Are Preferential Trade Agreements beneficial to EU trade? New evidence from the EU-South Korea treaty*

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Abstract

This paper empirically investigates the trade impact of the EU-South Korea FTA, that provisionally applied from mid-2011 and entered fully into force in 2015. By applying a state-of-the-art structural gravity model with intra-national trade and using disaggregated data, we quantify both the trade impact and the observed heterogeneity in the FTA estimates. Contrary to previous studies, which point to a positive effect on EU exports to South Korea and to a not significant trade impact on Korean exports, we find instead that the EU–South Korea FTA made a significantly positive and large impact on both EU and Korean bilateral exports. Namely, when controlling for sectoral developments that impacted on South Korea's economy, we show that the enforcement of the agreement has increased bilateral EU exports by 46 percent, while its trade impact on bilateral Korean exports is equal to 31 percent. We then investigate the substantial observed heterogeneity in pair-industry-specific estimates of the FTA. The main source of variation is represented by asymmetries in *ex ante* trade barriers across sectors, with a prominent role for non-tariff instruments. Stronger pre-FTA regulatory intensity is associated to a high liberalization potential, favouring larger FTA estimates. Tariffs instead do not explain the heterogeneity in the trade effects.

Keywords: EU-South Korea FTA, disaggregated gravity, heterogeneity

JEL-Classification: F10; F13; F14.

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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 (Mattoo et al., 2020).

As traditional tariff barriers are progressively reduced around the world, the European Commission is increasingly focusing the attention on non-tariff measures (NTMs), through appropriate channels such as free trade agreements or also multilateral trade rules set forth by the World Trade Organization (WTO), to facilitate transparency, mutual recognition and regulatory convergence in the context of a barrier removal strategy defined jointly with the EU Member States (ITC, 2016).[1] Although NTMs are mostly non-discriminatory regulations aimed at preserving a variety of public policy objectives such as health, safety or environmental protection, they can also raise costs and create hurdles for trade, especially when they differ across jurisdictions, have unnecessary compliance costs or simply reflect exclusively local concerns.[2]

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. First, it is among the first of the EU's "new generation" to cover most substantive areas of the EU common external commercial competencies such as trade in goods, services and intellectual property rights and to explicitly address NTMs at the sectoral level, with four sector-specific annexes regarding vehicles, electronics, chemicals, pharmaceutical products and medical devices. In addition, the FTA contains provisions on technical barriers to trade and on sanitary and phytosanitary measures, alongside simplification of the rules of origin. Second, it is the first free trade agreement between the EU and an Asian country. Since then, the EU

[1] In this paper, we use the terms preferential trade agreement (PTA), free trade agreement (FTA) and regional trade agreement (RTA) interchangeably.

[2] While tariffs are protectionist by definition, non-tariff instruments may be protectionist (by changing traded quantities and/or prices) or competitive for trade (by reducing asymmetric information and influencing the decision to import or export). However, a growing number of econometric studies suggest that NTMs restrict bilateral trade volumes substantially (Kee et al., 2009; Hoekman and Nicita, 2011; Niu et al., 2018; Grübler and Reiter, 2021), especially in country pairs with similar levels of economic development (Santeramo and Lamonaca, 2022).

has signed similar agreements with Japan (2019), Singapore (2019) and Vietnam (2020), and has started negotiating also with Australia and India.

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, 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. South 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 NTMs.

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. (2021) 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] for the period 2000-2014, 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. (2021), using a small sample of 36 countries for the period 2004-2015, found that the FTA increased EU bilateral exports by 21 percent, compared to a decline of 9 percent in bilateral Korean exports. This latter study mainly focused on the automotive industry estimating a significant and large sectoral effect exceeding total bilateral trade growth. Jung (2022), using data for 76 countries over 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

[3] See Timmer et al. (2015).

[4] Specifically, Jung (2022) considers both anticipation and lagged trade effects to account for a potential phasing-in period of the FTA in addition to the contemporaneous effect. The trade impact of a preferential trade agreement

from South Korea than viceversa. It is also worth mentioning the contribution of Grübler and Reiter (2021), who using data from UN-COMTRADE over the period 1996-2017 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 want to contribute to this debate by performing an updated assessment of the trade impact of the EU-South Korea FTA using a structural gravity framework, with theory-consistent multilateral trade resistance terms, asymmetric bilateral country-pair trade costs and intra-national trade flows. 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). Unlike most literature on the *ex post* analysis of the EU-South Korea FTA, and more generally on the evaluation of trade creation effects of regional trade agreements, we use disaggregated data at the sectoral level for the period 2002-2019, which allow to explore potential sectoral developments that may have driven the aggregate effect.[5]

While previous studies have unanimously found asymmetric directional effects of the agreement, showing that the EU-South Korea FTA has a not significant or even negative impact on South Korea's exports to the EU, our results indicate instead that the FTA made a significantly positive, large and robust impact on both directions of trade. Specifically, after controlling for some structural changes in 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 the FTA has increased EU exports to South Korea by 46 percent and Korean exports to the European Union have risen by 31 percent. Additionally, in our regressions we control for bilateral tariffs, to disentangle the effects of tariff liberalization from those stemming from the removal of non-tariff barriers.[6] We find that the FTA is still effective in promoting trade significantly to both directions.

The use of disaggregated data offers the opportunity of quantifying the potentially heterogeneous trade impact of the FTA. We show that the trade effects are strongly asymmetric across sectors and country pairs. Following the work of Baier et al. (2019), we then employ a second stage analysis in which we regress our 728 coefficient estimates on a set of covariates of interest to examine the main sources of variation. We find that the main driver of heterogeneity is represented by asymmetries in *ex ante* trade barriers across sectors, with differences in sectoral-specific pre-FTA

obtained from gravity estimations abstracting from phasing-in effects, as in our case, can be considered as an "average" trade impact.

