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INVITED REVIEW

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Are preferential agreements beneficial to EU trade? New evidence from the EU–South Korea treaty

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Abstract

This paper empirically investigates the effect of the EU–South Korea free trade agreement (FTA) on manufacturing trade flows. By applying a state-of-the-art structural gravity model with intra-national (i.e. domestic) trade and using disaggregated data, we quantify both the trade impact and the observed heterogeneity in the FTA estimates. In line with literature, we find that the EU–South Korea FTA exerted asymmetric effects in bilateral exports across directions of trade. Compared to previous studies, our findings suggest a different explanation for the poor performances of Korean exports to the EU in the post-FTA period, namely offshoring patterns in electronics and a broad-based decline in the shipbuilding industry. When we drop these two export categories from the analysis, we show that the FTA exerted a large effect on trade in both directions, increasing bilateral exports by about 30%. 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 liberalisation potential, favouring larger FTA estimates. Tariffs instead do not explain the heterogeneity in the trade effects.

KEYWORDS
EU–South Korea FTA, heterogeneous trade effects, structural gravity models

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, 2021b).[1] 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 importance of trade barriers resulting from non-tariff measures (NTMs) in trade policy has risen in recent years. These are defined as all policy measures other than tariffs that have an impact on international trade, affecting the price or the quantity of traded goods, or both (UNCTAD, 2010). 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. In those circumstances, NTMs become non-tariff barriers to trade (ITC, 2016).[2] In this perspective, the focus of the European Commission has gradually shifted to unlocking the benefits of the EU's RTAs, by tackling existing barriers more systematically to facilitate access to markets while continuing working to enhance regulatory cooperation (European Commission, 2021a).

The EU–South Korea Free Trade Agreement (FTA) is an excellent case study to disentangle the role of non-tariff barriers in trade liberalisation from tariff reductions. First, the agreement, which provisionally applied from mid-2011 and entered fully into force in 2015, 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,

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

[2]The demarcation line between non-tariff barriers and NTMs is not always clear. Non-tariff barriers refer to all frictions other than tariffs and tariff-rate quotas that can potentially have an economic effect on international trade. These include distance, institutional factors and restrictive regulations and procedures. NTMs instead refer to government regulations that affect exports and imports, such as sanitary and phytosanitary measures or technical barriers to trade. According to the theory, NTMs 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 (Grübler & Reiter, 2021; Hoekman & Nicita, 2011; Kee et al., 2009; Niu et al., 2018), especially in country pairs with similar levels of economic development (Santeramo & Lamonaca, 2022).

chemicals and pharmaceutical products.[3] Second, it is the first bilateral 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.

Furthermore, South Korea is an important economic partner for the EU in both trade and investment. During the 2000s South Korea had rapidly developed to become one of the key players over shipbuilding, automotive and semiconductors. After the failure of the Doha Round to achieve multilateral trade liberalisation, South Korea pursued an alternative approach by signing bilateral preferential trade agreements. The EU–South Korea FTA was unprecedent both in its scope and depth, representing the second largest free trade agreement in history at the time of signing. It 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. Since then, South Korea entered several other bilateral trade agreements, such as with Peru, USA, Turkey, Australia, Canada, China, Colombia, which have helped strengthen its export-oriented industrialisation development strategy.

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 EU–South Korea 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 83% and a 38% 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. All these sectors featured 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. (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[4] for the period 2000–2014, estimated an increase of 54% of EU exports to South Korea, compared to a rise of only 15% 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%, compared to a decline of 9% 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%, while he reported a statistically not significant effect on bilateral exports of South Korea.[5] According to the author, asymmetries in the effects are likely to reflect differences in *ex-ante* trade policies. It is also worth

[3]In addition, the FTA contains provisions on technical barriers to trade and on sanitary and phytosanitary measures, alongside simplification of the rules of origin.

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

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

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% due to the EU–South Korea FTA. However, this effect turns out to be not significant when they controlled for tariffs.

The contribution of this paper to the literature is threefold. First, the paper provides 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 fixed effects and intra-national, that is, domestic, trade flows. Second, 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 take a more fine-grained approach and use data for 74 trading partners at the sectoral level for the period 2002–2019. The use of both disaggregated data and intra-national trade allows to explore potential sectoral developments that may have impacted on Korean exports resulting in asymmetries of the trade impact.[6] The inclusion of intra-national trade, strongly recommended by a recent literature (Heid et al., 2021; Yotov, 2022), is particularly important in our framework as it allows to identify the effect of the EU–South Korea FTA on Korean trade flows vis-a'-vis non-EU countries after the signing of the agreement while properly accounting for multilateral resistance terms (i.e. in the presence of the full set of exporter-time and importer-time fixed effects). This approach, which follows recent contributions by Esteve-Pérez et al. (2020) and Larch et al. (2021), is crucial in order to inspect whether poor performances of Korean exports in specific sectors were caused by the agreement or instead reflected offshoring patterns.

Finally, the use of disaggregated data offers the opportunity of quantifying the potentially heterogeneous trade impact of the FTA. We analyse the EU–South Korea trade impact across country pairs, sectors and directions of trade (imports vs. exports) and then in a second stage we investigate the main drivers of variation. This approach closely follows recent contributions by Baier et al. (2019) and Larch et al. (2021). However, unlike these authors, we provide empirical evidence for the role of non-tariff measures in explaining larger FTA estimates.

