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# The Cost of Non-Europe, Revisited

Thierry Mayer (Sciences Po, Banque de France and CEPII)
Vincent Vicard (CEPII)
Soledad Zignago (Banque de France)

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# The Cost of Non-Europe, Revisited *

Thierry MAYER† Vincent VICARD‡ Soledad ZIGNAGO§

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In this paper we quantify the "Cost of Non-Europe", i.e. the trade-related welfare gains each country member has reaped from 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 to estimate 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 exit of the United Kingdom from the EU (Brexit) happening, which points to interesting cross-country differences and potential cascade effects in doing and undoing of trade agreements.

*Keywords*: Trade integration, Gravity, European Union.
*JEL classification*: F1.

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†Sciences-Po, Banque de France, CEPII and CEPR. E-mail: thierry.mayer@sciencespo.fr
‡CEPII. E-mail: vincent.vicard@cepii.fr.
§Banque de France. E-mail: soledad.zignago@banque-france.fr

# 1 Introduction

Sixty years after the Treaty of Rome came into force, and a quarter century after the implementation of the Single Market Program (SMP, started in 1987 and achieved in 1993), we live in an age where a possible scenario for the near future is one of trade *disintegration* in Europe, reversing what is probably the deepest and most prolonged trade liberalization processes 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 makes it a good time to revisit the gains the EU has reaped from trade integration since 1958 and what would be the costs of going backwards.[1]

On the academic front is a happy coincidence that the techniques available to estimate 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 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): i) trade frictions are estimable in a simple way using the "structural" version of the gravity equation; ii) endowed with those frictions, it is easy to run counterfactuals using an approach often referred to as Exact Hat Algebra (EHA) that imposes minimal data requirement.

This paper can be seen as a re-assessment of the "Cost of non-Europe". The very first assessment was the one carried out in 1988, in an official European Commission report estimating the likely gains that would come from the achievement of the Single Market Programme by the end of 1992 (Checchini *et al.*, 1988). 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. At the same period, a large number of partial or general equilibrium exercises – summarized in detail by Baldwin and Venables (1995) – have been conducted to quantify the gains to be expected from "EC92". The European Commission also commissioned in 1996 an early *ex-post* evaluation of the benefits of the Single Market; in particular, Fontagné *et al.* (1998) focus on the nature of intra-EU trade flows and emphasizes adjustments within industries on the quality spectrum. Our paper is an *ex-post* exercise quantifying what would be the costs of un-doing what has been achieved

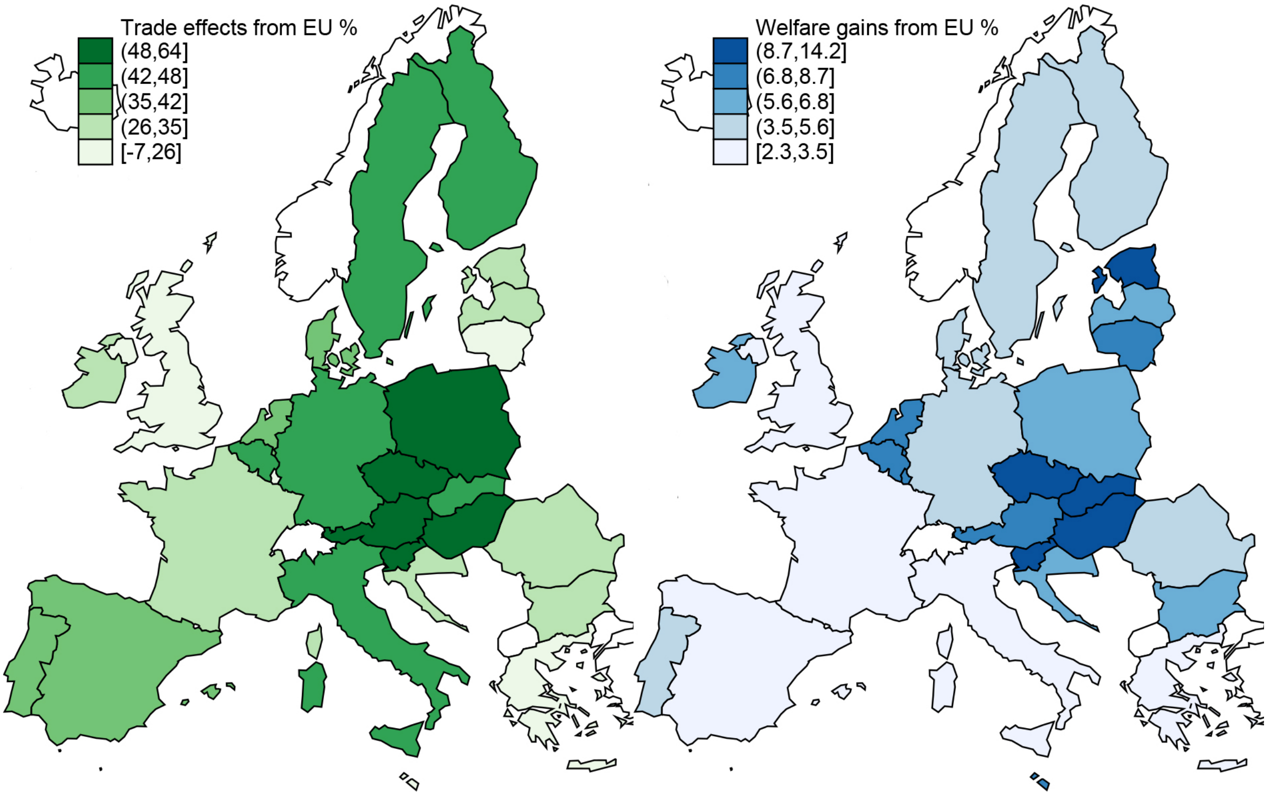
[1] In the following, we consider trade agreement creation and disintegration as symmetric and use alternatively the terms gains from EU integration and costs of exit. While taking an informed stance about potential asymmetries in long run comparative statics is difficult in our view, it should clearly matter in the short term: since any transition from one trade equilibrium to the other entails costs of reallocation, it should reduce the gains from EU creation in the transition path (compared to comparative statics) but magnifies the cost of EU disintegration. So this suggests an overestimation of long-term gains and underestimation of long-term losses.

over all those years in terms of European integration. We propose various scenarios of EU disintegration, ranging from the return to the customs union prevailing prior to the Single market, to the return to a "standard" free trade agreement or to WTO rules under which each former EU country would apply the current MFN (Most Favoured Nation) tariffs to its former EU partners.

Our work is related to numerous recent quantifications of trade policy scenarios, and in particular to Costinot and Rodriguez-Clare (2014) and Dhingra *et al.* (2016). The latter paper provides a 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. Another contribution is that we ground our simulations with our own estimates of the direct trade effects of the EU using the latest available data and techniques of structural gravity estimation, while Dhingra *et al.* (2016) rely on tariff-equivalent calculations of Non-Tariff-Barriers obtained from the literature. A particularly relevant paper to which our results are to be compared is the recent work by Felbermayr *et al.* (2018). In this independent and very recent paper, the authors run an industry-level gravity regression for the years 2000-2014. Over this period, they can collect bilateral tariff rates that are added to the regression on top of the EU dummy and provides them with their own estimate of the trade elasticity. This is useful to calculate the tariff equivalent of the EU and how much of the EU trade effect can be attributed to tariff cuts. Doing so, they find that most of the effect of the EU comes from factors other than tariffs, a result that confirms our inference based on trade elasticities borrowed from the literature. The advantage of our approach on this issue is that we are able, at the expense of losing the sectoral dimension, to estimate the effect of the EU over the full range of its implementation and distinguish the customs union effect from the single market for instance and also allowing for delays in effects. Our papers are complementary in that respect, and we provide a robustness analysis using the trade elasticity estimated in Felbermayr *et al.* (2018). Among the features that are unique to our paper is the provision of an interpretation for the difference between OLS and PPML coefficient estimates, and their implication for the welfare gains from trade. This turns out to be quite important. Since there are advantages and drawbacks to both estimation methods, we keep both and highlight how the estimator choice affects welfare calculations. Our paper is also the first one to our knowledge to do an ex-post evaluation of the ability of the model used to predict changes in bilateral trade. With data available in 2003, our model is doing a good job at predicting changes of trade patterns following the 2004 enlargement.

Our results show that the EU provides for deep trade integration over and above tariffs cuts: we find a (partial) trade impact of the Single Market more than three times larger than a regular RTA. In our preferred simulation, the Single market is found to have increased trade between EU members by 109% on average for goods and 58% for tradable services. The associated welfare gains from EU trade integration are estimated to reach 4.4% for the average European country (weighted by the size of the economy). Not all countries have benefited to the same extent however. In order to graphically illustrate the distribution of those gains, Figure 1 shows two maps. The map on the left of the figure shows trade increases and the one on the right shows welfare changes for each of the EU28 countries. Welfare gains from EU integration are significantly larger for small open economies than for large EU members. It is also very striking that Eastern European countries have been major winners in the integration process.

Figure 1: The effect of European integration on trade and welfare




Note: The left panel presents the percentage increase in total trade in goods due to EU membership from column (1) of Table 6. The right panel shows welfare changes from Table 7 (column (1)). Both panels report results from the RTA scenario including intermediate inputs.

Another of our results that parallels with a frequent finding in the literature, is that estimation methods matter. Using Pseudo-Poisson Maximum Likelihood (PPML) yields smaller (although still substantial and very significant) estimates of the trade gains associated with the EU compared to OLS. Interestingly, depending on how one interprets those lower estimated coefficients using PPML—as differences in trade elasticities or differences in ad valorem equivalent of trade costs—the gains from EU integration can be magnified or dampened compared to the standard OLS case.

Several qualifications are in order regarding the scope of our analysis. The EHA approach to counterfactual quantitative trade analysis has several versions, detailed in Costinot and Rodriguez-Clare (2014). As Dhingra *et al.* (2016) and Felbermayr *et al.* (2018), we use the version compatible with perfect competition. Our exercise can therefore be microfounded by the (mutli-sector versions) of either the Armington-based model of trade popularized by Anderson and van Wincoop (2003), or the Ricardian framework initiated by Eaton and Kortum (2002). We are therefore missing gains coming from "new" models, and in particular the ones coming from selection of the most productive firms into export markets and following trade liberalization.[2] Our calculations should be seen as conservative in that respect if we believe that imperfect competition and selection effects add to the trade gains. Evidence from Table 4.1 Costinot and Rodriguez-Clare (2014) simulations show countries where those add substantially to welfare gains, as well as lower gains under imperfect competition, with the USA and UK showing essentially no change. Intuitively, this diversity is due to the fact that the main change comes from Home Market Effects, that are absent under perfect competition. In a multi-country world, those are very complex, since they are critically affected by the geography /centrality of each country/sector combination. On average, gains are 20% larger under monopolistic competition.

We estimate the economic gains from European integration through the trade channel. We are therefore silent about other dimensions of European integration, such as the free mobility of capital and labor or the monetary union, or non-economic gains.[3] Also, by the supranational nature of the EU, member countries may benefit from a more efficient provision of public goods (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, being a classical reference on the topic).

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 trade liberalization (the increase of Chinese competition in their case) on innovation activities for a panel of European firms. Autor *et al.* (2016) find a contrasting negative impact on US firms. Taking a stance on this topic would involve a detailed empirical analysis of those dynamic gains nested within the structural gravity framework. Developing a fully dynamic model of structural gravity with endogenous innovation in general equilibrium goes beyond the scope of this paper. We therefore concentrate on static gains.

A very recent paper by Caliendo *et al.* (2018) has combined the analysis of trade policy and migration policy changes in a dynamic model where the whole sequence of each policy changes is considered, and productivity changes endogenously. It uses and extends the set of tools used in the New Quantitative Spatial Economics literature surveyed by Redding and Rossi-Hansberg (2017), which combines gravity-style relationships for both trade and

[2]A proper account of those features would require a larger set of parameters, in particular the ones describing the productivity distribution in all our countries of interest, and therefore firm-level data on sales, that is rarely accessible for multiple countries.

[3]Political stability being probably the most important of those non-economic gains. Martin *et al.* (2012) and Vicard (2012) emphasize the security gains associated with regional trade integration.

migration flows, and let those two flows interact. However, because we want to estimate the trade effects of the EU over the longest possible time period, it is difficult to follow the route of this new class of models, since they require in particular another critical elasticity driving migration choices which would need to be estimated in a bilateral migration regression. Caliendo *et al.* (2018) restrict their attention to the 2004 EU enlargement where the data is available. Their Table 5 contains interesting results for us, disentangling the respective effects of trade and migration policies. Trade policy is clearly the biggest contributor to welfare gains in that episode, specially for EU15 countries (which see their welfare reduced by migration policies, while New Member Countries benefit from them). Both policies show limited levels of complementarity, suggesting that our results would not be massively changed by considering migration policies on top of trade policy changes.

There are two main steps in our analysis. The first one produces estimates of EU integration effects on trade through gravity estimation. In those regressions, we separate the EU agreements from the rest of regional trade deals, and estimate the surplus of trade flows that is due to various sides of the EU process (the Single Market, Schengen, and the euro notably). This provides us with a set of parameters driving the *direct* trade 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 (EHA) counterfactual simulations. The first step is conducted in section 2; the methodology of the second is presented in section 3 and the results in section 4. Section 5 investigates how Brexit affects gains from EU integration of remaining members. The last section concludes.

# 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 $i$ in period $t$ react to changes in the level of bilateral "freeness" of trade, denoted $\phi_{nit}$. The gravity model has been used at least since the 1960s. Tinbergen (1962), often cited as the first application of gravity to trade flows, was actually an evaluation of the trade effects of preferential trading relationships (namely the British Commonwealth and the Belgium-Netherlands-Luxembourg customs union soon to be subsumed in the European Community). The modern version of gravity, motivated by evaluation of policy-relevant counterfactuals, requires theoretical foundations. A surprisingly large set of underlying trade models (covered in Head and Mayer (2014)) yield the same estimating equation for bilateral trade values. We will refer to this equation as *structural gravity*). Start with importing country $n$ total expenditure in year $t$ ($X_{nt}$), to be allocated to each producing country $i$ with the following identity

$$X_{nit} = \pi_{nit} X_{nt}, \tag{1}$$

where $\pi_{nit}$ is the share of expenditure spent by $n$ on goods from country $i$ this year. Two key assumptions lie behind structural gravity. The first one is the functional form of trade shares:

$$\pi_{nit} = \frac{S_{it}\phi_{nit}}{\Phi_{nt}}, \quad \text{with} \quad \Phi_{nt} \equiv \sum_{\ell} S_{it}\phi_{nit}. \tag{2}$$

A country $i$ in year $t$ is characterized by a "supply capacity" $S_{it}$, which depending on the underlying microfoundation can include the number and price of available varieties (Krugman (1980)), the quality-adjusted price of the offered product (Anderson and van Wincoop (2003)), the technology level of the country (Eaton and Kortum (2002)), etc. $S_{it}$ summarizes the attractiveness of goods from country $i$ to all destinations (including $i$). The $\Phi$ term represents competition between different sources that importing country $n$ is faced with, and its definition ensures that trade shares sum to one ($\sum_{\ell} \pi_{n\ell t} = 1$). The important assumption is here that expenditure shares do not depend on income (which is the case in all models behind structural gravity). The theoretical foundations of gravity have $\Phi_n$ closely related to the price index of country $n$. A higher $\Phi_n$ lowers the market share of country $\ell$ in $n$ by raising the relative price of buying from $\ell$.

