Trade vs integration

SUMMARY

In this paper, we quantify the "Cost of Non-Europe", that is, the trade-related welfare gains each country member has reaped from the European Union (EU). 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.

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The cost of non-Europe, revisited*

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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 European Union (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

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the EU has reaped from trade integration since 1958 and what would be the costs of going backward.[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 Program by the end of 1992 (Cecchini 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 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 emphasize 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 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 most favored nation (MFN) 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

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 with comparative statics) but magnifies the cost of EU disintegration. So this suggests an overestimation of long-term gains and underestimation of long-term losses.

latter paper provides a quantification of the trade effects of Brexit, using a framework very similar to ours. Compared with 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 2000–14. Over this period, they can collect bilateral tariff rates that are added to the regression on top of the EU dummy and provide 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 Pseudo-Poisson maximum likelihood (PPML) coefficient estimates, and their implication for the welfare GFT. 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 Regional Trade Agreement (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.

Another of our results that parallels with a frequent finding in the literature is that estimation methods matter. Using PPML yields smaller (although still substantial and very

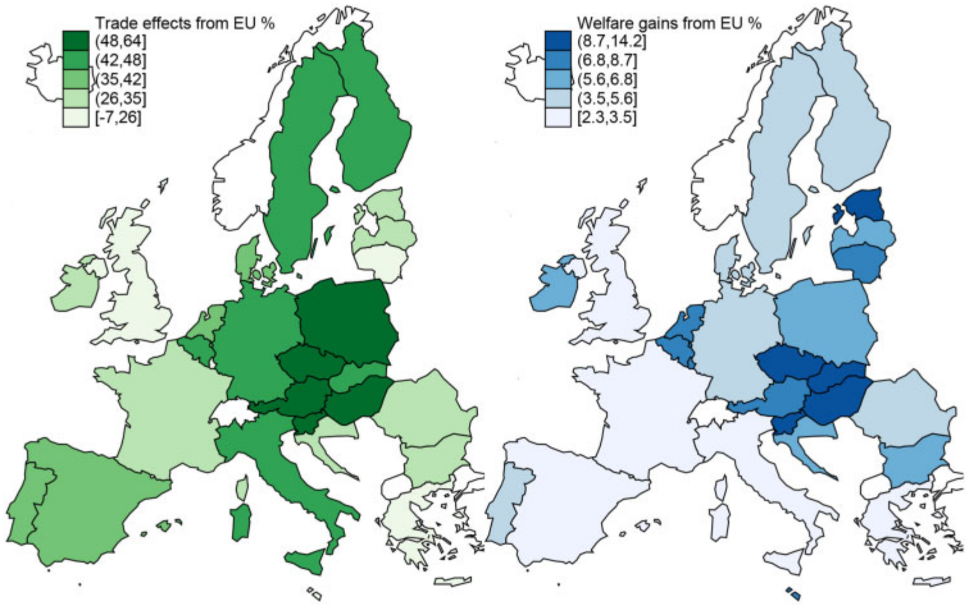

Figure 1. The effect of European integration on trade and welfare.

Notes: 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.

significant) estimates of the trade gains associated with the EU compared with 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 with 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 (multi-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 potential changes in market structure that might accompany trade liberalization, and more specifically the part of the gains that is specific to "new" models, in particular the ones coming from selection of the most productive firms into export markets following trade liberalization.[2] Our calculations should be seen as conservative in that respect if we believe

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.

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 United States and United Kingdom 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, and 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 GFT are ambiguous: improved market access may induce more innovation but increased competition may induce some of this innovation to be defensive, that is, to dampen the pro-competitive GFT. 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 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 are available. Their Table 5 contains

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.

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, especially 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 with the literature, and then used in the second step, that is, the 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 REGIONAL TRADE AGREEMENTS

2.1. Structural gravity

The first step toward 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 ϕ_{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 π_{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:

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

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 Φ 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 Φ_n closely related to the price index of country n. A higher Φ_n lowers the market share of country ℓ in n by raising the relative price of buying from ℓ.

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 π_{nit}, we therefore have

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

Ω_{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 (ϕ_{nit}/Φ_{nt}). Output in a country is therefore high because of a combination of intrinsic attractiveness S and good geography Ω. 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:

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

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

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

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

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 MR 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

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.	1.177[a]	1.118[a]	1.120[a]	1.172[a]	1.185[a]	1.181[a]	1.315[a]
(post-1992)	(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	849,147	849,147	849,147	849,147	849,147	849,147	174,217
R^2	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

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

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, that is, RTA is set to zero when EEC or EU equals 1 (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]

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.

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 (Carrère, 2006; Baier et al., 2008) have found converging estimates around 0.6–0.7 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 is 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 with 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 2000–14, 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 with 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 World Input–Output Database (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 goods and services).

2.3.2. Measuring different dimensions of European trade integration. 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 A1 in Appendix A.1 (Columns 5–8), 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 versus PPML. We now proceed to presenting results obtained with different estimators. PPML has been made popular as an

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

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 >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

Estimator	(1) OLS	(2) PPML	(3) PPML	(4) OLS weighted	(5) PPML share	(6) PPML share
Sample			flow >0			flow >0
RTA dum.	0.383[a]	0.060	0.065	0.077[b]	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.	1.181[a]	0.650[a]	0.649[a]	0.624[a]	0.944[a]	0.915[a]
(post-1992)	(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[c]	−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[b]	−0.049[b]	−0.048[b]	−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[b]	0.145	0.137	0.200[c]	0.013	0.027
	(0.124)	(0.107)	(0.108)	(0.098)	(0.192)	(0.203)
Observations	849,147	1,316,900	849,147	849,147	1,316,900	849,147
R^2	0.858	0.991	0.991	0.985	0.881	0.882
RMSE	1.254			0.266		

Notes: Standard errors clustered for intra-group correlation at the country pair level in parentheses, with significance levels indicated with [a]1%, [b]10%, and [c]5%. All dummy variables for regional agreement membership are "exclusive," that is, the RTA membership dummy equals zero when EEC or EU is equal to 1. 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) with 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 with 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-

Table 4. Gravity results of European integration in services

Sample	(1) Services	(2)	(3)	(4) Financial services	(5)	(6)
flow	Services		Goods	Services		Goods
RTA dum.	0.072	0.060	0.093[a]	0.098	0.116	0.100[b]
	(0.044)	(0.046)	(0.039)	(0.111)	(0.116)	(0.053)
EU dum.	0.174[a]	0.177[a]	0.320[c]	0.527[a]	0.513[a]	0.397[c]
	(0.071)	(0.070)	(0.060)	(0.216)	(0.216)	(0.081)
Both GATT dum.	0.217	0.219	0.258			
	(0.312)	(0.312)	(0.249)			
Euro area dum.	0.043	0.052	0.026	0.254	0.210	−0.014
	(0.057)	(0.060)	(0.047)	(0.164)	(0.166)	(0.051)
Shengen dum.		−0.032			0.156	
		(0.042)			(0.117)	
EEA dum.		0.231[b]			−0.391	
		(0.122)			(0.315)	
EU-Switzerland RTA dum.		−0.001			0.230	
		(0.100)			(0.210)	
EU-Turkey RTA dum.		0.071			0.110	
		(0.117)			(0.385)	
Observations	35,927	35,927	34,913	16,962	16,962	15,511
R^2	0.965	0.965	0.971	0.925	0.926	0.986
RMSE	0.568	0.568	0.506	0.985	0.985	0.327
Origin×year and dest×year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors clustered for intra-group correlation at the country pair level in parentheses, with significance levels indicated with [a]5%, [b]10%, and [c]1%. All dummy variables for regional agreement membership are "exclusive," that is, the RTA membership dummy equal zero when EU is equal to 1.

