Are Preferential Trade Agreements beneficial to EU trade? Lessons from the EU-South Korea treaty

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Abstract

The paper empirically investigates the trade impact of the EU-South Korea FTA, that provisionally applied from mid-2011 and entered fully into force in December 2015. We perform an ex-post analysis of the agreement, through a structural gravity model augmented with bilateral tariffs. Previous work in this area have shown that the trade impact of the FTA on Korean exports is weak or even negative. However, they use aggregate data ignoring important factors that have driven this effect. Using disaggregated data, which allow to control for sectoral developments in the Korean economy in the electronics and shipping sectors in the last decade, we find instead that the EU–South Korea FTA has increased EU exports to South Korea significantly by about 39 percent, while its trade impact on bilateral Korean exports is almost as strong and is equal to 29 percent. At the sectoral level, the enforcement of the FTA has significantly increased both European and Korean bilateral exports in most sectors. Additionally, we account for tariffs to disentangle the effects of tariff liberalization from those stemming from the removal of non-tariff barriers. Although tariffs show a robust negative effect, our estimates at the sectoral level point to a more prominent role of non-tariff provisions in fostering bilateral trade between the EU and South Korea.

Keywords: EU-South Korea Free Trade Agreement, disaggregated gravity, tariffs, non-tariff barriers

JEL-Classification: F10; F13; F14

1. Introduction

Since the early 1990s, preferential trade agreements have proliferated around the world and their content has changed over time. The European Union (EU) is one of the main promoters of trade agreements, since in 2020 roughly a third of trade between Europe and the rest of the world took place with preferential trading partner countries (European Commission, 2021). While before the 2000s, EU's trade arrangements were more limited in scope and mostly focused on tariff reductions, from 2010 onwards, and in particular in the framework of the agreement negotiated with South Korea, the EU has embarked on a new generation of deep and comprehensive trade agreements that include a set of provisions covering several policy areas. Such provisions typically encompass measures such as mutual recognition of professional qualifications for service providers, intellectual property rights protection, investment, and competition policy, among others.

The EU-South Korea Free Trade Agreement (FTA), which was provisionally applied from 1st July 2011 and came fully into force in December 2015, is one of the EU's most important free trade agreements for several reasons.[1] First, it covers most substantive areas of the EU common external commercial competencies such as trade in goods, services and intellectual property rights. In particular, the objectives of the FTA are: the removal of tariffs and other trade barriers; to simplify paperwork and streamlines technical regulations, customs procedures, rules of origin and product testing requirements; to boost trade in services in key sectors such as telecommunications, environmental services, shipping, and financial and legal services; to improve the protection of intellectual property rights in South Korea and to recognise a large variety of geographical indications for high-quality European food products on the Korean market. Second, it is the first free trade agreement between the EU and an Asian country. Since then, the EU has signed similar agreements with Japan (2019), Singapore (2019) and Vietnam (2020), and has started negotiating also with Australia and India. Third, the EU-South Korea FTA is among the first of the EU's "new generation" free trade agreements to tackle non-tariff barriers to trade, with a specific focus on the vehicles, pharmaceuticals, medical devices and electronics sectors, as a central component.[2]

Furthermore, South Korea is an important economic partner for the EU in both trade and investment. During the 2000's South Korea had rapidly developed to become one of the key players over shipbuilding, automotive and semiconductors, and by signing the FTA with the EU South Korea has entered a new phase of trade liberalisation, namely the trade agreement with the US and the recent Regional Comprehensive Economic Partnership (RCEP), which has helped strengthen its export-oriented industrialization development strategy. The EU-South Korea FTA has brought new opportunities for firms to increase their level of integration into European and Korean supply chains,

[1] In this paper, we use the terms preferential trade agreement, free trade agreement and regional trade agreement interchangeably.

[2] See *The EU-Korea Free Trade Agreement in practice*, Luxembourg: publications office of the EU,2011,p.1.

as evidenced by the assembly lines of Hyundai and Kia motor vehicles in the Czech Republic and Slovakia, respectively.

Being considered as an important benchmark for current and future agreements to be concluded, some thorough ex-ante evaluations focusing on the potential effects of the FTA have preceded the signing of the agreement. Among these, Decreux et al. (2010), using a computable general equilibrium model, anticipated an increase in bilateral EU exports of 82 percent and a 34 percent rise in Korean exports. According to the authors, the exceptionally high estimate for the EU was mainly driven by performances in chemicals, machinery, and food sectors. Korea instead was expected to improve its trade position for specific manufactured products (textiles, other transport equipment), while a sharp increase in intra-industry trade was expected for vehicles. Interestingly, all these sectors are those featuring the higher level of protection in the period prior to the agreement, especially in terms of non-tariff barriers.

The asymmetry of the trade impact on EU exports and Korean exports was confirmed by some ex-post evaluations of the FTA provided by the Civic Consulting and the Ifo Institute (2018), Juust et al. (2020) and Jung (2022), although with much lower magnitudes. The Civic Consulting and the Ifo Institute (2018), using trade data from the World Input-Output Database[3], estimated an increase of 54 percent of EU exports to South Korea, compared to a rise of only 15 percent in trade flows moving in the opposite direction. Juust et al. (2020), using a small sample of 36 countries for the period 2011-2015, found that the FTA increased EU bilateral exports by 36 percent, compared to a decline of 16 percent in bilateral Korean exports. This latter study mainly focused on the automotive industry estimating a significant positive sectoral effect on bilateral trade of almost 100 percent. Jung (2022), using data for 186 countries for the period 1980-2016, estimated a cumulative effect of the EU-South Korea FTA on exports of EU countries to South Korea of 39 percent, while he reported a statistically not significant effect on bilateral exports of South Korea.[4] He attributed his findings to a faster trade liberalization observed in the EU on imports from South Korea than viceversa. It is also worth mentioning the contribution of Grubler and Reiter (2021), who estimated an increase in aggregate bilateral trade, based on the sum of bilateral trade flows, by 9 percent due to the EU-South Korea FTA. However, this effect turns out to be not significant when they controlled for tariffs.

In this paper we perform an in-depth evaluation of the EU-South Korea FTA using a structural gravity model, which represents the workhorse of empirical research on the effects of trade-related policies. In line with the latest techniques in the literature, we apply the Poisson pseudo maximum likelihood (PPML) estimator proposed by Santos Silva and Tenreyro (2006). Besides providing an updating assessment of the trade impact of the agreement, unlike most literature on the ex-post analysis of the

[3] See Timmer et al., 2015.

[4] Specifically, Jung (2022) considered lagged trade effects to account for a potential phasing-in period of the FTA. The trade impact of a preferential trade agreement obtained from gravity estimations abstracting from phasing-in effects can be considered as an "average" trade impact.

FTA[5], and more generally on the evaluation of trade creation effects of regional trade agreements, we explore potential sectoral developments that may have driven the aggregate effect by using disaggregated data for the period 2002-2019.[6]

While previous studies have unanimously found that the trade effect of the EU-South Korea FTA is asymmetric, with a weak or even negative impact on South Korea's exports to the EU, we instead show that the FTA has been beneficial to both parties. Specifically, after controlling for some structural changes in the Korean economy that have negatively affected its exports in the last ten years, namely the relocation of electronics companies in the Southeast Asia and the collapse of the shipping sector due to oversupply, we find that both EU and Korean exports increased significantly. Furthermore, the use of disaggregated data offers the opportunity of quantifying the potentially heterogeneous trade impact of the FTA across sectors. We show that the enforcement of the FTA has significantly increased both European and Korean exports in most sectors, with a strong impact on intra-industry trade.