[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] The vast majority of papers focusing on the trade effects of preferential agreements typically abstract from tariffs and simply adopt a dummy variable to compute the average trade impact. We refer to Yotov et al. (2016) for a formal derivation of the structural gravity model with tariffs, and to Mattoo et al. (2017) and Heid and Maier (2021), among others, for studies adopting a gravity framework in which tariffs are considered explicitly.

regulatory measures, proxied by NTMs, assuming particular relevance. This finding supports the idea that highly regulated sectors are associated to a high liberalization potential *ex post,* favouring larger FTA effects.[7] Another plausible explanation is that some specific rules in deeper trade agreements do have asymmetric effects on trade. For example, regulatory provisions tend to reduce the fixed costs created by NTMs and thus increase the exports of regulatory intensive sectors, with considerable benefits for small exporters (see Fernandes et al., 2021). Conversely, our results suggest that the EU-South Korea FTA effects are not driven by tariff reduction. Interestingly, we find that the direction of trade is not a significant driver of heterogeneity, clearly indicating that, aside from tariffs, the level of *ex ante* trade barriers was not significantly different across directions. 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[8] 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 export destination for goods.[9] 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

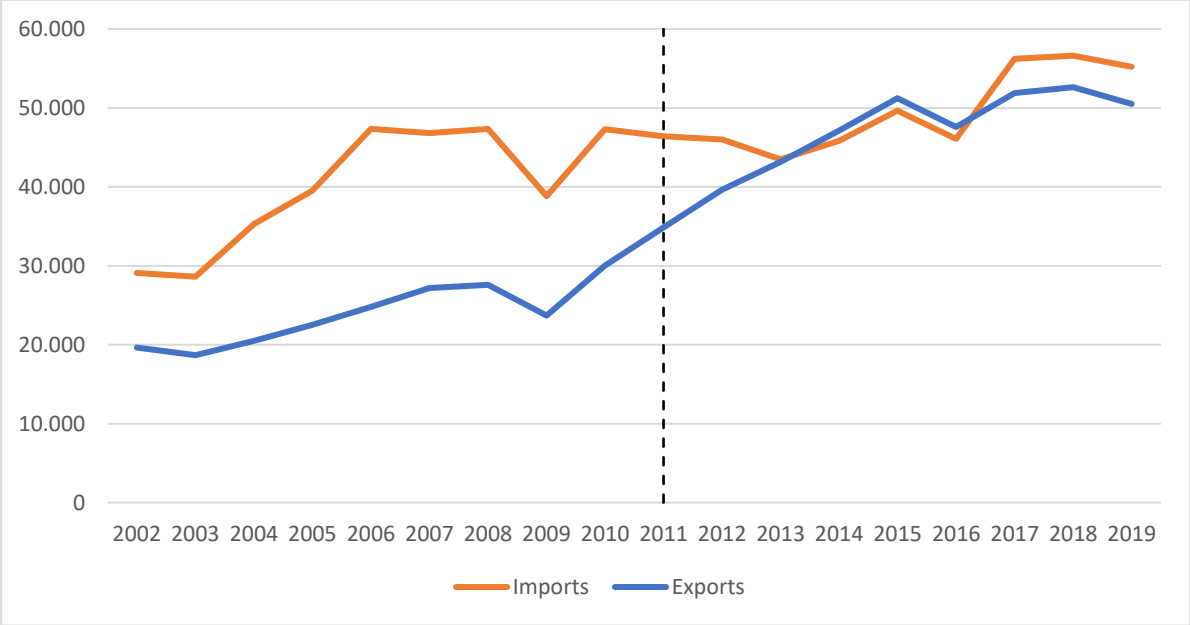
[7] This argument follows from a more general hypothesis, formalized by Baier et al. (2019), that countries with higher levels of trade frictions *ex ante* should have more potential for larger FTA partial effects *ex post*. It has also been emphasized by Larch et al. (2021) who analysed the heterogenous trade impact of the EU-Turkey Custom Union. Chen and Novy (2021) instead relate the substantial heterogeneity in trade effects of currency unions to import shares. They find that trade effects are larger for country pairs associated with smaller import shares. Among these studies, only Larch et al. (2021) consider sectoral disaggregation, as in our case.

[8] 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.

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

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[10], which decelerated import demand, and South Korea's high GDP growth.[11]

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



Source: Authors' calculations based on CEPII-BACI.

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 in 2011 and 1,17 percent in 2019.[12] Furthermore, the FTA addresses non-tariff barriers to trade, specifically in the automotive, pharmaceutical, medical devices and electronics sectors.

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

[11] 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 favour 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.

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

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	0,1	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 pr.	-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	20,9	5,7	0
Other transport equipment	-72,7	21,9	5	2,3	0
Other manufactured products	33,8	0,8	1	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	0,7	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 pr.	45,1	11,4	11,2	6,1	0
Machinery and Electrical Equipment	13,3	30,1	23	6,3	0
Vehicles	151,4	10	17	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

Notes: Tariffs are computed as simple averages across sectors based on pre-aggregated HS6-digit averages.
Source: Authors' calculations based on CEPII-BACI and UNCTAD-TRAINS.

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 (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 26 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 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.

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:

$$X_{ij} = \frac{E_j Y_i}{\Omega_i \Phi_j} T_{ij,} \quad (1)$$

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. Specifically, 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 industries. 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.[13]

We follow Heid et al. (2021) and define the trade cost variable T_{ij} as a function of two 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} is a measure of non-tariff barriers, also called "iceberg" trade costs, and θ is the trade elasticity.[14] The standard practice is to specify non-tariff barriers as a function of 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. Thus, the structural gravity model can be translated into the following empirical specification:

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

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. FTA_{ijt}^{EUKO}, the

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

[14] 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.

variable of primary interest, 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 South 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}[15], 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.[16] In addition, to reflect the use of intra-national trade flows we also use an indicator variable $BORDER_{\mathrm{ij}}$ 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 (asymmetric) country-pair fixed effects which absorb unobservable time-invariant trade costs and allow to address potential endogeneity concerns due to unobserved heterogeneity into trade policies.[17]

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, while ϵ_{ijt} is the error term.[18] Ignoring multi-way clustering in the data leads to misleading inference regarding the impact of trade-related policies (see Egger and Tarlea, 2015). Therefore, we report multiway clustered standard errors by exporter, importer and sector.[19]

3.2. Data

Our observations consist of 74 economies, 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.[20] Data on trade flows come from the BACI (CEPII) database, which provides the bilateral value of

[15] Mattoo et al. (2017) in their study on the trade effects of new generation deep agreements account also for the depth of the trade agreements, measured by the number of policy areas covered. They find that deep agreement lead to more trade creation than older and more traditional arrangements.

