Post-Brexit trade survival: Looking beyond the European Union

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Abstract

As the EU and UK negotiate a new relationship, this paper explores the welfare implications of this policy change and its interaction with major trade policy initiatives. We evaluate five Brexit scenarios, based on different assumptions regarding Brexit, TTIP and various free trade deals the UK may attempt to broker with the US or Commonwealth countries. We also consider the dynamics of welfare changes over a period of two decades. Our estimates suggest that the impact of Brexit is negative in all policy scenarios, with lower welfare losses under a soft Brexit scenario. The losses are exacerbated if TTIP comes into force, demonstrating the benefits of being a member of a large trade bloc. However, they occur gradually and can be partially compensated by signing new free trade agreements. To further minimise losses, the UK should avoid a hard Brexit.

JEL codes: F13, F15, F17

Keywords*:* Brexit, Transatlantic Trade and Investment Partnership, Gravity, UK, EU

1. Introduction

During the last century, the UK has transitioned from global trade power to 'awkward partner' in the EU; then most recently an outright rejection of EU membership. Following these events, a new wave of academic literature exploring the potential impact of Brexit has started to emerge (Ottaviano et

al., 2014; Dhingra et al., 2016; 2017, Ebell et al., 2016).[1] These nationalist tendencies are in contrast to the moves towards forming mega-regionals, where the EU negotiating team have been provided with a mandate to negotiate the Transatlantic Trade and Investment Partnership (TTIP) with the US.[2] Therefore, research exploring the effects of TTIP has also started to emerge (Francois et al., 2013; Egger et al., 2015; Felbermayr et al., 2015; Disdier et al. , 2016).[3] For the UK, its withdrawal from the EU is expected to exclude it from any TTIP deal. In addition, there have been mixed messages about the likelihood of restarting the TTIP negotiations and if the EU would be in front of the UK (US-UK FTA) in the queue.

Our contribution is to cut across these separate strands of literature and in doing so we assess the UK position in terms of TTIP and Brexit scenarios. We also go further than the existing Brexit literature by modelling future Commonwealth trade relationships as well as a possible US-UK FTA after Brexit. The main channel of welfare effects that we consider comes from the general equilibrium effect of changes in trade costs. Our analysis adopts an emerging research framework, which allows us to predict the impact of policy changes at the extensive and intensive margins, where this two-step methodology has not been applied within the Brexit literature. Given the uncertain outcomes and lack of detail regarding potential policy

[1] Dhingra et al. (2017) estimate welfare losses of 1.3 percent in a static model with 'soft Brexit' compared to 9.4 percent in a dynamic model with 'hard' Brexit. On the other hand, Ebel et al. estimate that real income will fall by 2.7 percent in the long run. For broad and comprehensive summary of Brexit literature, including future UK trade policy options and Brexit consequences for the UK and EU, please see Sampson (2017).

[2] The term mega-regionals refers to the TTIP, TPP and Regional Comprehensive Economic Partnership (RCEP).

[3] Felbermayr et al. predict gains of 3.9% for the EU, where Francoise et al. estimate a more moderate 0.48%. Furthermore, Felbermayr et al. expect third countries, outside the TTIP, to lose 0.9% due to trade diversion. Egger et al. suggest that the negative impact on third countries is likely to be exacerbated by a more discriminatory TTIP agreement. Disdier et al. investigate the interplay of the TTIP and Trans-Pacific Partnership (TPP) in terms of agriculture.

changes concerning TTIP and Brexit, it is problematic to pin down the changes in tariffs and non-tariff measures. We deal with this issue by considering 'soft' and 'hard' Brexit scenarios, which are evaluated based on actual data for trade effects of regional trade agreements (RTA) in general, and customs unions (CU) and free trade agreements (FTA) in particular, in 162 countries over the period 1960-2014. We also look at the dynamics of RTA effects on trade, conditional on its duration and decade, then incorporate it in our welfare analysis. Our underlying assumption is that effects of future trade agreements can be inferred from the effects of existing trade agreements. If, as some would argue, the TTIP goes further than the previous RTAs in terms of lowering trade costs and reducing waste of resources due to harmonization of actionable NTMs (see Berden et al., 2009), our baseline estimates would indicate a conservative lower bound.

This paper will highlight the losses stemming from the lower bargaining power of the UK as a stand alone country, rather than as a member of a powerful trading bloc.[4] We will also highlight that signing FTAs with more remote countries, such as the US or Commonwealth countries (Australia, Canada, New Zealand, India, Pakistan, South Africa) cannot compensate for these losses, as some commentators suggest. In case of a 'hard' Brexit, the TTIP would generate additional welfare losses for the UK equal to 0.5-2 percent of GDP. On the other hand, our results for the soft Brexit scenario indicate that the UK would experience welfare losses of approximately 3.1 percent if the TTIP comes into force alongside the UK withdrawal from the EU. The negative effect of Brexit alone is 2.7 percent. Signing an FTA with

[4] "The US government has proposed slapping punitive tariffs on Bombardier, a Canadian aircraft maker with operations in Northern Ireland. … The Bombardier case gives the lie to the notion that, outside the EU, the UK will find the behaviour of its leading non-European trade partners more benign." Financial Times, "Bombardier exposes post-Brexit realities", September 28, 2017 by Tony Barber.

the US or large Commonwealth countries would lower welfare losses by approximately 0.65 to 1.1 percent, depending on the scenario. A 'hard' Brexit would generate losses from 4.1 to 5.3 percent. These results are robust to various levels of TTIP impact on trade (as long as they are positive), external effects of higher economic growth caused by TTIP, and alternative definitions of Brexit.

We also run a number of robustness checks. First, we present evidence of heterogeneous effects of different types of RTAs on trade, which is related to extent that NTMs go beyond tariffs. Second, we consider how additional waste of resources due to NTMs and border controls influences welfare (see Baldwin et al., 1997).[5] Finally, we perform a sensitivity analysis by changing our assumptions about the trade creating effect of TTIP and its impact on economic growth.

There are two counteracting tendencies that should be taken into account when interpreting welfare gains. First, even the 'hard' Brexit scenario would not cause abrupt welfare losses and the catastrophic decline of trade flows between the EU and UK. These changes would occur gradually. However, RTAs (especially CUs and the EU in particular) had the strongest trade creating effect over the last 50 years, which would indicate that the welfare losses from Brexit are likely to be higher and the welfare gains of TTIP would increase over time.

The rest of the paper is organized as follows. Section 2 presents an overview of the evolution of the multilateral framework and the mega-regionals in the context of the UK. Section 3 discusses potential trade policy

[5] "Whitehall is planning to hire another 2,000 staff to deal specifically with Brexit in a sign of how its resources are being diverted towards the challenges of leaving the EU." Financial Times, "Ministers haggle over 2,000 new staff as Brexit tests civil service", October 12, 2017, by Jim Pickard and George Parker.

scenarios. Section 4 outlines the methodology and data, where Section 5 discusses the results of the analysis. Section 6 performs robustness checks. Finally, Section 7 concludes.

2. Multilateral negotiations and mega-regionals

History plays an important role in determining trade (Eichengreen and Irwin, 1998). Krasner (1976) emphasised the role of past decisions and policies, with particular reference to the UK and US as architects of the international trade structure. In the aftermath of World War II (WWII) the trade environment featured entrenched protectionist positions, following the market failure of the inter-war years (Irwin, 2011). The best case of global free trade, as proposed by neoclassical trade economists, was infeasible. Hence, national objectives including economic growth and political power were key issues. By the end of WWII, the UK's position as the dominant global trade power was overtaken by the US. During this period, there was a broad acceptance of the 'trade promotes peace' hypothesis (Anderton and Carter, 2001; Hull, 1948). Therefore, these two powerful states attempted to balance their interests in terms of political strength and a desire for global stability. Hence, reeling from conflict, the states looked to reduce trade barriers. However, perhaps inevitably, they remained unable to ignore national interests (Mavroidis et al., 2009).

Multilateralism held considerable appeal for policy makers looking to reverse the economic failures of the inter-war period. This was both in terms of promoting peace as well as swifter liberalisation than what was likely from negotiating separate bilateral deals. The US and UK policy makers dominated discussions that led to the signing of the GATT, the precursor to

the WTO (Toye, 2003). A range of concerns, including imperial preferences and promotion of the capitalist model, promoted legitimising FTAs and CUs within the GATT (Article XXIV, GATT). Despite the concessions regarding imperial preferences, from the 1950s, UK trade reoriented away from their (former) colonies towards European trade partners (Anderson and Norheim, 1993). More generally, Article XXIV permitted the segmentation of the world into overlapping trading blocks, where almost every country is a member of at least one RTA. Multilateral negotiations initially focussed on tariffs then as the attention moved towards NTBs, and regulation in particular, agreements proved more difficult. Low (2015) argued that the Article XXIV concession was pivotal. Therefore, this original compromise is key to understanding the current issues facing the WTO.

