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A Tale of (Almost) 1001 Coefficients: Deep and Heterogeneous Effects of the EU-Turkey Customs Unions

Abstract

In view of the deferred start of negotiations for the modernization of the Customs Union between the EU and Turkey (CU-EUT), we look back and analyse the ex post trade consequences of the CU-EUT. Employing up-to-date econometric best practices for regional integration agreements, we quantify both total and heterogeneous trade effects of the CU-EUT. In contrast to most previous studies, our results indicate a significantly positive, large, and robust impact of the CU-EUT, implying an additional increase in EU-Turkey manufacturing trade by 55-65% compared to the previously active Ankara Agreement. We also provide evidence that the CU-EUT significantly increased Turkey's trade with third countries. Additionally, a substantial heterogeneity in the CUEUT effect is found across different industries as well as for each of its member countries and the direction of trade. We link the heterogeneity of our up to 911 coefficient estimates to differences in initial trade costs and show that it cannot be ascribed to reductions in bilateral tariff rates.

JEL-Codes: F140, F150.

Keywords: gravity model, European integration, country-specific effects.

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Acknowledgments will be added.

1 Introduction

In May 2015, the Turkish government and the European Commission officially started a process for the modernization and expansion of the by now more than 20 years old Customs Union (CU) between the European Union (EU) and Turkey (hereafter called “CU-EUT”). In December 2016, the European Commission asked the European Council for a mandate to launch negotiations. However, in August 2017, the German government publicly opposed this decision and announced the suspension of any preparatory work for the reform of the CU-EUT over concerns about the democratic development and human rights situation in Turkey (Höhler, 2017; Tastan, 2017). Consultations in the European Council about the opening of negotiations are still ongoing.[1] Amidst recent political tensions between the EU and Turkey, an effort to look back and assess the economic consequences the CU-EUT has hitherto brought about for both parties seems worthwhile and well-timed.

For the preparation of the opening of negotiation talks the European Commission requested two external studies by the World Bank (2014) and by BKP, Panteia, and AESA (2016). In their empirical ex post evaluations these studies reach sobering conclusions regarding the effect of the CU-EUT on bilateral trade flows in a gravity modelling framework. While the World Bank (2014, pp. 93-96) finds no statistically significant effect, BKP, Panteia, and AESA (2016, pp. 66-67) identify an overall negative impact of the CU-EUT on two-way goods trade.

In addition to these two large-scale studies, also academic papers within the gravity modelling literature are inconclusive about the trade effects of the CU-EUT. Table A1 (along with a short discussion in Section A) in the Online Appendix summarizes the underlying data, empirical methods, and results of the World Bank (2014), BKP, Panteia, and AESA (2016), as well as seven other gravity studies. While Antonucci and Manzocchi (2006), Nowak-Lehmann,

[1] See http://ec.europa.eu/trade/policy/countries-and-regions/countries/turkey/ (accessed on October 8th, 2018).

Herzer, Martinez-Zarzoso, and Vollmer (2007), Magee (2016), Mumcu Akan and Engin Balin (2016) as well as Frede and Yetkiner (2017) do not find evidence for a significant and relevant trade-enhancing effect of the CU-EUT, Neyaptı, Taşkın, and Üngör (2007) and Adam and Moutos (2008) estimate a significantly positive and economically large impact. One of our contributions is to expose the methodological differences that may help explain the considerable divergence of results across these studies. When taking into account the latest developments in structural gravity estimation – namely non-linear estimation with exporter-time, importer-time, and country-pair fixed effects with both inter- and intranational trade flows and controlling for a general globalization trend – we find a strong, highly significant and positive effect.[2]

Turkey's continuous process of economic integration into the EU dates back to 1963 when both parties signed the Association Agreement, known as the Ankara Agreement, in which they agreed to establish a customs union. An Additional Protocol was signed in 1970 and set out the timetable for the progressive abolition of bilateral customs duties over 22 years. The protocol required both parties to completely remove bilateral tariffs and quantitative restrictions on all industrial goods and the industrial components of processed agricultural products. The implementation of the CU-EUT on January 1st 1996 committed Turkey to align to the EU's customs tariffs and rules, to its commercial policy vis-à-vis third countries, as well as to the EU's *acquis* in the areas covered by the CU-EUT. As the World Bank (2014, p. 19) confirms, the CU-EUT has harmonized and decreased Turkey's import tariffs by applying the EU's common external tariff for most industrial products. Moreover, the approximation of laws resulted in improvements in Turkey's internal technical legislation and provided an important impetus to customs reforms and trade facilitation in Turkey (World Bank, 2014, pp. 32, 46). Besides the immedi-

[2]Note that under the CU-EUT, deep trade liberalization is only secured in the industrial goods sector, which is subject to great legislative alignment, but its coverage of other policy areas – mainly primary agriculture, services and public procurement – is incomplete. We will therefore focus in our analysis on the effects of the CU-EUT on manufacturing trade flows.

ate effects on Turkish trade flows with the EU, these improvements may also foster trade with other partner countries. Based on recent contributions in the structural gravity literature, we are able to identify this unilateral liberalization effect in a theory-consistent specification. Hence, we are the first to demonstrate that the CU-EUT significantly fostered Turkish trade both with the EU member countries and with all other trading partners.[3]

One heavily debated feature of the CU-EUT is its asymmetric structure as to the external commercial policy. The CU-EUT requires Turkey to recognize all trade policies taken by the EU vis-à-vis third countries, such as the signing of a Free Trade Agreement (FTA), a tariff reduction, or preferential market access. At the same time, as Turkey is not a member of the EU, it neither receives automatic reciprocal access to these markets nor is it permitted to participate in the negotiations of trade liberalizations with outsiders. Consequently, Turkey has yielded part of its trade-policy sovereignty to the EU. If this set-up of the CU-EUT leads to asymmetric effects on Turkish im- and exports, Turkish consumers might benefit from cheaper imports from third countries, while Turkish producers may be confronted with higher competition without receiving easier access to non-EU markets (Yalcin, Aichele, and Felbermayr, 2016, pp. 12, 16). Our theory-consistent identification of trade effects with non-EU countries also allows us to investigate whether the concerns about asymmetric third country effects have empirical support. While imports to Turkey are indeed somewhat more strongly affected, Turkish exports also experience an economically and statistically significant increase.

Also for trade between different members of a trade agreement, policymakers often are particularly interested in the effects of Regional Trade Agreements (RTAs) for their country's exports and imports. Although economic theory suggests that generally countries gain from trade liberalization, recently

[3]Neyaptı, Taşkın, and Üngör (2007) also report some results for the trade effects with EU and non-EU countries. However, their identification of the non-EU country effect rests upon the complete omission of time-controls contradicting e.g. the authors' argumentation concerning global trade trends, financial crises, and the effects of the earthquake of 1999.

many political debates about RTAs have raised concerns about “one-way trade deals” and challenged that RTAs bring prosperity to the individual nations. Therefore, we also analyse the heterogeneous directional impacts of the CU-EUT for each pair of member countries within the customs union, both for aggregate and sectoral trade flows. We also use the resulting *almost 1001* different estimated pair-specific, directional, and sector-specific CU-EUT coefficients to (i) examine the robustness of the trade effects and (ii) identify potential drivers of observed trade impact heterogeneity.

The rest of this paper is structured as follows. Section 2 describes the structural gravity framework and its estimation challenges. In section 3, we briefly introduce the data set. Section 4 then displays and discusses our results. Finally, section 5 adds concluding remarks. A more detailed discussion of the literature, data description, and additional results can be found in an Online Appendix.

2 Estimation Strategy

Over the past four decades, the structural gravity equation has come to be the workhorse empirical model to study the determinants of bilateral trade flows and the ex post effects of trade policies in particular. The gravity equation owes its prominence within the empirical trade literature both to its remarkable predictive power and to its theoretical microeconomic foundations. We follow the representation by Anderson and van Wincoop (2003) who derive a gravity equation in an Armington (1969) setting with nationally differentiated goods:[4]

$$X_{ij,t} = \frac{Y_{i,t} E_{j,t}}{Y_t} \left(\frac{t_{ij,t} \left(\tau_{ij,t}\right)^{\frac{-\sigma}{1-\sigma}}}{\Pi_{i,t} P_{j,t}} \right)^{1-\sigma}, \tag{1}$$

[4]Equivalent formulations can be obtained based on a large number of major trade models (see Arkolakis, Costinot, and Rodríguez-Clare, 2012; Head and Mayer, 2014).

$$\Pi_{i,t}^{1-\sigma} = \sum_j \left(\frac{t_{ij,t} \left(\tau_{ij,t}\right)^{\frac{-\sigma}{1-\sigma}}}{P_{j,t}} \right)^{1-\sigma} \frac{E_{j,t}}{Y_t}, \tag{2}$$

$$P_{j,t}^{1-\sigma} = \sum_i \left(\frac{t_{ij,t}\tau_{ij,t}}{\Pi_{i,t}} \right)^{1-\sigma} \frac{Y_{i,t}}{Y_t}, \tag{3}$$

where $X_{ij,t}$ denotes inter- ($i \neq j$) and intranational ($i = j$) nominal trade flows from exporter i to destination j, $E_{j,t}$ is the total expenditure in j and $Y_{i,t}$ the value of total production in i, Y_t denotes the value of world output, $t_{ij,t}$ are bilateral trade frictions between i and j, $\tau_{ij,t} - 1$ is the tariff rate charged by importer j on goods from i (all for a specific year t), and $\sigma > 1$ indicates the elasticity of substitution among goods from different countries.