Additionally, in our regressions we control for applied bilateral tariffs, to disentangle the effects of tariff liberalization from those stemming from the removal of non-tariff barriers. We find that the FTA is still effective in promoting trade significantly to both directions. Overall, our results show the relevance of non-tariff barriers removal in enhancing bilateral trade.

The remainder of the paper is organized as follows. In Section 2, we provide an overview of the evolution of tariffs in the EU and South Korea and bilateral trade statistics. In Sections 3 we describe the structural gravity model and present the data. Section 4 presents empirical results and section 5 provides our conclusions.

2. Main Trade Patterns

2.1. Trade between the EU and South Korea

The EU-South Korea FTA has had a clear impact on the volume of bilateral trade since its entry into force in 2011, especially in terms of EU[7] exports to South Korea (Figure 1). In the period 2011-2019, EU exports of goods to South Korea increased by 45 percent, from 35 billion Euro to 50 billion Euro, whereas bilateral EU imports grew at a lower rate with a 19 percent increase observed in the same period. As a result, the EU consolidated its importance as an exporter to South Korea becoming its third largest export market as of 2021. Meanwhile, South Korea has become the EU's ninth largest

[5] An exception to previous studies is represented by the Ifo Institute and Civic Consulting (2018) but they cover a short time span, namely the period from 2000 until 2014 (one year before the FTA entered fully into force).

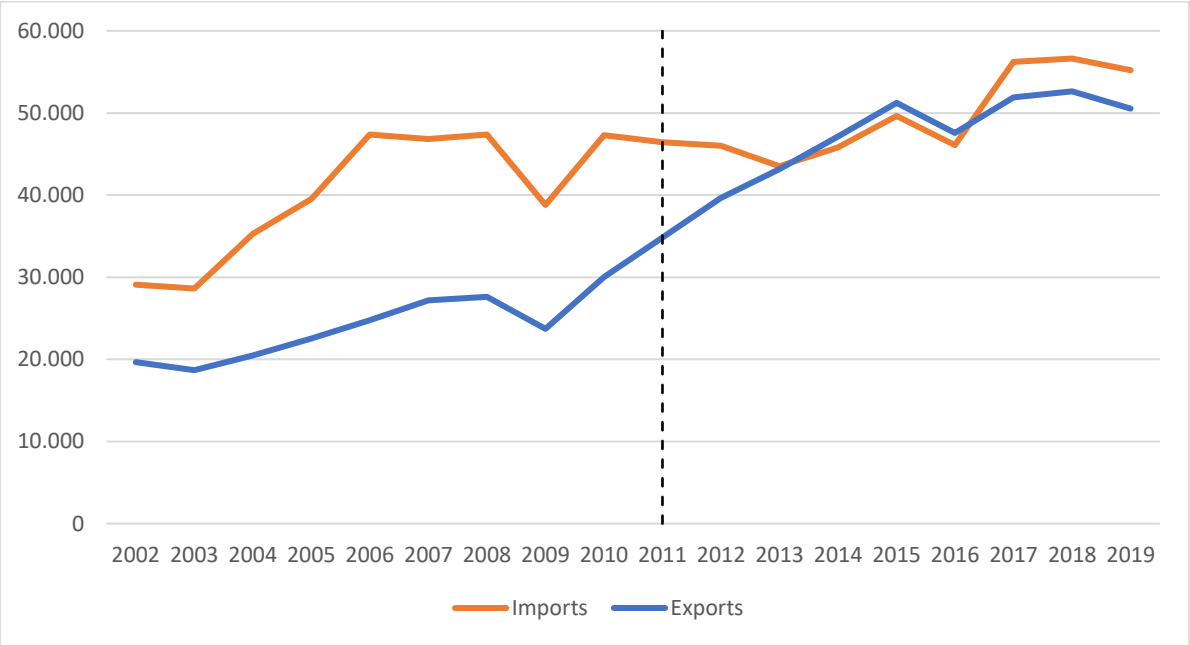
[6] In order to obtain theory motivated estimates of the impact of the FTA we use data on international (CEPII-BACI) as well as intra-national flows (ITPD-E, Borchert et al., 2021) for manufacturing goods at a detailed industry level.

[7] We refer to the EU as the EU-28, considering the United Kingdom as a Member State for the whole period covered by this article.

export destination for goods.[8] The stronger increase in EU exports than imports thus led to a gradual narrowing of the EU's trade deficit with South Korea, which was consistently negative until 2013 and is almost balanced since then.

The effect of trade-related policies is influenced by two group of drivers. The first is represented by macroeconomic and cyclical factors, such as the level of aggregate demand and supply alongside exchange rate dynamics. The second is represented by bilateral trade costs, which include both tariff and non-tariff barriers, summarized in this paper by the EU-South Korea FTA and their quantification will be assessed in the next sections. Among the macroeconomic factors affecting the difference between export and import growth rates observed in the EU and in South Korea are the slowdown of the EU's economic growth in addition to the weakening of the Euro in the 2010's against the Korean won[9], which decelerated import demand, and South Korea's high GDP growth.[10]

Figure 1: EU trade in goods with South Korea (million Euro).



Source: Authors' calculations based on CEPII-BACI.

[8] See Eurostat, https://ec.europa.eu/eurostat/statistics.

[9] The euro has weakened against the Korean won since 2009, from around 1800 Korean won per Euro to below 1300 in 2015.

[10] The decline in bilateral trade observed in 2016 has been largely due to the sharp and prolonged US dollar appreciation against the Korean won and other major currencies that took place a year before. As shown by Gopinath et al. (2019), there is empirical evidence in favor of the so called "dominant currency paradigm", according to which a country's import prices and quantities depend on the value of that country's currency relative to the dominantly invoiced currencies, which is the US dollar in most cases. In the context of the EU-South Korea FTA, Shimizu and Song (2021) show that a sizable portion of Korean imports from the EU is invoiced in US dollars.

Table 1: Evolution of bilateral import shares and tariffs.