In contrast with previous literature, our results indicate that the FTA made a significantly positive, large and robust impact on both directions of trade. Specifically, if we drop from the analysis two sectors, namely electronics which suffered the relocation of South Korea's companies in the Southeast Asia and other transports, which literally collapsed due to oversupply in the shipping sector, we find that the FTA has increased bilateral exports to both directions by about 30%.

Additionally, in our regressions we control for bilateral tariffs, to disentangle the effects of tariff liberalisation from those stemming from the removal of non-tariff barriers. To bypass the challenges related to the precise measurement of non-tariff barriers we employ a 'tariff-augmented umbrella approach'.[7] Since tariffs are explicitly considered in our regression, the indicator variable summarising the application of the FTA captures all trade effects attributable to non-tariff barriers.[8] We find that the FTA is still effective in promoting trade significantly to both

[6]An exception to previous studies is represented by the Civic Consulting and the Ifo Institute (2018) but they cover a short time span, namely the period from 2000 until 2014, 1 year before the FTA entered fully into force.

[7]The umbrella approach consists of a single dummy variable measuring the overall effects of trade liberalisation with proper use of fixed effects, without distinguishing between tariff and non-tariff barrier effects (Chowdhry & Felbermayr, 2021).

[8]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 Heid et al. (2021) and Mattoo et al. (2022), among others, for studies adopting a structural gravity framework in which tariffs are considered explicitly.

directions after netting out the tariff effect, clearly suggesting the agreement goes far beyond classic tariff reduction.

We then show that the trade effects are strongly asymmetric across sectors and country pairs. Specifically, we 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. The main driver of heterogeneity is represented by asymmetries in *ex-ante* trade barriers across sectors, with differences in sectoral-specific pre-FTA regulatory measures, proxied by observed NTMs, assuming particular relevance. This finding supports the idea that highly regulated sectors are associated to a high liberalisation potential *ex post*, favouring larger FTA effects.[9] 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, tariff reduction does not explain the heterogeneity in the trade effects. 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 organised 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[10] exports to South Korea (Figure 1). In the period 2011–2019, EU exports of goods to South Korea increased by 45%, from 35 billion Euro to 50 billion Euro, whereas bilateral EU imports grew at a lower rate with a 19% 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.[11] 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 has been almost balanced since then.

[9]This argument follows from a more general hypothesis, formalised 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*. This point has been emphasised by Larch et al. (2021) in their investigation of heterogeneity of the 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.

[10]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.

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

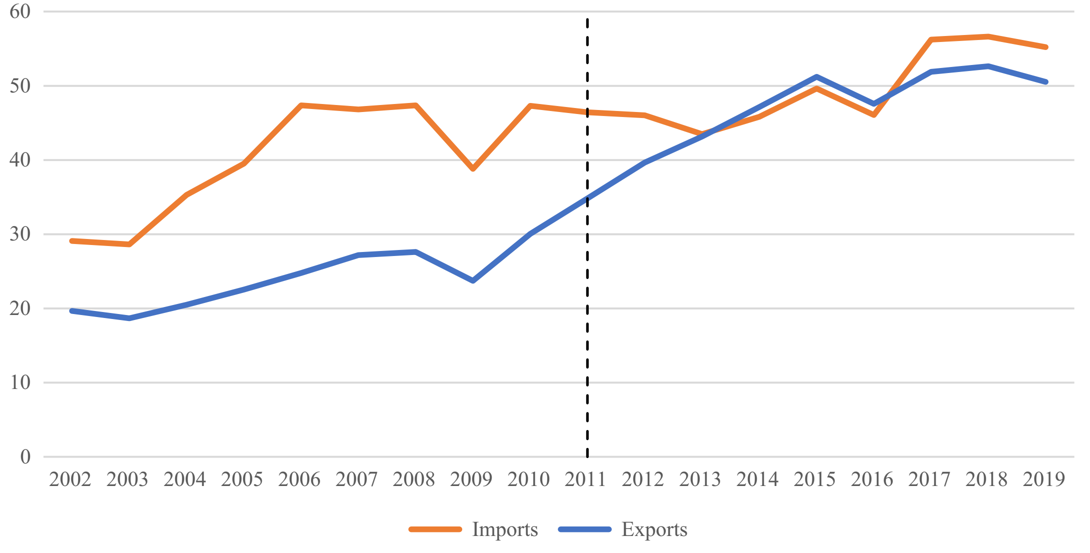

FIGURE 1 EU trade in goods with South Korea (billion Euro). *Source*: Authors' calculations based on CEPII-BACI.

The effect of trade-related policies is influenced by two groups 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, summarised 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 2010s against the Korean won,[12] which decelerated import demand, and South Korea's high GDP growth.[13] In the structural gravity framework, all factors other than the trade agreement that affect trade cross-country and over time are captured by country-time fixed effects.