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

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.

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 Columns (6) and (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) and (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 is that this year is also the one where the United Kingdom, Ireland, and Denmark enter the EC. Since those (and the United Kingdom 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 10 years of each enlargement. It is very clear that the drop in the 70s is mostly explained by the entry of the United Kingdom, 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 versus PPML mentioned above. The entry of United Kingdom and Spain in those 2 years yields large expected flows in those 2 years, to which PPML gives more weight. We

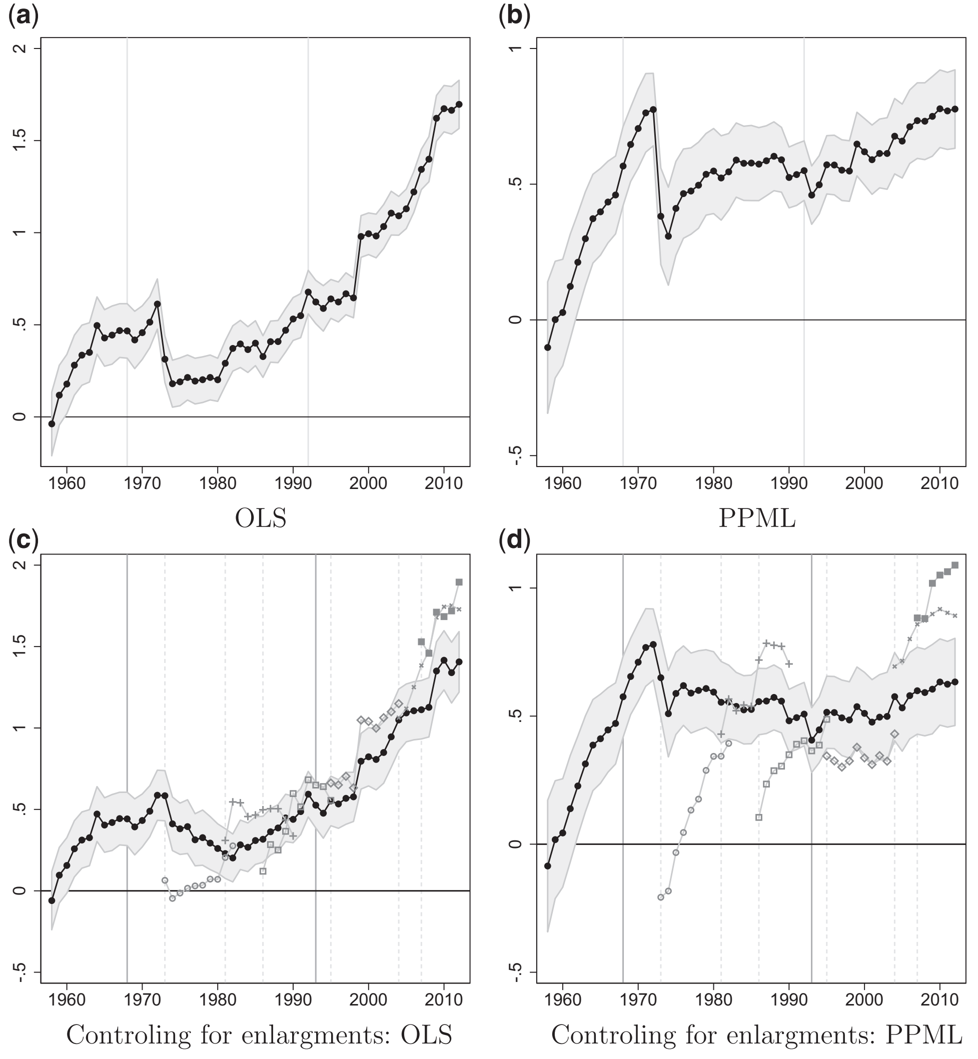

Figure 2. The effect of European integration on trade over time.

Notes: Table A1 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 10 years of each enlargement.

attribute what remains of the drop in the 70s to the first oil shock, which naturally should redirect trade toward 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 10 years. Table A1 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 finish this section by analyzing the effects of EU integration on trade in services. Our results are contained in Table 4. Our variables of interest reported in Column (1) have the expected positive signs. One noticeable difference is that the RTA dummy has a much dampened and more volatile influence. The EU dummy keeps a significantly positive, influence on trade in services, although the magnitude of the coefficient is substantially smaller than for trade in goods. Enlarging the set of European agreements to include Shengen, EEA-Switzerland, and EU-Turkey does not alter the positive effect of the EU dummy. As stated above, trade in services is available for a much reduced sample, which starts in the beginning of the 1990s, and covers a drastically smaller number of countries. We therefore report in Column (3) results for goods on the same sample as services for appropriate comparison with the baseline Column (1) for services. Both regressions have the full set of fixed effects and use OLS. RTAs have a smaller effect, around 7%, on trade in services that what we find for trade in goods (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 with 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. The comparison with goods in Column (3) makes it clear that most of the reduced effects from previous columns comes from the shortened panel [Limão (2016) also underlines that shorter panel is 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. This ratio is the one we will consider as our benchmark in the counterfactual scenarios.

In the last three columns of Table 4, we replicate the approach of Columns (1)–(3), restricting the focus to financial services, a sector that has raised a lot of interest in the context of Brexit notably. The first consequence is that the sample size is further reduced. As a consequence, we cannot identify the GATT dummy anymore since all pairs of countries with positive trade in financial services are pairs where both countries are members of GATT/WTO. The main change in results is that the point estimate of the single market effect on financial services is substantially larger than the one for all services. The precise mechanism behind this larger effect is not completely obvious. On the one hand, it might be argued that the harmonization of rules entailed by the single market is particularly important for this type of services. On the other hand, the complementarity with the ease of workers' mobility might be more critical for services other than financial ones. One explanation that seems possible to rule out is the one related to the further reduction in sample size, since the EU dummy on goods has very similar effects in Columns (3) and (6). As a consequence of this heterogeneity in coefficients, we also run the counterfactual simulations with an EU effect for services set to be the same as the one for 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 π_{ni}. Consider the case of a sector s where firms use labor in proportion μ_s and a CES composite index of tradable intermediates in proportion $1 - \mu_s$. Parameter μ_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 $\epsilon_s < 0$, 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

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

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

$$P_{n,s} \equiv \left(\sum\nolimits_{\ell} (w_{\ell,s}^{\mu_s} P_{\ell,s}^{1-\mu_s} \tau_{n\ell,s})^{\epsilon_s}\right)^{1/\epsilon_s}. \qquad (8)$$

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

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

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:

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

and

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

This is the EHA approach to counterfactuals first demonstrated and used in Dekle et al. (2007). Because of the CES structure of Equation (9), the change in trade shares is 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

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

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

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

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:

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

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 versus 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 ϵ_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 ϵ_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 β_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 $\hat{\tau}_{ni,s}^{\epsilon_s} \equiv \hat{\phi}_{ni,s} = \exp(-\beta_{\text{EU},s})$ for the ni pairs in which $\text{EU}_{ni} = 1$ and $\hat{\phi}_{ni,s} = 1$ for all other pairs ($\beta_{\text{EU},s}$ 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 $\hat{Y}_{i,s}^{\epsilon_s}$ 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 ϵ_s from the literature, calculate welfare changes using Equation (13) or (14) depending upon the case under consideration.