The right-hand side of Equation (1) is the product of two ratios: first, the size term that is interpretable as the predicted frictionless trade flow as if there were no trade costs and second, the trade cost term which is the ratio of predicted trade with to predicted trade without trade costs. In analogy with Newtonian gravity, Equation (1) predicts that international trade [gravitational force] between two countries [objects] is increasing in the product of their sizes [masses] and decreasing in the trade costs [the square of distance] between them (Anderson and Yotov, 2010; Yotov, Piermartini, Monteiro, and Larch, 2016).

Importantly, the trade cost term in Equation (1) also depends on the two structural terms Π_i and P_j that were coined as “multilateral resistance terms” (MRTs) by Anderson and van Wincoop (2003). The MRTs represent the average incidence of trade costs on buyers’ and sellers’ ability to access world markets and formalize the intuitive argument that two countries will trade more with each other the more remote they are from all other countries.

The modularity of the structural gravity system allows to treat bilateral trade frictions in each sector as an independent set of variables that can be estimated separately as if the data corresponded to aggregate trade (see e.g. Anderson, 2011).

Yotov, Piermartini, Monteiro, and Larch (2016) compile best practice solutions to translate the gravity system (1)-(3) into the following empirical specification that we use to estimate the CU-EUT trade effects:

$$X_{ij,t} = \exp(\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \mathbf{z}'_{ij,t}\boldsymbol{\beta} + \gamma \text{CU-EUT}_{ij,t}) + \varepsilon_{ij,t}. \quad (4)$$

$\varepsilon_{ij,t}$ denotes a remainder error term. The terms $\pi_{i,t}$ and $\chi_{j,t}$ are time-varying exporter and importer fixed effects that control for the MRTs Π_i and P_j which are not directly observable (see Feenstra, 2004). In addition to capturing the MRTs, the exporter-time and importer-time fixed effects absorb Y_i and E_j and further control for any other observable and unobservable exporter- and importer-specific factors that may influence trade flows and are not specifically related to bilateral trade frictions, such as national policies or productivity shocks (Yotov, Piermartini, Monteiro, and Larch, 2016, p. 19).[5] Furthermore, our specifications include asymmetric country-pair fixed effects μ_{ij} to tackle potential endogeneity concerns due to unobserved heterogeneity or selection into trade policies (see Baier and Bergstrand, 2007).

$\mathbf{z}_{ij,t}$ (with corresponding parameter vector $\boldsymbol{\beta}$) collects time-varying bilateral trade cost factors, such as an indicator variable $RTA_{ij,t}$ that equals 1 if i and j at time t belong to an RTA, aside from the CU-EUT, and zero otherwise. It also contains an international border dummy (equal to one for international trade and zero else) interacted with period dummies that hence flexibly control for changes of international relative to intranational trade costs over time (see Bergstrand, Larch, and Yotov, 2015). In some specifications, we also include indicator variables for membership in specific customs unions other than the CU-EUT, a WTO membership dummy, and the logarithm of the most favoured nation (MFN) tariff charged by the importer on international trade flows.

[5] Therefore, the fixed effects also control for macroeconomic disturbances that occurred in the period after the entry into force of the CU-EUT, mainly Turkey's balance of payments crisis in 2001 and the 2007-2008 global financial crisis, and that were mentioned by the World Bank (2014, p. 94) and BKP, Panteia, and AESA (2016, p. 27) as a concern for the identification of the CU-EUT effects in their gravity estimations.

Further, the main variable of interest is the indicator variable CU-EUT$_{ij,t}$ which becomes 1 for all trade flows between Turkey and EU members starting with the introduction of the CU-EUT in 1996. γ hence captures the trade liberalization between the EU and Turkey of the CU-EUT.

Besides estimating the overall impact of the CU-EUT, we identify heterogeneous effects of the CU-EUT by (i) including separate indicators for Turkish ex- and imports to and from the EU after 1996 ("CU-EUT: EU $\rightarrow$ TUR" and "CU-EUT: TUR $\rightarrow$ EU"), (ii) adding indicators for Turkish trade flows with non-EU countries after the introduction of the CU-EUT ("CU-EUT: TUR $\leftrightarrow$ Non-EU" or "CU-EUT: Non-EU $\rightarrow$ TUR" and "CU-EUT: TUR $\rightarrow$ Non-EU"), (iii) allowing the CU-EUT effect to be different for every EU-partner and (iv) considering the general CU-EUT effect as well as all aforementioned heterogeneous effects also at a more disaggregated industry-level.

The breaking down of effects according to trade directions, partners, and sectors follows recent contributions in the general RTA literature by Baier, Yotov, and Zylkin (2019) and Zylkin (2016). In estimating the third country effects, we draw upon recent advances in the gravity literature that make use of intranational trade flows to identify the effects of unilateral, non-discriminatory policies. Heid, Larch, and Yotov (2017) and Beverelli, Keck, Larch, and Yotov (2018) demonstrate that the multicollinearity of variables capturing such policies with the importer-time and exporter-time fixed effects can be overcome by interacting the policy variable with an international border dummy. Similarly, in our setting the "CU-EUT" and the "TUR$\leftrightarrow$Non-EU" variables would be jointly collinear with the set of fixed effects if we included only international trade flows in our analysis. By adding internal trade and introducing the same international border dummy interaction as Heid, Larch, and Yotov (2017), we are able to identify both the direct and the third country effect of the CU-EUT. Our application of this method is similar in spirit to the one of Larch, Wanner, and Yotov (2018) who also investigate the unilateral effect of a multilateral variable, in their case the effect of joining the Euro on trade flows between the new members and non-Euro member countries.

The majority of previous studies on the CU-EUT effects estimates a log-linearized version of the gravity equation using the Ordinary Least Squares (OLS) estimator. As Santos Silva and Tenreyro (2006) point out, this leads to inconsistent estimates in the presence of heteroscedasticity or systematic zero trade flows. We follow their suggestion and estimate the gravity model in its original multiplicative form with the Poisson Pseudo Maximum Likelihood (PPML) estimator. In order to overcome the computational challenge associated with PPML estimation with three types of high-dimensional fixed effects that until recently prevented the estimation of this specification, we use Tom Zylkin's `ppml_panel_sg`-command introduced by Larch, Wanner, Yotov, and Zylkin (forthcoming).

Finally, we follow Cheng and Wall (2005) and estimate our specification using three-year intervals instead of consecutive years in order to allow trade flows time to adjust in response to trade policy changes and report multiway clustered standard errors by exporter, importer, and year following the suggestion by Egger and Tarlea (2015) in order to capture error term correlations within the respective dimensions.

3 Data

The dataset used was kindly provided by Thomas Zylkin and is an industry-level version of the dataset employed by Baier, Yotov, and Zylkin (2019). The database is a balanced panel that covers bilateral trade in the manufacturing sector for a sample of 69 countries over the period 1988 – 2006.[6] Importantly, it does not only contain international but also intranational trade data. The intranational trade data is consistently constructed as the difference between gross production and total exports, which are originally obtained from UN COMTRADE, the CEPII TradeProd database, UNIDO IndStat, and the

[6] A list of included countries is provided in the Online Appendix.

World Bank "Trade, Production, and Protection" database.

RTA data are taken from Mario Larch's RTA database from Egger and Larch (2008). In addition, standard gravity covariates (distance, contiguity, common language, WTO membership, and colonial ties) are taken from the CEPII GeoDist database. From Yotov, Piermartini, Monteiro, and Larch (2016), we take data on most-favored-nation (MFN) tariffs which were compiled by Thomas Zylkin. However, the tariff data are only available for 52 of the 69 countries.

Finally, we retrieve bilateral tariff data for the EU and Turkey from the UNCTAD's Trade Analysis Information System database. Specifically, we use data on effectively applied tariffs at the 2- and 3-digit manufacturing industry level from wits.worldbank.org.

