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Impact of global value chains on tariffs and non-tariff measures in agriculture and food

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ABSTRACT

We analyse whether global value chains (GVCs) reduce trade barriers in the agricultural and food sectors as they affect lobbying and government incentives. Political economy theory predicts that tariffs will be lower in countries integrated in GVCs and that the effect will be stronger outside regional trade agreements (RTAs). We use data from 1995 to 2015 from 160 countries on tariffs and non-tariff measures (NTMs) in the agri-food sector. Our evidence indicates that GVC integration, measured as domestic (foreign) value added in foreign (domestic) final goods, does affect trade policy. Stronger GVC integration is associated with lower tariffs, but mainly outside RTAs, and lower NTMs, both inside and outside RTAs.

1. Introduction

There is a large literature documenting and analyzing the growth of global value chains (GVCs) and its implications, both in the general economy and for agriculture and food (Swinnen, 2007, World Bank, 2020a). Studies have pointed out how government policy, and especially trade policy, affect the integration of industries in GVCs, typically finding that border protection negatively affects the integration in GVCs (e.g., Greenville et al., 2017b; Balié et al. 2018).

However, economists have pointed out that trade policy not only influences GVCs, but that there is also an inverse relationship. Antràs and Staiger (2012), Blanchard (2007, 2010), Ornelas and Turner (2008, 2012) theoretically analyze how offshoring affects governments' optimal trade policy. Most recently, Blanchard, Bown, and Johnson (BBJ) (2021) integrate GVCs in the protection-for-sale model of Grossman and Helpman (1994, 1995). They show that industries' participation in GVCs affects the impacts of tariffs and industry incentives to lobby governments, and thereby government incentives to raise tariffs. The effects occur both in forward and backward participation in GVCs.[1] When domestic industries supply inputs to foreign industries, imposing tariffs on foreign producers' final products hurts domestic industries also. When foreign industries provide inputs to domestic industries, protecting domestic industries against import competition also benefits foreign input producers. BBJ's theory therefore predicts that more GVC integration will thus lead to lower tariffs.

A few empirical studies have tested these theories, including Ludema, Mayda, Yu and Yu (2018), Blanchard, Bown, and Johnson (2021), and Bown, Erbahar, and Zanardi (2021). They find that the national origin of the value-added content of traded goods indeed affects tariffs on final goods.[2] These empirical studies focus only on the manufacturing sector and mainly on tariffs as trade policy indicator.

Our paper is the first to analyze these relationships in the agricultural

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[1] In the GVCs literature "forward" and "backward" participation are also called "domestic" and "foreign" value added – DVA and FVA, respectively. In what follow we treat these two terms as substitute. Also note that, domestic value added indicates the extent of involvement in GVC for upstream industries. Instead, foreign value added captures the extent of involvement in GVC for downstream industries.

[2] Other contributions are found in Blanchard and Matschke (2015), and Jensen, Quinn, and Weymouth (2015) that empirically show how trade policy has become endogenous to FDI and cross-border intra-firm trade. More recently, the trade war between US and China has given rise to papers by Amiti, Redding, and Weinstein (2019), Bellora and Fontagné (2019), and Fajgelbaum, Goldberg, Kennedy, and Khandelwal (2020), among others, who focus on the welfare implications of trade protection that take vertical GVC linkages into account. See Antràs and Chor (2022) for an updated review of the GVC literature.

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and food sectors, and we extend previous analyses by using both tariffs and non-tariff measures as indicators of trade policy. GVCs have expanded significantly in the agricultural and food sectors over the past decades (Kowalski et al. 2015; Greenville et al., 2017a; Balié et al. 2018; Swinnen et al. 2021).[3] A strong growth has been observed in cross-border foreign direct investments in food processing and retailing, as well as in forward linkages in commodity chains such as coffee or cocoa (Barrett et al 2022; World Bank, 2020a). In addition, tariffs in the agri-food sector are widespread and typically higher than in the manufacturing sector where tariffs are already quite low worldwide (Teti, 2020; Niu et al. 2018).

In our analysis we also include non-tariff measures (NTMs) as indicators of trade policy. The use of NTMs has grown rapidly in recent decades, and these measures, including sanitary and phytosanitary food standards, are used extensively in the agri-food sectors (Beghin et al. 2015; Swinnen et al. 2015). Studying NTMs may yield important additional insights because governments have a greater degree of freedom to set NTMs than tariffs, as tariff setting may be bound by trade agreements, such as the GATT most-favoured-nation (MFN) rule.[4]

We use data on backward and forward GVC linkages and trade policies for 160 countries between 1995 and 2015. As mentioned, we use both tariffs and NTMs as policy variables, and we include indicators of trade agreements, since these are likely to affect the relationships that we study. We estimate a reduced form and an extended model, including a series of robustness tests and additional estimations to account for endogeneity issues. In particular, since GVC participation tends to be endogenous to trade policy, we account for this simultaneity bias through instrumental variable estimator, by using GVC participation in services as instrument for GVC in the agri-food sector.

In general, our empirical results are consistent with the theoretical predictions, i.e. participation in GVCs reduces both tariffs and non-tariff measures, and this holds for both backward and forward integration. We also find that trade agreements play a role: the effects are stronger outside trade agreements, albeit less so for NTMs than for tariffs.[5]

The paper is structured as follows: Section 2 summarizes the main predictions of the BBJ (2021) political economy model that will inform our empirical application. Section 3 presents the data, the empirical model, and potential identification issues. Section 4 discusses the main results and checks for the robustness of the results. Section 5 concludes.

2. Theory and hypotheses

2.1. The basic model

Blanchard, Bown, and Johnson (2021) develop a model with a stylized representation of the production process, where production of final goods in each country combines labour, sector-specific capital, and an input that is only produced in another country. Their model captures two essential features of global value chains: (a) both domestic and foreign factors of production are necessary to produce a final good within a GVC; and (b) GVCs often have a high degree of input specificity and lock-in between buyers and sellers (Antràs and Staiger 2012).[6] These GVC features are incorporated into the political economy model of Grossman and Helpman (1994, 1995) to identify the government's optimal tariffs on final goods in bilateral trade.[7]

The optimal non-cooperative tariff, t^i_{xj}, imposed by country i on imports of country j final goods x, is summarized in Eq. (1) with δ representing the political influence weights of interest groups relative to consumer welfare:[8]

$$t^i_{xj} = \frac{1}{e^i_{xj}}\left(1 + \left(1+\delta^{gh}_x\right)GH^{i\_sh}_{xj} - \left(1+\delta^{dva}_x\right)DVA^{j\_sh}_{xi} - \left(1+\delta^{fva}_{x^*}\right)FVA^{i\_sh}_x\right) \tag{1}$$

The first two terms of Eq. (1) are well-known from the original Grossman and Helpman model. The first captures the familiar terms-of-trade motive for protection, reflected in the inverse export supply elasticity $\frac{1}{e^i_{xj}}$. The second captures the influence of domestic political concerns, whereby the government trades off social welfare and the interests of import-competing industries, reflected in the (inverse) of import penetration term $GH^{i\_sh}_{xj}$, i.e. production of domestic final goods scaled by bilateral imports, and the political weight of these industries, δ^{gh}_x.[9] All else equal, the government will impose higher tariffs protection when import penetration is low, and the political weight of the import competing industries stronger.

The third and fourth term capture the impacts of GVC integration. GVC integration can occur through domestic industries supply inputs to foreign final good producers, and vice versa. $DVA^{j\_sh}_{xi}$ measures the share of domestic value added in the price of foreign final goods. By imposing tariffs, the government not only hurts the foreign producers of final products, but also the domestic industry that is supplying inputs to the foreign producers. These domestic producers will oppose such tariffs and thus reduce government incentives to raise tariffs. This negative impact, captured by the third term, is stronger when the share of domestic value added in the price of foreign final goods ($DVA^{j\_sh}_{xi}$) and the weight of these domestic producers (captured by δ^{dva}_x) is larger.

$FVA^{i\_sh}_x$ measures the role of foreign value added in domestically produced final goods. Raising tariffs to protect this domestic industry will also benefit the foreign industries that supply inputs – or in other words, part of the benefits of the protection go to foreign industries. The larger this effect (measured by $FVA^{i\_sh}_x$) the lower the incentives for governments to increase tariffs, captured by the fourth term ($\delta^{fva}_{x^*}$ represents the political weight of foreign input suppliers, which may

[3] For example, agri-food trade has more than quadrupled in nominal terms during the past three decades (see Balié et al. 2018) and more than 45% of this trade refers to intermediate inputs, according to the United Nations Broad Economic Classification system (OECD 2016).

[4] In fact, the most revealing empirical tests of the Grossman and Helpman (1994) theory used non-tariff-barriers (NTBs) as the outcome variable of interest, precisely because actual tariffs as an effect of several WTO agreements are set cooperatively (see Goldberg and Maggi, 1999; Gawande and Bandyopadhyay, 2000).

[5] Note, one feature of this paper, in addition to the focus on GVC participation, is to exploit bilateral variation in trade policy outcomes for identification, instead of focusing on cross-country (e.g. Olper and Raimondi, 2013; Olper et al. 2014), or cross-industry (Gawande and Hoekman 2006; Lopez and Matschke, 2006) variation. This is an important departure from previous applications, directly linked to the BBJ (2021) theoretical model, that significantly extends previous efforts to understand the relevant economic and political forces driving government policy decisions in the agri-food sector.

[6] In the model the buyer–seller lock-in is manifest as factors specificity and frictions in factors substitution, a logic that can be applied directly to the agri-food value chain transactions, particularly when product quality is taken into account.

[7] Note, some authors suggested that the original Grossman and Helpman (1994) protection for sale model is inconsistent with observed patterns of agricultural protection, particularly when poor vs rich countries are concerned (see Rodrik, 1995). Yet, a simple extension of the Grossman and Helpman model by Cadot et al. (2006) reconciled this potential ambiguity. For a test of the Grossman and Helpman model on US agricultural protection, see Gawande and Hoekman (2006), for a test on the US food industry, see Lopez and Matschke (2006).