[16] 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.

[17] Since we allow for asymmetric effects of the agreement it is necessary to also use asymmetric bilateral country-pair effects to obtain unbiased estimates (see Baier et al., 2019).

[18] Therefore, the fixed effects also control for macroeconomic disturbances that occurred in the period after the FTA entry into force, namely the EU's prolonged economic stagnation and exchange rate dynamics.

[19] The estimations are made using *ppmlhdfe*, a Stata command for gravity estimations with high-dimensional fixed effects written by Correia et al. (2020).

[20] We report in Table A1 in Appendix A1 the full list of countries and sectors and their concordances with ISIC codes.

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 for each industry 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).[21] 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.[22] This allows to construct intra-national trade flows which are consistent with our sectoral classification and we combine them with the BACI dataset.[23] [24] 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 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

[21] We restrict the sample to 74 countries because we consider only those for which data on intra-national trade flows are available for most sectors and years.

[22] See Table A1 for the conversion tables available from Borchert et al. (2021) to translate ITPD-E codes into ISIC.

[23] We prefer to rely on BACI for data on international trade because it covers a larger time span, as compared to the ITPD-E. The drawback is that for the period 2016-2019 we only have observations on international trade flows.

[24] We assume that missing values on a given year for a given product represent zero trade.

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-South 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.[25] 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 asymmetric directional country-pair fixed effects, which tend to make the trade impact of EU_KOR smaller in absolute value. In particular, the FTA has increased EU exports to South Korea significantly by about $[exp(0.345) - 1] \times 100 = 42$ percent, while this specification appears to exert a negative trade effect on Korean exports, which is, however, not significant.[26] When we account for bilateral tariffs (column (6)), which are highly significant and with the expected sign, the trade impact for EU_KOR decreases, with the coefficient being statistically significant.

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.[27] 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, differently from previous studies, that the FTA has had strong trade-enhancing effects also on bilateral Korean exports, although with lower magnitude if compared to the EU exports.

[25] 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.

[26] This finding is in line with Jung (2022), who report a (cumulative) trade effect of 39 percent on exports of EU countries to South Korea, while the effect on EU imports is not significant.

[27] We drop 195220 observations (about 15 percent of observations in the data).

Specifically, the FTA can be associated with a 46 percent increase in EU's bilateral exports and a 31 percent increase in South Korea's exports.

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

	(1) Baseline full sample	(2) Pair FEs full sample	(3) Pair FEs+tariffs full sample	(4) Baseline full sample	(5) Pair FEs full sample	(6) Pair FEs+tariffs full sample	(7) Pair FEs subsample	(8) Pair FEs+tariffs subsample
BORDER	-2.516*** (0.091)			-2.513*** (0.091)				
CONTIGUITY	0.399*** (0.043)			0.398*** (0.043)				
COMLANG	0.474*** (0.046)			0.474*** (0.046)				
COLONY	0.321*** (0.112)			0.321*** (0.112)				
ln(DIST)	-0.655*** (0.028)			-0.656*** (0.028)				
RTA	0.405*** (0.040)	0.224*** (0.024)	0.186*** (0.030)	0.404*** (0.040)	0.223*** (0.024)	0.186*** (0.030)	0.286*** (0.025)	0.248*** (0.033)
FTA^{EUKO}	0.233** (0.109)	0.090 (0.070)	0.056 (0.067)					
EU_KOR				0.624*** (0.148)	0.345*** (0.071)	0.259*** (0.068)	0.390*** (0.080)	0.307*** (0.075)
KOR_EU				-0.036 (0.143)	-0.107 (0.113)	-0.089 (0.097)	0.277*** (0.073)	0.272*** (0.071)
ln(1+tariff)			-0.058** (0.026)			-0.056** (0.026)		-0.058** (0.028)
Exp-industry-year FEs	X	X	X	X	X	X	X	X
Imp-industry-year FEs		X	X		X	X	X	X
Pair FEs								
Observations	1268930	1248549	1136191	1268930	1248549	1136961	1057189	962723

Notes: This table reports PPML gravity estimates of the effects of the EU-South Korea FTA obtained using panel data from 2002 to 2019 for 74 countries. The dependent variable is nominal trade in level. 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%.

We also find that the EU-South Korea FTA was more successful in promoting trade than other RTAs, which on average increased bilateral trade by 33 percent. These results are robust to the inclusion of tariffs (column (8)), as the trade impact for EU_KOR and KOR_EU only slightly decreases, with both coefficients being statistically significant. This finding also suggests that a large part of the effects of the EU-South Korea FTA can be explained by the removal of non-tariff barriers and by trade liberalising provisions beyond tariff cuts. One additional result which emerges consistently from all specifications employed is that, although their role in international trade has declined in

modern times, the robust negative effect of tariffs means that they are still an important trade barrier.

