col. (5) and (10))	-0.41	-2.53	-0.01
Panel B: Detailed sectoral disaggregation (estimates from Table 2)			
[5] Single EU dummy (col. (1) and (7))	-0.59	-3.50	-0.01
[6] Variable geometry (col. (2) and (8))	-0.43	-2.61	0.00
[7] UK and EU treated differently (col. (3) and (9))	-0.56	-3.29	0.00
[8] Allowing for directionality (col. (5) and (10))	-0.60	-3.45	0.00

Note: RoW: Rest of the World. The baseline year is 2014. All reported numbers are statistically different from zero at the 10%-level based on 1,000 replications.

Additionally, allowing for trade elasticities and treatment effects to vary within goods and services sectors tends to increase the damage of Brexit relative to estimates based on broad sectors (goods, services), but only through an interaction between sectoral heterogeneity and UK-specific treatments (rows [5] to [8]). Hence, details in the econometric identification of NTB effects do matter for macroeconomic outcomes, even if the most simplistic treatment (row[1]) and our preferred, more sophisticated one (row[8]) do not differ much.

4.3 Effects on Real Consumption

We now turn to the detailed GE analysis of Brexit by putting the shocks described in the counterfactural scenarios into our general equilibrium trade model. Table 4 starts by reporting changes in real consumption, our preferred measure of welfare, for 44 countries and three scenarios. We could also estimate real wage changes (see Table A11 in the Appendix), but these do not account for the direct effects of tariff income, transfers, and trade imbalances.

Table 4: Change in Real Consumption, in %

	S1	S2	S3		S1	S2	S3
UK	**-2.76**	**-0.93**	**-1.43**	Portugal	**-0.45**	-0.12	**-0.46**
	[-3.32, -2.19]	[-1.65, -0.21]	[-2.10, -0.76]		[-0.56, -0.35]	[-0.25, 0.01]	[-0.56, -0.35]
Austria	**-0.35**	**-0.09**	**-0.38**	Romania	**-0.37**	**-0.16**	**-0.39**
	[-0.42, -0.27]	[-0.19, -0.00]	[-0.45, -0.30]		[-0.45, -0.29]	[-0.25, -0.08]	[-0.47, -0.31]
Belgium	**-1.40**	-0.29	**-1.46**	Slovakia	**-0.73**	**-0.33**	**-0.77**
	[-1.71, -1.09]	[-0.71, 0.13]	[-1.77, -1.15]		[-0.86, -0.60]	[-0.52, -0.15]	[-0.91, -0.64]
Bulgaria	**-0.51**	**-0.24**	**-0.50**	Slovenia	**-0.42**	**-0.17**	**-0.46**
	[-0.62, -0.40]	[-0.36, -0.11]	[-0.60, -0.39]		[-0.50, -0.35]	[-0.25, -0.08]	[-0.54, -0.38]
Croatia	**-0.34**	-0.04	**-0.34**	Spain	**-0.39**	**-0.13**	**-0.42**
	[-0.43, -0.24]	[-0.17, 0.09]	[-0.43, -0.24]		[-0.48, -0.30]	[-0.23, -0.02]	[-0.50, -0.33]
Cyprus	**-1.37**	-0.35	**-1.36**	Sweden	**-0.75**	-0.11	**-0.79**
	[-1.80, -0.94]	[-0.91, 0.21]	[-1.79, -0.93]		[-0.91, -0.58]	[-0.34, 0.12]	[-0.95, -0.62]
Czech R.	**-0.75**	**-0.35**	**-0.84**	Australia	-0.00	-0.00	**0.12**
	[-0.90, -0.60]	[-0.51, -0.20]	[-0.99, -0.69]		[-0.01, 0.00]	[-0.01, 0.00]	[0.08, 0.15]
Denmark	**-0.89**	-0.12	**-0.91**	Brazil	**-0.01**	0.00	**-0.01**
	[-1.10, -0.67]	[-0.46, 0.22]	[-1.12, -0.70]		[-0.01, -0.01]	[-0.00, 0.00]	[-0.01, -0.00]
Estonia	**-0.70**	**-0.27**	**-0.71**	Canada	0.00	-0.01	**0.26**
	[-0.88, -0.51]	[-0.46, -0.07]	[-0.89, -0.52]		[-0.00, 0.01]	[-0.03, 0.00]	[0.15, 0.37]
Finland	**-0.50**	-0.08	**-0.52**	China	**0.05**	**0.02**	**0.13**
	[-0.60, -0.39]	[-0.22, 0.06]	[-0.62, -0.41]		[0.04, 0.05]	[0.00, 0.03]	[0.11, 0.14]
France	**-0.52**	-0.10	**-0.54**	India	**0.02**	0.00	**0.20**
	[-0.66, -0.38]	[-0.32, 0.12]	[-0.68, -0.40]		[0.01, 0.02]	[-0.00, 0.01]	[0.16, 0.25]
Germany	**-0.72**	**-0.20**	**-0.80**	Indonesia	**0.01**	-0.00	**0.00**
	[-0.84, -0.59]	[-0.36, -0.04]	[-0.92, -0.67]		[0.01, 0.01]	[-0.01, 0.00]	[0.00, 0.01]
Greece	**-0.39**	-0.12	**-0.37**	Japan	-0.00	0.00	**0.06**
	[-0.48, -0.29]	[-0.23, 0.00]	[-0.47, -0.28]		[-0.00, 0.00]	[-0.00, 0.01]	[0.05, 0.08]
Hungary	**-0.87**	**-0.34**	**-0.94**	Korea	-0.03	**-0.09**	**0.15**
	[-1.01, -0.74]	[-0.49, -0.18]	[-1.07, -0.80]		[-0.08, 0.02]	[-0.16, -0.02]	[0.09, 0.21]
Ireland	**-8.16**	**-3.08**	**-8.22**	Mexico	-0.01	**-0.01**	**0.04**
	[-9.60, -6.72]	[-4.82, -1.34]	[-9.66, -6.78]		[-0.01, 0.00]	[-0.02, -0.00]	[0.02, 0.05]
Italy	**-0.40**	-0.09	**-0.43**	Norway	**0.52**	0.23	**0.61**
	[-0.50, -0.31]	[-0.21, 0.04]	[-0.53, -0.34]		[0.10, 0.94]	[-0.37, 0.84]	[0.13, 1.09]
Latvia	**-0.58**	-0.16	**-0.58**	Russia	0.01	**-0.08**	-0.02
	[-0.76, -0.40]	[-0.36, 0.04]	[-0.75, -0.40]		[-0.02, 0.03]	[-0.16, -0.01]	[-0.05, 0.00]
Lithuania	**-0.51**	-0.07	**-0.55**	Switzerland	-0.01	0.04	-0.04
	[-0.66, -0.35]	[-0.28, 0.14]	[-0.71, -0.40]		[-0.16, 0.14]	[-0.12, 0.20]	[-0.19, 0.11]
Luxembourg	**-5.23**	2.15	**-5.46**	Taiwan	**0.13**	0.06	**0.09**
	[-8.61, -1.85]	[-2.64, 6.95]	[-8.82, -2.09]		[0.11, 0.16]	[-0.49, 0.61]	[0.06, 0.12]
Malta	**-5.19**	-0.76	**-5.16**	Turkey	**-0.04**	**-0.07**	**-0.08**
	[-6.65, -3.73]	[-2.94, 1.43]	[-6.63, -3.69]		[-0.07, -0.01]	[-0.10, -0.04]	[-0.11, -0.05]
Netherlands	**-1.64**	-0.37	**-1.71**	USA	**-0.01**	-0.00	**0.11**
	[-1.94, -1.33]	[-0.84, 0.10]	[-2.01, -1.40]		[-0.02, -0.01]	[-0.01, 0.00]	[0.08, 0.14]
Poland	**-0.69**	**-0.25**	**-0.73**	Other countries	-0.02	0.02	-0.02
	[-0.81, -0.57]	[-0.38, -0.12]	[-0.85, -0.61]		[-0.05, 0.01]	[-0.02, 0.06]	[-0.05, 0.01]
EU27	**-0.78**	**-0.20**	**-0.83**				
	[-0.93, -0.63]	[-0.38, -0.01]	[-0.97, -0.68]				
ROW	0.00	0.00	**0.08**				
	[-0.00, 0.01]	[-0.01, 0.01]	[0.06, 0.10]				

Note: The baseline year is 2014. Mean effects and [p5,p95] intervals. Bold characters indicate significance at the 10%-level based on 1,000 replications. Confidence intervals in square brackets. The results for EU27 and ROW are calculated as GDP weighted averages.

A hard Brexit (S1) decreases the UK's real consumption by 2.76% per annum relative to the status quo in year 2014.[24] This compares to a reduction of 0.93% in the case of a modern FTA (S2). Opening the British market toward non-EU countries (S3) cannot fully compensate for the negative effect of Brexit and causes the UK's real consumption to fall by 1.43%. This indicates that the well-established trade ties between EU27 economies and the UK cannot easily be compensated through trade agreements of the UK with other Commonwealth countries, Japan, Korea, or China, and the NAFTA economies. All real consumption effects for the UK and the EU27 average are statistically significant at the 10%-level. The changes in real consumption for the EU27 are on average smaller than those for the UK. The reason is that a smaller trade share per EU27 country is affected by Brexit compared to the UK. The EU27 real consumption losses are nearly four times as large under a hard Brexit (-0.78%) compared to a FTA (-0.20%). Global Britain slightly increases the losses (-0.83%) for the EU27 economies, as a hard Brexit with additional FTAs between the UK and non-EU countries would cause trade diversion away from Europe.

EU27 countries are affected very differently; mean losses lie between -8.16% in Ireland and -0.34% in Croatia, reflecting the initial strength of trade ties taking input-output linkages involving third countries into account.[25] In case of a hard Brexit, Luxembourg and Malta would face higher losses than the UK and the Netherlands, Belgium, and Cyprus would experience drops in real consumption of more than one percent each. Malta and Cyprus are former colonies; Luxembourg has strong linkages to the UK financial services industry, and the Netherlands and Belgium are geographically very close to the UK. Larger EU countries would experience smaller losses as they are protected by larger home markets and also tend to have more diversified trade ties. In case of a hard Brexit, Germany faces a decrease in real consumption of 0.72%, while France loses 0.52%. A FTA between the EU27 and the UK nearly divides the size of real consumption losses for EU27 by four. With a FTA, Ireland's real consumption decrease is 3.08%, still substantially more than the UK's with 0.93%. Germany would have to face a loss of 0.20%, almost identical to the EU27 average, and statistically different from zero at the 10% level. France, in contrast, would suffer a loss of 0.10% only, which is statistically not distinguishable from a zero effect.

Compared to a hard Brexit, losses in real consumption slightly worsen for EU27 countries under a global Britain scenario, as countries are negatively affected by trade diversion caused by the global Britain strategy. Germany and France would experience a drop in real con-

[24]This effect is different from Table 3 as it treats tariff and NTB changes separately. It uses detailed trade costs derived from Table 2.

[25]The relatively strong effect on Hungary or Slovakia has to do with those countries' role in German production networks.

sumption of 0.80% and 0.54%, respectively; the EU average goes from -0.78% under S1 to -0.83% under S3.

Turning to non-EU countries, we find small losses for Brazil, Turkey, or the US and slight benefits for China, India, Indonesia, Norway and Taiwan from a hard Brexit. Countries with whom the UK would conclude a new FTA would mostly benefit in real consumption terms; but the relative gains are rather small: India's real consumption would go up by about 0.20% or the real consumption of the US by 0.11%. Canada, with its relatively small home market, would benefit most: its real consumption could go up by 0.26%. All those gains are statistically different from zero.

In a next step, we break the hard Brexit scenario into its elements to identify the key components of the overall welfare effects; see Figure 3a for the UK and Figure 3b for the EU27.[26] We distinguish between the effects of (a) fiscal transfers, (b) tariffs on agriculture and (c) on manufacturing, (d) NTBs on agriculture, (e) on manufacturing, and (f) on services.[27]

Undoing net fiscal transfers has direct effects on real consumption, but also affects countries' terms-of-trade; see the famous debate about the German transfer problem between Keynes (1929) and Ohlin (1929). In Keynes's logic, transfers worsen the terms of trade (TOT) since exports would have to increase and imports to decrease so that the price for exported relative to imported goods would have to fall. Transfers, thus, impose an additional burden on the paying countries.

As shown in Table A2, UK net transfers to the EU27 amounted to an average of about 6.5 billion Euro in the 2010-2014 period or slightly more than 0.30% of GDP. As shown in Figure 3a, unwinding those transfers would allow UK consumers to increase real consumption by 0.29%, slightly less than the pure transfers. This suggests that, in line with Keynes (1929), the UK benefits from an end to transfers not only from a direct effect but also from an amelioration of its TOT, but that gain is extremely small. Regarding the other EU27 members, we assume that the end of UK transfers is borne by all countries proportionally to their GDP. This amounts to an average reduction of net transfers by 0.06% of GDP. Not surprisingly, the real consumption losses from such a scenario are indeed centered around 0.06%; losses in Ireland or Luxembourg, the Netherlands, or Germany are increased by adverse movements in TOT: these countries seem to benefit from the system of EU transfers as this drives up the relative demand for their exports.