In 2012 South Korea signed a free trade agreement with the US which likely impacted bilateral EU exports. Although the two FTAs have a different approach to address non-tariff barriers related to automobiles and the service sectors, they are similar in many respects. Both agreements are comprehensive and quickly eliminate tariffs on most trade in goods, agricultural products and services. Additionally, a large share of bilateral trade between USA and South Korea is highly concentrated on some important sectors for the EU, such as vehicles and machinery. In 2019, USA exports of goods to South Korea amounted to 50 billion Euro, increasing by 30% from 2011, while bilateral USA imports were 68 billion Euro with a 37% increase in the 2011–2919 period. In our estimation strategy, the

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

[13]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. (2020), 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.

TABLE 1 Evolution of bilateral import shares and tariffs.

	Δ Trade %	Import shares (%)		Bilateral tariffs (%)	
	2011–2019	2011	2019	2011 Average (MFN) tariff	2019 Average (preferential) tariff
(a) European Union imports from South Korea					
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					
Food, beverages and tobacco	78.9	5.8	7.1	39.6	17
Textiles, wearing apparel and related pr.	13.5	4.1	6.5	9.9	0
Wood and furniture	12.6	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

Note: 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.

TABLE 2 Main sectoral developments in South Korea in the post-FTA period (billion 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	13.2	3.8	52.9	25.4
2019	9.7	5.5	100.4	51.3
(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	10.1	1.4	42.5	5.8
2019	2.8	1.9	19.9	7.5

Source: Authors' calculations based on CEPII-BACI.

entry into force of the US–South Korea agreement is taken into consideration by means of a trade policy variable RTA that accounts for the presence of a trade agreement between trading partners.

2.2 | Sectoral trade dynamics and tariff structure

Table 1 summarises 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%) in a progressive manner. Most duties (75%) were lifted from the date of 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% in 2011 and 1.17% in 2019.[14] 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 (mainly shipbuilding), representing over 80% 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% of total Korean exports to the EU. However, its export amount fell by more than 26% since the implementation of the FTA. In fact, in the last 10 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)).

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

Additionally, that period has been marked by increasing EU imports from ASEAN countries in electronic components, with a 25% increase in 2019 compared to 2011, suggesting offshoring patterns shaping bilateral exports in this sector.

The collapse in Korean exports of ships, which accounted for 22% of total Korean exports to the EU in 2011 and in 2019 fell by more than 70% 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.

3 | METHODOLOGY AND DATA

3.1 | Structural gravity model with sectoral data

To quantify the changes in trade flows occurring due to the enforcement of the EU–South Korea FTA we employ a structural gravity framework at the industry level. In light of sectoral developments that impacted bilateral trade in the post-FTA period, it is important to evaluate the effect of the agreement using a more fine-grained approach. Moreover, the effects are expected to be heterogenous across industries, also because the FTA explicitly addresses non-tariff barriers in some specific sectors. Therefore, we provide estimates of the trade effect of the FTA by (1) pooling sectors together and (2) separately for each sector to allow for heterogeneity of the effect depending on the sector.

Yotov et al. (2016) demonstrate the equivalence of the structural gravity model derived from the demand side with the supply-side gravity equation, also at the industry level.[15] The demand-side structural gravity equation for bilateral trade flows X_{ijk} from country i to j in sector k is the following:

$$X_{ijk} = \frac{E_{jk} Y_{ik}}{Y_k} \left(\frac{T_{ijk}}{\Pi_{\mathrm{ik}}^{1-\sigma^k} P_{jk}^{1-\sigma^k}} \right), \tag{1}$$

where E_{jk} is country j's total expenditure in sector k, Y_{ik} is country i's income in sector k, Y_k is the world's output in sector k and T_{ijk} is a function of bilateral trade costs between exporter i and importer j in sector k. Following Anderson and van Wincoop (2003), Π_{ik} denotes the outward multilateral resistance, along with P_{jk} represents the inward 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 towards all other destinations, the importer country's trade resistance towards all other trading partners. Finally, σ^k is the sector-specific elasticity of substitution between different

[15]An important implication is that structural gravity models can be derived at any level of disaggregation for which data are available (see Anderson & van Wincoop, 2004).

varieties.[16] It is important also to notice that trade costs are sector-specific. We define the trade cost variable T_{ijk} as a function of two components:

$$T_{ijk} = t_{ijk}^{1-\sigma^k}\left(1+tariff_{ijk}\right)^{-\sigma^k}, \tag{2}$$

where $tariff_{ijk}$ is the ad-valorem import tariff imposed by country □ on goods imported from □ in sector k and t_{ijk} is a measure of non-tariff barriers, also called 'iceberg' trade costs. 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 was 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. The structural gravity model can be translated into the following empirical specification, estimated by pooling sectors together:

$$X_{ijtk} = \exp\left[\beta_1 FTA_{ijt}^{EUKO} + \beta_2 \ln\left(1 + tariff_{ijtk}\right) + \beta_3 RTA_{jjt} + \theta_{itk} + \eta_{jtk} + \mu_{ijk}\right] + \epsilon_{ijtk}. \tag{3}$$

Here, X_{ijtk} denotes nominal trade flows from exporter i to importer j in sector k 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 ($X_{ijtk}, j \neq i$) but also intra-national trade flows (X_{iitk}).[17] 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.