We investigate the robustness of the positive FTA effect on both EU and Korean bilateral exports by additionally considering specifications with three-year interval panel data and with three-year leads and lags of the EU-South Korea FTA. Our robustness exercise, shown in Table A3 in Appendix A3, strongly confirms the large trade impact observed for both EU_KOR and KOR_EU.[28]

4.2. Gravity Estimations across Sectors and Members

Our next task is to demonstrate whether our results mask heterogeneity in the trade effects of the EU-South Korea FTA across sectors and country pairs. Table 4 presents sectoral estimates of the trade effect of the agreement. Specifically, we estimate our preferred specification with exporter-time, importer-time, and directional asymmetric fixed effects for each of the 13 manufacturing industries. Then, 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 Machinery, Vehicles, Other Transport, Metals and, although less relevant in volume, Textile and Coke. Conversely, our results do not show any significant trade effects on EU exports of Chemicals and Electronics, which represent about 40 percent of total EU exports to South Korea in 2019.[29]

Focusing on Korean exports, the most important results are the negative and highly significant estimates for trade in Electronics and Other Transport. However, most sectors register positive and significant trade effects, especially Chemicals and Food. By contrast, we do not find evidence of trade effects on Vehicles, which were expected to bring significant benefits to Korean exports.[30] When controlling for tariffs, despite their declining role, they exert a statistically significant effect on many sectors. Overall, our sectoral estimates point to a prominent role of non-tariff provisions in fostering bilateral trade, beyond the pure reduction of tariffs, since we find that the effect of the FTA is still significant in most industries even when tariffs are explicitly taken into account. This is the case for Paper and Wood (for both directions of trade flows), Machinery, Vehicles and Other Transport (for EU exports), Chemicals and Food (for Korean exports).[31]

[28] The not significant coefficient of Korean exports in column (4) of Panel B is more than offset by a rather strong lagged effect. Substantial anticipation effects are found on EU exports instead.

[29] This finding is in contrast with the Civic Consulting and the Ifo Institute (2018) who found statistically significant effect of the EU-South Korea FTA in these sectors after the first three years of the agreement.

[30] See for example Decreux et al. (2010).

[31] The large positive estimates on EU exports of vehicles are in line with Juust et al. (2021) 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.

Figure A1 in Appendix A3 provides more intuition on some of the patterns emerging from our estimations and on the relevance of non-tariff instruments. Specifically, Figure A1 presents, for both the European Union and South Korea, the sectors with the highest number of NTM notifications to the WTO during the period 2002–2019, which we use as a proxy for observed NTMs.[32]

Table 4: Sectoral Gravity Estimates.

Sector	RTA	EU_KOR	KOR_EU	ln(1+tariff)	Observations
Food, beverages and tobacco	0.153***	0.065	0.348***		96859
	0.063	0.008	0.254**	-0.069***	88287
Textiles, wearing apparel and related products	0.207***	0.393***	0.335**		97399
	0.158**	0.284**	0.256	-0.040	88750
Wood and Furniture	0.106	0.275***	0.202***		96282
	0.040	0.172**	0.168*	-0.078***	87607
Paper Products	0.024	0.071***	0.537***		95329
	-0.032	0.017***	0.558***	-0.062***	86702
Coke and refined petroleum products	0.178*	1.498***	0.402**		89312
	0.167	1.633***	0.410**	0.064	81146
Chemicals and pharmaceuticals	0.124***	0.065	0.722***		97229
	0.072**	-0.005	0.669***	-0.044	88580
Rubber and plastics products	0.265***	0.396***	0.212		97089
	0.185***	0.219	0.109	-0.101***	88469
Metals, stone and glass	0.294***	0.210***	0.236**		97430
	0.225**	0.062	0.118	-0.119***	88810
Computer, electronic and optical products	-0.053	-0.226	-0.679***		97167
	-0.071	-0.263*	-0.705***	-0.016	88619
Machinery and Electrical Equipment	0.156***	0.108***	0.036		97520
	0.138***	0.083**	0.002	-0.028	88879
Vehicles	0.239***	0.768***	0.049		96008
	0.192**	0.646***	-0.024	-0.074***	87373
Other transport equipment	0.140*	0.447***	-0.257**		94193
	0.129	0.486***	-0.221*	0.023	85619
Other manufactured products	0.192**	-0.057***	-0.039***		96732
	0.157*	-0.141*	-0.110***	-0.073**	88120

Notes: This table reports PPML gravity estimates of the effects of the EU-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%.

According to the WTO I-TIP database, both the European Union and South Korea are among the heaviest users of these standard-like NTMs although the regulatory intensity has decreased in the post FTA period. Protection from NTMs is shown to be consistently high in the European Union within the Food and the Chemicals sectors, whereas the Electronics and Machinery sectors are

[32] Data on NTMs are from the WTO-ITIP database.

highly regulated in South Korea. Most importantly, we notice that most of the positive and significant directional industry-specific FTA effects are observed across sectors with the highest level of NTMs *ex ante*.[33] That is, sectors subject to a strong regulatory intensity appear to have experienced stronger trade effects after the introduction of the EU-South Korea FTA. This is consistent with the idea, as pointed out by Baier et al. (2019), that pairs of countries with higher levels of trade frictions before the signing of their agreement should have more potential for larger FTA effects *ex post.*[34]

In Table A4 in Appendix A3 we further exploit the heterogeneity in the effects of the EU-South Korea FTA along all potential dimensions. Specifically, we estimate our preferred specification for each sector and for each EU member's exports and imports with a full set of fixed effects. As expected, for aggregate manufacturing trade the results show a strong asymmetric FTA impact within pairs and across directions, confirming again the general pattern suggested by Table 3. We find that for almost all country pairs the EU-South Korea FTA has significantly increased European exports, with particularly strong effects for Cyprus, Estonia and Greece. At the same time, the trade impact of the FTA turns negative or not significant when considering EU imports from South Korea (with Czech Republic, Slovenia and Luxembourg as the only exceptions).[35] Again, this result largely reflects the weak performance registered by EU imports in both the Electronics and Other Transport sectors. Besides the substantial heterogeneity across sectors and member pairs, our findings also suggest that countries that have recently joined the European Union experience a more prominent impact on trade from the FTA.[36]

Overall, the large number of 728 sets of disaggregated gravity estimates from Table A4 confirm our previous intuition and point to substantial heterogeneous effects of the FTA on trade flows that are worth investigating further.

4.3. Analysing FTA Heterogeneity

Following Baier et al. (2019), we capitalize on the rich set of FTA estimates we have constructed to analyse the determinants of heterogeneity. The key prediction from the previous section is that the trade effects of the EU-South Korea FTA on bilateral trade go far beyond the simple elimination of tariffs suggesting instead a prominent role for non-tariff barriers. We now further investigate this claim by applying a "second stage" analysis, which takes our 728 coefficient estimates from the

[33] This is the case for EU exports of Machinery and Korean exports of Chemicals and Food, among others.