The second key assumption is market clearing, such that production in $i$ meets demand in all consumption countries: $Y_{it} = \sum_n X_{nit}$. Using the definition of $\pi_{nit}$, we therefore have

$$Y_{it} = S_{it}\Omega_{it} \quad \text{with} \quad \Omega_{it} \equiv \sum_{n} \frac{\phi_{nit}X_{nt}}{\Phi_{nt}}.$$

$\Omega_{it}$ is a term capturing the economic centrality of country $i$ this year $t$, since it sums all demand in the world, weighted by the relative quality of access to that demand ($\phi_{nit}/\Phi_{nt}$). Output in a country is therefore high because of a combination of intrinsic attractiveness $S$ and good geography $\Omega$. We can solve for the attractiveness $S_{it}$ level necessary to explain output in $i$ given its centrality: $S_{it} = Y_{it}/\Omega_{it}$. Substituting into the bilateral trade equation, one obtains structural gravity as a system of three equations:

$$X_{nit} = \underbrace{\frac{Y_{it}}{\Omega_{it}}}_{S_{it}} \underbrace{\frac{X_{nt}}{\Phi_{nt}}}_{M_{nt}} \phi_{nit}, \tag{3}$$

$$\Phi_{nt} = \sum_{\ell} \frac{\phi_{n\ell t}Y_{\ell t}}{\Omega_{\ell t}} \tag{4}$$

$$\Omega_{it} = \sum_{n} \frac{\phi_{nit}X_{nt}}{\Phi_{nt}}. \tag{5}$$

The two denominator terms $\Phi_{nt}$ and $\Omega_{it}$ are often named "multilateral resistance" (MR) after Anderson and van Wincoop (2003).

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 time-varying exporter and importer fixed effects:

$$\ln X_{nit} = \ln S_{it} + \ln M_{nt} + \ln \phi_{nit}. \tag{6}$$

Another key feature is that the level of trade flows between $n$ and $i$ is affected by third countries only through the $\Phi$ and $\Omega$ 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 $\phi_{nit}$. An increase in $\phi_{nit}$ 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. When estimating the gravity equation, the origin (-time) and destination (-time) fixed effects neutralize those reallocation effects, such that the coefficients estimated on the RTA dummies are the "pure" trade creation effects. In the counterfactual scenarios, the structure of the model is used to solve for the indirect effects of $\phi_{nit}$ that go through MR terms in (5). Those scenarios also take into account the response of each country output through the market clearing equation $Y_{it} = \sum_n X_{nit}$, which provides a general equilibrium feedback to the system.

## 2.2 Endogeneity of RTAs and zeroes

Apart from the use of fixed effects for origin-time and destination-time, there are two main remaining issues with estimation of equation (6). The first relates to potential endogeneity of the main variables of interest, i.e. different RTAs. It is very likely that pairs sharing a regional agreement are also characterized by other unobserved bilateral proximity factors. This is a concern that has been considered in the literature, examples including Carrere (2006), Baier and Bergstrand (2007) or more recently Bergstrand *et al.* (2015) and Limão (2016). The most common treatment of that issue is to include *bilateral* fixed effects to the regression:

$$\ln X_{nit} = \text{FE}_{it} + \text{FE}_{nt} + \text{FE}_{ni} + \ln \phi_{nit}. \tag{7}$$

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 purely in the 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 (even though there are obvious fluctuations in this relationship), 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 worry about 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 controls that vary over time. One such control that has been advocated for dealing with endogenous timing of RTA entrance is to include pair-specific time trends; in the context of European integration, they account for any trend specific to EU members that eventually led to the creation and then to each enlargement of the EEC/EU. We show in appendix A.1 that our main results are robust to the inclusion of time trends.

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. Since those computational issues have received more attention for PPML than for generalized Tobit, we present PPML results as a set of alternative estimates that can handle zeroes (on top of dealing with the type of heteroskedasticity that Santos Silva and Tenreyro (2006) originally advocated PPML for).

## 2.3 Results

Estimation of equation (7) 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 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).

Table 1: Different dimensions of EU integration for trade in goods

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| RTA dum. | 0.385$^a$ | 0.384$^a$ | 0.386$^a$ | 0.375$^a$ | 0.372$^a$ | 0.383$^a$ | 0.314$^a$ |
| | (0.024) | (0.024) | (0.024) | (0.024) | (0.024) | (0.024) | (0.027) |
| EEC dum. | 0.490$^a$ | 0.493$^a$ | 0.483$^a$ | 0.490$^a$ | 0.491$^a$ | 0.493$^a$ | 0.565$^a$ |
| | (0.041) | (0.041) | (0.041) | (0.041) | (0.041) | (0.041) | (0.046) |
| EU single market dum. (post 1992) | 1.177$^a$ | 1.118$^a$ | 1.120$^a$ | 1.172$^a$ | 1.185$^a$ | 1.181$^a$ | 1.315$^a$ |
| | (0.046) | (0.046) | (0.046) | (0.046) | (0.046) | (0.046) | (0.054) |
| Both GATT dum. | 0.134$^a$ | 0.136$^a$ | 0.136$^a$ | 0.138$^a$ | 0.139$^a$ | 0.137$^a$ | 0.163$^a$ |
| | (0.027) | (0.027) | (0.027) | (0.027) | (0.027) | (0.027) | (0.034) |
| Shared currency dum. | 0.338$^a$ | 0.339$^a$ | 0.339$^a$ | 0.339$^a$ | 0.339$^a$ | 0.339$^a$ | 0.341$^a$ |
| | (0.068) | (0.068) | (0.068) | (0.068) | (0.068) | (0.068) | (0.080) |
| Euro area dum. | -0.125$^b$ | -0.203$^a$ | -0.453$^a$ | -0.149$^a$ | -0.137$^b$ | -0.139$^b$ | -0.178$^a$ |
| | (0.052) | (0.058) | (0.068) | (0.056) | (0.056) | (0.056) | (0.063) |
| Shengen dum. | | 0.198$^a$ | 0.200$^a$ | 0.066$^c$ | 0.040 | 0.040 | -0.091$^c$ |
| | | (0.043) | (0.043) | (0.040) | (0.040) | (0.040) | (0.048) |
| Euro area dum. after 2002 | | | -0.309$^a$ | | | | |
| | | | (0.067) | | | | |
| Euro area dum. after 2009 | | | -0.015 | | | | |
| | | | (0.061) | | | | |
| EEA dum. | | | | 0.980$^a$ | 0.994$^a$ | 0.995$^a$ | 1.031$^a$ |
| | | | | (0.094) | (0.094) | (0.094) | (0.102) |
| EU-Switzerland RTA dum. | | | | | 0.781$^a$ | 0.782$^a$ | 0.826$^a$ |
| | | | | | (0.099) | (0.100) | (0.106) |
| EU-Turkey RTA dum. | | | | | | -0.243$^c$ | -0.172 |
| | | | | | | (0.124) | (0.128) |
| Observations | 849147 | 849147 | 849147 | 849147 | 849147 | 849147 | 174217 |
| R2 | 0.858 | 0.858 | 0.858 | 0.858 | 0.858 | 0.858 | 0.867 |
| RMSE | 1.254 | 1.254 | 1.254 | 1.254 | 1.254 | 1.254 | 1.296 |
| Periodicity | Yearly | Yearly | Yearly | Yearly | Yearly | Yearly | 5-years |

Note: Standard errors clustered for intra-group correlation at the country pair level in parentheses, with significance levels indicated with $^c$ for 10%, $^b$ for 5%, $^a$ for 1%. All dummy variables for regional agreement membership are "exclusive", i.e. the RTA membership dummy equal zero when EEC or EU is equal to one. Shared currency and euro area dummies are similarly exclusive. All columns include origin×year, destination×year and country pair fixed effects.

### 2.3.1 Trade in goods and the EU

Column (1) in Table 1 presents the simplest estimation of the gravity equation (7) for trade in goods, which features importer-time and exporter-time fixed effects, capturing the multilateral resistance terms, as well as a bilateral fixed effect accounting for (constant) unobservables in the dyadic relationship.

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 is to raise trade flows by around 50% (exp(0.385) = 1.469). Note that we define all membership variables in an exclusive manner, i.e. RTA is set to zero when EEC or EU equals one (the same applies to the shared currency and the euro area dummies). 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 turns out to have a perverse negative effect (more on that below).[4]

The European agreements have a larger effect than a standard RTA. This is true before and after the Single Market implementation, but especially after. The Single Market is estimated to triple trade ($\exp(1.177) = 3.24$). A very comparable recent estimate is the one from Limão (2016), who distinguishes between "standard" free trade agreements and a dummy variable for customs unions/common market/economic union. The benchmark estimate reported by Limão (2016) for this type of agreements, using structural gravity, is 1.16, strikingly close to our results, while he reports a coefficient of 0.533 for "normal" free trade areas. The preferred EU effects estimate of Baier *et al.* (2014) and Eicher and Henn (2011) are other examples finding that the deep integration agreements such as the EU have a much larger trade impact than standard RTAs. A number of older papers (Carrere (2006), Baier *et al.* (2008)) have found converging estimates around .6 to .7 for the EU.

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. The World Trade Organization (2011) reports an average preferential margin of 4.9 percentage points for trade within the EU compared to its MFN tariffs. Our preferred EU effect would involve an elasticity of trade of $1.177/\ln(1.049) = 24.6$, if accounted by tariff cuts only. This is well beyond the median 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 $1.049^{5.03} = 1.272$, to be compared with the overall EU effect around 3 that we estimate. Note that the trade impact implied by the preference margin is closer to the estimated effect of an average RTA ($\exp(0.385) = 1.47$), as in the meta-analysis of Head and Mayer (2014). This underlines the major role played by provisions on non-tariffs barriers in deep RTAs such as the EU, as emphasized by Limão (2016). A related result confirming our finding is to be found in Felbermayr *et al.* (2018). In their industry-level sample spanning 2000 to 2014, they regress bilateral trade on a EU dummy before adding a measure of bilateral applied tariff. The EU dummy effect shrinks but remains large and very significant. Combining the fall in the EU coefficient with the trade elasticity, they find that about three quarters of the EU trade effect is not tariff-related, and therefore must be related to "deeper" provisions of the EU compared to standard agreements. Dhingra *et al.* (2018) dig further into *which* provisions of the deep RTAs such as the Single Market matter most (they study all deep RTAs in WIOD data, but the EU forms the bulk of their dataset). The authors find that having provisions related to services, investment and competition in the agreement is a key driver of the trade effects of economic integration agreement. Those provisions represent 60% of the overall effect (considering both trade in

[4] In unreported regressions, our results confirm the literature finding (Baldwin, 2006, for instance) that 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.

goods and services).

### 2.3.2 Measuring different dimensions of European trade integration

Table 2: Date of entry into force of various European integration agreements (1948-2012)

| | EEC | EU (single market) | Schengen | Euro area | EEA | EU-Switzerland | EU-Turkey |
|---|---|---|---|---|---|---|---|
| Austria | - | 1995 | 1997 | 1999 | 1994 | 2002 | 1996 |
| Belgium | 1958 | 1993 | 1995 | 1999 | 1994 | 2002 | 1996 |
| Bulgaria | - | 2007 | - | - | 2007 | 2007 | 2007 |
| Cyprus | - | 2004 | - | 2008 | 2004 | 2004 | 2004 |
| Czech Republic | - | 2004 | 2008 | - | 2004 | 2004 | 2004 |
| Denmark | 1973 | 1993 | 2001 | - | 1994 | 2002 | 1996 |
| Estonia | - | 2004 | 2008 | 2011 | 2004 | 2004 | 2004 |
| Finland | - | 1995 | 2001 | 1999 | 1994 | 2002 | 1996 |
| France | 1958 | 1993 | 1995 | 1999 | 1994 | 2002 | 1996 |
| Germany | 1958 | 1993 | 1995 | 1999 | 1994 | 2002 | 1996 |
| Greece | 1981 | 1993 | 2000 | 2001 | 1994 | 2002 | 1996 |
| Hungary | - | 2004 | 2008 | - | 2004 | 2004 | 2004 |
| Ireland | 1973 | 1993 | - | 1999 | 1994 | 2002 | 1996 |
| Italy | 1958 | 1993 | 1997 | 1999 | 1994 | 2002 | 1996 |
| Latvia | - | 2004 | 2008 | 2014 | 2004 | 2004 | 2004 |
| Lithuania | - | 2004 | 2008 | 2015 | 2004 | 2004 | 2004 |
| Luxembourg | 1958 | 1993 | 1995 | 1999 | 1994 | 2002 | 1996 |
| Malta | - | 2004 | 2008 | 2008 | 2004 | 2004 | 2004 |
| Netherlands | 1958 | 1993 | 1995 | 1999 | 1994 | 2002 | 1996 |
| Poland | - | 2004 | 2008 | - | 2004 | 2004 | 2004 |
| Portugal | 1986 | 1993 | 1995 | 1999 | 1994 | 2002 | 1996 |
| Romania | - | 2007 | - | - | 2007 | 2007 | 2007 |
| Slovakia | - | 2004 | 2008 | 2009 | 2004 | 2004 | 2004 |
| Slovenia | - | 2004 | 2008 | 2007 | 2004 | 2004 | 2004 |
| Spain | 1986 | 1993 | 1995 | 1999 | 1994 | 2002 | 1996 |
| Sweden | - | 1995 | 2001 | - | 1994 | 2002 | 1996 |
| United Kingdom | 1973 | 1993 | - | - | 1994 | 2002 | 1996 |
| Iceland | - | - | 2001 | - | 1994 | - | - |
| Norway | - | - | 2001 | - | 1994 | - | - |
| Switzerland | - | - | 2009 | - | - | 2002 | - |
| Turkey | - | - | - | - | - | - | 1996 |

The other columns of Table 1 detail the different dimensions of trade creating effects of the EU by adding a number of controls in the following columns. The controls are describing the intricate network of European agreements that are likely to affect trade flows. In Table 2, we detail the dates of entry into force of those agreements and their different membership patterns.

The first of those controls is a dummy for the Schengen agreement. This agreement, which involves mostly—but not exclusively— EU countries improves on the liberalization of international travel inside the zone, which essentially operates as a border-less entity. Free mobility of labor therefore seems to have a substantial effect on trade flows. In column (2) the introduction of Schengen makes the eurozone dummy more negative and significant. In order to dig into this intriguing finding, we separate in column (3) the effect of the euro between different subperiods. Results show that the negative effect of the euro on trade within the euro area is particularly strong during the first years of the euro implementation. By 2009, the coefficient on euro area membership is close to 0 and insignificant.

Column (4) investigates the effect of the European Economic Area, a free trade agreement between the EU and the remaining parts of EFTA. EFTA was itself a free trade agreement passed in 1960 among a group of European nations that were not part of the European Community. Most of its members have gradually entered the EEC/EU, and in 1992, the EEA was signed to establish free trade (together with important rules concerning the adoption of EU legislation by EEA members) between EU and what remained of EFTA (today Iceland, Liechtenstein, Norway and Switzerland). Through membership to the EEA, Iceland, Liechtenstein and Norway are members of the Single market but do not form a customs union with the EU. Switzerland did not ratify the treaty, and its relations with the EU are governed by a number of bilateral treaties, which we consider with a dummy introduced in column (5). Both EEA and EU-Switzerland RTAs are important determinants of trade flows, coefficients being quite comparable to the EU-post 92 effect as should be expected from the nature of the agreements. Note that the slightly lower point estimate on the EEA, corresponding to the cost of customs formalities and/or of rules related to being a third party to the customs union, is not statistically different from the EU-post 92 coefficient. Last, we consider the EU-Turkey customs union entered into force in 1996, but the effects here are weak at best.

The last column of Table 1 follows an approach frequent in the literature that consists in averaging the data over periods of 5 years (Cheng and Wall, 2005). This tends to mitigate measurement error in the annual trade flows reported which can be quite large even at this level of aggregation. The changes in coefficients are marginal. Finally, in Table 13 in Appendix A.1 (columns (5) to (8)), we show that our results are robust to the inclusion of time trends specific to either all EU members or by entry date.

### 2.3.3 Heterogenous elasticities: OLS vs. PPML

We now proceed to presenting results obtained with different estimators. PPML has been made popular as an alternative to linear-in-logs OLS by Santos Silva and Tenreyro (2006). While the original motivation was to correct for a potential bias related to heteroskedasticity arising through log-linearization, it was also made attractive by its ability to handle zeroes.

Theoretical consistency requires to include a very large set of fixed effects: one for each importer-year, exporter-year, and pair of countries in a panel that spans over more than 60 years. This is made feasible in OLS through recent advances in this type of estimation.[5] This advance in estimation of high-dimensional fixed effects has now been ported to the PPML estimator.[6]

[5]The `reghdfe` Stata program that we use is particularly helpful in this respect.

[6]The `ppml_panel_sg` Stata program developed by Larch *et al.* (2017).

