The Cost of Non-Europe Revisited*

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PRELIMINARY AND INCOMPLETE

In this paper we quantify the "Cost of Non-Europe", i.e. the trade-related welfare losses that would occur under different scenarios of a collapse of the European Union. Thirty years after the terminology of Non-Europe was used to give estimates of the gains from *further* integration, we use modern versions of the gravity model estimates of the trade creation implied by the EU, and apply those to counterfactual exercises where for instance the EU returns to a "normal", shallow-type regional agreement, or reverts to WTO rules. Those scenarios are envisioned with or without the Brexit happening, which points to interesting cross-country differences and potential cascade effects in doing and undoing of trade agreements.

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1 Introduction

Nearly a quarter century after the implementation of the single market (started in 1987 and achieved in 1993), we live in a age where it seems that the most likely outcome in the near future will be one of trade *disintegration* in Europe, possibly reversing one of the deepest and most prolonged trade liberalization process in modern history. The choice of the United Kingdom to exit the EU (Brexit) combines with the calls from many governments (even ones seen as moderate) for a reversal of key integration agreements like Schengen, to give a bleak picture of what comes next.

This actually makes it a good time to revisit the gains the EU has reaped from trade integration since 1957 and what would be the costs of going backwards. On the academic front is also a happy coincidence that the techniques available to estimates those gains and costs have come to maturity recently, enabling a relatively easy quantification of different scenarios which might characterize the near future of the continent. In particular, the recent work by Dekle *et al.* (2007), Arkolakis *et al.* (2012), and following papers summarized in Costinot and Rodriguez-Clare (2014), has shown that the most popular models that trade economists have been developing and using since the late 1970s (a large class of models featuring important diversity in assumptions regarding demand systems and market structure) have two very convenient properties for the purpose of quantifying Gains From Trade (GFT):

1. trade frictions are estimable in a simple way using structural gravity;
2. endowed with those frictions, it is easy to run counterfactuals using an Exact Hat Algebra approach (EHA) that imposes minimal data requirement.

This paper can be seen as a re-assessment of the "Cost of non-Europe". The first assessment was one carried on in 1988, in an official European Commission report estimating the likely gains that would come from the achievement of the Single Market Programme (SMP). The initial report was an ambitious ex-ante exercise, aimed at identifying the gains from removing various types of non-tariff barriers (NTBs) that were seen as a major impediment in the full achievement of the initial goals of the Treaty of Rome. Our paper is an ex-post exercise quantifying what would be the costs of un-doing what has been achieved over all those years in terms of European integration. We propose various scenarios of EU disintegration, ranging from the return to a "standard" free trade agreement to the return to WTO rules under which each former EU country would apply the current MFN tariffs to its former EU partners. Our work is related to numerous recent quantification of trade policy scenarios, and in particular to Costinot and Rodriguez-Clare (2014) and Dhingra *et al.* (2016). The latter paper provides a rigorous quantification of the trade effects of Brexit, using a framework very similar to ours. Compared to this paper, our work takes a broader perspective and evaluates various scenarios of overall EU disintegration, taking into account Brexit. Furthermore we ground our simulations with our own estimates of the direct trade effects of the EU.

Several qualifications are in order regarding the scope of our analysis. We estimate the economic gains from European integration through the trade channel. We are therefore silent about other dimensions of European integration, such as e.g. the free mobility of capital and labor or the effects of the euro, or non-economic gains.[1] Also, by the supranational nature of the EU, member countries may benefit from a more efficient provision of public goods in common (e.g. external trade policy, competition policy, monetary policy...) as well as incur costs related to the heterogeneity of preferences between members (Spolaore *et al.*, 2000). In addition, our framework does not feature dynamic gains. From a theoretical point of view, dynamic gains from trade are ambiguous: improved market access may induce more innovation but increased competition may induce some of this innovation to be defensive, i.e. to dampen the pro-competitive gains from trade. Increased competition might also reduce the rents from innovation (Aghion and Howitt, 1992; Aghion *et al.*, 1997). From an empirical point of view, Bloom *et al.* (2016) find a positive impact of Chinese competition on innovation activities on a panel of European firms, while Autor *et al.* (2016) find a negative impact on US firms. Because we do not want to take a strong stance on this topic which would involve a detailed empirical analysis of those dynamic gains that go well beyond our paper, we concentrate on static gains.

There are two steps in our analysis. The first is a gravity estimation, which separates the EU agreements from the rest of regional trade deals, and estimates the surplus of trade flows that is due to various sides of the EU process (the single market, Schengen, and the euro). This provides us with a set of parameters that describe the *direct* effects of the EU. Those can be first compared to the literature, and then used in the second step, i.e. the exact hat algebra counterfactual simulations described above. The first step is conducted in section 2, and the second in section 3.

2 Estimating the impact of RTAs

2.1 Structural Gravity

The first step towards welfare evaluation of changes in trade policies relies on the gravity model, which describes how bilateral imports of country n from country i react to changes in the level of bilateral "freeness" of trade, noted ϕ_{ni}. The gravity model has been used at least since the 1960s, and Tinbergen (1962) often cited as the first application to trade flows was actually an evaluation of the trade effects of the European Community. The modern version of gravity, specially when motivated by evaluation of policy-relevant counterfactuals, requires theoretical foundations. A surprisingly large set of models (covered in Head and Mayer (2014), and referred to as *structural gravity*) explain trade flows as

$$X_{nit} = \underbrace{\frac{Y_{it}}{\Omega_{it}}}_{S_{it}} \underbrace{\frac{X_{nt}}{\Phi_{nt}}}_{M_{nt}} \phi_{nit}, \tag{1}$$

where $Y_{it} = \sum_n X_{nit}$ is the value of production, $X_{nt} = \sum_i X_{nit}$ is the value of the importer's expenditure on all source countries, and Ω_{it} and Φ_{nt} are "multilateral resistance" (MR) terms defined as

$$\Phi_{nt} = \sum_{\ell} \frac{\phi_{n\ell t} Y_{\ell t}}{\Omega_{\ell t}} \quad \text{and} \quad \Omega_{it} = \sum_{\ell} \frac{\phi_{\ell it} X_{\ell t}}{\Phi_{\ell t}}. \tag{2}$$

[1] In particular, Martin *et al.* (2012) and Vicard (2012) emphasize the security gains associated with regional trade integration.

An immediately apparent feature of structural gravity is its multiplicative form. After taking logs, this means that the effect of multilateral resistance terms can be captured by exporter and importer fixed effects, while ϕ_{ni} is measured through a vector of bilateral trade costs variables, including RTAs:

$$\ln X_{nit} = \ln S_{it} + \ln M_{nt} + \ln \phi_{nit}. \quad (3)$$

Another key feature is that the level of trade flows between n and i is affected by third countries, only through the Φ and Ω terms that are specific to the exporter and importer respectively. This points to a renewed interpretation of the trade creation and trade diversion concepts as *direct effects* and *indirect effects*, through multilateral resistance terms, of changes in policy variables included in ϕ_{nit}. An increase in ϕ_{nit} is directly increasing bilateral trade flows between n and i, while also changing the relative trade costs (and delivered price under the usual assumptions on pass-through) through its impact on MR terms. Consumers therefore reallocate demand according to new relative prices, diverting trade coming from all non-members in the case of RTA signature.