[34] These findings are also in line with ex-ante projections of Decreux et al. (2010), who found that many of these sectors featured the highest (ex-ante) ad-valorem equivalents of non-tariff barriers.

[35] The high estimate found for Czech Republic is essentially driven by strong intra-industry trade with South Korea in the automotive industry. Indeed, both Hyundai and Kia have produced motor vehicles in the Czech Republic and Slovak Republic, since 2007 and 2008, respectively.

[36] Kehoe and Ruhl (2013) demonstrate that country pairs that trade a limited number of products prior to the FTA are associated with higher trade growth thereafter.

previous section as the dependent variable and regress them on some covariates of interest.[37] We estimate:

$$\beta_{ij,k} = \alpha_0 + \alpha_1 Tariff\Delta_{jk} + \alpha_2 ln(1\ stage\ Pair\ FEs)_{ijk} + \alpha_3 ln(1 + NTM)_{jk} + v_{ijk} \qquad (4)$$

Among the possible determinants of heterogeneity in the FTA effects we consider bilateral sectoral tariff changes ($Tariff\ \Delta$) from 2011 to 2019. As largely discussed, we do expect the tariff effect to be weak or not significant, although tariff reduction is normally associated with high FTA coefficients. Typically, differences in the level of trade barriers between country pairs and sectors *ex ante* are captured by the estimated pair fixed effects. Therefore, we include in the analysis the estimated asymmetric pair fixed effects of our first stage analysis in Table A4, which constitute an inverse measure of the initial level of sectoral bilateral trade costs. Since pairs with lower pair fixed effects reflect higher *ex ante* bilateral trade frictions, we expect a negative correlation between the estimated fixed effects and our FTA point estimates.

While the first stage pair fixed effect term provides an inclusive measure of trade costs, as it controls for all observable and unobservable barriers that could potentially hamper trade between pairs prior to the agreement, to offer a detailed account of the role of non-tariff barriers to trade in explaining the heterogeneity in our FTA estimates, we introduce a measure of regulatory intensity. Specifically, we follow Murina and Nicita (2017) and use the (logarithmic) stock of accumulated number of NTMs notified by the importing country against the exports, before the signing of the agreement.[38] Because this variable captures the regulatory intensity applied on a specific industry *ex ante*, to the extent that large values reflect a high liberalization potential *ex post*, we expect the NTM effect to be positively correlated with the estimated FTA coefficients.

Our key findings are presented in Table 5.[39] The results in column (1) confirm that tariff cuts do not explain the observed differences in the EU-South Korea FTA. Conversely, in column (2) the significant and negative coefficient on the first stage pair fixed effects indicates that the EU-South Korea FTA has stronger effects in sectors and for country pairs with larger *ex ante* trade frictions. In column (3) the pre-FTA regulatory intensity level seems to play no role in explaining heterogeneity in the FTA estimates. Instead, in column (4) when the issues related to sector-specific regulatory intensity are controlled for by employing industry fixed effects, we find that the coefficient enters with the expected sign and is strongly statistically significant. This result is robust to the inclusion of the covariates of interest in the analysis in column (5) and of a full set of fixed effects in column

[37] Larch et al. (2021) explore a similar idea in their study on the trade effects of the EU-Turkey Custom Union.

[38] First, notice that given the limited data available on NTMs, these are defined multilaterally, namely the same barrier is applied by a country on its imports. Although non-tariff barriers are applied to all trading partners, they generate heterogeneous effects since the sectoral composition of bilateral trade differs within pairs. Second, most of the applications use an NTM dummy indicator, while we follow the more recent literature by using the number of measures accumulated over years instead. See also Ghodsi and Stehrer (2022).

[39] To account for the unobservable error from previous analysis that enters our second stage methodology we use OLS with robust standard errors.

(6), although the statistical significance of *ln (1 stage Pair FEs)* disappears.[40] This finding suggests a stronger role for *ex ante* NTM measures in capturing the variation in ex post estimates of the EU-South Korea FTA rather than the inclusive measure of pre-FTA trade frictions. Highly regulated sectors are associated to a high liberalization potential *ex post* through a substantial simplification of NTM requirements, favouring larger FTA effects.

Table 5: The determinants of heterogeneity in the FTA estimates.

	Dependent variable: First-stage heterogenous EU-South Korea FTA point estimates					
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff Δ	0.005				-0.006	-0.005
	(0.009)				(0.022)	(0.021)
ln (1 st. Pair FEs)		-0.046**			-0.019	-0.015
		(0.018)			(0.032)	(0.039)
ln(1+NTM)			0.036	0.320***	0.272**	0.275**
			(0.038)	(0.106)	(0.117)	(0.117)
EU_KOR					0.060	
					(0.116)	
Constant	0.201***	-0.025	0.081	-0.661**	-0.679*	-0.636*
	(0.074)	(0.088)	(0.118)	(0.271)	(0.354)	(0.381)
Observations	728	728	728	728	728	728
Country-pair FEs	X	X	X			X
Industry FEs				X	X	X

Notes: This table reports OLS estimates of the second stage analysis using robust standard errors. The dependent variable is the pair-sector-specific EU-South Korea FTA trade effect which we have estimated in Table A4. All specifications include country-pair fixed effects, while in columns 4, 5 and 6 we also include industry-specific fixed effects. Respectively, *, **, and *** denote significance at the level of 10%, 5%, and 1%.

Finally, we add our EU_KOR dummy in the analysis to test whether asymmetries between EU exports and imports might help to explain the observed heterogeneity in the FTA estimates. To properly control for sectoral developments that impacted on Korean exports, we run this specification with industry fixed effects (column (5)). We find that the direction of trade is not a significant driver of heterogeneity. This finding indicates that, aside from tariffs, the level of *ex ante* trade barriers was not significantly different in the two directions of trade.