(a) European Union imports from South Korea					
	Δ Trade %	Import shares (%)		Bilateral Tariffs (%)	
	2011-2019	2011	2019	2011 Average (MFN) tariff	2019 Average (preferential) tariff
Food, beverages and tobacco	69,3	0,8	1,1	8,5	0
Textiles,wearing apparel and related pr.	12,4	1,7	1,6	7,8	0
Wood and Furniture	77,0	0,1	0,1	2,4	0
Paper Products	23,6	0,2	0,3	0,2	0
Coke and refined petroleum products	114,9	4,3	2,9	0,3	0
Chemicals and pharmaceuticals	214,5	5,6	14,7	4,4	0
Rubber and plastics products	67,7	2,7	3,9	4,6	0
Metals, stone and glass	52,8	7,5	9,7	2,3	0
Computer, electronic and optical prod.	-26,2	28,5	17,7	2,5	0
Machinery and Electrical Equipment	114,9	11,8	21,3	1,9	0
Vehicles	76,6	14,0	20,9	5,7	0
Other transport equipment	-72,7	21,9	5,0	2,3	0
Other manufactured products	33,8	0,8	1,0	2,7	0
(b) South Korea imports from the European Union					
	Δ Trade %	Import shares (%)		Bilateral Tariffs (%)	
	2011-2019	2011	2019	2011 Average (MFN) tariff	2019 Average (preferential) tariff
Food, beverages and tobacco	78,9	5,8	7,1	39,6	17
Textiles,wearing apparel and related pr.	133,5	4,1	6,5	9,9	0
Wood and Furniture	126,0	0,7	1,1	5,6	0
Paper Products	27,3	0,8	0,7	0,4	0
Coke and refined petroleum products	1,1	2,7	2,1	4,6	0
Chemicals and pharmaceuticals	47,8	17,2	17,1	6,1	0,2
Rubber and plastics products	73,6	1,4	1,6	7,2	0
Metals, stone and glass	1,2	9,6	6,5	5,1	0
Computer, electronic and optical prod.	45,1	11,4	11,2	6,1	0
Machinery and Electrical Equipment	13,3	30,1	23,0	6,3	0
Vehicles	151,4	10,0	17,0	7,8	0
Other transport equipment	31,3	4,3	3,8	4,1	0
Other manufactured products	88,5	1,9	2,4	7,3	0

Source: Authors' calculations based on CEPII-BACI and UNCTAD-TRAINS.

2.2. Sectoral trade dynamics and tariff structure

Table 1 summarizes bilateral tariffs and import shares of the EU and South Korea for the years 2011 (the year of entry into force of the FTA) and 2019 at the sectoral level. Since 2011 the EU-South Korea FTA has eliminated tariffs on nearly all products (99 percent) in a progressive manner. Most duties (75 percent) were lifted by the entry into force of the agreement, while the remaining ones were removed by 2016. The tariff cut effect was expected to be particularly beneficial for South Korea's imports given that, prior to the agreement, Korean tariffs were higher than in the EU, averaging 7,48

percent and 1,17 percent in 2019.[11] Furthermore, the FTA addresses non-tariff barriers to trade, specifically in the automotive, pharmaceutical, medical devices and electronics sectors.

Prior to the FTA, the main manufacturing sectors in total bilateral trade between the EU and South Korea were machinery, chemicals, electronics, vehicles, and other transport equipment (mainly shipbuilding), representing over 80 percent of total bilateral trade between the two parties. In 2019, total bilateral trade between the EU and South Korea remained highly concentrated in these sectors, although some structural changes occurred in ships and electronics, which constituted by far South Korea's most important export items in 2011.

It is important to remark that, prior to the FTA, exports of computer, electronic and optical products accounted for almost 30 percent of total Korean exports to the EU. However, its export amount fell by over than 25 percent since the implementation of the FTA. In fact, in the last ten years Korean exports of mobile phones, televisions and semiconductors suffered the relocation of production to Southeast Asia, which means that South Korea has increased considerably intra-industry trade with China and Asian countries in medium and high technology products (see Table 2, panel (a)). The collapse in Korean exports of ships, which accounted for 22 percent of total Korean exports to the EU in 2011 and in 2019 fell by over than 70 percent compared to 2011, is instead due to the enormous overcapacities in the global market, as shown in Table 2, panel (b). Given that South Korea's exports to the EU are highly concentrated in these few industries, the above mentioned sectoral developments have exerted undoubtedly a very negative influence on total bilateral EU imports. On the other hand, an increase in both bilateral EU exports and imports was observed over a wide range of manufacturing sectors, with a strong rise in intra-industry trade in vehicles, chemicals, and machinery, for which tariff cut was important.

Table 2: Main sectoral developments in South Korea in the post-FTA period (million Euro).

(a) C26 - Manufacture of computer, electronic and optical products

	South Korea's exports to the EU	South Korea's imports from the EU	South Korea's exports to Asean + China	South Korea's imports from Asean + China
2011	13.209	3.822	52.860	25.424
2019	9.741	5.548	100.427	51.302

(b) C30 - Manufacture of other transport equipment

	South Korea's exports to the EU	South Korea's imports from the EU	South Korea's exports to world	South Korea's imports from world
2011	10.129	1.442	42.462	5.833
2019	2.760	1.894	19.944	7.537

Source: Authors' calculations based on CEPII-BACI.

[11] These are trade-weighted tariff averages. Data and sectoral aggregation will be discussed in the next section.

3. Methodology and Data

3.1. Structural gravity model augmented with tariffs

To quantify the changes in trade flows occurring due to the enforcement of the EU-South Korea FTA we employ a structural gravity framework. As demonstrated by Arkolakis et al. (2012), Costinot and Rodríguez-Clare (2014), and Head and Mayer (2014) a wide range of trade models can be nested in the following structural gravity equation for bilateral trade flows X_{ij} from country i to j:

$$X_{ij} = \frac{E_j Y_i}{\Omega_i \Phi_j} T_{ij} \tag{1}$$

Where E_j is country *j*'s total expenditure, Y_i is country *i*'s income and T_{ij} is a function of bilateral trade costs between exporter *i* and importer *j*. Structural gravity models impose the condition that the value of income in country i equals its total sales, including domestic sales, $Y_i = \sum_j X_{ij}$, and that expenditure in country *j* equals the sum over all imports, $E_j = \sum_i X_{ij}$, including the expenditures in *j*. Following Anderson and van Wincoop (2003), Φ_j denotes the inward multilateral resistance, along with Ω_i represents the outward multilateral resistance. These terms are related to price indices and are important to analyse the effects of an RTA between two countries on the rest of the trading system. In particular, these incorporate trade resistance factors in international trade, such as the exporter country's trade resistance toward all other destinations, the importer country's trade resistance toward all other trading partners and also bilateral trade barriers.

Another important implication of equation (1) is that trade separability implies that the structural gravity model can be derived at any level of disaggregation for which data are available (see Anderson and van Wincoop, 2004). Moreover, even for policies that are negotiated at the aggregate level, it may be desirable to also obtain sectoral effects because the impact of a regional trade agreement may be quite heterogeneous across sectors. Therefore, we use disaggregated data and we estimate the gravity equation 1) by aggregating trade flows across 13 different sectors, 2) separately for each sector.[12]

We can define the trade cost variable T_{ij} as a function of different components:

$$T_{ij} = t_{ij}^{-\theta} \left(1 + tariff_{ij}\right)^{-\theta} \tag{2}$$

Where $tariff_{ij}$ is the ad-valorem import tariff imposed by country j on goods imported from i, t_{ij} are a measure of non-tariff barriers, also called "iceberg" trade costs, and θ is the trade elasticity.[13] Following Yotov et al. (2016), the standard practice is to specify non-tariff barriers as a function of

[12] All variables in equation (1) should be understood as having superscript *k*'s to denote the sector in question.