Our main variable of interest is the indicator variable FTA_{ijt}^{EUKO}, which takes the value of one for country pairs consisting of South Korea and EU Member States, starting from 2012. As described earlier, trade costs are a function of tariffs and of non-tariff barriers. In gravity specifications explicitly including tariffs, the indicator variable summarising the application of the FTA captures all trade effects attributable to non-tariff barriers, which allows to disentangle tariff liberalisation effects from those stemming from non-tariff removal. 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. We also include a time-varying trade policy covariate, RTA_{ijt},[18] 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, such as the US–South Korea FTA.[19]

[16]The elasticity of substitution is often interpreted as trade elasticity in gravity models. The interpretation of this parameter varies across the micro-foundations of the structural gravity equation. In the Eaton and Kortum supply-side approach (2002), $1 - \sigma^k = -\theta^k$, where θ^k is the dispersion technology parameter.

[17]Dai et al. (2014), Yotov et al. (2016), Heid et al. (2021) and Yotov (2022), among others, highlight the importance of including intra-national trade flows in the estimation of the gravity equation.

[18]Mattoo et al. (2022) 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 agreements lead to more trade creation than older and more traditional arrangements.

[19]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.

θ_{itk} and η_{jtk} are time-varying fixed effects capturing unobservable factors that affect trade, including the theoretical multilateral resistance terms, and any other observable country-year specific factor. Macroeconomic disturbances that occurred in the period after the FTA entry into force, namely the EU's prolonged economic stagnation and exchange rate dynamics, are therefore captured by these terms. Importantly, consistent with theory, exporter/importer-time fixed effects in our disaggregated gravity specification are at the industry level. Therefore, they further control for sectoral developments not specifically related to bilateral trade frictions, such as industry-specific productivity shocks.

An important issue in the estimation of the impact of trade policies is endogeneity, as countries may sign agreements with partners with whom they already trade more intensively, thus biasing the estimates, especially with cross-sectional data (Trefler, 1993). We control for endogeneity by using panel data and by including in our specification (asymmetric) industry-country-pair fixed effects, μ_{ijk}, which also absorb unobservable time-invariant trade costs, such as distance and contiguity (Baier & Bergstrand, 2007).[20] ϵ_{ijtk} is the error term. Ignoring multi-way clustering in the data leads to misleading inference regarding the impact of trade-related policies (see Egger & Tarlea, 2015). Therefore, we report multiway clustered standard errors by exporter, importer and sector.[21]

Besides estimating the impact of the EU–South Korea FTA on bilateral trade flows, we take advantage of some recent advances in the literature to estimate the third-country effect of the agreement (Esteve-Pérez et al., 2020; Heid et al., 2021; Larch et al., 2021). Our aim was to investigate whether negative performances of Korean exports in both electronics and other transport equipment were caused by the agreement or were broad-based. Since offshoring activities in the electronics sector cannot be identified using trade data in final goods, as they are reflected in bilateral trade flows and thus not captured by country-time fixed effects, we proceed in two steps. We first estimate the gravity Equation (3) after excluding the two export categories from the analysis and then we further estimate the following specifications:

$$X_{ijt} = \exp\left[\beta_1 EU\_KOR_{ijt} + \beta_2 KOR\_EU_{ijt} + \beta_3 KOR\_ASEAN_{ijt} + \beta_4 KOR\_ROW_{ijt} + \beta_5 RTA_{jjt} + \theta_{it} + \eta_{jt} + \mu_{ij}\right] + \epsilon_{ijt}, \tag{4}$$

$$X_{ijt} = \exp\left[\beta_1 EU\_KOR_{ijt} + \beta_2 KOR\_EU_{ijt} + \beta_3 KOR\_ROW_{ijt} + \beta_4 RTA_{jjt} + \theta_{it} + \eta_{jt} + \mu_{ij}\right] + \epsilon_{ijt}, \tag{5}$$

where Equation (4) is estimated for the electronics sector, while Equation (5) is estimated for the other transport sector. The two additional variables, KOR_ASEAN_{ijt} and KOR_ROW_{ijt} are two indicators for Korean exports vis-a'-vis ASEAN countries (and China) and the rest of the world after the introduction of the agreement respectively. These are meant to capture possible offshoring

[20]Baier and Bergstrand (2007) show that estimates of the RTAs using standard cross-section gravity equations are biased downwards. They recommend the use of panel data with bilateral country-pair fixed effects which is equivalent to implementing an average treatment effect to account for endogeneity of RTAs. Baldwin and Taglioni (2007) show that bilateral time invariant fixed effects mitigate endogeneity issues stemming from self-selection of countries into trade policies when estimating currency union trade effects. In our case, 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).

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

TABLE 3 Estimated impacts of the EU–Korea FTA.