Table 3: Gravity results of European integration in goods: alternative estimators

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Estimator | OLS | PPML | PPML | OLS weighted | PPML share | PPML share |
| Sample | | | flow>0 | | | flow>0 |
| RTA dum. | 0.383$^{a}$ | 0.060 | 0.065 | 0.077$^{c}$ | 0.168$^{a}$ | 0.207$^{a}$ |
| | (0.024) | (0.046) | (0.046) | (0.042) | (0.027) | (0.025) |
| EEC dum. | 0.493$^{a}$ | 0.558$^{a}$ | 0.566$^{a}$ | 0.580$^{a}$ | 0.634$^{a}$ | 0.642$^{a}$ |
| | (0.041) | (0.059) | (0.059) | (0.055) | (0.047) | (0.046) |
| EU single market dum. (post 1992) | 1.181$^{a}$ | 0.650$^{a}$ | 0.649$^{a}$ | 0.624$^{a}$ | 0.944$^{a}$ | 0.915$^{a}$ |
| | (0.046) | (0.059) | (0.058) | (0.054) | (0.067) | (0.064) |
| Both GATT dum. | 0.137$^{a}$ | -0.096 | -0.063 | 0.084 | 0.042 | 0.106$^{a}$ |
| | (0.027) | (0.074) | (0.075) | (0.065) | (0.041) | (0.038) |
| Shared currency dum. | 0.339$^{a}$ | 0.816$^{a}$ | 0.779$^{a}$ | 0.536$^{a}$ | 0.476$^{a}$ | 0.454$^{a}$ |
| | (0.068) | (0.127) | (0.125) | (0.098) | (0.060) | (0.059) |
| Euro area dum. | -0.139$^{b}$ | -0.047 | -0.051 | -0.039 | 0.022 | 0.013 |
| | (0.056) | (0.036) | (0.036) | (0.034) | (0.072) | (0.070) |
| Shengen dum. | 0.040 | -0.047$^{c}$ | -0.049$^{c}$ | -0.048$^{c}$ | -0.013 | -0.027 |
| | (0.040) | (0.028) | (0.028) | (0.027) | (0.050) | (0.049) |
| EEA dum. | 0.995$^{a}$ | 0.411$^{a}$ | 0.410$^{a}$ | 0.421$^{a}$ | 0.579$^{a}$ | 0.605$^{a}$ |
| | (0.094) | (0.090) | (0.090) | (0.080) | (0.102) | (0.098) |
| EU-Switzerland RTA dum. | 0.782$^{a}$ | -0.026 | -0.029 | -0.027 | 0.363$^{a}$ | 0.329$^{a}$ |
| | (0.100) | (0.093) | (0.092) | (0.088) | (0.109) | (0.109) |
| EU-Turkey RTA dum. | -0.243$^{c}$ | 0.145 | 0.137 | 0.200$^{b}$ | 0.013 | 0.027 |
| | (0.124) | (0.107) | (0.108) | (0.098) | (0.192) | (0.203) |
| Observations | 849147 | 1316900 | 849147 | 849147 | 1316900 | 849147 |
| R2 | 0.858 | 0.991 | 0.991 | 0.985 | 0.881 | 0.882 |
| RMSE | 1.254 | | | 0.266 | | |

Note: Standard errors clustered for intra-group correlation at the country pair level in parentheses, with significance levels indicated with $^{c}$ for 10%, $^{b}$ for 5%, $^{a}$ for 1%. All dummy variables for regional agreement membership are "exclusive", i.e. the RTA membership dummy equal zero when EEC or EU is equal to one. Shared currency and euro area dummies are similarly exclusive. All columns include origin×year, destination×year and country pair fixed effects.

Column (1) of Table 3 replicates our preferred estimation with OLS (column 6, 1). Comparing column (1) to column (3) shows the pure effect of switching from OLS to PPML, since it keeps the zeroes out of the regression for PPML. The effect of RTAs is made very close to zero by this method. Most important for our purposes, the EU effects are reduced but still (very) significantly positive. Maintaining zeroes in the sample in column (2) does not change matters substantially compared to column (3) as is frequently the case.

We find essentially no effect of the euro on trade over the columns of this table. Note that our insignificant results regarding the trade effect of the euro in column (3) are close to Santos Silva and Tenreyro (2010) or Larch *et al.* (2017) who also use PPML. In parallel to our negative effects in column (1) using OLS, Baldwin and Taglioni (2007) find a statistically significant negative coefficient of -0.09 in their Table 4, when using the proper specification of the gravity equation including country-time and bilateral fixed effects. This table also shows that the estimated trade effect of the euro is very sensitive to the structure of fixed effects included.[7]

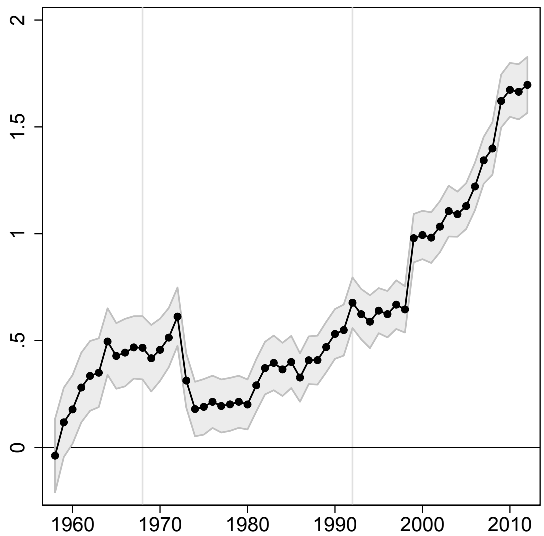
Table 3 also shows large variance in the estimates of GATT / WTO , shared currency, EU-Switzerland and EU-Turkey when switching estimator from OLS to PPML. Those differences, sometimes large, have already been documented in the literature, in particular related to colonial linkages. As emphasized by Eaton *et al.* (2013) and Head and Mayer (2014), when studying the discrepancies between PPML and linear-in-logs OLS estimators, it is useful to consider how different are their first order conditions. The former works with deviations from levels of the flow with respect to its prediction, while the latter works with log deviations. PPML will therefore naturally tend to put more weight on pairs of countries with large levels of trade. If ever those countries have a true underlying effect of RTA that differs from the rest of the sample, it will lead PPML to give an overall coefficient closer to this specific part of the sample (large flows) than to the unweighted average effect (this point was made and demonstrated by Monte Carlo simulations in Head and Mayer (2014)).

One way to see this effect at work is to apply weights proportional to levels of flows to the linear-in-logs specification. This is done in column (4) which shows results strikingly closer to column (3). A confirmation of that pattern is given in columns (5) and (6), which runs PPML on trade shares (bilateral imports divided by total imports) rather than trade flows. This is a method suggested by Eaton *et al.* (2013) so as to estimate their model of trade with discrete numbers of firms. This specification also will naturally give less weight to large flows in levels, since it works with trade shares for a given importer. The natural comparison is now column (6) and column (1). Those are indeed much more proximate. To sum up, linear-in-logs and PPML estimates of RTA effects (and of currency effects, see Santos Silva and Tenreyro (2010) or Larch *et al.* (2017) for instance) can be quite different. This is mainly due to how those estimators weight different parts of the sample, and in particular dyads with large predicted flows, which seem to generally have lower trade elasticities (Novy (2013) and Bas *et al.* (2017) are two papers providing (different) theoretical models featuring this type of heterogeneous elasticities together with empirical evidence). Our counterfactuals will therefore also consider results using PPML estimates of the EU effect on trade.

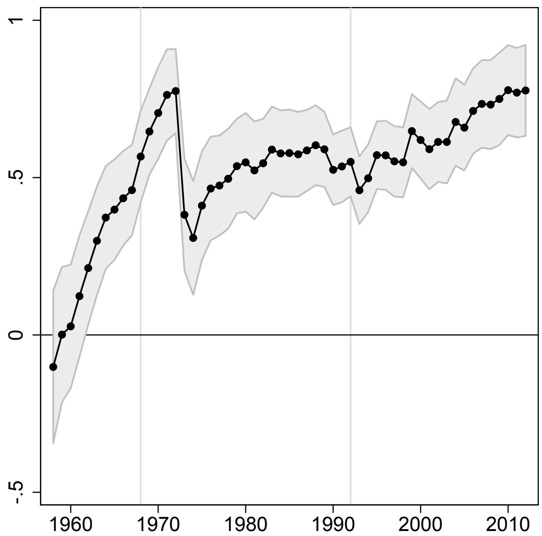
Figure 2 shows the evolution of the EU trade effect over time under several specifications. Panel (a) runs a regression where an EEC/EU membership dummy is interacted with year dummies since 1958. It also highlights two important dates: i) 1968 which marks the end of the phasing-in period (after this, tariffs are uniformly zero among members), ii) 1993 which is the date of entry into force of the Single Market. Panel (b) is reporting coefficients and confidence intervals for the same setup using PPML. The overall trend is quite clear in both cases: the effect of the EU is large and getting larger over time. Both panels also show an impressive drop in years 1973/1974. A likely explanation for this drop

[7] One noticeable difference with the literature is that our paper accounts for the deepening of the European union, through in particular the implementation of the single market beginning in 1993. It seems to be of utmost importance when measuring the trade impact of the creation in 1999 of the euro area, whose members all belong to the EU.

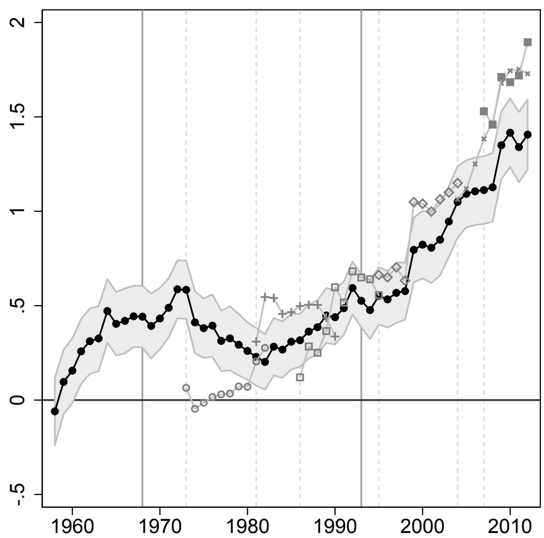
Figure 2: The effect of European integration on trade over time



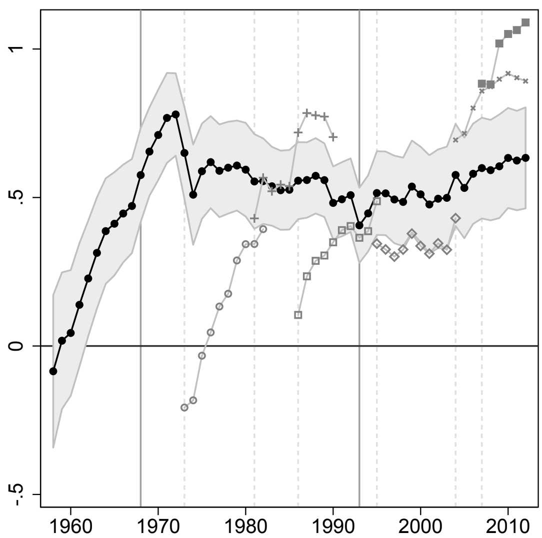

(a) OLS




(b) PPML




(c) Controling for enlargments: OLS




(d) Controling for enlargments: PPML

Note: Table 13 in Appendix provides the full set of coefficient estimates. Panels (c) and (d) introduce specific effects for EEC/EU enlargements occurring in 1973 and later (1981, 1986, 1995, 2004 and 2007 for our sample), consisting of dummies turning one between new members and incumbents during the first ten years of each enlargement.

is that this year is also the one where the United Kingdom, Ireland and Denmark enter the EC. Since those (and the UK in particular) should be initially trading relatively little with incumbent members, the composition effect might drive the overall effect down. This is investigated in panels (c) and (d) of the figure, where we introduce specific effects for EEC/EU enlargements occurring in 1973 and later (1981, 1986, 1995, 2004 and 2007 for our sample). Those consists of dummies turning one between new members and incumbents during the first ten years of each enlargement. It is very clear that the drop in the 70s is mostly explained by the entry of the UK, Ireland and Denmark. The overall effect (in black dots, now purged from enlargements) is much smoother under that configuration. Note that accounting for the entries is particularly important for PPML. The difference is especially strong in 1973 and 1986. This is to be expected based on the different weighting properties of linear-in-logs OLS vs PPML mentioned above. The entry of UK and Spain in those two years yields large expected flows in those two years, to which PPML gives more weight. We attribute what remains of the drop in the seventies to the first oil shock, which naturally should redirect trade towards non-member countries.

The trade impact of the single market strengthens over time, as expected from its gradual implementation. The effects are large at the end of the estimation period for both the OLS and the PPML estimates: the specification from Figure 2.c yields a coefficient on the EU of 1.406 in 2012, while the PPML specification in Figure 2.d yields a coefficient of 0.633. Baier *et al.* (2014) also find that the effect of deep agreements takes time to be fully realized. They report that deep integration approximately doubles trade after ten years. Table 13 in our Appendix provides the full set of EU coefficient estimates over time. During the 1992-2002 period, the excess trade attributed to EU is multiplied by $\exp(0.849 - 0.593) = 1.29$, while over 15 years, we obtain a $\exp(1.112 - 0.593) = 1.68$ surplus in trade.

### 2.3.4 Trade in services

We last turn to trade in services in Table 4. The traditional gravity variables in column (1) have the expected effects, but the RTA dummy has a much dampened and more volatile influence. The EU dummy keeps a positive, although smaller, influence on trade over all specifications, including our preferred one in column (4). 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 (6) results for goods on the same sample as services for appropriate comparison. Both regressions have the full set of fixed effects and use OLS. RTAs have a smaller effect, around 6%, on trade in services that what we find for trade in goods (9%). 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). Note that the relative impact of the Single market compared to a regular RTA is similar to one estimated for trade in goods in column (1) of Table 1: the EU post-92 increases three times more trade in services than a regular RTA.

Table 4: Gravity results of European integration in services

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Sample | | | Services | | | Services |
| Flow | | | Services | | | Goods |
| ln Pop, origin | 0.879$^a$ | -1.091$^a$ | | | | |
| | (0.015) | (0.251) | | | | |
| ln Pop, dest | 0.879$^a$ | 1.033$^a$ | | | | |
| | (0.014) | (0.284) | | | | |
| ln GDP/Pop, origin | 1.366$^a$ | 0.559$^a$ | | | | |
| | (0.024) | (0.039) | | | | |
| ln GDP/Pop, dest | 1.395$^a$ | 0.889$^a$ | | | | |
| | (0.024) | (0.046) | | | | |
| ln distance(avg) | -0.950$^a$ | | -1.296$^a$ | | | |
| | (0.033) | | (0.060) | | | |
| Shared Border dum. | 0.417$^a$ | | 0.409$^a$ | | | |
| | (0.110) | | (0.133) | | | |
| Shared language dum. | 0.491$^a$ | | -0.136 | | | |
| | (0.112) | | (0.126) | | | |
| Shared legal origin dum. | 0.198$^a$ | | 0.421$^a$ | | | |
| | (0.053) | | (0.045) | | | |
| Colonial history dum. | 1.280$^a$ | | 0.841$^a$ | | | |
| | (0.234) | | (0.216) | | | |
| Ever sibling dum. | 1.017$^a$ | | 0.417$^a$ | | | |
| | (0.098) | | (0.126) | | | |
| RTA dum. | -0.044 | 0.047 | 0.107 | 0.072 | 0.060 | 0.093$^b$ |
| | (0.062) | (0.036) | (0.093) | (0.044) | (0.046) | (0.039) |
| EU dum. | 0.121$^c$ | 0.183$^a$ | -0.174 | 0.174$^b$ | 0.177$^b$ | 0.320$^a$ |
| | (0.072) | (0.054) | (0.123) | (0.071) | (0.070) | (0.060) |
| Both GATT dum. | 0.074 | 0.210$^a$ | -0.006 | 0.217 | 0.219 | 0.258 |
| | (0.082) | (0.053) | (0.325) | (0.312) | (0.312) | (0.249) |
| Euro area dum. | -0.181$^a$ | 0.031 | -0.355$^a$ | 0.043 | 0.052 | 0.026 |
| | (0.061) | (0.050) | (0.082) | (0.057) | (0.060) | (0.047) |
| Shengen dum. | | | | | -0.032 | |
| | | | | | (0.042) | |
| EEA dum. | | | | | 0.231$^c$ | |
| | | | | | (0.122) | |
| EU-Switzerland RTA dum. | | | | | -0.001 | |
| | | | | | (0.100) | |
| EU-Turkey RTA dum. | | | | | 0.071 | |
| | | | | | (0.117) | |
| Observations | 35874 | 35874 | 35963 | 35927 | 35927 | 34903 |
| R2 | 0.776 | 0.515 | 0.865 | 0.965 | 0.965 | 0.971 |
| RMSE | 1.330 | 0.603 | 1.070 | 0.568 | 0.568 | 0.506 |
| Origin×year and dest×year FE | - | - | Yes | Yes | Yes | Yes |
| Country pair FE | - | Yes | - | Yes | Yes | Yes |
| Year FE | Yes | Yes | - | - | - | - |

Note: Standard errors clustered for intra-group correlation at the country pair level in parentheses, with significance levels indicated with $^c$ for 10%, $^b$ for 5%, $^a$ for 1%. All dummy variables for regional agreement membership are "exclusive", i.e. the RTA membership dummy equal zero when EEC or EU is equal to one.