2.2 Endogeneity of RTAs and zeroes

There are two main remaining issues with estimation of equation (3). The first relates to potential endogeneity of the main variables of interest, i.e. different RTAs. It is quite obvious that pairs sharing a regional agreement might also be characterized by other unobserved bilateral proximity factors. This is a concern that has been considered recently in the literature, examples including Carrere (2006), Baier and Bergstrand (2007) or recently Bergstrand *et al.* (2015) and Limão (2016). The most common treatment of that issue is to include bilateral fixed effects to the regression:

$$\ln X_{nit} = \text{FE}_{it} + \text{FE}_{nt} + \text{FE}_{ni} + \ln \phi_{nit}. \quad (4)$$

Because of the very large size of datasets in gravity equations (combined with improved estimation techniques), this high-dimensional fixed effects approach is a feasible one, that identifies variables in the pure within dimension. For instance, we might be concerned that Canada and the United States are in a RTA because of their continued good political relationship over the last century (at least), and that this might affect directly trade flows, biasing the estimated coefficient on CUSA/NAFTA. The bilateral fixed effect is treating this concern, which is now passed to the within dimension: we have to be concerned with the *timing* of CUSA/NAFTA. Maybe it is because the alignment of those two countries' diplomatic interests was especially high during the end of the 1980s that those agreements were signed. At this point, there is little else to do than to add a credible set of bilateral-time controls. The alternative is to find an IV that would cause RTAs in that same dimension, without affecting trade directly. We are not aware of many convincing examples to date.

Another issue is that even at the aggregate level of total trade in the recent period, there are combinations of country-pairs that do not trade. Those zeroes are again obviously not random, and might introduce selection bias, as first emphasized by Helpman *et al.* (2008). There are several approaches to deal with this type of selection bias. One is the PPML approach emphasized by Santos Silva and Tenreyro (2006), an alternative is the generalized tobit introduced by Eaton and Kortum (2001). Unfortunately i) none of them is ideal since the performance of each method depends on assumptions on the process generating the zeroes, and on the type of error term (for an indepth survey analysis of the potential biases, see Head and Mayer (2014)), ii) both methods present computational challenges when the dataset gets large.

2.3 Results

Estimation of equation (3) is carried out in two parts, the first–covering goods–uses a large scale bilateral dataset that covers all country pairs from 1950 to 2012. This dataset is an extension of Head *et al.* (2010) to most recent years. It is primarily based on IMF DOTS trade flows data combined with CEPII gravity datasets, updated notably on the relevant policy variables. As pointed out in Limão (2016), estimates of RTA effects might suffer from small sample bias, since those are identified on a few observations inside a country pair. This is our main motivation for using this long-run panel for trade in goods, the downside being its lack of sectoral detail. We also use a (shorter) panel of bilateral flows in commercial services, which is an extended version of the data used in Head *et al.* (2009). The primary source for this type of trade is Eurostat, which provides the best available data to our knowledge for trade in services. We feel that accounting for trade in services is quite important since there are many aspects of the EU integration process that concern trade in services directly (free trade in services was an objective from the very start of the process) or indirectly (notably through the free mobility of people and capital, since trade in services often requires movement of labor and/or local investment).

Column (1) in Table 1 presents results of a naive gravity estimate, that replaces the theoretically-consistent country-year effects in equation (3) with size proxies accounting for population and income per capita. The naive approach also features the usual time invariant bilateral variables such as distance or common language in place of the bilateral fixed effect. The findings are in line with the rest of the literature, where size effects exhibit elasticities near 1, and distance reduces trade with an elasticity close to -1. The usually included set of proximity variables all promote trade, colonial linkages, contiguity and common language being the most substantial trade-promoters.

The variables of interest for our purpose start with RTA, which is estimated to strongly promote trade. The direct (partial) impact of having an RTA active between two countries being to more than double trade flows. Such naive gravity however yields disappointing estimates for the EC/EU, implying a much smaller trade increase before 1992 and similar to the average RTA after the implementation of the single market. While the effect is smaller, the impact of belonging to the Schengen zone is significantly positive, around 10%. GATT/WTO has a positive estimated effect, substantial but markedly smaller than the effect of regional agreements. Finally, sharing a currency has the usual positive and large effect. We add a dummy variable for the euro, which does not seem to significantly promote trade.

Column (2) starts to introduce fixed effects, accounting for bilateral heterogeneity in trade patterns. The set of time-invariant bilateral variables like distance are dropped and the set of variables of interest in the bottom of the table is now estimated in the within dimension. The effect of standard RTAs drop as expected. RTAs are likely to be associated with omitted positive drivers of trade that are captured by the bilateral fixed effects. It however remains positive and very significant: bilateral trade is estimated to be around 40% larger after the signature of a

Table 1: Gravity results of European integration in goods and services

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample			Goods				Services	
Flow			Goods				Services	Goods
ln Pop, origin	0.926^a	0.410^a			0.426^a	0.551^a		
	(0.005)	(0.039)			(0.041)	(0.047)		
ln Pop, dest	0.795^a	1.109^a						
	(0.005)	(0.036)						
ln GDP/Pop, origin	1.054^a	0.723^a			0.758^a	0.759^a		
	(0.007)	(0.014)			(0.015)	(0.019)		
ln GDP/Pop, dest	0.858^a	0.651^a						
	(0.007)	(0.013)						
ln Dist (avg)	-0.944^a							
	(0.014)							
Shared Border	0.629^a							
	(0.065)							
Shared Language	0.336^a							
	(0.036)							
Shared legal origin	0.033							
	(0.023)							
Colonial History	1.314^a							
	(0.073)							
Ever sibling	0.477^a							
	(0.034)							
RTA	0.836^a	0.332^a	0.371^a	0.373^a	0.381^a	0.086^a	0.071^b	0.090^a
	(0.036)	(0.023)	(0.024)	(0.024)	(0.027)	(0.032)	(0.033)	(0.028)
European Union	0.266^a	0.688^a	0.420^a	0.411^a	0.638^a	0.414^a	0.177^a	0.333^a
	(0.061)	(0.036)	(0.041)	(0.041)	(0.044)	(0.033)	(0.058)	(0.046)
EU post 92	0.869^a	0.790^a	1.040^a	1.041^a	1.068^a	0.531^a		
	(0.043)	(0.038)	(0.044)	(0.044)	(0.049)	(0.034)		
Shengen	0.097^b	0.105^a	0.173^a	0.175^a	0.221^a	0.092^a	-0.027	-0.096^a
	(0.046)	(0.036)	(0.042)	(0.043)	(0.042)	(0.022)	(0.032)	(0.023)
Both GATT	0.195^a	0.239^a	0.151^a	0.151^a	0.250^a	0.305^a	0.215	0.153
	(0.018)	(0.015)	(0.027)	(0.027)	(0.024)	(0.036)	(0.366)	(0.151)
Shared Currency	0.677^a	0.586^a	0.341^a	0.341^a	0.523^a	0.791^a		
	(0.089)	(0.089)	(0.068)	(0.068)	(0.081)	(0.081)		
EuroZone	0.031	0.083^c	-0.119^b	-0.365^a	-0.125^c	-0.063^b	0.051	0.046
	(0.057)	(0.048)	(0.056)	(0.067)	(0.067)	(0.025)	(0.038)	(0.033)
EuroZone after 2002				-0.221^a				
				(0.066)				
EuroZone after 2009				0.062				
				(0.060)				
Observations	739215	760444	848879	848879	159249	233420	35927	33822
R^2	0.630	0.435	0.859	0.859	0.855		0.965	0.972
Origin×year and dest×year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses, with significance levels indicated with [c] for 10%, [b] for 5%, [a] for 1%.

regional agreement. The EU is estimated to be an even larger trade creator unlike in the first column. Note that the EU is a particular case in several dimensions. The depth of the agreement is the first dimension. The effect of depth of the agreement is perhaps most visible in the post 92 effect, estimated to more than double trade ($\exp(0.79) = 2.2$). The second dimension is that the EU experienced several enlargements over time (in 1973, 1981, 1986, 1995, 2004, 2007 and 2013). Each of those helps identification of the trade creating effects of the two EU variables in the within dimension. Shengen, GATT/WTO, Shared currency and the eurozone dummies all keep the same sign with the use of bilateral fixed effects. It is interesting to note that the within estimate of the euro is larger and more statistically significant than the naive coefficient from column (1) that comes mostly from the cross-sectional dimension.