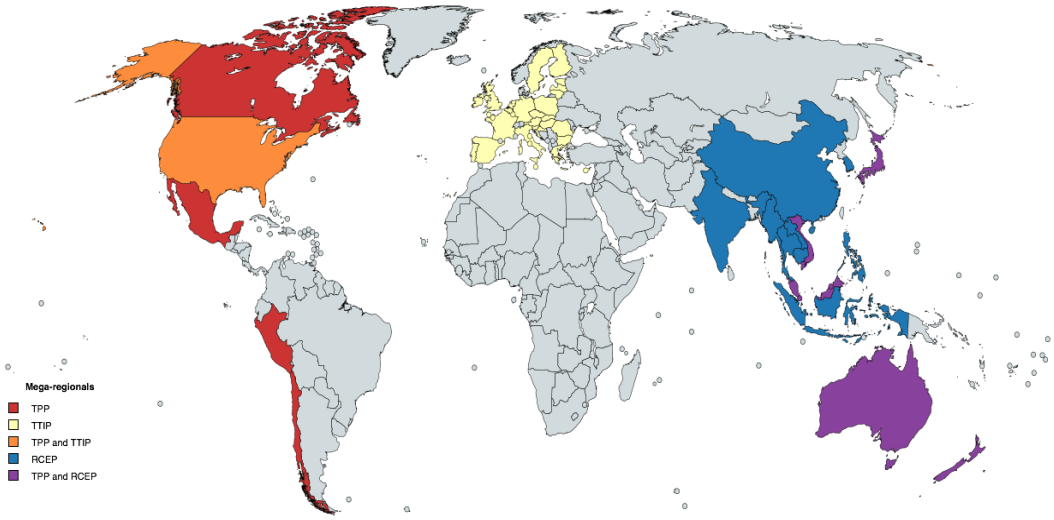
Recently, the WTO has struggled to provide an effective multilateral negotiating framework (Azevêdo, 2016; Froman, 2015; Wilkinson, 2002). This vacuum and the emergence of the BRICS (Brazil, Russia, India, China and South Africa) countries as key players in the global economy provided fertile ground for the development of the mega-regionals (Figure 1). These new groupings provide a much greater challenge to the WTO than their predecessors, which were geographically localised and considerably smaller. Furthermore, the mega-regionals are looking to address regulatory barriers, which have proved difficult to deal with on a multilateral basis. The WTO's inability to meaningfully regulate RTAs, where the seed was sown during the inception of the GATT, suggests that the WTO will not block the formation of the mega-regionals. Moreover, there are suggestions that the WTO may view mega-regions as a stepping-stone towards multilateral liberalisation (Schott, 2014).

Negotiating these blocks requires large-scale trade diplomacy and prolonged discussions. This makes the US's recent withdrawal from the TPP and suspension of the TTIP talks particularly unwelcome. Since WWII, the key players have shifted from the US and UK to the US and China. The US is witnessing a decline in its position, not unlike the UK in the early 20th century. Where the UK attempted to retain its strong position by arguing for imperial preferences, similarly, the US is looking to its historical partnerships (and potentially, mega-deals) to tackle the growing strength of China. However, we should not underestimate the importance of the EU trading bloc, where Fan et al. (2014) use network analysis to find that disconnecting EU exports from Japan or the US would lead to the collapse of the world trade system. Therefore, the mega-regionals/blocs have formed an important part of the geopolitical 'game'. These mega arrangements are likely to impose rules on those countries outside the blocks, suggesting that been outside one of the three clubs could prove costly (Li et al., 2016).

The EU also shares the US concerns regarding the growing importance of China. They have been engaged in extensive negotiations towards a new China-EU Investment Agreement, which may turn into a China-EU FTA. Furthermore, EU members fear a US-Asia powerhouse from which they would be excluded. The TPP was signed 4 February 2016, providing an incentive for the TTIP negotiations to forge ahead (until recently). The main points of contention include agricultural subsidies, services (i.e. audio and visual, financial), food safety and environment, labour standards, investor-to-state dispute settlement system and public procurement. EU and US levels of GDP and trade make this a formidable arrangement (Akhtar and Jones, 2014). However, the process has been

plagued with controversy, leaving the Commission to insist that they are engaging with the public as openly as possible (Malmström, 2015). Supporters of the TTIP claim that it may raise welfare in the EU and US through increases in productivity and higher consumer surplus. Opponents argue that the welfare gains would be small, while the effects on standards in the labour market, health and safety in product markets, and environmental standards may outweigh the benefits (Pitlik, 2016).

Figure 1: Mega-regionals



Source: Authors work

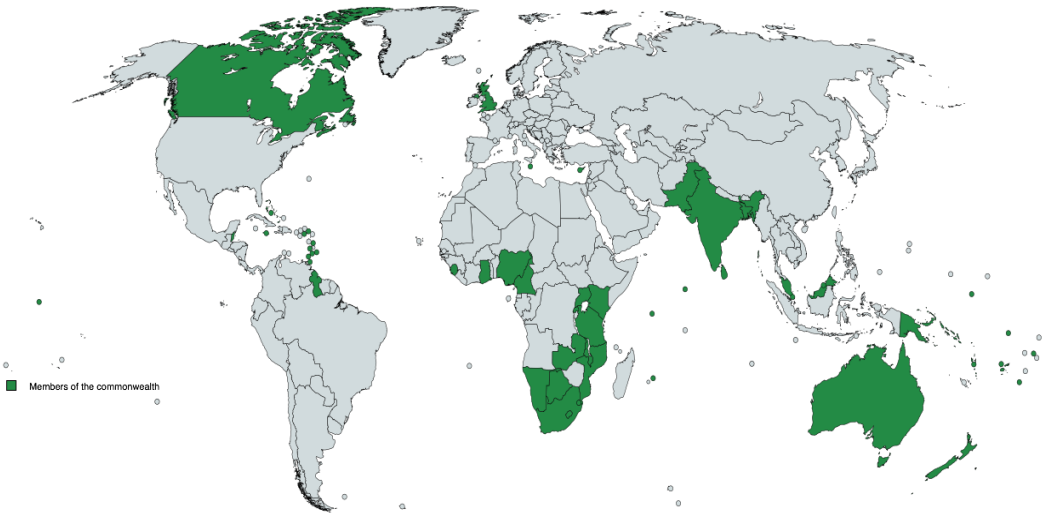
Notes:
1/ TPP: countries only included in this mega-regional arrangement
2/ TTIP: countries only included in this mega-regional arrangement
3/ TPP and TTIP: countries included in both arrangements
4/ RCEP: countries only included in this mega-regional arrangement
5/ TPP and RCEP: countries included in both arrangements

Meanwhile, UK trade negotiations have been integrated and subsumed within the EU. EU member states, including the UK, monitor and assist the EU Commission but are not permitted to conduct independent trade negotiations. Whereas, trade missions to extra-EU countries involving business-to-business (B2B) dialogues are targeted at internationalising firms. Therefore, Brexit presents the UK government with significant

challenges including increasing capacity within the Department for International Trade (previously UK Trade and Investment, until July 2016). This newly formed department will need to address rising costs through trade preference erosion as well as the UK being a less attractive destination for investment. This situation has been further exacerbated by the recent UK election results, which provide an even more questionable basis for exit negotiations. In the face of such difficulties it is somewhat predictable that the Commonwealth is mentioned. The Commonwealth remains but re-establishing it as a strong preferential trading club headed by the UK, or the UK signing of a collection of bilateral FTAs, may prove difficult (Figure 2). After WWII, the UK defence of imperial preferences was seen by some as a desperate attempt to maintain a powerful position in the world-trading environment. In fact, it was increasingly the case that the UK relied on the colonies, particularly during WWII (Lee, 1977). More recently, the situation has worsened; with African countries becoming reticent to sign up to EU trade deals as well as accusations of such deals being a type of colonialism[6]. At the same time, India is backing their 'Buy in India' programme rather than looking to a new deal with the UK[7]. In summary, the relevance of Commonwealth nostalgia for post-Brexit UK trade deals is questionable. Therefore, the UK is struggling to retain a powerful position in the world-trading environment. A key feature of this power-play is the TTIP and the possibility of a US-UK FTA. At the same time there is the complex and emotive issue of the UK relationship with the EU, whether this is a 'soft' or 'hard' Brexit.

[6] On 26 Feb 2017, Tanzanian President John Magufuli held a joint press conference with visiting Ugandan President Yoweri Museveni where he described the Economic Partnership Agreement with the EU as a form of colonialism.
[7] Public Procurement (Preference to Make in India), Order 2017 was issued on 15 June 2017

Figure 2: Members of the commonwealth



Source: Authors work

3. Trade policy scenarios: interaction of mega-regionals with other agreements and impact on third countries

By lowering tariffs and eliminating non-tariff measures, bilateral and plulateral trade agreements increase national welfare due to allocation and accumulation effects (Baldwin & Venables, 1995). We mainly focus on the effect of *redistribution* of trade caused by the interplay of TTIP and Brexit, but briefly consider the effect of *changes in resource costs* due to elimination/introduction of NTMs (Baldwin et al., 1997).