The comparison with goods in column (6) 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). Overall, we find an almost twice lower impact of the EU and regular RTAs on trade in services than trade in goods.

# 3 Quantifying the welfare impact of European integration

## 3.1 General Equilibrium Trade Impact and Welfare changes

With the gravity estimates of EU effects in hand, we now turn to simulations of different scenarios of EU disintegration, which also informs us about the gains associated with the current situation. Those exercises rely heavily on the recent stream of work quantifying the impact of various trade policy scenarios using the gravity equation as a building block for the construction of counterfactuals. Up until this stage, we remained voluntarily general in terms of the foundations of structural gravity, since it is precisely its advantage to be compatible with most of the existing trade models. For counterfactual analysis, we have to restrict ourselves a little bit more in order to exploit the structure of the model in the scenarios of trade policy changes.

In their very complete coverage of this line of research, Costinot and Rodriguez-Clare (2014) considering many cases, varying in particular market structure, the presence of intermediates, the number of sectors and factors considered. We focus on the case relevant for i) multiple sectors (aggregated with Cobb-Douglas preferences), ii) including tradable intermediates and iii) perfect or Bertrand competition (à la Bernard *et al.* (2003)) as our benchmark. To be very precise, our setup amounts to the perfect/Bertrand competition case for the model considered in section 3.4 of Costinot and Rodriguez-Clare (2014). It is a simplification of Caliendo and Parro (2015), very close to the framework used in Dhingra *et al.* (2016) and Felbermayr *et al.* (2018).

Returning to the trade share equation (2), we now have to specify the exporting country fundamental attractiveness $S_{it}$ in order to obtain a microfounded version of trade shares $\pi_{ni}$. Consider the case of a sector $s$ where firms use labor in proportion $\mu_s$ and a CES composite index of tradable intermediates in proportion $1 - \mu_s$. Parameter $\mu_s$ is also the share of value added in the output of sector $s$. Demand will adjust to change in production costs (fully transmitted in prices) with an elasticity $\varepsilon_s < 0$, the price elasticity relevant in the sector. As often the case in this literature, we simplify the input-output matrix such that intermediates come from own sector. Omitting the time subscript for clarity in this section, we therefore have

$$S_{i,s} = (w_{i,s}^{\mu_s} P_{i,s}^{1-\mu_s})^{\varepsilon_s},$$

where $w$ refers to unit wage and $P$ to the price index of varieties used as inputs in the production process:

$$P_{n,s} \equiv \left( \sum_{\ell} (w_{\ell,s}^{\mu_s} P_{\ell,s}^{1-\mu_s} \tau_{n\ell,s})^{\varepsilon_s} \right)^{1/\varepsilon_s}. \tag{8}$$

Using $S_{i,s}$ in (2) yields the bilateral trade values equation

$$X_{ni,s} = \pi_{ni,s} X_{n,s} = \frac{(w_{i,s}^{\mu_s} P_{i,s}^{1-\mu_s} \tau_{ni,s})^{\varepsilon_s}}{\sum_{\ell} (w_{\ell,s}^{\mu_s} P_{\ell,s}^{1-\mu_s} \tau_{n\ell,s})^{\varepsilon_s}} X_{n,s}. \tag{9}$$

We will consider scenarios of different policy changes. We therefore need to consider how equation (9) adjusts when trade costs are changed. Let us follow the convention established in that literature and use hats to denote percentage changes ($\hat{x} = \frac{x'}{x}$, with $x$ the initial level $x'$ the new one after policy change. Assuming that output value is entirely distributed to workers ($L_{i,s}$ of them), we have $w_{i,s} = Y_{i,s}/L_{i,s}$. If the employment structure is held constant, we obtain:

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

and

$$\hat{P}_{n,s} = \left( \sum_{\ell} \pi_{n\ell,s} (\hat{Y}_{\ell,s}^{\mu_s} \hat{P}_{\ell,s}^{1-\mu_s} \hat{\tau}_{n\ell,s})^{\varepsilon_s} \right)^{1/\varepsilon_s} \tag{11}$$

This is the Exact Hat Algebra (EHA) approach to counterfactuals first demonstrated and used in Dekle *et al.* (2007): Because of the CES structure of (9), the change in trade shares are a function of i) two known variables: initial levels of trade shares, and changes in trade costs ; ii) changes in two endogenous variables $Y$ and $P$ that can be solved for.

The last step uses the market clearing condition that $Y'_{i,s} = \sum_n \pi'_{ni,s} X'_{n,s}$, to solve for the changes in production of each origin country. The change in expenditure is obtained by assuming that trade balances are exogenously given on a per capita basis, $X_{n,s} = w_{n,s} L_{n,s}(1 + d_{n,s})$, so that $\hat{X}_{n,s} = \hat{w}_{n,s} = \hat{Y}_{n,s}$. Combining those last two equations yields

$$\hat{Y}_{i,s} = \frac{1}{Y_{i,s}} \sum_n \hat{\pi}_{ni,s} \pi_{ni,s} \hat{Y}_{n,s} X_{n,s} = \frac{1}{Y_{i,s}} \sum_n \frac{\pi_{ni,s} (\hat{Y}_{i,s}^{\mu_s} \hat{P}_{i,s}^{1-\mu_s} \hat{\tau}_{ni,s})^{\varepsilon_s}}{\sum_{\ell} \pi_{n\ell,s} (\hat{Y}_{\ell,s}^{\mu_s} \hat{P}_{\ell,s}^{1-\mu_s} \hat{\tau}_{n\ell,s})^{\varepsilon_s}} \hat{Y}_{n,s} X_{n,s}. \tag{12}$$

Equations (12) and (11) are all that we need to compute the counterfactual trade matrix (including domestic flows) using nested fixed point iteration. Once endowed with this matrix of trade changes, one can very easily compute the welfare changes. Indeed, adapting equation (28) of Costinot and Rodriguez-Clare (2014) to our case, the welfare gains (the change in real income of country $n$) can be written as

$$\hat{C}_n = \prod_s (\hat{\pi}_{nn,s})^{\beta_{n,s} a_{n,ss}/\varepsilon_s} \tag{13}$$

In terms of welfare determinants, $\pi_{nn,s}$ denotes the domestic share in total expenditure of country $n$ in sector $s$, $a_{n,ss}$ are the elements of an inverse Leontief matrix of input-output linkages $(I - A_n)^{-1}$, $\beta_{n,s}$ is the exogenous preference parameter for $s$ in $n$, such that $\sum_s \beta_{n,s} = 1$. Since we simplified the structure of I/O linkages, as in Dekle *et al.* (2007) assuming that intermediate inputs are mostly sourced from the sector itself , $A_n$ is diagonal with elements that are technology parameter $\alpha_{n,ss}$. In the version without intermediate goods, equation (13) reduces to:

$$\hat{C}_n = \prod_s (\hat{\pi}_{nn,s})^{\beta_{n,s}/\varepsilon_s}, \tag{14}$$

in which we can recognize the well-known result by Arkolakis *et al.* (2012) that welfare changes of any policy counterfactual can be captured by a very small number of sufficient statistics, among which the change in domestic expenditure share and the trade elasticity are key. The intuition behind this equation is the following: Trade costs are distorting the relative domestic vs foreign price, which means that the change in the domestic share of consumption summarizes all the complex set of reallocations that occur in response to a rise or a fall in trade costs. The fact that we do not need to know either the levels of "fundamentals" of different countries or even the whole set of import share changes by $n$ is a surprising result of the CES structure of the model that was one of the highlights of by Arkolakis *et al.* (2012). The influence of $\varepsilon_s$ is more subtle. A rise in trade costs essentially forces consumers to turn excessively to domestic varieties. If domestic and foreign varieties are very close substitutes (a high $\varepsilon_s$), this is not a big hit on consumer utility. However if products are very differentiated, this is more harmful to welfare. Last, each sector is weighted by its preference parameter $\beta_s$.

We consider counterfactual scenarios where the current EU is replaced by a i) EEC (i.e. remove Single Market), ii) a "normal", shallow-type, regional agreement, or iii) reverts to WTO rules. The algorithm solving for equilibrium changes in trade shares, income, output and welfare follows four steps:[8]

1. Calculate $\hat{\tau}_{ni,s}^{\varepsilon_s} \equiv \hat{\phi}_{ni,s} = \exp(-\beta_{EU,s})$ for the $ni$ pairs in which $\text{EU}_{ni} = 1$ and $\hat{\phi}_{ni,s} = 1$ for all other pairs ($\beta_{EU,s}$ being the estimated coefficient relevant for the considered scenario);

2. Initialize all $\hat{Y}_{i,s}$ and $\hat{P}_{n,s}$ at 1. Plug estimated $\hat{\phi}_{ni,s}$ with levels of the trade share matrix $\pi_{ni,s}$ into equation (11) to solve for the vector of price indices.

3. Plug estimated $\hat{\phi}_{ni,s}$ and $\hat{P}_{n,s}$ obtained from step 2 (along with values of $Y_{i,s}$, $X_{n,s}$, and the $\pi_{ni,s}$) into equation (12), substitute $\hat{\phi}_{ni,s}$ and $\hat{Y}_{i,s}^{\varepsilon_s}$ into equation (10) to get the matrix of trade changes and iterate using a dampening factor until $\hat{\pi}_{ni,s}$ stops changing. This also provides the equilibrium vector of $\hat{Y}_{i,s}$.

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

4. Calculate the General Equilibrium Trade impact (GETI), $\hat{\pi}_{ni,s}\hat{Y}_{n,s}$, for each country pair and the change in intra-national trade $\hat{\pi}_{nn,s}$. Combined with estimates of $\beta_{n,s}$, $a_{n,ss}$ from data and $\varepsilon_s$ from the literature, calculate welfare changes using (13) or (14) depending upon the case under consideration.

## 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.[9] We aggregate the data into three broad sectors: goods, tradable services and non-tradable services.[10] 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 full effect of the single market membership, i.e. the EU estimated direct impact at the end of the estimation period. For trade in goods, we use results from Figure 2.c, i.e. $\beta_{EU,goods} = 1.406$, $\beta_{RTA,goods} = 0.391$ and and $\beta_{EEC,goods} = 0.593$ (the coefficient on EU for the year 1992, just prior to the implementation of the Single market, from Table 13, column 2).[11] As underlined in section 2, the impact found on trade in services is about half the impact on trade in goods when estimated on the same sample (columns (4) and (6) in Table 4). We therefore assume $\beta_{EU,serv} = 1.406/2 = 0.703$.

## 3.3 The fit of Exact Hat Algebra: the case of the 2004 enlargement

Our first exercise is to assess the goodness of fit of counterfactual analysis using the experiment of EU enlargement to 10 new members in 2004. We want to see whether the model is doing a reasonable job at predicting the outcome of past liberalization episodes, i.e. how trade shares and output in Europe changed following the enlargement of the EU to Central and Eastern Europe.

The exercise runs as follows: we take as our baseline year what is reported by WIOD in 2003 (one year prior to enlargement), combined with PTI estimates from the previous section, and *compare trade shares that our model predicts should be in 2014 ($\pi'_{ni,s}$) to actual trade shares in 2014.* The trade cost shock fed into the simulation is the 2004 enlargement,

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

[10]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).

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

and therefore the entry of 10 Central and European Countries in the EU, which get attributed the relevant gravity coefficient.[12] Since the model also includes an adjustment of each country's production, we can also assess the goodness of fit on production data as measured by shares in total EU output by sector.

Table 5: Goodness of fit for the 2004 enlargement

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector | good | serv | good | good | good | good | good | serv | serv | serv | serv | serv |
| Level/diff | level | level | diff | diff | diff | diff | diff | diff | diff | diff | diff | diff |
| Comparison year | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 |
| Sample | | | | eu25 | enlarg04 | intra | intra no outlier* | | eu25 | enlarg04 | intra | intra no outlier* |
| | Change in trade share | | | | | | | | | | | |
| Counterfactual change | 0.941*** | 0.984*** | 0.531*** | 0.570*** | 0.549*** | 0.662*** | 0.744*** | 0.926*** | 1.026*** | 0.973*** | 1.009*** | 1.003*** |
| | (0.004) | (0.001) | (0.018) | (0.024) | (0.018) | (0.078) | (0.043) | (0.056) | (0.083) | (0.061) | (0.167) | (0.179) |
| R2 | 0.962 | 0.996 | 0.312 | 0.477 | 0.698 | 0.890 | 0.974 | 0.123 | 0.198 | 0.388 | 0.801 | 0.797 |
| Observations | 1,936 | 1,936 | 1,936 | 625 | 400 | 10 | 9 | 1,936 | 625 | 400 | 10 | 9 |
| | Change in EU-25 production share | | | | | | | | | | | |
| Counterfactual change | 0.983*** | 0.987*** | 3.579*** | 3.579*** | 3.153*** | - | 4.535*** | 15.196*** | 15.196*** | 11.521*** | - | -0.579 |
| | (0.010) | (0.006) | (0.446) | (0.446) | (0.230) | - | (1.025) | (2.969) | (2.969) | (2.063) | - | (5.457) |
| R2 | 0.998 | 0.999 | 0.728 | 0.728 | 0.954 | - | 0.710 | 0.522 | 0.522 | 0.776 | - | 0.001 |
| Observations | 25 | 25 | 25 | 25 | 10 | - | 9 | 25 | 25 | 10 | - | 9 |

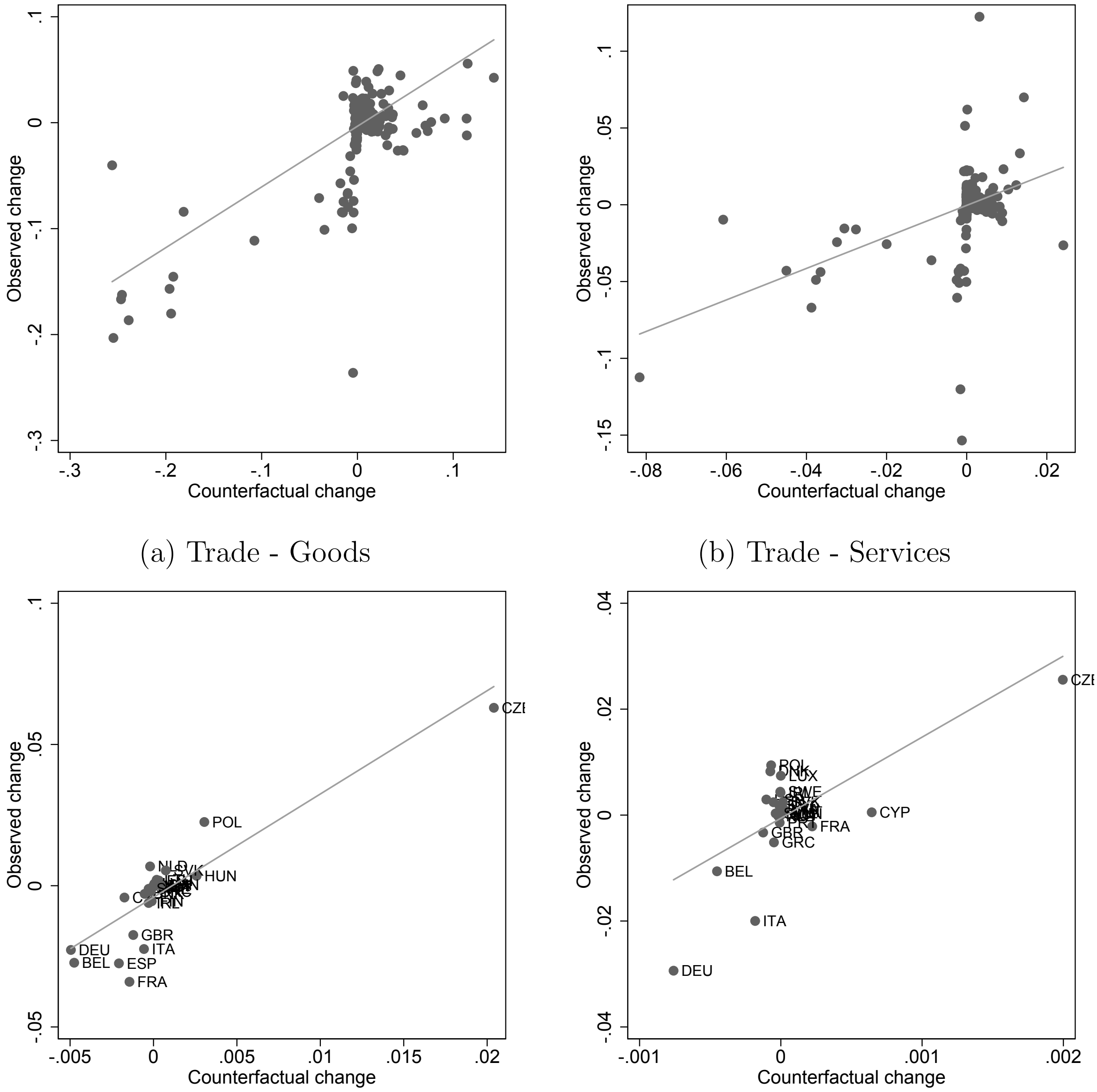
Note: * Poland in case of trade and Czech Republic in case of production.