3.2. Data

We use data from the WIOD developed by Timmer et al. (2015), which provide production and trade data for 43 countries and 56 two-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: $\mu_{\text{good}} = 0.321$ and $\mu_{\text{busserv}} = 0.548$. 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 $\beta_{\text{EU},s}$ is taken from Section 2 and encompasses the full effect of the single market membership, that is, the EU estimated direct impact at the end of the estimation period. For trade in goods, we use results from Figure 2(c), that is,$\beta_{\text{EU,goods}} = 1.406$, $\beta_{\text{RTA,goods}} = 0.391$ and $\beta_{\text{EEC,goods}} = 0.593$ (the coefficient on EU for the year 1992, just prior to the implementation of the single market, from Table A1, 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 $\beta_{\text{EU,serv}} = 1.406/2 = 0.703$.

3.3. The fit of EHA: 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, that is, 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 (1 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*

9 The data are 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, that is, ISIC rev.4 sectors 01–33; the tradable services sector includes all business services, that is, sectors 45–75; and non-tradable services includes all other services, that is, electricity; gas and water supply (sectors 35–39); construction (41–43); and community, social, and personal services (77–99).

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

shares in 2014. The trade cost shock fed into the simulation is the 2004 enlargement, 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 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 are 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, that is, 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 underestimated.

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

4. THE GAINS FROM THE EU

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 EU is

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.

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[a]		eu25	enlarg04	intra	intra no outlier[a]
	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)
R^2	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

[a]Poland in case of trade and Czech Republic in case of production.
Standard errors in parentheses, *** denotes 5% significance level.

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 EU is governed by the MFN 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 EU 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 with 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 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 (Φ) effects have a strong connection to the trade creation/trade diversion effects from classical Vinerian analysis. Together they drive the re-orientation of expenditure sourcing by consumers in n following the price changes implied by the policy experiment. The changes in GDP and outward MR (Ω) drive the relative attractiveness of products proposed by country i.

In total, those effects imply a massive trade reallocation following the implementation (or collapse) of the EU. Bilateral imports of goods within the EU are on average close to twice as large compared with the counterfactual. The impact is particularly large for

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.

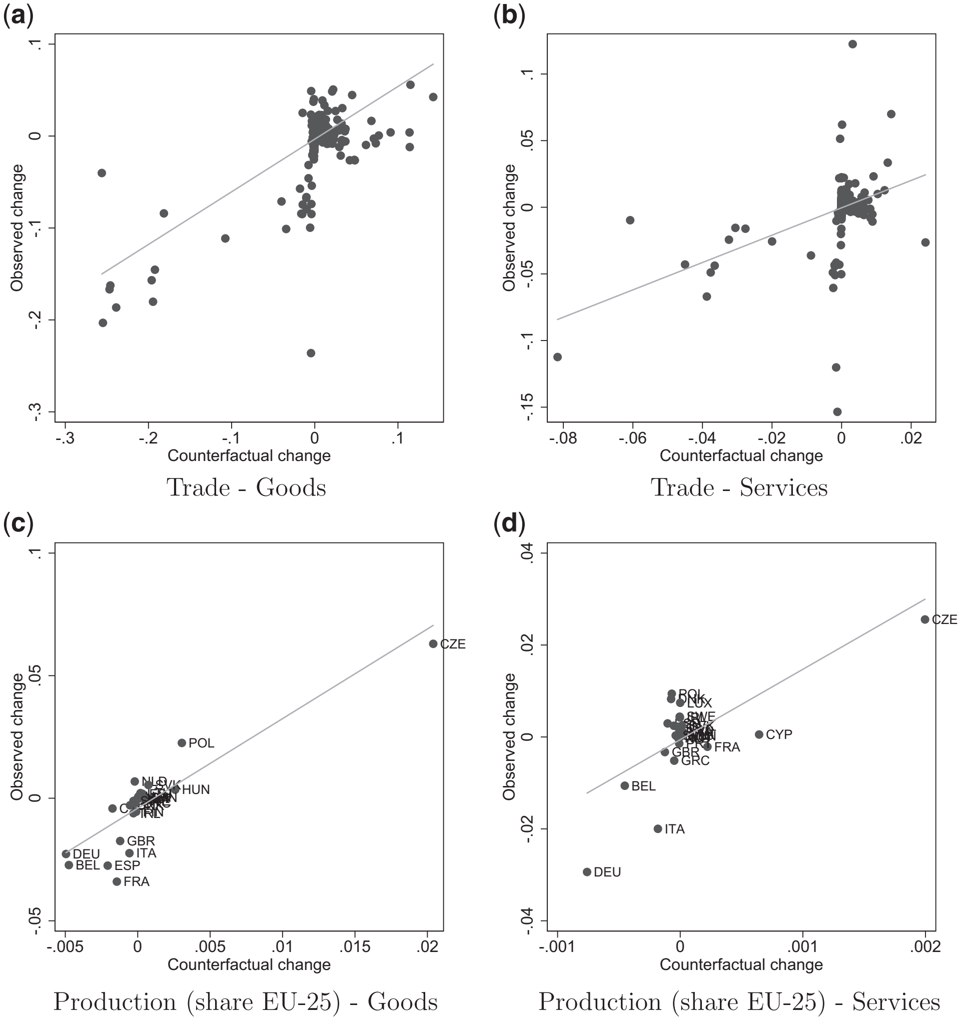

Figure 3. Simulated versus real changes following the 2004 enlargement.

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 with 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 MR 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

Table 6. The trade effect of EU integration (RTA scenario with intermediate inputs, %)

Sector Var.	Goods imports with/without EU			Goods Import/ consumption		Tradable services Imports with/without EU			Tradable services Import/ consumption	
Origin	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

Notes: 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.

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.

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 weighted	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

Notes: 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 (Columns 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)–(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, GFT integration is substantially larger with intermediate goods (Columns 1–3) than without (Columns 4–6).

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 Appendix Table A3, we re-express the gains from the existence of the EU from Columns (1)–(3) of Table 7 in percentage of total GFT, that is, 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 GFT 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, and 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.

In results available upon request, we replicated the analysis of Table 7, raising the impact of the EU on trade in services from being half the impact on trade in goods to being the same as for trade in goods. This robustness check is motivated by our results for trade in financial services reported in Section 2.3.4. As expected, the overall welfare gains from EU integration rise. The EU-weighted figure of 4.4% reported in Column (2) of Table 7 becomes 5.2%. Perhaps even more interestingly, the two countries where it makes the most difference are Luxembourg (8.2–10.9%) and Malta (8.3–11.5%).