Once countries join the TTIP by virtue of EU membership, third countries are expected to experience from trade diversion and trade preference erosion. Countries outside the EU will find it difficult to negotiate similar or better terms. Furthermore, if mega-regional blocs expand their membership to new countries this could generate increased costs of being outside the EU. We examine a number of scenarios in terms of the UK relationship with the EU and the outcome of the TTIP negotiations:

1. EU&TTIP: UK remains a member of the EU and the TTIP is signed (Scenario 1)
2. Brexit&TTIP: UK exits the EU and the TTIP is signed (Scenario 2)
3. Brexit: UK exits the EU and the TTIP is not signed (Scenario 3)

In addition, we consider two post-Brexit scenarios, which are discussed as alternative UK policies in order to mitigate consequences of Brexit:

4. UK&US: UK exits the EU and successfully negotiates an FTA with the US (Scenario 4)
5. Commonwealth FTA: UK exits the EU and signs FTAs with the largest Commonwealth countries: Australia, Canada, India, Nigeria, New Zealand, Pakistan, and South Africa (Scenario 5)

The last two scenarios are chosen to investigate the validity of a popular claim that the UK has an opportunity to compensate the losses in the European markets by freely negotiating FTAs with non-European countries.

We model the UK exiting the EU under soft Brexit and 'hard' Brexit scenarios. Under the 'hard' Brexit, the UK would not be able to maintain preferential tariffs with the EU, and will instead face the Most-Favoured Nation (MFN) rates. We also assume that the NTBs applied to UK exporters would be similar to those applied to exporters from outside the EU free trade zone. Furthermore, in terms of the TTIP, we assume that the effect of the arrangement would be typical of the FTAs signed over the period 1960-2014. Therefore, to model the effect of the TTIP we rely on our estimates of the average effect of RTAs during 1960-2014.

4. Methodology and Data

The underlying model for our analysis is a structural 'new trade theory' model (Helpman et al., 2008), which captures selection into positive

bilateral trading partners and the effect of trade policy on extensive and intensive margins of trade. As pointed out by Head and Mayer (2014), the structural gravity model is consistent with a wide class of models, including Armington (1969), Krugman (1980), and Melitz (2003). This model has been used to estimate the effect of preferential trade agreements (Egger et al., 2011).

Trade flows are determined by

$$X_{ij} = \frac{Y_i E_j}{\Omega_i P_j}\varphi_{ij} \qquad (1)$$

where X_{ij} is exports from country *i* to country *j*, $Y_i = \sum_j X_{ij}$ is total production in country *i* and $E_j = \sum_i X_{ij}$ is total expenditure in country *j*. $\Omega_i = \sum_j \frac{\varphi_{ij} E_j}{P_j}$ is outward multilateral resistance and $P_j = \sum_i \frac{\varphi_{ij} Y_i}{\Omega_i}$ is the inward multilateral resistance term.[8] Furthermore, φ_{ij} represents bilateral trade costs, which are influenced by the choice of trade policy. Our bilateral trade costs are given by

$$\ln \varphi_{ij} = \ln dist_{ij} + EU_{ij} + RTA_{ij} + Z_{ij}\gamma + u_{ij} \qquad (2)$$

where $\ln dist_{ij}$ is the logarithm of bilateral distance between trading partners *i* and *j*, EU_{ij} is a dummy variable representing EU membership status, RTA_{ij} is a dummy variable representing the presence (or otherwise) of an RTA and Z_{ij} denotes other variables influencing trade costs (e.g. common language, common legal system, colonial relationship).

[8] When a large economy or trade block changes its policy towards another country, it influences bilateral trade directly and the trade of other countries indirectly. However, the indirect effect can be large. For instance, Russia introduced an embargo on imports of food from the EU in 2014. This action was in response to economic sanctions and it lead to the growth of food imports from countries that did not support the sanctions. Anecdotal evidence suggest that this policy allowed countries such as Belarus, which is landlocked, to export shrimps and salmon to Russia. At the same time, sales of Norwegian salmon to Belarus increased by 50 percent, where a large proportion was re-exported to Russia under new label of “Belorussian” salmon (Newsweek, “Busting a few lox”, 19, 09/04/2015).

Our empirical strategy proceeds in two stages. The first stage involves modelling the selection into trade partners as well as estimating the trade elasticities with respect to trade policy variables. To estimate extensive and intensive trade elasticities with respect to trade policies, we follow Egger et al. (2011). This procedure allows us to estimate a structural model with responses to trade policy at extensive and intensive margins. It also addresses the issue of zero trade flows and provides unbiased estimates in the presence of heteroskedasticity. The second step uses simulations by means of a structural gravity approach to model the alternative scenarios/counterfactuals outlined above. We compute welfare gains/losses of each of the scenarios compared to the status quo. Therefore, we examine changes in real income using results derived by Arkolakis et al. (2012) and the structural gravity equation (1).

4.1. Modelling the selection into trading partners and estimating trade policy effects

We first deal with the sample selection correction. Some countries are more likely to trade than others and the probability of positive trade flows depends on fixed and variable trade costs. Therefore, we estimate a probit model to explore $T_{ij,t}$, the probability of positive trade flows between *i* and *j:*

$$T_{ij,t} = \Pr(Trade_{ij,t} = 1 \mid .) = \Phi(H_{ij,t}\Gamma^{Trade}) \quad (3)$$

where $Trade_{ij,t}$ is a binary variable that takes value of 1 if we observe positive trade flows and zero otherwise, $H_{ij,t}$ denotes policy variables (RTA and EU) as well as the determinants of fixed and variable trade costs including distance, common border, common spoken language, common legal system and year fixed effects. The exclusion restriction that we exploit is common religion, which is customary in the literature. We further form

variables that control for the selection into positive trade flows and heterogeneity of exporting firms (Helpman et al., 2008):

$$\hat{\rho}_{ij,t} = \Phi\left(H_{ij,t}\hat{\Gamma}^{Trade}\right) = \Phi(\hat{z}_{ij,t}) \qquad (4)$$

$$\hat{\eta}_{ij,t} = \frac{\phi(\hat{z}_{ij,t})}{\Phi(\hat{z}_{ij,t})} \qquad (5)$$

$$\hat{\tilde{z}}_{ij,t} = \hat{z}_{ij,t} + \hat{\rho}_{ij,t} \qquad (6)$$

Next, we augment the gravity equation (1), by using $\hat{\eta}$, a third degree polynomial of $\hat{\tilde{z}}$, as well as introducing a full set of exporter-time, importer-time and bilateral fixed effects to control for multilateral resistance terms:

$$\ln X_{ij,t} = \gamma_0 + \gamma_1 EU_{ij,t} + \gamma_2 RTA_{ij,t} + \gamma_3\hat{\eta}_{ij,t} + \sum_{m=1}^{3}\gamma_{m+3}(\hat{\tilde{z}}_{ij,t})^m + D_{it} + D_{jt} + D_{ij} + \epsilon_{ij,t} \quad (7)$$

We estimate (7) using a panel of bilateral export and import data from 1960-2014 for 162 countries. The length of the sample and larger cross-section of countries distinguishes our estimation from both Felbermayr et al. (2015) and Dhingra et al. (2017). It gives us more time and cross-section variation in order to pin down the effects of RTAs in general and EU in particular on trade. It also gives us an opportunity to look at dynamics and trends in the effect of RTAs on trade. We overcome the computational issue of dealing with 36,000 fixed effects by applying an algorithm developed by Guimaraes and Portugal (2010).

4.2. Accounting for endogenous RTA formation

The outlined procedure captures heterogeneity of country-pairs, controls for country-time specific effects and accounts for the selection into trading partners. However, it does not deal with endogeneity of trade policy. A decision to sign an RTA is driven by bilateral relationships between countries that may evolve over time. Moreover, it is influenced by trade costs. Ignoring the selection into RTA partners is likely to bias downwards

the estimation of the effect of an RTA on trade (Baier and Bergstrand, 2007).[9] We deal with this issue by modelling the selection into RTA and EU partners as well as further instrumenting our policy variables with obtained selection probabilities. We estimate the probit models of RTA and EU formation as follows:

$$\delta_{ij,t}^{RTA} = \Pr\left(RTA_{ij,t} = 1 \middle| .\right) = \Phi(G_{ij,t}\Gamma^{RTA}) \qquad (8)$$

$$\delta_{ij,t}^{EU} = \Pr\left(EU_{ij,t} = 1 \middle| .\right) = \Phi(G_{ij,t}\Gamma^{EU}) \qquad (9)$$

where $G_{ij,t}$ captures fixed and variable trade costs including distance, common border, common spoken language and common legal system. In addition, for (9) we include an indicator variable, whether both countries are located in Europe since joining EU is only allowed for European countries. We then re-estimate model (7) using instrumental variables method, where RTA and EU variables are instrumented by predicted values of $\hat{\delta}_{ij,t}^{RTA}$ and $\hat{\delta}_{ij,t}^{EU}$ and the inverse Mill's ratios.