[40] In the specification used in column (6) we obtain an R^2 of 0.21, a significant but modest amount of the overall heterogeneity in the EU-South Korea FTA effects. Among the other possible determinants of the asymmetries in FTA effects across pairs, Baier et al. (2019) investigate the extensive margin of trade, a terms of trade index, economic size and institutional quality. However, they also find a substantial remaining unexplained variation.

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 not significant 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, using a state-of-the-art gravity model with disaggregated data at the sectoral level, that the FTA made a significantly positive and large impact on both EU and Korean bilateral exports. 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 Korean exports to the European Union significantly by about 31 percent, while its trade impact on bilateral EU exports is equal to 46 percent. The significant trade-promoting effect observed on both directions of trade is confirmed by both industry and pair-specific estimates.

Our disaggregated estimates also show that the trade effect of the EU-South Korea FTA is strongly heterogeneous across country pairs and sectors. We then employ a second stage analysis to examine the main sources of variation in these trade effects. We find that the main driver of heterogeneity is represented by asymmetries in *ex ante* trade barriers across sectors, with a prominent role for non-tariff instruments. Highly regulated sectors appear to be associated to a large liberalization potential *ex post* and, consequently, to a substantial simplification of NTM requirements, favouring larger FTA effects. On the contrary, our results suggest that the EU-South Korea FTA effects are not driven by tariff reduction. These findings provide a solid argument in favour of recently concluded trade agreements in fostering bilateral trade by pursuing a faster and deeper liberalization than older agreements.

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, in terms of bilateral trade creation. 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 and Japan, 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 countries and sectors

The sample includes the following countries: Argentina, Australia, Austria, Bangladesh, Belgium, Bolivia, Bosnia ed Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Cyprus, the Czech Republic, Denmark, Ecuador, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kuwait, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Morocco, Myanmar, the Netherlands, New Zealand, Nigeria, North Macedonia, Norway, Oman, Peru, the Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Trinidad and Tobago, Turkey, Ukraine, Uruguay, the United Kingdom, and the United States.

Table A1: ITDP-E industry classification and concordances with ISIC rev.4 sectors.

Sector description	ISIC4 code	ITPD-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, p. 39).
Source: Authors' calculations based on Borchert et al. (2021).

Appendix A2: Descriptive statistics

Table A2: Summary statistics.

	N	Mean	SD	Min	Max
Nominal trade at the sectoral level (million $)	1268930	334,83	8800,61	0,00	2420307,00
if i ≠ j	1256476	150,35	1221,37	0,00	187628,40
if i = j	12454	18496,77	85974,69	0,00	2420307,00
FTA^{EUKO}	1268930	0,01	0,07	0	1
EU_KOR	1268930	0,00	0,05	0	1
KOR_EU	1268930	0,00	0,05	0	1
RTA	1268930	0,36	0,48	0	1
Tariff (%)	1157806	5,06	7,10	0	113,16
Common language	1268930	0,09	0,29	0	1
Colony	1268930	0,03	0,18	0	1
Contiguity	1268930	0,03	0,18	0	1
Distance (km)	1268930	6776,35	4790,02	8,45	19650,13

Notes: This table reports the summary statistics for the full sample. According to UNCTAD-TRAINS, simple averages of most-favoured nation tariffs employed by Egypt in the food sector in 2003 amounted to 113,16%.