Column (3) is the theory-consistent estimate of the gravity equation in goods, which add importer-time and exporter-time fixed effects, which capture the multilateral resistance terms that go beyond size effects of the importer and exporter. The qualitative pattern of our variables of interest is unchanged for the most part, one exception being the trade impact of the euro. The introduction of country-year effects reverses its sign. Note that the coefficient on shared currency is also substantially reduced. Both results are in line with the literature (Baldwin, 2006): a common currency, and the euro in particular have a trade effect that is very sensitive to the set of fixed effects introduced in the regression. When the regression is micro-founded, the effect of the euro becomes slightly negative.[2] In order to dig into this intriguing finding, we separate in column (4) the effect of the euro between different subperiods. Results suggest that the negative effect of the euro on trade within the euro area is specific to the first decade of the euro. By 2009, the coefficient on euro area membership turns positive but insignificant.

As emphasized by Limão (2016), we can use our results to show that the impact of RTAs on trade goes well beyond the fall in tariffs implied by the agreement. In the case of a deep agreements such as the EU, the reduction of non-tariffs barriers and other behind-the-border trade costs are even more prevalent and should add a lot to the simple cut in tariffs. World Trade Organization (2011) reports a preferential margin of 4.9 percentage points in the specific case of the EU. The EU effect estimated in table 1, column 4 for instance, has an estimated coefficient of 1.041. It would involve an elasticity of trade of $1.041/\ln(1.049) = 21.8$, well beyond the standard estimate of 5.03 found in the meta analysis of Head and Mayer (2014), which summarizes the typical findings of that literature. Put another way, the direct (partial) trade impact of tariffs cut alone under the EU would be to multiply bilateral trade between members by a factor of $(\exp^{0.049})^{5.03} = 1.28$, to be compared with an overall effect of the EU of $\exp^{1.041} = 2.83$ estimated from a gravity equation in Table 1. Note that the trade impact implied by the preference margin is close to the estimated effect of an average RTA ($\exp^{0.373} = 1.45$). This underlines the major role played by provisions on non-tariffs barriers in deep RTAs such as the EU.

The results from columns (3) and (4) include a very large set of fixed effects, one for each importer-year, exporter-year, and pair of countries in a very large panel that spans over more than 60 years. This is made feasible in OLS through recent advances in this type of estimation.[3] This is however much more problematic for the PPML estimation mentioned in the previous section

[2]Note that accounting properly for the deepening of the European union, through in particular the implementation of the single market beginning in 1992, is of utmost importance when measuring the trade impact of the creation in 1999 of the euro area, whose members all belong to the EU.

[3]The `reghdfe` procedure is particularly helpful in this respect.

as one way to deal with zeroes in gravity. We managed to estimate the model with country-pair and importer-year effects, for five years intervals of the data, controlling for exporter-year determinants with the traditional size variables. This is reported in column (6). Column (5) replicates the estimation with OLS in the same sample, for comparison purposes. The 5 year intervals and proxy of exporter-year determinants with size variables does not seem to influence results too much comparing columns (3) and (5). Coefficients of interest systematically exhibit the same signs and are often very close in magnitude. Comparing column (6) to column (5) shows the pure effect of switching from OLS to PPML. The effect of RTAs is smaller but still significantly positive. Most important for our purposes, the EU and Shengen effects are still (very) significantly positive.

We last turn to trade in services. As stated above, this is a much reduced sample, which starts in the beginning of the 1990s, and covers a much smaller number of countries. We therefore report in column (7) results for services, and in column (8) results for goods on the same sample of services for appropriate comparison. Both regressions have the full set of fixed effects and use OLS. RTAs have a smaller effect, around 7%, on trade in services that what we find for trade in goods in the preceding columns. The EU still exhibits a substantially larger effect than the average agreement on flows of services (note that this is the equivalent of EU post-92 since the sample starts in 1992). The comparison with goods in column (8) makes it clear that most of the reduced effects from previous columns comes from the shortened panel (Limão (2016) also underlines that shorter panel are unable to capture the long term effect of RTAs).

3 Quantifying the welfare impact of European integration

3.1 General Equilibrium Trade Impact and Welfare changes

Costinot and Rodriguez-Clare (2014) show that a variety of trade models (the ones most used in the field) yield the same (simple) formula which can be used to quantify welfare gains associated with trade openness. In a multi-sector framework with tradable intermediate goods, welfare changes associated to a change in trade costs write:[4]

$$\hat{C}_n = \prod_{s,k} \left(\hat{\pi}_{nn,k} \left(\frac{\hat{e}_{n,k}}{\hat{v}_n}^{\eta_k} \frac{\hat{r}_{n,k}}{\hat{v}_j} \right)^{-\delta_k} \right)^{-\beta_{n,s}\tilde{a}_{n,sk}/\varepsilon_k}$$

where hats denote percentage changes ($\hat{C}_n = \frac{C'_n}{C_n}$, with C_n the initial welfare and C'_n the new welfare after policy change). $\hat{v}_n$ is the change in the ratio of value added to output, $\hat{e}_{n,s}$ and $\hat{r}_{n,s}$ are changes in expenditures and revenues respectively, η_k is a measure of firm heterogeneity. The equation is able to deal with both monopolistic competition ($\delta_s = 1$) and perfect competition ($\delta_s = 0$). $a_{n,ss}$ are the elements of an adjusted Leontief inverse matrix of input-output linkages $(I - \tilde{A_n})^{-1}$. The elements of $\tilde{A_n}$ are given by: $\tilde{\alpha}_{n,ss} = \alpha_{n,ss}(1 + (\delta_s/\varepsilon_s))$, where $\alpha_{n,ss}$ are the standard technology parameter from the input-output matrix.

One can calculate welfare gains under perfect competition and Cobb-Douglas preferences,

[4] See equation 28 p.217 in Costinot and Rodriguez-Clare (2014).

which simplifies to:

$$\hat{C}_n = \prod_s \left(\hat{\pi}_{nn,s}\right)^{-\beta_{n,s} a_{n,ss}/\varepsilon_s} \tag{5}$$

Further assuming that intermediate inputs are sourced from the sector itself only ($\alpha_{n,ss'} = 0$ if $s \neq s'$), A_n is diagonal with elements that are technology parameter $\alpha_{n,ss}$.

Without intermediate goods, equation 5 reduces to:[5]

$$\hat{C}_n = \prod_s \left(\hat{\pi}_{nn,s}\right)^{-\beta_{n,s}/\varepsilon_s}. \tag{6}$$

Equipped with those formulas, we can quantify the welfare changes implied by various scenarios. In all those configurations, we need to compute the counterfactual trade shares, which will yield $\pi'_{nn,s}$ under $\phi'_{n,s}$, i.e. under each of the alternative scenarios of EU dissolution. Adopting terminology from Head and Mayer (2014), and using equation (1), we can compute the General Equilibrium Trade Impact (GETI) of a change in trade costs from $\phi_{n,s}$ to $\phi'_{n,s}$ ($\phi_{ni} \equiv \tau_{ni}^{\epsilon}$):

$$\text{GETI}_{ni,s} = \frac{X'_{ni,s}}{X_{ni,s}} = \underbrace{\exp[\beta_{EU,s}(\text{EU}'_{ni} - \text{EU}_{ni})]}_{\text{PTI}} \times \underbrace{\frac{\Omega_{i,s}\Phi_{n,s}}{\Omega'_{i,s}\Phi'_{n,s}}}_{\text{MR adj.}} \times \underbrace{\frac{Y'_{i,s}X'_{n,s}}{Y_{i,s}X_{n,s}}}_{\text{GDP adj.}} = \frac{\hat{Y}_{i,s}\hat{X}_{n,s}}{\hat{\Omega}_{i,s}\hat{\Phi}_{n,s}}\hat{\phi}_{ni}. \tag{7}$$

We therefore need to solve for counterfactual multilateral resistance terms and GDPs to assess the trade impact of specific regional trade agreements on members and non-members trade.