	(1) Baseline	(2) Direction trade	(3) Tariffs	(4) Trade share	(5) Subsample	(6) Sub. + tariffs	(7) Electronics	(8) Other transp.
RTA	0.189***	0.187***	0.090***	0.080***	0.257***	0.201***	0.147***	−0.032
	0.026	0.026	0.019	0.011	0.022	0.023	0.043	0.048
FTA^{EUKO}	0.036							
	0.063							
EU_KOR		0.212***	0.105**	0.266***	0.265***	0.156**	0.004	0.234
		0.077	0.044	0.047	0.075	0.077	0.121	0.178
KOR_EU		−0.099	−0.136*	−0.010	0.269***	0.198***	−0.761**	−0.889***
		0.090	0.070	0.074	0.066	0.068	0.308	0.242
ln(1 + tariff)			−0.042***			−0.067***		
			0.008			0.010		
KOR_ASEAN							0.602*	
							0.358	
KOR_ROW							−0.296	−0.466**
							0.310	0.237
Exp.-sector-year Imp.-sector-year FEs	X	X	X	X	X	X	X	X
Exp.-Imp.-sector FEs	X	X	X	X	X	X	X	X
Observations	1,250,359	1,250,359	1,126,013	1,251,202	1,058,735	964,143	97,305	94,319

Note: 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, except for column (4) where the bilateral share in total (sectoral) imports is used. Importer/exporter-sector-year and importer-exporter-sector bilateral fixed effects are used in all specifications, except for the last two columns in which the sector dimension is removed, as estimations are performed at the industry level. The standard errors are reported in parentheses and clustered by country-pair and sector. Respectively, *, ** and ***Significance at the level of 10%, 5% and 1%.

patterns in the electronics industry and a more general decline in Korean world exports of ships.[22] It is important to notice that the addition of domestic trade allows us to add exporter/importer-time fixed effect, because the variables of interests, that is, Korean exports versus FTA members and FTA non-members, are perfectly collinear with those. As shown by Heid et al. (2021), these effects are then identified by interacting the indicators with an international border dummy, taking a value of one for international trade and zero for domestic sales. The remaining variables are defined as in Equation (3), but now they are all interacted with the international border dummy.

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.[23] 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 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 (Table A2). These are taken from the International Trade and Production Database for Estimation (ITPD-E), developed by the US 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, 2022).[24] 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.[25] This allows to construct intra-national trade flows which are consistent with our sectoral classification and we combine them with the BACI dataset.[26,27] Gravity controls for trade agreements come from CEPII (Head et al., 2010; Head & Mayer, 2014).

[22]We therefore expect β_3 to be positive in Equation (4) and negative in Equation (5).

[23]We report in Table A1 in Appendix 1 the full list of countries and sectors and their concordances with ISIC codes.

[24]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.

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

[26]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 2017–2019, only observation on international trade flows is included.

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

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, while we then allow for the trade effect to differ by the direction of the trade flow. We also report estimates based on trade shares rather than trade flows. As explained before, the total trade effect may be driven by strong sectoral effects in the electronics and the shipping sectors. Therefore, in Table 3 we also present our results after excluding the two export categories from the sample. Finally, we provide estimates based on gravity Equations (4) and (5) for these two sectors only.

The coefficient of the FTA_{ijt}^{EUKO} in column (1) is not statistically significant at conventional levels. This is in contrast with Grübler and Reiter (2021) and Jung (2022), who find statistically significantly positive trade effects of the agreement, although their results are based on a shorter dataset. On the other hand, other RTAs have a strong a trade-enhancing effect, as expected, as on average increased bilateral trade by $\left[exp(0.189) - 1\right] \times 100 = 21$ percent.

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 (2), we observe the unequal impact of the EU–South Korea FTA on EU exports and Korean exports. In particular, the FTA has increased EU exports to South Korea significantly by about 24%, while this specification appears to exert a negative trade effect on Korean exports, which is, however, not significant. These estimates are qualitatively in line with previous studies, although with lower magnitudes for bilateral EU exports.[28] When we account for bilateral tariffs (column (3)), which are highly significant and with the expected sign, the trade impact for EU_KOR decreases, with the coefficient being statistically significant. For comparison purposes, column (4) replicates the estimation reported in column (2) using bilateral shares in total (sectoral) imports rather than trade flows.[29] The results remain unaltered, with a slightly larger effect observed for EU_KOR.

An advantage of using disaggregated data is the possibility of exploring sectoral developments that may have driven the trade effects. As already outlined in the descriptive statistics, the decline in bilateral Korean exports in these two industries in the post-FTA period might have driven the asymmetry in the effects of the agreement across directions of trade. Therefore, in columns (5) and (6) we re-estimate Equation (3) after dropping from the sample both the electronics and the other transport sectors.[30] In column (5) we observe, differently from previous studies, that the FTA has had strong trade-enhancing effects also on bilateral Korean exports, with similar magnitude if compared to the EU exports. Specifically, the FTA can be associated with a 30% increase in bilateral exports to both directions of trade. These results are robust to the inclusion of tariffs (column (6)), which are consistently negative in the various specifications employed, as the trade

[28]Jung (2022) reports a (cumulative) trade effect of 39 percent on exports of EU countries to South Korea, while the effect on EU imports is not significant.

[29]In this exercise we follow Mayer et al. (2019), who apply this transformation to overcome a potential issue related to the PPML as it naturally tends to assign more weight on pairs of countries with large levels of trade.

[30]We drop 195,220 observations (about 15% of observations in the data).