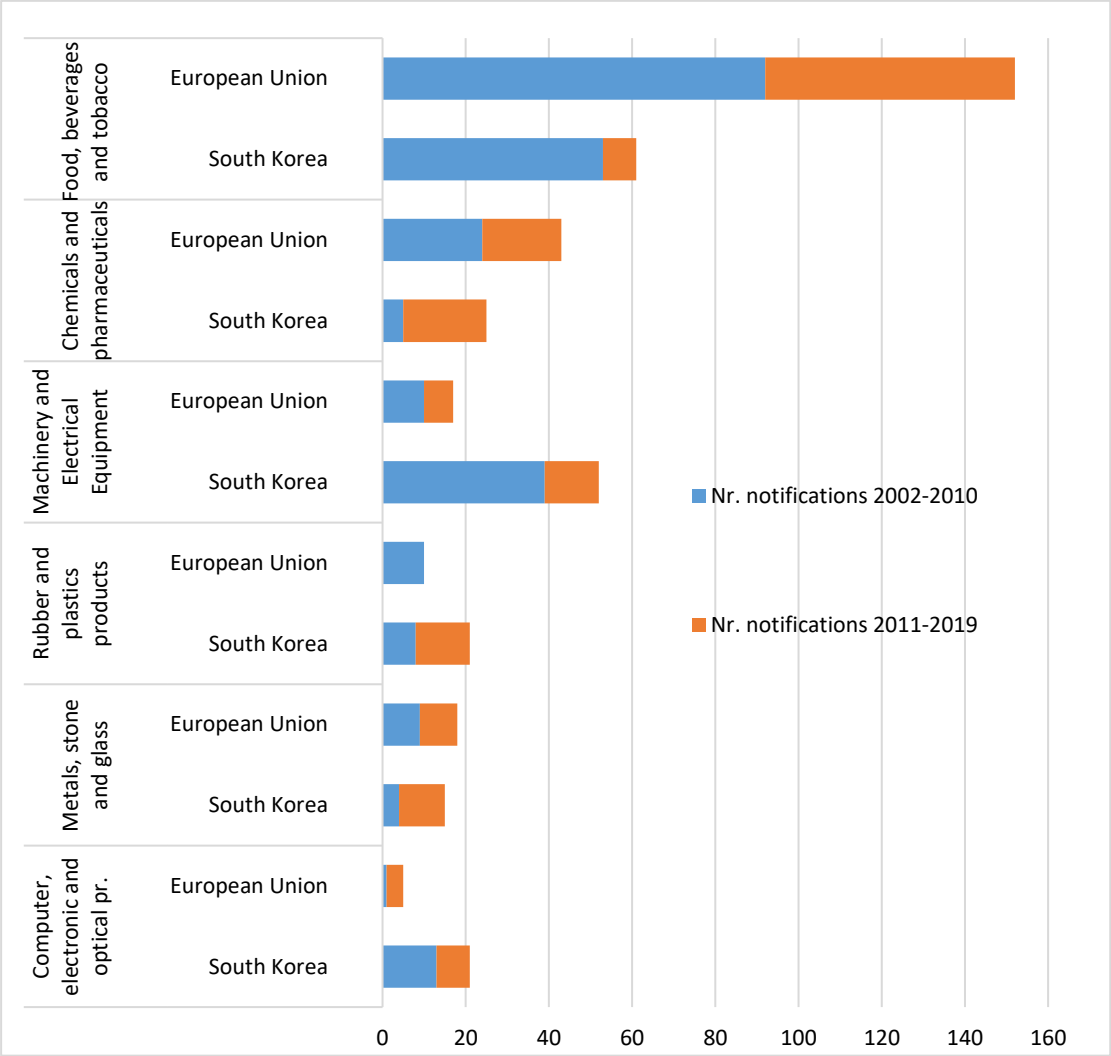
Appendix A3: Additional results

Table A3: Robustness checks: 3-year intervals, anticipation and lagged effects.

	PANEL A: 3-year interval				PANEL B: Anticipation and lagged effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	full sample	tariffs full sample	subsample	tariffs subsample	full sample	tariffs full sample	subsample	tariffs subsample
RTA	0.201***	0.124***	0.255***	0.164***	0.064***	0.029	0.106***	0.066***
	(0.023)	(0.025)	(0.022)	(0.024)	(0.021)	(0.023)	(0.019)	(0.020)
EU_KOR	0.194***	0.129**	0.242***	0.165**	0.100*	0.058	0.155***	0.107**
	(0.058)	(0.062)	(0.064)	(0.068)	(0.059)	(0.057)	(0.054)	(0.053)
KOR_EU	-0.090	-0.169*	0.233***	0.141*	-0.192**	-0.261***	0.094*	0.019
	(0.088)	(0.090)	(0.074)	(0.079)	(0.093)	(0.099)	(0.056)	(0.056)
RTA_{t+3}					0.068***	0.072***	0.081***	0.089***
					(0.009)	(0.010)	(0.010)	(0.010)
EU_KOR_{t+3}					0.156***	0.132***	0.153***	0.125***
					(0.034)	(0.036)	(0.036)	(0.038)
KOR_EU_{t+3}					0.093*	0.095*	-0.025	-0.011
					(0.054)	(0.054)	(0.048)	(0.049)
RTA_{t-3}					0.143***	0.130***	0.171***	0.158***
					(0.011)	(0.011)	(0.011)	(0.011)
EU_KOR_{t-3}					0.083*	0.061	0.083**	0.062
					(0.043)	(0.043)	(0.041)	(0.042)
KOR_EU_{t-3}					0.081	0.106	0.196***	0.217***
					(0.065)	(0.068)	(0.040)	(0.043)
ln(1+tariff)		-0.074***		-0.089***		-0.043***		-0.050***
		(0.013)		(0.014)		(0.008)		(0.007)
Observations	477499	429018	404627	363595	1248549	1136961	1057189	962723

Notes: This table reports PPML estimates of the effects of the EU-South Korea FTA with 3-year interval data (in Panel A) and PPML estimates with all data adding three-year lags and leads of the policy variables (in Panel B). The dependent variable is nominal trade in levels. In each panel we replicate the estimates from columns (5), (6), (7) and (8) in Table 1, namely the specifications 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. 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%.

Figure A1: EU and South Korea's notifications of NTMs 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 most regulated sectors during the period 2002-2019.
Source: Authors' calculations based on WTO-Integrated Trade Intelligence Portal (I-TIP) database.

Table A4: Heterogeneity across Members and Sectors.