Table 5 presents the R-squared from regressing predicted trade or production shares on observed counterparts in 2014. Such regressions are performed in level and differences with respect to 2003 (the data from which the simulation exercise is done). The fit of the model in levels is quite high which should not be too surprising since the cross-section part of the variance in bilateral trade is quite persistent and is a fundamental driver of the level attained in 2014 as predicted by the model. What is more difficult is for the model to have a good prediction of changes. Despite the myriad of country and country-pair specific shocks hitting over that 10-year period which can cause the realized change to deviate substantially from the prediction of the trade model, the simulation does a fairly good job at predicting patterns of changes. For trade in goods, the prediction explains nearly 50% of the variance in changes of bilateral trade shares in the EU over that decade (column (4), upper panel), and even 70% of the variance of trade flows involving at least one accession member (column (5), upper panel). As expected, the fit is substantially lower for trade in services. The estimated coefficients reported in the upper panel suggest that the model tends to overestimate more small changes in trade share, i.e. for country pairs not directly concerned with the 2004 enlargement. The model also explains a large share of the variance of output share changes, nearly 70% for good for EU countries (column (4), bottom panel), but changes are substantially underesstimated.

Results can also be visually summarized in figure 3. In each panel, the x-axis plots the predicted change, while the y-axis is the true change. Panel (a) is trade in goods, Panel (b) trade in services for all pairs of countries inside EU (after enlargement). Panels (c) and (d) show changes in output. While a host of other determinants explain actual changes,

[12] Note that we consider further enlargements (in 2007 and 2013) as having taken place in the simulation exercise but do not consider those countries when considering the fit of our simulations since we want to compare long term adjustments.

Figure 3: Simulated vs real changes following the 2004 enlargement




(a) Trade - Goods

(b) Trade - Services

(c) Production (share EU-25) - Goods

(d) Production (share EU-25) - Services

Note:

the model suggests that the enlargement can explain relatively well the central patterns of observed evolutions.

# 4 The gains from the European Union

We now turn to our counterfactuals meant to assess the gains from having the EU-28 as it is against several alternatives (we defer the analysis of the impact of Brexit on gains from the EU to the next section). We consider two alternative scenarios to assess the gains from European integration. In a first counterfactual, we assume that the European Union 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.[13]

## 4.1 The trade effect of EU membership

In this section, we present results obtained after computing the counterfactual (GETI) trade matrix under our scenario of EU returning to a "normal" RTA. Table 6 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 36% on average in the RTA scenario presented in Table 6, with a particularly large impact on small open economies and on Central and Eastern European countries. The import penetration ratio (total imports over consumption) in the goods sector is more than a 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 figures often close to 50%.[14] The impact on imports of services is lower, with an average increase of 29% (column (6)) involving a 21% larger import penetration ratio (two last columns of Table 6.

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 (PTI) of the EU, by neutralizing general equilibrium effects that happen through changes in multilateral resistance (MR) terms and changes in GDPs through the use of origin×year and destination×year fixed effects. Results in Table 6 include all effects. The PTI and inward MR adjustment ($\Phi$) effects have

[13] 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 tariff revenues would however dampen the difference between the RTA and WTO scenarios.

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

Table 6: 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 | 152% | 202% | 82% | 60% | 41% | 132% | 156% | 95% | 13% | 10% |
| BEL | 144% | 221% | 89% | 72% | 56% | 126% | 156% | 96% | 24% | 19% |
| BGR | 128% | 209% | 83% | 55% | 43% | 136% | 160% | 98% | 11% | 8% |
| CYP | 93% | 154% | 59% | 68% | 63% | 137% | 166% | 102% | 18% | 13% |
| CZE | 164% | 228% | 92% | 61% | 41% | 125% | 146% | 90% | 14% | 11% |
| DEU | 146% | 226% | 93% | 46% | 33% | 122% | 150% | 94% | 11% | 9% |
| DNK | 140% | 203% | 81% | 59% | 44% | 119% | 157% | 96% | 19% | 16% |
| ESP | 138% | 240% | 95% | 39% | 29% | 130% | 157% | 96% | 6% | 5% |
| EST | 133% | 195% | 78% | 71% | 56% | 139% | 154% | 94% | 16% | 11% |
| FIN | 143% | 222% | 89% | 44% | 31% | 116% | 147% | 89% | 13% | 11% |
| FRA | 135% | 212% | 85% | 47% | 35% | 128% | 161% | 99% | 8% | 6% |
| GBR | 116% | 198% | 81% | 47% | 39% | 131% | 165% | 101% | 8% | 6% |
| GRC | 110% | 201% | 79% | 46% | 40% | 118% | 152% | 92% | 10% | 8% |
| HRV | 135% | 195% | 79% | 54% | 40% | 126% | 154% | 94% | 12% | 10% |
| HUN | 152% | 214% | 86% | 69% | 50% | 133% | 158% | 97% | 21% | 16% |
| IRL | 132% | 217% | 83% | 79% | 66% | 109% | 155% | 96% | 52% | 48% |
| ITA | 145% | 239% | 95% | 33% | 24% | 123% | 150% | 92% | 6% | 5% |
| LTU | 126% | 220% | 88% | 68% | 57% | 121% | 161% | 100% | 19% | 15% |
| LUX | 122% | 158% | 65% | 84% | 72% | 118% | 151% | 92% | 52% | 45% |
| LVA | 128% | 190% | 76% | 64% | 51% | 139% | 160% | 99% | 11% | 8% |
| MLT | 111% | 184% | 72% | 72% | 63% | 129% | 142% | 89% | 52% | 41% |
| NLD | 142% | 241% | 97% | 67% | 53% | 130% | 175% | 107% | 19% | 15% |
| POL | 154% | 230% | 93% | 43% | 29% | 144% | 180% | 109% | 10% | 7% |
| PRT | 136% | 199% | 78% | 49% | 35% | 131% | 152% | 92% | 8% | 6% |
| ROU | 135% | 204% | 82% | 39% | 28% | 146% | 174% | 106% | 9% | 6% |
| SVK | 148% | 219% | 90% | 65% | 48% | 151% | 173% | 105% | 12% | 8% |
| SVN | 149% | 216% | 86% | 68% | 50% | 132% | 161% | 97% | 14% | 11% |
| SWE | 143% | 208% | 83% | 51% | 36% | 124% | 155% | 95% | 16% | 12% |
| EU (mean) | 136% | 209% | 84% | 58% | 45% | 129% | 158% | 97% | 17% | 14% |
| EU (median) | 137% | 210% | 83% | 59% | 42% | 129% | 156% | 96% | 13% | 10% |

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.

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 ($\Omega$) 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 60%), with increases caused by the EU ranging from +42% for Malta to +80% for Poland.

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 6 reveals that imports of goods from non-EU countries are expected to be on average 16% (100-84, column 3) lower than without the EU, but those imports are more stable for countries like the Netherlands, Italy or Poland. The same pattern holds for trade in services, even though to a lower extent with an average reduction of 3% (100-97, column 8).

## 4.2 Welfare gains by country member

Table 7 reports the welfare gains in percent with three different scenarios and two different assumptions regarding whether intermediates are included or not in the model. Columns (1) to (3) consider the benchmark case with intermediates, when the three next columns omit them . Columns (1) and (4) take the most extreme route where EU countries return to the WTO option under which MFN tariffs replace the EU. Columns (2) and (5) consider the scenario under which a regular RTA replaces the EU, and columns (3) and (6) the EEC scenario.

The main conclusion is very clear: all member countries unambiguously obtain sizable welfare gains from the EU as it is. The average gain across columns ranges from 2.0% to 8.2%. Average gains are slightly lower on a weighted basis, ranging from 1.3% to 5.5%, 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 has generated a *permanent* real GDP increase that is far from negligible. Those are comparative statics results and reflect long term changes in the *level* of GDP. The magnitude of the estimated gains however depends on the specific modeling assumptions regarding intermediate goods: whatever the scenario, gains from trade integration are substantially larger with intermediate goods

Table 7: Welfare gains from EU under different scenarios

| Counterfactual Assumption | (1) to MFN | (2) to RTA | (3) to EEC | (4) to MFN | (5) to RTA | (6) to EEC |
|---|---|---|---|---|---|---|
| | with intermediates | | | without intermediates | | |
| AUT | 9,6% | 7,7% | 6,6% | 3,2% | 2,6% | 2,2% |
| BEL | 10,7% | 8,5% | 7,2% | 3,8% | 3,0% | 2,6% |
| BGR | 8,1% | 6,6% | 5,7% | 2,7% | 2,2% | 1,9% |
| CYP | 4,3% | 3,5% | 3,0% | 1,6% | 1,3% | 1,1% |
| CZE | 13,3% | 10,7% | 9,1% | 4,4% | 3,6% | 3,0% |
| DEU | 5,7% | 4,6% | 3,9% | 1,9% | 1,6% | 1,3% |
| DNK | 7,0% | 5,6% | 4,8% | 2,4% | 1,9% | 1,7% |
| ESP | 3,9% | 3,2% | 2,7% | 1,3% | 1,1% | 0,9% |
| EST | 13,1% | 10,5% | 8,8% | 4,3% | 3,5% | 3,0% |
| FIN | 5,0% | 4,1% | 3,5% | 1,7% | 1,4% | 1,2% |
| FRA | 4,2% | 3,4% | 2,9% | 1,4% | 1,2% | 1,0% |
| GBR | 2,8% | 2,3% | 2,0% | 1,0% | 0,8% | 0,7% |
| GRC | 3,0% | 2,4% | 2,1% | 1,0% | 0,8% | 0,7% |
| HRV | 7,5% | 6,1% | 5,2% | 2,5% | 2,0% | 1,7% |
| HUN | 17,7% | 14,1% | 11,9% | 5,8% | 4,7% | 4,0% |
| IRL | 8,5% | 6,8% | 5,7% | 3,4% | 2,7% | 2,3% |
| ITA | 3,3% | 2,7% | 2,3% | 1,1% | 0,9% | 0,8% |
| LTU | 10,7% | 8,6% | 7,3% | 3,6% | 2,9% | 2,5% |
| LUX | 10,5% | 8,2% | 6,9% | 4,4% | 3,5% | 2,9% |
| LVA | 7,9% | 6,4% | 5,4% | 2,6% | 2,1% | 1,8% |
| MLT | 10,5% | 8,3% | 6,9% | 4,6% | 3,6% | 3,0% |
| NLD | 9,4% | 7,5% | 6,4% | 3,3% | 2,7% | 2,3% |
| POL | 7,4% | 6,0% | 5,1% | 2,5% | 2,0% | 1,7% |
| PRT | 6,4% | 5,2% | 4,5% | 2,1% | 1,7% | 1,5% |
| ROU | 5,6% | 4,6% | 3,9% | 1,8% | 1,5% | 1,3% |
| SVK | 14,9% | 12,0% | 10,1% | 4,9% | 3,9% | 3,3% |
| SVN | 13,1% | 10,5% | 8,9% | 4,4% | 3,5% | 3,0% |
| SWE | 5,9% | 4,8% | 4,1% | 2,1% | 1,7% | 1,4% |
| EU weigthed | 5,5% | 4,4% | 3,8% | 1,9% | 1,5% | 1,3% |
| EU mean | 8,2% | 6,6% | 5,6% | 2,8% | 2,3% | 2,0% |

Note: welfare gains are relative to the counterfactual scenario, in which the EU is either replaced by WTO rules (columns (1) and (4)), a standard RTA (columns (2) and (5)) or the EEC (column (3) and (6)). Welfare gains computed from equation (13) in columns (1)-(3) and equation (14) in columns (4)-(6). * weighted by share in consumption.

(columns (1) to (3)) than without (columns (4) to (6)).

The counterfactual scenario where the EU is replaced by a normal RTA (i.e. 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.) suggests that the Single market has generated an average 6.6% (4.4% when weighted) permanent real GDP gain for EU countries (column (1) of table 7). 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 alternative European integration would have been costly. While the alternative scenario of MFN status would of course have yielded the largest welfare losses, the persistence of a normal RTA would also have been very costly. Actually, the loss of deep integration represents more than four fifths ($4.4/5.5 \simeq 6.6/8.2 \simeq 80\%$) of the total effect of a return to WTO rules (clearly the worst case scenario). Such conclusion holds when considering the third scenario, in which the EU Single market is replaced by the EEC, yet with slightly lower gains than in the RTA scenario (3.8% on average instead of 4.4%) because of the larger trade integration provided by the customs union.

In the appendix Table 15, we re-express the gains from the existence of the EU from columns (1) to (3) of Table 7 in percentage of total gains from trade, i.e. with respect to autarky. Such quantification has the advantage of being essentially independent of the trade elasticity as pointed out by Comerford and Rodriguez-Mora (2017). Depending on the scenario, the EU account for one quarter to one third of total gains from trade of EU countries on average. Those are large orders of magnitude which seem in line with the estimated impact on import penetration shown in Table 6. Comerford and Rodriguez-Mora (2017) find in their EU dissolution exercise magnitudes even larger (between a third and a half) using a different methodology for the trade shock which makes use of trade with self in order to obtain the causal effect of national borders.