[8] Equation (1) above is an over-simplification of equation 3.3 in Blanchard et al. (2021), which the interested reader is referred to for additional details.

[9] The term, GH^i_{xj}, also incorporates the inverse of the price elasticity of demand for imports of the final good (Grossman and Helpman, 1994). Essentially, this is the Ramsey argument that the more inelastic is demand, the higher the optimal tax (tariff), due to the lower deadweight loss of that tax (tariff).

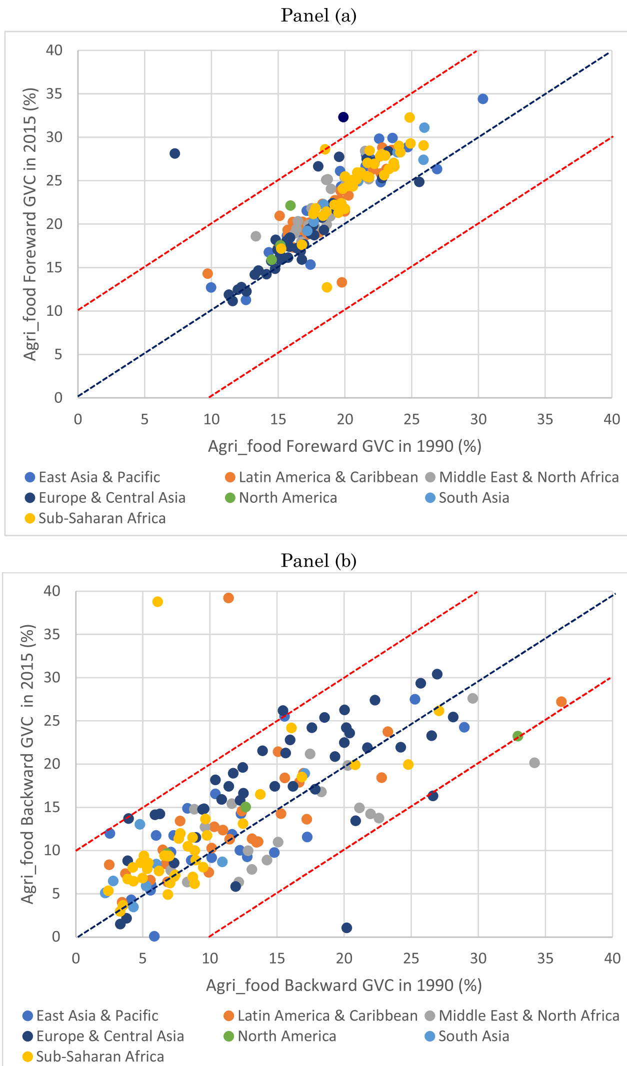

Fig. 1. Evolution of DVA (a) and FVA (b) in the whole sample. Source: Authors' elaborations, using data from Eora26 database. *Notes*: Forward GVC (panel a) and Backward GVC (panel b) shares are computed as average export share, over trading partners. The blue 45-degree line marks instances in which GVC participation for a given country are the same in 1990 and 2015. The red 45-degree lines mark a 10 percentage points change in the rate of GVC participation between 1990 and 2015. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

be zero).

Finally, note that domestic and foreign value added in Eq. (1) are both scaled (sh) by bilateral imports (M^i_{xj}), just as the (inverse) of import penetration ratio term of the standard Grossman and Helpman model. Thus, the DVA and FVA value-added terms act as counterweights to the standard terms-of-trade motive for protection, whose strength is related to the level of bilateral imports, M^i_{xj}.

2.2. Discussion and implications

The optimal BBJ (2021) tariff formula thus predicts that the home (foreign) supply of inputs dampens the terms-of-trade motive for tariffs on final goods, and that this effect will be stronger with stronger integration in GVCs, measured by the shares of traded inputs in the price of the final product.[10]

As discussed in BBJ (2021), there are additional implications when Eq. (1) is taken to the data. First, the GATT most-favoured-nation rule suggests that World Trade Organization members cannot discriminate across their trading partners. Thus, MFN tariff rates represent an upper bound on applied bilateral tariffs. For this reason, empirical applications focus on bilateral applied tariff *deviations* from MFN tariffs or, in other words, preference margins.[11]

Second, bilateral or regional trade agreements (RTAs) are likely to affect these relations. This is because a (reciprocal) trade agreement tends to eliminate or soften the terms-of-trade motive for protection. Hence, it is reasonable to expect that the degree of cooperation between RTA members could change the relationship between value-added content and applied tariffs for countries within and outside an RTA. More specifically, this argument predicts that the negative relationship between GVC participation and tariffs is stronger outside RTAs.

The impact of RTAs may be different for the two types of GVC integration. The mechanism through which the share of foreign input in domestic final goods industry (FVA) affects tariffs in the model is through increases in domestic prices, and there is little evidence on the potential for cooperative agreements to mitigate behind-the-border impacts (BBJ, 2021).[12] Note in addition that, the FVA effect reflects a multilateral (not a bilateral) effect, and bilateral agreement may not (fully) mitigate this multilateral effect. In summary, the effect of RTAs on the GVC impact may well differ between these different GVC systems.

So far, we have focused on tariffs. However, a substantive share of protectionist instruments are non-tariff measures (NTMs). The theoretical predictions on tariffs may not simply apply to non-tariff measures, because they are largely set as non-discriminatory, behind-the-border, domestic regulations. There is some evidence showing that deep-integration clauses in trade agreements tend to reduce the protectionist effect of NTMs (see Cadot and Gourdon, 2016; Santeramo, 2020). However, current RTAs only rarely have legally enforceable provisions concerning convergence in regulations, such as mutual recognition or harmonization rules (see Grossman et al. 2020; World Bank, 2020b; Fernandez et al., 2021). As a result, there are arguments to expect that NTMs may be affected similarly as tariffs, both inside and outside RTAs, and some arguments that would imply different hypotheses.

A final issue is whether a model that was developed with GVC linkages with manufacturing in mind can be applicable to agri-food GVCs. Overall, we believe that the predictions and the mechanisms of the BBJ (2021) model are also relevant for the agri-food sector. First, the standard Grossman and Helpman (1994) model has been successfully applied to protection patterns in the agri-food sector (see Gawande and Hoekman, 2006; Lopez and Matschke, 2006). Second, although GVC participation is significantly deeper in manufacturing and services than in the agri-food sector, GVCs have grown in the agri-food sector as well, particularly

[10] While the strength of the effects is also influenced by the political weights (δ^i_x) of the different industries, testing the BBJ (2021) model empirically does not require data on political organization (see, e.g., Goldberg and Maggi, 1999). This is an important advantage given the difficulty in collecting data on the political organization for many countries and sectors.

[11] Current bond tariffs in the agri-food sector were set under the 1994 Uruguay Round, the first multilateral trade agreement involving this sector. This preceded the post-1990 rise in global value chain activity following the Round. Note that the empirical setting exploits variation in tariff preferences across trade partners within a given importer and industry (over time), meaning that we differentiated MFN tariffs in our empirical specifications (see section 3.3 for details).

[12] For example, the recent political economy model of Bouët et al. (2021), inspired by the complexity of border and domestic behind-the-border policy in agriculture, suggests that in the presence of asymmetric information, it may become impossible to eliminate those instruments by means of a trade agreement, once the domestic government has private information on their redistributive effects.

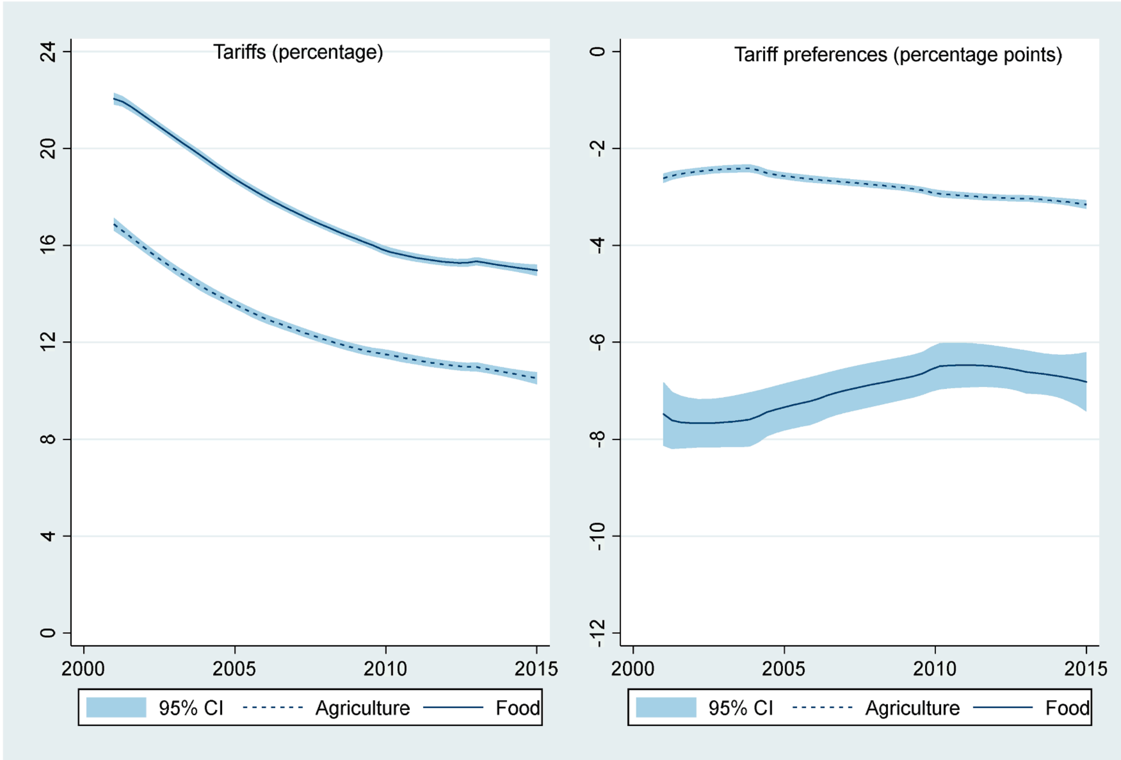

Fig. 2. Bilateral tariffs and bilateral tariff preferences. Source: Authors' analysis based on MAcMaps database and WTO database. Bilateral tariff preferences are obtained as the (negative) deviation from MFN tariffs (see text).

referring to forward GVC participations (see Fig. 1), and display a huge heterogeneity across countries and geographical areas (see Fig. 1, and World Bank, 2020a). Importantly, one reason behind the lower GVC participations in the agri-food sector, other than its peculiarity, lies in the high level of border protection (see Balié et al. 2018). Third, the underlying mechanism used by BBJ (2021) to model the international links induced by GVC participation is mainly based on input search costs, a mechanism also found in the modern agri-food supply chain, particularly when food safety, quality and environmental concerns are at stake.