4 Estimation Results

4.1 Main Results

Table 1 reports the main results for the estimation of model (4) with aggregate trade data. The coefficient of the CU-EUT in column (1) is highly significant and indicates an economically large effect: the CU-EUT has increased bilateral trade between the EU and Turkey by $(e^{0.472} - 1) \times 100 = 60\%$. The effect of the CU-EUT is an additional effect to the average trade effect of the RTAs included in the dataset (which also covers the Ankara Agreement). These initial results demonstrate that the CU-EUT was much more successful in promoting trade than other RTAs, which on average increased bilateral trade by 28%.

One explanation for the strong impact of the CU-EUT may arise from the structural advantage of a customs union compared to an FTA which lies in the removal of the requirement for certificates of origin. Magee (2008), Roy (2010), Baier, Bergstrand, and Feng (2014), and Baier, Bergstrand, and Clance (2018) all find that customs union and other types of deeper agreements (common

Table 1: Main Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CU-EUT	0.472***	0.444***		0.499***	0.501***		
	(0.041)	(0.045)		(0.045)	(0.045)		
All RTAs	0.243**		0.243**	0.242**	0.242**		
	(0.113)		(0.113)	(0.113)	(0.113)		
EU		0.338**				0.274	0.343**
		(0.157)				(0.182)	(0.151)
CU		0.539*				0.501	0.508*
		(0.297)				(0.308)	(0.300)
FTA or EIA or PS		0.243**				0.151	0.195*
		(0.113)				(0.148)	(0.118)
CU-EUT: EU → TUR			0.402***			0.479***	0.567***
			(0.121)			(0.051)	(0.049)
CU-EUT: TUR → EU			0.555***			0.517***	0.481***
			(0.140)			(0.065)	(0.083)
CU-EUT: TUR ↔ Non-EU				0.247***		0.277***	0.299***
				(0.061)		(0.072)	(0.088)
CU-EUT: Non-EU → TUR					0.273***		
					(0.065)		
CU-EUT: TUR → Non-EU					0.212***		
					(0.064)		
WTO						0.456***	0.459***
						(0.078)	(0.090)
ln(1 + MFN tariff)							-1.751*
							(0.992)
N	33026	33026	33026	33026	33026	33026	18886

Notes: All estimations are performed with exporter-time, importer-time, and country-pair fixed effects, using the PPML estimator. Additionally, *International Border* × *Period* dummies are included, but omitted for brevity. Standard errors are multiway clustered by importer, exporter, and year and reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

markets or economic unions) have larger average effects than FTAs. Motivated by these findings, in column (2) of Table 1 the RTA dummy is split in CUs and other RTAs (free trade agreements, economics integration agreements, and partial scope agreements), as well as a separate EU dummy. The results suggest that these deeper agreements promote trade more strongly.[7]

Column (3) of Table 1 analyses the possible asymmetry of trade effects of the CU-EUT in the direction of trade, i.e. for EU vs. Turkish exports. Results indicate that while the CU-EUT has increased EU exports to Turkey by 49%, Turkish exports to the EU have risen by 74%. These results contradict the findings of Neyaptı, Taşkın, and Üngör (2007), Adam and Moutos (2008) and Frede and Yetkiner (2017) who identify larger benefits from the CU-EUT for EU exports than for Turkish exports.

The CU-EUT required Turkey to align with the EU's common external tariff which led to a reduction of Turkey's import tariffs for third countries and thereby reduced the EU preferential access to the Turkish market. Moreover, some provisions of the CU-EUT, for example Turkey's adoption of the EU *acquis* or the improvement of customs procedures in Turkey, may have a unilateral liberalization component and may have stimulated Turkey's trade with the rest of the world. Our inter- and intranational trade data as well as the specification uniquely enable us to also allow us to quantify this unilateral component while still rigorously sticking to the theoretical constraints of structural gravity. Specifically, we do so by adding in column (4) a dummy

[7] Heterogeneity in the trade effects of RTAs may also arise from their scope and the specific provisions that are covered by an RTA. Dür, Baccini, and Elsig (2014), Kohl (2014), Kohl, Brakman, and Garretsen (2016), and Mattoo, Mulabdic, and Ruta (2017) find robust evidence that comprehensive agreements stimulate trade substantially more than shallow agreements and that trade policy areas that do not directly concern tariffs – such as those regulating customs administration, liberalizing public procurement or protecting intellectual property rights – have a significant effect on trade flows. When retrieving aggregated depth indices from the datasets of Dür, Baccini, and Elsig (2014) and Kohl, Brakman, and Garretsen (2016), CU-EUT is coded to cover inter alia export and import restrictions, technical barriers to trade, customs administration, anti-dumping and countervailing measures, and intellectual property rights, while it misses agreements on services, public procurement, investment, capital mobility as well as on environmental and labour standards. Overall, the CU-EUT cannot be considered an exceedingly deep agreement in terms of covered policy areas.

for Turkey's international trade flows with all non-EU countries after 1996, seeking to control for Turkey's overall liberalization vis-à-vis third countries as a consequence of the CU-EUT.

The indicator for Turkey's outside trade is highly significant and suggests that the reductions in bilateral trade frictions between Turkey and Non-EU countries after the entry into force of the CU-EUT have increased trade flows by 28%. This finding provides evidence that the CU-EUT is rightly "generally credited with Turkey's openness to the world" (BKP, Panteia, and AESA, 2016, p. 11). Importantly, in this specification the CU-EUT coefficient has increased in size, which indicates that without properly controlling for Turkey's liberalization towards third countries the CU-EUT impact may be biased downward. Column (5) further investigates whether the effects of the CU-EUT on Turkey's bilateral market access with the rest of the world are asymmetric in the direction of trade. A larger increase is found for Turkish imports from non-EU countries than for its exports, which may be explained by the required lowering of Turkey's import tariffs. Although the hypothesis of asymmetric third country effects is confirmed by our estimates, the results also indicate benefits for Turkish exporters gaining market access in non-EU countries as a consequence of the CU-EUT. In an additional robustness test reported in the Online Appendix, we find evidence that Turkey faces a higher competitive pressure from EU-RTA partners who gain preferential access to the Turkish market without reciprocity.[8]

Column (6) also analyses how the asymmetric effects of the CU-EUT on member trade flows are changed by the inclusion of the dummy for Turkey's trade with non-EU countries after 1996. The estimate for EU exports to Turkey increases considerably when accounting for the preference erosion faced by EU exporters in the Turkish market. Overall, the asymmetry in the CU-

[8] Specifically, Table A3 adds to specifications (4) to (7) of Table 1 the variable "CU-EUT: EU-RTA partners $\rightarrow$ TUR" capturing differential trade effects of imports from EU-RTA partners to Turkey after the entry into force of the respective RTA from 1996 onwards. While the results for this effect are highly statistically significant, the other CU-EUT effects remain very robust.

EUT effects shrinks and now indicates that Turkish exports benefited only a little more than EU exports. A Wald test on equality of both coefficients gives a p-value of 0.64 and does thereby not provide any evidence that the CU-EUT's trade effects are significantly different for EU vs. Turkish exports.[9] The World Bank (2014, p. 94) and (BKP, Panteia, and AESA, 2016, p. 28) are concerned that China's WTO accession and general tariff reductions due to WTO agreements reduced relative preferences in the EU-Turkey trade relation. Therefore, we additionally included a WTO dummy in column (6), which is positive and highly statistically significant.

What may explain this large effect of the CU-EUT? Bilateral tariffs in EU-Turkey trade have already been widely removed before the entry into force of the CU-EUT due to the Ankara Agreement and the *Additional Protocol*. Therefore, tariff reductions are unlikely to explain the large trade effect of the CU-EUT. Column (7) follows Heid, Larch, and Yotov (2017) and includes MFN tariffs as additional control. We find a negative and significant effect of MFN tariffs that allows to recover an elasticity of substitution of $\hat{\sigma} = 1.8$. The CU-EUT coefficients are robust to the inclusion of MFN tariffs, supporting the view that the trade gains are not primarily driven by tariff reductions.

We investigate the robustness of the large and positive CU-EUT effects by additionally considering specifications with consecutive years, three-year lags and leads of the policy variables, as well as bilateral time trends. The robustness experiments strongly confirm the significant bilateral CU-EUT effect and the CU-EUT's additional non-EU liberalization impact.[10]

Overall, our estimates provide strong evidence that the CU-EUT effect is not only significantly larger than the average effect of all other RTAs but is

[9]The specification with asymmetric CU-EUT effects of column (6) cannot be estimated with two asymmetric dummies for Turkey's trade with non-EU countries after 1996 which were included in column (5). Even with intranational trade data, these four indicators would be perfectly collinear with the exporter-time and importer-time fixed effects.