Structural gravity also writes:

$$X_{ni,s} = \pi_{ni,s}X_{n,s} = \frac{(w_{i,s}^{\mu_s}P_{i,s}^{1-\mu_s}\tau_{ni,s})^{\varepsilon_s}}{\sum_\ell (w_{\ell,s}^{\mu_s}P_{\ell,s}^{1-\mu_s}\tau_{n\ell,s})^{\varepsilon_s}} X_{n,s}, \tag{8}$$

where μ_s is the share of value added in output of sector s. As in Dekle *et al.* (2007), we assume that sector s consumes its own production as intermediate inputs.

Assuming $Y_{i,s} = w_{i,s}L_{i,s}$, with $L_{i,s}$ constant, we get:

$$\frac{\pi'_{ni,s}}{\pi_{ni,s}} = \hat{\pi}_{ni,s} = \frac{(\hat{Y}_{i,s}^{\mu_s}\hat{P}_{i,s}^{1-\mu_s}\hat{\tau}_{ni,s})^{\varepsilon_s}}{\sum_\ell \pi_{n\ell,s}(\hat{Y}_{\ell,s}^{\mu_s}\hat{P}_{\ell,s}^{1-\mu_s}\hat{\tau}_{n\ell,s})^{\varepsilon_s}}. \tag{9}$$

We further assume constant trade balances on a per capita basis, $X_{n,s} = w_{n,s}L_{n,s}(1 + d_{n,s})$, so that $\hat{X}_{n,s} = \hat{w}_{n,s} = \hat{Y}_{n,s}$. Using the market clearing condition that $Y'_{i,s} = \sum_n \pi'_{ni,s}X'_{n,s}$, one can solve for the changes in production of each origin country:

$$\hat{Y}_{i,s} = \frac{1}{Y_{i,s}}\sum_n \hat{\pi}_{ni,s}\pi_{ni,s}\hat{Y}_{n,s}X_{n,s} = \frac{1}{Y_{i,s}}\sum_n \frac{\pi_{ni,s}\hat{Y}_{i,s}^{\mu_s\varepsilon_s}\hat{P}_{i,s}^{(1-\mu_s)\varepsilon_s}\hat{\phi}_{ni,s}}{\sum_\ell \pi_{n\ell,s}\hat{Y}_{\ell,s}^{\mu_s\varepsilon_s}\hat{P}_{\ell,s}^{(1-\mu_s)\varepsilon_s}\hat{\phi}_{n\ell,s}}\hat{Y}_{n,s}X_{n,s}. \tag{10}$$

Our algorithm follows three steps:[6]

- calculate $\text{PTI}_{ni,s} = \hat{\phi}_{ni,s} = \exp(\beta_{EU,s})$ for the ni for whom $\text{EU}_{ni} = 1$ and $\hat{\phi}_{ni,s} = 1$ for all other pairs;

[5] See equation 22 p.214 in Costinot and Rodriguez-Clare (2014).

[6] Since we assume that intermediate goods are consumed from the sector itself only, the computation can be run separately for each sector s.

- plug estimated $\hat{\phi}_{ni,s}$ (along with initial values of $Y_{i,s}$, $X_{n,s}$, and the $\pi_{ni,s}$) into equation (10), substitute $\hat{\phi}_{ni,s}$ and $\hat{Y}_{i,s}^{\varepsilon_s}$ into equation (9) to get the matrix of trade changes and iterate using a dampening factor until $\hat{\pi}_{ni,s}$ stops changing;
- calculate the GETI, $\hat{\pi}_{ni,s}\hat{Y}_{n,s}$, for each country pair and the change in intra-national trade $\hat{\pi}_{nn,s}$.

3.2 Data

We use data from the World Input-Output Database (WIOD) developed by Timmer *et al.* (2015), which provides production and trade data for 43 countries and 56 2-digit (ISIC rev4) sectors covering the whole economy. We use data for 2014, the most recent year available.[7] We aggregate the data into three broad sectors: goods, tradable services and non-tradable services.[8] The share of intermediate inputs in production of each sector is taken from WIOD as the world average of value added to production by sector: $\mu_{good} = 0.321$ and $\mu_{busserv} = 0.548$. The trade elasticity $\epsilon_s = 5.03$ is taken from the preferred value reported in Head and Mayer (2014).

The estimate of the trade impact $\beta_{EU,s}$ is taken from section 2, and encompasses the impact of the single market and the Schengen area. For trade in goods, we use results from column (4) in Table 1, i.e. $\beta_{EU,goods} = 1.041 + 0.175 = 1.216$.[9] As underlined in section 2, the impact found on trade in services is half the impact on trade in goods when estimated on the same sample (columns (7) and (8) in Table 1). Since the smaller absolute estimated coefficient on both goods and services trade is likely related to the shortened panel, we assume $\beta_{EU,serv} = 1.216/2 = 0.608$.

We consider two alternative scenarios to assess the gains from European integration. In a first counterfactual, we assume that the European Union (including the Schengen agreement) is replaced by a regular/standard RTA, corresponding to the average effect of RTAs found in section 2. In a tougher scenario, we assume that trade between actual members of the European Union is governed by the Most Favored Nation tariffs in application of the World Trade Organization membership.[10]

4 The gains from the European Union

4.1 The trade effect of EU membership

In this section, we present the counterfactual trade matrix under our scenario of EU returning to a "normal" RTA. Table 2 reports our results with the first columns showing the ratio of real to counterfactual trade flows. The first insight obtained from this table is that the European Union in its current state promotes trade strongly: total imports of goods by EU members increase by 30% on average in the RTA scenario presented in Table 2, with a particularly large impact on

[7] The data is extracted from the 2016 release of WIOD: `http://www.wiod.org/release16`.

[8] The goods sector includes agriculture, hunting, forestry and fishing, mining and quarrying and total manufactures, i.e. ISIC rev.4 sectors 01 to 33; the tradable services sector includes all business services, i.e. sectors 45 to 75; and non-tradable services includes all other services, i.e. electricity, gas and water supply (sectors 35-39), construction (41-43) and community, social and personal services (77 to 99).

[9] We disregard the euro area membership since we find an insignificant impact on trade after 2009.

[10] Note that in this scenario, we abstract from tariffs revenues. It is unlikely to significantly change results since tariff reduction typically represent a small share of the reduction in trade costs between members as shown in section 2. Accounting for tariffs would however dampen the difference between the RTA and WTO scenarios.