[13] The interpretation of the trade elasticity varies across the micro-foundations of the structural gravity equation. In the Anderson and van Wincoop framework (2003), $-\theta = 1 - \sigma$, where $\sigma > 1$ is the elasticity of substitution across varieties.

bilateral distance between countries, common language, trade agreement membership, etc. Given that the objective of this paper is to obtain estimates of the effects of the EU-South Korea FTA, we also include in the trade cost vector a dummy variable, FTA^{EUKO}, which is discussed next. Taking the log of both sides of equation (1), the gravity equation becomes:

$$X_{ijt} = \exp\left[\beta_1 FTA_{ijt}^{EUKO} + \beta_2 ln\left(1 + tariff_{ijt}\right) + GRAV_{ijt}\gamma + \eta_{it} + \mu_{jt}\right] + \epsilon_{ijt} \quad (3)$$

Here, X_{ijt} denotes nominal trade flows from exporter i to importer j at time t over the period 2002-2019. An important feature of the dependent variable is that, consistent with the recent literature, it includes not only international trade flows data ($X_{ijt}, j \neq i$) but also intra-national trade flows (X_{iit}). The regressors enter equation (3) exponentially since, in order to obtain our estimates we follow Santos Silva and Tenreyro (2006), and we employ the Poisson Pseudo Maximum Likelihood (PPML) estimator. We favour the PPML estimator because of its ability to handle zeroes and to correct for a potential bias due to a large degree of heteroscedasticity in trade data. We also present our estimates using OLS in the appendix.

As described earlier, trade costs are a function of tariffs and of non-tariff barriers, with the latter defined by a dummy FTA_{ijt}^{EUKO}, which is the variable of primary interest, and by a vector $GRAV_{ijt}$.[14] FTA_{ijt}^{EUKO} takes the value of one for country-pairs consisting of South Korea and EU Member States, starting from 2012. As shown in the previous section, we observe a stronger increase in EU exports than imports. Given this unequal effect, in a second specification we allow for the effects of the EU-South Korea FTA to be directional by using the dummy variable EU_KOR_{ijt} for EU exports to Korea and KOR_EU_{ijt} for Korean exports to the European Union.

$GRAV_{ijt}$ is a vector which includes all standard time-invariant gravity covariates (for example, the log of distance, and some other bilateral control dummies as explanatory variables) as well as a time-varying trade policy covariate, RTA_{ijt}, to control for the presence of any other regional trade agreement that may have impacted trade between the countries in our sample during the period of investigation.[15] In addition, to reflect the use of intra-national trade flows, we also use an indicator variable $BORDER_{ij}$ that takes a value of one for international trade and it is equal to zero for domestic sales. This variable captures all other observable and unobservable barriers to trade, after controlling for the standard gravity covariates. Then, we replace the time-invariant bilateral gravity covariates with a full set of country-pair fixed effects which absorb unobservable time-invariant trade costs.

[14] Mattoo et al. (2017) in their study on the trade effects of new generation deep agreements account for the depth of the trade agreements, measured by the number of policy areas covered, to proxy for non-tariff barriers. They find that deep agreement lead to more trade creation than older agreements.

[15] Note that FTA_{ijt}^{EUKO} and RTA_{ijt} are coded to be mutually exclusive, that is, RTA_{ijt} is set to zero when FTA_{ijt}^{EUKO} is equal to 1.

Following Yotov et al. (2016), the proper treatment of the multilateral resistance terms in disaggregated gravity regressions is with exporter-industry-year and importer-industry-year fixed effects. Therefore, η_{it} and μ_{jt} capture the effect of multilateral resistance terms and any country-year-industry specific shocks. ϵ_{ijt} is the error term. Errors in trade gravity models are likely clustered within exporters and importers (see Egger and Tarlea, 2015).

3.2. Data

Our observations consist of 103 economies[16], 18 years from 2002 to 2019 and 13 sectors, which roughly follow the two-digit ISIC rev.4 classification system and span the manufacturing sector.[17] Data on trade flows come from the BACI (CEPII) database, which provides the bilateral value of trade by product, origin and destination at the HS6 level. BACI is based on UN-COMTRADE, but its main feature is that it reconciles Comtrade discrepancies in bilateral trade flows between CIF import values and FOB export values, so that export values and import values are identical in year *t*. We obtain tariffs data, namely the simple averages of both MFN (most favoured nation) and preferential tariff rates, for each HS6 product from the United Nations Statistical Division, Trade Analysis and Information System (UNCTAD-TRAINS). Specifically, we consider preferential tariffs if exporting and importing countries are part of a preferential trade agreement, otherwise the MFN tariffs will be used. Then we aggregate HS6-level products to the sector level to obtain bilateral trade flows and tariffs at the sectoral level.

To ensure theory consistent estimators of bilateral trade policy, not only international but intra-national trade flows are included as well. These are taken from the International Trade and Production Database for Estimation (ITPD-E), developed by the U.S. International Trade Commission, which consists of inter- and intra-national trade flows for 243 countries and 170 industries for the period between 2000 and 2016 (Borchert et al., 2021). The main advantage of this data source is that the manufacturing sector consists of 120 industries which cover products that are part of ISIC rev. 4. This allows to construct intra-national trade flows which are consistent with our sectoral classification to combine with the BACI dataset.[18] [19] Gravity controls for distance, common language, colonial ties, contiguity, and trade agreements come from CEPII (Head et al. (2010), Head and Mayer (2014)).

4. Empirical Results

4.1. Impact of the EU-South Korea FTA on bilateral trade flows

Table 3 reports the PPML estimates of the effects of the EU-South Korea FTA from the gravity equation (3) using panel data over the period 2002-2019. We start by estimating the average trade

[16] The country coverage is determined by the availability of comprehensive tariff data for the entire period.
[17] We report in Table A1 the full list of sectors and their concordances with ISIC codes.
[18] We prefer to rely on the BACI dataset for data on international trade because it covers a larger time span, as compared to the ITPD-E.
[19] We assume that missing values on a given year for a given product represent zero trade.

effect of the FTA, based on the sum of bilateral trade flows (in the first three columns), while we then allow for the trade effect to differ by the direction of the trade flow (from column (4) to (6)). As explained before, the total trade effect may be driven by strong sectoral effects in the electronics and the shipping sectors. Therefore, in columns (7) and (8) we present our results after excluding the two export categories from the sample.

Column (1) of Table 3 reports the estimates of the dummy variable of interest, FTA_{ijt}^{EUKO}, in addition to the standard gravity determinants of trade costs. First, notice that the estimates of the effects of the gravity covariates are in accordance with benchmark meta analysis gravity estimates of Head and Maier (2014) at the aggregate level as well as with findings from disaggregated gravity estimations (see Borchert et al., 2022). Specifically, we find that distance is a significant impediment to trade, the average impact of borders on international relative to internal trade is large and significant and the estimated coefficients on contiguity, common language and past colonial relationships are also positive and highly significant, as expected.

Turning the focus on our variable of interest, while the results from column (1) suggest a positive average effect of the EU-Korea FTA on bilateral member's trade, column (2), in which we control for directional country-pair fixed effects, and column (3), in which in addition to the fixed effects we also account for bilateral tariffs, show that the total trade effect of the agreement is statistically and essentially insignificant.[20] However, in order to provide an in-depth assessment of the FTA, in the next columns we perform our estimations by: 1) analysing the individual bilateral exports of the EU and South Korea; 2) accounting for the above mentioned sectoral dynamics that may have affected South Korean exports.