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***		96,859
	0.063	0.008	0.254**	−0.069***	88,287
Textiles, wearing apparel and related products	0.207***	0.393***	0.335**		97,399
	0.158**	0.284**	0.256	−0.040	88,750
Wood and furniture	0.106	0.275***	0.202***		96,282
	0.040	0.172**	0.168*	−0.078***	87,607
Paper products	0.024	0.071***	0.537***		95,329
	−0.032	0.017***	0.558***	−0.062***	86,702
Coke and refined petroleum products	0.178*	1.498***	0.402**		89,312
	0.167	1.633***	0.410**	0.064	81,146
Chemicals and pharmaceuticals	0.124***	0.065	0.722***		97,229
	0.072**	−0.005	0.669***	−0.044	88,580
Rubber and plastics products	0.265***	0.396***	0.212		97,089
	0.185***	0.219	0.109	−0.101***	88,469
Metals, stone and glass	0.294***	0.210***	0.236**		97,430
	0.225**	0.062	0.118	−0.119***	88,810
Computer, electronic and optical products	−0.053	−0.226	−0.679***		97,167
	−0.071	−0.263*	−0.705***	−0.016	88,619
Machinery and electrical equipment	0.156***	0.108***	0.036		97,520
	0.138***	0.083**	0.002	−0.028	88,879
Vehicles	0.239***	0.768***	0.049		96,008
	0.192**	0.646***	−0.024	−0.074***	87,373
Other transport equipment	0.140*	0.447***	−0.257**		94,193
	0.129	0.486***	−0.221*	0.023	85,619
Other manufactured products	0.192**	−0.057***	−0.039***		96,732
	0.157*	−0.141*	−0.110***	−0.073**	88,120

Note: 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 ***significance at the level of 10%, 5% and 1%.

impact for *EU_KOR* and *KOR_EU* only slightly decreases, with both coefficients being statistically significant. This last finding clearly indicates 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 far beyond tariff reduction.[31]

In the last two columns of Table 3 we test our hypothesis explaining the negative effect in Korean exports to the EU after 2011 by estimating gravity Equations (4) and (5) for the two export categories taken separately. In column (7) we observe a negative trade effect for *KOR_EU* in the electronics sector, as expected. Conversely, the indicator for South Korea's

[31]This result is consistent with the literature on the trade effects of the EU-South Korea FTA from a macroeconomic perspective, as well as with findings of Chowdhry and Felbermayr (2021) at the firm-level.

trade with ASEAN countries (and China) is significantly positive, while the impact on trade between South Korea and the rest of the world is found to be negative although not significant. This finding provides evidence that South Korea has increased considerably intra-industry trade with China and ASEAN countries in medium and high technology products in the last 10 years. This suggests that the negative trade effect for *KOR_EU* was likely driven by increasing offshoring activities of Korean firms, particularly relevant in the case of Samsung Electronics' mobile phone assembly to China and Vietnam. In column (8) the trade impact for *KOR_EU* in the other transport sector is found to be strongly negative, with the indicator for South Korea's outside trade being also significant and negative, although to a lower extent.[32] This result provides some evidence of a broad-based decline in Korean exports in the shipping sector driving the negative trade effect in other transport equipment, rather than this being a consequence of the agreement.

Finally, we investigate the robustness of our main results from Table 3 by considering additional specifications, reported in Appendix 3. First, we show how the results are affected when we exclude intra-national trade data from the analysis (Table A3 in Appendix 3, panel A). Although the main findings are qualitatively unchanged, we find smaller estimates in absolute value indicating that the omission of internal trade leads to a downward bias in the estimates. Our robustness exercise additionally considers specifications with3-year leads and lags of the EU–South Korea FTA (Table A3, panel B), with 3-year interval (Table A4, panel A) and using the Gamma Pseudo Maximum Likelihood estimator (Table A4, panel B). Overall, our main findings are largely confirmed.

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 liberalisation 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% of total EU exports to South Korea in 2019.[33]

Focusing on Korean exports, the most important results are the negative and highly significant estimates for trade in electronics and other transport, as previously discussed. 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

[32]Here *KOR_ROW* also includes ASEAN countries.

[33]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 3 years of the agreement.

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(1st. 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

Note: 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 A5. Specifications in columns 1, 2, 3 include only country-pair fixed effects, columns 4 and 5 include only industry fixed effects, while in column 6 we include both country-pair and industry-specific fixed effects. Respectively, *, ** and ***significance at the level of 10%, 5% and 1%.

significant benefits to Korean exports.[34] 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 considered. 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).[35]

Figure A1 in Appendix 3 provides more intuition on some of the patterns emerging from our estimations and on the relevance of non-tariff barriers. 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 specific proxy of non-tariff barriers.[36] 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 highly regulated in South Korea. Most importantly, we notice that most of the

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

[35]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.

[36]Data on NTMs are from the WTO I-TIP database.

positive and significant directional industry-specific FTA effects are observed across sectors with the highest level of NTMs *ex-ante*.[37] 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*.[38]

In Table A5 in Appendix 3 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).[39] 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.[40]

Overall, the large number of 728 sets of disaggregated gravity estimates from Table A5 confirms our previous intuition pointing 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 capitalise 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 previous section as the dependent variable and regress them on some covariates of interest.[41] We estimate:

$$\beta_{ijk} = \alpha_0 + \alpha_1 Tariff\Delta_{jk} + \alpha_2 \ln(1\ stage\ Pair\ FEs)_{ijk} + \alpha_3 \ln(1+NTM)_{jk} + \nu_{ijk} \quad (6)$$

[37]This is the case for EU exports of machinery and Korean exports of chemicals and food, among others.

[38]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.

[39]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.

[40]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.