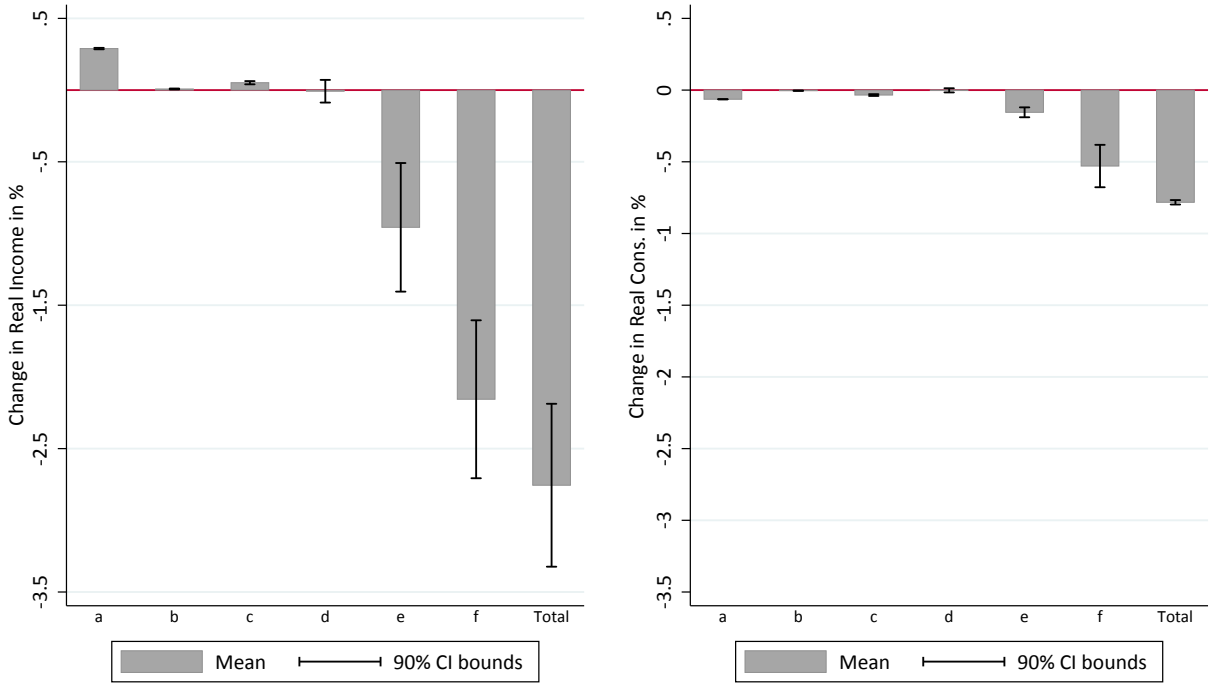
Figure 3a and 3b also show that the reintroduction of agricultural tariffs yields a very

[26]Detailed results are provided in Tables A5 and A6 in the Appendix.

[27]Note that separate welfare effects of (a) to (f) do not add up to the total effect of all components together, as the different barriers may complement or substitute each other.

small positive consumption effect in the UK; the negative allocative effects are outweighed by positive TOT effects, so that the UK benefits. Tariffs are at least partly absorbed by the UK's trading partners while tariff income remains in the country. A similar picture emerges in the area of manufacturing. However, gains and losses on real consumption from reintroducing tariffs are very minor, as tariff income is rebated and welfare damages are always of a "triangular" form.

Figure 3: Decomposing the Real Consumption Effects of a Hard Brexit



(a) United Kingdom (b) EU27

Note: a: fiscal transfers; b: tariffs in agriculture; c: tariffs in manufacturing; d: NTBs in agriculture; e: NTBs in manufacturing; f: NTBs in services. The baseline year is 2014. Bars depict real consumption percentage changes; details are shown in Tables A5 and A6 in the Appendix. The black solid lines show 90%-confidence bounds, which are based on 1,000 replications.

4.4 Effects on Bilateral Trade

Table 5 reports changes in bilateral trade flows in our three scenarios for the EU27, the UK and the rest of the world (ROW). Sectors are aggregated into three broad categories: agriculture, manufacturing, and service. Bold face characters denote mean effects that are statistically different from zero.[28] Trade flows are impacted by changes in bilateral trade

[28]Tables A7 to A9 in the Appendix provide details on confidence intervals.

costs and by general equilibrium forces through changes in total expenditure and revenue, and by multilateral resistance terms. Note that we keep the trade surplus of countries relative to GDP constant; quite mechanically, this forces some additional asymmetry in the rates of change in trade flows even if trade cost shocks are very similar.

Table 5: Bilateral Exports, in %

	Percentage Changes of							
	EU27 Exports to			UK Exports to		ROW Exports to		
	EU27	UK	ROW	EU27	ROW	EU27	UK	ROW
S1: WTO								
Agriculture	-0.24	**-22.74**	**0.85**	-4.46	**-6.31**	**-1.19**	**10.05**	**0.25**
Manufacturing	-0.14	**-30.63**	**1.15**	**-32.19**	**-10.00**	**-0.91**	**9.80**	**0.24**
Services	**-0.30**	**-21.21**	**0.44**	**-20.85**	**-0.43**	**-0.96**	0.07	**0.20**
Total	**-0.18**	**-27.42**	**0.87**	**-24.69**	**-4.57**	**-0.97**	**7.16**	**0.23**
S2: FTA								
Agriculture	-1.34	40.06	-0.13	96.05	**-7.20**	-1.96	9.62	-0.04
Manufacturing	-0.31	-4.71	**0.35**	7.16	**-7.58**	**-0.68**	1.80	0.06
Services	0.25	**-7.55**	**0.32**	**-7.16**	**-0.76**	-0.33	1.04	0.01
Total	-0.20	-4.15	**0.33**	3.15	**-3.80**	**-0.75**	2.40	0.03
S3: Global Britain								
Agriculture	-0.34	**-19.87**	**0.95**	-6.70	7.11	**-1.49**	**22.05**	**0.27**
Manufacturing	**-0.35**	**-34.35**	**1.14**	**-32.33**	**14.80**	**-1.35**	**34.19**	0.03
Services	**-0.48**	**-19.76**	**0.37**	**-21.33**	**4.49**	**-1.13**	**9.04**	**0.11**
Total	**-0.39**	**-29.31**	**0.84**	**-25.11**	**8.81**	**-1.30**	**26.05**	**0.08**

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications. Table reports cross-border trade only (no domestic trade). Full results are presented in Tables A7, A8, and A9 in the Appendix.

Our analysis implies that EU27 exports to the UK would fall by 27% in the hard Brexit scenario (S1), with 90% of the probability mass lying in the interval [-30,-25]. Exports would fall by 29% in the global Britain scenario (S3). With a FTA (S2), exports would fall by an expected effect of 4%, but the associated confidence interval is large: [-9,1]. So, if the EU27 and the UK sign an ambitious FTA, it is not longer certain that trade will actually fall. Interestingly, this does not apply to services transactions, where we report a statistically significant expected drop of 8%. In the other scenarios, EU27 exports to the UK would contract in all sectors, with the largest effects expected in manufacturing.

Overall, we find that UK exports to the EU27 fall by 25% in S1 and S3, which is 3 to 4 percentage points less than what is expected to happen to EU27 exports to the UK. However, the difference is not statistically distinguishable from zero. UK manufacturing exports suffer most; in agriculture, effects are not significant, reflecting the lack of trade cost reductions in this area. Services exports of the UK fall by about 21% in S1 and S3; with a FTA, they drop by 7% only, but trade effects in other sectors are indistinguishable from zero.

EU27 exports to RoW increase by about 1% in S1 and S3, signaling the presence of some trade diversion. Interestingly, exports from one EU27 member to the other barely change; and if they do, the sign is negative. It appears that the increased trade costs with the UK lead to an overall reduction of intra-EU27 trade flows along the highly-integrated EU production networks. Similarly, the model does not predict that UK exports to the RoW go up from Brexit scenarios S1 and S2, as increased trade costs with Europe reduce the UK's competitiveness with third countries. Of course, in the context of global Britain, UK exports to third countries would go up quite substantially; in manufacturing, the increase can be expected to be about 15%; exports of third countries to the UK are expected to go up by much more. Again, this reflects the lack of evidence for strong trade creating effects of existing FTAs with third countries for the UK.

4.5 Effects on Overall Trade

Table 6 reports the effects on overall trade, i.e., across all trade partners for the UK, the EU27 and the Rest of the World (RoW) across our three scenarios. We show baseline trade levels for 2014, where the UK features a small deficit in goods and services trade, while the EU27 has a substantial surplus of 780 bn USD. Across all scenarios, overall UK exports and imports drop; compared to the change in GDP, trade falls more such that the openness of the UK economy (measured as total trade over GDP) drops quite substantially. With a hard Brexit (S1), the reduction in both exports and imports is strongest in manufacturing, but UK services imports drop substantially as well, as domestic output is increasingly absorbed by domestic rather than foreign demand. Total EU27 exports fall by 1.4% and total imports by 1.8%; on the export side, manufacturing falls most; on the import side, the picture is dominated by services. Trade effects for the RoW are relatively low yet statistically significant and typically positive.

With a FTA (S2), trade losses for all parties are strongly reduced, but they remain about 5 times as large for the UK as compared to the EU27, and the effects are mostly not statistically significant. As expected, UK trade losses fall by about two thirds under global Britain (S3) compared to a hard Brexit, while they increase slightly for the EU27. RoW can expect a small and statistically significant increase in its overall trade, most pronounced in the manufacturing sector.

4.6 Changes in Sectoral Value Added

Changes in bilateral trade depend on the sectoral composition of value added trade flows. The dependence on (imported) intermediate inputs varies greatly across sectors, but it is

Table 6: Changes in Overall Trade

	Initial Exports bn USD	Changes in Exports in % S1	S2	S3	Initial Imports bn USD	Changes in Imports in % S1	S2	S3
UK								
Agriculture	29.9	-5.52	36.83	1.22	50.4	1.50	**17.56**	**11.12**
Manufacturing	304.4	**-18.50**	-1.94	-3.25	489.6	**-12.19**	-1.74	**-3.08**
Services	413.6	**-8.35**	**-3.24**	**-5.52**	225.9	**-11.96**	**-3.81**	**-7.24**
Total	747.9	-12.36	-1.11	-4.33	765.9	-11.22	-1.08	-3.37
EU27								
Agriculture	194.5	**-1.45**	1.80	-1.30	462.8	**-1.02**	0.91	**-1.32**
Manufacturing	4,180.0	**-1.55**	-0.32	**-1.90**	3,470.0	**-1.48**	-0.18	**-1.76**
Services	2,060.0	**-1.20**	-0.20	**-1.22**	1,720.0	**-2.49**	**-0.68**	**-2.69**
Total	6,434.5	**-1.43**	-0.22	**-1.67**	5,652.8	**-1.75**	-0.25	**-2.01**
ROW								
Agriculture	2,040.0	**0.20**	-0.17	**0.39**	1,750.0	**0.21**	-0.11	**0.35**
Manufacturing	8,120.0	**0.34**	0.00	**0.77**	8,630.0	**0.20**	-0.05	**0.57**
Services	3,210.0	**-0.07**	-0.03	**0.10**	3,740.0	**0.23**	0.05	**0.48**
Total	13,370.0	0.22	-0.03	**0.55**	14,120.0	**0.21**	-0.03	**0.52**

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications. Confidence intervals can be retrieved from Table A10 in the Appendix.

generally more important for complex manufacturing goods than for raw materials or services. We show changes in sectoral value added for the UK and the EU27 average in Table 7.[29] Sectoral value added is affected by a price and a quantity effect. Brexit changes the wage rate by the same rate in all sectors (roughly by the same effect as GDP per capita; see Table A11 in the Appendix), and it reallocates labor between sectors. For the UK, for example, sectors whose value added falls by less than 3.37% under a hard Brexit (S1) experience an increase in employment, while sectors whose value added falls by more see their employment shrink.

Within manufacturing, the largest sectors for the UK in terms of value added are food, beverages & tobacco, mining & quarrying (includes oil and gas extraction), machinery & equipment, fabricated metals, pharmaceuticals, and motor vehicles, with 47, 43, 32, 28, 22, and 21 bn USD value added, respectively. Amongst these, mining & quarrying and machinery & equipment are expected to lose most with a hard Brexit (-8% and -7%, respectively). The other mentioned sectors feature changes that are not statistically significant; the food sector even is expected to expand as higher trade costs force the UK to move into this comparative disadvantaged sector. The same is true for crops & animals. The largest percentage loss is expected in basic metals (-17%) and fishing & aquaculture (-16%), but initial value added

[29]Full results and initial VA per sector in 2014 are provided in Tables A12, A13, A14, and A15 in the Appendix. Country-sector level results on all remaining economies in the sample can be obtained from the authors on request.