Table 2: The trade effect of EU integration (RTA scenario with intermediate inputs)

Sector	Goods			Goods		Tradable Services			Tradable Services	
Var.	Imports with/without EU			Import/ consumption		Imports with/without EU			Import/ consumption	
Origin / State of the world	Total	EU	non EU	Total With EU	Total Without EU	Total	EU	non EU	Total With EU	Total Without EU
AUT	142%	177%	84%	60%	44%	126%	144%	95%	13%	11%
BEL	135%	191%	90%	72%	59%	121%	144%	97%	24%	20%
BGR	124%	183%	85%	55%	45%	130%	148%	98%	11%	9%
CYP	95%	141%	64%	68%	63%	130%	152%	102%	18%	14%
CZE	151%	196%	92%	61%	44%	121%	137%	92%	14%	11%
DEU	138%	195%	93%	46%	35%	118%	140%	95%	11%	9%
DNK	133%	178%	84%	59%	46%	116%	145%	96%	19%	17%
ESP	132%	206%	95%	39%	31%	125%	146%	96%	6%	5%
EST	127%	172%	80%	71%	58%	131%	143%	95%	16%	12%
FIN	136%	192%	90%	44%	33%	113%	138%	91%	13%	12%
FRA	129%	185%	87%	47%	37%	123%	149%	99%	8%	7%
GBR	114%	175%	83%	47%	40%	125%	152%	101%	8%	6%
GRC	109%	176%	82%	46%	40%	115%	141%	94%	10%	8%
HRV	130%	172%	82%	54%	42%	122%	143%	95%	12%	10%
HUN	142%	186%	88%	69%	53%	127%	146%	97%	21%	17%
IRL	127%	188%	84%	79%	68%	108%	144%	97%	52%	48%
ITA	138%	204%	96%	33%	25%	119%	140%	94%	6%	5%
LTU	122%	190%	89%	68%	59%	118%	148%	100%	19%	16%
LUX	119%	145%	70%	84%	74%	115%	140%	93%	52%	46%
LVA	124%	169%	79%	64%	53%	132%	148%	99%	11%	8%
MLT	110%	164%	75%	72%	64%	123%	133%	90%	52%	43%
NLD	134%	205%	96%	67%	55%	124%	159%	105%	19%	16%
POL	144%	198%	93%	43%	31%	136%	162%	107%	10%	8%
PRT	131%	176%	81%	49%	37%	126%	142%	94%	8%	6%
ROU	130%	179%	85%	39%	30%	137%	159%	105%	9%	6%
SVK	139%	189%	91%	65%	51%	141%	158%	104%	12%	8%
SVN	140%	187%	88%	68%	53%	126%	148%	98%	14%	11%
SWE	135%	182%	86%	51%	38%	120%	144%	96%	16%	13%
EU (mean)	130%	182%	85%	58%	47%	124%	146%	97%	17%	14%
EU (median)	131%	184%	85%	59%	44%	124%	145%	97%	13%	11%

Note: Columns (1)-(3) and (6)-(8) present the ratio of actual imports (total, from EU countries and from extra EU countries respectively) to imports in the counterfactual without the EU. A ratio larger than 100% indicates that the EU increases imports from the specific origin. Columns (4) and (9) report the actual openness ratio (import/consumption) for goods or tradable services and columns (5) and (10) the openness ratio in the counterfactual case without the EU.

small open economies and on Central and Eastern European countries. The import penetration ratio (total imports over consumption) in the goods sector is almost one quarter larger on average for EU countries compared to the counterfactual situation, with heterogeneous impacts depending on the initial geographical specialization of countries. Peripheral countries like Greece, Malta or Cyprus benefit less in terms of EU trade integration while small and Eastern European countries increase their trade openness in goods by close to 30%.[11] The impact on imports of services is lower, with an average increase of 24% involving a 21% larger import penetration ratio.

An important difference between results in that section and the ones in section 2 lies in the indirect effects of the policy experiment (here EU integration). In the simple gravity setup of section 2, we estimate the direct impact (partial trade impact, PTI) of the EU, by neutralizing general equilibrium effects that happen through changes in multilateral resistance (MR) terms and changes in GDPs (shown in equation 7) through the use of origin×year and destination×year fixed effects. Results in Table 2 include all effects. The PTI and inward MR adjustment (Φ) effects have a strong connection to the trade creation / trade diversion effects from classical Vinerian analysis. Together they drive the re-orientation of expenditure sourcing by consumers in n following the price changes implied by the policy experiment. The changes in GDP and outward multilateral resistance (Ω) drive the relative attractiveness of products proposed by country i.

In total, those effects imply a massive trade reallocation following the implementation (or collapse) of the EU. Bilateral imports of goods within the EU are on average close to twice as large compared to the counterfactual. The impact is particularly large for small open economies like the Netherlands, Belgium, Ireland, Slovakia, the Czech Republic or Poland. The impact on trade in services is much smaller (around 50%), with increases caused by the EU ranging from +62% for Poland to +38% for Finland.

A key distinctive feature of the GETI approach, compared to traditional gravity is third-country effects, that are not quantifiable with gravity estimation. Those third-country effects are subject to contradicting forces: the larger inward multilateral resistance in EU economies decreases trade from countries that do not benefit from preferential market access but the beneficial impact of the EU on member countries GDPs dampens this effect. Overall, Table 2 reveals that imports of goods from non-EU countries are expected to be on average 15% lower than without the EU, but those imports are more stable for countries like the Netherlands and Poland. The same pattern holds for trade in services, even though to a lower extent with an average reduction of 3%.

4.2 Welfare gains by country member

Table 3 reports the welfare gains in percent with two different scenarios and two different assumptions regarding whether intermediates are included or not in the model. Columns (1) and (2) consider the simplest case with only final goods, when the two next columns include intermediates. Columns (1) and (3) consider the scenario under which a regular RTA replaces the EU, columns (2) and (4) take the most extreme route where EU countries return to the WTO option under which MFN tariffs replace the EU.

The main conclusion is very clear: all member countries unambiguously obtain positive wel-

[11] Note that the change in trade openness combines the direct impact on trade and the indirect one coming from endogenous GDP adjustments.

Table 3: Welfare gains from EU under different scenarios

Counterfactual Assumption	(1) to RTA	(2) to MFN	(3) to RTA	(4) to MFN
	without intermediates		with intermediates	
AUT	2,2%	2,9%	6,7%	8,8%
BEL	2,7%	3,4%	7,4%	9,7%
BGR	1,9%	2,5%	5,8%	7,5%
CYP	1,1%	1,5%	3,1%	4,0%
CZE	3,1%	4,0%	9,3%	12,1%
DEU	1,4%	1,8%	4,1%	5,2%
DNK	1,7%	2,2%	5,0%	6,4%
ESP	0,9%	1,2%	2,8%	3,6%
EST	3,1%	4,0%	9,1%	11,9%
FIN	1,2%	1,6%	3,6%	4,6%
FRA	1,0%	1,3%	3,0%	3,8%
GBR	0,7%	0,9%	2,0%	2,6%
GRC	0,7%	0,9%	2,2%	2,7%
HRV	1,8%	2,3%	5,3%	6,9%
HUN	4,1%	5,3%	12,2%	16,2%
IRL	2,3%	3,1%	5,9%	7,7%
ITA	0,8%	1,0%	2,4%	3,0%
LTU	2,5%	3,3%	7,5%	9,8%
LUX	3,0%	4,0%	7,1%	9,5%
LVA	1,9%	2,4%	5,6%	7,2%
MLT	3,2%	4,2%	7,1%	9,5%
NLD	2,3%	3,0%	6,5%	8,5%
POL	1,8%	2,3%	5,3%	6,7%
PRT	1,5%	1,9%	4,6%	5,8%
ROU	1,3%	1,7%	4,0%	5,1%
SVK	3,4%	4,5%	10,4%	13,7%
SVN	3,1%	4,0%	9,1%	12,0%
SWE	1,5%	1,9%	4,2%	5,4%
EU (weighted mean)⋆	1,3%	1,7%	3,9%	5,0%
EU (mean)	2,0%	2,6%	5,8%	7,5%

Note: welfare gains are relative to the counterfactual scenario, in which the EU is either replaced by a standard RTA (columns (1) and (3)) or WTO rules (columns (2) and (4)). Welfare gains computed from equation (6) in columns (1)-(2) and equation (5) in columns (3)-(4). ⋆ weighted by share in consumption.