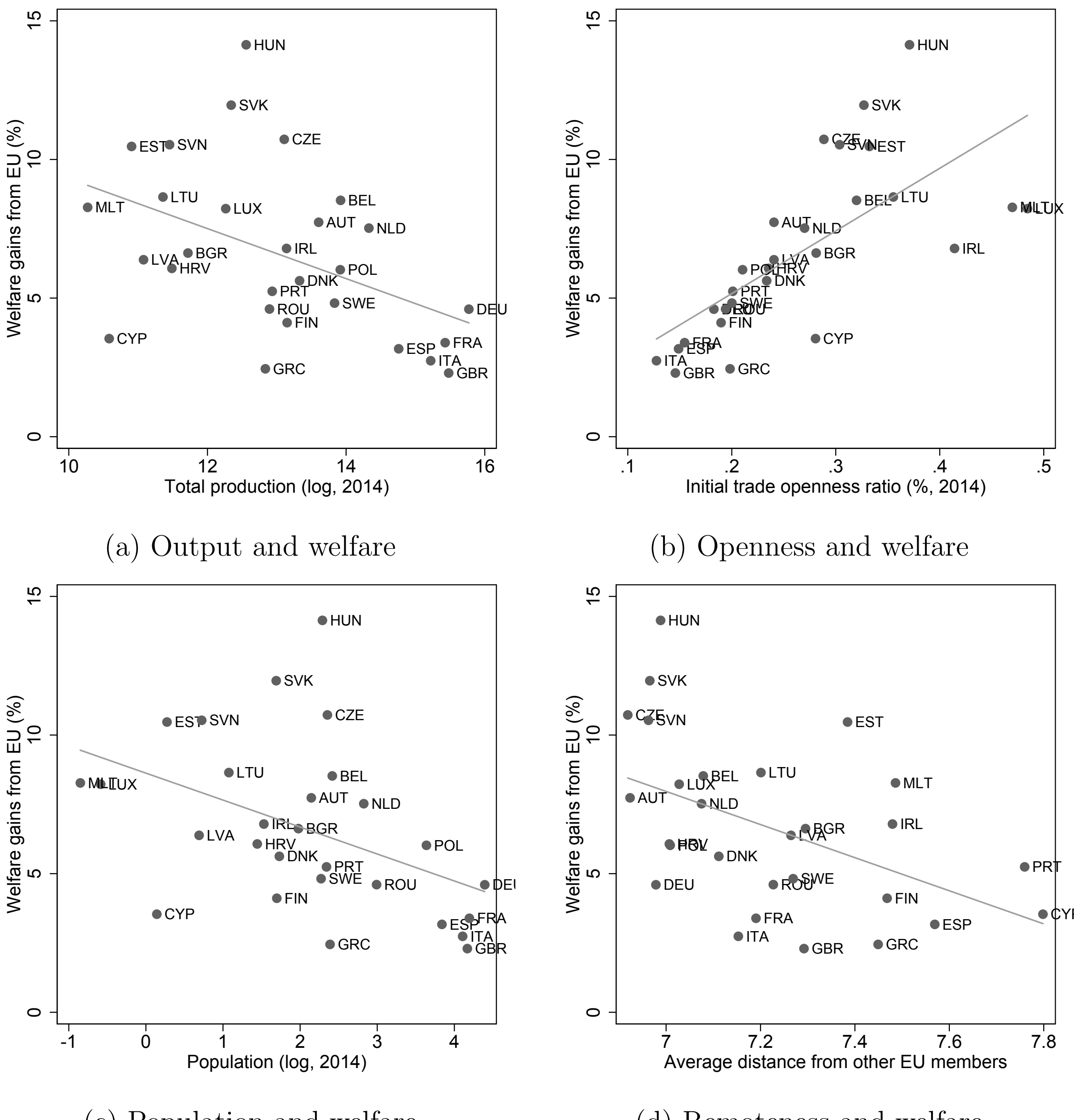
Looking at the distribution of EU gains (or Non-Europe losses) across countries, again a very clear pattern emerges: small and open economies benefit more from EU integration as it is, and therefore would bear the largest costs under the dis-integration scenarios. Particularly interesting is the case 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 17.7% 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. Those results are in line with the ones by Felbermayr *et al.* (2018): they report for instance a welfare loss of 14% for Hungary and 5% for Germany following the complete dissolution of the EU. This is strikingly close to our numbers.

We provide two sets of figures to illustrate how welfare gains from EU integration are related to country characteristics. Equation (13) 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 4 (panel a), while the opposite is true regarding countries initially more open to trade (Figure 4, panel b). In panels c and d of figure 4, we relate those same welfare gains to "first nature" observables that are less endogenous to the EU integration process: population in panel c and geographical remoteness in panel d. Again, large and/or peripheral countries that are expected to be less integrated in the European trade network are the ones where the gains from the EU are the more modest (still being far from trivial). Again those patterns are confirmed by results in Felbermayr *et al.* (2018) (their figure 7).

### 4.3 Welfare gains under alternative gravity estimators

Table 8 evaluates how sensitive are the welfare results to the method used in the gravity estimates of EU trade effects. As Table 3 shows, the OLS and PPML estimation of EU PTI effects can be quite different. EU estimates are still quite large and show a similarly increasing pattern, but the absolute level of the effect is smaller under PPML. There are two interpretations possible. The one we highlighted above, is that the key difference lies in the estimated trade elasticity: PPML focuses on the part of the sample with high predicted trade, those have theoretical reasons to have smaller response to trade costs (Novy (2013) and Bas *et al.* (2017) are two recent examples), therefore we should expect a smaller coefficient on EU integration. However the coefficient estimated is the interaction of two effects: the trade elasticity and the ad valorem equivalent of the change in trade costs due to implementation of the EU. In the case of the RTA scenario, the AVE of our OLS estimates combined with our benchmark trade elasticity $\varepsilon = -5.03$ is $\text{AVE}_{\text{OLS}} = \exp((1.406 - 0.391)/5.03) - 1 \simeq 22\%$ (Table 13, column (2)). With the PPML estimate, keeping trade elasticity unchanged, it is $\text{AVE}_{\text{PPML}} = \exp(0.633/5.03) - 1 \simeq 13\%$ (Table 13, column (4)). At the opposite, keeping the AVE of OLS estimates and accounting for the difference in coefficients through trade elasticity alone gives an estimate of $\varepsilon_{\text{PPML}} = 0.633/\ln(1.22) = 3.18$. The consequence of either interpretation is very different in terms of welfare change. Very intuitively, the trade cost interpretation lowers welfare gains, since the EU is assumed to have done less in terms of trade costs reduction (compared to OLS estimates). The trade gains are about a third smaller in that case (column (2)). The trade elasticity interpretation is radically different. EU-related trade costs cuts are assumed identical, but the consumer now sees foreign and domestic goods as less substitutable. The distorsion imposed by trade costs is more damaging if substitution away from expensive varieties is difficult. A same drop in the AVE thus yields more gains everything else equal. Column (1) in Table 8 reports our benchmark results, while columns (2) and (3) report the welfare effects using the two versions associated with PPML PTI effects. It is interesting to note that the benchmark welfare effects using OLS gravity results are bracketed by the

Figure 4: EU-membership welfare gains




(a) Output and welfare

(b) Openness and welfare

(c) Population and welfare

(d) Remoteness and welfare

Note: Welfare gains are from column (1) of Table 7: the standard RTA scenario with intermediate goods. Trade openness computed as total exports over production.

Table 8: Welfare gains from EU under different scenarios

| | (1) | (2) | (3) |
|---|---|---|---|
| Counterfactual Assumption | to RTA | to RTA with intermediates | to RTA |
| Estimate of EU PTI trade impact: | OLS | PPML trade costs | PPML trade elasticity |
| AUT | 7,7% | 5,4% | 12,4% |
| BEL | 8,5% | 5,8% | 13,4% |
| BGR | 6,6% | 4,7% | 10,7% |
| CYP | 3,5% | 2,5% | 5,9% |
| CZE | 10,7% | 7,4% | 17,1% |
| DEU | 4,6% | 3,2% | 7,3% |
| DNK | 5,6% | 3,9% | 9,0% |
| ESP | 3,2% | 2,2% | 5,0% |
| EST | 10,5% | 7,2% | 16,8% |
| FIN | 4,1% | 2,9% | 6,6% |
| FRA | 3,4% | 2,4% | 5,4% |
| GBR | 2,3% | 1,6% | 3,7% |
| GRC | 2,4% | 1,7% | 4,0% |
| HRV | 6,1% | 4,2% | 9,8% |
| HUN | 14,1% | 9,6% | 22,7% |
| IRL | 6,8% | 4,6% | 10,6% |
| ITA | 2,7% | 1,9% | 4,3% |
| LTU | 8,6% | 6,0% | 13,7% |
| LUX | 8,2% | 5,5% | 13,2% |
| LVA | 6,4% | 4,4% | 10,3% |
| MLT | 8,3% | 5,6% | 13,4% |
| NLD | 7,5% | 5,2% | 11,7% |
| POL | 6,0% | 4,2% | 9,6% |
| PRT | 5,2% | 3,7% | 8,5% |
| ROU | 4,6% | 3,3% | 7,4% |
| SVK | 12,0% | 8,2% | 19,1% |
| SVN | 10,5% | 7,2% | 16,7% |
| SWE | 4,8% | 3,4% | 7,7% |
| EU weigthed | 4,4% | 3,1% | 7,0% |
| EU mean | 6,6% | 4,6% | 10,6% |

Note: welfare gains are relative to the counterfactual scenario, in which the EU is replaced by a standard RTA. Welfare gains computed from equation (13). $^{\star}$ weighted by share in consumption. The trade elasticity is -5.03 in column (1) and (2) and -3.18 in column (3).

two versions of the PPML welfare calculations. Overall, the average effect of the EU on welfare on member states is bounded between 3% and 7%.

### 4.4 Robustness

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 consider the sensitivity of our results to alternative assumptions. Table 9 focuses on the RTA scenario with intermediate goods; column (1) reproduces our benchmark results (i.e. column (1) of Table 7) for comparison purpose.

First, we investigate the welfare gains of European integration under a different counterfactual where the EU is still in place between other members and each country taken in isolation does not participate. Results are presentedl in column (2) of Table 9. 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 (13). 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 elimination, specially for small countries.

Our second sensitivity test relates to the trade elasticity, one of the critical source of model uncertainty in our framework. Column (3) provides a set of results using $\epsilon_s = -3.5$, as estimated by Felbermayr *et al.* (2018) in their pooled regression (column (3) of Table 1, p.11), as an alternative value for the trade elasticity. As expected, using a lower elasticity than our benchmark $\epsilon_s = -5.03$ from Head and Mayer (2014) magnifies gains from trade significantly: welfare gains from EU are almost 50% larger on average, and range from 3.4% for the UK to 21% for Hungary.

Our last exercises adresses the issue of heterogeneities in EU trade effects, which points to the fact that the choice of sample for estimation may not be innocuous. Our first step gravity estimation enables to detect potential country specific EU trade creating effects. More specifically, the specification presented in column (2) of Table 13 in Appendix A.1 includes a set of post entry dummies specific to each wave of EU enlargement that show that only those post-enlargement dummies are significant for the 2004 and 2007 enlargements only (i.e. the 2012 dummies for both the 2004 and 2007 enlargements are positive and significant, while post-enlargement dummies are not significant after 10 years for all other enlargements). The coefficient for the 2004 enlargement is 0.322 for year 2012. We therefore implemented a robustness test using a flexible set of enlargement-specific coefficients; the partial impact of EU membership on trade is 1.406 for EU-15 countries and 1.406+0.322 for later EU members. The estimated gains from the EU are accordingly larger for the latest EU members, and countries trading intensively with them like Austria, compared to a benchmark with homogenous trade effects (as shown in column (4) of Table 9).

Table 9: Welfare gains from EU: robustness

| Counterfactual Assumption | (1) to RTA benchmark | (2) to RTA with intermediates unilateral exit | (3) to RTA with intermediates Alt. elasticity | (4) to RTA EU enlarg. specific dum. |
|---|---|---|---|---|
| AUT | 7,7% | 8,2% | 11,3% | 8,0% |
| BEL | 8,5% | 9,1% | 12,3% | 8,6% |
| BGR | 6,7% | 7,0% | 9,7% | 7,9% |
| CYP | 3,5% | 3,7% | 5,3% | 4,2% |
| CZE | 10,8% | 11,4% | 15,6% | 13,0% |
| DEU | 4,5% | 4,9% | 6,7% | 4,8% |
| DNK | 5,6% | 5,9% | 8,2% | 5,7% |
| ESP | 3,2% | 3,3% | 4,6% | 3,2% |
| EST | 10,4% | 11,1% | 15,4% | 12,7% |
| FIN | 4,1% | 4,4% | 6,0% | 4,2% |
| FRA | 3,4% | 3,6% | 5,0% | 3,4% |
| GBR | 2,3% | 2,4% | 3,4% | 2,3% |
| GRC | 2,4% | 2,6% | 3,7% | 2,5% |
| HRV | 6,1% | 6,5% | 9,0% | 7,3% |
| HUN | 14,2% | 15,2% | 20,7% | 17,3% |
| IRL | 6,8% | 7,0% | 9,7% | 6,9% |
| ITA | 2,8% | 2,9% | 4,0% | 2,8% |
| LTU | 8,7% | 9,2% | 12,5% | 10,4% |
| LUX | 8,2% | 8,7% | 12,1% | 8,3% |
| LVA | 6,4% | 6,9% | 9,4% | 7,7% |
| MLT | 8,2% | 8,6% | 12,2% | 10,2% |
| NLD | 7,6% | 8,0% | 10,8% | 7,6% |
| POL | 6,0% | 6,4% | 8,8% | 7,2% |
| PRT | 5,2% | 5,5% | 7,7% | 5,3% |
| ROU | 4,6% | 4,9% | 6,8% | 5,5% |
| SVK | 12,0% | 12,9% | 17,5% | 14,5% |
| SVN | 10,5% | 11,2% | 15,3% | 12,8% |
| SWE | 4,8% | 5,0% | 7,1% | 4,9% |
| EU (weighted mean) | 4,4% | 4,7% | 6,4% | 4,7% |
| EU (mean) | 6,6% | 7,0% | 9,7% | 7,5% |

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 (13). * weighted by share in consumption. In column (2), we assume that only the country considered did not enter the EU. In column (3), the trade elasticity is -3.467, from Felbermayr *et al.* (2018). In column (4), the partial trade impact of EU membership is 1.406 for EU-15 countries and 1.406 + 0.322 for later EU members (Table 13).

# 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.

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. T he limitations of such exercise should however be clear: we only calculate the difference in EU trade-related gains for each country with and without Brexit happening. Our model does not feature any political economy equation governing the decision of whether or not to renegotiate the existing agreement with the EU.

## 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 WTO rules, or by a "standard", a "EU-Switzerland" RTA or a EEA-type RTA. We focus here on the benchmark cas with intermediates (equation 13).

The results presented in Table 10 show substantial welfare losses for the UK in the range of -1.1% to -2.8% of GDP (first row of the table) depending on the scenario. While the losses are larger in a post-Brexit governed by WTO rules, it is interesting to note that around 85% of the losses come from leaving the single market (2.4/2.8), i.e. are not related to the re-installation of tariffs barriers which remain at zero in the scenario of a standard RTA arrangement. Scenarios that preserve some dimensions of deep integration of the Single market (an EU-Switzerland type of bilateral agreements or accession to the EEA) entail lower but still significant estimated costs (-1.6% to -1.1% of GDP).

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 0.2% 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.

## 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

Table 10: Welfare losses under different scenarios of post Brexit trade agreement

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Counterfactual | to MFN | to RTA | to EU-CHE | to EEA |
| Assumption | | with intermediates | | |
| GBR | -2,8% | -2,4% | -1,6% | -1,1% |
| AUT | -0,1% | -0,1% | -0,1% | 0,0% |
| BEL | -0,8% | -0,6% | -0,4% | -0,3% |
| BGR | -0,2% | -0,1% | -0,1% | -0,1% |
| CYP | -0,5% | -0,4% | -0,3% | -0,2% |
| CZE | -0,3% | -0,3% | -0,2% | -0,1% |
| DEU | -0,4% | -0,3% | -0,2% | -0,1% |
| DNK | -0,5% | -0,4% | -0,3% | -0,2% |
| ESP | -0,3% | -0,2% | -0,1% | -0,1% |
| EST | -0,3% | -0,2% | -0,1% | -0,1% |
| FIN | -0,2% | -0,2% | -0,1% | -0,1% |
| FRA | -0,3% | -0,3% | -0,2% | -0,1% |
| GRC | -0,2% | -0,1% | -0,1% | -0,1% |
| HRV | -0,1% | -0,1% | 0,0% | 0,0% |
| HUN | -0,4% | -0,3% | -0,2% | -0,1% |
| IRL | -3,1% | -2,5% | -1,6% | -1,1% |
| ITA | -0,2% | -0,2% | -0,1% | -0,1% |
| LTU | -0,5% | -0,4% | -0,2% | -0,2% |
| LUX | -1,9% | -1,5% | -0,9% | -0,6% |
| LVA | -0,3% | -0,2% | -0,1% | -0,1% |
| MLT | -1,9% | -1,5% | -0,9% | -0,6% |
| NLD | -0,8% | -0,6% | -0,4% | -0,3% |
| POL | -0,3% | -0,3% | -0,2% | -0,1% |
| PRT | -0,3% | -0,2% | -0,1% | -0,1% |
| ROU | -0,1% | -0,1% | -0,1% | 0,0% |
| SVK | -0,3% | -0,3% | -0,2% | -0,1% |
| SVN | -0,2% | -0,1% | -0,1% | -0,1% |
| SWE | -0,4% | -0,3% | -0,2% | -0,2% |
| EU weigthed | -0,8% | -0,6% | -0,4% | -0,3% |

Note: welfare gains are relative to the counterfactual scenario, in which the EU is either replaced by WTO rules (column (1)), a standard RTA (columns (2)), an EU-CHE type agreement (column (3)) or an EEA type agreement (columns (4)). Welfare gains computed from equation (13).