Table 7: Changes in Sectoral Value Added, in %

		UK			EU 27		
		S1	**S2**	**S3**	**S1**	**S2**	**S3**
1	Crops & Animals	**7.87**	**6.71**	**8.30**	**-1.36**	**-0.70**	**-1.46**
2	Forestry & Logging	-1.96	-1.28	-1.22	**-0.52**	0.04	**-0.63**
3	Fishing & Aquaculture	**-15.83**	-7.68	-10.36	1.08	0.91	1.00
4	Mining & Quarrying	**-7.93**	8.22	-3.60	**2.51**	**5.86**	**2.75**
5	Food, Beverages & Tobacco	1.86	**2.39**	**3.50**	**-1.55**	**-0.53**	**-1.67**
6	Textiles, Apparel,Leather	**-6.82**	-2.97	**-10.62**	-0.38	0.93	**-0.83**
7	Wood & Cork	0.43	-3.86	-1.78	**-0.72**	0.16	**-0.88**
8	Paper	0.81	0.36	1.00	**-0.83**	-0.29	**-0.88**
9	Recorded Media Reproduction	**-1.13**	1.10	0.55	**-0.47**	**-0.23**	**-0.62**
10	Coke, Refined Petroleum	4.13	18.84	**19.89**	-0.44	2.02	-0.82
11	Chemicals	**-5.71**	0.34	**-4.12**	**-1.10**	**-0.64**	**-1.33**
12	Pharmaceuticals	-3.08	-5.82	**-11.94**	-0.67	**-2.16**	-0.02
13	Rubber & Plastics	-0.68	0.93	0.66	**-1.16**	**-0.49**	**-1.37**
14	Other non-Metallic Mineral	-1.01	0.94	0.71	**-0.70**	**-0.23**	**-0.84**
15	Basic Metals	**-16.95**	**-9.73**	-6.11	**-0.43**	-0.14	**-0.74**
16	Fabricated Metal	-0.49	1.44	**2.63**	**-0.79**	**-0.26**	**-1.00**
17	Electronics & Optical Products	-3.05	-2.15	-6.60	**-1.73**	**-2.69**	**-1.48**
18	Electrical Equipment	**-8.48**	-0.35	**-8.93**	**-0.60**	-0.25	**-1.18**
19	Machinery & Equipment	**-6.86**	-3.93	-4.11	-0.12	-0.24	-0.16
20	Motor Vehicles	-2.52	-1.49	**5.13**	**-1.57**	-0.21	**-2.24**
21	Other Transport Equipment	-2.80	11.80	**23.45**	-0.77	1.22	**-3.86**
22	Furniture & Other Manufacturing	-3.10	-1.29	-2.29	-0.27	**-0.58**	-0.05
23	Electricity & Gas	**-1.08**	0.67	**0.99**	**-0.67**	-0.12	**-0.86**
24	Water Supply	**-0.67**	0.46	**0.91**	**-0.61**	-0.07	**-0.80**
25	Sewerage & Waste	**-1.72**	-0.79	-0.84	**-0.62**	-0.14	**-0.79**
26	Construction	-0.46	0.87	**1.15**	**-0.70**	**-0.18**	**-0.89**
27	Trade & Repair of Motor Vehicles	**-2.14**	-0.74	0.38	**-0.45**	0.09	**-0.69**
28	Wholesale Trade	**-7.91**	**-6.50**	**-5.40**	0.05	**0.51**	-0.10
29	Retail Trade	-0.60	0.49	**1.01**	**-0.65**	-0.14	**-0.83**
30	Land Transport	**-1.86**	-0.58	-0.30	**-0.51**	-0.01	**-0.68**
31	Water Transport	0.78	-1.00	0.97	**-0.41**	0.33	**-0.52**
32	Air Transport	-0.84	-0.25	0.49	**-0.62**	0.06	**-0.68**
33	Aux. Transportation Services	**-3.28**	**-2.08**	**-1.76**	**-0.39**	0.06	**-0.55**
34	Postal & Courier	0.03	**1.71**	**1.41**	**-0.86**	**-0.48**	**-1.01**
35	Accommodation & Food	**-0.76**	0.47	0.53	**-0.57**	**-0.15**	**-0.75**
36	Publishing	**-1.59**	-0.73	-0.64	**-0.82**	-0.18	**-0.96**
37	Media Services	**-1.77**	-0.54	-0.67	-0.17	0.15	**-0.34**
38	Telecommunications	-0.65	0.62	0.64	**-0.68**	-0.17	**-0.82**
39	Computer & Information Services	**-0.64**	**1.02**	**0.89**	**-0.43**	**-0.23**	**-0.56**
40	Financial Services	0.38	**1.78**	**1.43**	**-0.78**	**-0.43**	**-0.94**
41	Insurance	1.17	**3.17**	2.29	**-0.94**	**-0.61**	**-1.09**
42	Real Estate	-0.35	0.73	**1.09**	**-0.67**	**-0.17**	**-0.85**
43	Legal & Accounting	**-1.51**	0.66	0.74	**-0.46**	-0.05	**-0.62**
44	Business Services	**-2.57**	0.51	0.78	**-0.39**	-0.12	**-0.58**
45	Research & Development	-0.68	0.41	0.52	**-0.56**	-0.12	**-0.73**
46	Admin. & Support Services	-0.17	1.47	1.16	**-0.77**	-0.37	**-0.90**
47	Public & Social Services	**-0.59**	0.61	**0.93**	**-0.67**	**-0.15**	**-0.87**
48	Education	**-0.66**	0.49	**0.84**	**-0.68**	-0.14	**-0.87**
49	Human Health & Social Work	-0.52	0.60	**0.94**	**-0.71**	-0.14	**-0.91**
50	Other Services, Households	-0.22	0.89	0.80	**-0.70**	-0.21	**-0.89**

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications. Full results and initial value added per sector in 2014 are provided in Tables A12, A13, A14, and A15 in the Appendix.

positions in these sectors are relatively small.

Value added changes from a FTA (S2) differ from those in S1 in sign, size and statistical significance, because the structure of trade cost savings available under the FTA may differ from those obtained in the EU Single Market. Nonetheless, the overall picture remains: Brexit drives the UK into the agri-food sectors and out of manufacturing sectors, such as basic metals. Note, however, that changes are statistically insignificant for many UK sectors in S2. Global Britain (S3) yields sectoral value added gains where trade cost reductions with third countries are expected. This is the case in transportation, for example, but not in chemicals or pharmaceuticals, where reductions in NTBs are usually harder to realize. The expansion of agri-food remains, as historical experience does not suggest significant trade costs savings from FTAs with third countries in these sectors. UK textiles is expected to shed employment as import competition goes up.

Regarding services, the largest losses from a hard Brexit (S1) are expected in wholesale trade (-8%), a sector that in 2014 generates value added worth 88 bn USD; legal & accounting and business services, both quantitatively important sectors, also have to expect sizeable losses of 2% and 3%, respectively. Interestingly, financial services are not affected in a statistically significant way. This is due to the combination of two effects. First, the ex post analysis of trade integration does not suggest large trade cost savings in the first place, second, the UK has a strong comparative advantage over its competitors. This is less true for publishing and media services, two sectors with smaller quantitative importance which would lose about 2% of their value added.

In the EU27, sectoral value added effects are generally less pronounced. One sector worth pointing out is motor vehicles, where losses of about 2% are to be expected, as the relatively high EU tariffs of 10% kick in and the tight production network between the EU27 and the UK is strongly affected by this. In the global Britain scenario (S3), the loss increases as EU firms face tougher competition from third country suppliers in the UK. In contrast, if the EU and the UK strike a FTA (S2), losses for the EU car industry disappear.

5 Robustness

Next, we analyze the robustness of our findings with regard to the choice of trade elasticities. We focus on changes in real consumption for the hard Brexit scenario. Results are summarized Table A17 in the Appendix.

First, even though our calculated services elasticities are in line with the above discussed literature on services elasticities, we now rely on elasticities of a value of 5 as assumed in

Caliendo and Parro (2015) and Costinot and Rodriguez-Clare (2014). Overall, we find that real consumption losses are slightly smaller due to the down weighting of trade cost changes in services. We need to keep in mind that services sectors are extremely important for the UK, hence, assuming a much higher trade elasticity might strongly affect results. For a hard Brexit, losses are 5.4 times smaller compared to the baseline in Table 4 for the most extreme case (Luxembourg) with its very strong reliance on services sectors. Other EU27 countries experience losses that are 2 to 3 times smaller compared to the baseline. The UK faces losses of -1.17% of real consumption, which is 2.4 times smaller than in the baseline of -2.76%.

Second, we apply sectoral elasticities estimated by Caliendo and Parro (2015) (see Table A16 in the Appendix). To be empirically consistent, we re-estimate our sector-level gravity equations constraining θ to equal the external estimate and backing out new NTB changes. We find that countries lose less from a hard Brexit comparing magnitudes to the baseline. In relative terms, EU27 countries real consumption losses are 1.4 to 2.3 times smaller than in the baseline. On the contrary, the UK loses 0.8 times more (-3.27% compared to -2.76%). Note, that 10% confidence intervals in the baseline are [-3.32, -2.19] and [-3.95, -2.59] for the UK, such that the slightly higher losses are still close to the range of our baseline estimates.

Further, while the magnitudes of real consumption changes vary slightly with the choice of elasticities, the ranking of countries does not vary much from the baseline. Countries with the highest losses in the baseline and both robustness checks are Ireland, the UK, Malta, Luxembourg and the Netherlands. EU27 countries with the lowest losses are Greece, Romania, Austria, Croatia. Germany varies between rank 11 and 15, while France switches between rank 17 and 19. Hence, we are confident that our baseline results represent reasonable estimates for the changing trade policy environment with Brexit.

6 Conclusion

In this paper, we conduct an ex ante analysis of trade and welfare effects of Brexit based on an econometric ex post assessment of EU integration agreements and other FTAs. We quantify potential economic consequences of Brexit using asymmetries in the relation between the UK and EU27 economies. The analysis is based on a quantitative trade theory framework that gives rise to a structural gravity equation. The integration of parameter calibration and scenario definition based on the estimation of sector-level gravity equations allows simulating confidence intervals for all endogenous variables. This makes an important component of uncertainty surrounding our results visible. Interestingly, in most cases, the confidence intervals are rather narrow.

In the partial equilibrium gravity analysis, we find that the EU and trade agreements have been very successful in reducing trade costs and boosting trade between its members, but effects turn out to be asymmetric, in particular, with respect to the UK. We make use of the heterogeneity identified at the finer sectoral level and of the model structure to back out the trade cost effects of European integration steps. We reverse these effects in the counterfactual general equilibrium analysis. Allowing for treatment heterogeneity in the ex post analysis is relevant quantitatively for the overall size of the economic costs of Brexit and its distribution between the UK and the other European countries.

We distinguish three different scenarios and simulate real consumption, gross and value added trade changes. While we find a lot of heterogeneity across the 43 geographical countries and the RoW component, a general pattern persists. Both, the UK and EU27 countries lose welfare in any of the assumed Brexit scenarios. Some small EU27 countries with very close trade ties to the UK, such as Ireland, Luxembourg, and Malta, lose even more than the UK itself. Overall, conducting new trade agreements outside of the EU cannot fully compensate the losses suffered from Brexit for the UK, while EU27 countries lose even more in this scenario due to trade diversion. Generally, a modern and ambitious trade agreement between the UK and the EU27 countries generates the smallest losses, as a lot of potential still exists in trade relation between the UK and the remaining EU countries.

Our paper is probably the most ambitious amongst the existing studies on Brexit in mapping out the trade effects. But it does not feature labor or capital mobility. Needless to say, a careful analysis of these facets of European integration would be important but faces both modeling and data-related issues. Brexit underlines the urgency for additional research in these areas.

References

Aichele, R., Heiland, I., 2018. Where is the Value Added? Trade Liberalization and Production Networks. Journal of International Economics, forthcoming.

Alvarez, F., Lucas, R. E., 2007. General Equilibrium Analysis of the Eaton–Kortum Model of International Trade. Journal of Monetary Economics 54 (6), 1726–1768.

Baier, S., Bergstrand, J., 2007. Do Free Trade Agreements Actually Increase Members' International Trade? Journal of International Economics 71 (1), 72–95.

Baier, S. L., Yotov, Y. V., Zylkin, T., 2016. On the Widely Differing Effects of Free Trade Agreements: Lessons from Twenty Years of Trade Integration. CESifo Working Paper 6174.

Caliendo, L., Parro, F., 2015. Estimates of the Trade and Welfare Effects of NAFTA. Review of Economic Studies 82 (1), 1–44.

Costinot, A., Rodriguez-Clare, A., 2014. Trade Theory with Numbers: Quantifying the Consequences of Globalization. In: Gopinath, G., Helpman, E., Rogoff, K. (Eds.), Handbook of International Economics. Vol. 4. Elsevier, Ch. 4, pp. 197–261.

Dekle, R., Eaton, J., Kortum, S., 2008. Global Rebalancing with Gravity: Measuring the Burden of Adjustment. IMF Economic Review 55 (3), 511–540.

Dhingra, S., Huang, H., Ottaviano, G., Paulo Pessoa, J., Sampson, T., Van Reenen, J., 2017. The Costs and Benefits of Leaving the EU: Trade Effects. Economic Policy 32 (92), 651–705.

Eaton, J., Kortum, S., 2002. Technology, Geography, and Trade. Econometrica 70 (5), 1741–1779.

Egger, P. H., Larch, M., Staub, K. E., 2012. Trade Preferences and Bilateral Trade in Goods and Services: A Structural Approach. CEPR Discussion Paper No. DP9051.

Fally, T., 2015. Structural Gravity and Fixed Effects. Journal of International Economics 97 (1), 76–85.

Felbermayr, G., Gröschl, J., Steinwachs, T., 2018. The Trade Effects of Border Controls: Evidence from the European Schengen Agreement. Journal of Common Market Studies 2 (56), 335–351.

Hobijn, B., Nechio, F., 2018. Sticker Shocks: Using VAT Changes to Estimate Upper-Level Elasticities of Substitution. Journal of the European Economic Association, forthcoming.

Keynes, M., 1929. The German Transfer Problem. Economic Journal 39, 1–7.

Lakatos, C., Nilsson, L., 2017. The EU-Korea FTA: Anticipation, Trade Policy Uncertainty and Impact. Review of World Economics 153 (1), 179–198.

Marquez, J., 2006. Estimating Elasticities for US Trade in Services. Economic Modelling 23 (2), 276–307.

Mayer, T., Vicard, V., Zignago, S., 2018. The Cost of Non-Europe, Revisited. CEPII Working Paper 2018-06.

Ohlin, B., 1929. The German Transfer Problem: A Discussion. Economic Journal 39, 172–182.

Sampson, T., 2017. Brexit: The Economics of International Disintegration. Journal of Economic Perspectives 31 (4), 163–84.

Santos Silva, J., Tenreyro, S., 2006. The Log of Gravity. Review of Economics and Statistics 88 (4), 641–658.

Timmer, M., Dietzenbacher, E., Los, B., Stehrer, R., Vries, G., 2015. An Illustrated User Guide to the World Input–Output Database: The Case of Global Automotive Production. Review of International Economics 23 (3), 575–605.

Vandenbussche, H., Connell, W., Simons, W., 2017. Global Value Chains, Trade Shocks, and Jobs: An Application to Brexit. CEPR Discussion Paper No. DP12303.

Ward, M., 2017. Statistics on UK-EU Trade. House of Commons Briefing Paper 7851.

Yotov, Y., Larch, M., Monteiro, J.-A., Piermartini, R., 2016. An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model. United Nations Conference on Trade and Development and World Trade Organization.

A Appendix

A.1 The Model in Changes

We solve for counterfactual changes in all variables of interest using the following system of equations:[30]

$$\hat{c}_n^j = \hat{w}_n^{\beta_n^j} \left(\prod_{i=1}^{N} [\hat{p}_n^j]^{\gamma_n^{k,j}} \right)^{1-\beta_n^j}, \tag{11}$$

$$\hat{p}_n^j = \left(\sum_{i=1}^{N} \pi_{in}^j [\hat{\kappa}_{in}^j \hat{c}_i^j]^{-1/\theta^j} \right)^{-\theta^j}, \tag{12}$$

$$\hat{\pi}_{in}^j = \left(\frac{\hat{c}_i^j}{\hat{p}_n^j} \hat{\kappa}_{in}^j \right)^{-1/\theta^j}, \tag{13}$$

$$X_n^{j'} = \sum_{j=1}^{J} \gamma_n^{j,k} (1-\beta_n^k) \left(\sum_{i=1}^{N} \frac{\pi_{ni}^{k'}}{1+t_{ni}^{k'}} X_i^{k'} \right) + \alpha_n^j I_n', \tag{14}$$

$$\frac{1}{B} \sum_{j=1}^{J} F_n^{j'} X_n^{j'} + s_n = \frac{1}{B} \sum_{j=1}^{J} \sum_{i=1}^{N} \frac{\pi_{ni}^{j'}}{1+t_{ni}^{j'}} X_i^{j'}, \tag{15}$$

where $\hat{w}_n$ are wage changes, X_n^j are sectoral expenditure levels, $F_n^j \equiv \sum_{i=1}^{N} \frac{\pi_j^{in}}{(1+t_{in}^j)}$, $I_n' = \hat{w}_n w_n L_n + \sum_{j=1}^{J} X_n^{j'}(1-F_n^{j'}) - S_n$, L_n denotes country n's labor force, and S_n is the (exogenously given) trade surplus. We fix $s_n \equiv S_n/B$, where $B \equiv \sum_n w_n L_n$ is global labor income, to make sure that the system is homogenous of degree zero in prices.