[10]The detailed results are shown in Table A4 in the Online Appendix. The only specifications where there is no significant unilateral effect are the ones including bilateral time trends, leaving only very little variation for identifying unilateral effects.

also considerably higher than suggested by many previous gravity studies on the CU-EUT.

4.2 Explaining Differences to Previous Studies

In order to analyse to what extent the recent methodological innovations of the gravity literature incorporated in our specifications can explain the differing estimates compared to previous studies, Table 2 depicts the estimation results for various changes in the model specification. Column (1) replicates our preferred specification from column (4) in Table 1. Column (2) reproduces column (1) of Table 1, following all best practices but without controlling for the unilateral liberalization component. Altering the control group in this way slightly reduces the magnitude of the CU-EUT effect. Column (3) follows all previous studies on the trade effect of the CU-EUT by not considering intranational trade flows. Due to the exclusion of observations for intranational trade, the coefficient of the CU-EUT shrinks and is now interpreted as a partial effect of the CU-EUT of 39%. This indicates that the CU-EUT enhanced bilateral trade at the expense of domestic sales within its member countries (Yotov, Piermartini, Monteiro, and Larch, 2016, p. 50). Mattoo, Mulabdic, and Ruta (2017, p. 26) provide another reason for the diverging estimates with and without internal flows: if deep agreements also promote trade with third countries, the unilateral effect of deep agreements is absorbed by the exporter-time and importer-time fixed effects when including only international trade. Since the CU-EUT is generally credited with Turkey's commitment to an open trading regime and its unilateral liberalization to the rest of the world, the inclusion of intranational trade data is crucial for the identification of the overall impact of the CU-EUT on bilateral trade flows. No previous CU-EUT gravity study includes intranational trade, which is an important explanation for their typically lower estimates.

Columns (4) to (6) in turn each add one other deviation from the state-of-the-art specification. Specifically, column (4) reports results from the specifi-

Table 2: Explaining Differences to Previous Studies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CU-EUT	0.499***	0.472***	0.326***	0.256**	0.242**	-0.045	0.038	0.125	0.160	0.144
	(0.045)	(0.041)	(0.030)	(0.130)	(0.077)	(0.046)	(0.118)	(0.098)	(0.098)	(0.122)
All RTAs	0.242**	0.243**	-0.057	0.478***	0.164*	0.499***	-0.020	0.414***	0.176	0.199
	(0.113)	(0.113)	(0.088)	(0.123)	(0.076)	(0.060)	(0.126)	(0.101)	(0.120)	(0.133)
CU-EUT: TUR ↔ Non-EU	0.247***									
	(0.061)									
ln(Y)				0.755***		0.931***	0.597***	1.075***	1.211***	1.226***
				(0.207)		(0.012)	(0.173)	(0.022)	(0.032)	(0.051)
ln(E)				0.473**		0.882***	0.328*	0.870***	0.934***	0.910***
				(0.220)		(0.016)	(0.191)	(0.039)	(0.033)	(0.053)
ln(Distance)						-0.398***		-0.923***	-0.966***	-1.196***
						(0.028)		(0.065)	(0.081)	(0.114)
Contiguity						0.588***		0.032	0.534**	0.021
						(0.066)		(0.183)	(0.198)	(0.395)
Common language						0.363***		0.286	0.839***	-0.076
						(0.053)		(0.283)	(0.168)	(0.604)
Colony						-0.008		0.137	0.644***	0.372
						(0.044)		(0.192)	(0.157)	(0.306)
N	33026	33026	32543	952	30182	32844	933	952	30233	933
Unilateral effect	x									
X_{ii} and globalization trend	x	x								
MRT controlled	x	x	x		x					
Unobserved heterogeneity controlled	x	x	x	x	x		x			
PPML	x	x	x	x		x		x		
All trade flows	x	x	x		x	x			x	

Notes: We include at least year-fixed effects in all specifications. Standard errors are reported in parentheses. In columns (1), (2), (3), (5), and (9) standard errors are multiway clustered by importer, exporter, and year. In columns (4), (7), and (10) standard errors are clustered by country-pair. In columns (6) and (8) standard errors are robust. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

cation of column (3) based on Turkish trade flows only (see Magee (2016) for such an application). With this restriction no exporter-time and importer-time fixed effects can be estimated and hence MRTs are not properly controlled for. Column (5) estimates the specification from column (3) in log-linearised from with OLS (see Adam and Moutos (2008) for such a model). The omission of the zero trade flows from the reference group as well as heteroskedasticity are two aspects that may bias the estimates of the effects of the CU-EUT. Column (6) repeats the specification from (3) not including any country-related fixed effects but adding standard gravity covariates instead. In line with the RTA results of Baier and Bergstrand (2007) and Yotov, Piermartini, Monteiro, and Larch (2016, pp. 51-52), the estimated CU-EUT effect may be underestimated without properly accounting for the endogeneity of the trade policy variable. Indeed, in the first two cases the estimated CU-EUT effect is lowered a little further. In the specification without any fixed effects (column (6)), the CU-EUT completely loses its significance and is estimated to be close to zero.

Column (7) follows Antonucci and Manzocchi (2006), Neyaptı, Taşkın, and Üngör (2007), Nowak-Lehmann, Herzer, Martinez-Zarzoso, and Vollmer (2007), as well as Mumcu Akan and Engin Balin (2016) by estimating a model using only a sample for Turkey's bilateral trade with all other countries in the log-linearised version using OLS (i.e., combining the shortcomings from columns (4) and (5)). In line with the majority of these papers, we find no economically or statistically significant effect of the CU-EUT in this case.

In column (8) we combine the problems of columns (4) and (6) and estimate a specification with Turkish trade flows that does not control for unobserved bilateral heterogeneity. This specification resembles the one used in BKP, Panteia, and AESA (2016). This specification also turns out to be clearly downward biased with an insignificant estimated coefficient of 0.125. The direction of the bias provides a (partial) rational for the finding of BKP, Panteia, and AESA (2016) who estimate an even significantly negative effect of 0.14. A plausible explanation for the remaining discrepancy is that BKP, Panteia, and AESA (2016) use a sample from 1990 to 2015 (i.e., also capturing the Turkish balance of payments crisis as well as the global trade collapse during the financial crisis starting in 2008) without controlling for time effects. In their consideration of the pre-crisis period from 1990 to 2000 they find a positive significant effect of 0.33.

Column (9) combines the problems of columns (5) and (6) and estimates a log-linearised model without fixed effects. This is comparable to the specification of World Bank (2014).[11] Our estimated coefficient is reduced to 0.160 and turns insignificant. World Bank (2014) find a similar insignificant coefficient of 0.2.

Finally, column (10) combines all deviations from the best practices considered before, i.e., it reports results of estimating a log-linearised gravity equa-

[11] Note that strictly speaking World Bank (2014) estimate a Heckman-model following Helpman, Melitz, and Rubinstein (2008). This however also features a log-linearised intensive margin component which faces the same heteroscedasticity bias (Santos Silva, Tenreyro, and Windmeijer, 2015).

tion of Turkish international trade flows only without any country-related fixed effects, similar to the specification by Frede and Yetkiner (2017). In this specification we again do not find a significant impact of CU-EUT on its members' trade flows.

4.3 Heterogenous Effects Across Sectors and Members

Until now, the trade effects of the CU-EUT have been evaluated for aggregate manufacturing trade flows. However, the implied trade cost changes may have quite heterogeneous effects across different sectors. Panel A of Table 3 shows the estimation results for the CU-EUT effects across eight different manufacturing industries, each analysed in a separate regression. It reveals that the CU-EUT has very different impacts across industries. The largest effects of the CU-EUT are found for trade in *Machinery* and *Wood*, whereas the smallest coefficients are estimated for *Minerals* and *Chemicals*. In all sectors except *Metals* the CU-EUT has significantly promoted trade flows. The elimination of the need for certificates of origin in the CU-EUT is likely to explain the large impact in the *Machinery* sector because industries that feature a deep integration with multiple border crossings along the value chain tend to benefit disproportionately from this trade cost reduction. Panel A additionally shows significant liberalization effects with third countries in almost all sectors, except an insignificant increase in *Metals* and a significant negative effect in *Food*, indicating that the CU-EUT actually diverted Turkish food trade away from non-members.