3. Data, variables and empirical specification

3.1. GVC data and measures

Measures of backward and forward GVC participation are derived from the UNCTAD-Eora Global Value Chain Database. The database provides balanced multi-region input–output tables, combined with bilateral trade statistics, for 186 countries and 25 harmonised ISIC-type sectors from 1990 to 2015. We focus on agriculture, and the food and beverage sectors (ISIC codes 1,15–16).[13]

Decomposition of the flow of gross exports is performed with the R *decompr* package (Quast and Kummritz, 2015), which together with the Wang et al. (2013) decomposition algorithms allow us to split bilateral gross exports into 16 value-added components. We use this export decomposition and follow Balié et al (2018) to construct two measures of GVC participation: forward and backward GVC participation by country. The forward component (DVA) measures the exports of intermediate goods used as inputs in the production of other countries' exports and is an indicator of the extent of involvement in GVC for upstream industries.[14] The backward component (FVA) measures value added in intermediate inputs imported from abroad used in the production of a country's exports, and captures the extent of involvement in GVC for downstream industries.[15]

The core determinant of trade policy in the Grossman and Helpman (1994) model is the (inverse) import penetration variable, GH, which is measured as the production of domestic final goods scaled by bilateral imports.[16]

In computing the GVC variables we included all countries where data was available. The 27 EU members are reported as individual countries in the dataset. We compute value added content using the fully disaggregated country data, and then aggregate value-added contents across EU countries to form the EU composite value added.

Fig. 1 reports the domestic and foreign value added as share of gross exports between 1990 and 2015 over the sample of countries where data was available. The two GVA participation variables are computed as the average of a country's share of exports over its trading partners. The blue line in the middle depicts situations where GVC participation remains constant over the period under analysis, whereas the red lines give the upper and lower bounds of a 10-percentage points positive and negative change, respectively, in the rate of GVC participation between 1990 and 2015. Forward GVC links (DVA) grew in almost all countries. Countries

[13] We also measure forward GVC for sector "Education, Health and Other Services", used as instrument in the IV regressions discussed below.

[14] This is measured by adding the six export components concerning the two groups of domestic value added in intermediate exports re-exported to third countries and domestic value-added returning home.

[15] Backward GVC is obtained by adding the five exports components involving foreign value added in final and intermediate goods exports, and pure double counting due to the direct imported exports production.

[16] Specifically, we use domestic value-added content in final exports as a proxy of the national value added contained in importer industry's final goods production.

with the larger increase in the Forward DVA component are in Sub-Saharan Africa (yellow circles), Latin America (orange circle) and South Asian (blue circle). Instead, Backward GVC links (FVA) grew particularly in Europe and Central Asia, but there was a reduction in the FVA share in the Middle-East, North Africa and North America. The average patterns of GVC participation in the agri-food sector confirm previous decomposition by other authors (see Balié et al. 2018; World Bank, 2020a).

3.2. Trade policy variables

For tariff indicators, we use both bilateral applied tariffs and multilateral MFN applied tariffs, sourced from CEPII-MAcMaps database and WTO database, respectively.[17] The CEPII MAcMaps-HS6 database provides the ad valorem equivalent of applied protection for each product importer-exporter at HS 6-digit level for the years 2001, 2004, 2007, 2010, and 2015. MAcMaps applied tariffs represent a consistent and comparable measure across products and countries. The ad valorem equivalent (AVE) calculation uses ad valorem duties, the main border measure, several other types of duties, besides tariff rate quotas (TRQs) (Guimbard et al., 2012).[18]

To identify tariffs on final goods in the data, we use the Broad Economic Categories (BEC) classification, keeping HS 6-digit categories classified as "Mainly for household consumption", and discarding both mixed use and intermediate input categories.[19] Then, to concord these HS 6-digit final goods categories to Eora industries, HS 6-digit products are converted to ISIC 4-digit classification and aggregated at 2-digit level. We take the simple average of HS product tariffs within each industry to measure both industry-level applied bilateral tariffs and multilateral MFN tariffs.

Finally, following BBJ (2021), we measure bilateral tariff preferences as the (negative) deviation from MFN tariffs: $tp^x_{ijt} = t^x_{ijt} - tMFN^x_{it}$. Thus, the larger (in absolute value) the bilateral tariff preference (tp^x_{ijt}) granted by country i to country j in sector $\times$, in year t, the lower the applied bilateral tariff between countries (t^x_{ijt}).

Fig. 2 presents the evolution of bilateral tariffs and bilateral preferential tariffs in the observed period. Tariffs are lower in agriculture than in the food industry, consistent with tariff escalation. Average tariffs declined significantly between 2001 and 2015: agricultural tariffs decreased from 17% to 10%; in the food industry, tariffs decreased from 22% to 15%. The trend of the mean difference between the applied bilateral tariff and the applied MFN tariff changed slightly over time: it increased from 2.6 to 3.2 percentage points for agricultural products, while it fell from 7.5 to 6.8 percentage points in the food industry.

Finding a good indicator for NTMs is less obvious since NTMs are mainly unilateral in nature, whereas the theoretical model and our estimation framework relies on bilateral measures of protection. To address this issue, we rely on a particular sub-set of non-tariff measures, i.e. SPS standards affected by specific trade concerns (STCs).[20] As discussed in detail by Fontagné et al. (2015) and Curzi et al. (2020), an analysis of SPS measures affected by STCs shows that, although they are behind-the-border measures in nature, they are far from being non-discriminatory. Indeed, they can discriminate not only between domestically produced and imported products, but across exporting countries or potentially against specific exporting firms.[21]

An important advantage of SPSs affected by specific trade concerns over standard SPS notifications is that they identify a sub-set of SPSs in force that are perceived by exporters and/or governments as major obstacles to trade. As a result, the information they provide relates to *restrictive* trade measures only. This is important because many SPS measures notified to the WTO, such as those addressing problems of asymmetric information or network externalities may even increase trade, as recently shown by Curzi et al. (2020) and others. A potential shortcoming in using SPS affected by specific trade concerns is that they represent only a sample of the universe of SPS concerns. As discussed in Grant and Arita (2017), the countries represented in STC data are predominantly middle- and high-income countries with the technical and financial capacity to have representation at the SPS committee meetings. Indeed, there are pecuniary or reputation costs of notifying the WTO when a country's exporters are hit with an SPS. As a result, there could be selection bias in the countries represented in our NTM data. However, Grant and Arita (2017) also showed that the countries represented in the STCs dataset are comparable to the ones present in other NTM datasets (e.g. UNCTAD Trains), suggesting that selection bias should not constitute a relevant problem.

To build our bilateral NTM^i_{xjt} measure we use information from the WiiW database, based on the WTO notifications available from the Integrated Trade Intelligence Portal (I-TIP).[22] The dataset provides information on (i) the country raising the concern and the country imposing the (restrictive) SPS measure; (ii) the year of the concern; (iii) the product subject to the concern at the HS 6-digit level; (iv) the type of measure and subject of the concern; (v) the eventually date of resolution of the concern. Here we focus on STCs raised on Sanitary and Phytosanitary (SPS) measures, which primarily target the agri-food sector. The data cover 170 SPS food standards directly notified to the WTO against which STCs were raised by at least one country. The final data, available from 1995 to 2015, concern 86 imposing countries and 157 exporting countries and involves around 700 HS 6-digit agri-food products. To build our bilateral index, we keep only the HS 6-digit products classified as "Mainly for household consumption", using the BEC classification. These product codes represent the 57% of HS 6-digit agri-food products. Then, we average the number of STCs recorded for final products at bilateral and time level, over our two ISIC 2-digit sectors, agriculture and food. The resulting bilateral NTMs varies from 0 – bilateral relation without any SPS affected by STCs – to 3 – the maximum (average) number of (restrictive) SPS in force in country i affected by STCs raised by country j (see Appendix Table A2).

Data on regional trade agreements (RTAs) come from the updated version of the Egger and Larch (2008) database, which includes 455 bilateral agreements distinguished by type of trade agreements and notified to the World Trade Organization from 1950 to 2015. We used (reciprocal) Regional Trade Agreements, as defined in Paragraph 8(b) of

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[17] Multilateral MFN applied tariffs are obtained through the WITS website (https://wits.worldbank.org).

[18] Changes in protection for TRQ products, while playing a minor role at aggregate level, are not negligible when agricultural products are considered. In the UNCTAD-TRAINS database, while specific tariffs are converted in their respective ad-valorem equivalent (AVE), the database does not provide ad valorem equivalent of TRQs. For discussion, see Teti (2020).

[19] The HS 6-digit products classified as "mainly for household consumption" (codes 112 and 122 of BEC classification) represent, on average, the 67% of agri-food product tariff lines. Specifically, the share is 56% for agricultural products, and it is 72% for food products.

[20] Over the period 1995–2015, has been raised about 400 STCs related to 170 SPS measures, with more than 100 countries involved (in either raising, maintaining, or supporting an STC). About 150 HS-4 product codes, over the 220 HS-4 total in the agri-food, were affected by at least one STC. This suggests a quite broad incidence of product concern, with an amount of about 28,500 country-pair-by-HS4-code combinations with at least one STC. See Grant and Arita (2017) for and indebt discussion and analysis of the SPS specific trade concerns.

[21] An interesting example discussed in Fontagné et al. (2015) is the specific trade concern raised by the EU in 1998 and related to the US requirement on refrigeration and labeling for shell eggs. The EU required clarifications regarding the non-application of the measure to production units with 3000 hens or lower and asked the United States to explain the discrimination between foreign and domestic eggs. This is a clear example showing a measure that discriminate against large exporting firms.