4.3. Simulations

Once we have estimated the RTA and EU impact on trade, we start the simulation part of our analysis. Following Anderson et al. (2015), we estimate a structural gravity model using 2012 data and applying the Poisson Pseudo Maximum Likelihood estimator (PPML estimator, see Silva and Tenreyro, 2006). We constrain the coefficients of the policy and selection variables to be equal to our estimated coefficients from the previous stage. Our estimated model is given by

$$X_{ij} = \exp\left(\hat{\gamma}_1 EU_{ij,t} + \hat{\gamma}_2 RTA_{ij,t} + \underset{\upsilon_{ij}}{\hat{\gamma}_3\hat{\eta}} + \sum_{m=1}^{3}\hat{\gamma}_{m+3}(\hat{z}_{ij,t})^m + Z_{ij}\pi + \chi_i + \xi_j\right) + \qquad (10)$$

[9] The downward bias occurs if high, unobserved bilateral trade costs makes an RTA more likely.

where Z_{ij} are bilateral trade costs variables including distance, common border, colonial links, common legal origin, common spoken language and common religion. Using result by Fally (2015), we compute the inward and outward multilateral resistance terms according to the following expressions:

$$\hat{P}_j^{1-\sigma} = E_j \exp\left(-\hat{\xi}_j\right)/E_0 \qquad (11)$$

$$\hat{\Omega}_i^{1-\sigma} = E_0 Y_i \exp\left(-\hat{\chi}_i\right) \qquad (12)$$

where E_0 is the level of expenditure in the country for which the inward multilateral resistance is normalized to $P_0 = 1$.[10]

The model is further re-estimated with modified policy variables $EU_{ij,t}^{*}$ and $RTA_{ij,t}^{*}$, which switch on and off according to various scenarios, as well as the inward and outward multilateral resistance terms re-calculated with new fixed effects, $\hat{\chi}_i^{*}$ and $\hat{\xi}_j^{*}$, according to the expressions (11) and (12).

4.3.1. Conditional Effects of TTIP and Brexit

Conditional effects of a change in policy, (i.e. the UK exiting the EU or the EU signing the TTIP) are modelled by modifying policy variables to reflect the expected policy changes, taking the income and expenditure of countries, Y_i and E_j, as given.[11] This approach highlights the changes in trade patterns due to the changes in the corresponding trade costs caused by policy changes. Therefore, it does not rely on any other channels of economic changes required for gains/losses to materialize. The limitations of this approach are as follows. First, it assumes that the effect of the TTIP is equal to the average effect of the RTAs in the past. Second, it shuts down

[10] In our estimation, Afghanistan is the reference country. Welfare changes are estimated relative to Afghanistan.
[11] Head and Mayer (2014) label this approach as Modular Trade Impact (MTI).

the effects that the TTIP and UK exit from the EU may have on production, technology, employment and relative wages. Third, it does not account for welfare gains caused by saving resources due to NTM removal. Fourth, it does not account for the effect on non-tradables and services. We further discuss and address these issues in the robustness checks section.

4.3.2. Evaluating welfare

We compute changes in direction and value of trade and evaluate welfare changes according to the following:

$$\hat{W}_i^{CE} = 100\% \times \left(\frac{Y_i^* / \hat{P}_i^*}{Y_i / \hat{P}_i} - 1 \right) = 100\% \times \left(\frac{\hat{P}_i}{\hat{P}_i^*} - 1 \right) \qquad (13)$$

where $i = 1,2,3,4,5$ are policy scenarios described in the previous section. The last equality is due to the fact that in the conditional scenario we keep outputs and expenditures constant.[12]

4.4. Data

Our dataset covers 162 countries for 1960-2014. Aggregate bilateral exports and imports measured in thousands of current US dollars are taken from the Direction of Trade Statistics (DOTS) provided by the International Monetary Fund (IMF). To compute welfare gains, data on internal trade is required. We approximate internal trade as given by

$$X_{ii} = (1 - s_{services}) \times GDP_i - \sum_{j \neq i} X_{ij} + \sum_{j \neq i} X_{ji}$$

[12] It is worth mentioning that our welfare results does not depend on the choice of the reference country. Since we keep expenditure levels of all countries constant, welfare changes are given by the ratio of exponentiated fixed effects in the status quo and counterfactual scenarios: $\frac{\hat{P}_i}{\hat{P}_i^*} = \frac{\exp\left(-\hat{\xi}_i\right)}{\exp\left(-\hat{\xi}_i^*\right)}$. Also, this formula is consistent with a wide class of models, including a Melitz model with heterogeneous firms, which was the basis for our first-stage estimation.

where $s_{services}$ is the share of services in *GDP*, $\sum_{j \neq i} X_{ij}$ is total export of country *i*, and $\sum_{j \neq i} X_{ji}$ is total import of country *i*.[13]

RTA data are taken from the Centre D'Etudes Prospectives et D'Informations Internationales (CEPII) database and updated to 2014 using the WTO database of regional trade agreements. RTA is a binary variable that takes value of 1 if a country-pair has an active RTA agreement in place (including the EU agreement) and 0 otherwise. In addition, we introduce a binary variable 'EU' that takes value of 1 if both trading countries are EU members and 0 otherwise. A positive and significant coefficient of the EU variable would indicate that the EU generates more trade relative to the other trade agreements. We complement the RTA data with Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008). This data allows us to distinguish between different types of RTAs, such as FTAs and CUs. Finally, data on applied tariff rates is collected from the TRAINS database for the period 2003-2013.

The data on Gross Domestic Product (GDP) in current US dollars and total population are from the World Development Indicators (WDI) 2014 published by the World Bank. Geographical characteristics and distance between countries are taken from CEPII, (see Head et al. (2010) for a detailed description of the data). Colony and contiguity dummy variables are used to control for pair-specific trade costs that are not directly related to distance. Furthermore, the dummy representing common legal origin captures the compatibility of the legal systems of trading partners and captures trade costs related to the signing of contracts. The common

[13] Data on the share of services in GDP in 2012 is taken from the World Bank. In several cases, when the data for 2012 is not available, the latest available data is taken.

spoken language and common religion dummy variables capture the effect of cultural similarities on trade (Melitz and Toubal, 2014).

We carefully record both positive and zero trade flows for both exports and imports, while distinguishing zero trade flows from missing data. Some countries, such as the USSR, ceased to exist within this period. Our dataset does not contain the bilateral trade of these countries. However, trade of newly created states, such as Russia and Ukraine, is recorded since the date of their creation.

5. Empirical Results

We present our empirical results according to the sequence of the discussion outlined in the previous section.

5.1. Selection into positive trade and RTA partners

We begin with the selection into trade and preferential trading partners. Table 1 reports estimates of these selection processes, where columns (1) and (2) refer to the selection into exporting while controlling for RTA/EU and FTA/CU, respectively. Columns (3) and (4) explore the determinants of the selection into regional trading/economic blocks, while columns (5) and (6) look at the differences in selection between FTA and CU.[14] For each model we report marginal effects estimated using the average values of the explanatory variables. We find that an RTA is positively associated with probability of exporting and importing. An RTA increases the probability of positive exports by 17 percent. This aligns with our expectations given that one of the main goals of trade agreements is to ease market access.

[14] For instance, Lake & Yildiz (2016) argue that over longer distances FTA is preferable to CU.

Moreover, EU membership is positively associated with the probability of trade, but the effect is not significant. The effect is more pronounced for a CU, while an FTA increases probability of trade by only 9.8 percent. This may reflect the fact that a CU goes beyond reductions in applied tariffs and eliminates NTMs as well, which in the era of low tariffs play a more prominent role in shaping trade flows.

Positive trade is more likely if countries share a common spoken language and a common colonial past. Higher levels of production in exporting countries and a higher level of expenditure in importing countries are also positively linked to the probability of trade. On the other hand, higher levels of population are negatively linked to probability of trade, which among other things reflects a home market effect. We also find a negative effect of common religion on trade (conditional on controlling for common language, colonial past, etc.), which may be capturing the fact that more similar countries have less incentive to trade.

According to the model in column (3), the probability of creating an RTA is positively linked to a common spoken language and the economic size of exporting and importing countries. Yet, it is negatively linked to a common border, sharing the same religion and a larger population. The probability of EU membership in column (4) is positively related to a common legal system and larger economic size. The effect of economic size on being a member of the EU for both exporting and importing countries is about four times larger than the effect of forming a common RTA.