Panel B of Table 3 analyses heterogeneity in the effects of the CU-EUT for each EU member's ex- and imports. Focusing on column (9) which reports the estimated coefficients for aggregate manufacturing trade flows, we find that for almost all country pairs the CU-EUT has significantly increased trade flows (with negatively affected imports from Malta and Cyprus as two notable exceptions)[12]. At the same time, the results also demonstrate that much variation

[12]Note that the estimated effects for Turkey's trade with Cyprus, Malta, Hungary, and

Table 3: Heterogeneity across Sectors and Members

	(1) Food	(2) Textile	(3) Wood	(4) Paper	(5) Chemicals	(6) Minerals	(7) Metals	(8) Machinery	(9) Aggregate
	Panel A: Average Member Effect								
CU-EUT	0.288***	0.547***	0.881***	0.664***	0.270***	0.250**	0.362	0.948***	0.499***
CU-EUT: TUR ↔ Non-EU	-0.140***	0.557***	0.824***	0.845***	0.209**	0.747***	0.134	0.606***	0.247***
	Panel B: Heterogeneous Member Effects								
BEL → TUR	0.550***	0.739**	-0.884***	1.121***	0.110	0.274	-0.287	1.630***	0.900***
TUR → BEL	0.769**	0.492**	2.781***	1.549***	-0.259	1.007***	0.569**	2.073***	0.968***
FRA → TUR	0.165	0.386**	0.763***	0.440**	0.494***	0.508**	-0.241	0.809***	0.416***
TUR → FRA	0.050	0.495***	2.214***	1.837***	0.146	0.697***	1.854***	1.368***	0.708***
ITA → TUR	0.065	0.479***	0.201	0.663**	0.0301	0.054	-0.750***	0.600**	0.193
TUR → ITA	0.507***	-0.106	0.063	-1.082**	-0.004	0.092	1.197***	1.093***	0.363**
DEU → TUR	0.183	0.040	0.331	0.637**	0.165	0.200	-0.442**	0.895***	0.357***
TUR → DEU	0.208*	0.535***	1.158***	0.444**	0.965***	-0.023	0.781***	0.547***	0.232**
NLD → TUR	0.510***	0.447*	0.466	0.895***	0.221**	0.258	-0.069	1.085***	0.475***
TUR → NLD	-0.007	0.712***	1.347***	1.395***	0.190	-0.228	1.654***	0.852***	0.447***
DNK → TUR	0.218	-0.016	2.082***	0.001	0.232	-0.475	1.586***	0.195	0.135
TUR → DNK	0.038	1.221***	0.472	2.153***	0.459**	1.045***	1.754***	0.852***	0.843***
IRL → TUR	1.742***	2.342***	2.482***	1.896***	0.627***	0.862***	0.563	0.766***	0.741***
TUR → IRL	0.226	0.737***	1.646***	3.639***	1.045***	1.280***	2.001***	2.498***	1.561***
GBR → TUR	0.552***	0.819***	0.972***	0.193	0.235**	-0.150	0.026	0.797***	0.371***
TUR → GBR	0.094	1.008***	1.601***	2.391***	0.665***	1.100***	1.634***	1.196***	1.012***
GRC → TUR	0.588**	1.119***	3.260***	0.703**	0.301*	-0.871**	-0.323	0.801***	0.580***
TUR → GRC	0.121	2.412***	2.605***	1.231***	-0.068	0.430	1.773***	1.095***	0.940***
PRT → TUR	0.429	1.191***	1.198***	0.481	0.981***	1.112***	0.990**	1.410***	0.979***
TUR → PRT	0.149	1.715***	3.203***	3.212***	0.307	1.560***	4.814***	0.874***	1.510***
ESP → TUR	-0.019	1.801***	1.362***	0.970***	0.494***	0.800***	-0.270	1.840***	0.923***
TUR → ESP	0.693**	1.720***	4.054***	0.933***	0.707***	0.111	2.273***	1.601***	1.385***
AUT → TUR	0.605	0.180	0.437	0.102	0.182	-0.833***	-0.909***	0.540*	0.060
TUR → AUT	0.299	0.024	1.530***	1.822***	0.577*	0.157	2.215***	0.617**	0.379***
FIN → TUR	0.431	1.662***	0.0893	1.098***	0.0111	1.618***	-0.192	1.230***	0.816***
TUR → FIN	-0.284	1.738***	1.161*	1.901***	0.288	0.550***	-0.238	1.596***	1.013***
SWE → TUR	0.485*	-0.373	0.446	0.363	0.623***	-0.195	-0.0105	0.880***	0.499***
TUR → SWE	0.020	1.137***	1.212***	1.671***	1.233***	0.184	0.325	1.714***	0.916***
CYP → TUR	-0.169	-1.273***	-0.203	-2.887***	-1.900***	-2.222***	0.513	-1.193***	-0.964***
TUR → CYP	0.429**	-0.082	0.466	0.674**	0.395*	0.309	0.498*	-0.109	0.123
MLT → TUR	1.612***	0.832**		-5.592***	-0.962**		1.630***	-1.259***	-0.980***
TUR → MLT	-0.272	-0.761**	1.424***	0.841***	0.847***	-0.746**	0.596**	0.346**	0.260**
HUN → TUR	-0.078	-0.089	2.493***	-0.062	1.068**	0.998***	-2.004***	1.474***	1.090***
TUR → HUN	-0.371	0.639**	1.100***	1.541***	0.232	0.898***	1.378***	0.457***	0.402**
POL → TUR	1.312***	-0.417	2.385***	0.696***	0.664***	1.145***	0.793***	1.668***	1.179***
TUR → POL	1.121***	0.800***	2.182***	1.737***	0.217	0.705***	1.133**	0.970***	0.665***
CU-EUT TUR ↔ Non-EU	-0.121	0.589***	0.902***	0.808***	0.223**	0.813***	0.215**	0.609***	0.257***

Notes: All estimations are performed with exporter-time, importer-time, and exporter-importer fixed effects, using the PPML estimator. Additionally, *International Border* × *Period* dummies and the indicator for *All RTAs* are included, but omitted for brevity. Standard errors are multiway clustered by importer, exporter, and year and reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

is missed out when looking solely at the average CU-EUT effect. Besides the heterogeneity across partners, our results indicate that for most pairs the trade effect is larger for Turkish exports than for the exports of the respective EU partner. The large variation in CU-EUT effects both across and within pairs of members is consistent with the results in Baier, Yotov, and Zylkin (2019), who found that around two-thirds of the variation in RTA effects occurs within RTAs. Columns (1) to (8) of panel B combine the two dimensions of heterogeneity, allowing for different ex- and import effects in each sector and country pair.[13] Overall the 286 coefficients on the 2-digit level confirm the robustness of the CU-EUT effect with an average point estimate of 0.697. Two thirds of the coefficients are significantly positive (at the 10% level). At the same time, the standard deviation of 1.022 shows the substantial heterogeneity across pairs, directions, and sectors. A similar pattern emerges when re-estimating at the 3-digit level. The average of the 911 coefficients is 0.766 with again a share of two thirds of significantly positive estimates and a somewhat higher variation (standard deviation of 1.346). We will next make use of the 2-digit coefficients to graphically highlight potential underlying patterns and determinants of the heterogeneous CU-EUT trade effects.

Baier, Yotov, and Zylkin (2019) and Zylkin (2016) analyse a variety of possible determinants of heterogeneous trade effects within the same RTA. As Zylkin (2016) states, a typical perspective in ex ante studies on the effects of RTAs is to assume that heterogeneous member effects arise from differences in their ex ante tariff levels. However, for the case of NAFTA Zylkin (2016)

Poland should be interpreted with caution since these countries joined the EU in 2004 which is why the identification of their dummies rely on a single post-CU-EUT observation. To maximize the comparability between considered EU member states and reduce outliers, we will limit our sample in the following graphical analysis to countries that were already EU members at the introduction of the CU-EUT in 1996.

[13] Yalcin, Aichele, and Felbermayr (2016) use a multi-sector general equilibrium (GE) model to quantify the welfare effects of various CU-EUT scenarios. Our new set of coefficient estimates could easily be fed into such a GE framework in order to translate them into welfare effects. Given the clear predominance of strong and positive coefficients for Turkish trade flows both with EU members and outsiders, the qualitative welfare predictions are clearly positive, while the exact quantitative magnitudes would be model- and scenario-dependent.

has shown that the ex post estimates of heterogeneous trade effects are not correlated with what projections based on tariffs would have suggested. For the CU-EUT there are two reasons that make it unlikely that ex ante tariffs explain the estimated heterogeneous member effects. First, as noted above, due to the large tariff reductions determined by the *Additional Protocol* there were few remaining tariffs before the CU-EUT went into force. Second, within the EU all member countries applied the same import tariffs in 1995, while at the same time there is a large variation in the estimated CU-EUT effects for EU imports from Turkey. Figure 1 displays a scatterplot with the bilateral tariff changes between the introduction of CU-EUT and the end of our sample. If tariffs were to explain the heterogeneity in estimated coefficients, we would see a negative correlation as stronger tariff reductions should go hand in hand with higher trade effects. The graph indicates that bilateral sectoral tariff changes do a poor job in explaining heterogeneous changes in trade frictions from the CU-EUT and contribute to the overall conclusion that the effects of the CU-EUT on bilateral trade go far beyond the removal of tariffs. The plot demonstrates that the introduction of the CU-EUT did not lower all tariffs to zero. Specifically, Turkey actually increased its import tariffs in the *Food* sector.