Splitting the effect of the EU-South Korea FTA into two directions offers more insights. Our variables of interest are now EU_KOR for European exports to South Korea and KOR_EU for Korean exports to the European Union. In column (4), which replicates the estimates in column (1), we observe the unequal impact of the EU–South Korea FTA on EU exports and Korean exports. The asymmetry of the impact of the FTA is also observed in column (5) where we address endogeneity by adding directional country-pair fixed effects, which tend to make the estimated coefficients smaller in absolute value. In particular, the FTA has increased EU exports to South Korea significantly by about $[exp(0.278) - 1] \times 100 = 32$ percent, while this specification appears to exert a negative trade effect on Korean exports, which is, however, not significant. When we account for bilateral tariffs (column (6)), which are highly significant and with the expected sign, the trade impact for EU_KOR slightly decreases, with the coefficient being statistically significant.

[20] Gravity models without bilateral country-pair fixed effects tend to overestimate the impact of trade-related policies because the countries engaging in RTAs show a preference for country pairs with historically high levels of bilateral trade flows. To address any endogeneity concerns, the standard practice is to control for directional country-pair fixed effects.

An advantage of using disaggregated data is the possibility of exploring sectoral developments that may have driven the trade effects. Therefore, in columns (7) and (8) we re-estimate the two previous specifications after dropping from the sample both the electronics and the shipping sectors.

Table 3: Estimated impacts of the EU-Korea FTA.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	trade	trade	trade	trade	trade	trade	trade	trade
BORDER	-2.217***			-2.217***				
	(0.360)			(0.360)				
CONTIGUITY	0.429***			0.429***				
	(0.117)			(0.117)				
COMLANG	0.579***			0.579***				
	(0.103)			(0.103)				
COLONY	0.636***			0.636***				
	(0.209)			(0.209)				
ln(DIST)	-0.579***			-0.579***				
	(0.122)			(0.122)				
RTA	0.450***	0.121***	0.086***	0.450***	0.118***	0.082***	0.165***	0.132***
	(0.152)	(0.020)	(0.029)	(0.152)	(0.021)	(0.030)	(0.025)	(0.032)
FTA^{EUKO}	0.261	0.079	0.008					
	(0.391)	(0.097)	(0.108)					
EU_KOR				0.603**	0.278***	0.217***	0.330***	0.275***
				(0.280)	(0.023)	(0.021)	(0.022)	(0.029)
KOR_EU				-0.058	-0.052	-0.128**	0.256***	0.183**
				(0.313)	(0.033)	(0.058)	(0.064)	(0.093)
ln(1+tariff)			-0.078***			-0.079***		-0.074**
			(0.029)			(0.029)		(0.031)
Exporter-sector-year Importer-sector-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bilateral FEs	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Observations	2429077	2429077	2292181	2429077	2429077	2292181	2252988	1963608

Notes: This table reports PPML gravity estimates of the effects of the Europe-South Korea FTA obtained using panel data from 2002 to 2019 for 103 countries. Different settings of fixed effects are used across various specifications. Coefficient estimates of the fixed effects are omitted for reasons of brevity. The standard errors are reported in parentheses and clustered by country pair. Respectively, *, **, and *** denote significance at the level of 10%, 5%, and 1%.

As already outlined in the descriptive statistics, these two industries have been particularly critical for the South Korea economy in the last ten years, for several reasons: electronics exports to EU have suffered the relocation of production from South Korea to other Asian countries, while the shipping sector has literally collapsed. In column (7) we observe that the impact of the FTA turns positive and significant to both directions of trade flows. Namely, the FTA can be associated with a 39 percent increase in EU's bilateral exports and a 29 percent increase in South Korea's exports.

When controlling for bilateral tariffs (column (8)), the trade impact for EU_KOR and KOR_EU only slightly decreases, with both coefficients being statistically significant. This finding indicates that a large part of the effects of the FTA can be explained by the removal of non-tariff barriers and by trade liberalising provisions beyond tariff cuts, regarding for example international flows of investment, labour, protection of intellectual property rights and the environment. Two other results emerge consistently from all specifications employed. First, although their role in international trade has declined in modern times, the robust negative effect of tariffs means that they are still an important barrier to trade. Second, differently from previous studies we find that the FTA has had strong trade-enhancing effects also on bilateral Korean exports, although with lower magnitude if compared to the EU exports. This confirms the idea, as already discussed, that EU exporters had more to gain in terms of decreasing protectionism.

4.2 Sector-level Gravity Estimations

Next, we turn our focus to the heterogeneous impact of the EU-South Korea FTA across sectors. Table 4 presents sectoral estimates of the trade effect of the FTA using panel data for 2002-2019. Specifically, we estimate our preferred specification with exporter-time, importer-time, and directional fixed effects for each of the 13 sectors. Then, in order to assess whether the sector-specific FTA effect, if any, is attributable to tariff liberalization or to non-tariff policies, this regression is re-estimated by additionally considering bilateral tariffs.

We find that the enforcement of the FTA has significantly increased European exports to South Korea in most sectors, with particularly strong trade-enhancing effects on vehicles, other transport equipment, textile and, although less relevant in volume, coke products. Large positive effects are found also for machinery and chemicals which, taken together, represent about 40 percent of total EU exports to South Korea in 2019. Conversely, our results do not show any significant trade effects on EU exports of electronics and food products, despite both sectors showing a substantial increase in bilateral EU exports from 2011 to 2019. Focusing on Korean exports, the most important results are the negative and highly significant estimates for trade in electronics and other transport equipment. Most sectors register positive and significant trade effects, especially chemicals and food products. By contrast, we do not find evidence of trade effects on vehicles, which were expected to bring

significant benefits to Korean exports.[21] When controlling for tariffs, our sectoral estimates point to a prominent role of non-tariff provisions in fostering bilateral trade, beyond the pure reduction of tariffs, since the latter exert a statistically significant effect only on a few sectors.

Table 4: Sectoral Gravity Estimates.

Sector	RTA	EU_KOR	KOR_EU	ln(1+tariff)	Observations
Food Products, Beverages and Tobacco	0.869***	0.458	2.004***		305398
	0.647***	0.427	1.462***	-0.358***	264680
Textiles,Wearing apparel and Related Products	0.107	0.401***	0.363***		185272
	0.092	0.343***	0.321**	-0.014	161640
Wood and Furniture	0.103*	0.252***	0.196***		177156
	0.057	0.165**	0.221***	-0.078***	154208
Paper Products	0.004	0.087***	0.450***		171770
	-0.009	0.067***	0.497***	-0.021	149648
Manufacture of coke and refined petroleum products	0.070	1.175***	0.110		151096
	0.069	1.309***	0.111	0.094	131853
Chemicals and Pharmaceuticals	0.077***	0.126***	0.730***		181962
	0.081***	0.123**	0.749***	-0.002	158813
Rubber and Plastics Products	0.090***	0.191***	-0.010		181666
	0.075***	0.159***	-0.025	-0.028	158390
Metals, stone and glass	0.252***	0.331***	0.407***		184056
	0.234**	0.290***	0.359***	-0.054	160590
Computer, Electronic and Optical Products	-0.061	-0.006	-0.552***		183606
	-0.041	0.003	-0.511***	0.040	160064
Machinery and Electrical Equipment	0.082***	0.109***	0.034**		185542
	0.080***	0.107***	0.016	-0.021	161662
Vehicles	0.156***	0.710***	0.064		176862
	0.153***	0.672***	0.048	-0.031*	153928
Other Transport Equipment (Ships and aircraft)	0.060	0.420***	-0.323***		166462
	0.079	0.440***	-0.292**	0.054	145220
Other Manufactured Products	0.144	0.012	0.038*		179942
	0.151	0.012	0.010	-0.017	156725