The shift in unit costs due to changes in input prices (i.e., wage and intermediate price changes) is laid out in equation (11). Trade cost changes directly affect the sectoral price index p_n^j, while changes in unit costs have an indirect effect (see equation (12)). Trade shares change as a reaction to changes in trade costs, unit costs, and prices. The productivity dispersion θ^j indicates the intensity of the reaction. Higher θ^j's imply bigger trade changes. Equation (14) ensures goods market clearing in the new equilibrium and the counterfactual income-equals-expenditure or balanced trade condition is given by equation (15).

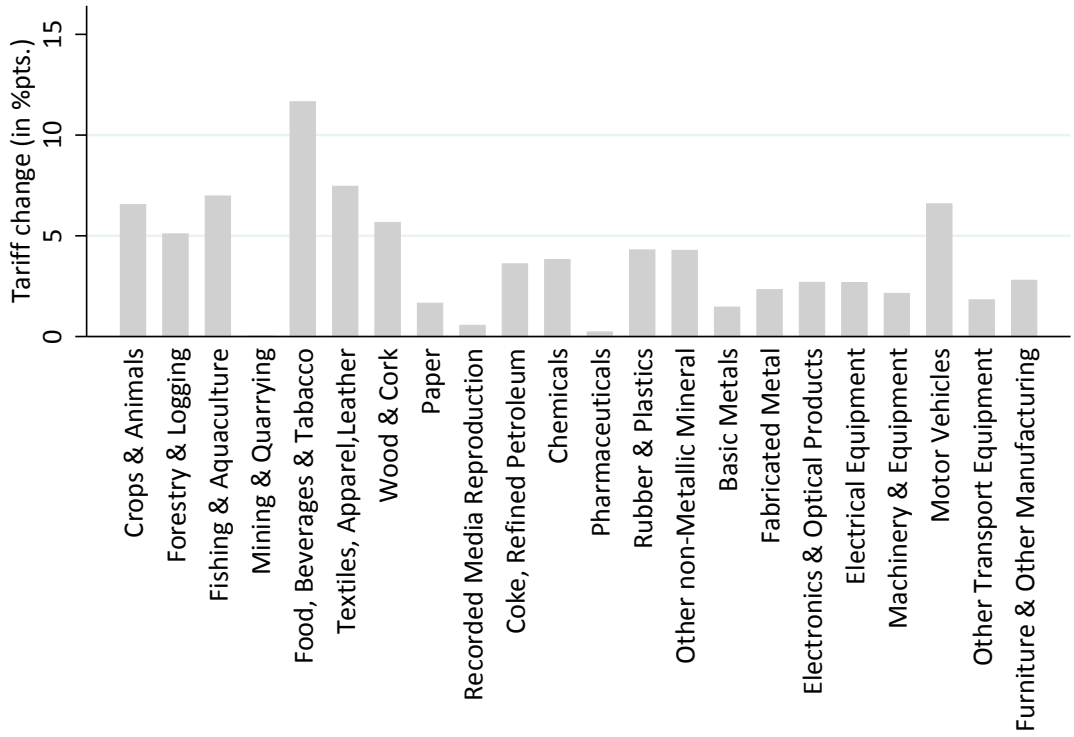
To solve the system for multiple sectors, we again relate to Caliendo and Parro (2015), who extend the single-sector solution algorithm proposed by Alvarez and Lucas (2007). We start

[30] See also Caliendo and Parro (2015). Solving for counterfactual changes rather than levels strongly reduces the set of parameters and moments that have to be estimated or calibrated. In particular, no information on price levels, iceberg trade costs, or productivity levels is needed.

with an initial guess about a vector of wage changes. Using (11) and (12), it computes changes in prices, trade shares, expenditure levels, evaluates the trade balance condition (15), and updates the change in wages based on deviations in the trade balance.

A.2 Details on Data and Results

Figure 4: Average MFN Tariffs on Intra-EU Trade, 2014



Note: Averages of sectoral bilateral tariffs across intra-EU country-pairs. Sectoral bilateral tariffs are trade-weighted MFN averages of the product-level MFN tariffs imposed by the EU in 2014.

Table A1: List of WIOD Manufacturing Sectors

Sector ID	Sector Name	ISIC Rev. 4
1	Crops & Animals	A01
2	Forestry & Logging	A02
3	Fishing & Aquaculture	A03
4	Mining & Quarrying	B
5	Food, Beverages & Tabacco	C10-C12
6	Textiles, Apparel,Leather	C13-C15
7	Wood & Cork	C16
8	Paper	C17
9	Recorded Media Reproduction	C18
10	Coke, Refined Petroleum	C19
11	Chemicals	C20
12	Pharmaceuticals	C21
13	Rubber & Plastics	C22
14	Other non-Metallic Mineral	C23
15	Basic Metals	C24
16	Fabricated Metal	C25
17	Electronics & Optical Products	C26
18	Electrical Equipment	C27
19	Machinery & Equipment	C28,C33
20	Motor Vehicles	C29
21	Other Transport Equipment	C30
22	Furniture & Other Manufacturing	C31_C32
23	Electricity & Gas	D35
24	Water Supply	E36
25	Sewerage & Waste	E37-E39
26	Construction	F
27	Trade & Repair of Motor Vehicles	G45
28	Wholesale Trade	G46
29	Retail Trade	G47
30	Land Transport	H49
31	Water Transport	H50
32	Air Transport	H51
33	Aux. Transportation Services	H52
34	Postal and Courier	H53
35	Accommodation and Food	I
36	Publishing	J58
37	Media Services	J59_J60
38	Telecommunications	J61
39	Computer & Information Services	J62_J63
40	Financial Services	K64
41	Insurance	K65_K66
42	Real Estate	L68
43	Legal and Accounting	M69_M70
44	Business Services	M71,M73-M75
45	Research and Development	M72
46	Admin. & Support Services	N
47	Public & Social Services	O84
48	Education	P85
49	Human Health and Social Work	Q
50	Other Services, Households	R-U

Table A2: Gross National Income and Transfer Redistribution

	Gross National Income in mn EUR	Fiscal Transfers
Austria	328,897	183
Belgium	402,665	224
Bulgaria	40973	23
Cyprus	16,583	9
Czech Republic	144473	81
Germany	2,972,188	1657
Denmark	264,873	148
Spain	1,052,245	587
Estonia	19,049	11
Finland	203,977	114
France	2,179,155	1215
United Kingdom	2,174,280	-6549
Greece	178,381	99
Croatia	41,773	23
Hungary	100,695	56
Ireland	159,732	89
Italy	1,613,795	900
Lithuania	35,203	20
Luxembourg	29,477	16
Latvia	23,868	13
Malta	7,629	4
Netherlands	662,465	369
Poland	396,058	221
Portugal	171,108	95
Romania	146,462	82
Slovak Republic	73,854	41
Slovenia	36,676	20
Sweden	445,168	248
EU27	11,747,422	6549

Note: Redistribution calculated based on the operating budgetary balance as stated by the European Commission for the 2010-2014 UK average, relative to each country's gross national income. The value of fiscal transfers that get redistributed make up 0.06% of EU27 member states' GNI and 0.30% of UK's GNI.

Table A3: EU Integration Steps and Bilateral Imports, Goods (2000 - 2014)

Dep. var.:	Bilateral Imports									
Sector Description	Both EU27	exp: EU27 imp: UK	exp: UK imp: EU27	Euro	Schengen	EU27-KOR	UK-KOR	Other FTAs	Tariffs	Obs.
1 Crops & Animals°	1.154***	1.254***	0.733***	0.236***	0.184***	0.327	−0.212	0.144	−3.471***	27,735
2 Forestry & Logging°	0.075	0.194	0.267	0.414***	0.179***	0.091	−0.919***	−0.204	−3.471***	26,490
3 Fishing & Aquaculture°	0.711***	0.003	1.057	0.097	0.053	−0.174	0.605	−0.213	−3.471***	25,755
4 Mining & Quarrying°	0.013	−0.797***	−0.192	0.936***	0.016	1.136***	2.792***	−0.519***	−3.471***	27,705
5 Food, Beverages & Tobacco	0.706***	0.736***	0.555***	0.061	0.216***	0.18	−0.611***	0.106	−1.066	27,735
6 Textiles, Apparel, Leather°	0.440***	0.117	0.295ă	−0.035	0.032	0.345***	−0.414*	0.173	−3.471***	27,735
7 Wood & Cork°	0.298**ă	0.076	−0.109	0.131**	0.013	0.410***	0.479***	0.054	−3.471***	27,735
8 Paper°	0.438***	0.369	0.307**	0.037	0.041***	0.341***	−0.167	−0.003	−3.471***	27,735
9 Recorded Media Reproduction	−0.040	−0.111	−0.011	−0.175	0.052	0.879***	0.174	−0.203	−1.254	26,520
10 Coke, Refined Petroleum	−0.067	−0.294	−0.031	0.198*	0.217***	0.512*	0.372***	−0.108	−6.021***	26,795
11 Chemicals	0.459***	0.778***	0.254**	0.128**	0.106***	0.318***	0.166**	0.032	−3.530***	27,735
12 Pharmaceuticals	1.003***	1.099***	0.829***	0.008	0.178***	−0.061	−0.088	0.336**	−11.388 ***	26,310
13 Rubber & Plastics	0.609***	0.698***	0.448***	0.069*	0.154***	0.307***	0.116*	0.289***	−2.258**	27,735
14 Other non-Metallic Mineral	0.389***	0.265	0.223*	0.176***	0.069***	0.029	0.033	0.188*	−1.365*	27,735
15 Basic Metals	0.574***	0.681**	0.641***	0.154	0.130***	0.308***	0.075	0.280***	−3.191***	27,735
16 Fabricated Metal	0.457***	0.551***	0.254	0.121***	0.065***	0.275***	0.135	0.217***	−1.543***	27,090
17 Electronics & Optical Products	0.130	0.694***	−0.208	−0.176	−0.028	−0.150	−0.809***	−0.044	−7.780***	27,735
18 Electrical Equipment	0.554***	0.601***	0.151	0.053	0.092***	0.370***	−0.003	0.207***	−6.001***	27,090
19 Machinery & Equipment	0.264***	0.570***	0.214*	0.040	0.065***	0.119*	0.180***	0.053	−7.870***	27,735
20 Motor Vehicles	0.525***	0.731***	0.364	−0.088	0.117**	0.311***	0.144	0.249***	−4.610***	27,735
21 Other Transport Equipment	−0.041	0.187	−0.303	0.270**	−0.043	0.315	0.169	0.026	−2.948	27,090
22 Furniture & Other Manufacturing	0.008	−0.086	−0.149	0.076	0.130***	−0.571***	−1.110***	−0.164	−3.727***	27,735

Note: ***, **, * denote significance at the 1%, 5%, 10% levels, respectively. All models estimated use Poisson Pseudo Maximum Likelihood (PPML) methods. Robust standard errors (not reported) allow for clustering at the country-pair level. Pair as well as year specific importer and exporter fixed effects included but not reported. Sectors marked with ° report estimates based on tariff adjusted imports, applying overall trade elasticities for goods trade from Table (1) column (5).

Table A4: EU Integration Steps and Bilateral Imports, Services (2000 - 2014)

Dep. var.:	Bilateral Imports								
Sector Description	Both EU27	exp: EU27 imp: UK	exp: UK imp: EU27	Euro	Schengen	EU27-KOR	UK-KOR	Other FTAs	Obs.
23 Electricity & Gas	0.903**	0.895**	1.068**	−0.169	0.065	0.356	−1.653***	0.605*	27,225
24 Water Supply	−0.098	−0.336	0.000	0.105	0.117**	0.628***	0.623***	−0.530***	23,085
25 Sewerage & Waste	1.183***	1.314***	0.893***	0.080	0.016	−0.015	−0.015	0.716***	24,435
26 Construction	1.269***	1.239***	2.154***	0.000	0.102	0.137	0.234	0.763***	27,210
27 Trade & Repair of Motor Vehicles	0.705**	1.501**	2.251***	−0.030	0.518***	0.735***	1.096***	−0.051	25,770
28 Wholesale Trade	0.753***	1.515***	2.611***	0.105	0.215***	0.471***	1.299***	0.198**	27,285
29 Retail Trade	0.710***	1.373***	1.571***	−0.063	0.198***	0.425*	0.847***	0.105	25,740
30 Land Transport	0.617***	0.333*	1.047***	0.291**	−0.039	0.327*	0.384	−0.199**	27,630
31 Water Transport	0.782***	0.679**	0.759**	0.050	−0.015	0.302	−1.020**	0.141	27,480
32 Air Transport	0.344**	0.198	0.700***	−0.097	0.054	0.108	−0.859**	−0.289**	27,735
33 Aux. Transportation Services	0.246*	0.240	0.638***	−0.194**	0.082***	0.040	−0.025	−0.260**	27,525
34 Postal and Courier	0.620***	1.266***	0.245	−0.343**	0.445***	0.680**	−0.163	0.638***	23,475
35 Accommodation and Food	−0.315*	0.002	−0.018	0.382***	−0.305***	−0.457***	−1.576***	−0.450***	25,455
36 Publishing	0.200	0.230	0.542*	−0.487***	−0.010	−0.191	−0.096	−0.286**	24,270
37 Media Services	0.347*	0.027	0.565**	0.246*	−0.084	0.071	0.063	−0.144	24,165
38 Telecommunications	0.166	0.466	0.323	0.281***	0.103***	0.604***	−0.060	−0.067	27,720
39 Computer & Information Services	0.825***	1.067***	0.532**	0.207**	0.154***	0.848**	−0.221	−0.084	26,955
40 Financial Services	0.616**	1.809***	0.484	0.558***	−0.067	0.899***	−0.366*	−0.055	27,015
41 Insurance	−0.103	−0.121	−0.609	0.471***	−0.143	0.058	−0.147	−0.246	26,370
42 Real Estate	0.336	0.832**	1.104***	0.208	−0.008	0.040	0.544	−0.095	23,565
43 Legal and Accounting	0.451***	0.520**	0.599**	−0.011	0.143***	0.160	0.018	0.243*	24,960
44 Business Services	1.116***	0.999***	0.993***	−0.028	0.063	0.809***	0.413***	0.632***	25,635
45 Research and Development	0.163**	−0.134	−0.049	0.097	0.035	−0.138	−1.095***	−0.024	24,647
46 Admin. & Support Services	0.450***	0.229	−0.097	0.176	0.133***	0.046	−0.509***	−0.140	26,910
47 Public & Social Services	0.533***	0.438	0.656	0.027	0.084**	0.095	1.085***	0.272*	25,785
48 Education	0.427***	1.062***	1.503***	0.289**	0.292***	0.555	1.065***	0.021	25,950
49 Human Health and Social Work	0.377*	0.271	0.959**	0.317**	0.456***	0.971***	1.058***	0.036	26,160
50 Other Services, Households	0.963	0.824	0.397	−0.243**	−0.089	0.023	0.919***	0.078	27,495

Note: ***, **, * denote significance at the 1%, 5%, 10% levels, respectively. All models estimated use Poisson Pseudo Maximum Likelihood (PPML) methods. Robust standard errors (not reported) allow for clustering at the country-pair level. Pair as well as year specific importer and exporter fixed effects included but not reported. For services sectors, we calculate the trade elasticity for services according to Egger et al. (2012).