Table 1: Selection models

	Selection into bilateral trading partners		RTA and EU selection		FTA and CU selection	
	RTA/EU (1)	FTA/CU (2)	RTA (3)	EU (4)	FTA (5)	CU (6)
RTA	.170**					
	(.011)					
EU	.073					
	(.042)					
FTA		.098**				
		(.009)				
CU		.184**				
		(.010)				
Both in Europe				.013**		
				(.001)		
Com. border	.024	.020	-.003*	-.007**	-.007**	-.004**
	(.022)	(.021)	(.002)	(.002)	(.002)	(.001)
Colonial past	.165**		-.002	-.004*	.006*	-.002
	(.022)		(.002)	(.001)	(.002)	(.001)
Com. legal	.006	.007*	.001	.002*	.000	.000
	(.003)	(.003)	(.001)	(.001)	(.001)	(.000)
Com. religion	-.049**	-.050**	-.009**	.001	-.000	-.003**
	(.006)	(.006)	(.001)	(.001)	(.001)	(.001)
Com. language	.269**	.268**	.016**	.003	.024**	.010**
	(.007)	(.007)	(.001)	(.001)	(.001)	(.001)
$\ln \text{Dist}_{ij}$	-.116**	-.111**	-.021**	-.008**	-.020**	-.012**
	(.002)	(.003)	(.001)	(.001)	(.001)	(.001)
$\ln \text{GDP}_{it}$	.105**	.106**	.003**	.006**	.006**	-.001**
	(.001)	(.001)	(.000)	(.000)	(.000)	(.000)
$\ln \text{Pop}_{it}$	-.017**	-.018**	-.002**	-.004**	-.004**	.001**
	(.001)	(.001)	(.000)	(.000)	(.000)	(.000)
$\ln \text{GDP}_{jt}$	.081**	.082**	.003**	.006**	.006**	-.001**
	(.001)	(.001)	(.000)	(.000)	(.000)	(.000)
$\ln \text{Pop}_{jt}$	-.009**	-.010**	-.002**	-.004**	-.004**	.001**
	(.001)	(.001)	(.000)	(.000)	(.000)	(.000)
Observations	965973	965973	965973	965973	965973	965973

*Notes: ** Significant at the 1% level. * Significant at 5% level. Marginal effects estimated at average values are reported. Standard errors clustered at country-pair in brackets. All models are estimated by probit. Columns (1) and (2) report selection into exporting country-pairs. Columns (3) and (4) report selection into RTA/EU country-pairs. Columns (5) and (6) report selection into FTA/CU country-pairs. All models are estimated for 162 countries in 1960-2014.*

FTA is more likely to be created between countries sharing colonial past, while it is not a significant determinant of CU formation (columns (5) and (6)). Common language is important for all types of RTAs, but is relatively more important for FTA formation, while common religion has a negative and significant effect on CU formation.

Table 2: Long-term gravity estimates

	RTA and EU				FTA and CU	Applied tariff
	FE	Selection	IV	PPML		
	(1)	(2)	(3)	(4)	(5)	(6)
RTA	.353**	.562**	1.242**	.100**		-.034
	(.026)	(.053)	(.103)	(.028)		(.059)
EU	.656**	.630**	.582**	.382**		.437**
	(.040)	(.043)	(.110)	(.035)		(.053)
FTA					.296**	
					(.037)	
CU					.928**	
					(.065)	
Applied tariff						-1.025**
ln(1 + t_{ijt})						(.136)
η_{ijt}		2.497**			2.625**	1.357**
		(.120)			(.121)	(.264)
z_{ijt}		3.455**			3.384**	3.171**
		(.228)			(.232)	(.465)
z_{ijt}^2		-1.242**			-1.253**	-.856**
		(.074)			(.074)	(.145)
z_{ijt}^3		.130**			.135**	.078**
		(.008)			(.008)	(.015)
Observations	579989	537390	537390	971189	537390	266554
R^2	.864	.870	.868	.992	.871	.906

*Notes: ** Significant at the 1% level. * Significant at 5% level. Standard errors clustered at country-pair in brackets. All models are estimated with a full set of country-pair, exporter-year, and importer-year fixed effects. To deal with high dimensionality problem of adding more than 36,000 fixed effects, we use the algorithm developed by Guimaraes et al. (2010). Dependent variable in all models except (4) is ln(exp). Dependent variable in (4) is exp. Models (1)-(5) are estimated for 162 countries in 1960-2014. Model (6) is estimated for 162 countries in 1993-2014.*

5.2. Long-run RTA elasticity of trade

Table 2 presents estimates of the effects of trade policy on exports at intensive margins. We control for exporter-year, importer-year, and country-pair time invariant effects. Standard errors are clustered by

country-pair. Columns (1)-(4) present results for all types of RTAs. In column (1) we do not control for selection and heteroskedasticity driven by firm-level heterogeneity. In this case, on average, signing an RTA increases trade by 35.3 percent. Joining the EU will have even stronger trade-creating effect, additionally boosting exports by 65.6 percent. These numbers are slightly higher than are typically found in other studies (see Head and Mayer, 2014 for a meta-analysis of the effect of RTAs on trade). In column (2), we account for heterogeneity of firms and the mechanism of selection of firms into exporters. The results remain significant, while the RTA coefficient has higher value. Variables controlling for firm level heterogeneity are all significant and of expected sign and magnitude (see Table 2 in Helpman et al., 2008). Finally, in column (3) we present results of IV estimation, which noticeably increases the estimates of the effects of the policy variables, RTA in particular. This effect is well-documented in the literature, which finds that not accounting for endogeneity of trade policy considerably biases the estimates of trade policy variables downwards (Baier and Bergstrand, 2007). In fact, our estimate of the RTA coefficient is remarkably close to the estimate in Felbermayr et al. (2014), which equals 1.21. We also estimate the gravity mode by the PPML method, which produced smaller coefficients of the effect of RTAs and EU on trade. This fact is also well-documented, as discussed in Head & Mayer (2014). In order to account for a range of coefficient estimates for RTA and EU variables, we perform a sensitivity analysis in the robustness checks section.

5.3. Tariff and non-tariff measures: comparison of FTA and CU elasticity of trade

We also report the effects of different types of RTAs – FTA vs CU – in column (5). The effect of CU on trade is much stronger, which is consistent with the

fact that CU goes much deeper than a FTA and removes non-tariff barriers to trade, while FTAs are mostly focused on reduction of applied tariffs. In fact, once we control for the level of tariffs, the positive effect of RTAs disappears, while the effect of the EU on trade remains strongly positive and significant. We will use these results later when we discuss the differences in the effects of tariffs vs non-tariff measures and contrast FTAs and CUs.

5.4. Dynamic effect of RTA and hysteresis

Two important issues need to be addressed in order to understand the dynamics of transition between steady states. First, little is known about the dynamics of the impact of an RTA on bilateral trade flows. Does it boost trade at the early stage or does it increase trade gradually? Second, even less is known about the effect of withdrawal from a trade agreement. Is it symmetric and opposite in size? Does the RTA effect immediately disappear or linger over time?

We start our discussion with the second of these issues. There are not many examples countries walking away from a trade agreement in recent times. However, the study of Head, Mayers and Ries (2010) on the dynamics of trade of former colonies with their metropoles provides us with some insights.[15] Its main finding is in favour of a strong hysteresis effect of the RTAs. The decline in bilateral trade between the metropole and its colony is gradual, but very substantial. It drops to 35% of the initial level within 30-40 years. Also, there is a similar decline in bilateral trade with the other colonies of the same metropole. Finally, there is an overall decline in

[15] Another example, which confirm this pattern, is the breakup of the Soviet Union, which led to dramatic reduction in bilateral trade between former USSR republics and to overall economic decline (Fidrmuc and Fidrmuc, 2003).

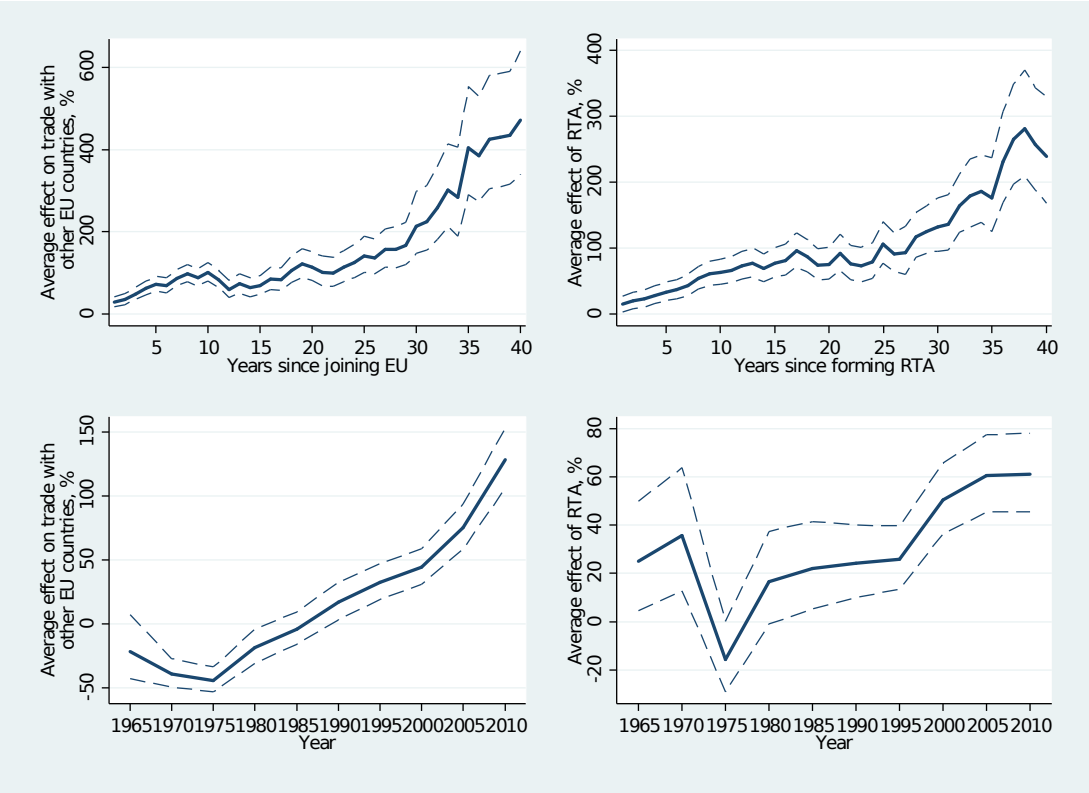
trade of about 20% after independence. One explanation of these patterns may be that the metropole has trade policy capacity and expertise that is commonly shared with its colonies. Once the colony gets independence, it loses access to this facility, which has negative effect on its trade with all countries.