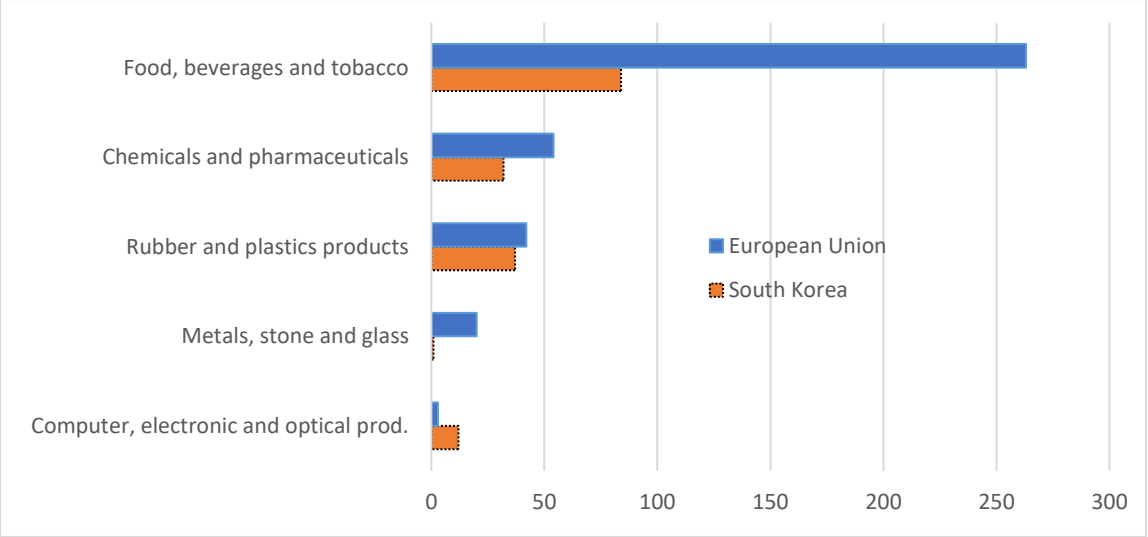
[21] See for example Decreux et al., 2010.

Notes: This table reports PPML gravity estimates of the effects of the Europe-South Korea FTA for 13 sectors. The dependent variable is nominal trade in level. All estimates are obtained with exporter-time, importer-time and bilateral country-pair fixed effects, whose estimates are omitted for brevity. We also omit for brevity the standard errors and t-statistics of the estimates. Respectively, *, **, and *** denote significance at the level of 10%, 5%, and 1%.

In fact, we find that the effect of the FTA is still significant in most sectors even when tariffs are explicitly taken into account. This is the case for chemicals, paper products, wood, textiles and metals (for both directions of trade flows), vehicles and other transports (for EU exports) and food products (for Korean exports).[22]

Tariffs play a significant role in the food sector, characterised by historically high levels of protection. However, only bilateral Korean exports benefited from the enforcement of the FTA while we do not find evidence of significant effects on EU exports, which may be due to, although declining, the still high level of tariffs imposed by South Korea in food products, hampering the EU market access. EU exports of electronic products are limited instead by the high level of technical barriers to trade applied by South Korea in this sector, such as testing and certification procedures, even during the FTA. Similarly, technical barriers to trade in addition to antidumping and sanitary and phytosanitary measures are still intensively used by the European Union in the rubber and plastics sector where South Korea registers a poor export performance (see Figure 2).

Figure 2: EU and South Korea's notifications of non-tariff measures by sector for the period 2002-2019.



Notes: Non-tariff measures include technical barriers to trade, sanitary and phytosanitary measures, anti-dumping and countervailing measures. We show the top five most affected sectors.
Source: WTO-Integrated Trade Intelligence Portal (I-TIP).

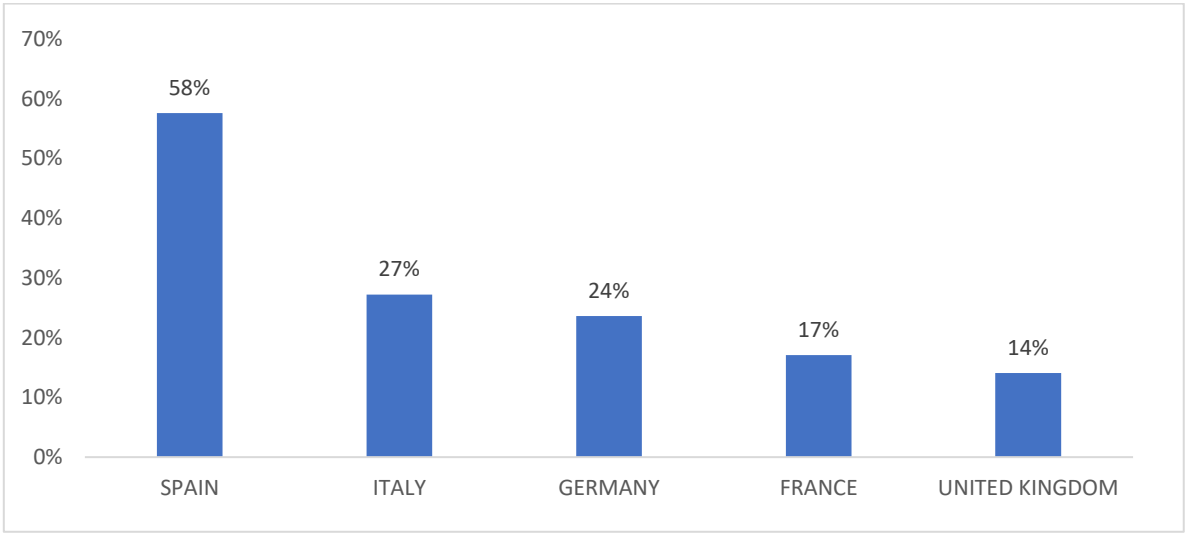
[22] Many of these findings are in line with ex-ante projections of Decreux et al. (2010), with those sectors featuring the highest ad-valorem equivalents of non-tariff barriers. The large positive estimates on EU exports of vehicles are in line with Juust et al. (2020) who attributed the positive effect of the FTA on trade in vehicles to the initially high level of non-tariff measures in the automotive sector.

4.3 Effects of the FTA on major EU countries

We also provide gravity estimations of the trade effects of the Europe-South Korea FTA for the five largest EU countries individually. Although the agreement has been negotiated by the European Union, EU Member States may experience different outcomes given their geographic characteristics, economic structure and differences in comparative advantages. We re-estimate equation (3) by additionally employing an exporter country dummy[23] which interacts with our variable of interest, FTA^{EUKO}, to obtain the effects of the FTA on exports of the main EU countries.[24] The results are depicted in Figure 3. As expected, all the largest EU Member States have registered significant export creation to South Korea due to the FTA, with Spain having larger trade-enhancing effects in percentage terms with respect to other major EU countries. Spain recorded very high export growth to South Korea between 2011 and 2019 (in 2019 over 240 percent above compared to 2011), much higher than the other largest EU countries. The gravity model predicts that the FTA is found to significantly increase the exports of Spain to South Korea by 58 percent.

To interpret correctly these results we need to take into consideration export volumes, with Germany, Italy, France and the United Kingdom starting from a much larger base than Spain (in 2019 exports of Germany to South Korea were 10 times larger than those of Spain).