[22] For more information on WiiW-NTM data see Ghodsi et al. (2017). The NTM database is publicly available at https://wiiw.ac.at/wiiw-ntm-data-ds-2.html.

Table 1
Bilateral tariffs and DVA: Baseline regressions.

	Agri-food			Agriculture			Food		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\ln(DVA^j_{xit})$	−0.200***	−0.175***		−0.171***	−0.157***		−0.228***	−0.189***	
	(0.030)	(0.029)		(0.030)	(0.029)		(0.043)	(0.042)	
RTA		−3.365***	−4.553***		−3.084***	−3.774***		−3.631***	−5.283***
		(0.184)	(0.323)		(0.194)	(0.374)		(0.216)	(0.386)
$\ln(DVA^j_{xit})$ RTA = 1			0.042			−0.032			0.114
			(0.066)			(0.070)			(0.086)
$\ln(DVA^j_{xit})$ RTA = 0			−0.216***			−0.181***			−0.246***
			(0.028)			(0.027)			(0.039)
ln(distance)	1.484***	1.184***	1.185***	1.347***	1.048***	1.049***	1.598***	1.301***	1.300***
	(0.073)	(0.075)	(0.075)	(0.078)	(0.083)	(0.083)	(0.084)	(0.085)	(0.085)
Colony	−0.329	−0.337*	−0.321	−0.910***	−0.873***	−0.864***	0.186	0.131	0.154
	(0.211)	(0.202)	(0.201)	(0.231)	(0.224)	(0.223)	(0.228)	(0.219)	(0.217)
Language	−1.932***	−1.794***	−1.758***	−1.742***	−1.606***	−1.580***	−2.108***	−1.971***	−1.930***
	(0.175)	(0.167)	(0.165)	(0.190)	(0.180)	(0.177)	(0.199)	(0.190)	(0.188)
Contiguity	−2.257***	−1.974***	−2.043***	−2.057***	−1.800***	−1.847***	−2.491***	−2.186***	−2.267***
	(0.390)	(0.387)	(0.385)	(0.394)	(0.392)	(0.391)	(0.440)	(0.436)	(0.434)
Fixed effects									
Imp-Ind-Year (*ixt*)	Yes	Yes	Yes	No	No	No	No	No	No
Exp-Ind-Year (*jxt*)	Yes	Yes	Yes	No	No	No	No	No	No
Imp-Year (*it*)	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Exp-Year (*jt*)	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	171,056	171,056	171,056	81,819	81,819	81,819	89,237	89,237	89,237
R-Sq	0.883	0.885	0.886	0.921	0.923	0.923	0.841	0.844	0.844

Notes: OLS regressions. The dependent variable is bilateral applied tariffs. RTA refers to reciprocal Free Trade Agreement-FTA as defined in Paragraph 8(b) of Article XXIV of GATT 1994. Standard errors (in parentheses) are clustered by importer-exporter pair.
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Article XXIV of GATT 1994.[23] Finally, we use standard gravity variables as additional (bilateral) controls, such as language, contiguity, colonial link, and bilateral distance between countries. These variables are taken from CEPII (Centre d'Etude Prospectives et d'Informations Internationales).

Our final dataset for the analysis of tariff preferences includes bilateral data on 163 importing (180 exporting) countries over the period 2001–2015. For the NTM analysis our dataset includes 70 importing (86 exporting) countries over the period 1995–2015. Summary statistics of all the variables described above, together with the list of countries involved in the two datasets (tariffs, and NTMs) are reported in the Appendix Tables A1 and A2.

3.3. Empirical specifications

To empirically test Eq. (1) we first use a reduced form specification focusing on the impact of domestic value added in foreign production (DVA), i.e. forward GVC linkages, isolating the other terms in Eq. (1) through fixed effects. The main advantage in comparison to the full specification discussed below, is the possibility to properly account of simultaneity bias through an instrumental variable estimator (IV). Formally, we estimated the following specification:

$$t^i_{xjt} = \Phi_{xit} + \Phi_{xjt} + \beta \ln\left(DVA^j_{xit}\right) + \nu_{xijt} \quad (2)$$

where the dependent variable t^i_{xjt} is, alternatively, the minimum between the preferential or MFN tariff, $\min\left\{t^{i,p}_{xjt}, t^{i,MFN}_{xt}\right\}$, or the NTM bilateral index, NTM^i_{xjt}; Φ_{xit} and Φ_{xjt} are importer-industry-year and exporter-industry-year fixed effects.[24] Our right-hand side variable of interest is $\ln\left(DVA^j_{xit}\right)$, with coefficient sign prediction $\beta < 0$. In some specifications we also add a full set of gravity controls to reduce omitted variable bias.

We estimate Eq. (2) both for the agricultural and food sectors combined and for each separately, to investigate possible heterogeneity of the DVA effect. We include importer-year and exporter-year fixed effects (and importer-industry-year and exporter-industry-year fixed effects for the pooled regression). The inclusion of these fixed effects is crucial for identification because they should absorb the (omitted) inverse export supply elasticity $\frac{1}{e^j_{xj}}$, the inverse of import penetration and the foreign value added (FVA), all factors affecting the applied equilibrium tariff in Eq. (1). The identification hypothesis is that the inclusion of these fixed effects could properly account for these omitted terms, thereby minimizing the correlation between $\ln\left(DVA^j_{xit}\right)$ and the error term ν_{xijt}.

To check this identification hypothesis and address possible endogeneity bias due to reverse causation between DVA and tariffs, we also run a specification through instrumental variable estimator (IV), where agriculture and food DVA are instrumented by DVA in the service sectors.

To study the impact of backward GVC linkages captured by the

[23] Note, the Egger and Larch data on RTAs distinguish four distinct (but not mutually exclusive) types of RTAs: reciprocal Free Trade Agreement-FTA as defined in Paragraph 8(b) of Article XXIV of GATT 1994, the one considered here and called for simplicity RTAs; Customs Union (as defined in Paragraph 8 (a) of Article XXIV of GATT 1994); "Partial Scope" Agreements (notified under paragraph 4(a) of the Enabling Clause); Economic Integration Agreement (as defined in Article V of GATS). Thus, outside RTAs as defined in this paper, there can be other tariff variations related to agreements different from our formal definition, such as preferences granted under the generalized system of preferences (GSPs), and other miscellaneous preference programs.

[24] We cannot use bilateral (importer-exporter) fixed effects for three main reasons. First, many bilateral preferences schemes are present in our data, so that adding bilateral fixed effects tend to remove the bulk of variation, rendering identification problematic. Second, equation (1), does not directly support the inclusion of additional fixed effects (see Blanchard et al. 2021), i.e., the specification includes proxies or controls for the key determinants of optimal tariffs suggested by the theory. Third, differently from previous applications based on the manufacturing sector, working with the agri-food sector we cannot exploit cross-industry variation. For example, Blanchard et al. (2021) exploit also cross-industry variation in 16 manufacturing sectors for identification, notwithstanding they did not use bilateral fixed effects.

Table 2
Bilateral tariffs and DVA: Instrumental variable (IV) regressions.

	Agri-food		Agriculture		Food	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(DVA^{j}_{xit})$ RTA = 1	0.009	0.258**	−0.036	0.201*	0.059	0.290**
	(0.075)	(0.117)	(0.074)	(0.120)	(0.105)	(0.136)
$\ln(DVA^{j}_{xit})$ RTA = 0	−0.207***	−0.523***	−0.137***	−0.438***	−0.270***	−0.610***
	(0.032)	(0.076)	(0.030)	(0.076)	(0.046)	(0.087)
RTA	−3.558***	−6.470***	−2.887***	−5.643***	−4.241***	−7.183***
	(0.424)	(0.603)	(0.447)	(0.663)	(0.546)	(0.691)
ln(distance)	1.676***	1.438***	1.412***	1.204***	1.908***	1.631***
	(0.092)	(0.105)	(0.099)	(0.106)	(0.106)	(0.124)
Colony	−0.375	−0.234	−1.073***	−0.962***	0.262	0.437
	(0.259)	(0.255)	(0.282)	(0.278)	(0.281)	(0.279)
Language	−1.762***	−1.547***	−1.519***	−1.315***	−1.994***	−1.767***
	(0.215)	(0.212)	(0.224)	(0.218)	(0.247)	(0.245)
Contiguity	−0.663*	−0.519	−0.864**	−0.716*	−0.520	−0.361
	(0.379)	(0.392)	(0.374)	(0.392)	(0.437)	(0.449)
K-P F-statistic		763.953		517.709		700.997
No. of obs.	123,036	123,036	59,562	59,562	63,474	63,474
R-Sq	0.895		0.931		0.856	

Notes: The dependent variable is bilateral applied tariffs. RTA refers to reciprocal Free Trade Agreement-FTA as defined in Paragraph 8(b) of Article XXIV of GATT 1994. Each regression includes importer-industry-year and exporter-industry-year fixed effects. The first stage IV regression used DVA in services as instrument for agri-food DVA; The K-P F-statistic is the weak-identification test of Kleibergen and Paap (2006). First stage results are reported in Table A3 in Appendix. Standard errors (in parentheses) are clustered by importer-exporter pair.
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

foreign value added (FVA) indicator on trade policy (and the other terms of Eq. (1)), it is first necessary to change the model specification, because an important component of FVA operates at the multilateral level. Following BBJ (2021), we replace the importer-industry-year fixed effects with importer-industry and importer-year fixed effects. In this specification, in line with Eq. (1), all the determinants of equilibrium trade barrier enter as a share (*sh*) of bilateral final imports:

$$t^{i}_{xjt} - t^{i,MFN}_{xt} = \Phi_{xi} + \Phi_{it} + \Phi_{xjt} + \beta^{GH}\ln\left(GH^{i-sh}_{xt}\right) + \beta^{FVA}\ln\left(FVA^{i-sh}_{xt}\right) + \beta^{DVA}\ln\left(DVA^{j-sh}_{xit}\right) + \omega_{xijt} \quad (3)$$

Table 3
Tariff preferences and GVC participation in agri-food sector: Baseline results.