To answer the question about the dynamics of the RTA effect, we perform the analysis, similar to Head, Mayer, and Reis (2010). For each bilateral trade agreement, we establish its starting point and include the interaction terms of the RTA variable with its duration. Duration is categorized from 1 to 40 years.[16] We do the same for our EU variable. As an alternative specification, we also consider whether the effect of an RTA varies over time, by interacting the RTA variable with decade indicators. The average effects on trade for RTA/EU members relative to non-members, in percent, are presented in Figure 3.

Several important regularities emerge. First, the positive effect of RTAs accumulates over time with some acceleration for RTAs over 25 years old. Second, both RTA and, in particular, EU are currently having the strongest impact on trade over the period 1960-2014. It follows from the first effect and recent surge in RTA formation, but may also reinforce itself as more and more countries rely on RTAs.

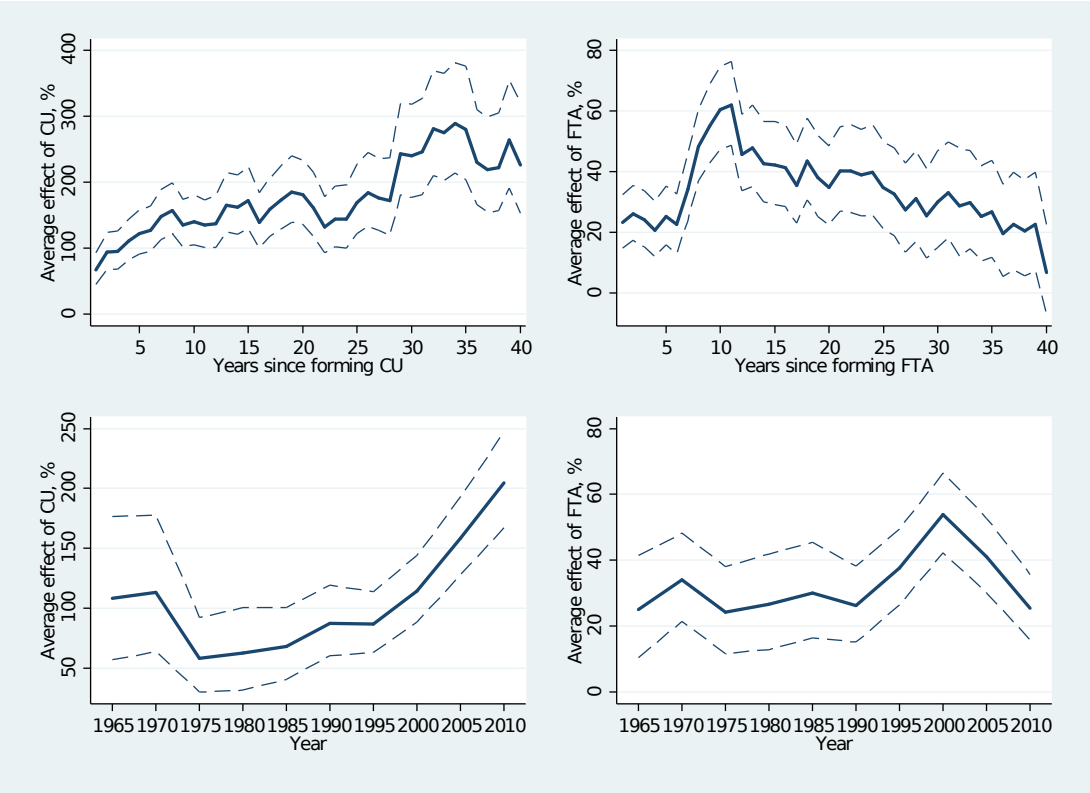
[16] We include all RTAs with duration above 40 years in the same category.

Figure 3: Dynamics of RTA and EU in 1960-2014



We repeat the same exercise to study FTA and CU agreements separately. CUs have the same pattern as RTAs in general (see Figure 4). However, FTAs have a much weaker and shorter trade creation effect, which reaches its maximum after 12 years from its formation and rapidly declines after that. FTAs had the strongest trade creation effect in the 00’s, and are currently experience a downward trend, while the trade creating effect of the CUs accelerates and is currently at its peak.

Figure 4: Dynamics of FTA vs CU



5.5. Counterfactual scenarios: trade flows and welfare gains

As the benchmark, we take the estimated effects of the trade policy from column (2) of Table 2 as given and estimate the effects of changes in trade policy of the UK on its exports and imports, following the constrained PPML methodology outlined in the previous section. The benchmark estimation and simulations are performed using a 2012 sample; while we would like to use most recent data to evaluate the effects of policy changes, unfortunately the data for 2013 and 2014 has gaps. In what follows, we present predictions and welfare gains based on the PPML simulation exercise.

Table 3: UK actual exports, imports, and counterfactual changes by regions in 2012

Region	Status Quo, bln. USD	TTIP & EU, %	TTIP & Brexit, %	No TTIP Brexit, %	US UK FTA, %	CMWTH FTA, %
			A. Export from UK			
EU	230.35	-5.9	-38.1	-36.7	-39.7	-37.1
US	45.76	46.8	-0.3	7.8	68.3	3.7
Rest of the World	132.2	-10.1	3.1	6.8	-1.4	23.2
All countries	408.31					
			B. Import to UK			
EU	347.7	-4.8	-33.8	-31.7	-33.6	-33.0
US	54.86	54	9.3	14.1	80.7	7.9
Rest of the World	257.03	-6.4	10.3	12.3	6.2	24.9
All countries	659.59					

Notes: Table reports actual exports and imports of UK in 2012 in USD to different groups of countries and counterfactual changes relative to the status quo levels in percent. We assume that a "shallow" FTA is in place.

Panel A of Table 3 presents changes in exports under the five scenarios. The first column presents the status quo exports of the UK to EU, US and the Rest of the World in 2012. The other five columns report percentage changes from the status quo levels of exports for the five specified scenarios. Relative to the status quo, signing the TTIP and remaining in the EU would increase British exports to the US by 46.8 percent (20.9 billion USD). It also would lower exports to the EU by 5.9 percent (13.5 billion USD) and the rest of the world by 10.1 percent (13.3 billion USD). This result illustrates the trade diversion caused by lowering trade barriers towards UK goods sold in the US. Brexit combined with free trade between the US and EU would lower exports from the UK to the EU by 38.1 percent, while the UK exports to the US will remain almost unchanged.[17] Furthermore, UK exports to the rest of the World would increase by 3.1 percent. If the TTIP is not

[17] Teulings (2017), who studied how Brexit influences exports found similar results.

signed and the UK still leaves the EU, this would cause a similar drop of exports to the EU, and increase in exports to the US and Rest of the World by 7.8 and 6.8 percent respectively. If the UK negotiates an FTA with the US after Brexit, it would boost its exports to the UK by 68.3 percent. In case of FTAs with 6 large Commonwealth countries, the UK expands its exports to the rest of the world by 23.2 percent.

Panel B of Table 3 presents changes in British imports under the five scenarios. These results are quite similar to the results for the UK exports since we consider reciprocal trade liberalization; hence, trade barriers are reduced identically for both exports and imports. Relative to the status quo, signing the TTIP and remaining in the EU would increase British imports from US by 54 percent. It also would lower imports from the EU by 4.8 percent or by 16.7 billion USD. Brexit would lower UK imports from the EU by 32-34 percent or by 115-118 billion USD.

Table 4: Main welfare results

Elast. of subst.	Welfare gains, %				
	TTIP EU	TTIP Brexit	No TTIP and Brexit	US UK FTA	CMWTH FTA
	A. Baseline results, “Shallow FTA EU/UK”, Table 2 column (2)				
4	0.23	-3.97	-3.49	-2.66	-2.56
5	0.17	-2.99	-2.63	-2	-1.93
6	0.14	-2.4	-2.11	-1.61	-1.54
Average	0.18	-3.12	-2.74	-2.09	-2.01
	B. ‘Hard’ Brexit, Table 2 column (2)				
4	0.23	-6.71	-6.32	-5.47	-5.24
5	0.17	-5.08	-4.78	-4.13	-3.96
6	0.14	-4.08	-3.84	-3.32	-3.18
Average	0.18	-5.29	-4.98	-4.31	-4.13
	C. Only intensive margins, “Shallow FTA EU/UK”, Table 2 column (1)				
4	0.17	-3.75	-3.46	-2.92	-2.81
5	0.13	-2.83	-2.61	-2.2	-2.11
6	0.1	-2.27	-2.09	-1.76	-1.69
Average	0.13	-2.95	-2.72	-2.3	-2.2
	D. IV results, “Shallow FTA EU/UK”, Table 2 column (3)				
4	0.85	-5.56	-3.84	-0.73	-0.72
5	0.63	-4.2	-2.9	-0.54	-0.54
6	0.51	-3.37	-2.32	-0.44	-0.43
Average	0.66	-4.38	-3.02	-0.57	-0.56

Notes: Table presents a representative consumer welfare gains or losses due to 5 counterfactual scenarios. The gains and losses are measured relative to the status quo of the UK as a member of EU and no TTIP is signed. Computations are performed for different levels of sigma, which is elasticity of substitution parameter in the utility function.