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 $\epsilon = -5.03$ is $\text{AVE}_{\text{OLS}} = \exp((1.406 - 0.391)/5.03) - 1 \simeq 22\%$ (Table A1, 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 A1, Column 4). At the opposite, keeping the AVE of OLS

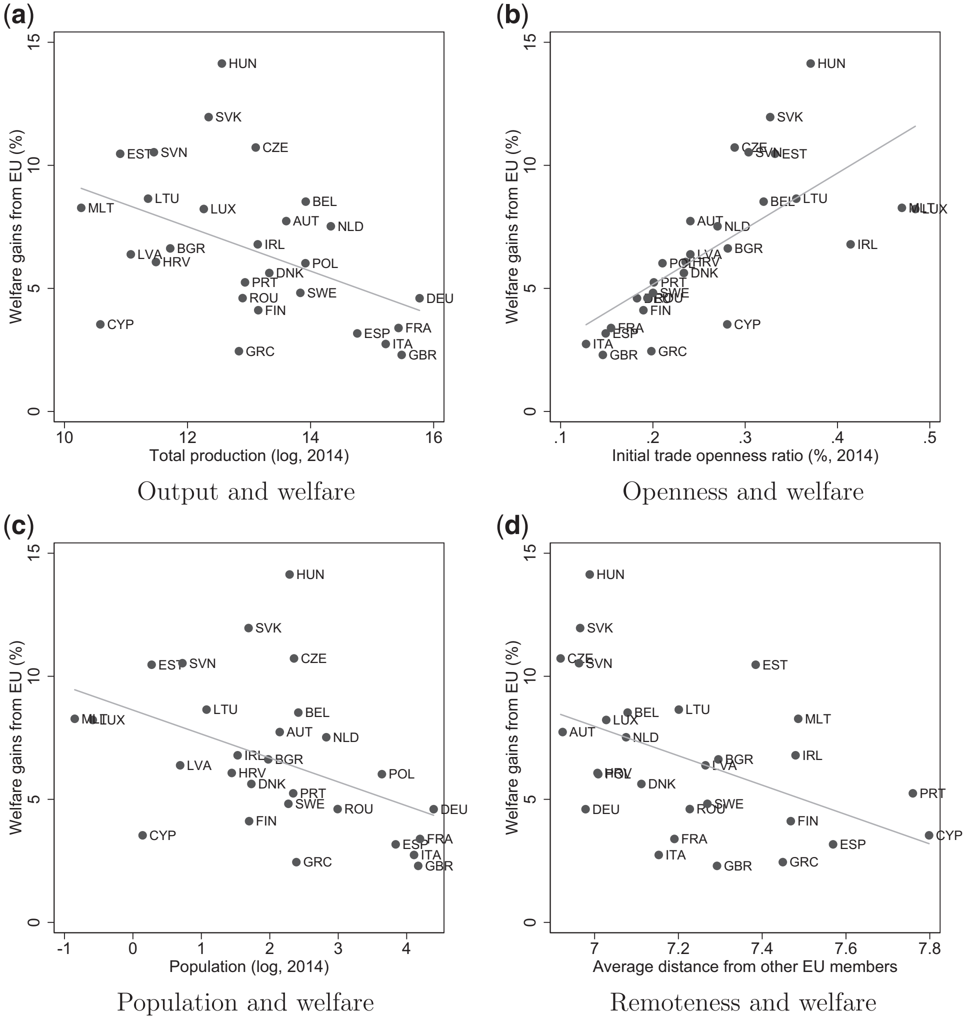

Figure 4. EU-membership welfare gains.

Notes: Welfare gains from the standard RTA scenario with intermediate goods reported in Column (1) of Table 7. Trade openness is computed as total exports over production.

estimates and accounting for the difference in coefficients through trade elasticity alone give an estimate of $\epsilon_{\text{PPML}} = 0.633/\ln(1.22) = 3.18$. 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 with 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 distortion 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

Table 8. Welfare gains from EU under different scenarios (with intermediates, %)

Counterfactual assumption	(1) to RTA	(2) to RTA with intermediates	(3) 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 weighted	4.4	3.1	7.0
EU mean	6.6	4.6	10.6

Notes: Welfare gains are relative to the counterfactual scenario, in which the EU is replaced by a standard RTA. Welfare gains computed from Equation (13). Weighted by share in consumption. The trade elasticity is −5.03 in Columns (1) and (2) and −3.18 in Column (3).

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 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 EU, replaced by WTO rules or a standard RTA between EU members. In this sub-section, we

Table 9. Welfare gains from EU: robustness (with intermediates, %)

Counterfactual assumption	(1) to RTA	(2) to RTA	(3) to RTA	(4) to RTA
	benchmark	unilateral exit	Alternative elasticity	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

Notes: 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 A1).

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 presented in Column (2) of Table 9. Compared with the benchmark scenario, the trade impact is ambiguous since such single country non-membership would have two opposite impacts through the MR 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 MR 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 with the benchmark. Overall, the losses from unilateral exits seem marginally larger than the losses from complete EU elimination, especially 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), 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 GFT significantly: welfare gains from EU are almost 50% larger on average, and range from 3.4% for the United Kingdom to 21% for Hungary.

Our last exercises address 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 A1 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 with a benchmark with homogenous trade effects (as shown in Column 4 of Table 9).

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 United Kingdom 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. The 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 re-negotiate 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 EU under alternative scenarios for the post-Brexit EU–UK trade relationship: trade between the United Kingdom 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 case with intermediates (Equation 13).

The results presented in Table 10 show substantial welfare losses for the United Kingdom 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), that is, 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 EU, but these are generally one order of magnitude lower than for the United Kingdom. GDP decreases by 0.2–0.6% for the average EU country. With its close geographic and historical linkages with the United Kingdom, Ireland stands as an exception with losses comparable to United Kingdom ones.

5.2. Brexit: signing with third countries

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

Table 11 shows that the United Kingdom 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 United Kingdom; by their geographic location, other large countries, even those sharing historical linkages with the

Table 10. Welfare losses under different scenarios of post-Brexit trade agreement (with intermediates, %)

Counterfactual assumption	(1) to MFN	(2) to RTA	(3) to EU-CHE	(4) to EEA
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 weighted	−0.8	−0.6	−0.4	−0.3

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

Table 11. Welfare gains from alternative RTAs (with intermediates, %)

Counterfactual	(1) to RTA	(2) to MFN
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

Notes: Welfare gains are relative to the counterfactual scenario, in which the UK–EU trade relationships are either governed by a standard RTA (Column 1) or WTO rules (Column 2). Welfare gains computed from Equation (13).

United Kingdom, 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 United Kingdom. Finally, Ireland would be the EU country suffering the most from the trade diversion effects of the new RTAs signed by the United Kingdom, with a cumulated maximum loss of −0.01% of GDP.

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 with Table 7, it however shows that the exit of the United Kingdom from the EU 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 GFT 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%, for example, 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.

6. CONCLUSION

We provide in this paper quantified evidence regarding different scenarios of a deconstruction of the EU. 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/

Table 12. Welfare gains from EU after Brexit (with intermediates, %)

Counterfactual assumption	(1) to RTA	(2) to RTA	(3) Difference
	baseline	Brexit	(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

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

when the United Kingdom already left the Union. We also quantify the compensation that the United Kingdom 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 GFT integration.