A different source for the observed heterogeneity may be the initial level of sectoral bilateral trade costs. Similar to Baier, Yotov, and Zylkin (2019), we use the estimated asymmetric pair fixed effects from the regressions in column (1) to (8) of panel B of Table 3 as an inverse measure for bilateral trade costs. If the CU-EUT has stronger effects in sectors and for country pairs that had a high liberalization potential (i.e. a low initial openness), we expect a negative correlation between the estimated coefficients and estimated fixed effects. Figure 2 confirms this hypothesis. It further illustrates the asymmetries between Turkish ex- and imports. Turkish exports tend to face higher initial trade frictions and experience stronger increases after the introduction of the CU-EUT, while EU exports are on average more open to begin with and increase to a

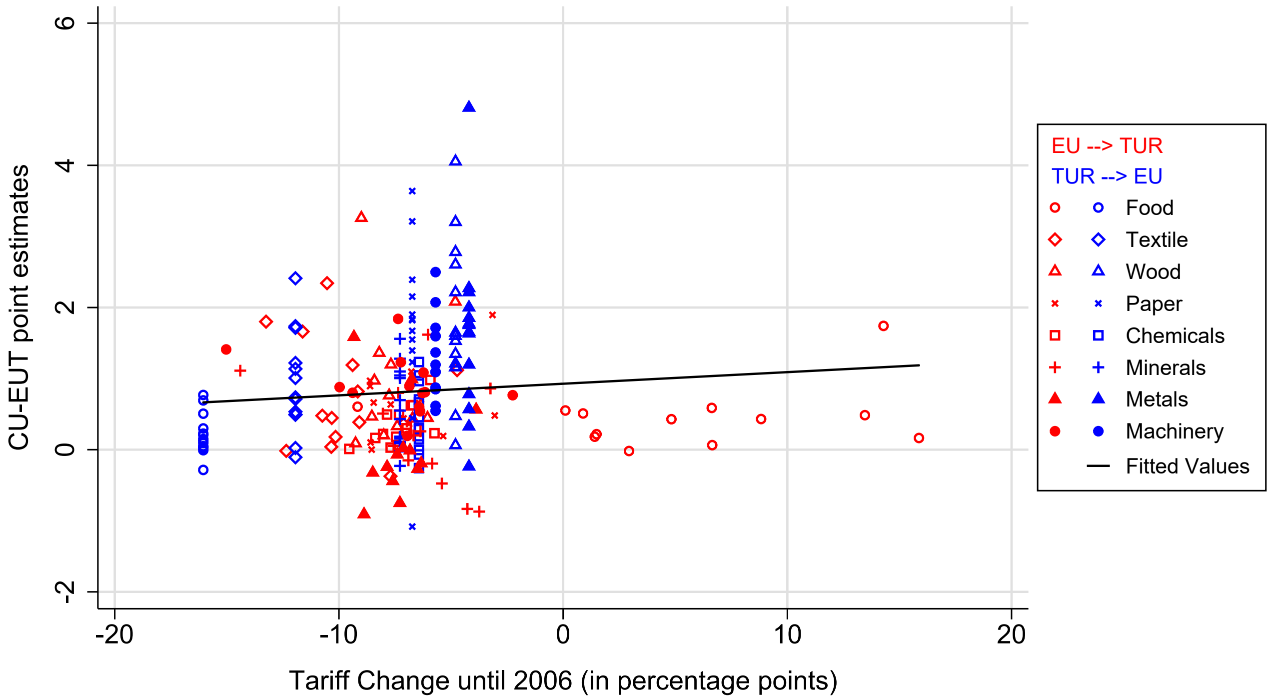

Figure 1: Tariff Changes and Heterogeneous CU-EUT Effects.

smaller extent.

Baier, Yotov, and Zylkin (2019) develop a two-stage estimation procedure to more formally analyse the effects of multiple determinants of the heterogeneous member effects of RTAs. We follow their approach and run regressions of the estimated CU-EUT coefficients on tariff reductions, bilateral trade costs, a Turkish export indicator variable, and a set of sector dummies. Table 4 displays the second stage regression results for up to almost 1001 coefficient estimates at the 2-digit and 3-digit level. In line with the graphical evidence, the important drivers of heterogeneity are initial bilateral trade costs and the direction of trade. Additionally, the regression confirms the sectoral heterogeneity. We use the *Food* sector as our base category, since the CU-EUT has liberalized trade in agricultural products to a very limited extent. Indeed, all other sectors experience (mostly significantly) stronger trade increases (conditional on tariff changes and pre-CU-EUT bilateral trade costs that also differ between sectors). Tariff cuts, in contrast, do not explain the observed differ-

Table 4: Explaining Heterogeneous CU-EUT Effects, All CU-EUT Members

Dependent variable: First-stage heterogeneous CU-EUT point estimates					
	(1)	(2)	(3)	(4)	(5)
Tariff Change	-0.002		-0.005	-0.004	-0.004
	(0.004)		(0.003)	(0.004)	(0.005)
ln(Pair FE)		-0.150***	-0.148***	-0.139***	-0.221***
		(0.037)	(0.038)	(0.038)	(0.026)
TUR $\rightarrow$ EU				0.468***	0.268***
				(0.119)	(0.091)
Sector = *Textile*				0.532***	0.501***
				(0.185)	(0.188)
Sector = *Wood*				0.941***	0.555***
				(0.181)	(0.201)
Sector = *Paper*				0.371	0.340
				(0.258)	(0.226)
Sector = *Chemicals*				0.143	0.329*
				(0.159)	(0.177)
Sector = *Minerals*				0.034	0.495**
				(0.173)	(0.198)
Sector = *Metals*				0.647***	0.572***
				(0.210)	(0.218)
Sector = *Machinery*				0.769***	0.711***
				(0.177)	(0.179)
Constant	0.687***	-0.299	-0.322	-0.921***	-1.399***
	(0.0760)	(0.214)	(0.221)	(0.272)	(0.236)
N	277	286	277	277	860
Aggregation level	2-digit	2-digit	2-digit	2-digit	3-digit

Notes: Second-stage estimations are performed using OLS. The omitted category of the industry fixed effects is the *Food* sector. The number of observations reduces from 286 (911) to 277 (860) at the 2-digit (3-digit) level because of missing tariff data. Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

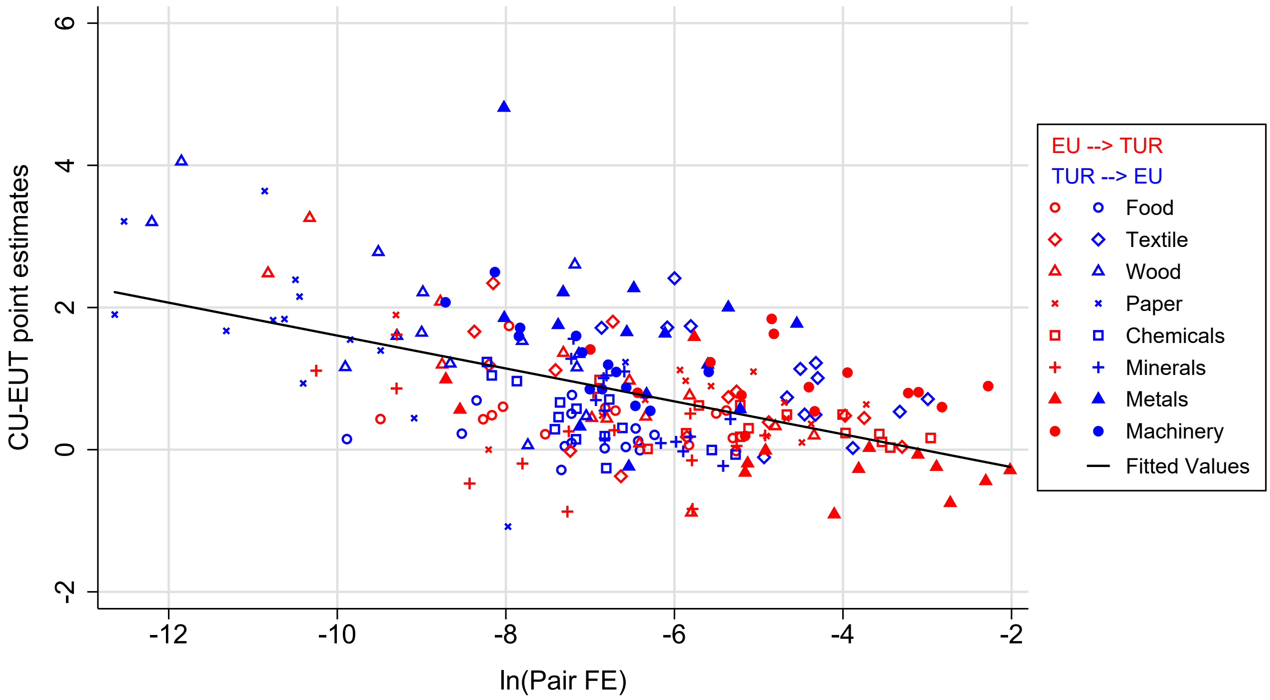

Figure 2: Bilateral Openness and Heterogeneous CU-EUT Effects.