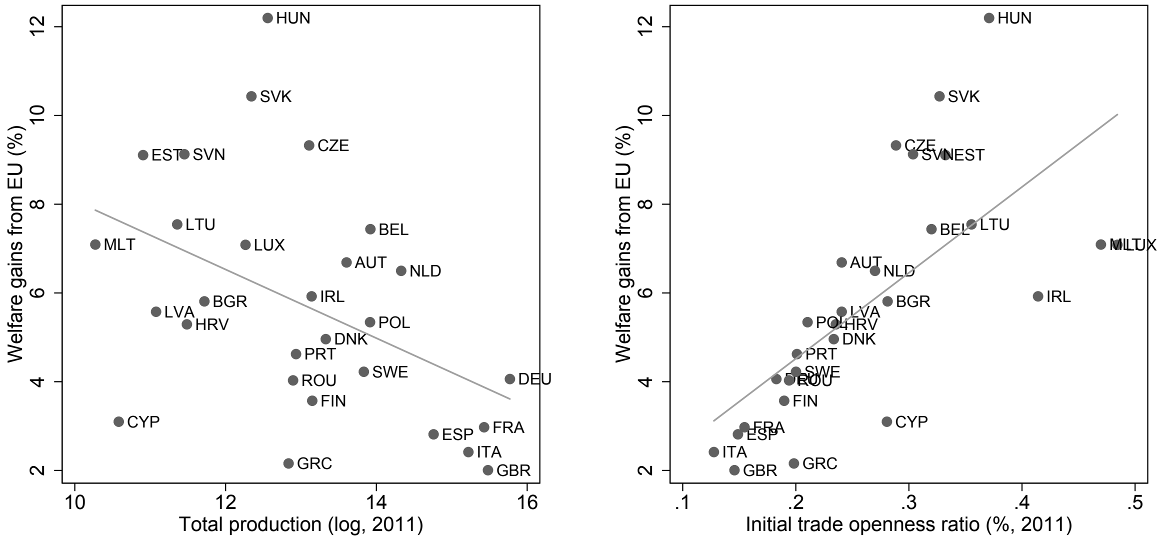
fare gains from the EU as it is. The average gain ranges from 2% to 7.5%. Average gains are slightly lower on a weighted basis, ranging from 1.3% to 5.0%, reflecting the lower dependence of large countries on international trade. In the type of model generating the equations we use for those calculations, there is an exact correspondence between welfare and real GDP. Hence, the EU on average generates a *permanent* real GDP increase that is very sizable. The magnitude of the estimated gains however depend on the specific modeling assumptions regarding intermediate goods: whatever the scenario, gains from trade integration are substantially larger with intermediate goods (columns (3) and (4)) than without (columns (1) and (2)).

Taking an optimistic scenario where the decomposition of the EU would simply mean getting back to a normal RTA (dropping the "deep integration" characteristics such as free movement of labor, single market disposition regarding harmonization of norms, common competition policy with an objective to foster the EU integration, etc.), generates an average 5.8% (3.9% when weighted) permanent real GDP loss for EU countries (column (3) of table 3). In our view, it is not trivial to find an easily implementable policy change that would yield such a large average gain to European countries, with extremely robust empirical evidence (such as gravity for the present case of EU integration) backing up that policy. It is also important to note that both scenarios of EU collapse would be costly. While the return to MFN status would of course yield the largest welfare losses, the return to a normal RTA would also be very costly. Actually, the loss of deep integration represents more than three quarters (1.3/1.7 = 76% or 3.9/5.0 = 78%) of the total effect of a return to WTO rules (clearly the worst case scenario).

Looking at the distribution of EU gains (or Non-Europe losses) across countries, again a very clear pattern emerges: small and open economies benefit more from EU integration as it is, and therefore would bear the largest costs under the dis-integration scenarios. Particularly interesting is the case of the Eastern part of the EU. Hungary, Slovakia, Slovenia, Czech Republic are systematically ranked high on the list of countries that would suffer most from a collapse of the EU. Hungary for instance would loose 4% of real GDP under the most optimistic scenario, and 16% under the worst one. The most important losses are in the case where intermediate inputs are taken into account, which suggests that the deep input-output linkages that Eastern Europe has constructed with "Old Europe" would be very costly to undo.

We provide two sets of figures to illustrate how welfare gains from EU integration are related to country characteristics. Equation (5) states that the gains from a given reduction in international trade costs are increasing in the share of domestic trade affected. Larger countries (in terms of total production), which everything else equal consume more of their domestic production, indeed experience lower gains from European trade integration as shown in Figure 2 (panel a), while the opposite is true regarding countries initially more open to trade (Figure 2, panel b). In Figure 2, we relate those same welfare gains to "first nature" observables that are less endogenous to the EU integration process: population in panel a and geographical remoteness in panel b. Again, large and/or peripheral countries that are expected to be less integrated in the European trade network are the ones where the gains form the EU are the more modest (still being non-negligible in any sense).

Figure 1: EU-membership welfare gains

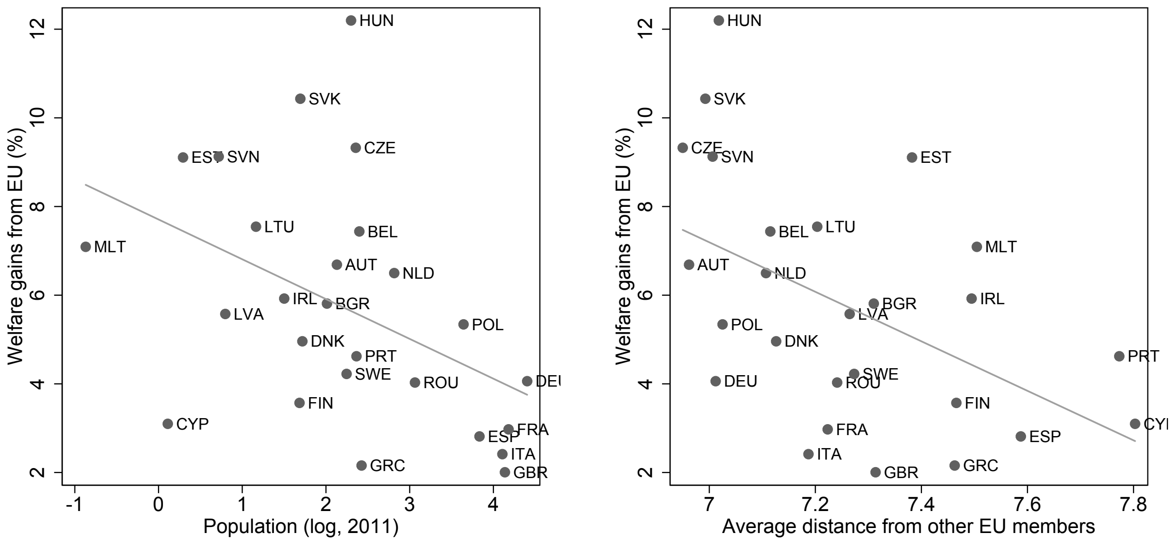


(a) Size and welfare gains

(b) Openness and welfare gains

Note: Welfare gains are from column (3) in Table table 3, under an RTA scenario with intermediate goods. Trade openness computed as total exports over production.

Figure 2: EU-membership welfare gains



(a) Size and welfare gains

(b) Remoteness and welfare gains

Note: Welfare gains are from column (3) in Table table 3, under an RTA scenario with intermediate goods.

4.3 Unilateral exits

So far, we have assumed as a counterfactual scenario a world without the European Union, replaced by WTO rules or a standard RTA between EU members. In this sub-section, we investigate the welfare gains of European integration under a different counterfactual where the EU is still in place between other members than the country under consideration.