Finally, another critical dimension of trade integration from which we abstract regards distributional effects. It is possible to extend the canonical model that we use here in order to include several primary factors (skilled and unskilled labor for instance) used with different intensities in different sectors. In such a setup, the European integration episode would be predicted to have an impact on relative incomes. Those Stolper–Samuelson mechanisms can in particular generate important effects on inequality and on the wage premium associated with higher skills. Until recently, the common wisdom among economists was that factor endowments in Europe were sufficiently similar to make such distributional issues relatively small. The 2004 enlargement and recent public concern about those issues in many European countries suggest that we may have to revisit those initial beliefs. In a recently published paper, Burstein and Vogel (2017) provide a very complete setup which incorporates such Hecksher–Ohlin effects within a quantitative model of heterogeneous firms where the best firms are also using skills more intensively. Unfortunately, the model does not yield structural gravity and therefore cannot use the EHA techniques for computing counterfactuals. The Burstein and Vogel (2017) model must therefore be solved numerically, requiring the calibration of a very large number of parameters. The framework most comparable to ours (maintaining structural gravity), described in Section 3.5 of Costinot and Rodriguez-Clare (2014), introduces different skills in a model very similar to the one we use here. In the quantification provided by the authors, they find that while this modification accounts for distributional effects, the *overall* GFT are almost unaffected by the modification. Since our paper is focused on providing evidence of the nation-wide GFT of different scenarios of European integration/disintegration scenarios, we have abstracted from considering several factors. It would clearly be interesting to pursue that route in future research. In particular, this extension could be used to empirically assess whether the level of public support to EU integration observed in a country can be related to what the model predicts in terms of increased inequality among factors inside this country.

Discussion

Banu Demir

Bilkent University

The paper by Thierry Mayer, Vincent Vicard and Soledad Zignago is motivated by a number of recent developments concerning the EU: increasing concerns regarding the relevance of the EU institutions; rise of populist movements within the region; and growing resistance against immigrants. Partly as a result of these developments, the future of the EU remains uncertain. Then the question is whether the implementation of the Single Market is still an option. As part of the answer, T.M., V.V., and S.Z. focus on understanding the trade-related benefits arising from European integration. Therefore, their carefully written paper is very timely and informative.

The paper uses the latest methods developed in the international trade literature to study the implications for the EU of reverting to alternative trade arrangements, namely signing a standard RTA and applying the WTO rules. The method employed by the authors is implemented in two steps. The first step involves estimating trade frictions based on a structural gravity model of international trade. The estimated trade frictions are then used to run counterfactual scenarios of trade policy in the region using the Exact Hat Algebra approach. In doing so, the authors also investigate the differential effects of the Single Market policy on manufacturing and services.

The paper reports some interesting and novel results regarding the trade-related consequences of the EU. First, the trade effect of the Single Market is an order of magnitude higher than that of a standard RTA. Second, the effects differ substantially between the two broad sectors: trade effect on goods is twice as much as its effect on services. However, the effects are heterogenous across industries within services. In particular, the effect of the Single Market on trade in financial services among the EU countries is considerably higher than its effect in an average service industry. This is an important result as financial services are an important input into manufacturing. Third, the welfare effects of the Single Market are heterogeneous across the EU countries: Eastern European countries have benefited to a larger extent from deep trade integration than other EU28 countries.

The main limitation of the paper, as also acknowledged by the authors, is that it is silent on the distributional consequences of the EU. The extension of the current analysis to multiple factors of production (skilled and unskilled labor) could be used to study the distributional consequences of the Single Market as well as the alternative scenarios for the EU trade integration. It would be extremely useful to know whether the Single Market aggravates or reduces inequality across different types of individuals within countries. The results from such an analysis would also be informative about the political economy considerations of the EU integration.

Overall, the paper by T.M., V.V., and S.Z. is carefully executed and insightful. There is no doubt that the results will be of great interest to researchers and policymakers alike.

Gino Gancia

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What are the economic gains that EU has granted to its member countries? In the midst of the Brexit negotiations and given the growing discontent at EU institutions, answering this question is of the utmost importance. Thierry Mayer, Vincent Vicard and Soledad Zignago provide a quantification of the trade-related gains relative to alternative scenarios. The analysis is conducted in two steps. The first step consists in evaluating the trade-promoting effect of the EU through the estimation of gravity equations. In essence, bilateral trade flows are regressed on a number of fixed effects and dummy variables indicating whether the countries belong to the EU or other RTAs. The second step embeds the results from the gravity regressions into structural equations to perform counterfactual simulations of the trade effect of dismantling the EU and converts it into welfare losses.

The paper is impressive in many dimensions. Besides the obviously important question, the empirical analysis is rigorous and well-grounded in state-of-the-art models. The result is a piece of applied theory at its best: a paper that is as beautiful and elegant as important and insightful. My comments are mostly aimed at discussing the advantages and limitations of the approach, how to interpret the results and what can be learnt from them.

I will start from the estimation of the gravity equations. The approach used is simple, powerful, and transparent. This is no surprise. Gravity equations have a long tradition and have by now reached a stage of maturity. In the preferred specification, bilateral trade flows are regressed on a host of fixed effects: destination-time FEs, capturing any time-varying factor affecting all imports in a given country; origin-time FEs, capturing any time-varying factor affecting all exports from a given country; and destinationorigin FEs, capturing any time-invariant determinant of bilateral trade, such as distance, sharing a common language, or cultural ties. One may imagine that all these fixed affects would absorb most of the observed variation in trade flows, so that little would be left to be explained. On the contrary, the main finding is that the EU dummy triples the volume of trade between member countries.

While not entirely unexpected, given what has been found in the literature, this result remains nonetheless remarkable. To understand its magnitude, it is useful to note that the effect is much larger than what one could predict from the implied reduction in tariffs. Indeed, this illustrates one key advantage of the gravity approach: the EU dummy captures all trade-promoting aspects of the complex process of European integration. It is agnostic about the underlying mechanisms.

Despite its power, the approach has limitations too. As shown by the authors, the results are somewhat sensitive to the estimation method (OLS versus PPML). Moreover, one may argue that all the fixed effects may not necessarily solve the fundamental problem that EU members are not randomly selected. A final limitation is that gravity equations alone cannot be used to study counterfactuals. Once you remove the EU dummy, all the fixed effects will change in an unknown way. In other words, gravity equations shows that EU countries trade significantly more between each other, but they cannot tell how much they would trade in a counterfactual scenario without the EU.

Fortunately, the structural approach comes to the rescue. Besides providing solid micro-foundations for the gravity equations, the formulas of the structural model can be used to perform general-equilibrium counterfactuals and compute welfare effects. The approach is both simple, in that it only requires readily available data, and general, because it is based on formulas that hold across different trade models (e.g., Arkolakis et al., 2012).

However, it comes at a cost. Differently from the gravity equations, the structural approach is not agnostic about the underlying mechanisms. In particular, the equations are valid only under restrictive assumptions. Here, I will mention a few. First, they require sales across firms and products to be Pareto distributed. In reality, they are not, as shown for instance in Head et al. (2014). In turn, deviations from a Pareto distribution can increase the gains form trade. Second, the formulas also require these distributions to be identical across countries. This is also at odds with the data, as shown for instance in Bonfiglioli et al. (2019). Third, the paper uses a single trade elasticity. However, estimates of the trade elasticity vary dramatically across sectors (e.g., Caliendo and Parro, 2015) and are likely to vary across countries as well (e.g., Melitz and Redding, 2015). Since restricting trade might be particularly costly in some specific sectors, this heterogeneity can increase the gains from trade by a factor of 3 (e.g., Costinot and Rodriguez-Clare, 2014; Ossa, 2015). Fourth, the structural equations neglect several important phenomena that may have contributed to the gains from integration, such as the increase in competition and dynamic effects through innovation and migration. Due to these limitations, it is probably fair to say that the gains computed in this paper are a lower bound.