Dependent variable	Tariff preferences			
	(1)	(2)	(3)	(4)
$\ln(DVA^{j-sh}_{xit})$	−0.004	−0.389***	−0.011	−0.374***
	(0.053)	(0.047)	(0.052)	(0.046)
$\ln(FVA^{i-sh}_{xt})$	−0.127**		−0.113**	
	(0.049)		(0.049)	
$\ln(GH^{i-sh}_{xt})$	0.332***		0.319***	
	(0.032)		(0.032)	
$\ln(FVA^{i-sh}_{xt} + GH^{i-sh}_{xt})$		0.277***		0.267***
		(0.028)		(0.028)
RTA			−1.664***	−1.703***
			(0.146)	(0.146)
Gravity controls	Yes	Yes	Yes	Yes
Fixed effects				
Importer-year (*it*)	Yes	No	Yes	No
Industry-year (*xt*)	Yes	No	Yes	No
Imp-ind-year (*ixt*)	No	Yes	No	Yes
Exp-ind-year (*jxt*)	Yes	Yes	Yes	Yes
No. of obs.	96,552	96,552	96,552	96,552
R-Sq	0.98	0.99	0.98	0.99

Notes: The dependent variable is bilateral tariff preference, obtained as the (negative) deviation from MFN tariff. RTA refers reciprocal Free Trade Agreement-FTA as defined in Paragraph 8(b) of Article XXIV of GATT 1994. All columns include control gravity variables, not reported. Standard errors (in parentheses) are clustered by importer-exporter pair. DVA^{j-sh}_{xit}, FVA^{i-sh}_{xt} and domestic final goods production (GH^{i-sh}_{xt}) enter as a share of (bilateral) imports.
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

where GH^{i-sh}_{xt} is the domestic production of final goods scaled by bilateral imports. Similarly, FVA^{i-sh}_{xt} and DVA^{j-sh}_{xit} are taken as shares of bilateral final imports of goods. The other terms in Eq. (3) are fixed effects and the error term. The expected signs are $\beta^{GH} > 0$, $\beta^{DVA} < 0$ and $\beta^{FVA} < 0$. Note that, the dependent variable is now expressed in terms of tariff preferences, $t^{i}_{xjt} - t^{i,MFN}_{xt}$, because the omission of importer-sector-year fixed effects no longer controls for the MFN tariff, as in Eq. (2). Conversely, in regressions with the NTMs, the dependent variable is the same of the reduced form Eq. (2).

It is important to note that for the specification based on Eq. (3) we cannot easily run IV regressions, because there are now several potential endogenous variables (DVA, FVA, GH, and bilateral import), which makes identification a challenge. Notwithstanding, it is important to keep in mind that Eq. (3) includes all the relevant determinants of trade policy suggested by theory. Thus, to the extent to which we are estimating an equilibrium relationship from the model, the estimated OLS parameters are still informative, irrespective of simultaneity problems.

Finally, as discussed in Section 3, RTAs may affect the relationships, and this impact may differ for tariffs, NTMs and different forms of GVC integration. Eqs. (2) and (3) will therefore include also interaction terms between DVA (FVA and GH) and an RTA^{i}_{jt} dummy, equal to 1 for countries signing a (reciprocal) regional trade agreement in year t onward, and with an indicator variable equal to $(1 - RTA^{i}_{jt})$ otherwise.[25]

4. Results

4.1. Tariffs and forward GVC integration

Baseline estimates. Table 1 reports our baseline estimates of Eq. (2) with bilateral applied tariffs as the dependent variable and a set of bilateral controls from the gravity literature (distance, language, colony, and contiguity) to attenuate omitted variable bias. Columns 1–3 use data for the pooled agri-food sector. The coefficient of ln(DVA) is negative

[25] In specifications including GVC interactions with the RTA dummy, we always include the RTA^{i}_{jt} dummy directly in order to capture level differences in tariffs inside and outside preferential trade agreements.

Table 4
Tariff preferences and GVC participation in agri-food sector: Heterogeneity inside and outside RTA.

Dependent variable	Tariff preferences	
	(1)	(2)
$\ln(DVA^{j-sh}_{xit})$ RTA = 1	−0.075	−0.248**
	(0.094)	(0.097)
$\ln(DVA^{j-sh}_{xit})$ RTA = 0	−0.002	−0.391***
	(0.051)	(0.045)
$\ln(FVA^{i-sh}_{xt})$ RTA = 1	−0.016	
	(0.105)	
$\ln(FVA^{i-sh}_{xt})$ RTA = 0	−0.127***	
	(0.047)	
$\ln(GH^{i-sh}_{xt})$ RTA = 1	0.069	
	(0.070)	
$\ln(GH^{i-sh}_{xt})$ RTA = 0	0.360***	
	(0.030)	
$\ln(FVA^{i-sh}_{xt} + GH^{i-sh}_{xt})$ RTA = 1		0.105**
		(0.052)
$\ln(FVA^{i-sh}_{xt} + GH^{i-sh}_{xt})$ RTA = 0		0.292***
		(0.027)
RTA	0.282	−0.600
	(0.527)	(0.368)
Gravity controls	Yes	Yes
Fixed effects		
Importer-year (*it*)	Yes	No
Industry-year (*xt*)	Yes	No
Imp-ind-year (*ixt*)	No	Yes
Exp-ind-year (*jxt*)	Yes	Yes
No. of obs.	96,552	96,552
R-Sq	0.98	0.99

Notes: The dependent variable is bilateral tariff preference, obtained as the (negative) deviation from MFN tariff. RTA refers to reciprocal Free Trade Agreement-FTA as defined in Paragraph 8(b) of Article XXIV of GATT 1994. All columns include control gravity variables, not reported. Standard errors (in parentheses) are clustered by importer-exporter pair. DVA^{j-sh}_{xit}, FVA^{i-sh}_{xt} and domestic final goods production (GH^{i-sh}_{xt}) enter as a share of (bilateral) imports. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

and statistically significant at 1% level.

Columns 2 and 3 test the impact of RTAs. The linear coefficient of the RTA dummy is negative and strongly significant, confirming that, on average, countries inside RTAs have lower bilateral tariffs. In column (3), we estimate separate DVA coefficients, for inside and outside RTAs. The estimated (absolute) coefficient of DVA is large and significant only outside RTAs. In combination, the results of Columns 2 and 3 suggest an important role of RTAs, as they imply lower tariffs in general but also less impact of DVA integration as suggested by theory.

Quantitatively, the magnitude of the estimated DVA coefficient of −0.175 (in column 2) means that one standard deviation increase of ln(DVA) (equal to 2.78 log points, see Table A2) induces a tariff reduction of about 0.5 percentage points, on average. Since the median tariff in this sample is around 12%, this represents a 4% reduction in the typical tariff level.[26]

Columns 4–6 and 7–9 show results when we use data for Agriculture and Food products separately. They display similar results, with the magnitude of the estimated (absolute) DVA coefficients and the RTA effect being somewhat larger in the food industry.

Robustness checks. We performed a robustness test to check the endogeneity of the DVA variable, with tariffs potentially pushing down the price of the inputs country *i* supplies to production in country *j*. We use a similar strategy to BBJ (2021) to address this endogeneity concern by instrumenting the ln(DVA) in Eq. (1) with the service sector ln(DVA) of country *i* used in country *j*.[27]

Table 2 reports IV estimates.[28] First, the Kleibergen-Paap F-statistic is high, suggesting that the DVA in services is a good instrument for DVA. The IV estimates are consistent with the main OLS results and the DVA coefficient outside RTAs increases in (absolute) magnitude (from –0.21 to –0.52), while the inside RTA effect is positive and now significant at 5% level. As in the baseline model, the results are similar for agriculture (Column 4) and the food sector (Column 6).

In summary, we find a strong and robust negative effect of forward GVC integration on tariffs, particularly outside RTAs. The IV results suggest that the OLS estimated coefficients are biased downward.

4.2. Tariffs and backward and forward GVC integration

As explained above, to test the backward GVC integration hypothesis, including FVA as explanatory variable and tariff preferences as dependent variable, we estimate Eq. (3) with adjusted fixed effects specifications since $FVA^{i_{sh}}_{xt}$ does not display bilateral-industry-time but only country-industry-time variation. We substitute importer-industry-year fixed effects with importer-year and industry-year fixed effects.

Table 3 reports the OLS estimates. Columns (1) and (3) show that the estimated coefficient of ln(FVA) share is negative and significant at 5% level, meaning that applied bilateral tariffs are lower (tariffs preferences are larger) when the multilateral FVA is higher.

Note that in these estimations, which use a more parsimonious set of fixed effects, the (log of) DVA share, is still negative but no longer statistically significant. An explanation for this could be omitted variable bias which (in addition to possible reverse causality as shown above) results in an insignificant DVA coefficient. To test if this is the explanation, we reintroduce importer-industry-year fixed effects in the specification (realizing that with this specification we can only identify the FVA and GH effect together). The results in columns (2) and (4) of Table 3 confirm that the DVA impact is strong and negative on the optimal applied tariffs (preferences) and is now estimated with great precision.

The results in columns 1 and 3 also show that the import penetration effect (GH) on tariffs is positive and strongly significant, consistent with the basic insights of the Grossman and Helpman (1994, 1995) model. Finally, the RTA dummy in columns 3 and 4 is significant negative, meaning that tariffs are higher outside RTAs than inside, but only slightly affects the magnitude of the DVA and FVA coefficient.

Table 4 tests for the heterogeneity of the effect inside and outside RTAs. The backward GVC effect (coefficient of ln(FVA)) is negative and significant only outside RTAs (Column 1). The impact of the ln(GH) share is positive but again significant only outside RTAs. This is consistent with the argument that RTAs constrain the impact of political pressures on trade policy, at least when tariffs are considered. Finally, as in the main estimations (Columns 1 and 3 in Table 3) with the more parsimonious set of fixed effects, the impact of DVA is not well estimated. Yet, in Column 2 of Table 4, by reintroducing importer-industry-year fixed effects the DVA coefficient becomes significant negative in both cases, and larger in absolute magnitude outside RTAs, corroborating our previous (reduce form) findings.