Figure 3: Impact of the EU-South Korea FTA on EU exports to South Korea by country.



Notes: This figure shows the trade effect (expressed in percentage terms) of the FTA on individual Member States obtained employing Equation (3) with exporter-time, importer-time and bilateral country-pair fixed effects using panel data over the period 2002-2019. Estimates are obtained using the PPML estimator. Trade effects are statistical significant at the 1% significance level.

[23] Although in this exercise we focus on EU exports, we also employ an importer country dummy to acquire the trade-effects in terms of EU imports from South Korea. These results can be retrieved upon request to the authors.

[24] See Nguyen (2019) for a similar analysis on the trade impact of eighteen trade agreements on member countries at the aggregate level.

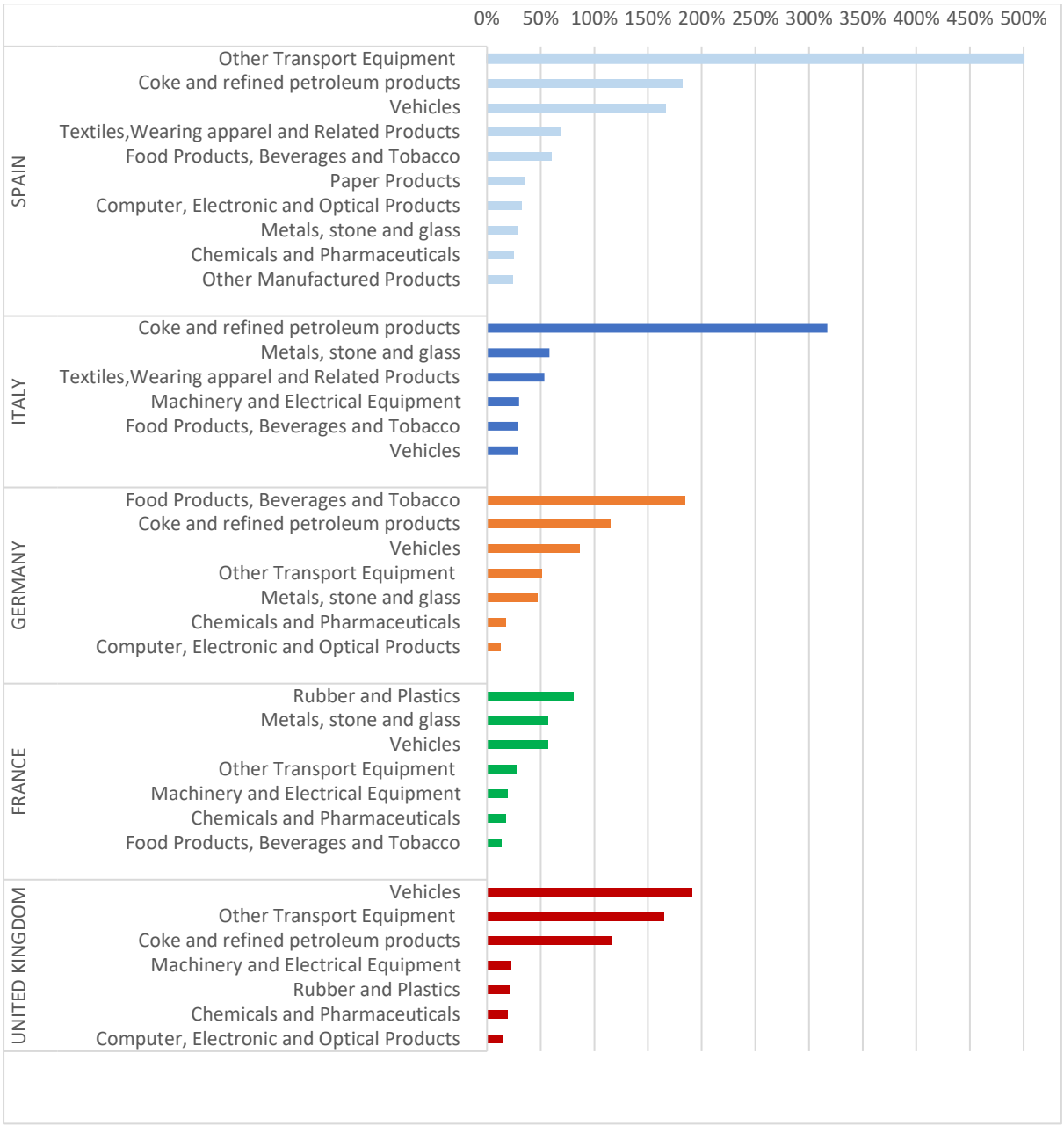
In this regard, the FTA has been particularly effective in enhancing bilateral exports of Italy and Germany. For example, Germany is by far South Korea's most important European trading partner (ranking fifth in world's exports to South Korea) with about 18 billion Euro of merchandise exports in 2019 (CEPII-BACI). Since the agreement, bilateral German exports rose by 50 percent, with a trade impact of 24 percent due to the enforcement of the FTA. Also, Italian exports rose consistently to South Korea from 2011, namely 70 percent above in 2019 compared to the base year (bilateral exports increased from 3,2 billion Euro in 2011 to 5,5 billion Euro in 2019) against a 45 percent increase in EU exports. The gravity model attributes 27 percent of this increase to the enforcement of the FTA EU-South Korea. Lower but significant trade-promoting effects are experienced by France and the United Kingdom (UK).[25]

Figure 4 presents estimates of the trade effect of the FTA on exports of the five EU countries to South Korea at the sectoral level. This exercise allows to identify the major drivers of export creation of each country individually. As expected, sectoral performances for the five economies largely reflect those found in the previous section for the European Union, as they account for just over 80 percent of the EU trade with South Korea. We find that that the most prominent trade-enhancing effects are in the transport sector, including both vehicles and other transport equipment (taken together these sectors account for over 20 percent of EU exports to South Korea in 2019). In particular, the large trade effects for Spain are driven by other transport equipment (with an estimated impact of over 400 percent), while exports of the United Kingdom to South Korea have benefited from a 200 percent trade impact in vehicles. Strong effects in these two sectors, particularly relevant in terms of levels of trade rather than in percentage, are also found for Germany, Italy and France.

Although slightly smaller, positive trade effects are estimated for the chemical and the machinery sectors, largely due to their importance in Korean imports and to strong comparative advantages of European countries in these sectors. A large impact is also found on exports of food products (almost 200 percent of export creation for Germany) and the textile sector (over 50 percent of export creation for Italy and France), two sectors characterized by a substantial increase in their share in bilateral South Korea's imports. Exceptionally large trade effects are found on coke products, with an estimated trade impact of about 500 percent for Spain's exports, but due to the size of the sector (its weight on EU exports to South Korea is less than 1 percent) this result is economically less relevant. In general, we find that sectors with positive estimates are compatible with analyses mentioned above for the European Union mainly reflecting comparative advantages of each country on a given sector.

[25] Following Brexit, the UK and South Korea agreed a continuity deal in 2019 to maintain the trading arrangements the UK previously had with the country as a member of the EU. The continuity deal is in line with the terms of the existing EU-South Korea FTA.

Figure 4: Impact of the EU-South Korea FTA on exports of individual EU Members to South Korea by sector.