Does this mean that the structural approach is inevitably less credible than the estimates from gravity equations? Not necessarily. On the contrary, I would argue that the model could also be used in an alternative way to complement the gravity regressions. Rather than making quantitative predictions, the two approaches could be combined to provide a full account of the data. In particular, the model tells us exactly what is inside all the fixed effects in the gravity equations, such as GDP, population (and hence migration), price indexes, any barrier to trade. Year after year, these fixed effects summarize how changes in all these variables affect bilateral trade flows; it would be fascinating to see how these underlying variables, some of which are easy to measure, account for these movements. But this would be for another paper.

Instead, let me return to the analysis and conclude by commenting on the main results. The paper finds that the average gain from the EU relative to a regional trade agreement is 6.6% in real GDP. This is a sizable effect. Interestingly, however, the paper finds a large heterogeneity across member countries and identifies some clear patterns: countries that gain the most tend to be small, open, and centrally located. This is no surprise, as these countries are heavily dependent on trade with the rest of Europe. The countries with the smallest benefit are Great Britain (2.3%), Greece (2.4%), and Italy (2.8%). Remarkably, these are precisely some of the countries where the sentiment against the EU is strongest.

Can the model teach us other lessons relevant for understanding the growing discontent toward EU institutions? The paper contains additional hints on the effect of two major events in the recent history of Europe: the introduction of the Euro and the 2004 enlargement. The gravity regressions show that the new common currency failed to promote trade. Understanding why remains an important open question. Regarding the 2004 enlargement, the simulations show that it indeed created a large surplus, but also that this surplus was unequally shared: by far, the biggest beneficiaries were the accessing countries. Could these unequal gains be sources of discontent? This hypothesis seems consistent with Gancia et al. (2018), who showed that economic unions become weaker as they become more heterogeneous in size, income, and factor endowments.

So, with populism on the rise and Brexit underway, is Europe doomed? Interestingly, the paper also provides some insight on this question. It helps us evaluate the risk of socalled domino effects by computing the welfare gain from the EU enjoyed by each country after the United Kingdom has left. Fortunately, the negative effect of Brexit on remaining countries is found to be small. But this result does not guarantee the future survival of the union. As noted above, the computed benefits of Greece and Italy staying in the EU are not far from those enjoyed by the United Kingdom, which were not enough to prevent Brexit. What if they exit too? One could use the methodology of the paper of computing the benefit from the EU after sequentially removing more and more countries and see whether we can identify a set of "core" countries that are likely to stay. Alternatively, the exercise may identify a critical point after which the process ultimately leads to the unraveling of the union.

This takes me to my final point, the worst-case scenario. If the EU collapses, what would be the real economic costs of Non-Europe? Probably far greater than 6.6% of real GDP. As the potential benefits of globalization are likely to grow, so are the missed opportunities that market integration in Europe offers. Or maybe trade opportunities will not be missed. After all, history shows that, despite temporary setbacks, markets have always grown. But in different time periods they have grown in different ways. Before World Word II, empires made markets (e.g., Findlay and O'Rourke, 2007). After it, peaceful trade agreements replaced empires (e.g., Gancia et al., 2018). This suggests that, if economic cooperation collapses, the greatest risk might be the advent of a new era of economic imperialism.

Panel discussion

Atish Ghosh began the discussion by asking whether the welfare losses and gains are GDP equivalent or actual GDP, and whether they are static or dynamic. He added that, although we typically think of static gains from trade as being relatively small, a lot of the talk in the build up to the EU was about dynamic gains.

Thierry Mayer replied that the welfare change is in real GDP, equivalent to GDP per capita since population is fixed. He also explained that the model is completely static as there is no way they can include structural estimation of a growth equation.

Atish Ghosh went on to ask how the result that the Euro produces no gains squares with Andy Rose's results from the early 2000s. He pointed out that one of the gains from the Euro was the convergence of interest rates which led to a huge consumption boom in the periphery. Arnaud Mehl followed up on this, asking whether the authors have an explanation for the lack of effect, and whether this is due to other things that were going on at the same time (such as the creation of global value chains) or whether the "Rose Effect" just doesn't exist.

T.M. pointed out that many of Rose's citations claimed that the results were overestimations and that most of the currency unions in Rose's dataset are for small open islands near a big country. He went on to argue that the literature on the Euro is much more pessimistic and it's not rare to find negative effects (e.g., a paper by Tenreyro in the Annual Review several years ago). He explained that there isn't an accepted answer yet, perhaps because it's a recent phenomenon and perhaps because, in the middle of the process, the financial crisis put a lot of noise in the data.

Kevin O'Rourke added that he was not surprised by the Euro effect given that the local economy in Ireland is completely integrated across the border, not because of a single currency but because of the customs union and the single market.

Neeltje van Horen asked how much the effect is driven by financial services and, if the authors take financial services into account, how that affects the calculations for the EU losses from Brexit.

T.M. responded that the trade in services data is much worse than for trade in goods but that it's possible to isolate commercial services and financial services. He explained that, including financial services, the EU has half the effect for services compared with goods. He acknowledged that they could separate these services using their approach.

Giacomo Calzolari suggested that the correct counterfactual, as discussed in Italy, may not be pre-union but rather forming small groups with foreign countries. T.M. explained that it is possible to run any of these counterfactuals with their model and that, for example, they find the gains of post-Brexit free-trade agreements between the United Kingdom and the United States, Canada, New Zealand, and Australia to be only about one-tenth of the losses from the EU. He went on to argue that, if Italy was to sign with its friends, they had better be close by and really big to compensate at least partly what is destroyed.

Ralph de Haas pointed out that what would have happened in the absence of the EU is different to what would happen now if a country were to leave the EU after so many years of integration. T.M. replied that he doesn't know of much literature on the asymmetry of joining and leaving, but that there is some literature which shows that the Rose effect is much stronger when countries leave than when they join. He recognized that this would be interesting to do, but that it would require a more radical departure in terms of the model.

Andrea Ichino proposed synthetic control as an alternative method which could reduce the bias. T.M. responded that matching solves selection on observables but requires a leap of faith to claim that the bias from unobservables is reduced as well.

Roberto Galbiati asked how much of the results depend on the common regulatory framework over and above the trade agreement. T.M. answered that the comparison between the RTA, EC, and Single Market included in the paper already gives an idea. He also argued that the elasticity required to explain this level of trade creation with only tariffs is much too high, and that common regulation and free mobility of people are likely to be important.

Kevin O'Rourke argued that in the 1950s there were historical changes going on at the same time as the formation of the EEC which may lead to overestimation of the gains from the union. These include increasing currency convertibility under the auspices of the European Payments Union, the OEEC's decade long programme of eliminating quantitative restrictions on trade and the Greek Association Agreement in 1961. T.M. responded that the changes in the EFTA composition are included but not the convertibility of currencies. He also argued that these factors would need to vary for a dyad of countries over time to matter.

Kevin O'Rourke also asked when supply chains and FDI will be included with trade in gravity-type estimations. T.M. replied that FDI data are even worse than trade in services data but that he has a piece of work on cars which uses a triatic gravity equation incorporating headquarters, destination, and production. He finds that the sourcing elasticity with respect to tariffs of choosing between different places is 8, twice as big as the demand elasticity.

A. APPENDIX

A.1. TIME VARYING PARTIAL TRADE IMPACT OF THE EU

The first part of Table A1 reports the results used in Figure 2. Columns (1)–(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.