Table A5: Change in Real Consumption of Welfare Decomposition (S1), in %

	All Sub-Scenarios	Transfers Only	Agri. Tariffs Only	Manuf. Tariffs Only	Agri. NTBs Only	Manuf NTBs Only	Serv. NTBs Only
UK	**-2.61**	**0.29**	**0.01**	**0.05**	0.03	**-0.73**	**-2.31**
	[-3.21, -2.00]	[0.29, 0.29]	[0.00, 0.01]	[0.04, 0.06]	[-0.04, 0.11]	[-1.11, -0.36]	[-2.79, -1.83]
Austria	**-0.33**	**-0.06**	0.00	**-0.01**	0.00	**-0.03**	**-0.23**
	[-0.38, -0.27]	[-0.06, -0.06]	[-0.00, 0.00]	[-0.02, -0.01]	[-0.00, 0.01]	[-0.05, -0.02]	[-0.28, -0.18]
Belgium	**-1.36**	**-0.06**	**-0.00**	**-0.07**	0.02	**-0.20**	**-1.04**
	[-1.60, -1.12]	[-0.07, -0.06]	[-0.00, -0.00]	[-0.09, -0.06]	[-0.01, 0.04]	[-0.27, -0.13]	[-1.26, -0.82]
Bulgaria	**-0.46**	**-0.04**	0.00	**-0.00**	0.00	**-0.07**	**-0.35**
	[-0.54, -0.38]	[-0.04, -0.04]	[-0.00, 0.00]	[-0.01, -0.00]	[-0.00, 0.01]	[-0.11, -0.03]	[-0.42, -0.28]
Croatia	**-0.37**	**-0.05**	0.00	-0.00	-0.00	**-0.03**	**-0.28**
	[-0.44, -0.29]	[-0.05, -0.05]	[-0.00, 0.00]	[-0.00, 0.00]	[-0.00, 0.00]	[-0.05, -0.02]	[-0.35, -0.21]
Cyprus	**-1.45**	**-0.05**	**-0.01**	0.00	-0.00	**-0.19**	**-1.21**
	[-1.80, -1.09]	[-0.05, -0.05]	[-0.01, -0.00]	[-0.00, 0.01]	[-0.01, 0.01]	[-0.33, -0.05]	[-1.55, -0.88]
Czech R.	**-0.54**	**-0.07**	-0.00	**-0.04**	**0.01**	**-0.06**	**-0.37**
	[-0.65, -0.44]	[-0.07, -0.07]	[-0.00, 0.00]	[-0.05, -0.04]	[0.00, 0.02]	[-0.11, -0.00]	[-0.46, -0.28]
Denmark	**-0.93**	**-0.07**	**-0.00**	**-0.03**	-0.00	**-0.12**	**-0.72**
	[-1.10, -0.77]	[-0.07, -0.07]	[-0.00, -0.00]	[-0.03, -0.02]	[-0.03, 0.03]	[-0.16, -0.08]	[-0.87, -0.57]
Estonia	**-0.64**	**-0.06**	**-0.00**	**-0.02**	0.00	**-0.11**	**-0.46**
	[-0.79, -0.50]	[-0.06, -0.06]	[-0.00, -0.00]	[-0.03, -0.01]	[-0.01, 0.01]	[-0.21, -0.01]	[-0.57, -0.35]
Finland	**-0.49**	**-0.06**	-0.00	-0.01	0.01	**-0.05**	**-0.39**
	[-0.58, -0.41]	[-0.06, -0.06]	[-0.01, 0.01]	[-0.01, 0.00]	[-0.00, 0.03]	[-0.08, -0.01]	[-0.46, -0.31]
France	**-0.52**	**-0.06**	-0.00	**-0.02**	0.01	**-0.07**	**-0.38**
	[-0.63, -0.40]	[-0.06, -0.06]	[-0.00, 0.00]	[-0.02, -0.02]	[-0.00, 0.02]	[-0.10, -0.04]	[-0.50, -0.27]
Germany	**-0.60**	**-0.07**	-0.00	**-0.05**	0.02	**-0.09**	**-0.41**
	[-0.69, -0.50]	[-0.07, -0.07]	[-0.01, 0.00]	[-0.05, -0.04]	[-0.00, 0.05]	[-0.13, -0.05]	[-0.49, -0.33]
Greece	**-0.38**	**-0.04**	**0.00**	0.00	0.00	**-0.04**	**-0.31**
	[-0.46, -0.31]	[-0.04, -0.04]	[0.00, 0.00]	[-0.00, 0.00]	[-0.00, 0.01]	[-0.07, -0.02]	[-0.38, -0.23]
Hungary	**-0.68**	**-0.06**	0.00	**-0.04**	**0.01**	**-0.05**	**-0.52**
	[-0.78, -0.58]	[-0.07, -0.06]	[-0.00, 0.00]	[-0.05, -0.04]	[0.00, 0.02]	[-0.09, -0.01]	[-0.60, -0.43]
Ireland	**-7.25**	**-0.09**	**-0.16**	**-0.25**	**-0.21**	**-1.48**	**-5.14**
	[-8.36, -6.14]	[-0.10, -0.09]	[-0.21, -0.12]	[-0.40, -0.09]	[-0.38, -0.03]	[-1.81, -1.14]	[-5.92, -4.36]
Italy	**-0.40**	**-0.06**	-0.00	**-0.02**	0.00	**-0.04**	**-0.28**
	[-0.47, -0.32]	[-0.06, -0.06]	[-0.00, 0.00]	[-0.02, -0.02]	[-0.00, 0.01]	[-0.06, -0.02]	[-0.34, -0.21]
Latvia	**-0.58**	**-0.05**	-0.00	**-0.03**	0.00	-0.10	**-0.41**
	[-0.72, -0.43]	[-0.05, -0.05]	[-0.00, 0.00]	[-0.04, -0.02]	[-0.00, 0.01]	[-0.21, 0.01]	[-0.51, -0.30]
Lithuania	**-0.47**	**-0.06**	0.00	**-0.07**	**-0.01**	-0.07	**-0.27**
	[-0.60, -0.33]	[-0.06, -0.06]	[-0.00, 0.00]	[-0.08, -0.06]	[-0.01, -0.00]	[-0.17, 0.03]	[-0.34, -0.19]
Luxembourg	**-6.36**	**-0.12**	**-0.01**	**-0.06**	-0.02	**-0.09**	**-6.05**
	[-8.79, -3.93]	[-0.12, -0.12]	[-0.01, -0.00]	[-0.07, -0.06]	[-0.05, 0.00]	[-0.16, -0.02]	[-7.69, -4.40]
Malta	**-4.63**	**-0.03**	**0.00**	**0.02**	0.01	**-0.32**	**-4.32**
	[-5.78, -3.47]	[-0.03, -0.03]	[0.00, 0.00]	[0.02, 0.03]	[-0.01, 0.03]	[-0.48, -0.15]	[-5.50, -3.14]
Netherlands	**-1.63**	**-0.09**	**-0.01**	**-0.10**	-0.05	**-0.24**	**-1.15**
	[-1.85, -1.41]	[-0.09, -0.09]	[-0.02, -0.01]	[-0.11, -0.09]	[-0.11, 0.02]	[-0.32, -0.16]	[-1.31, -0.99]
Poland	**-0.63**	**-0.06**	**0.00**	**-0.04**	0.01	**-0.08**	**-0.45**
	[-0.71, -0.54]	[-0.06, -0.06]	[0.00, 0.00]	[-0.05, -0.04]	[-0.01, 0.02]	[-0.12, -0.04]	[-0.52, -0.37]

Table A6: Change in Real Consumption of Welfare Decomposition (S1), continued, in %

	All Sub-Scenarios	Transfers Only	Agri.	Manuf.	Agri.	Manuf	Serv.
			Tariffs Only			NTBs Only	
Portugal	**-0.45**	**-0.05**	**0.00**	**-0.02**	-0.00	**-0.05**	**-0.34**
	[-0.56, -0.35]	[-0.05, -0.05]	[0.00, 0.00]	[-0.02, -0.02]	[-0.01, 0.01]	[-0.08, -0.03]	[-0.44, -0.23]
Romania	**-0.37**	**-0.05**	**0.00**	**-0.01**	**-0.00**	**-0.05**	**-0.26**
	[-0.45, -0.29]	[-0.05, -0.05]	[0.00, 0.00]	[-0.01, -0.00]	[-0.00, -0.00]	[-0.07, -0.03]	[-0.33, -0.18]
Slovakia	**-0.73**	**-0.06**	**-0.00**	**-0.04**	0.00	**-0.16**	**-0.48**
	[-0.86, -0.60]	[-0.06, -0.06]	[-0.00, -0.00]	[-0.05, -0.04]	[-0.01, 0.01]	[-0.19, -0.12]	[-0.62, -0.35]
Slovenia	**-0.42**	**-0.06**	**-0.00**	**-0.01**	-0.00	**-0.07**	**-0.28**
	[-0.50, -0.35]	[-0.07, -0.06]	[-0.00, -0.00]	[-0.01, -0.01]	[-0.01, 0.00]	[-0.09, -0.05]	[-0.36, -0.20]
Spain	**-0.39**	**-0.06**	**-0.00**	**-0.01**	-0.00	**-0.07**	**-0.23**
	[-0.48, -0.30]	[-0.06, -0.06]	[-0.00, -0.00]	[-0.02, -0.01]	[-0.02, 0.01]	[-0.09, -0.05]	[-0.31, -0.14]
Sweden	**-0.75**	**-0.07**	**-0.00**	**-0.02**	0.00	**-0.09**	**-0.58**
	[-0.91, -0.58]	[-0.07, -0.07]	[-0.00, -0.00]	[-0.02, -0.02]	[-0.03, 0.04]	[-0.14, -0.04]	[-0.75, -0.42]
Australia	-0.00	**0.00**	0.00	**0.00**	**0.00**	0.00	-0.00
	[-0.01, 0.00]	[0.00, 0.00]	[-0.00, 0.00]	[0.00, 0.00]	[0.00, 0.01]	[-0.00, 0.01]	[-0.00, 0.00]
Brazil	**-0.01**	**-0.00**	0.00	**-0.00**	**0.00**	-0.00	**-0.00**
	[-0.01, -0.01]	[-0.00, -0.00]	[-0.00, 0.00]	[-0.00, -0.00]	[0.00, 0.00]	[-0.00, 0.00]	[-0.01, -0.00]
Canada	0.00	0.00	0.00	**-0.00**	**-0.01**	**0.01**	-0.01
	[-0.00, 0.01]	[-0.00, 0.00]	[-0.00, 0.00]	[-0.00, -0.00]	[-0.01, -0.00]	[0.00, 0.02]	[-0.01, 0.00]
China	**0.05**	**-0.00**	0.00	**0.01**	-0.00	**0.02**	**0.02**
	[0.04, 0.05]	[-0.00, -0.00]	[-0.00, 0.00]	[0.01, 0.01]	[-0.00, 0.00]	[0.01, 0.03]	[0.01, 0.03]
India	**0.02**	**0.00**	0.00	**0.00**	**0.00**	**0.00**	**0.01**
	[0.01, 0.02]	[0.00, 0.00]	[-0.00, 0.00]	[0.00, 0.01]	[0.00, 0.00]	[0.00, 0.01]	[0.00, 0.01]
Indonesia	**0.01**	**-0.00**	0.00	0.00	-0.00	**0.00**	**0.00**
	[0.01, 0.01]	[-0.00, -0.00]	[-0.00, 0.00]	[-0.00, 0.00]	[-0.00, 0.00]	[0.00, 0.00]	[0.00, 0.01]
Japan	-0.00	**0.00**	0.00	**0.00**	0.00	**0.00**	**-0.01**
	[-0.00, 0.00]	[0.00, 0.00]	[-0.00, 0.00]	[0.00, 0.00]	[-0.00, 0.00]	[0.00, 0.00]	[-0.01, -0.00]
Korea	-0.03	**0.00**	0.00	-0.00	**0.00**	**0.04**	**0.04**
	[-0.08, 0.02]	[0.00, 0.00]	[-0.00, 0.00]	[-0.00, 0.00]	[0.00, 0.00]	[0.02, 0.05]	[0.03, 0.06]
Mexico	-0.01	**0.00**	**0.00**	**0.00**	**-0.00**	**0.01**	0.00
	[-0.01, 0.00]	[0.00, 0.00]	[0.00, 0.00]	[0.00, 0.00]	[-0.00, -0.00]	[0.01, 0.01]	[-0.00, 0.00]
Norway	**0.52**	**0.01**	0.00	**0.01**	-0.09	0.02	-0.05
	[0.10, 0.94]	[0.01, 0.01]	[-0.00, 0.00]	[0.01, 0.01]	[-0.19, 0.01]	[-0.05, 0.08]	[-0.17, 0.06]
Russia	0.01	**-0.00**	0.00	0.00	-0.01	0.00	0.01
	[-0.02, 0.03]	[-0.00, -0.00]	[-0.00, 0.00]	[-0.00, 0.00]	[-0.03, 0.01]	[-0.01, 0.02]	[-0.01, 0.03]
Switzerland	-0.01	**-0.00**	**-0.00**	**0.01**	0.00	**0.10**	0.06
	[-0.16, 0.14]	[-0.00, -0.00]	[-0.00, -0.00]	[0.01, 0.01]	[-0.00, 0.00]	[0.06, 0.14]	[-0.01, 0.14]
Taiwan	**0.13**	**-0.00**	0.00	**0.02**	-0.00	**0.05**	**0.07**
	[0.11, 0.16]	[-0.00, -0.00]	[-0.00, 0.00]	[0.02, 0.02]	[-0.00, 0.00]	[0.03, 0.08]	[0.04, 0.09]
Turkey	**-0.04**	**0.00**	**0.00**	**0.03**	**0.00**	**0.03**	-0.01
	[-0.07, -0.01]	[0.00, 0.00]	[0.00, 0.00]	[0.02, 0.03]	[0.00, 0.00]	[0.02, 0.04]	[-0.02, 0.00]
USA	**-0.01**	**0.00**	**0.00**	**0.00**	**0.00**	-0.00	**-0.01**
	[-0.02, -0.01]	[0.00, 0.00]	[0.00, 0.00]	[0.00, 0.00]	[0.00, 0.00]	[-0.00, 0.00]	[-0.02, -0.01]
ROW	-0.02	**0.00**	0.00	**0.00**	**-0.00**	**0.01**	-0.02
	[-0.05, 0.01]	[0.00, 0.00]	[-0.00, 0.00]	[0.00, 0.01]	[-0.01, -0.00]	[0.00, 0.01]	[-0.05, 0.01]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets.