Table 4 focuses on the RTA scenario with intermediate goods (i.e. column (3) of table 3) and compares benchmark results (column 1) with a scenario under which the exit is unilateral in column (2). Compared to the benchmark scenario, the trade impact is ambiguous since such single country non-membership would have two opposite impacts through the multilateral resistance adjustment and the GDP adjustment in equation (7). By restricting the access to EU markets only to one outside country, the trade impact should be larger because multilateral resistance would drop less in EU markets, whereas the GDP adjustment would go in the opposite direction and reduce less the trade impact in this alternative counterfactual compared to the benchmark. Overall, the losses from unilateral exits seem marginally larger than the losses from complete EU collapse, specially for small countries.

5 How does Brexit affect the gains from EU?

In this section, we consider how Brexit will affect the gains from European integration for the remaining EU members. We re-run the counterfactual exercise conducted in section 4.2 assuming that the exit of the UK from the EU has already happened, and compare the welfare gains under the two scenarios. More precisely, we assume a similar scenario in the post-Brexit case as the one prevailing in the counterfactual considered in our main exercise. Note that since the United Kingdom was not part of the Schengen agreement, $\text{PTI}_{ni,s}$ is different in the Brexit case since $\beta_{EU,Brexit,good} = \exp \beta_{EU} + \beta_{EU,post92} = 1.041$ (see Table 1).

Such an exercise is especially interesting in the context of the domino's theory of the spread of RTAs put forward by Baldwin (1993) and Baldwin and Jaimovich (2012), which implies that changes in the gains from regional integration are likely to affect the political balance regarding trade integration in member countries.

5.1 Brexit

We first present the results of the Brexit counterfactual on its own. As in the baseline analysis, we consider the impact of the exit of the United Kingdom from the European Union under alternative scenarios for the post-Brexit EU-UK trade relationship – trade between the UK and the EU is governed by either a "standard" RTA or by WTO rules –, and under different modeling assumptions – with intermediate goods (equation 5) or without (equation 6). The resulting trade matrix under each case is used as an input in the corresponding counterfactual.

The results presented in Table 5 show substantial welfare losses for the UK in the range of -0.6% to -2.5% of GDP (first row of the table) depending on the scenario and modeling assumptions. Considering intermediate goods magnifies the losses from reduced trade openness, by a factor of about 3. While the losses are larger in a post-Brexit governed by WTO rules only, it is interesting to note that around three quarters of the losses come from leaving the single market

Table 4: Welfare gains from EU under different scenarios

Counterfactual Assumption	(1) to RTA baseline	(2) to RTA Unilateral Exit
	with intermediates	
AUT	6,7%	7,2%
BEL	7,4%	7,9%
BGR	5,8%	6,2%
CYP	3,1%	3,3%
CZE	9,3%	10,1%
DEU	4,1%	4,3%
DNK	5,0%	5,3%
ESP	2,8%	3,0%
EST	9,1%	9,8%
FIN	3,6%	3,8%
FRA	3,0%	3,1%
GBR	2,0%	2,1%
GRC	2,2%	2,3%
HRV	5,3%	5,7%
HUN	12,2%	13,2%
IRL	5,9%	6,2%
ITA	2,4%	2,5%
LTU	7,5%	8,2%
LUX	7,1%	7,6%
LVA	5,6%	6,0%
MLT	7,1%	7,5%
NLD	6,5%	7,0%
POL	5,3%	5,7%
PRT	4,6%	4,8%
ROU	4,0%	4,3%
SVK	10,4%	11,3%
SVN	9,1%	9,9%
SWE	4,2%	4,5%
EU (weighted mean)⋆	3,9%	4,1%
EU (mean)	5,8%	6,2%

Note: welfare gains are relative to the counterfactual scenario, in which the EU is either replaced by a standard RTA. Welfare gains computed from equation (5). ⋆ weighted by share in consumption.

(0.6/0.8 and 1.8/2.5), i.e. are not related to the re-installation of tariffs barriers which remain at zero in the scenario of a standard RTA arrangement.

Brexit also imposes losses to other members of the European Union, but these are generally one order of magnitude lower than for the UK. GDP decreases by 0.1% to 0.6% for the average EU country. With its close geographic and historical linkages with the UK, Ireland stands as an exception with losses comparable to UK ones.

Table 5: Welfare losses from Brexit under different scenarios

	(1)	(2)	(3)	(4)
Counterfactual	to RTA	to MFN	to RTA	to MFN
Assumption	without intermediates		with intermediates	
GBR	-0,6%	-0,8%	-1,8%	-2,5%
AUT	0,0%	0,0%	-0,1%	-0,1%
BEL	-0,2%	-0,3%	-0,5%	-0,6%
BGR	0,0%	-0,1%	-0,1%	-0,1%
CYP	-0,1%	-0,2%	-0,3%	-0,4%
CZE	-0,1%	-0,1%	-0,2%	-0,3%
DEU	-0,1%	-0,1%	-0,2%	-0,3%
DNK	-0,1%	-0,2%	-0,3%	-0,4%
ESP	-0,1%	-0,1%	-0,2%	-0,2%
EST	-0,1%	-0,1%	-0,2%	-0,2%
FIN	-0,1%	-0,1%	-0,1%	-0,2%
FRA	-0,1%	-0,1%	-0,2%	-0,3%
GRC	0,0%	-0,1%	-0,1%	-0,1%
HRV	0,0%	0,0%	-0,1%	-0,1%
HUN	-0,1%	-0,1%	-0,2%	-0,3%
IRL	-0,7%	-1,0%	-1,9%	-2,6%
ITA	0,0%	-0,1%	-0,1%	-0,2%
LTU	-0,1%	-0,1%	-0,3%	-0,4%
LUX	-0,6%	-0,8%	-1,1%	-1,5%
LVA	-0,1%	-0,1%	-0,2%	-0,2%
MLT	-0,6%	-0,8%	-1,1%	-1,6%
NLD	-0,2%	-0,2%	-0,5%	-0,6%
POL	-0,1%	-0,1%	-0,2%	-0,3%
PRT	-0,1%	-0,1%	-0,2%	-0,2%
ROU	0,0%	0,0%	-0,1%	-0,1%
SVK	-0,1%	-0,1%	-0,2%	-0,3%
SVN	0,0%	0,0%	-0,1%	-0,1%
EU (mean)	-0,1%	-0,2%	-0,3%	-0,5%

Note: welfare gains are relative to the counterfactual scenario, in which the EU is either replaced by a standard RTA (columns (1) and (3)) or WTO rules (columns (2) and (4)). Welfare gains computed from equation (6) in columns (1)-(2) and equation (5) in columns (3)-(4).

5.2 Brexit: signing with third countries

We now want to illustrate the specificities of European integration by investigating to which extent the UK could compensate the losses from leaving the single market by signing RTAs with third countries (a possibility that has been put forward forcefully by Brexit proponents). Specifically, we compute the welfare gains from implementing an RTA with the United States, Canada, and Australia (all three) after Brexit, and contrast the magnitude with the losses from exiting the EU computed in the above section.

Table 6 shows that the UK would benefit from signing trade agreements with large English-speaking third countries. Those would however not offset the loss of EU market access for at least two reasons. First, the rules of gravity in international trade make EU countries natural trade partners for the UK; by their geographic location, other large countries, even those sharing historical linkages with the UK, cannot replace the closest partners from continental Europe. After Brexit, 32% (in the WTO scenario) to 39% (in the RTA scenario) of British imports of goods and services would still originate from the EU, down from 53% before. Second, trade agreements with other countries cannot match the depth of integration provided by the European Single market, that goes well beyond regular trade agreements tariff reductions by addressing behind-the-border trade impediments. Overall, signing RTAs with all three countries would increase the UK GDP by 0.45% (respectively 0.16% when assuming no intermediate goods), offsetting around a quarter of the losses from Brexit. Each of these four countries would gain little: Gains from Canada for instance are 0.11% of GDP under the best scenario of signing an RTA with the UK. Finally, Ireland would be the EU country suffering the most from the trade diversion effects of the new RTAs signed by the UK, with a cumulated loss of -0.01% to -0.02% of GDP.