[26] Another way to see this economic effect, that is comparable with BBJ (2021), is to consider the median variation of ln(DVA) (median difference between maximum and minimum values across exporters in each importer-industry-year cell), equal to about 9.2 log points in our sample (see Table A.2). Thus, moving from low to high DVA yields a tariff reduction of about −1.61% points (=-0.175*9.2). Since the median tariff is around 12%, this represents a 13% reduction in the typical tariff level. BBJ (2021) working on 14 developed and emerging countries, found a larger tariff reduction in the manufacturing sector.

[27] This instrument should be correlated with DVA in the agri-food sector, as there are common supply-factors that render country *i* an attractive supplier of inputs for country *j* in different sectors. In addition, the instrument should satisfy the exclusion restriction, since it is unlikely that the level of tariff on final agri-food products in country *i* has a direct effect on DVA inputs used by the service sector of country *j*.

[28] The respective first stage regressions are relegated in Appendix (see Table A.3).

Table 5
Restrictive NTMs and DVA: OLS and IV regression results.

	Panel A: Agri-food				
	OLS (1)	OLS (2)	OLS (3)	IV (4)	IV (5)
$\ln(DVA^{j}_{xit-5})$	−0.014*** (0.002)	−0.015*** (0.002)		−0.032*** (0.005)	
RTA		0.086*** (0.014)	0.091*** (0.021)	0.103*** (0.014)	0.094*** (0.024)
$\ln(DVA^{j}_{xit-5})$ RTA = 1			−0.016*** (0.003)		−0.030*** (0.005)
$\ln(DVA^{j}_{xit-5})$ RTA = 0			−0.015*** (0.002)		−0.032*** (0.005)
KP F-statistic				462.119	217.434
No. of obs.	97,080	97,080	97,080	97,080	97,080
R-Sq	0.765	0.766	0.766		
	Panel B: Agriculture				
	OLS (6)	OLS (7)	OLS (8)	IV (9)	IV (10)
$\ln(DVA^{j}_{xit-5})$	−0.010*** (0.003)	−0.012*** (0.003)		−0.032*** (0.006)	
RTA		0.127*** (0.020)	0.159*** (0.034)	0.149*** (0.021)	0.156*** (0.037)
$\ln(DVA^{j}_{xit-5})$ RTA = 1			−0.017*** (0.005)		−0.033*** (0.008)
$\ln(DVA^{j}_{xit-5})$ RTA = 0			−0.011*** (0.003)		−0.032*** (0.007)
KP F-statistic				462.119	217.434
No. of obs.	44,665	44,665	44,665	44,665	44,665
R-Sq	0.756	0.758	0.758		
	Panel C: Food				
	OLS (11)	OLS (12)	OLS (13)	IV (14)	IV (15)
$\ln(DVA^{j}_{xit-5})$	−0.018*** (0.003)	−0.019*** (0.0025)		−0.031*** (0.005)	
RTA		0.053*** (0.017)	0.032 (0.020)	0.065*** (0.017)	0.046* (0.025)
$\ln(DVA^{j}_{xit-5})$ RTA = 1			−0.016*** (0.003)		−0.029*** (0.006)
$\ln(DVA^{j}_{xit-5})$ RTA = 0			−0.019*** (0.003)		−0.032*** (0.006)
KP F-statistic				439.204	213.669
No. of obs.	52,415	52,415	52,415	52,415	52,415
R-Sq	0.776	0.776	0.776		

Notes: The dependent variable is the number of SPS measures affected by specific trade concerns. Each regression includes importer-industry-year and exporter-industry-year fixed effects. The DVA^{j}_{xit-5} enters lagged 5 years to reflect information available when SPSs were adopted. IV regressions used DVA in services as instrument for agri-food DVA; The K-P F-statistic is the weak-identification test of Kleibergen and Paap (2006). First stage results in Table A6 in Appendix. Standard errors (in parentheses) are clustered by importer-exporter pair.
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For the more elaborate specification of Eq. (3) we cannot easily run IV regressions, because there are now several potential endogenous variables (DVA, FVA, GH, and bilateral imports) rendering identification a challenge. To partially address this concern, we run IV regressions where the determinants of bilateral tariff preferences are instrumented with their ten-years lags.[29] The results are summarized in Appendix Tables A.4 and A.5. Overall, these additional robustness checks corroborate our main findings showing that the estimated coefficients of IV regressions are close of the OLS ones.

4.3. Non-tariff measures and GVC integration

Table 5 reports results from the reduced form Eq. (2) with dependent variable, NTM^{i}_{xjt}. In all specifications with NTMs as dependent variable, the right-hand side variables – i.e. GVC variables – are with five-year lags. This approach attempts to account for the fact that the dependent variable is also the result of the accumulation over time of new SPS-STCs and, as such, it could be endogenous by construction.[30]

As in the tariff regressions, the DVA coefficient is negative and

[29] Note, though aware that "lagged IV" can be still problematic - being GVA variables quite persistent over time - we would like with these additional robustness check to confirm that OLS results represent a lower bound of the "true" estimated impacts, and, as reported in the Appendix (see Tables A4), "lagged IV" do, indeed, display results very close to the OLS ones.

[30] Using as dependent variable the SPS affected by specific trade concerns the over-time accumulation of NTMs is, in theory, of less relevance. This is because we know both the timing when a country/s raise the concern and the year related to the resolution of the concern (if any). However, as a matter of fact, the last information is often lacking in the original WTO row data, so that our restrictive SPS (the dependent variable) measures the stock of SPS measures in force, rather than the flow of new (restrictive) SPS imposed/removed.

Table 6
Restrictive NTMs and GVC participation in agri-food sector: OLS results.

	(1)	(2)	(3)	(4)
$\ln(DVA^{j\_sh}_{xit-5})$	0.008	−0.031***		
	(0.006)	(0.005)		
$\ln(FVA^{i\_sh}_{xt-5})$	−0.023***			
	(0.005)			
$\ln(GH^{i\_sh}_{xt-5})$	0.020***			
	(0.003)			
$\ln(FVA^{i\_sh}_{xt-5} + GH^{i\_sh}_{xt-5})$		0.018***		
		(0.003)		
$\ln(DVA^{j\_sh}_{xit-5})$ RTA = 1			0.006	−0.036***
			(0.009)	(0.005)
$\ln(DVA^{j\_sh}_{xit-5})$ RTA = 0			0.008	−0.031***
			(0.006)	(0.005)
$\ln(FVA^{i\_sh}_{xt-5})$ RTA = 1			−0.026***	
			(0.009)	
$\ln(FVA^{i\_sh}_{xt-5})$ RTA = 0			−0.022***	
			(0.005)	
$\ln(GH^{i\_sh}_{xt-5})$ RTA = 1			0.018***	
			(0.003)	
$\ln(GH^{i\_sh}_{xt-5})$ RTA = 0			0.020***	
			(0.003)	
$\ln(FVA^{i\_sh}_{xt-5} + GH^{i\_sh}_{xt-5})$ RTA = 1				0.016***
				(0.003)
$\ln(FVA^{i\_sh}_{xt-5} + GH^{i\_sh}_{xt-5})$ RTA = 0				0.019***
				(0.003)
RTA	0.093***	0.085***	0.093***	0.084***
	(0.014)	(0.014)	(0.012)	(0.012)
Fixed effects				
Importer-year (*it*)	Yes	No	Yes	No
Industry-year (*xt*)	Yes	No	Yes	No
Imp-ind-year (*ixt*)	No	Yes	No	Yes
Exp-ind-year (*jxt*)	Yes	Yes	Yes	Yes
No. of obs.	83,093	83,093	83,093	83,093
R-Sq	0.724	0.751	0.725	0.751

Notes: OLS regressions. The dependent variable is the number of SPS measures affected by specific trade concerns. $DVA^{j\_sh}_{xit-5}$, $FVA^{i\_sh}_{xt-5}$ and domestic final goods production ($GH^{i\_sh}_{xt-5}$) enter as a share of (bilateral) imports and are lagged 5 years to reflect information available when SPSs were adopted. Standard errors (in parentheses) are clustered by importer-exporter pair.
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

significant at a 1% level (Columns 1 and 2). Quantitatively, the estimated coefficient of − 0.0150 in Column 2 suggests that a standard deviation increase of ln(DVA) induces a reduction in the number of SPS measures affected by specific-trade concerns of about 0.04. Because the sample average of restrictive SPS is equal to 0.21, this corresponds to about 20% reduction, thus a notable economic effect.

In contrast to tariffs, the RTA effect in Column 2 is positive and significant: this suggest that there are more restrictive NTMs on average inside RTAs than outside. This is an unexpected result, suggesting that joining a regional trade agreement, on average, affects positively the probability of raising a specific trade concern on restrictive SPS measures, *ceteris paribus*.[31]

However, adding the RTA variable does not affect the DVA coefficient. Column 3 tests for the heterogeneity of the effect for countries inside and outside RTAs. Interestingly, the estimated effect of DVA is significant negative, and of similar order of magnitude, both inside and outside RTAs, suggesting that cooperation within trade agreements is still low when behind-the-border measure are considered.

Columns 4 and 5 test the robustness of our findings running IV regressions using the domestic value-added in services as an instrument for agri-food DVA in the first stage (see Appendix, Table A6 for the first stage). Similarly, to tariff regressions, when we isolate the exogenous component of DVA, the (absolute) magnitude of the estimated DVA effect increases substantially (from − 0.015 to − 0.036), implying that OLS results tend to bias the estimated coefficient toward zero.

Panels B and C in Table 5 display the same battery of regressions run separately for the agricultural and food sectors, respectively. Overall, the results are alike: the impact of DVA on restrictive SPSs is always negative and significant at 1% level and does not suggest differences between inside and outside RTAs.

Finally, Table 6 displays results for the estimation of the full Eq. (3) to study the impact on NTMs of backward GVC linkages captured by FVA. In Column 1, with the more parsimonious set of importer-year and industry-year fixed effects (plus exporter-industry-year), the ln(FVA) coefficient is negative and strongly significant, indicating that backward GVC linkages do negatively affect SPS affected by specific trade concerns.