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

Among the possible determinants of heterogeneity in the FTA effects we consider bilateral sectoral tariff changes (*Tariff* Δ) 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 A5, 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.[42] Because this variable captures the regulatory intensity applied on a specific industry *ex-ante*, to the extent that large values reflect a high liberalisation 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.[43] 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 (6), although the statistical significance of *ln*(1 *stage Pair FEs*) disappears.[44] 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 liberalisation potential *ex post* through a substantial simplification of NTM requirements, favouring larger FTA effects.

[42]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).

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

[44]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.

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.

5 | CONCLUSIONS

This paper evaluates the 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. First, we show that the FTA has stimulated bilateral trade unequally, with a not significant trade impact on South Korea's exports to the EU and a positive and large effect on bilateral EU exports. By using a state-of-the-art gravity model with industry-level data and intra-national trade, we provide evidence of sectoral developments weighing on bilateral Korean exports during the post-FTA period. When we drop from the analysis both the electronics, subject to intense offshoring by Korean firms, and the other transport sectors, affected by a broad-based decline in Korean shipbuilding exports, we find that the FTA has equally increased bilateral exports by about 30%. 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 liberalisation 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 liberalisation than older agreements.

However, bilateral free trade is limited in some sectors by technical barriers in addition to anti-dumping and sanitary and phytosanitary measures which are still used by both parties. Furthermore, the last 10 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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DATA AVAILABILITY STATEMENT

All data used are from publicly available sources. All necessary details are included in the main text.

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APPENDIX 1

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

Note: 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 2

DESCRIPTIVE STATISTICS

TABLE A2 Summary statistics.

	N	Mean	SD	Min	Max
Nominal trade at the sectoral level (million $)	1,268,930	334.83	8800.61	0.00	2420307.00
if $i \neq j$	1,256,476	150.35	1221.37	0.00	187628.40
if $i = j$	12,454	18496.77	85974.69	0.00	2420307.00
FTA^{EUKO}	1,268,930	0.01	0.07	0	1
EU_KOR	1,268,930	0.00	0.05	0	1
KOR_EU	1,268,930	0.00	0.05	0	1
RTA	1,268,930	0.36	0.48	0	1
Tariff (%)	1,157,806	5.06	7.10	0	113.16

Note: 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 3

ADDITIONAL RESULTS

TABLE A3 Robustness checks: No intra-national trade flows, anticipation and lagged effects.

	PANEL A: No intra-national trade				PANEL B: Anticipation and lagged effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full sample	Full sample	Subsample	Subsample	Full sample	Full sample	Subsample	Subsample
RTA	0.108***	0.090***	0.145***	0.123***	0.064***	0.029	0.106***	0.066***
	0.018	0.019	0.019	0.020	0.021	0.023	0.019	0.020
EU_KOR	0.174***	0.105**	0.198***	0.119**	0.100*	0.058	0.155***	0.107**
	0.042	0.044	0.048	0.048	0.059	0.057	0.054	0.053
KOR_EU	−0.098	−0.136*	0.149**	0.104*	−0.192**	−0.261***	0.094*	0.019
	0.070	0.070	0.060	0.062	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)		−0.042***		−0.050***		−0.043***		−0.050***
		0.008		0.008		0.008		0.007
Observations	1,236,824	1,126,013	1,047,176	953,381	1,250,359	1,126,013	1,058,735	964,143

Note: This table reports PPML estimates of the effects of the EU–South Korea FTA with international trade flows only (in Panel A) and PPML estimates with the full data adding 3-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 (2), (3), (5) and (6) in Table 3, namely the specifications with the directional indicators (exports and imports) for the trade effects of the FTA, accounting for tariffs and using a subsample after dropping the electronics and the other transport sectors from the analysis. All estimates are obtained with exporter-time-sector, importer-time-sector and exporter-importer-sector fixed effects. The standard errors are reported below the estimates and clustered by country-pair and sector. Respectively, *, ** and ***significance at the level of 10%, 5% and 1%.

TABLE A4 Robustness checks: 3-year intervals and Gamma Pseudo Maximum Likelihood.

	PANEL A: PPML 3-year interval				PANEL B: Gamma pseudo ML			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full sample	Full sample	Subsample	Subsample	Full sample	Full sample	Subsample	Subsample
RTA	0.201***	0.124***	0.255***	0.164***	0.233***	0.147***	0.301***	0.190***
	0.023	0.025	0.022	0.024	0.039	0.039	0.041	0.042
EU_KOR	0.194***	0.129**	0.242***	0.165**	0.185*	0.050	0.287**	0.100
	0.058	0.062	0.064	0.068	0.105	0.131	0.135	0.162
KOR_EU	−0.090	−0.169*	0.233***	0.141*	−0.062	−0.139	0.245*	0.140
	0.088	0.090	0.074	0.079	0.109	0.118	0.134	0.171
ln(1 + tariff)		−0.074***		−0.089***		−0.083***		−0.115***
		0.013		0.014		0.030		0.033
Observations	477,499	429,018	404,627	363,595	1,250,359	1,126,013	1,058,735	964,143

Note: This table reports PPML estimates of the effects of the EU–South Korea FTA with 3-year interval data (in Panel A) and estimates with all data using the Gamma Pseudo Maximum Likelihood estimator (in Panel B). The dependent variable is nominal trade in levels. In each panel we replicate the estimates from columns (2), (3), (5) and (6) in Table 3, namely the specifications with the directional indicators (exports and imports) for the trade effects of the FTA, accounting for tariffs and using a subsample after dropping the electronics and the other transport sectors from the analysis. All estimates are obtained with exporter-time-sector, importer-time-sector and exporter-importer-sector fixed effects. The standard errors are reported below the estimates and clustered by country-pair and sector. Respectively, *, ** and ***significance at the level of 10%, 5% and 1%.