Table 6: Welfare gains from alternative RTAs

	(1)	(2)	(3)	(4)
Counterfactual	To RTA	To MFN	To RTA	To MFN
	without intermediate		with intermediate	
GBR	0,16%	0,16%	0,45%	0,45%
AUS	0,02%	0,02%	0,05%	0,05%
CAN	0,04%	0,04%	0,11%	0,11%
USA	0,02%	0,02%	0,05%	0,06%
IRL	-0,01%	-0,00%	-0,02%	-0,01%

Note: welfare gains are relative to the counterfactual scenario, in which theUK- EU trade relationships are either governed by a standard RTA (columns (1) and (3)) or WTO rules (columns (2) and (4)). Welfare gains computed from equation (6) in columns (1)-(2) and equation (5) in columns (3)-(4).

5.3 Gains from the EU following Brexit

Table 7 presents the gains that members obtain from belonging to the EU taking Brexit into account. Gains remain substantial on average. Comparing to Table 3, it however shows that the exit of the UK from the European Union reduces the gains from EU integration for the remaining members. While on average the foregone gains are small, they can be substantial for specific countries that have special linkages with the British economy. The average reduction in the welfare gains from EU stands between 0.1% and 0.4% on a non-weighted basis, which represents one twentieth of the overall estimated gains from trade integration today (estimated at 2% to 7.5% in our baseline analysis, see Table 3). An exception is Ireland which is particularly exposed to the exit of its main economic partner, with a reduction of the gains from EU integration by close to 40% e.g. from 5.9% to 3.5% in the RTA scenario with intermediates. It is interesting to note that following Brexit, Ireland does not stand as one of the main winner of European trade integration as is the case now, and retreat to below the average EU member. Malta and Cyprus also experience a substantial reduction in the gains they derive from the EU after Brexit.

Table 7: Welfare gains from EU after Brexit

	(1)	(2)	(3)	(4)
Counterfactual	to RTA	to MFN	to RTA	to MFN
Assumption	without intermediates		with intermediates	
AUT	2,2%	2,9%	6,6%	8,6%
BEL	2,4%	3,1%	6,8%	8,9%
BGR	1,8%	2,4%	5,6%	7,3%
CYP	1,0%	1,3%	2,8%	3,4%
CZE	3,0%	3,9%	9,1%	11,9%
DEU	1,3%	1,6%	3,7%	4,8%
DNK	1,6%	2,0%	4,6%	5,9%
ESP	0,9%	1,1%	2,5%	3,3%
EST	3,0%	3,9%	8,9%	11,7%
FIN	1,2%	1,5%	3,5%	4,4%
FRA	0,9%	1,1%	2,8%	3,5%
GRC	0,6%	0,8%	2,0%	2,5%
HRV	1,7%	2,2%	5,3%	6,7%
HUN	4,0%	5,2%	12,0%	15,8%
IRL	1,4%	1,9%	3,5%	4,6%
ITA	0,8%	1,0%	2,2%	2,9%
LTU	2,4%	3,1%	7,2%	9,2%
LUX	2,3%	3,1%	5,8%	7,6%
LVA	1,8%	2,3%	5,3%	7,0%
MLT	2,5%	3,3%	5,7%	7,6%
NLD	2,1%	2,8%	6,0%	7,7%
POL	1,7%	2,2%	5,0%	6,4%
PRT	1,4%	1,8%	4,3%	5,6%
ROU	1,3%	1,7%	4,0%	5,0%
SVK	3,4%	4,3%	10,1%	13,3%
SVN	3,1%	3,9%	8,9%	11,8%
SWE	1,4%	1,7%	3,9%	5,0%
EU (weighted mean)⋆	1,3%	1,7%	3,9%	5,0%
EU (mean)	1,9%	2,5%	5,5%	7,1%

Note: welfare gains are relative to the counterfactual scenario, in which the EU is either replaced by a standard RTA (columns (1) and (3)) or WTO rules (columns (2) and (4)). Welfare gains computed from equation (6) in columns (1)-(2) and equation (5) in columns (3)-(4). ⋆ weighted by share in consumption.

6 Conclusion

We provide in this paper quantified evidence of different scenarios of a de-construction of the European Union. Those can naturally also be interpreted as what the EU brought in terms of welfare to the population of member countries. The costs of Non-Europe (weighted by country size) are estimated to vary between 1.3 and and 5.0% depending on the counterfactual ("normal" RTA vs return to WTO rules notably).There is wide variation across member countries, with costs reacting strongly to size and initial openness ratio of the separating countries: small open economies in Europe would suffer the most, particularly the Eastern part of the continent. We also consider unilateral exits which systematically exhibit larger losses. Last, we quantify the domino effects linked to Brexit. The costs of leaving the EU are smaller if/when the United Kingdom already left the Union. We also quantify the compensation that the UK would obtain in terms of welfare with signing agreements with "new" partners such as the United States, Canada, Australia. The welfare gains are positive but an order of magnitude smaller than the losses incurred from Brexit.

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A Appendix

A.1 Alternative trade and production data from OEDC-TiVA

Table 8: Welfare gains from EU under different scenarios using TiVA trade and production data

Counterfactual Assumption	(1) to RTA without intermediates	(2) to MFN without intermediates	(3) to RTA with intermediates	(4) to MFN with intermediates
AUT	1,6%	2,0%	4,4%	5,6%
BEL	1,4%	1,7%	3,5%	4,5%
BGR	1,9%	2,4%	5,2%	6,8%
CYP	1,2%	1,6%	3,1%	3,9%
CZE	2,2%	2,8%	6,2%	8,0%
DEU	1,1%	1,4%	3,0%	3,8%
DNK	1,2%	1,6%	3,1%	3,9%
ESP	1,1%	1,3%	2,9%	3,7%
EST	2,0%	2,6%	5,3%	6,8%
FIN	1,1%	1,4%	3,1%	4,0%
FRA	0,9%	1,1%	2,5%	3,2%
GRC	0,9%	1,0%	2,2%	2,8%
HUN	2,9%	3,8%	8,2%	10,6%
IRL	2,3%	2,9%	5,3%	6,9%
ITA	0,8%	1,1%	2,3%	2,9%
LTU	1,7%	2,2%	4,7%	6,0%
LUX	3,9%	5,2%	8,9%	11,8%
LVA	1,6%	2,1%	4,5%	5,8%
MLT	1,5%	2,0%	3,3%	4,1%
NLD	0,7%	0,9%	1,7%	2,2%
POL	1,5%	1,9%	4,2%	5,3%
PRT	1,5%	2,0%	4,3%	5,4%
ROU	1,3%	1,6%	3,6%	4,6%
SVK	2,5%	3,2%	6,9%	8,9%
SVN	2,2%	2,8%	6,0%	7,8%
SWE	1,4%	1,8%	3,7%	4,9%
EU (weighted mean)*	1,1%	1,5%	3,1%	4,0%
EU (mean)	1,6%	2,1%	4,3%	5,5%

Note: welfare gains are relative to the counterfactual scenario, in which the EU is either replaced by a standard RTA (columns (1) and (3)) or WTO rules (columns (2) and (4)). Welfare gains computed from equation (6) in columns (1)-(2) and equation (5) in columns (3)-(4). * weighted by share in consumption. Trade and production data are from the OECD-TiVA database for year 2011.