Table A7: Bilateral Exports of EU27, in %

	Exports to EU27		Exports to UK		Exports to ROW	
	Initial mn USD	Δ in %	Initial in mn USD	Δ in %	Initial in mn USD	Δ in %
S1						
Agriculture	126230.6	-0.24 [-0.72, 0.25]	13150.26	**-22.74** [-41.40, -4.09]	55078.38	**0.85** [0.50, 1.19]
Manufacturing	2185370	-0.14 [-0.34, 0.07]	266238	**-30.63** [-34.45, -26.81]	1726202	**1.15** [0.86, 1.44]
Services	839322.2	**-0.30** [-0.53, -0.06]	127694	**-21.21** [-24.98, -17.43]	1097312	**0.44** [0.25, 0.63]
Total	3150923	**-0.18** [-0.36, -0.01]	407082.2	**-27.42** [-30.14, -24.71]	2878593	**0.87** [0.67, 1.08]
S2						
Agriculture	126230.6	-1.34 [-2.97, 0.30]	13150.26	40.06 [-15.79, 95.91]	55078.38	-0.13 [-0.50, 0.23]
Manufacturing	2185370	-0.31 [-0.62, 0.00]	266238	-4.71 [-10.75, 1.34]	1726202	**0.35** [0.00, 0.69]
Services	839322.2	0.25 [-0.02, 0.51]	127694	**-7.55** [-13.07, -2.03]	1097312	**0.32** [0.05, 0.59]
Total	3150923	-0.20 [-0.45, 0.04]	407082.2	-4.15 [-9.03, 0.72]	2878593	**0.33** [0.07, 0.58]
S3						
Agriculture	126230.6	-0.34 [-0.84, 0.15]	13150.26	**-19.87** [-39.10, -0.64]	55078.38	**0.95** [0.54, 1.35]
Manufacturing	2185370	**-0.35** [-0.56, -0.15]	266238	**-34.35** [-38.42, -30.29]	1726202	**1.14** [0.82, 1.47]
Services	839322.2	**-0.48** [-0.72, -0.24]	127694	**-19.76** [-23.72, -15.81]	1097312	**0.37** [0.18, 0.56]
Total	3150923	**-0.39** [-0.56, -0.21]	407082.2	**-29.31** [-32.21, -26.41]	2878593	**0.84** [0.62, 1.07]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets. Domestic trade is not taken into account.

Table A8: Bilateral Exports of UK, in %

	Exports to EU27		Exports to ROW	
	Initial mn USD	Δ in %	Initial in mn USD	Δ in %
S1				
Agriculture	12761.92	-4.46	17163.94	**-6.31**
		[-37.27, 28.35]		[-8.11, -4.52]
Manufacturing	116610.8	**-32.19**	187800.8	**-10.00**
		[-38.09, -26.28]		[-11.98, -8.02]
Services	160391.2	**-20.85**	253204.4	**-0.43**
		[-26.24, -15.45]		[-0.80, -0.06]
Total	289763.9	**-24.69**	458169.1	**-4.57**
		[-28.29, -21.08]		[-5.49, -3.65]
S2				
Agriculture	12761.92	96.05	17163.94	**-7.20**
		[-14.14, 206.25]		[-9.57, -4.82]
Manufacturing	116610.8	7.16	187800.8	**-7.58**
		[-6.68, 21.00]		[-10.24, -4.93]
Services	160391.2	**-7.16**	253204.4	**-0.76**
		[-14.19, -0.13]		[-1.33, -0.20]
Total	289763.9	3.15	458169.1	**-3.80**
		[-4.83, 11.12]		[-5.15, -2.45]
S3				
Agriculture	12761.92	-6.70	17163.94	7.11
		[-38.26, 24.86]		[-5.83, 20.04]
Manufacturing	116610.8	**-32.33**	187800.8	**14.80**
		[-38.11, -26.55]		[8.30, 21.31]
Services	160391.2	**-21.33**	253204.4	**4.49**
		[-26.50, -16.16]		[2.94, 6.03]
Total	289763.9	**-25.11**	458169.1	**8.81**
		[-28.70, -21.53]		[6.07, 11.56]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets. Domestic trade is not taken into account.

Table A9: Bilateral Exports of the Rest of the World, in %

	Exports to EU27		Exports to UK		Exports to ROW	
	Initial mn USD	Δ in %	Initial in mn USD	Δ in %	Initial in mn USD	Δ in %
S1						
Agriculture	323832.4	**-1.19**	37293.41	**10.05**	1678540	**0.25**
		[-2.13, -0.25]		[1.73, 18.37]		[0.17, 0.33]
Manufacturing	1172862	**-0.91**	223334.2	**9.80**	6719728	**0.24**
		[-1.18, -0.65]		[7.46, 12.14]		[0.19, 0.29]
Services	721619.4	**-0.96**	98251.83	0.07	2389414	**0.20**
		[-1.27, -0.65]		[-0.89, 1.03]		[0.16, 0.23]
Total	2218314	**-0.97**	358879.5	**7.16**	1.08e+07	**0.23**
		[-1.23, -0.71]		[5.24, 9.08]		[0.19, 0.28]
S2						
Agriculture	323832.4	-1.96	37293.41	9.62	1678540	-0.04
		[-4.55, 0.62]		[-3.23, 22.47]		[-0.20, 0.12]
Manufacturing	1172862	**-0.68**	223334.2	1.80	6719728	0.06
		[-1.12, -0.24]		[-1.35, 4.94]		[-0.02, 0.14]
Services	721619.4	-0.33	98251.83	1.04	2389414	0.01
		[-0.67, 0.02]		[-0.37, 2.46]		[-0.05, 0.07]
Total	2218314	**-0.75**	358879.5	2.40	1.08e+07	0.03
		[-1.22, -0.28]		[-0.29, 5.09]		[-0.05, 0.11]
S3						
Agriculture	323832.4	**-1.49**	37293.41	**22.05**	1678540	**0.27**
		[-2.42, -0.55]		[11.28, 32.81]		[0.14, 0.39]
Manufacturing	1172862	**-1.35**	223334.2	**34.19**	6719728	0.03
		[-1.64, -1.06]		[28.66, 39.73]		[-0.05, 0.10]
Services	721619.4	**-1.13**	98251.83	**9.04**	2389414	**0.11**
		[-1.42, -0.83]		[6.21, 11.87]		[0.07, 0.14]
Total	2218314	**-1.30**	358879.5	**26.05**	1.08e+07	**0.08**
		[-1.58, -1.02]		[21.96, 30.13]		[0.02, 0.15]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets. Domestic trade is not taken into account.

Table A10: Changes in Gross Trade Flows in %

	Initital Exports	Changes of Exports in %			Initial Imports	Changes of Imports in %		
	mn USD	S1	S2	S3	mn USD	S1	S2	S3
EU27								
Agriculture	194459.27	**-1.45**	1.80	-1.30	462824.98	**-1.02**	0.91	**-1.32**
		[-2.80, -0.11]	[-1.23, 4.84]	[-2.67, 0.07]		[-1.49, -0.54]	[-0.30, 2.12]	[-1.77, -0.86]
Manufacturing	4.18e+06	**-1.55**	-0.32	**-1.90**	3.47e+06	**-1.48**	-0.18	**-1.76**
		[-1.80, -1.30]	[-0.70, 0.06]	[-2.16, -1.64]		[-1.63, -1.32]	[-0.46, 0.09]	[-1.92, -1.60]
Services	2.06e+06	**-1.20**	-0.20	**-1.22**	1.72e+06	**-2.49**	**-0.68**	**-2.69**
		[-1.46, -0.94]	[-0.60, 0.20]	[-1.49, -0.95]		[-2.91, -2.07]	[-1.30, -0.06]	[-3.11, -2.28]
Total	6.44e+06	**-1.43**	-0.22	**-1.67**	5.66e+06	**-1.75**	-0.25	**-2.01**
		[-2.27, -0.59]	[-2.66, 2.22]	[-2.62, -0.71]		[-2.79, -0.71]	[-1.59, 1.10]	[-2.99, -1.03]
UK								
Agriculture	29925.86	-5.52	36.83	1.22	50443.67	1.50	**17.56**	**11.12**
		[-19.64, 8.59]	[-9.66, 83.33]	[-14.70, 17.13]		[-7.01, 10.02]	[0.76, 34.35]	[1.00, 21.24]
Manufacturing	304411.58	**-18.50**	-1.94	-3.25	489572.22	**-12.19**	-1.74	**-3.08**
		[-21.23, -15.76]	[-7.27, 3.40]	[-7.57, 1.06]		[-13.65, -10.72]	[-4.25, 0.77]	[-5.17, -1.00]
Services	413595.62	**-8.35**	**-3.24**	**-5.52**	225945.80	**-11.96**	**-3.81**	**-7.24**
		[-10.44, -6.26]	[-5.93, -0.56]	[-7.62, -3.43]		[-14.09, -9.82]	[-7.05, -0.58]	[-9.64, -4.83]
Total	747933.06	-12.36	-1.11	-4.33	765961.69	-11.22	-1.08	-3.37
		[-24.80, 0.07]	[-42.83, 40.62]	[-15.28, 6.63]		[-22.82, 0.38]	[-20.09, 17.93]	[-17.67, 10.93]
ROW								
Agriculture	2.04e+06	**0.20**	-0.17	**0.39**	1.75e+06	**0.21**	-0.11	**0.35**
		[0.11, 0.29]	[-0.58, 0.24]	[0.29, 0.49]		[0.12, 0.29]	[-0.27, 0.04]	[0.20, 0.51]
Manufacturing	8.12e+06	**0.34**	0.00	**0.77**	8.63e+06	**0.20**	-0.05	**0.57**
		[0.27, 0.41]	[-0.12, 0.12]	[0.66, 0.88]		[0.17, 0.23]	[-0.13, 0.03]	[0.47, 0.67]
Services	3.21e+06	**-0.07**	-0.03	**0.10**	3.74e+06	**0.23**	0.05	**0.48**
		[-0.12, -0.01]	[-0.10, 0.03]	[0.01, 0.19]		[0.17, 0.28]	[-0.05, 0.15]	[0.37, 0.59]
Total	1.34e+07	0.22	-0.03	**0.55**	1.41e+07	**0.21**	-0.03	**0.52**
		[-0.06, 0.50]	[-0.32, 0.25]	[0.10, 1.00]		[0.14, 0.27]	[-0.20, 0.14]	[0.33, 0.71]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution.