	(1) Food	(2) Textile	(3) Chemicals	(4) Metals	(5) Electronics	(6) Machinery	(7) Vehicles	(8) Other transport	(9) Aggregate
ITA → KOR	0.256***	0.432**	-0.256**	0.276**	-0.578***	0.262***	0.319***	0.019	0.207**
KOR → ITA	-0.004	0.671***	0.662***	0.395**	-1.403***	-0.165***	-0.261***	-0.335***	-0.157
FRA → KOR	0.041	0.440**	0.113	0.344***	-0.422***	0.195***	0.895***	0.759***	0.238**
KOR → FRA	1.153***	0.292*	0.697***	0.211	-0.793***	0.187***	0.229**	-0.219	-0.058
DEU → KOR	1.117***	-0.062	-0.011	0.198*	-0.187	-0.034	0.809***	0.374***	0.156
KOR → DEU	0.617***	0.145	0.820***	0.215	-0.709***	0.275***	0.145	-1.004***	-0.276
GBR → KOR	-0.568***	-0.083	0.160	-0.289	-0.212	0.222***	1.252***	1.065***	0.118
KOR → GBR	0.818***	0.249	0.581***	-0.183	-1.177***	-0.347***	-0.124	0.610***	-0.156
ESP → KOR	0.272***	0.701***	0.175*	0.102	-0.071	0.150*	1.037***	2.308***	0.447***
KOR → ESP	-0.599***	0.378**	0.786***	0.355**	-1.337***	-0.407***	-0.154	0.020	-0.242
NLD → KOR	-0.012	-0.671***	-0.293***	0.185	-0.618***	0.199**	0.413***	0.649***	0.093
KOR → NLD	0.806***	0.162	0.290***	0.253	-0.466***	-0.174*	-0.361***	-1.150***	-0.242
DNK → KOR	-0.018	0.095	-0.042	0.162	-0.316*	-0.082	-0.254**	2.026***	0.056
KOR → DNK	0.080	-0.159	0.795***	0.290*	-1.001***	-0.673***	-0.488***	0.543***	0.106
GRC → KOR	-0.079	0.859***	1.391***	0.778***	-0.427*	-0.017	2.209***	-0.645**	1.126***
KOR → GRC	1.968***	0.049	1.178***	-0.065	-1.436***	-0.516***	-1.204***	0.331	0.106
AUT → KOR	0.020	-0.575***	-0.233**	0.025	-0.213	-0.088	1.723***	0.228*	0.155
KOR → AUT	1.261***	0.172	0.272**	0.073	-0.389***	0.400***	-0.062	-0.185	-0.104
SWE → KOR	0.103	-0.030	0.496***	0.251**	0.184	0.016	0.433***	0.314**	0.220**
KOR → SWE	0.687***	0.240	0.089	0.291*	-0.838***	0.222***	0.273***	-0.947***	-0.246
BEL → KOR	-0.423***	-0.419**	-0.293***	0.111	-0.259	0.021	0.161	0.558***	-0.132
KOR → BEL	-0.106	0.385**	0.405**	-0.113	-0.829***	-0.215***	-0.066	-1.498***	-0.196
IRL → KOR	0.267**	-1.295***	0.522***	0.211	-0.881***	0.112	-1.662***	-0.823***	-0.288
KOR → IRL	0.419***	-0.061	1.687***	-0.033	-0.285*	-1.399***	0.278**	-1.509***	-0.208
POL → KOR	-0.140	0.232	1.043***	0.795***	0.084	0.229**	0.190*	0.805***	0.402***
KOR → POL	2.011***	0.078	1.093***	0.310*	-0.552***	0.403***	-0.112	0.961***	-0.094
LVA → KOR	1.478***	1.586***	1.588***	2.645***	-0.283	-0.178	3.110***	2.964***	0.728**
KOR → LVA	0.369**	0.117	-0.254*	-0.297*	-1.082***	-0.234***	-1.645***	0.430	-0.347
LTU → KOR	1.308***	1.177***	0.027	-1.368***	0.658***	1.040***	1.380***	6.274***	0.638**
KOR → LTU	-0.405***	-0.301**	0.786***	0.068	-2.381***	-0.795***	-2.087***	4.019***	-0.022
EST → KOR	0.866***	2.433***	1.150***	0.631***	0.103	1.241***	0.971***	4.825***	1.129***
KOR → EST	0.809***	0.895***	-0.267*	0.247	-1.138***	-0.012	-1.260***	0.848***	-0.466
MLT → KOR	-0.205	-0.009	-0.805***	-1.011***	-0.529***	0.686***	0.078	1.356***	0.563
KOR → MLT	0.623***	0.187	-0.574**	1.596***	0.206	-0.021	-0.716***	-0.458**	-0.369*
SVN → KOR	1.122***	-0.600***	-0.688***	0.563***	-0.286	0.704***	-0.055	1.700***	0.391*
KOR → SVN	1.976***	1.128***	0.347**	1.050***	1.018***	0.776***	0.282**	-0.869***	0.559***
BGR → KOR	-0.364***	1.161***	-0.536***	-0.140	-0.710***	0.185*	-1.049***	-0.158	0.048
KOR → BGR	1.212***	-0.106	0.009	-0.039	-1.170***	-0.739***	-1.478***	0.993***	-0.644***
CYP → KOR	-1.018***	-1.547***	-0.245*	0.003	1.021**	1.744***	0.963***	-2.079***	2.529***
KOR → CYP	-1.154***	-0.556***	0.285**	-1.399***	-0.920***	0.048	-0.023	-1.153***	-1.041***
ROM → KOR	0.837***	1.550***	1.392***	-0.456***	0.747**	0.650***	1.763***	-0.886***	0.620**
KOR → ROM	1.045***	0.942***	0.100	0.136	-1.073***	-0.692***	-1.485***	-0.328	-0.533**
SVK → KOR	0.040	0.975***	-0.938***	0.125	-1.005***	1.084***	0.259**	2.108***	0.361
KOR → SVK	0.135	0.853***	0.532***	0.283*	-0.230	0.792***	0.407***	2.214***	0.196
LUX → KOR	-0.798***	-0.023	0.427**	0.830***	-1.580***	-0.472***	-2.968***	1.241***	-0.223
KOR → LUX	1.839***	1.185***	0.111	0.924***	1.560***	0.212	0.474***	0.748***	0.886***
PRT → KOR	-0.344***	1.110***	0.831***	0.741***	-0.715***	0.094	1.235***	0.739***	0.441
KOR → PRT	0.888***	0.774***	1.164***	0.391**	-0.908***	-0.467***	-0.303**	-0.766***	-0.178
CZE → KOR	1.290***	0.278*	0.323***	0.122	0.595***	0.028	0.841***	0.449***	0.264*
KOR → CZE	0.668***	0.708***	0.919***	1.042***	0.064	0.689***	1.436***	1.010***	0.773***
FIN → KOR	0.214**	-0.092	0.697***	0.261*	0.323	0.207***	-0.101	0.316	0.300***
KOR → FIN	-0.123*	0.447***	1.002***	0.179	-0.967***	-0.479***	-0.030	4.026***	-0.436
HUN → KOR	-1.015***	1.599***	0.521***	1.316***	-0.090	0.297***	0.648***	1.855***	0.243
KOR → HUN	1.106***	1.392***	1.626***	0.020	-0.505***	0.080	-0.885***	5.304***	-0.436
HRV → KOR	-0.166	-0.401**	0.005	0.450***	0.163	-0.470***	2.351***	0.224	0.239
KOR → HRV	0.408***	-0.605***	2.435***	0.038	-1.700***	-1.053***	-1.075***	1.110***	-0.015
Observations	96859	97399	97229	97430	97167	97520	96008	94193	1248549

Notes: This table reports PPML estimates of the effects of the EU-South Korea FTA for the 8 main sectors and for all country pairs. The aggregate effect in column (9) is obtained by summing observations across all sectors. The dependent variable is nominal trade in level. All estimations are performed with exporter-time, importer-time and country-pair fixed effects. Additionally, the indicator *RTA* is included in the regressions, but omitted in the table for brevity. Respectively, *, **, and *** denote significance at the level of 10%, 5%, and 1%.