Table 4 compares consumer welfare estimated according to (13) under different scenarios and different levels of elasticity of substitution. According to Head and Mayer (2014), 622 studies that used a structural gravity approach found an average value of $\sigma = 5.13$. We have chosen three levels of sigma: $\sigma=4$, $\sigma=5$ and $\sigma=6$. Panel A reports the results for RTA and EU estimated effects taken from Table 2, column (2). It assumes a shallow FTA is negotiated between the EU and UK, but NTMs between the EU and

UK will emerge. As expected, British consumers would experience the largest losses in welfare of around 3.1 percent on average if the UK exits the EU and the EU signs the TTIP. If the EU does not sign the TTIP, the impact is slightly improved with a 2.74 percent loss. This result is similar to Dhingra et al. (2017) who found a loss in welfare of 1.34 percent in the optimistic case and 2.66 percent in the pessimistic case. Finally, signing the TTIP and staying in the EU would increase consumer welfare in the UK by 0.17 percent. This result is lower than estimates of Felbermayr et al. (2015), but similar to Francois et al. (2013). As results in columns (4) and (5) indicate, the loss of welfare caused by Brexit cannot be compensated by signing an FTA with the US or with Commonwealth countries. The losses of welfare in those scenarios are still substantial, 2.1 and 2 percent, repectively.

Panel B of Table 4 present the welfare analysis of 'hard' Brexit, when the UK withdraws from the single market, imposes MFN tariffs and both sides erect NTM barriers typical to the ones they impose against countries without preferential treatment. Such a negative scenario would lead to 4.1-5.2 percent welfare losses relative to the benchmark status quo. Panel C of Table 4 presents welfare changes if we ignore the effect of the extensive margins on trade flows. As these results show, the trade-creating effect of TTIP and potential FTAs is lower while the trade-reducing effect of Brexit is lower. These results highlight importance of modelling both impact of trade policy changes on extensive and intensive trade margins.

Finally, in Panel D of Table 4 we present the welfare analysis for the trade effects estimated by the IV technique with point estimates taken from column (3) of Table 2. Staying in the EU and signing TTIP would have increased welfare in the UK by 0.66 percent. All Brexit scenarios generate welfare losses. The losses from Brexit are stronger than the more

conservative estimates based on coefficients from column (3). Average loss of welfare due to Brexit is 3 percent if TTIP is not signed and 4.4 percent if TTIP is signed. Taking the elasticity of substitution equal to 4, conditional on Brexit, British consumers would be almost 2 percent better off if the TTIP is not signed. This result highlights benefits of being a member of a large economic bloc in negotiating trade deals. Welfare losses of Brexit are substantially mitigated by negotiating new trade deals with the US or Commonwealth countries, leading to only 0.57 and 0.56 percent welfare losses.

Finally, given estimation of the dynamic effects of RTA/EU elasticities of trade presented in section 5.4, there are two conflicting tendencies that should be taken into account when interpreting welfare gains presented in Table 4. First, even the 'hard' Brexit scenario would not cause abrupt welfare losses and catastrophic decline of trade flows between the EU and UK. The changes occur gradually. On the other hand, currently, RTAs especially CUs and EU in particular, have the strongest trade creation effect over the last 50 years, which would indicate that the welfare losses of Brexit are likely to be higher and welfare gains of TTIP would increase over time.

5.6. CU vs FTA

According to the comparison of the FTA and CU coefficients (column (5) of Table 2), CUs generate 118% more trade then FTAs. This result is attributed to the absence of non-tariff barriers and going through customs, associated with CUs. Shallow FTAs, which target tariff reductions only, do not generate much trade in the current low-tariff environment. Column (6) of Table 2 presents estimates of the elasticity of trade with respect to the applied tariff while controlling for RTA and EU, which is close to -1. Given that the average MFN rate in the EU is around 3 percent, this suggests that by keeping zero

applied tariffs with the EU, the UK would be able to avert an additional 3 percent reduction in its exports to the EU. However, the negative effect is much larger. When we analyse the welfare impact, it does not translate into noticeable welfare improvements for the scenarios that involve Brexit, essentially leaving our baseline results intact.

6. Robustness checks

6.1. Resource cost barriers and welfare

We consider a sensitivity analysis exploring whether an increase/reduction in resource costs, required to satisfy to NTM requirements (i.e. rules of origin, technical standards, sanitary and phytosanitary measures) associated with Brexit/TTIP, influences our welfare analysis. We model the resource cost as additional cost that increases the price of output $p' = p + \tau$ by certain value, τ, which is scaled in proportion to the trade costs $\ln \varphi$. Exit from the EU would increase resource costs required to organize border controls, check NTM requirements and rule of origins, etc. TTIP, on the other hand, would reduce resource costs due to NTM harmonization. Table 5 presents our results. Higher resource costs increase negative effect of Brexit on welfare, while having a small effect on welfare gains for UK due to TTIP. Welfare costs increase monotonically with increasing resource costs.

Table 5: Resource cost barriers and welfare

Additional resource cost, share of total trade costs	Welfare gains, %				
	TTIP EU	TTIP Brexit	No TTIP and Brexit	US UK FTA	CMWTH FTA

0.01	0.17	-3.00	-2.46	-1.83	-1.76
0.02	0.17	-3.31	-2.60	-1.97	-1.89
0.03	0.17	-3.62	-2.75	-2.11	-2.03
0.04	0.17	-3.93	-2.90	-2.24	-2.16
0.05	0.16	-4.23	-3.04	-2.38	-2.30
0.06	0.16	-4.54	-3.19	-2.52	-2.43
0.07	0.16	-4.85	-3.33	-2.66	-2.56
0.08	0.16	-5.15	-3.48	-2.79	-2.69
0.09	0.15	-5.45	-3.62	-2.93	-2.83
0.1	0.15	-5.75	-3.77	-3.07	-2.96

Notes: This table presents a representative consumer welfare gains or losses due to 5 counterfactual scenarios, under assumptions of soft Brexit, which maintains shallow FTA, but imposes NTMs on EU and the UK. The gains and losses are measured relative to the status quo of the UK as a member of EU and no TTIP is signed. Computations are performed for $\sigma = 5.16$

6.2. Sensitivity analysis: different levels of RTA impact on trade

Proponents of the TTIP may argue that our method of modelling this arrangement as an average trade agreement, representative of past agreements, is too conservative. They may argue that the TTIP is a completely new, XXIst century type of FTA, which will go much further in terms of the liberalization of goods, services, and removal of NTBs. On the other hand, critics of the TTIP may claim that the effect of the agreement will be close to zero because trade has already been liberalised between the EU and US.

Table 6: Welfare gains for different levels of RTA impact

Scenario and RTA strength	**Mean welfare gain, %**	**Standard Deviation**	**5th percentile, %**	**95th percentile, %**
EU&TTIP, $\hat{W}_1^{CE}$	0.15	0.21	-0.06	0.54

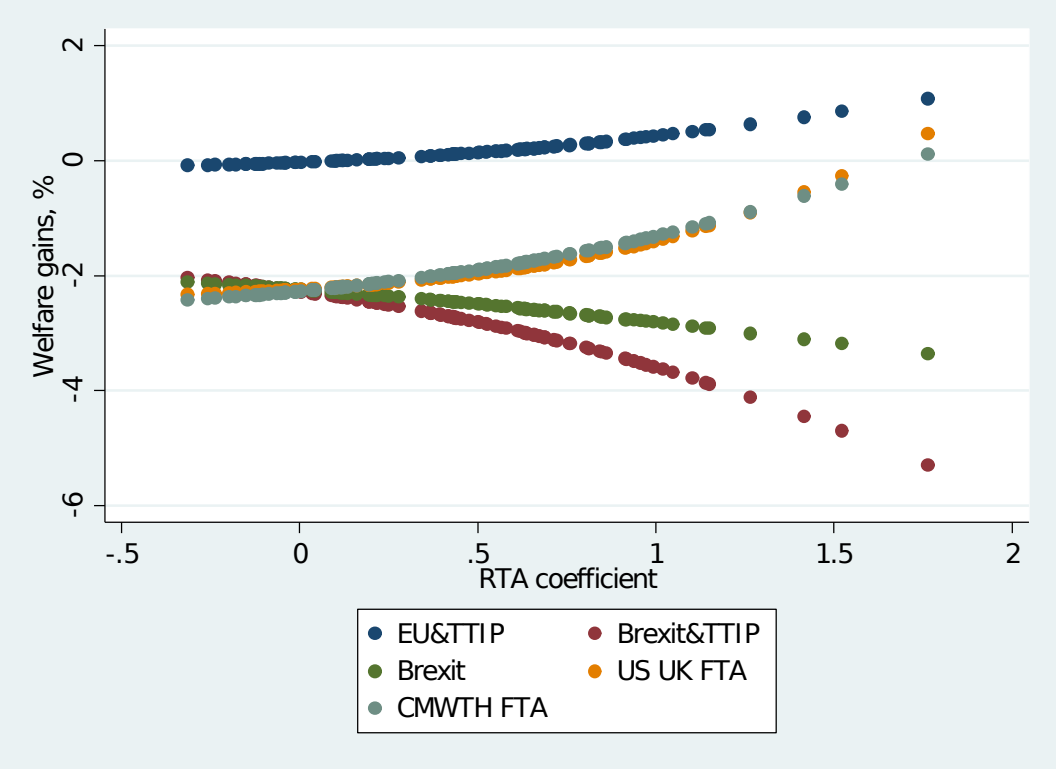
Brexit&TTIP, $\hat{W}_2^{CE}$	-2.81	0.60	-3.87	-2.14
Brexit&No TTIP, $\hat{W}_3^{CE}$	-2.48	0.25	-2.92	-2.17
US UK FTA, $\hat{W}_4^{CE}$	-1.91	0.45	-2.29	-1.14
CMWTH FTA, $\hat{W}_5^{CE}$	-1.88	0.45	-2.36	-1.09

Notes: Computations are based on the estimated effect of EU from column (2) of Table 2. The effect of RTA is drawn from a distribution with mean 0.36 and standard deviation 0.42, which matches the sample moments for the distribution of the RTA coefficients from the meta study by Head and Mayer (2014). This analysis is repeated 100 times and the distribution of welfare gains is generated. Elasticity sigma is fixed at 5.13 for this exercise.