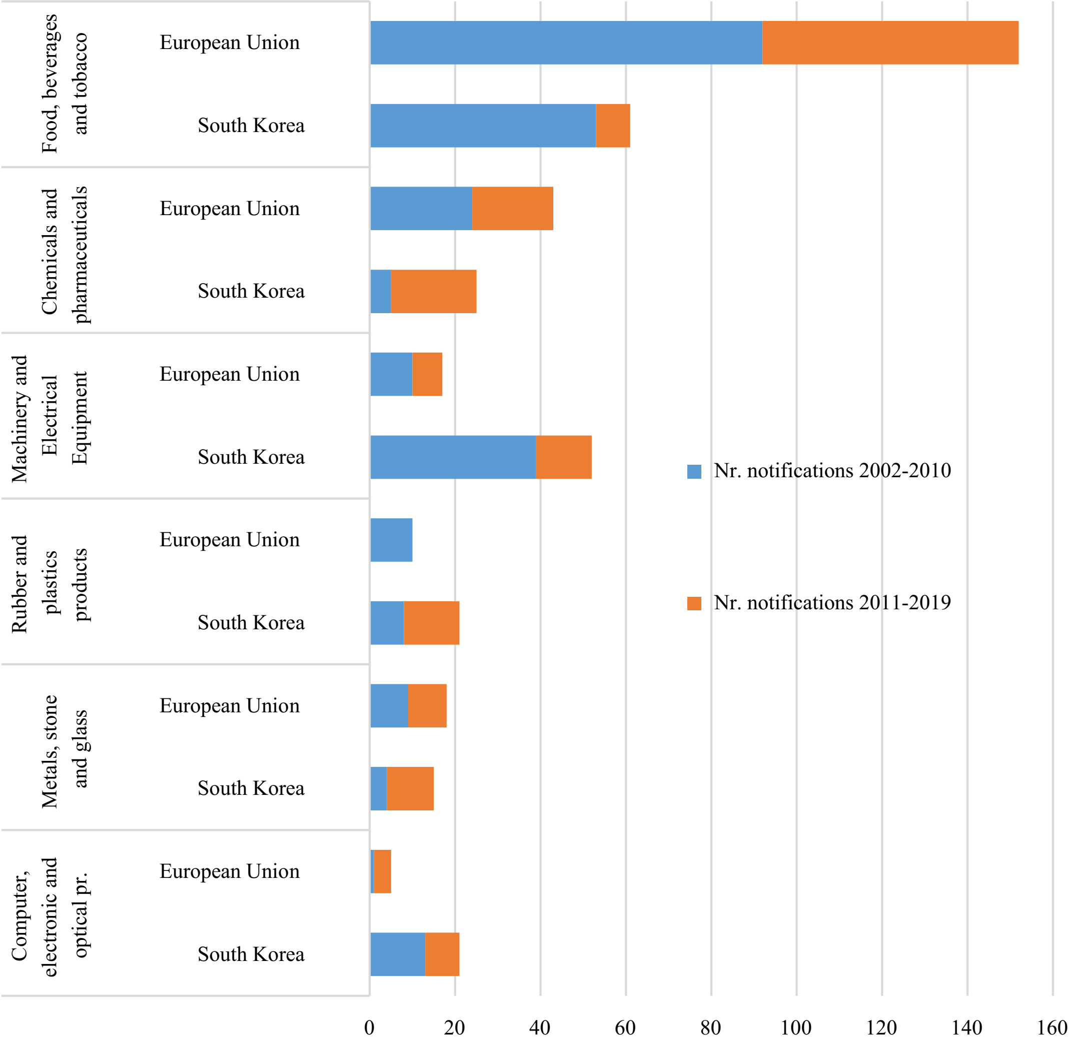

FIGURE A1 EU and South Korea's notifications of NTMs by sector for the period 2002–2019. *Note*: Non-tariff measures include technical barriers to trade, sanitary and phytosanitary measures, anti-dumping and countervailing measures. We show the most regulated sectors during the period 2002–2019. *Source*: Authors' calculations based on WTO-Integrated Trade Intelligence Portal (I-TIP) database.

TABLE A5 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

	(1) Food	(2) Textile	(3) Chemicals	(4) Metals	(5) Electronics	(6) Machinery	(7) Vehicles	(8) Other transport	(9) Aggregate
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

	(1) Food	(2) Textile	(3) Chemicals	(4) Metals	(5) Electronics	(6) Machinery	(7) Vehicles	(8) Other transport	(9) Aggregate
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	96,859	97,399	97,229	97,430	97,167	97,520	96,008	94,193	1,248,549

Note: This table reports PPML estimates of the effects of the EU–South Korea FTA for the eight 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 ***significance at the level of 10%, 5% and 1%.