Table A11: Changes in Real Wage, in %

	S1	S2	S3		S1	S2	S3
UK	**-3.37**	**-0.95**	**-1.78**	Portugal	**-0.45**	**-0.13**	**-0.47**
	[-3.38, -3.37]	[-0.96, -0.94]	[-1.79, -1.77]		[-0.46, -0.45]	[-0.13, -0.13]	[-0.47, -0.47]
Austria	**-0.28**	**-0.08**	**-0.29**	Romania	**-0.33**	**-0.16**	**-0.35**
	[-0.28, -0.28]	[-0.08, -0.08]	[-0.29, -0.29]		[-0.33, -0.33]	[-0.16, -0.16]	[-0.35, -0.35]
Belgium	**-1.27**	**-0.27**	**-1.31**	Slovakia	**-0.58**	**-0.28**	**-0.59**
	[-1.28, -1.27]	[-0.27, -0.27]	[-1.31, -1.30]		[-0.58, -0.58]	[-0.28, -0.28]	[-0.60, -0.59]
Bulgaria	**-0.51**	**-0.25**	**-0.51**	Slovenia	**-0.35**	**-0.15**	**-0.35**
	[-0.51, -0.51]	[-0.25, -0.24]	[-0.52, -0.51]		[-0.35, -0.34]	[-0.15, -0.15]	[-0.36, -0.35]
Croatia	**-0.30**	**-0.04**	**-0.30**	Spain	**-0.35**	**-0.13**	**-0.37**
	[-0.30, -0.30]	[-0.04, -0.04]	[-0.30, -0.30]		[-0.35, -0.35]	[-0.14, -0.13]	[-0.37, -0.37]
Cyprus	**-1.49**	**-0.37**	**-1.48**	Sweden	**-0.68**	**-0.14**	**-0.69**
	[-1.49, -1.48]	[-0.37, -0.36]	[-1.49, -1.48]		[-0.68, -0.67]	[-0.15, -0.14]	[-0.70, -0.69]
Czech R.	**-0.57**	**-0.28**	**-0.61**	Australia	0.00	0.00	**0.14**
	[-0.57, -0.57]	[-0.28, -0.28]	[-0.61, -0.60]		[-0.00, -0.00]	[-0.00, -0.00]	[0.14, 0.14]
Denmark	**-0.75**	**-0.15**	**-0.75**	Brasil	0.00	0.00	0.00
	[-0.75, -0.75]	[-0.15, -0.14]	[-0.76, -0.75]		[-0.00, -0.00]	[-0.00, -0.00]	[-0.00, -0.00]
Estonia	**-0.67**	**-0.26**	**-0.67**	Canada	0.00	**-0.01**	**0.28**
	[-0.67, -0.66]	[-0.27, -0.26]	[-0.67, -0.67]		[-0.00, -0.00]	[-0.01, -0.01]	[0.28, 0.28]
Finland	**-0.46**	**-0.08**	**-0.47**	China	0.00	0.00	**0.08**
	[-0.46, -0.46]	[-0.08, -0.08]	[-0.47, -0.47]		[0.00, 0.00]	[0.00, 0.00]	[0.08, 0.08]
France	**-0.50**	**-0.10**	**-0.52**	India	0.00	0.00	**0.18**
	[-0.50, -0.50]	[-0.10, -0.10]	[-0.52, -0.52]		[0.00, 0.00]	[-0.00, 0.00]	[0.18, 0.18]
Germany	**-0.53**	**-0.14**	**-0.55**	Indonesia	0.00	-0.00	-0.00
	[-0.53, -0.53]	[-0.14, -0.14]	[-0.55, -0.55]		[0.00, 0.00]	[-0.00, 0.00]	[-0.00, 0.00]
Greece	**-0.40**	**-0.13**	**-0.40**	Japan	0.00	**0.01**	**0.07**
	[-0.40, -0.39]	[-0.13, -0.13]	[-0.40, -0.40]		[0.00, 0.01]	[0.01, 0.01]	[0.07, 0.07]
Hungary	**-0.69**	**-0.27**	**-0.71**	Korea	**-0.08**	**-0.09**	**0.09**
	[-0.69, -0.69]	[-0.27, -0.27]	[-0.71, -0.71]		[-0.08, -0.08]	[-0.09, -0.09]	[0.09, 0.09]
Ireland	**-5.13**	**-1.59**	**-5.13**	Mexico	**-0.01**	**-0.02**	**0.04**
	[-5.13, -5.12]	[-1.60, -1.59]	[-5.14, -5.12]		[-0.01, -0.01]	[-0.02, -0.02]	[0.04, 0.04]
Italy	**-0.34**	**-0.08**	**-0.36**	Norway	**0.04**	**-0.03**	**0.08**
	[-0.34, -0.34]	[-0.08, -0.08]	[-0.36, -0.36]		[0.03, 0.04]	[-0.04, -0.02]	[0.08, 0.09]
Latvia	**-0.58**	**-0.16**	**-0.58**	Russia	**-0.02**	**-0.06**	**-0.02**
	[-0.58, -0.58]	[-0.16, -0.16]	[-0.59, -0.58]		[-0.02, -0.02]	[-0.06, -0.05]	[-0.02, -0.02]
Lithuania	**-0.42**	**-0.10**	**-0.44**	Switzerland	**-0.05**	0.00	**-0.05**
	[-0.43, -0.42]	[-0.10, -0.10]	[-0.44, -0.44]		[-0.05, -0.05]	[0.00, 0.00]	[-0.05, -0.05]
Luxembourg	**-3.61**	**0.70**	**-3.66**	Taiwan	**0.02**	**0.02**	**0.02**
	[-3.62, -3.60]	[0.69, 0.71]	[-3.67, -3.66]		[0.02, 0.03]	[0.02, 0.02]	[0.02, 0.02]
Malta	**-5.54**	**-0.81**	**-5.51**	Turkey	**-0.06**	**-0.08**	**-0.09**
	[-5.55, -5.53]	[-0.83, -0.80]	[-5.52, -5.50]		[-0.06, -0.06]	[-0.08, -0.08]	[-0.10, -0.09]
Netherlands	**-1.14**	**-0.33**	**-1.15**	USA	0.00	0.00	**0.12**
	[-1.14, -1.14]	[-0.34, -0.33]	[-1.15, -1.15]		[-0.00, -0.00]	[-0.00, -0.00]	[0.12, 0.12]
Poland	**-0.61**	**-0.23**	**-0.63**	ROW	0.00	**0.01**	**-0.01**
	[-0.61, -0.60]	[-0.23, -0.23]	[-0.63, -0.63]		[-0.00, -0.00]	[0.01, 0.01]	[-0.01, -0.01]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets.

Table A12: Changes of UK's Sectoral Value Added of Agricultural and Manufacturing Goods, in %

	initial VA in mn USD	Change of Sectoral Value Added in % S1	S2	S3
Crops & Animals	18,168	**7.87**	**6.71**	**8.30**
		[3.63, 12.11]	[0.91, 12.50]	[4.14, 12.46]
Forestry & Logging	300	-1.96	-1.28	-1.22
		[-7.28, 3.35]	[-7.47, 4.90]	[-6.59, 4.15]
Fishing & Aquaculture	1,099	**-15.83**	-7.68	-10.36
		[-27.09, -4.56]	[-27.12, 11.76]	[-22.42, 1.71]
Mining & Quarrying	43,315	**-7.93**	8.22	-3.60
		[-14.07, -1.79]	[-9.03, 25.48]	[-10.54, 3.33]
Food, Beverages & Tobacco	47,220	1.86	**2.39**	**3.50**
		[-0.84, 4.55]	[0.21, 4.57]	[0.95, 6.04]
Textiles, Apparel,Leather	10,096	**-6.82**	-2.97	**-10.62**
		[-10.17, -3.47]	[-7.70, 1.76]	[-15.84, -5.39]
Wood & Cork	4,056	0.43	-3.86	-1.78
		[-5.22, 6.08]	[-12.01, 4.29]	[-7.91, 4.34]
Paper	7,484	0.81	0.36	1.00
		[-5.49, 7.12]	[-6.77, 7.48]	[-5.37, 7.36]
Recorded Media Reproduction	8,128	**-1.13**	1.10	0.55
		[-1.94, -0.31]	[-0.38, 2.59]	[-0.37, 1.47]
Coke, Refined Petroleum	7,602	4.13	18.84	**19.89**
		[-10.10, 18.35]	[-14.06, 51.75]	[0.11, 39.66]
Chemicals	16,774	**-5.71**	0.34	**-4.12**
		[-8.85, -2.58]	[-4.15, 4.84]	[-7.67, -0.58]
Pharmaceuticals	22,050	-3.08	-5.82	**-11.94**
		[-10.73, 4.57]	[-14.87, 3.23]	[-21.46, -2.41]
Rubber & Plastics	16,810	-0.68	0.93	0.66
		[-2.26, 0.90]	[-1.03, 2.89]	[-1.28, 2.61]
Other non-Metallic Mineral	8,577	-1.01	0.94	0.71
		[-2.24, 0.22]	[-0.51, 2.40]	[-0.53, 1.96]
Basic Metals	7,651	**-16.95**	**-9.73**	-6.11
		[-23.43, -10.47]	[-16.10, -3.36]	[-13.20, 0.98]
Fabricated Metal	28,099	-0.49	1.44	**2.63**
		[-2.14, 1.17]	[-0.28, 3.17]	[0.83, 4.43]
Electronics & Optical Products	19,366	-3.05	-2.15	-6.60
		[-10.83, 4.72]	[-11.46, 7.17]	[-15.11, 1.92]
Electrical Equipment	8,910	**-8.48**	-0.35	**-8.93**
		[-12.88, -4.07]	[-6.79, 6.09]	[-13.93, -3.93]
Machinery & Equipment	32,117	**-6.86**	-3.93	-4.11
		[-11.18, -2.54]	[-8.87, 1.01]	[-8.63, 0.41]
Motor Vehicles	20,517	-2.52	-1.49	**5.13**
		[-7.15, 2.11]	[-8.46, 5.49]	[0.17, 10.10]
Other Transport Equipment	17,066	-2.80	11.80	**23.45**
		[-7.70, 2.11]	[-0.21, 23.81]	[4.48, 42.43]
Furniture & Other Manufacturing	16,106	-3.10	-1.29	-2.29
		[-6.72, 0.53]	[-4.46, 1.87]	[-6.45, 1.87]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets.

Table A13: Changes of UK's Sectoral Value Added of Services, in %

	initial VA in mn USD	Change of Sectoral Value Added in % **S1**	**S2**	**S3**
Electricity & Gas	43,740	**-1.08**	0.67	**0.99**
		[-1.74, -0.42]	[-0.49, 1.84]	[0.14, 1.85]
Water Supply	8,828	**-0.67**	0.46	**0.91**
		[-1.29, -0.05]	[-0.63, 1.54]	[0.14, 1.68]
Sewerage & Waste	21,167	**-1.72**	-0.79	-0.84
		[-3.15, -0.30]	[-2.70, 1.11]	[-3.24, 1.56]
Construction	179,017	-0.46	0.87	**1.15**
		[-1.10, 0.19]	[-0.24, 1.98]	[0.34, 1.95]
Trade & Repair of Motor Vehicles	52,638	**-2.14**	-0.74	0.38
		[-3.23, -1.04]	[-2.25, 0.78]	[-0.79, 1.56]
Wholesale Trade	87,853	**-7.91**	**-6.50**	**-5.40**
		[-11.18, -4.65]	[-10.11, -2.89]	[-8.60, -2.20]
Retail Trade	151,457	-0.60	0.49	**1.01**
		[-1.23, 0.03]	[-0.52, 1.51]	[0.25, 1.77]
Land Transport	52,683	**-1.86**	-0.58	-0.30
		[-2.68, -1.04]	[-1.77, 0.62]	[-1.24, 0.64]
Water Transport	11,472	0.78	-1.00	0.97
		[-0.63, 2.20]	[-3.90, 1.90]	[-0.47, 2.40]
Air Transport	14,985	-0.84	-0.25	0.49
		[-2.59, 0.90]	[-2.37, 1.87]	[-1.35, 2.33]
Aux. Transportation Services	30,772	**-3.28**	**-2.08**	**-1.76**
		[-4.45, -2.12]	[-3.45, -0.70]	[-2.99, -0.52]
Postal and Courier	19,150	0.03	**1.71**	**1.41**
		[-0.93, 1.00]	[0.41, 3.02]	[0.40, 2.41]
Accommodation & Food	85,664	**-0.76**	0.47	0.53
		[-1.37, -0.16]	[-0.42, 1.35]	[-0.18, 1.24]
Publishing	17,750	**-1.59**	-0.73	-0.64
		[-2.58, -0.60]	[-2.02, 0.56]	[-1.66, 0.39]
Media Services	23,527	**-1.77**	-0.54	-0.67
		[-2.77, -0.76]	[-2.14, 1.06]	[-1.76, 0.43]
Telecommunications	46,927	-0.65	0.62	0.64
		[-2.46, 1.15]	[-1.58, 2.82]	[-1.20, 2.47]
Computer & Information Services	78,127	**-0.64**	**1.02**	**0.89**
		[-1.27, -0.01]	[0.00, 2.04]	[0.14, 1.64]
Financial Services	125,534	0.38	**1.78**	**1.43**
		[-0.51, 1.27]	[0.39, 3.17]	[0.50, 2.35]
Insurance	109,604	1.17	**3.17**	2.29
		[-1.15, 3.49]	[0.07, 6.27]	[-0.07, 4.65]
Real Estate	303,820	-0.35	0.73	**1.09**
		[-0.97, 0.28]	[-0.33, 1.78]	[0.32, 1.87]
Legal & Accounting	96,495	**-1.51**	0.66	0.74
		[-2.57, -0.44]	[-0.86, 2.18]	[-0.44, 1.92]
Business Services	87,560	**-2.57**	0.51	0.78
		[-3.69, -1.45]	[-0.92, 1.95]	[-0.50, 2.06]
Research & Development	15,230	-0.68	0.41	0.52
		[-1.66, 0.30]	[-0.77, 1.60]	[-0.55, 1.60]
Admin. & Support Services	128,914	-0.17	1.47	1.16
		[-2.35, 2.00]	[-1.10, 4.04]	[-1.10, 3.41]
Public & Social Services	154,785	**-0.59**	0.61	**0.93**
		[-1.18, -0.01]	[-0.39, 1.62]	[0.19, 1.66]
Education	171,370	**-0.66**	0.49	**0.84**
		[-1.23, -0.10]	[-0.47, 1.45]	[0.12, 1.56]
Human Health & Social Work	199,282	-0.52	0.60	**0.94**
		[-1.11, 0.06]	[-0.41, 1.61]	[0.21, 1.67]
Other Services, Households	120,406	-0.22	0.89	0.80
		[-1.19, 0.74]	[-0.42, 2.20]	[-0.33, 1.94]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets.