Notes: This figure shows the trade effect (expressed in percentage terms) of the FTA on exports of the five EU member states at the sectoral level obtained employing Equation (3) separately for each sector and with the full set of fixed effects using panel data over the period 2002-2019. Estimates are obtained using the PPML estimator. Only estimates of the effect of the FTA that are positive and statistical significant at least at the 10% significance level are shown in this figure.

5 Conclusions

This paper evaluates the ex-post effects of the EU-South Korea FTA on bilateral trade in manufacturing goods by applying some of the most up-to-date methodological improvements in the empirical literature on trade. A consistent result which emerges from previous work is that the EU-

South Korea FTA has stimulated bilateral trade unequally, with a weak or even negative trade impact on South Korea's exports to the EU. However, these studies use aggregate trade data to evaluate the average effect of the FTA on members' trade flows, thereby ignoring sectoral developments that have driven the total effect. We instead show that, using a gravity model with disaggregated data, that the FTA has been beneficial to both parties. Specifically, after controlling for some structural changes affecting Korean exports in the electronics and shipping sectors, we find that the EU–South Korea FTA has increased EU exports to South Korea significantly by about 39 percent, while its trade impact on bilateral Korean exports is almost as strong and is equal to 29 percent. Sectoral estimates show that the enforcement of the FTA has significantly increased both European and Korean bilateral exports in most sectors.

Although tariffs show a robust negative effect, which suggests that they are still an important barrier to trade, our estimates at the sectoral level point to a more prominent role of non-tariff provisions in fostering bilateral trade between the EU and South Korea, beyond tariff cut. However, bilateral free trade is limited in some sectors by technical barriers in addition to antidumping and sanitary and phytosanitary measures which are still used by both parties. Furthermore, the last ten years have also been marked by trade disputes, namely issues over labour law standards and hygiene standards, that have in part undermined the dismantling of non-tariff barriers. The new era of next generation free trade agreements requires further integration, especially considering that the COVID 19 crisis has called for shorter supply chains, moving from global to regional value chains.

In summary, the EU-South Korea FTA has proven to be beneficial for both parties, either in terms of bilateral trade creation and investment. Our findings assume great relevance considering that the FTA is the first of a series of deep and comprehensive trade agreements negotiated by the EU in the last decade and is presented as a benchmark for EU's trade agreements with other Asian countries. Although the EU and Asia have strong ties with one another, as the EU has signed free trade agreements also with Vietnam, Singapore, Japan and more recently China, the signing of RCEP will further change the gravity of trade more towards the Asia-Pacific. The emergence of this new free trade zone should be an incentive to the EU to strengthen trade links in the region by securing new trade partnerships with other RCEP countries.

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Appendix

A1: List of sectors and Concordances

Table A1: ITDP-E industry classification and concordances with ISIC3 sectors.

Sector description	ISIC4 code	ITDP-E code
Food Products, Beverages and Tobacco	1010-1200	34-51
Textiles,Wearing apparel and Related Products	1311-1520	52-62
Wood and Furniture	1610-1629, 3100	63-67, 148
Paper Products	1701-1820	68-77
Mineral Products	1910-1920	78-80
Chemicals and Pharmaceuticals	2011-2100, 2680	81-89
Rubber and Plastics Products	2211-2220	90-92
Metals, stone and glass	2310-2599	93-108, 121
Computer, Electronic and Optical Products	2610-2670	124, 131-170
Machinery and Electrical Equipment	2710-2829	109-120, 122-123, 125-130
Vehicles	2910-2930	138-140
Other Transport Equipment	3011-3099	141-147
Other Manufactured Products	3212-3290	149-153

Notes: the manufacturing sector in the ITDP-E dataset consists of 120 industries. See Borchert et al., 2021.

A2. Robustness

In this section we offer results from two robustness experiments. Specifically, we compare our benchmark PPML estimates from Table 1 with the results from the following alternative specifications: PPML estimates with three-year interval panel data (Panel A) and OLS estimates that are obtained with the full sample (Panel B). The motivation for the first exercise is based on the fact that trade flows need time to adjust in response to trade policy changes, as suggested by Baier and Bergstrand (2007). The second robustness exercise is instead motivated by the fact that, although Santos and Silva (2006) provided conceptual arguments and empirical evidence favouring the use of the PPML estimator for the estimation of gravity models, it is useful to obtain OLS estimates for comparison.

In each panel we replicate the estimates from Table 1, namely the specifications used in the last four columns with the full set of fixed effects, accounting for tariffs and using a sub-sample after dropping the electronics and the shipping sector from the analysis. Regarding the results presented in Panel A, the gravity estimates that are obtained with 3-year intervals deliver consistent results with regard to the baseline results built on consecutive years. Thus, the effects of the FTA on bilateral trade flows are asymmetric, with a positive and significant trade effect for EU exports to South Korea and the two export categories drive the negative total trade effect of South Korea's exports to the European Union. Also, estimates from Panel A confirm that, although the coefficients of tariffs are negative and highly significant, a substantial part of the trade impact of the EU-Korea FTA is attributable to the reduction of non-tariff barriers in some specific sectors.

Panel B shows the results using the OLS estimator and logarithmized trade flows as dependent variable. Contrary to PPML, the estimated coefficient for Korean exports to the European Union is positive and significant, although considerably smaller than the coefficient for EU exports. Also, when tariffs are accounted for, all estimates become not significant. This may be due to the problem of the zero trade flows which cannot be handled by OLS and to the fact that it tends to put relatively more weight on smaller trade flows compared with PPML. However, the results are consistent with those obtained using the PPML estimator when we drop from the sample the electronics and the shipping sectors.

Table A2: Robustness checks: 3-year intervals and OLS.

	PANEL A: PPML (3-year intervals)				PANEL B: OLS fixed effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	trade	trade	trade	trade	ln(trade)	ln(trade)	ln(trade)	ln(trade)
RTA	0.146***	0.127***	0.186***	0.173***	0.051**	0.042	0.052**	0.049*
	(0.023)	(0.034)	(0.031)	(0.042)	(0.019)	(0.025)	(0.019)	(0.026)
EUKO	0.266***	0.185***	0.287***	0.213***	0.120***	0.079	0.114**	0.084
	(0.027)	(0.022)	(0.032)	(0.039)	(0.028)	(0.052)	(0.037)	(0.057)
KOEU	-0.087***	-0.156**	0.250***	0.191**	0.068*	0.076	0.123**	0.159
	(0.032)	(0.063)	(0.065)	(0.095)	(0.035)	(0.138)	(0.041)	(0.139)
ln(1+tariff)		-0.072***		-0.062**		-0.019		0.002
		(0.028)		(0.030)		(0.082)		(0.082)
Observations	874866	742177	749314	635467	1894531	1678939	1624414	1438742

Notes: This table reports PPML gravity estimates of of the effects of the Europe-South Korea FTA with 3-year interval data (in Panel A) and OLS gravity estimates with all data (in Panel B). The dependent variable in Panel A is nominal trade in levels, while the dependent variable in Panel B is the logarithm of nominal bilateral trade flows. All estimates are obtained with exporter-time-sector, importer-time-sector and bilateral country-pair fixed effects. Coefficient estimates of the fixed effects are omitted for reasons of brevity. The standard errors are reported in parentheses and clustered by country pair. Respectively, *, **, and *** denote significance at the level of 10%, 5%, and 1%.