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 11 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, 26% (in the WTO scenario) to 33% (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 0.48%, offsetting around a fifth of the losses from Brexit. Each of these four countries would gain little: gains from Canada for instance are 0.12% 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 maximum loss of -0.01% of GDP.

Table 11: Welfare gains from alternative RTAs

| Counterfactual | (1) To RTA | (2) To MFN |
|---|---|---|
| | with intermediate | |
| GBR | 0,48% | 0,48% |
| AUS | 0,05% | 0,05% |
| CAN | 0,12% | 0,12% |
| USA | 0,06% | 0,06% |
| IRL | -0,01% | -0,01% |

Note: welfare gains are relative to the counterfactual scenario, in which the UK-EU trade relationships are either governed by a standard RTA (columns (1)) or WTO rules (columns (2)). Welfare gains computed from equation (13).

## 5.3 Gains from the EU following Brexit

Table 12 presents the gains that members obtain from belonging to the EU taking Brexit into account. Gains remain substantial on average. Comparing to Table 7, 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 at 0.5% on a non-weighted basis, which represents a small part of the overall estimated gains from trade integration today (estimated between 2% and 8% in our baseline analysis, see Table 7). 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 6.8% to 4.1% in the RTA scenario with intermediates. Malta and Cyprus also experience a substantial reduction in the gains they derive from the EU after Brexit.

Table 12: Welfare gains from EU after Brexit

| Counterfactual Assumption | (1) to RTA with intermediates baseline | (2) to RTA Brexit | (3) Difference (2)-(1) |
|---|---|---|---|
| AUT | 7,7% | 7,6% | 0,1% |
| BEL | 8,5% | 7,8% | 0,6% |
| BGR | 6,7% | 6,5% | 0,2% |
| CYP | 3,5% | 3,1% | 0,4% |
| CZE | 10,6% | 10,4% | 0,3% |
| DEU | 4,5% | 4,3% | 0,3% |
| DNK | 5,6% | 5,2% | 0,5% |
| ESP | 3,2% | 3,0% | 0,2% |
| EST | 10,4% | 10,3% | 0,2% |
| FIN | 4,1% | 3,8% | 0,3% |
| FRA | 3,4% | 3,1% | 0,3% |
| GRC | 2,4% | 2,3% | 0,1% |
| HRV | 6,1% | 6,0% | 0,1% |
| HUN | 14,2% | 13,8% | 0,4% |
| IRL | 6,8% | 4,1% | 2,7% |
| ITA | 2,8% | 2,6% | 0,2% |
| LTU | 8,7% | 8,2% | 0,5% |
| LUX | 8,2% | 6,6% | 1,6% |
| LVA | 6,3% | 6,2% | 0,1% |
| MLT | 8,2% | 6,6% | 1,6% |
| NLD | 7,4% | 6,9% | 0,5% |
| POL | 6,0% | 5,7% | 0,3% |
| PRT | 5,1% | 5,0% | 0,1% |
| ROU | 4,5% | 4,4% | 0,1% |
| SVK | 12,0% | 11,7% | 0,3% |
| SVN | 10,5% | 10,4% | 0,1% |
| SWE | 4,8% | 4,5% | 0,3% |
| EU (mean) | 6,8% | 6,3% | 0,5% |

Note: welfare gains are relative to the counterfactual scenario, in which the EU is replaced by a standard RTA. Welfare gains computed from equation (13).

# 6 Conclusion

We provide in this paper quantified evidence regarding 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 3.8% and 5.5% on average for the EU depending on the counterfactual (return to EEC, to a "normal" RTA or to WTO rules). 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 gain 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 gains from EU trade integration 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.

One of the major inputs of our calculations is a gravity estimation of the direct impact of EU integration on trade patterns. This econometric step estimates in particular different aspects of European integration, like the single market and the Schengen agreement. We point to strong effects–rising over time–consistently across different estimation methods. The large estimated trade effect of the EU is the major explanation for our conclusion that a dismantling of the EU (partial or complete) would have important negative effects on welfare. Why are those gravity estimates large? One aspect that the ex-post gravity approach is able to capture through large EU coefficients is the multidimensional nature of the European integration process. Note first that EU provisions regarding barriers to trade in goods are much deeper than usual RTA tariff removal. The handling of norms is particularly telling: the mutual recognition principle going far beyond regular product standard harmonization in reducing the cost of meeting norms requirements on destination markets. Moreover the umbrella of the European Court of Justice guarantees the current and future mutual recognition of norms and standards, reducing policy uncertainty (Handley and Limão, 2017). But other dimensions of the Single Market, not directly related to trade in goods, are likely to favor further trade integration between EU members. The four freedoms guaranteed by the Single Market allow for the free movement of goods, services, capital and labor, which are likely to complement each other in complex ways. For instance, the liberalization of trade in service is likely to increase trade in goods since selling complementary services increases the profitability of manufacturing exporters (Ariu *et al.*, 2017). In turn, the free movement of labor facilitates the provision of services abroad through mobility of employees or commercial presence through subsidiaries, potentially boosting exports of goods or services (Krautheim, 2013). Other illustrations for service trade regard exports of financial services which typically require flows of data and so agreements on data privacy, or licensing that require strong intellectual property right protection. Such complementarities are implicitly contained in estimates of the trade impact of the Single market using the gravity framework. Identifying those complementarities separately seems interesting avenue for future research.

A caveat to our results is that we restrain our exercise to comparative statics long-run effects (once the estimated partial effects on trade have fully taken place), with no ambition of looking at what happens in the short run. Also there is no dynamic mechanism that would operate through a growth-promoting effect of trade in our analysis, and we keep our sectoral dimension quite rough in the simulation part of the paper, in order to match with the econometric part, which sacrifices sectoral detail for time coverage of the analysis. Other effects of EU disintegration might be channeled through lower migration and capital flows. The literature strongly suggests all those omitted dimensions to increase welfare gains from trade integration.

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# A Appendix

## A.1 Time varying partial trade impact of the EU

The first part of Table 13 reports the results used in Figure 2. Columns (1) to (4) include interactions between the EEC/EU membership dummy and year dummies to our benchmark gravity estimation (column (6) in Table 1). Columns (2) and (4) additionally control for enlargement specific trends by including a set of year specific dummies for each enlargement (1973, 1981, 1986, 1995, 2004, 2007) over a 10 year period following entry. Columns (1) and (2) are estimated through OLS while columns (3) and (4) report results using a PPML estimator.

The second part of Table 13 tests the sensitivity of our main gravity specifications to the inclusion of EU pairs specific time trends. For the sake of comparison, column (5) reports our benchmark results from column (6) in Table 1. Columns (6) adds an EU specific time trend and column (7) time trends specific for each EU entry waves (1958, 1973, 1981, 1986, 1995, 2004, 2007). The coefficients on EEC and EU are both slightly reduced but remain large and highly significant. Finally, column (8) adds time trends specific for each EU entry to the specification presented in column (2), i.e. including year specific EEC/EU membership dummies. The coefficient on EU in 2012 increases slightly. All in all we find a limited (negative or positive) impact of the inclusion of EU specific time trends on our coefficients of interest.

Table 13: The effect of European integration on trade over time: detailed results

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Estimator | OLS | OLS | PPML | PPML | OLS | OLS | OLS | OLS |
| EU dum. 1958 | -0.038 | -0.060 | -0.102 | -0.085 | | | | -0.083 |
| | (0.088) | (0.091) | (0.123) | (0.131) | | | | (0.066) |
| EU dum. 1959 | 0.118 | 0.096 | 0.001 | 0.018 | | | | 0.080 |
| | (0.083) | (0.087) | (0.110) | (0.117) | | | | (0.070) |
| EU dum. 1960 | 0.178$^{b}$ | 0.156$^{c}$ | 0.027 | 0.044 | | | | 0.149$^{c}$ |
| | (0.082) | (0.087) | (0.100) | (0.108) | | | | (0.078) |
| EU dum. 1961 | 0.281$^{a}$ | 0.258$^{a}$ | 0.123 | 0.139 | | | | 0.260$^{a}$ |
| | (0.083) | (0.088) | (0.098) | (0.106) | | | | (0.078) |
| EU dum. 1962 | 0.335$^{a}$ | 0.312$^{a}$ | 0.212$^{b}$ | 0.227$^{b}$ | | | | 0.324$^{a}$ |
| | (0.083) | (0.088) | (0.092) | (0.099) | | | | (0.083) |
| EU dum. 1963 | 0.350$^{a}$ | 0.326$^{a}$ | 0.299$^{a}$ | 0.314$^{a}$ | | | | 0.347$^{a}$ |
| | (0.082) | (0.088) | (0.088) | (0.096) | | | | (0.086) |
| EU dum. 1964 | 0.496$^{a}$ | 0.472$^{a}$ | 0.373$^{a}$ | 0.387$^{a}$ | | | | 0.501$^{a}$ |
| | (0.079) | (0.086) | (0.083) | (0.091) | | | | (0.086) |
| EU dum. 1965 | 0.428$^{a}$ | 0.404$^{a}$ | 0.398$^{a}$ | 0.412$^{a}$ | | | | 0.440$^{a}$ |
| | (0.078) | (0.085) | (0.081) | (0.089) | | | | (0.087) |

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|---|---|---|---|---|---|---|
| EU dum. 1966 | 0.444$^a$ | 0.419$^a$ | 0.434$^a$ | 0.446$^a$ | | 0.464$^a$ |
| | (0.081) | (0.088) | (0.077) | (0.084) | | (0.085) |
| EU dum. 1967 | 0.469$^a$ | 0.444$^a$ | 0.460$^a$ | 0.471$^a$ | | 0.495$^a$ |
| | (0.074) | (0.083) | (0.073) | (0.081) | | (0.082) |
| EU dum. 1968 | 0.467$^a$ | 0.442$^a$ | 0.567$^a$ | 0.575$^a$ | | 0.502$^a$ |
| | (0.075) | (0.084) | (0.074) | (0.081) | | (0.084) |
| EU dum. 1969 | 0.418$^a$ | 0.393$^a$ | 0.646$^a$ | 0.655$^a$ | | 0.461$^a$ |
| | (0.079) | (0.088) | (0.070) | (0.076) | | (0.089) |
| EU dum. 1970 | 0.457$^a$ | 0.432$^a$ | 0.705$^a$ | 0.711$^a$ | | 0.509$^a$ |
| | (0.074) | (0.083) | (0.074) | (0.078) | | (0.081) |
| EU dum. 1971 | 0.514$^a$ | 0.489$^a$ | 0.763$^a$ | 0.768$^a$ | | 0.574$^a$ |
| | (0.071) | (0.080) | (0.074) | (0.077) | | (0.079) |
| EU dum. 1972 | 0.613$^a$ | 0.587$^a$ | 0.775$^a$ | 0.780$^a$ | | 0.680$^a$ |
| | (0.070) | (0.078) | (0.068) | (0.071) | | (0.078) |
| EU dum. 1973 | 0.313$^a$ | 0.584$^a$ | 0.382$^a$ | 0.650$^a$ | | 0.689$^a$ |
| | (0.065) | (0.079) | (0.091) | (0.079) | | (0.078) |
| EU dum. 1974 | 0.180$^a$ | 0.411$^a$ | 0.308$^a$ | 0.509$^a$ | | 0.524$^a$ |
| | (0.065) | (0.084) | (0.092) | (0.086) | | (0.080) |
| EU dum. 1975 | 0.190$^a$ | 0.381$^a$ | 0.411$^a$ | 0.588$^a$ | | 0.502$^a$ |
| | (0.066) | (0.080) | (0.088) | (0.082) | | (0.079) |
| EU dum. 1976 | 0.214$^a$ | 0.394$^a$ | 0.465$^a$ | 0.619$^a$ | | 0.523$^a$ |
| | (0.062) | (0.084) | (0.084) | (0.079) | | (0.086) |
| EU dum. 1977 | 0.194$^a$ | 0.313$^a$ | 0.475$^a$ | 0.590$^a$ | | 0.450$^a$ |
| | (0.063) | (0.082) | (0.081) | (0.080) | | (0.082) |
| EU dum. 1978 | 0.202$^a$ | 0.327$^a$ | 0.496$^a$ | 0.600$^a$ | | 0.471$^a$ |
| | (0.063) | (0.086) | (0.081) | (0.079) | | (0.086) |
| EU dum. 1979 | 0.214$^a$ | 0.293$^a$ | 0.537$^a$ | 0.608$^a$ | | 0.446$^a$ |
| | (0.062) | (0.083) | (0.077) | (0.077) | | (0.083) |
| EU dum. 1980 | 0.201$^a$ | 0.260$^a$ | 0.548$^a$ | 0.594$^a$ | | 0.421$^a$ |
| | (0.060) | (0.077) | (0.080) | (0.080) | | (0.077) |
| EU dum. 1981 | 0.291$^a$ | 0.229$^a$ | 0.523$^a$ | 0.554$^a$ | | 0.400$^a$ |
| | (0.062) | (0.078) | (0.079) | (0.081) | | (0.079) |
| EU dum. 1982 | 0.372$^a$ | 0.202$^a$ | 0.546$^a$ | 0.555$^a$ | | 0.381$^a$ |
| | (0.063) | (0.075) | (0.072) | (0.073) | | (0.077) |
| EU dum. 1983 | 0.396$^a$ | 0.283$^a$ | 0.589$^a$ | 0.538$^a$ | | 0.441$^a$ |
| | (0.065) | (0.077) | (0.070) | (0.068) | | (0.073) |
| EU dum. 1984 | 0.365$^a$ | 0.267$^a$ | 0.577$^a$ | 0.524$^a$ | | 0.429$^a$ |
| | (0.063) | (0.076) | (0.070) | (0.068) | | (0.072) |
| EU dum. 1985 | 0.400$^a$ | 0.309$^a$ | 0.578$^a$ | 0.526$^a$ | | 0.474$^a$ |
| | (0.062) | (0.075) | (0.071) | (0.068) | | (0.072) |
| EU dum. 1986 | 0.327$^a$ | 0.317$^a$ | 0.574$^a$ | 0.557$^a$ | | 0.492$^a$ |
| | (0.058) | (0.072) | (0.069) | (0.066) | | (0.071) |
| EU dum. 1987 | 0.408$^a$ | 0.363$^a$ | 0.586$^a$ | 0.559$^a$ | | 0.543$^a$ |
| | (0.057) | (0.073) | (0.066) | (0.065) | | (0.074) |