ences in trade effects.[14]

5 Conclusion

Has the CU-EUT actually increased trade flows between the EU and Turkey? Many academic papers within the gravity literature as well as the two large-scale studies on the CU-EUT by the World Bank (2014) and by BKP, Panteia, and AESA (2016) do not find a significantly positive and economically relevant trade effect of the CU-EUT.

We provide a thorough reassessment of the CU-EUT, estimating both total and heterogeneous effects using a non-linear structural gravity specification with three-way fixed effects and intranational trade flows. We find a significant, strongly positive, and robust impact of the CU-EUT. We are also able to

[14]Regression results for the sample including only EU member countries from 1996 (as in the graphs) are given in Table A5 in the Online Appendix and are in line with the results presented here.

quantify the CU-EUT effect on trade flows between Turkey and non-EU members. Remarkably, both Turkish exports to and imports from third countries are positively affected.

The strong trade-enhancing effect is confirmed in a more disaggregated bilateral and sectoral consideration. While confirming the overall robustness, it also reveals substantial heterogeneity. In order to understand the potentially underlying driving mechanisms of these differences, we regress our 277 bilateral, directional, 2-digit industry-level coefficients and our 911 3-digit level coefficients on tariff changes, initial bilateral trade cost proxies, a trade direction indicator, and sector dummies. This second-stage analysis reveals that only tariff changes do not contribute to explaining the observed differences, suggesting that the CU-EUT effects are not driven by mere tariff cuts.

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Online Appendix for

"A Tale of (Almost) 1001 Coefficients: Deep and Heterogeneous Effects of the EU-Turkey Customs Union"

by Mario Larch, Aiko F. Schmeißer, and Joschka Wanner

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A Literature Review

The two large studies on the CU-EUT commissioned by the EU both do not find a positive effect of the CU-EUT on bilateral trade flows within an empirical gravity modelling approach. The (World Bank, 2014, pp. 93-96) uses a panel data set for bilateral trade in industrial goods between 150 countries over the period 1990-2010 and finds no significant coefficient for the dummy variable that captures the effect of the CU-EUT. In addition, when dividing the panel data set in a series of cross sections, the authors show that the impact of the CU-EUT is insignificant in every single year. In contrast, BKP, Panteia, and AESA (2016, pp. 272-275) use data of Turkey's bilateral goods trade between 1990 and 2014. Surprisingly, the authors find a significantly negative effect on two-way trade over the whole period and only when limiting the analysis to the early phase of the CU-EUT with data from 1990 to 2000 they find a positive effect. Both studies provide several explanations why their gravity models may fail to identify a positive impact of the CU-EUT. These include the large bilateral tariff reductions in EU-Turkey trade before the entry into force of the CU-EUT and the detrimental impact of macroeconomic disturbances on bilateral trade, as well as the preference erosion in the EU-Turkey trade relations which may arise from the liberalization vis-à-vis third parties by both the EU and Turkey and from other liberalization efforts among third countries (World Bank, 2014, p. 7, 94; BKP, Panteia, and AESA, 2016, pp. 10-11, 27-28). Also, other academic papers in the empirical gravity that make use of different samples and identification strategies are inconclusive about the impact of the CU-EUT on the involved parties (see Table A1). All these studies deviate from the specification discussed in our main manuscript along several dimensions.

Importantly, exporter-time and importer-time fixed effects are not included in any of the panel studies on the CU-EUT of Table A1. Antonucci and Manzocchi (2006), Neyaptı, Taşkın, and Üngör (2007), Nowak-Lehmann, Herzer, Martinez-Zarzoso, and Vollmer (2007), BKP, Panteia, and AESA (2016), Magee (2016), Mumcu Akan and Engin Balin (2016) as well as Frede and Yetkiner (2017) only use data on Turkey's bilateral trade and are therefore unable to fully control for the MRTs of Turkey's trade partners. Adam and Moutos (2008) include exporter fixed effects and importer fixed effects but do not account for the possible time variation in the MRTs in most specifications.[15] To capture the MRT terms, the empirical models of the World Bank (2014) and Frede and Yetkiner (2017) add "remoteness indexes" that are GDP-weighted averages of the distance of each country from its trade partners. However, Anderson and van Wincoop (2003) and Head and Mayer (2014, pp. 150-151) criticize that these proxy variables bear little resemblance to the theoretical structure of the MRTs and show that gravity results can differ significantly when instead estimated with a proper control for MRTs. Overall, all studies of Table A1 fail to properly account for MRTs, which makes them inconsistent with the structural gravity system given by Equations (1) to (3) of the main text and can result in an omitted variable bias, possibly leading to severe distortions in their estimates of the trade effects of the CU-EUT.

Another notable difference concerns the choice of estimator. From the studies on the CU-EUT of Table A1, BKP, Panteia, and AESA (2016) and Magee (2016) are the only contributions that use the PPML estimator. The World Bank (2014) applies the two-stage selection procedure of Helpman, Melitz, and Rubinstein (2008). In order to account for zero trade flows, first a probit estimation identifies the probability to export. Second, the gravity equation on the positive observations is estimated with OLS and a selection correc-

[15]They state for one specification (Table 1, column (III)) that they interact the time, exporter, and importer fixed effects to include bilateral, exporter-time, and importer-time fixed effects. This would be in line with our specification. However, it would not permit identification of the effects for GDPs and population, which they still report in column (III).

tion. The procedure, however, faces the challenge of finding an appropriate exclusion restriction, which is a variable that enters the first-stage equation but can be excluded from the gravity equation (Head and Mayer, 2014, pp. 178-179; Yotov, Piermartini, Monteiro, and Larch, 2016, p. 20). The World Bank (2014) uses a dummy that is 1 if countries were the same country at some point of time. Besides the generally weak exclusion restriction, the two stage-approach does not account for the heteroskedasticity issue (see Santos Silva and Tenreyro, 2015). All other studies estimate a log-linearised gravity model with OLS.

One of the heterogeneity dimensions considered in our study has already been discussed in the CU-EUT literature. Specifically, the debate about the asymmetric design of the CU-EUT regarding Turkeys' participation rights in decision making on the common commercial policy and on regulatory harmonization additionally motivates the question if the benefits of the CU-EUT in terms of its effect on bilateral trade differ for EU and Turkish exports. Such heterogeneous directional effects of the agreement are found by BKP, Panteia, and AESA (2016, pp. 274-275), who show that the CU-EUT has a significantly positive effect on Turkish exports to the EU but a negative effect on EU exports to Turkey. The authors argue that this result reflects the fact that the treaty required large tariff reductions for Turkish imports from third countries in order to align with the EU's common external tariff, which resulted in a loss of trade preferences for EU exports. In line with this reasoning, Ketenci (2017) shows empirically that the CU-EUT improved Turkey's trade balance with EU countries, but deteriorated its trade balance with non-EU OECD countries. In contrast, Neyaptı, Taşkın, and Üngör (2007), Adam and Moutos (2008), and Frede and Yetkiner (2017) find that the CU-EUT had larger positive effects for EU exports to Turkey than for Turkish exports to the EU, which may be explained by the fact that the EU had already opened its markets for Turkish exports long before the CU-EUT came into effect (World Bank, 2014, p. 7).