Table A1. The effect of European integration on trade over time: detailed results

Estimator	(1) OLS	(2) OLS	(3) PPML	(4) PPML	(5) OLS	(6) OLS	(7) OLS	(8) 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[a]	0.156[b]	0.027	0.044				0.149[b]
	(0.082)	(0.087)	(0.100)	(0.108)				(0.078)
EU dum. 1961	0.281[c]	0.258[c]	0.123	0.139				0.260[c]
	(0.083)	(0.088)	(0.098)	(0.106)				(0.078)
EU dum. 1962	0.335[c]	0.312[c]	0.212[a]	0.227[a]				0.324[c]
	(0.083)	(0.088)	(0.092)	(0.099)				(0.083)
EU dum. 1963	0.350[c]	0.326[c]	0.299[c]	0.314[c]				0.347[c]
	(0.082)	(0.088)	(0.088)	(0.096)				(0.086)
EU dum. 1964	0.496[c]	0.472[c]	0.373[c]	0.387[c]				0.501[c]

(*continued*)

Table A1. Continued

Estimator	(1) OLS	(2) OLS	(3) PPML	(4) PPML	(5) OLS	(6) OLS	(7) OLS	(8) OLS
	(0.079)	(0.086)	(0.083)	(0.091)				(0.086)
EU dum. 1965	0.428^{c}	0.404^{c}	0.398^{c}	0.412^{c}				0.440^{c}
	(0.078)	(0.085)	(0.081)	(0.089)				(0.087)
EU dum. 1966	0.444^{c}	0.419^{c}	0.434^{c}	0.446^{c}				0.464^{c}
	(0.081)	(0.088)	(0.077)	(0.084)				(0.085)
EU dum. 1967	0.469^{c}	0.444^{c}	0.460^{c}	0.471^{c}				0.495^{c}
	(0.074)	(0.083)	(0.073)	(0.081)				(0.082)
EU dum. 1968	0.467^{c}	0.442^{c}	0.567^{c}	0.575^{c}				0.502^{c}
	(0.075)	(0.084)	(0.074)	(0.081)				(0.084)
EU dum. 1969	0.418^{c}	0.393^{c}	0.646^{c}	0.655^{c}				0.461^{c}
	(0.079)	(0.088)	(0.070)	(0.076)				(0.089)
EU dum. 1970	0.457^{c}	0.432^{c}	0.705^{c}	0.711^{c}				0.509^{c}
	(0.074)	(0.083)	(0.074)	(0.078)				(0.081)
EU dum. 1971	0.514^{c}	0.489^{c}	0.763^{c}	0.768^{c}				0.574^{c}
	(0.071)	(0.080)	(0.074)	(0.077)				(0.079)
EU dum. 1972	0.613^{c}	0.587^{c}	0.775^{c}	0.780^{c}				0.680^{c}
	(0.070)	(0.078)	(0.068)	(0.071)				(0.078)
EU dum. 1973	0.313^{c}	0.584^{c}	0.382^{c}	0.650^{c}				0.689^{c}
	(0.065)	(0.079)	(0.091)	(0.079)				(0.078)
EU dum. 1974	0.180^{c}	0.411^{c}	0.308^{c}	0.509^{c}				0.524^{c}
	(0.065)	(0.084)	(0.092)	(0.086)				(0.080)
EU dum. 1975	0.190^{c}	0.381^{c}	0.411^{c}	0.588^{c}				0.502^{c}
	(0.066)	(0.080)	(0.088)	(0.082)				(0.079)
EU dum. 1976	0.214^{c}	0.394^{c}	0.465^{c}	0.619^{c}				0.523^{c}
	(0.062)	(0.084)	(0.084)	(0.079)				(0.086)
EU dum. 1977	0.194^{c}	0.313^{c}	0.475^{c}	0.590^{c}				0.450^{c}
	(0.063)	(0.082)	(0.081)	(0.080)				(0.082)
EU dum. 1978	0.202^{c}	0.327^{c}	0.496^{c}	0.600^{c}				0.471^{c}
	(0.063)	(0.086)	(0.081)	(0.079)				(0.086)
EU dum. 1979	0.214^{c}	0.293^{c}	0.537^{c}	0.608^{c}				0.446^{c}
	(0.062)	(0.083)	(0.077)	(0.077)				(0.083)
EU dum. 1980	0.201^{c}	0.260^{c}	0.548^{c}	0.594^{c}				0.421^{c}
	(0.060)	(0.077)	(0.080)	(0.080)				(0.077)
EU dum. 1981	0.291^{c}	0.229^{c}	0.523^{c}	0.554^{c}				0.400^{c}
	(0.062)	(0.078)	(0.079)	(0.081)				(0.079)
EU dum. 1982	0.372^{c}	0.202^{c}	0.546^{c}	0.555^{c}				0.381^{c}
	(0.063)	(0.075)	(0.072)	(0.073)				(0.077)
EU dum. 1983	0.396^{c}	0.283^{c}	0.589^{c}	0.538^{c}				0.441^{c}
	(0.065)	(0.077)	(0.070)	(0.068)				(0.073)
EU dum. 1984	0.365^{c}	0.267^{c}	0.577^{c}	0.524^{c}				0.429^{c}
	(0.063)	(0.076)	(0.070)	(0.068)				(0.072)
EU dum. 1985	0.400^{c}	0.309^{c}	0.578^{c}	0.526^{c}				0.474^{c}
	(0.062)	(0.075)	(0.071)	(0.068)				(0.072)
EU dum. 1986	0.327^{c}	0.317^{c}	0.574^{c}	0.557^{c}				0.492^{c}
	(0.058)	(0.072)	(0.069)	(0.066)				(0.071)
EU dum. 1987	0.408^{c}	0.363^{c}	0.586^{c}	0.559^{c}				0.543^{c}
	(0.057)	(0.073)	(0.066)	(0.065)				(0.074)
EU dum. 1988	0.409^{c}	0.386^{c}	0.603^{c}	0.573^{c}				0.570^{c}
	(0.058)	(0.073)	(0.065)	(0.065)				(0.074)
EU dum. 1989	0.470^{c}	0.448^{c}	0.590^{c}	0.558^{c}				0.636^{c}
	(0.060)	(0.074)	(0.061)	(0.063)				(0.077)
EU dum. 1990	0.531^{c}	0.439^{c}	0.525^{c}	0.482^{c}				0.631^{c}

(*continued*)