As with the tariff estimations, the estimated coefficient of ln(DVA) depends on the specification. In the basic model (Column 1) the coefficient is insignificant. The introduction of importer-industry-fixed effects in column 2, as before, renders the ln(DVA) coefficient significantly negative, in line with expectation.[32]

In Columns 3 and 4 we study the heterogeneity of the effects inside and outside RTAs. Overall, the results show that when (restrictive) NTMs are concerned, the estimated coefficients of all the determinants of the equilibrium trade policy (DVA, FVA and GH shares) are virtually the same inside and outside of RTAs, consistent with the reduced form equation results.

In summary, our results suggest that both forward and backward GVC linkages reduce restrictive SPS measures. We also find that, unlike tariffs, there is no significant difference caused by RTAs. One interpretation of this result is that governments do not have enough economic and/or political incentive to sign bilateral trade agreements that account effectively for specific provisions concerning domestic regulation, such as mutual recognition and harmonization on SPS measures (see Grossman et al. 2020; Bouët et al. 2021).

5. Conclusions and policy implications

This paper empirically tests the theoretical predictions of Blanchard, Bown, and Johnson (2021) that GVC participation reduces protection with data from the agri-food sector and with both tariffs and NTMs as trade policy indicators.

Using different estimators (OLS and IV) and identification strategies, we found that both forward (DVA) and backward (FVA) linkages are important determinants of trade policy. Both DVA and FVA reduce bilateral tariffs and NTMs in final products. These results are not only statistically robust but also economically meaningful.

Trade agreements matter for these effects. In the model, domestic value added (i.e., home supply of inputs) acts through dampening the terms-of-trade motives for protection on final goods. This mechanism is attenuated for tariffs within RTAs. We find evidence that in the agri-food sector DVA exerts a negative effect on tariffs only outside RTA, as predicted by the theory. The RTA effect is less clear for restrictive NTMs. This may be explained by the complexity and government motivations behind agri-food standards. This result appears consistent with recent contributions on the economics of trade agreements (see Grossman et al. 2020) highlighting that in presence of consumption externalities, or informational problems (see Bouët et al. 2021), the cooperation requirements are more stringent, so that "old bilateral trade agreements" cannot effectively account for this externality through specific provisions, such as mutual recognition or harmonization of domestic regulations.

[31] One interpretation of this result is that countries involved in several RTAs, by losing degrees of freedom in setting their optimal tariff, use restrictive SPSs as a compensation tool for politically active sectors.

[32] As before, note that in this specification, the impact of FVA can only be identify together with the (inverse) of the import penetration (GH), suggested by the Grossman and Helpman (1994) model.

We can draw two main policy implications from our analysis. First, concerning tariffs, the findings that more *Forward* and *Backward* GVC participation reduce the government's incentive to rise tariffs reveal that trade policy is not only becoming endogenous to GVC linkages but that the effects are economically large. Thus, our results can potentially shed light on another channel through which GVC expansion contributed to the reduction of trade barriers, benefiting consumers, and improving economic efficiency. Second, concerning NTMs, our empirical finding showing that GVC participation reduced the average number of (restrictive) SPSs is particularly relevant. This is because, differently from tariffs, when NTMs are at stake the objective is not their elimination, but the minimization of their (negative) trade effects, and this can be achieved in fact through a reduction of the most restrictive food standards induced by GVC expansion.

The paper has several caveats largely related to the availability of more disaggregated data on agriculture and food GVAs participation, constraining our ability to properly identify, particularly the FVA and GH effect in the full specification (Eq. (3)). From this point of view, it is important to keep in mind that our results of the GVA effects on the equilibrium trade policy, represent just robust associations, rather than causal relationships. Notwithstanding, to the extent to which we are estimating an equilibrium relation with all the relevant determinants of trade policy included, then our results are still informative. In addition, the paper focuses only on the main heterogeneity suggested by the theory, i.e. GVA average effects inside and outside RTAs, without investigating other forms of heterogeneity, particularly at the institutional level. In fact, there are reasons to believe that the optimal tariff formula can be sensitive to the quality of countries' political institutions, particularly when democratic vs. autocratic government institutions are considered. We left this and other potentially interesting research questions for future research.

CRediT authorship contribution statement

Valentina Raimondi: Software, Validation, Data curation, Visualization. **Andreea Piriu:** Writing – review & editing. **Jo Swinnen:** Conceptualization, Validation, Writing – review & editing. **Alessandro Olper:** Conceptualization, Validation, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Table A1
Countries included in the Tariff and NTM samples.

	Tariffs	NTMs		Tariffs	NTMs		Tariffs	NTMs
Aruba	*		Gabon	*		Nigeria	*	
Afghanistan	*		United Kingdom	*	*	Nicaragua	*	*
Angola	*		Georgia	*	*	Netherlands	*	*
Albania	*	*	Ghana	*		Norway	*	*
United Arab Emirates	*	*	Guinea	*		Nepal	*	
Argentina	*	*	Gambia, The	*		New Zealand	*	*
Armenia	*		Greece	*	*	Oman	*	*
Antigua and Barbuda	*		Guatemala	*	*	Pakistan	*	*
Australia	*	*	Guyana	*		Panama	*	
Austria	*	*	Hong Kong, China	*		Peru	*	*
Azerbaijan	*	*	Honduras	*	*	Philippines	*	*
Burundi	*		Croatia	*	*	Papua New Guinea	*	*
Belgium	*	*	Haiti	*		Poland	*	*
Benin	*	*	Hungary	*	*	Portugal	*	*
Burkina Faso	*		Indonesia	*	*	Paraguay	*	*
Bangladesh	*		India	*	*	French Polynesia	*	
Bulgaria	*	*	Ireland	*	*	Qatar	*	*
Bahrain	*	*	Iran, Islamic Rep.	*		Russian Federation	*	*
Bahamas, The	*		Iceland	*		Rwanda	*	
Bosnia and Herzegovina	*		Israel	*	*	Saudi Arabia	*	*
Belarus	*		Italy	*	*	Senegal	*	
Belize	*	*	Jamaica	*	*	Singapore	*	
Bermuda	*		Jordan	*	*	Sierra Leone	*	
Brazil	*	*	Japan	*	*	El Salvador	*	*
Barbados	*	*	Kazakhstan	*		Suriname	*	
Brunei	*		Kenya	*	*	Slovak Republic	*	*
Bhutan	*		Kyrgyz Republic	*		Slovenia	*	*
Botswana	*		Cambodia	*	*	Sweden	*	*
Central African Republic	*		Korea, Rep.	*	*	Swaziland	*	
Canada	*	*	Kuwait	*	*	Seychelles	*	
Switzerland	*	*	Lao PDR	*		Syrian Arab Republic	*	
Chile	*	*	Lebanon	*		Chad	*	
China	*	*	Sri Lanka	*	*	Togo	*	
Cote d'Ivoire	*	*	Lesotho	*		Thailand	*	*

(*continued on next page*)

Table A1 (*continued*)

	Tariffs	NTMs		Tariffs	NTMs		Tariffs	NTMs
Cameroon	*		Lithuania	*	*	Tajikistan	*	
Congo, Rep.	*		Luxembourg	*	*	Trinidad and Tobago	*	*
Colombia	*	*	Latvia	*	*	Tunisia	*	*
Cape Verde	*		Macao	*		Turkey	*	*
Costa Rica	*	*	Morocco	*	*	Taiwan	*	*
Cuba	*	*	Moldova	*	*	Tanzania	*	*
Cyprus	*	*	Madagascar	*		Uganda	*	
Czech Republic	*	*	Maldives	*		Ukraine	*	*
Germany	*	*	Mexico	*	*	Uruguay	*	*
Djibouti	*		Macedonia, FYR	*		United States	*	*
Denmark	*	*	Mali	*		Uzbekistan	*	
Dominican Republic	*	*	Malta	*	*	Venezuela	*	*
Algeria	*		Myanmar	*		Vietnam	*	*
Ecuador	*	*	Mongolia	*		Vanuatu	*	
Egypt, Arab Rep.	*	*	Mozambique	*		Samoa	*	
Spain	*	*	Mauritania	*		Yemen, Rep.	*	
Estonia	*	*	Mauritius	*	*	South Africa	*	*
Ethiopia (excludes Eritrea)	*		Malawi	*		Zambia	*	
Finland	*	*	Malaysia	*	*	Zimbabwe	*	
Fiji	*	*	Namibia	*				
France	*	*	Niger	*				

Table A2
Summary Statistics.

	Agri-food				
Variable	**Mean**	**Std. Dev**	**Min**	**Max**	**Obs**
Bilateral Tariffs (t^{i}_{xjt})	15.28	15.44	0.00	130.58	171,056
Pref. Tariffs ($t^{i}_{xjt} - t^{i,\,MFN}_{xt}$)	−5.44	30.99	−464.00	0.00	96,552
NTM^{i}_{xjt}	0.21	0.42	0.00	3.04	97,080
RTA	0.10	0.30	0.00	1.00	171,056
$\ln(DVA^{j}_{xit})$	3.70	2.78	−4.09	14.45	171,056
$\ln(DVA^{j}_{xit})$ RTA = 1	0.45	1.65	−3.55	12.98	171,056
$\ln(DVA^{j}_{xit})$ RTA = 0	3.25	2.81	−4.09	14.45	171,056
$\ln(DVA^{j-sh}_{xit})$	−1.81	2.58	−12.70	8.14	96,552
$\ln(FVA^{i-sh}_{xt})$	−2.02	2.72	−13.27	8.93	96,552
$\ln(GH^{i-sh}_{xt})$	7.31	3.25	−3.65	15.82	96,552
$\ln(FVA^{i-sh}_{xt} + GH^{i-sh}_{xt})$	5.29	5.29	−14.19	21.50	96,552
	Agriculture				
Bilateral Tariffs (t^{i}_{xjt})	12.79	15.47	0.00	130.58	81,819
NTM^{i}_{xjt}	0.22	0.46	0.00	3.04	44,665
RTA	0.10	0.30	0.00	1.00	81, 819
$\ln(DVA^{j}_{xit})$	3.78	2.80	−3.37	14.19	81, 819
$\ln(DVA^{j}_{xit})$ RTA = 1	0.46	1.67	−2.76	12.98	81, 819
$\ln(DVA^{j}_{xit})$ RTA = 0	3.32	2.85	−3.37	14.19	81, 819
	Food				
Bilateral Tariffs (t^{i}_{xjt})	17.56	15.07	0.00	114.47	89,237
NTM^{i}_{xjt}	0.21	0.38	0.00	2.44	52,415
RTA	0.09	0.29	0.00	1.00	89, 237
$\ln(DVA^{j}_{xit})$	3.62	2.75	−4.09	14.45	89, 237
$\ln(DVA^{j}_{xit})$ RTA = 1	0.44	1.63	−3.55	12.78	89, 237
$\ln(DVA^{j}_{xit})$ RTA = 0	3.18	2.77	−4.09	14.45	89, 237

Notes: See main text for variables description and data sources.