To confirm the robustness of our results for different levels of the TTIP impact on trade flows we perform additional simulations. We consider a distribution of plausible TTIP effects as given by the RTA coefficients from the meta-study conducted by Head and Mayer (2014). They found that the distribution of the impact of RTAs on trade flows, from 108 studies using structurally estimated gravity modelling, to have a mean of 0.36 and standard deviation of 0.42. Therefore, we model the potential TTIP impact as a normally distributed random variable, $N(0.36, 0.42)$. We take 100 random draws from this distribution and evaluate welfare gains for each RTA draw, ranging from 0.31 to 1.76. The results of the distribution of welfare gains for different policy scenarios and the elasticity of substitution parameter $\sigma = 5.13$ are presented in Table 6. On average, Scenario 1 generates a welfare gain of 0.15 percent, Scenario 2 generates a welfare loss of 2.81 percent, and Scenario 3 generates a welfare loss of 2.48 percent. Scenario 2 also generates the highest volatility. Scenarios 4 and 5 generate losses of 1.91 and 1.88 percent respectively. We also report 5^{th} and 95^{th} percentiles of the distributions of gains for each scenario and indicate them in the table. The results demonstrate that our welfare gain estimates are quite robust to the error in the estimation of the effect of FTA. Figure 5 presents the welfare gains depending on the strength of RTA

impact. These simulations indicate that the best option for the UK would be to stay within the EU regardless of whether TTIP is signed or not. Moreover, the negative effect of Brexit on UK welfare increases as the TTIP impact on trade becomes stronger.

Figure 5: Welfare gains for different levels of RTA impact

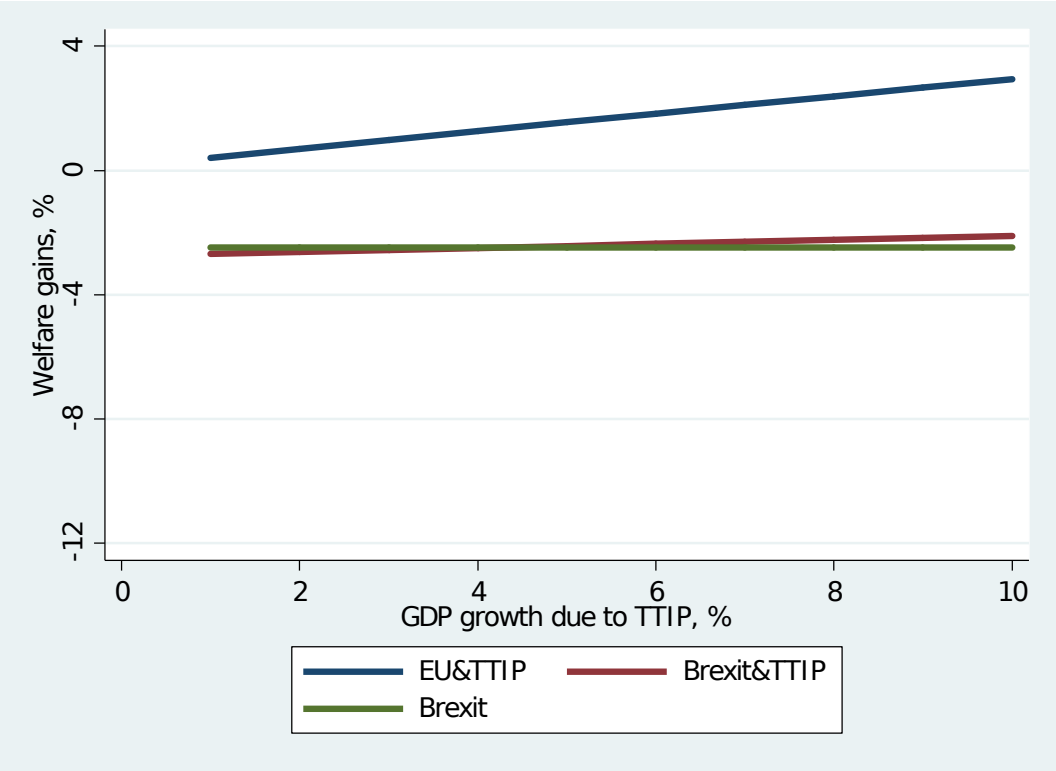


6.3. Sensitivity analysis: TTIP and economic growth

For robustness, we also consider how the additional effects from the TTIP would influence our results. Suppose the TTIP generates economic growth in the country-members due to liberalization of capital and migration flows, and reduction of NTBs. We model this as a uniform increase in GDP of the TTIP members of g percent, where g takes values of 1 to 10 percent. Further, we re-estimate our structural model and compute corresponding welfare gains, assuming $\sigma = 5.13$. The results are presented in Figure 6. As expected, the UK would benefit from being a member of TTIP, but if the UK

is out of EU, the additional indirect welfare gains from TTIP would not compensate for the welfare losses from exiting the EU.

Figure 6: Welfare gains for different levels of GDP growth



7. Conclusion

Given the current difficulties in achieving multilateral trade liberalization alongside the geopolitical power struggle, our analysis indicates that countries benefit from integrating into large regional trade/economic blocs. Our results demonstrate that countries left out of this process experience significant economic losses, stemming from trade diversion and trade preference erosion. Our structural gravity results are benchmarked against the findings in the existing literature. Furthermore, we have conducted additional experiments to confirm the robustness of our results. This emerging research framework provides a tractable model of global trade without compromising its general equilibrium features. We estimate a lower bound of UK welfare losses from exiting the EU and signing the TTIP. The

losses are derived from changes in trade costs, while output and expenditure stay constant. If we account for other channels mentioned in the literature, the negative effects of exiting the EU will be higher.

Depreciation of the pound after the Brexit referendum boosted exports, but the effect is likely to be short lived. Cover and Mallick (2012) highlight that historically exchange rate shocks have not had a significant impact on UK business cycles. Moreover, consumers have already experienced welfare losses due to the acceleration of inflation. Therefore, the net overall effect of the pound depreciation is likely to be small in the long run.

A resurgence of the Commonwealth group as a mega-regional would be beneficial, although not to the extent that it would compensate for the losses associated with Brexit. Furthermore, signing FTAs with the largest commonwealth countries will not be without its challenges, in terms of competing trade policy objectives as well as the perception of imbalanced colonial-style partnerships. A US-UK FTA also faces significant political difficulties and if realised, the benefits would not outweigh the negative effect of Brexit.

The UK decision to step outside the EU framework and embark on independently negotiating trade deals is a risky endeavour and likely to bring significant welfare losses. The signature of the TTIP would further weaken the UK's position. The UK would be wise to negotiate a route to play the new mega-regional 'game' as part of the EU bloc, although this seems unlikely. It remains to be seen whether the UK can remain an integral part of the EU project, perhaps even EU member in all but name, while seeming to accept the democratic result of the referendum. Moreover, the UK's lack of commitment towards the EU project needs to reach some degree of

resolution so that members can focus on reforms and address the geopolitical pressures from Asia.

We recognize that the TTIP can generate several important economic benefits, which go beyond the scope of this paper. First, the TTIP can boost productivity growth due to better access to a larger variety of inputs and services. Second, it can generate efficiency gains due to external economies of scale and scope. Third, it can boost knowledge spillovers, and improve the allocation of capital and labour. Recent studies have introduced dynamic knowledge accumulation into trade models and shown that the dynamic welfare gains may be substantial (Sampson, 2016). Fourth, our model does not look at sectoral effects of Brexit, which are important for policy analysis. It is also true that introduction of sectors in the model may change the welfare calculations, but only if one does not appropriately deal with zero trade flows (Ossa, 2015). Our approach models and structurally estimates selection into exporters with heterogeneous firms and the possibility of zero trade flows. Finally, special treatment should be considered for agricultural and services sectors. We leave these important questions for future research.

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