Table A1. Continued

Estimator	(1) OLS	(2) OLS	(3) PPML	(4) PPML	(5) OLS	(6) OLS	(7) OLS	(8) OLS
	(0.059)	(0.073)	(0.057)	(0.063)				(0.077)
EU dum. 1991	0.549^{c}	0.487^{c}	0.535^{c}	0.494^{c}				0.717^{c}
	(0.061)	(0.072)	(0.058)	(0.064)				(0.076)
EU dum. 1992	0.678^{c}	0.593^{c}	0.550^{c}	0.508^{c}				0.832^{c}
	(0.060)	(0.071)	(0.056)	(0.063)				(0.078)
EU dum. 1993	0.624^{c}	0.526^{c}	0.460^{c}	0.406^{c}				0.773^{c}
	(0.060)	(0.071)	(0.055)	(0.065)				(0.080)
EU dum. 1994	0.589^{c}	0.477^{c}	0.498^{c}	0.446^{c}				0.733^{c}
	(0.063)	(0.078)	(0.055)	(0.065)				(0.085)
EU dum. 1995	0.640^{c}	0.552^{c}	0.571^{c}	0.515^{c}				0.817^{c}
	(0.054)	(0.078)	(0.055)	(0.072)				(0.088)
EU dum. 1996	0.624^{c}	0.534^{c}	0.571^{c}	0.514^{c}				0.820^{c}
	(0.055)	(0.076)	(0.056)	(0.072)				(0.087)
EU dum. 1997	0.669^{c}	0.568^{c}	0.552^{c}	0.493^{c}				0.861^{c}
	(0.058)	(0.081)	(0.057)	(0.075)				(0.092)
EU dum. 1998	0.646^{c}	0.577^{c}	0.549^{c}	0.485^{c}				0.881^{c}
	(0.055)	(0.077)	(0.057)	(0.076)				(0.091)
EU dum. 1999	0.979^{c}	0.796^{c}	0.648^{c}	0.537^{c}				1.080^{c}
	(0.058)	(0.087)	(0.060)	(0.079)				(0.098)
EU dum. 2000	0.994^{c}	0.823^{c}	0.619^{c}	0.511^{c}				1.111^{c}
	(0.058)	(0.091)	(0.062)	(0.082)				(0.102)
EU dum. 2001	0.982^{c}	0.807^{c}	0.590^{c}	0.477^{c}				1.091^{c}
	(0.060)	(0.095)	(0.065)	(0.085)				(0.106)
EU dum. 2002	1.033^{c}	0.849^{c}	0.613^{c}	0.496^{c}				1.144^{c}
	(0.061)	(0.096)	(0.065)	(0.085)				(0.108)
EU dum. 2003	1.106^{c}	0.946^{c}	0.613^{c}	0.499^{c}				1.251^{c}
	(0.061)	(0.095)	(0.067)	(0.088)				(0.109)
EU dum. 2004	1.092^{c}	1.049^{c}	0.677^{c}	0.576^{c}				1.321^{c}
	(0.054)	(0.097)	(0.071)	(0.088)				(0.111)
EU dum. 2005	1.130^{c}	1.093^{c}	0.659^{c}	0.532^{c}				1.334^{c}
	(0.055)	(0.091)	(0.070)	(0.086)				(0.113)
EU dum. 2006	1.221^{c}	1.106^{c}	0.712^{c}	0.580^{c}				1.355^{c}
	(0.057)	(0.091)	(0.069)	(0.086)				(0.116)
EU dum. 2007	1.344^{c}	1.112^{c}	0.734^{c}	0.599^{c}				1.362^{c}
	(0.056)	(0.092)	(0.071)	(0.087)				(0.119)
EU dum. 2008	1.399^{c}	1.127^{c}	0.732^{c}	0.592^{c}				1.384^{c}
	(0.063)	(0.093)	(0.072)	(0.086)				(0.120)
EU dum. 2009	1.621^{c}	1.350^{c}	0.750^{c}	0.605^{c}				1.611^{c}
	(0.063)	(0.091)	(0.075)	(0.089)				(0.122)
EU dum. 2010	1.673^{c}	1.416^{c}	0.778^{c}	0.633^{c}				1.683^{c}
	(0.064)	(0.093)	(0.073)	(0.086)				(0.126)
EU dum. 2011	1.664^{c}	1.340^{c}	0.770^{c}	0.624^{c}				1.614^{c}
	(0.066)	(0.095)	(0.072)	(0.085)				(0.128)
EU dum. 2012	1.697^{c}	1.406^{c}	0.777^{c}	0.633^{c}				1.687^{c}
	(0.067)	(0.095)	(0.074)	(0.087)				(0.130)
EEC dum.					0.493^{c}	0.347^{c}	0.430^{c}	
					(0.041)	(0.041)	(0.039)	
EU single market dum. (post-1992)					1.181^{c}	0.894^{c}	0.935^{c}	
					(0.046)	(0.046)	(0.046)	
Both GATT dum.	0.135^{c}	0.133^{c}	−0.082	−0.084	0.137^{c}	0.137^{c}	0.128^{c}	0.130^{c}
	(0.027)	(0.027)	(0.074)	(0.075)	(0.027)	(0.027)	(0.027)	(0.027)
Shared currency dum.	0.339^{c}	0.340^{c}	0.828^{c}	0.838^{c}	0.339^{c}	0.342^{c}	0.344^{c}	0.345^{c}

(continued)

Table A1. Continued

Estimator	(1) OLS	(2) OLS	(3) PPML	(4) PPML	(5) OLS	(6) OLS	(7) OLS	(8) OLS
	(0.068)	(0.068)	(0.126)	(0.127)	(0.068)	(0.067)	(0.068)	(0.068)
Euro area dum.	−0.262^{c}	−0.187^{c}	−0.105^{a}	−0.027	−0.139^{a}	−0.205^{c}	0.026	−0.127^{a}
	(0.060)	(0.063)	(0.043)	(0.041)	(0.056)	(0.058)	(0.055)	(0.063)
RTA dum.	0.391^{c}	0.391^{c}	0.058	0.054	0.383^{c}	0.356^{c}	0.358^{c}	0.370^{c}
	(0.024)	(0.024)	(0.046)	(0.046)	(0.024)	(0.024)	(0.024)	(0.025)
Shengen dum.	−0.099^{a}	−0.080	−0.057^{b}	−0.055	0.040	0.005	0.067^{b}	−0.041
	(0.044)	(0.054)	(0.030)	(0.035)	(0.040)	(0.040)	(0.040)	(0.053)
EEA dum.	1.068^{c}	1.057^{c}	0.428^{c}	0.403^{c}	0.995^{c}	1.015^{c}	0.988^{c}	1.046^{c}
	(0.094)	(0.095)	(0.091)	(0.089)	(0.094)	(0.094)	(0.094)	(0.096)
EU-Switz. RTA dum.	0.853^{c}	0.847^{c}	0.014	0.006	0.782^{c}	0.798^{c}	0.796^{c}	0.845^{c}
	(0.100)	(0.100)	(0.096)	(0.096)	(0.100)	(0.100)	(0.101)	(0.101)
EU-Turkey RTA dum.	−0.235^{b}	−0.236^{b}	0.233^{a}	0.253^{a}	−0.243^{b}	−0.230^{b}	−0.224^{b}	−0.220^{b}
	(0.125)	(0.125)	(0.103)	(0.105)	(0.124)	(0.124)	(0.124)	(0.124)
Observations	849,147	849,147	1,316,900	1,316,900	849,147	849,147	849,147	849,147
R^2	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

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

The second part of Table A1 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. Column (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), that is, 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.

A.2. TRADE EFFECTS USING PPML ESTIMATES OF THE EU PARTIAL TRADE IMPACT

Table A2 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 A1) instead of the OLS results used in Table 6.

Table A2. The trade effect of EU integration (RTA scenario with intermediate inputs, PPML estimate of EU PTI, %)

Sector Var.	Goods Imports with/without EU			Goods Import/ consumption		Tradable services Imports with/without EU			Tradable services 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	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

Notes: 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 GFT

Table A3. Welfare gains from EU under different scenarios (percentage of total GFT)

Counterfactual assumption	(1) to MFN	(2) to RTA with intermediates (%)	(3) to EEC
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 weighted[a]	36.4	29.5	25.1
EU mean	35.6	28.8	24.4

Notes: Welfare gains are expressed in percentage of total GFT, that is, with respect to autarky. They are relative to the counterfactual scenario, in which the EU is either replaced by WTO rules (Column 1), a standard RTA (Column 2) or the EEC (Column 3); see Columns (1)–(3) in Table 7 for baseline results. Welfare gains computed from Equation (13). [a]Weighted by share in consumption.

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