Table A3
First stage of IV regressions of Table 2: Bilateral tariffs and DVA.

	IV First Stage					
	Agri-food		Agriculture		Food	
	ln(DVA) RTA = 1 (1)	ln(DVA) RTA = 0 (2)	ln(DVA) RTA = 1 (3)	ln(DVA) RTA = 0 (4)	ln(DVA) RTA = 1 (5)	ln(DVA) RTA = 0 (6)
ln(DVA)	0.939***	−0.337***	0.901***	−0.304***	0.979***	−0.368***
Services_RTA = 1	(0.020)	(0.017)	(0.024)	(0.020)	(0.021)	(0.019)
ln(DVA)	−0.009	0.615***	−0.011	0.607***	−0.008	0.623***
Services_RTA = 0	(0.006)	(0.016)	(0.007)	(0.019)	(0.006)	(0.017)
RTA	1.089***	−0.904***	1.118***	−1.025***	1.051***	−0.787***
	(0.095)	(0.073)	(0.115)	(0.087)	(0.100)	(0.076)
ln(distance)	−0.006	−0.568***	−0.005	−0.505***	−0.006	−0.624***
	(0.010)	(0.021)	(0.012)	(0.025)	(0.010)	(0.022)
Colony	0.030	0.285***	0.036	0.200***	0.026	0.361***
	(0.023)	(0.047)	(0.029)	(0.059)	(0.024)	(0.052)
Language	−0.014	0.332***	−0.040	0.315***	0.010	0.347***
	(0.020)	(0.040)	(0.024)	(0.049)	(0.021)	(0.042)
Contiguity	0.268***	0.659***	0.345***	0.736***	0.193***	0.590***
	(0.053)	(0.089)	(0.063)	(0.101)	(0.056)	(0.096)
No. of obs.	123,036	123,036	59,562	59,562	63,474	63,474
R-Sq	0.903	0.841	0.890	0.830	0.917	0.852
K-P F statistic	763.953		517.709		700.997	

Notes: Columns report first stage of IV regressions reported of Table 2; specifically, columns 1 and 2 refer to Table 2-Column 2; columns 3–4 refer to Table 2-Column 4; columns 5–6 refer to Table 2-Column 6. RTA refers to reciprocal Free Trade Agreement-FTA as defined in Paragraph 8(b) of Article XXIV of GATT 1994. The two endogenous variables instrumented are: DVA outside and inside RTA. DVA in services outside and inside RTA are used as instruments. Each regression includes importer-industry-year and exporter-industry-year fixed effects. Standard errors (in parentheses) are clustered by importer-exporter pair. The K-P F-statistic is the weak-identification test of Kleibergen and Paap (2006).
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A4
Tariff preferences and GVA participation: OLS vs IV regressions.

Dependent variable	Tariff preferences							
	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(DVA)_sh	−0.001	−0.390***	−0.008	−0.374***	−0.017	−0.410***	−0.017	−0.389***
	(0.053)	(0.047)	(0.052)	(0.047)	(0.056)	(0.050)	(0.056)	(0.049)
ln(FVA)_sh	−0.130***		−0.116**		−0.125**		−0.116**	
	(0.049)		(0.049)		(0.053)		(0.052)	
ln(GH)_sh	0.330***		0.317***		0.343***		0.327***	
	(0.032)		(0.032)		(0.034)		(0.033)	
ln(FVA_GH)_sh		0.277***		0.267***		0.289***		0.276***
		(0.028)		(0.028)		(0.030)		(0.029)
RTA			−1.669***	−1.707***			−1.667***	−1.705***
			(0.146)	(0.146)			(0.146)	(0.146)
Fixed effects								
Importer-year	Yes	No	Yes	No	Yes	No	Yes	No
Industry-year	Yes	No	Yes	No	Yes	No	Yes	No
Imp-ind-year	No	Yes	No	Yes	No	Yes	No	Yes
Exp-ind-year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	96,074	96,074	96,074	96,074	96,074	96,074	96,074	96,074
R-Sq	0.980	0.990	0.980	0.990				
K-P F-statistic					45,000		100,000	

Notes: The dependent variable is bilateral tariff preference, obtained as the (negative) deviation from MFN tariff. RTA refers reciprocal Free Trade Agreement-FTA as defined in Paragraph 8(b) of Article XXIV of GATT 1994. All columns include control gravity variables, not reported. The first stage IV regression used GVCs variables with ten-year lags as instruments. The K-P F-statistic is the weak-identification test of Kleibergen and Paap (2006). First stage results are reported in Table A5. Standard errors (in parentheses) are clustered by importer-exporter pair.
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A5
First stage of IV regressions of Table A4 (Columns 5 and 6).

	ln(DVA)_sh (1)	ln(FVA)_sh (2)	ln(GH)_sh (3)	ln(DVA)_sh (4)	ln(FVA_GH)_sh (5)
ln(DVA $_{t\text{-}10}$)_sh	0.949***	0.001	−0.001	0.950***	−0.039***
	(0.007)	(0.007)	(0.005)	(0.005)	(0.007)
ln(FVA $_{t\text{-}10}$)_sh	0.001	0.949***	−0.011***		
	(0.006)	(0.007)	(0.004)		
ln(GH $_{t\text{-}10}$)_sh	−0.000	−0.001	0.973***		
	(0.003)	(0.003)	(0.002)		
ln(FVA_GH $_{t\text{-}10}$)_sh				0.001	0.975***
				(0.003)	(0.004)
No. of obs.	96,074	96,074	96,074	96,074	96,074
R-Sq	0.95	0.95	0.98	0.95	0.97
K-P F-statistic	45,000			100,000	

Notes: Columns report first stage of IV regressions in Table A4 (Columns 5 – 6). Specifically, columns 1 – 3 refer to Table A4-Column 5; columns 4 – 5 refer to Table A4 -Column 6. GVCs variables with ten-year lags are used as instruments. All columns include control gravity variables, not reported. Standard errors (in parentheses) are clustered by importer-exporter pair. The K-P F-statistic is the weak-identification test of Kleibergen and Paap (2006).
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A6
First stage of IV regressions of Table 5.

	Panel A: Agri-food Sector		
	ln(DVA $_{t-5}$) (1)	ln(DVA $_{t-5}$) RTA = 1 (2)	ln(DVA $_{t-5}$) RTA = 0 (3)
ln(DVA $_{t-5}$) Services	0.716***		
	(0.029)		
RTA	0.561***	0.968***	−0.660***
	(0.106)	(0.211)	(0.187)
ln(DVA $_{t-5}$) Serv_RTA = 1		1.031***	−0.269***
		(0.036)	(0.037)
ln(DVA $_{t-5}$) Serv_RTA = 0		0.006	0.704***
		(0.006)	(0.029)
No. of obs.	97,080	97,080	97,080
R-Sq	0.856	0.939	0.873
K-P F-statistic	627.912	302.094	
	Panel B: Agriculture		
	ln(DVA $_{t-5}$) (4)	ln(DVA $_{t-5}$) RTA = 1 (5)	ln(DVA $_{t-5}$) RTA = 0 (6)
ln(DVA $_{t-5}$) Services	0.800***		
	(0.037)		
RTA	0.496***	0.535**	−0.574***
	(0.130)	(0.261)	(0.221)
ln(DVA $_{t-5}$) Serv_RTA = 1		1.080***	−0.184***
		(0.045)	(0.045)
ln(DVA $_{t-5}$) Serv_RTA = 0		0.016**	0.772***
		(0.007)	(0.037)
No. of obs.	44,665	44,665	44,665
R-Sq	0.844	0.936	0.862
K-P F statistic	462.119	217.434	
	Panel C: Food		
	ln(DVA $_{t-5}$) (7)	ln(DVA $_{t-5}$) RTA = 1 (8)	ln(DVA $_{t-5}$) RTA = 0 (9)
ln(DVA $_{t-5}$) Services	0.651***		
	(0.031)		
RTA	0.601***	1.285***	−0.741***
	(0.119)	(0.220)	(0.210)
ln(DVA $_{t-5}$) Serv_RTA = 1		0.998***	−0.337***
		(0.037)	(0.040)
ln(DVA $_{t-5}$) Serv_RTA = 0		−0.001	0.651***
		(0.007)	(0.031)
No. of obs.	52,415	52,415	52,415
R-Sq	0.868	0.942	0.882
K-P F-statistic	439.204	213.669	

Notes: Columns report first stage of IV regressions reported in Table 5. Specifically, columns 1, 4, and 7 refer to Table 5-Columns 4, 9, and 14, when the DVA in services is used as instrument. Columns 2 – 3, columns 5–6, and columns 8–9 refer to Table 5-Columns 5, 10, and 15, respectively. RTA refers reciprocal Free Trade Agreement-FTA as defined in Paragraph 8(b) of Article XXIV of GATT 1994. Here, the two endogenous variables that are instrumented are DVA outside and inside RTA, and the instruments are DVA in services outside and inside RTA. Each regression includes importer-industry-year and exporter-industry-year fixed effects. Standard errors (in parentheses) are clustered by importer-exporter pair. The K-P F-statistic is the weak-identification test of Kleibergen and Paap (2006).
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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