Table A14: Changes of EU27's Sectoral Value Added of Agricultural and Manufacturing Goods, in %

	initial VA in mn USD	Change of Sectoral Value Added in % S1	S2	S3
Crops & Animals	221,514	**-1.36**	**-0.70**	**-1.46**
		[-1.65, -1.08]	[-1.14, -0.25]	[-1.75, -1.18]
Forestry & Logging	29,863	**-0.52**	0.04	**-0.63**
		[-0.85, -0.20]	[-0.38, 0.47]	[-0.97, -0.29]
Fishing & Aquaculture	7,486	1.08	0.91	1.00
		[-0.29, 2.45]	[-1.21, 3.04]	[-0.35, 2.36]
Mining & Quarrying	78,597	**2.51**	**5.86**	**2.75**
		[0.46, 4.56]	[1.48, 10.24]	[0.60, 4.89]
Food, Beverages & Tobacco	311,327	**-1.55**	**-0.53**	**-1.67**
		[-1.94, -1.15]	[-0.90, -0.16]	[-2.07, -1.28]
Textiles, Apparel,Leather	83,953	-0.38	0.93	**-0.83**
		[-1.05, 0.29]	[-0.22, 2.08]	[-1.53, -0.14]
Wood & Cork	44,213	**-0.72**	0.16	**-0.88**
		[-1.19, -0.26]	[-0.54, 0.87]	[-1.36, -0.41]
Paper	55,968	**-0.83**	-0.29	**-0.88**
		[-1.57, -0.08]	[-1.15, 0.56]	[-1.64, -0.12]
Recorded Media Reproduction	40,974	**-0.47**	**-0.23**	**-0.62**
		[-0.61, -0.33]	[-0.46, -0.01]	[-0.77, -0.47]
Coke, Refined Petroleum	60,143	-0.44	2.02	-0.82
		[-1.52, 0.64]	[-0.25, 4.29]	[-1.87, 0.23]
Chemicals	178,271	**-1.10**	**-0.64**	**-1.33**
		[-1.42, -0.79]	[-1.05, -0.24]	[-1.66, -1.01]
Pharmaceuticals	121,944	-0.67	**-2.16**	-0.02
		[-2.38, 1.04]	[-3.70, -0.61]	[-1.93, 1.89]
Rubber & Plastics	113,713	**-1.16**	**-0.49**	**-1.37**
		[-1.39, -0.93]	[-0.81, -0.17]	[-1.62, -1.12]
Other non-Metallic Mineral	84,895	**-0.70**	**-0.23**	**-0.84**
		[-0.85, -0.54]	[-0.42, -0.04]	[-0.99, -0.69]
Basic Metals	91,464	**-0.43**	-0.14	**-0.74**
		[-0.79, -0.07]	[-0.60, 0.32]	[-1.12, -0.37]
Fabricated Metal	220,110	**-0.79**	**-0.26**	**-1.00**
		[-0.97, -0.61]	[-0.47, -0.05]	[-1.20, -0.81]
Electronics & Optical Products	126,896	**-1.73**	**-2.69**	**-1.48**
		[-2.54, -0.92]	[-3.58, -1.80]	[-2.33, -0.63]
Electrical Equipment	124,261	**-0.60**	-0.25	**-1.18**
		[-1.09, -0.10]	[-0.88, 0.38]	[-1.66, -0.71]
Machinery & Equipment	381,086	-0.12	-0.24	-0.16
		[-0.55, 0.30]	[-0.67, 0.19]	[-0.61, 0.28]
Motor Vehicles	249,064	**-1.57**	-0.21	**-2.24**
		[-2.03, -1.10]	[-0.84, 0.42]	[-2.74, -1.73]
Other Transport Equipment	68,303	-0.77	1.22	**-3.86**
		[-1.87, 0.33]	[-0.69, 3.14]	[-5.85, -1.87]
Furniture & Other Manufacturing	103,874	-0.27	**-0.58**	-0.05
		[-0.88, 0.34]	[-1.14, -0.01]	[-0.76, 0.67]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets.

Table A15: Changes of EU27's Sectoral Value Added of Services, in %

	initial VA in mn USD	Change of Sectoral Value Added in % S1	S2	S3
Electricity & Gas	284,959	**-0.67**	-0.12	**-0.86**
		[-0.77, -0.57]	[-0.27, 0.02]	[-0.96, -0.75]
Water Supply	37,499	**-0.61**	-0.07	**-0.80**
		[-0.71, -0.51]	[-0.21, 0.08]	[-0.90, -0.70]
Sewerage & Waste	99,891	**-0.62**	-0.14	**-0.79**
		[-0.84, -0.41]	[-0.38, 0.10]	[-1.00, -0.58]
Construction	751,630	**-0.70**	**-0.18**	**-0.89**
		[-0.80, -0.60]	[-0.31, -0.04]	[-1.00, -0.79]
Trade & Repair of Motor Vehicles	209,725	**-0.45**	0.09	**-0.69**
		[-0.70, -0.20]	[-0.22, 0.41]	[-0.94, -0.44]
Wholesale Trade	762,831	0.05	**0.51**	-0.10
		[-0.31, 0.42]	[0.11, 0.90]	[-0.46, 0.26]
Retail Trade	600,221	**-0.65**	-0.14	**-0.83**
		[-0.77, -0.53]	[-0.29, 0.01]	[-0.96, -0.71]
Land Transport	357,195	**-0.51**	-0.01	**-0.68**
		[-0.61, -0.41]	[-0.15, 0.13]	[-0.78, -0.57]
Water Transport	42,166	**-0.41**	0.33	**-0.52**
		[-0.71, -0.12]	[-0.37, 1.03]	[-0.83, -0.21]
Air Transport	43,027	**-0.62**	0.06	**-0.68**
		[-1.20, -0.04]	[-0.67, 0.78]	[-1.28, -0.08]
Aux. Transportation Services	266,620	**-0.39**	0.06	**-0.55**
		[-0.49, -0.28]	[-0.07, 0.19]	[-0.66, -0.43]
Postal & Courier	60,266	**-0.86**	**-0.48**	**-1.01**
		[-1.09, -0.64]	[-0.77, -0.19]	[-1.23, -0.78]
Accommodation & Food	407,634	**-0.57**	**-0.15**	**-0.75**
		[-0.67, -0.47]	[-0.28, -0.03]	[-0.86, -0.64]
Publishing	79,566	**-0.82**	-0.18	**-0.96**
		[-1.02, -0.63]	[-0.42, 0.06]	[-1.16, -0.76]
Media Services	73,756	-0.17	0.15	**-0.34**
		[-0.44, 0.09]	[-0.26, 0.55]	[-0.60, -0.09]
Telecommunications	185,217	**-0.68**	-0.17	**-0.82**
		[-1.09, -0.27]	[-0.68, 0.34]	[-1.23, -0.40]
Computer & Information Services	315,976	**-0.43**	**-0.23**	**-0.56**
		[-0.53, -0.32]	[-0.38, -0.07]	[-0.67, -0.45]
Financial Services	498,840	**-0.78**	**-0.43**	**-0.94**
		[-0.95, -0.60]	[-0.69, -0.16]	[-1.11, -0.76]
Insurance	249,245	**-0.94**	**-0.61**	**-1.09**
		[-1.35, -0.52]	[-1.17, -0.06]	[-1.50, -0.69]
Real Estate	1,574,061	**-0.67**	**-0.17**	**-0.85**
		[-0.77, -0.57]	[-0.30, -0.04]	[-0.96, -0.75]
Legal & Accounting	439,618	**-0.46**	-0.05	**-0.62**
		[-0.63, -0.28]	[-0.27, 0.17]	[-0.79, -0.44]
Business Services	328,994	**-0.39**	-0.12	**-0.58**
		[-0.60, -0.18]	[-0.36, 0.12]	[-0.79, -0.38]
Research & Development	121,236	**-0.56**	-0.12	**-0.73**
		[-0.69, -0.43]	[-0.28, 0.05]	[-0.87, -0.60]
Admin. & Support Services	581,599	**-0.77**	-0.37	**-0.90**
		[-1.19, -0.35]	[-0.84, 0.11]	[-1.33, -0.47]
Public & Social Services	993,571	**-0.67**	**-0.15**	**-0.87**
		[-0.78, -0.57]	[-0.28, -0.02]	[-0.97, -0.76]
Education	731,363	**-0.68**	-0.14	**-0.87**
		[-0.79, -0.58]	[-0.27, 0.00]	[-0.98, -0.76]
Human Health and Social Work	1,096,971	**-0.71**	-0.14	**-0.91**
		[-0.82, -0.61]	[-0.28, 0.00]	[-1.02, -0.80]
Other Services, Households	504,146	**-0.70**	-0.21	**-0.89**
		[-0.88, -0.52]	[-0.43, 0.00]	[-1.07, -0.70]

Note: The baseline year is 2014. Bold characters indicate significance at the 10%-level based on 1,000 replications and an approximate normal distribution. Confidence intervals in square brackets.

Table A16: Sectoral Elasticities from Caliendo & Parro (2015)

Sector ID	Sector Name	Trade Elasticity
1	Crops & Animals	8.11
2	Forestry & Logging	8.11
3	Fishing & Aquaculture	8.11
4	Mining & Quarrying	15.72
5	Food, Beverages & Tobacco	2.55
6	Textiles, Apparel,Leather	5.56
7	Wood & Cork	10.83
8	Paper	9.07
9	Recorded Media Reproduction	9.07
10	Coke, Refined Petroleum	51.08
11	Chemicals	4.75
12	Pharmaceuticals	4.75
13	Rubber & Plastics	1.66
14	Other Non-Metallic Mineral	2.76
15	Basic Metals	7.99
16	Fabricated Metal	4.3
17	Electronics & Optical Products	10.60
18	Electrical Equipment	10.60
19	Machinery & Equipment	1.52
20	Motor Vehicles	1.01
21	Other Transport Equipment	0.37
22	Furniture & Other Manufacturing	5.00
23	Electricity & Gas	5.00
24	Water Supply	5.00
25	Sewerage & Waste	5.00
26	Construction	5.00
27	Trade & Repair of Motor Vehicles	5.00
28	Wholesale Trade	5.00
29	Retail Trade	5.00
30	Land Transport	5.00
31	Water Transport	5.00
32	Air Transport	5.00
33	Aux. Transportation Services	5.00
34	Postal and Courier	5.00
35	Accommodation & Food	5.00
36	Publishing	5.00
37	Media Services	5.00
38	Telecommunications	5.00
39	Computer & Information Services	5.00
40	Financial Services	5.00
41	Insurance	5.00
42	Real Estate	5.00
43	Legal and Accounting	5.00
44	Business Services	5.00
45	Research and Development	5.00
46	Admin. & Support Services	5.00
47	Public & Social Services	5.00
48	Education	5.00
49	Human Health and Social Work	5.00
50	Other Services, Households	5.00

Table A17: Change in Real Consumption, in %

Elasticities:	Services = 5	Caliendo & Parro (2015)		Services = 5	Caliendo & Parro (2015)
UK	**-1.17**	**-3.27**	Portugal	**-0.16**	**-0.24**
	[-1.65, -0.68]	[-3.95, -2.59]		[-0.18, -0.13]	[-0.27, -0.20]
Austria	**-0.15**	**-0.20**	Romania	**-0.14**	**-0.19**
	[-0.16, -0.13]	[-0.24, -0.17]		[-0.16, -0.12]	[-0.22, -0.17]
Belgium	**-0.49**	**-0.72**	Slovakia	**-0.48**	**-0.46**
	[-0.55, -0.42]	[-0.82, -0.62]		[-0.58, -0.39]	[-0.54, -0.39]
Bulgaria	**-0.17**	**-0.25**	Slovenia	**-0.17**	**-0.22**
	[-0.21, -0.14]	[-0.28, -0.22]		[-0.19, -0.15]	[-0.25, -0.19]
Croatia	**-0.13**	**-0.15**	Spain	**-0.17**	**-0.22**
	[-0.16, -0.10]	[-0.21, -0.09]		[-0.19, -0.14]	[-0.27, -0.18]
Cyprus	**-0.48**	**-0.82**	Sweden	**-0.23**	**-0.40**
	[-0.63, -0.34]	[-1.01, -0.63]		[-0.28, -0.19]	[-0.47, -0.34]
Czech R.	**-0.33**	**-0.40**	Australia	**-0.01**	**-0.02**
	[-0.37, -0.30]	[-0.44, -0.36]		[-0.01, -0.00]	[-0.02, -0.01]
Denmark	**-0.30**	**-0.40**	Brazil	**-0.00**	**-0.01**
	[-0.35, -0.26]	[-0.45, -0.35]		[-0.00, -0.00]	[-0.01, -0.00]
Estonia	**-0.25**	**-0.39**	Canada	0.00	**-0.02**
	[-0.34, -0.17]	[-0.47, -0.32]		[-0.00, 0.01]	[-0.03, -0.01]
Finland	**-0.16**	**-0.29**	China	**0.03**	**0.02**
	[-0.19, -0.13]	[-0.35, -0.23]		[0.02, 0.03]	[0.02, 0.03]
France	**-0.21**	**-0.27**	India	**0.01**	-0.00
	[-0.24, -0.18]	[-0.31, -0.22]		[0.01, 0.01]	[-0.01, 0.01]
Germany	**-0.32**	**-0.36**	Indonesia	**0.01**	**0.00**
	[-0.35, -0.29]	[-0.44, -0.28]		[0.00, 0.01]	[0.00, 0.01]
Greece	**-0.13**	**-0.19**	Japan	**0.00**	**-0.00**
	[-0.16, -0.10]	[-0.23, -0.16]		[0.00, 0.01]	[-0.01, -0.00]
Hungary	**-0.35**	**-0.42**	Korea	0.00	-0.06
	[-0.38, -0.32]	[-0.46, -0.38]		[-0.03, 0.04]	[-0.29, 0.16]
Ireland	**-2.94**	**-4.40**	Mexico	0.00	**-0.01**
	[-3.22, -2.66]	[-4.70, -4.10]		[-0.00, 0.00]	[-0.02, -0.01]
Italy	**-0.17**	**-0.22**	Norway	**0.47**	0.08
	[-0.19, -0.15]	[-0.26, -0.18]		[0.27, 0.67]	[-0.06, 0.23]
Latvia	**-0.23**	**-0.30**	Russia	0.00	**-0.03**
	[-0.32, -0.13]	[-0.37, -0.23]		[-0.01, 0.02]	[-0.05, -0.02]
Lithuania	**-0.17**	**-0.36**	Switzerland	0.03	**-0.08**
	[-0.22, -0.12]	[-0.42, -0.29]		[-0.01, 0.07]	[-0.15, -0.00]
Luxembourg	-0.97	-0.96	Taiwan	**0.07**	**0.08**
	[-2.64, 0.70]	[-2.60, 0.68]		[0.06, 0.08]	[0.08, 0.09]
Malta	**-2.55**	**-2.77**	Turkey	0.01	**-0.08**
	[-3.52, -1.58]	[-3.65, -1.89]		[-0.01, 0.03]	[-0.10, -0.05]
Netherlands	**-0.67**	**-0.86**	USA	**-0.01**	**-0.02**
	[-0.74, -0.60]	[-0.94, -0.77]		[-0.01, -0.01]	[-0.02, -0.01]
Poland	**-0.31**	**-0.39**	ROW	-0.00	-0.01
	[-0.34, -0.28]	[-0.43, -0.35]		[-0.01, 0.00]	[-0.03, 0.00]
EU27	**-0.31**	**-0.41**			
	[-0.35, -0.28]	[-0.46, -0.35]			
ROW	**0.01**	**-0.01**			
	[0.00, 0.01]	[-0.02, -0.00]			

Note: The baseline year is 2014. Mean effects and [p5,p95] intervals. Bold characters indicate significance at the 10%-level based on 1,000 bootstrap replications. Confidence intervals in square brackets. The results for EU27 and ROW are calculated as GDP weighted averages. Caliendo & Parro (2015) results use elasticities from Table A16 and tariff adjusted imports in all goods sectors in the underlying gravity estimations to back out NTB changes.