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|---|---|---|---|---|---|---|
| EU dum. 1988 | 0.409$^a$ | 0.386$^a$ | 0.603$^a$ | 0.573$^a$ | | 0.570$^a$ |
| | (0.058) | (0.073) | (0.065) | (0.065) | | (0.074) |
| EU dum. 1989 | 0.470$^a$ | 0.448$^a$ | 0.590$^a$ | 0.558$^a$ | | 0.636$^a$ |
| | (0.060) | (0.074) | (0.061) | (0.063) | | (0.077) |
| EU dum. 1990 | 0.531$^a$ | 0.439$^a$ | 0.525$^a$ | 0.482$^a$ | | 0.631$^a$ |
| | (0.059) | (0.073) | (0.057) | (0.063) | | (0.077) |
| EU dum. 1991 | 0.549$^a$ | 0.487$^a$ | 0.535$^a$ | 0.494$^a$ | | 0.717$^a$ |
| | (0.061) | (0.072) | (0.058) | (0.064) | | (0.076) |
| EU dum. 1992 | 0.678$^a$ | 0.593$^a$ | 0.550$^a$ | 0.508$^a$ | | 0.832$^a$ |
| | (0.060) | (0.071) | (0.056) | (0.063) | | (0.078) |
| EU dum. 1993 | 0.624$^a$ | 0.526$^a$ | 0.460$^a$ | 0.406$^a$ | | 0.773$^a$ |
| | (0.060) | (0.071) | (0.055) | (0.065) | | (0.080) |
| EU dum. 1994 | 0.589$^a$ | 0.477$^a$ | 0.498$^a$ | 0.446$^a$ | | 0.733$^a$ |
| | (0.063) | (0.078) | (0.055) | (0.065) | | (0.085) |
| EU dum. 1995 | 0.640$^a$ | 0.552$^a$ | 0.571$^a$ | 0.515$^a$ | | 0.817$^a$ |
| | (0.054) | (0.078) | (0.055) | (0.072) | | (0.088) |
| EU dum. 1996 | 0.624$^a$ | 0.534$^a$ | 0.571$^a$ | 0.514$^a$ | | 0.820$^a$ |
| | (0.055) | (0.076) | (0.056) | (0.072) | | (0.087) |
| EU dum. 1997 | 0.669$^a$ | 0.568$^a$ | 0.552$^a$ | 0.493$^a$ | | 0.861$^a$ |
| | (0.058) | (0.081) | (0.057) | (0.075) | | (0.092) |
| EU dum. 1998 | 0.646$^a$ | 0.577$^a$ | 0.549$^a$ | 0.485$^a$ | | 0.881$^a$ |
| | (0.055) | (0.077) | (0.057) | (0.076) | | (0.091) |
| EU dum. 1999 | 0.979$^a$ | 0.796$^a$ | 0.648$^a$ | 0.537$^a$ | | 1.080$^a$ |
| | (0.058) | (0.087) | (0.060) | (0.079) | | (0.098) |
| EU dum. 2000 | 0.994$^a$ | 0.823$^a$ | 0.619$^a$ | 0.511$^a$ | | 1.111$^a$ |
| | (0.058) | (0.091) | (0.062) | (0.082) | | (0.102) |
| EU dum. 2001 | 0.982$^a$ | 0.807$^a$ | 0.590$^a$ | 0.477$^a$ | | 1.091$^a$ |
| | (0.060) | (0.095) | (0.065) | (0.085) | | (0.106) |
| EU dum. 2002 | 1.033$^a$ | 0.849$^a$ | 0.613$^a$ | 0.496$^a$ | | 1.144$^a$ |
| | (0.061) | (0.096) | (0.065) | (0.085) | | (0.108) |
| EU dum. 2003 | 1.106$^a$ | 0.946$^a$ | 0.613$^a$ | 0.499$^a$ | | 1.251$^a$ |
| | (0.061) | (0.095) | (0.067) | (0.088) | | (0.109) |
| EU dum. 2004 | 1.092$^a$ | 1.049$^a$ | 0.677$^a$ | 0.576$^a$ | | 1.321$^a$ |
| | (0.054) | (0.097) | (0.071) | (0.088) | | (0.111) |
| EU dum. 2005 | 1.130$^a$ | 1.093$^a$ | 0.659$^a$ | 0.532$^a$ | | 1.334$^a$ |
| | (0.055) | (0.091) | (0.070) | (0.086) | | (0.113) |
| EU dum. 2006 | 1.221$^a$ | 1.106$^a$ | 0.712$^a$ | 0.580$^a$ | | 1.355$^a$ |
| | (0.057) | (0.091) | (0.069) | (0.086) | | (0.116) |
| EU dum. 2007 | 1.344$^a$ | 1.112$^a$ | 0.734$^a$ | 0.599$^a$ | | 1.362$^a$ |
| | (0.056) | (0.092) | (0.071) | (0.087) | | (0.119) |
| EU dum. 2008 | 1.399$^a$ | 1.127$^a$ | 0.732$^a$ | 0.592$^a$ | | 1.384$^a$ |
| | (0.063) | (0.093) | (0.072) | (0.086) | | (0.120) |
| EU dum. 2009 | 1.621$^a$ | 1.350$^a$ | 0.750$^a$ | 0.605$^a$ | | 1.611$^a$ |
| | (0.063) | (0.091) | (0.075) | (0.089) | | (0.122) |

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|---|---|---|---|---|---|---|---|---|
| EU dum. 2010 | 1.673$^a$ | 1.416$^a$ | 0.778$^a$ | 0.633$^a$ | | | | 1.683$^a$ |
| | (0.064) | (0.093) | (0.073) | (0.086) | | | | (0.126) |
| EU dum. 2011 | 1.664$^a$ | 1.340$^a$ | 0.770$^a$ | 0.624$^a$ | | | | 1.614$^a$ |
| | (0.066) | (0.095) | (0.072) | (0.085) | | | | (0.128) |
| EU dum. 2012 | 1.697$^a$ | 1.406$^a$ | 0.777$^a$ | 0.633$^a$ | | | | 1.687$^a$ |
| | (0.067) | (0.095) | (0.074) | (0.087) | | | | (0.130) |
| EEC dum. | | | | | 0.493$^a$ | 0.347$^a$ | 0.430$^a$ | |
| | | | | | (0.041) | (0.041) | (0.039) | |
| EU single market dum. | | | | | 1.181$^a$ | 0.894$^a$ | 0.935$^a$ | |
| (post 1992) | | | | | (0.046) | (0.046) | (0.046) | |
| Both GATT dum. | 0.135$^a$ | 0.133$^a$ | -0.080 | -0.084 | 0.137$^a$ | 0.137$^a$ | 0.128$^a$ | 0.130$^a$ |
| | (0.027) | (0.027) | (0.074) | (0.075) | (0.027) | (0.027) | (0.027) | (0.027) |
| Shared currency dum. | 0.339$^a$ | 0.340$^a$ | 0.828$^a$ | 0.838$^a$ | 0.339$^a$ | 0.342$^a$ | 0.344$^a$ | 0.345$^a$ |
| | (0.068) | (0.068) | (0.126) | (0.127) | (0.068) | (0.067) | (0.068) | (0.068) |
| Euro area dum. | -0.262$^a$ | -0.187$^a$ | -0.105$^b$ | -0.027 | -0.139$^b$ | -0.205$^a$ | 0.026 | -0.127$^b$ |
| | (0.060) | (0.063) | (0.043) | (0.041) | (0.056) | (0.058) | (0.055) | (0.063) |
| RTA dum. | 0.391$^a$ | 0.391$^a$ | 0.058 | 0.054 | 0.383$^a$ | 0.356$^a$ | 0.358$^a$ | 0.370$^a$ |
| | (0.024) | (0.024) | (0.046) | (0.046) | (0.024) | (0.024) | (0.024) | (0.025) |
| Shengen dum. | -0.099$^b$ | -0.080 | -0.057$^c$ | -0.055 | 0.040 | 0.005 | 0.067$^c$ | -0.041 |
| | (0.044) | (0.054) | (0.030) | (0.035) | (0.040) | (0.040) | (0.040) | (0.053) |
| EEA dum. | 1.068$^a$ | 1.057$^a$ | 0.429$^a$ | 0.403$^a$ | 0.995$^a$ | 1.015$^a$ | 0.988$^a$ | 1.046$^a$ |
| | (0.094) | (0.095) | (0.091) | (0.089) | (0.094) | (0.094) | (0.094) | (0.096) |
| EU-Switz. RTA dum. | 0.853$^a$ | 0.847$^a$ | 0.015 | 0.006 | 0.782$^a$ | 0.798$^a$ | 0.796$^a$ | 0.845$^a$ |
| | (0.100) | (0.100) | (0.096) | (0.096) | (0.100) | (0.100) | (0.101) | (0.101) |
| EU-Turkey RTA dum. | -0.235$^c$ | -0.236$^c$ | 0.233$^b$ | 0.253$^b$ | -0.243$^c$ | -0.230$^c$ | -0.224$^c$ | -0.220$^c$ |
| | (0.125) | (0.125) | (0.103) | (0.105) | (0.124) | (0.124) | (0.124) | (0.124) |
| Observations | 849147 | 849147 | 1316900 | 1316900 | 849147 | 849147 | 849147 | 849147 |
| R2 | 0.858 | 0.858 | 0.991 | 0.991 | 0.858 | 0.858 | 0.858 | 0.858 |
| RMSE | 1.253 | 1.253 | | | 1.254 | 1.253 | 1.253 | 1.253 |

Note: Standard errors clustered for intra-group correlation at the country pair level in parentheses, with significance levels indicated with $^c$ for 10%, $^b$ for 5%, $^a$ for 1%. All dummy variables for regional agreement membership are "exclusive", i.e. the RTA membership dummy equal zero when EEC or EU is equal to one. Shared currency and euro area dummies are similarly exclusive. All columns include origin×year, destination×year and country pair fixed effects. Columns (2), (4) and (8) include year specific dummies for each enlargement (over a 10 year period following the entry); the coefficients are not reported. Column (5) reports our benchmark results from column (6) in Table 1. Column (6) includes EU pairs specific time trends; the coefficients are not reported. Columns (7) and (8) include pair specific time trends for each EU entry wave; the coefficients are not reported).

## A.2 Trade effects using PPML estimates of the EU partial trade impact

Table 14 presents counterfactual trade results under the scenario of the EU returning to a normal RTA using the partial trade impact estimated from the PPML estimator (column (4) of Table 13) instead of the OLS results used in Table 6.

Table 14: The trade effect of EU integration (RTA scenario with intermediate inputs, PPML estimate of EU PTI)

| Sector | Goods | | | Goods | | Tradable Services | | | Tradable Services | |
|---|---|---|---|---|---|---|---|---|---|---|
| Var. | Imports with/without EU | | | Import/ consumption | | Imports with/without EU | | | Import/ consumption | |
| Origin | Total | EU | non EU | Total | Total | Total | EU | non EU | Total | Total |
| State of the world | | | | With EU | Without EU | | | | With EU | Without EU |
| AUT | 131% | 152% | 87% | 60% | 48% | 119% | 132% | 96% | 13% | 11% |
| BEL | 126% | 160% | 92% | 72% | 62% | 116% | 132% | 98% | 24% | 21% |
| BGR | 118% | 156% | 88% | 55% | 47% | 122% | 134% | 99% | 11% | 9% |
| CYP | 97% | 128% | 71% | 68% | 64% | 122% | 137% | 101% | 18% | 15% |
| CZE | 136% | 163% | 93% | 61% | 48% | 116% | 127% | 94% | 14% | 12% |
| DEU | 128% | 164% | 95% | 46% | 37% | 114% | 129% | 96% | 11% | 9% |
| DNK | 124% | 153% | 87% | 59% | 49% | 112% | 132% | 97% | 19% | 17% |
| ESP | 124% | 170% | 96% | 39% | 32% | 119% | 132% | 97% | 6% | 5% |
| EST | 120% | 149% | 84% | 71% | 61% | 123% | 131% | 96% | 16% | 13% |
| FIN | 126% | 162% | 92% | 44% | 35% | 110% | 127% | 93% | 13% | 12% |
| FRA | 122% | 157% | 90% | 47% | 39% | 118% | 135% | 99% | 8% | 7% |
| GBR | 111% | 151% | 87% | 47% | 42% | 119% | 137% | 101% | 8% | 7% |
| GRC | 107% | 152% | 85% | 46% | 42% | 111% | 129% | 95% | 10% | 8% |
| HRV | 122% | 149% | 86% | 54% | 45% | 116% | 131% | 96% | 12% | 10% |
| HUN | 130% | 157% | 90% | 69% | 57% | 120% | 133% | 98% | 21% | 18% |
| IRL | 120% | 159% | 87% | 79% | 71% | 106% | 131% | 97% | 52% | 49% |
| ITA | 128% | 170% | 96% | 33% | 27% | 114% | 129% | 95% | 6% | 5% |
| LTU | 117% | 160% | 91% | 68% | 61% | 113% | 134% | 100% | 19% | 17% |
| LUX | 115% | 132% | 76% | 84% | 76% | 111% | 129% | 95% | 52% | 47% |
| LVA | 118% | 147% | 84% | 64% | 55% | 123% | 134% | 99% | 11% | 9% |
| MLT | 108% | 144% | 80% | 72% | 66% | 117% | 124% | 93% | 52% | 45% |
| NLD | 125% | 170% | 97% | 67% | 57% | 118% | 142% | 104% | 19% | 16% |
| POL | 132% | 165% | 94% | 43% | 33% | 126% | 144% | 105% | 10% | 8% |
| PRT | 123% | 152% | 85% | 49% | 39% | 119% | 130% | 95% | 8% | 7% |
| ROU | 123% | 154% | 88% | 39% | 32% | 127% | 141% | 104% | 9% | 7% |
| SVK | 128% | 160% | 93% | 65% | 54% | 130% | 141% | 103% | 12% | 9% |
| SVN | 129% | 158% | 90% | 68% | 56% | 120% | 134% | 98% | 14% | 12% |
| SWE | 126% | 155% | 88% | 51% | 41% | 115% | 131% | 97% | 16% | 13% |
| EU (mean) | 122% | 155% | 88% | 58% | 49% | 118% | 133% | 98% | 17% | 15% |
| EU (median) | 123% | 157% | 88% | 59% | 48% | 118% | 132% | 97% | 13% | 12% |

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.

## A.3 Welfare gains from EU relative to total gains from trade

Table 15: Welfare gains from EU under different scenarios (percentage of total gains from trade)

| Counterfactual Assumption | (1) to MFN | (2) to RTA | (3) to EEC |
|---|---|---|---|
| | with intermediates | | |
| AUT | 45,9% | 37,0% | 31,4% |
| BEL | 37,6% | 30,0% | 25,3% |
| BGR | 33,1% | 27,0% | 23,0% |
| CYP | 18,0% | 14,9% | 12,8% |
| CZE | 47,4% | 38,2% | 32,3% |
| DEU | 39,2% | 31,9% | 27,2% |
| DNK | 37,3% | 30,2% | 25,6% |
| ESP | 35,3% | 28,9% | 24,7% |
| EST | 37,2% | 29,8% | 25,1% |
| FIN | 37,6% | 30,6% | 26,1% |
| FRA | 36,3% | 29,7% | 25,3% |
| GBR | 26,8% | 21,9% | 18,7% |
| GRC | 20,9% | 17,2% | 14,7% |
| HRV | 38,4% | 31,1% | 26,5% |
| HUN | 43,3% | 34,5% | 29,1% |
| IRL | 22,7% | 18,1% | 15,2% |
| ITA | 38,3% | 31,4% | 26,9% |
| LTU | 27,8% | 22,4% | 19,0% |
| LUX | 27,2% | 21,4% | 17,8% |
| LVA | 35,9% | 29,1% | 24,7% |
| MLT | 27,9% | 22,1% | 18,5% |
| NLD | 35,1% | 28,2% | 23,9% |
| POL | 44,3% | 36,1% | 30,8% |
| PRT | 39,8% | 32,6% | 27,9% |
| ROU | 38,1% | 31,3% | 26,8% |
| SVK | 41,5% | 33,3% | 28,1% |
| SVN | 42,7% | 34,3% | 28,9% |
| SWE | 39,7% | 32,1% | 27,3% |
| EU weigthed* | 36,4% | 29,5% | 25,1% |
| EU mean | 35,6% | 28,8% | 24,4% |

Note: welfare gains are expressed in percentage of total gains from trade, i.e. with respect to autarky. They are relative to the counterfactual scenario, in which the EU is either replaced by WTO rules (columns (1)), a standard RTA (columns (2)) or the EEC (column (3)); see columns (1) to (3) in Table 7 for baseline results. Welfare gains computed from equation (13).
* weighted by share in consumption.