Table A1: Review of Gravity Studies on the Partial Trade Effects of the CU-EUT

Study	**Data**	**Estimation**	**Fixed effects**	**Controls**	**CU-EUT coefficient**
Adam and Moutos (2008)	Bilateral manufacturing trade of 24 OECD countries, 1988-2004	Log-linear	Exporter Importer Time Interactions	GDP_i, GDP_j Pop_i, Pop_j Real exchange rate	EU → Turkey: 0.501* Turkey → EU: 0.267*
Antonucci and Manzocchi (2006)	Turkey's bilateral trade with 45 countries, 1967-2001, over GDP_{Turkey}	Log-linear	Country	Sum of GDP, Size similarity Difference in GDP p.c. RTA	EU → Turkey: 0.063 Turkey → EU: 0.024
BKP, Panteia, and AESA (2016)	Turkey's bilateral trade, 1990-2014	PPML	-	GDP_i, GDP_j Distance RTA Contiguity	-0.14*
Frede and Yetkiner (2017)	Turkey's bilateral trade with 180 countries, 1960-2012	Log-linear	-	GDP_i, GDP_j Distance, Contig, Lang Trade Agreements, Region dummies Remoteness index, Other	EU → Turkey: 0.272* Turkey → EU: -0.779*
Magee (2016)	Turkey's sectoral imports (6-digit HS) from 125 countries, 1993 and 1996-2010	PPML	Country (exporter-industry) Time	GDP_i Tariff Tariff preference	0.101 (CU-EUT effect not caused by tariff reductions)
Mumcu Akan and Engin Balin (2016)	Turkey's bilateral trade with EU-15 countries, 1980-2013	Log-linear	Country	GDP_i, GDP_j Pop_i, Pop_j Distance	EU → Turkey: 0.074 Turkey → EU: -0.022
Neyapti, Taskin, and Üngör (2007)	Turkey's bilateral trade with more than 150 countries, 1980-2001	Log-linear	Country	GDP_i / GDP_j Real exchange rate	Turkish imports: 0.23* EU → Turkey: 0.23* Turkish exports: 0.58* Turkey → EU: -0.26*
Nowak-Lehmann, Herzer, Martinez -Zarzoso, and Vollmer (2007)	Turkey's exports to the EU in 16 sectors, 1988-2002	Log-linear; SUR [+ GMM] pooled OLS	Country	Sum of GDP, Difference in GDP p.c. Real effective exchange rate (captures import tariffs and subsidies) Transport costs, [AR terms]	Significant and positive in only one sector ("Other textile articles")
World Bank (2014)	Bilateral trade of 150 countries, 1990-2010	Log-linear; two-stage procedure of Helpman, Melitz, and Rubinstein (2008)	Exporter Importer Time	GDP_i, GDP_j, GDP p.c.$_i$, GDP p.c.$_j$ Distance, Contig, Lang, Colony Remoteness indexes	0.2

Notes: * denotes that the respective study finds significance at a conventional level. The studies use different computation methods for the standard errors.

B Data

The sample includes the following countries: Argentina, Australia, Austria, Belgium-Luxembourg, Bolivia, Brazil, Bulgaria, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Cyprus, Denmark, Ecuador, Egypt, Finland, France, Germany, Greece, Hong Kong (China), Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Jordan, Kenya, Kuwait, Macao (China), Malaysia, Malta, Mauritius, Malawi, Mexico, Morocco, Myanmar, the Netherlands, Nepal, Niger, Nigeria, Norway, Panama, the Philippines, Poland, Portugal, Qatar, Romania, Senegal, Singapore, South Africa, the Republic of Korea, Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uruguay, the United Kingdom, and the United States.

Table A2: Summary Statistics for the Aggregate Trade Dataset

	N	Mean	SD	Min	Max
Nominal trade (million$)	90459	3408.56	63642.19	0.00	4233436.10
if $i \neq j$	89148	825.72	5156.32	0.00	241536.93
if $i = j$	1311	179041.93	496536.96	91.26	4233436.10
CU-EUT	90459	0.00	0.06	0	1
All RTAs	90459	0.24	0.43	0	1
WTO	90459	0.17	0.38	0	1
MFN tariff	18928	0.06	0.07	0	0.45
Distance (km)	90459	7491.23	4503.10	1.88	19658.13
Contiguity	90459	0.02	0.15	0	1
Common language	90459	0.13	0.33	0	1
Colony	90459	0.02	0.15	0	1
Y (million$)	90459	470381.53	1186636.23	393.23	10039926.78
E (million$)	90459	470381.53	1190021.15	563.47	11126120.45

C Additional Results

Table A3: Robustness Tests for the Third-country CU-EUT Effect

	(1)	(2)	(3)	(4)
CU-EUT	0.487***	0.488***		
	(0.044)	(0.043)		
All RTAs	0.242**	0.242**		
	(0.114)	(0.114)		
CU-EUT: TUR ↔ Non-EU	0.219***		0.251***	0.273***
	(0.055)		(0.072)	(0.091)
CU-EUT: EU-RTA partners → TUR	0.196***	0.193***	0.197**	0.189**
	(0.073)	(0.073)	(0.091)	(0.083)
CU-EUT: Non-EU → TUR		0.234***		
		(0.057)		
CU-EUT: TUR → Non-EU		0.199***		
		(0.063)		
CU-EUT: EU → TUR			0.478***	0.566***
			(0.051)	(0.051)
CU-EUT: TUR → EU			0.490***	0.456***
			(0.063)	(0.085)
EU			0.274	0.342**
			(0.182)	(0.151)
CU			0.499	0.505*
			(0.308)	(0.300)
FTA or EIA or PS			0.151	0.194*
			(0.148)	(0.118)
WTO			0.456***	0.458***
			(0.082)	(0.091)
ln(1 + MFN tariff)				-1.755*
				(0.991)
N	33026	33026	33026	18886

Notes: All estimations are performed with exporter-time, importer-time, and country-pair fixed effects, using the PPML estimator. Additionally, *International Border* × *Period* dummies are included, but omitted for brevity. Standard errors are multiway clustered by importer, exporter, and year and reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A4: Robustness Tests

	(1)	(2)	(3)	(4)	(5)	(6)
CU-EUT	0.499***	0.476***	0.375***	0.367***	0.270***	0.175***
	(0.045)	(0.044)	(0.042)	(0.029)	(0.060)	(0.031)
CU-EUT: TUR ↔ Non-EU	0.247***	0.263***	0.207***	0.180***	-0.017	-0.037
	(0.061)	(0.043)	(0.057)	(0.067)	(0.114)	(0.078)
All RTAs	0.242**	0.255**	0.084	0.280**	0.130**	0.140**
	(0.113)	(0.104)	(0.102)	(0.115)	(0.052)	(0.066)
CU-EUT$_{t-3}$			0.126**			0.075
			(0.060)			(0.046)
All RTAs$_{t-3}$			0.180*			0.173***
			(0.096)			(0.046)
CU-EUT$_{t+3}$				0.175***		0.066
				(0.054)		(0.049)
All RTAs$_{t+3}$				0.041		0.101**
				(0.143)		(0.046)
N	33026	90212	28302	28206	33026	23495
Year interval	3-year	consecutive	3-year	3-year	3-year	3-year
3-year lag (Phase in)			x			x
3-year lead				x		x
Bilateral time trends					x	x

Notes: All estimations are performed with exporter-time, importer-time, and country-pair fixed effects, using the PPML estimator. Additionally, *International Border* × *Period* dummies are included, but omitted for brevity. Standard errors are multiway clustered by importer, exporter, and year and reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Explaining Heterogeneous CU-EUT Effects

Dependent variable: First-stage heterogeneous CU-EUT point estimates	(1)	(2)	(3)	(4)	(5)
Tariff Change	0.016		0.005	0.020**	-0.001
	(0.011)		(0.011)	(0.008)	(0.005)
ln(Pair FE)		-0.231***	-0.228***	-0.233***	-0.299***
		(0.027)	(0.028)	(0.030)	(0.026)
TUR $\rightarrow$ EU				0.238**	-0.039
				(0.105)	(0.090)
Sector = *Textile*				1.048***	0.772***
				(0.156)	(0.181)
Sector = *Wood*				0.878***	0.421**
				(0.161)	(0.179)
Sector = *Paper*				0.633***	0.411**
				(0.167)	(0.188)
Sector = *Chemicals*				0.349***	0.412***
				(0.116)	(0.154)
Sector = *Minerals*				0.157	0.449**
				(0.135)	(0.177)
Sector = *Metals*				0.845***	0.713***
				(0.216)	(0.193)
Sector = *Machinery*				1.080***	0.974***
				(0.124)	(0.152)
Constant	0.928***	-0.709***	-0.654***	-1.325***	-1.720***
	(0.106)	(0.165)	(0.197)	(0.211)	(0.226)
N	215	224	215	215	681
Aggregation level	2-digit	2-digit	2-digit	2-digit	3-digit

Notes: Second-stage estimations are performed using OLS. The omitted category of the industry fixed effects is the *Food* sector. The point estimates for Cyprus, Hungary, Malta, and Poland are excluded from the analysis. Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$