BATModel

better agri-food trade modelling for policy analysis

Deliverable D4.1

Trade policies and GVC participation

Project funded under the Horizon 2020 Research and Innovation Programme.

Dissemination Level

P	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	
CI	Classified, as referred to Commission Decision 2001/844/EC	

Type

R	Document, Report	X
DEM	Demonstrator, Pilot, Prototype	
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Other	(Please describe the type)	

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Summary

Project Number: 861932

Project: BATModel

Topic: **RUR-04-2018-2019-2 | Rural Renaissance**
Analytical tools and models to support policies related to agriculture and food

Duration: 48 Months

Start date of Project: 1st September 2020

End date of the Project: 31st August 2024

Coordinator: UMIL

Deliverable: D4.1

Due date of deliverable: August 2021

Actual submission date: August 2021

Work package number: WP4

WP Leader (name and organisation): Luca Salvatici - UNIROMA3

Person in charge of the deliverable (name and organisation): Alessandro Olper - UMIL

Version: V1

The BATModel project (Grant Agreement No.: 861932) has received funding from the European union' Horizon 2020 Research and Innovation Programme. The views and opinions expressed in this report does not represent the official position of the European Commission and is entirely the responsibility of the authors.

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Contents

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1. EXECUTIVE SUMMARY

Since production and trade are increasingly organized within global value chains (GVCs), assessing who effectively pays the cost of protection is not straightforward, and since production processes are internationallyfragmented, quantifying the effects of trade policy requires an enhanced analytical framework that takes international input–output linkages into account to assess the implications trade costs have on competitivenessat national and sector levels. At the same time, there is growing evidence showing that countries and sectors participation in GVCs change the government incentive to rise trade policy. This deliverable addresses these two issues presenting new empirical evidence on the interlink between GVC participations and their implications for trade costs and to what extent the GVC participation affected the government choices about tariffs and non-tariff-measures (NTMs) to trade.

The first contribution defines a new synthetic measure of trade protection based on the value added in trade, capturing the effects that the tariff structure has on exporting firms that rely on imported intermediate inputs. The index, defined in a general equilibrium framework, provides a theoretically sound protection measurementin the context of GVCs. We assess trade protection by defining and computing new protection indexes on bothgross imports and imports to exports using the Global Trade Analysis Project computable general equilibriummodel. These indexes are used to investigate the relationship between the European Union tariffs and the integration of the agri-food GVCs. Results show that EU tariffs impact the export performance of the EU countries under examination. The impact of the same EU trade policy is heterogeneous across member countries, depending on the structural characteristics of exporting economies. Germany is the most impacted country showing the highest index in both gross and VA terms (5.73% and 4.63%, respectively), while Franceseems to be the less affected (1.49% for gross exports and 1.29% for DVA). In all the cases under examination,the impact is lower for indirect exports of agricultural value added, that is the agri-food value added embeddedin other sectors' exports.

The second contribution empirically tests the model of Blanchard, Bown, and Johnson (2021) according to which an increase in forward and backward GVC participation, reduces the government incentive to rise tradeprotection against imported final goods. These authors extend the protection for the sale model of Grossman and Helpman (1994; 1995) to trade in value added, by considering both domestic (DVA) and foreign value added (FVA). The model emphasizes how the national origin of the value-added content of traded goods affected final goods tariffs, showing that a rise of countries/sectors participation in value-added trade reduces the government incentive to rise trade protection. The contribution exploits information on bilateral tariffs andregulatory distance in non-tariff measures (NTMs), to shed light on whether the use of domestic intermediateinputs in third-country export (DVA) and the use of foreign inputs for a country's exports (FVA) play the predicted role in affecting the determination of final goods tariffs and NTM regulatory distance. This test is applied to a large sample of over 150 countries observed from 1995 to 2015 and focusing on the agricultural and food sectors. Consistent with theoretical predictions, we show that the GVC effect on final goods tariffs works only outside regional trade agreements (FTAs). We find similar results also for NTM regulatory

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distance, but only for a sub-set of bilateral agreements involving, legally enforceable, deep SPS and TBT provisions.

Keywords: Trade policies, Tariffs, NTMs, Trade restrictiveness index (TRI), Global trade analysis project (GTAP), Global value chains (GVCs), Value added trade, Deep preferential trade agreements (PTAs), Politicaleconomy.

2. INTRODUCTION

The long European stagnation has fuelled renewed debate about the importance of global value chains (GVCs) to sustain and strengthen recovery and foster competitiveness. The debate is currently gaining even more importance due to the economic consequences of the COVID-19 pandemic. The design of appropriate trade policy measures to achieve the post-pandemic goals requires a full understanding of the characteristics of the current production paradigm in terms of organization of international supply chains and production networks,and clear identification of the main linkages between countries and sectors. About one half of global exchangesis related to GVCs. The associated increase in trade in intermediates (that is, parts and components used as inputs in the production of final goods for end consumers) magnifies trade costs that are incurred several timesalong the chain (Yi 2003). Since the income generation role of exports strongly depends on international exchanges of intermediates and services that are required by domestic firms to produce exported goods, tariffs on imports translate into higher costs associated with a country's exports. Therefore, restrictive trade policies negatively affect domestic producers' competitiveness in international markets since they reduce access to the most efficient inputs (Cattaneo et al. 2013; Taglioni and Winkler 2014).
At the same time in the last decades, there has been a remarkable increase in the countries' propensity to sign preferential trade agreements (PTAs), covering not just tariffs but also additional policy areas that are not necessarily related to trade (Ruta, 2017). In the agri-food sector, these deep PTAs addressed mainly issues of mutual recognition and harmonization in sanitary and phytosanitary standards (SPS) and technical barriers totrade (TBT). These important changes lead to several fundamental questions: are the GVC expansion and theproliferation of deep PTAs inter-related, and does GVC participation change government incentives over trade policy and the country-sector impact on the respective trade costs?
This section briefly explains how the contributions in this deliverable address these questions focusing on therole of GVCs links in affecting trade costs and trade policy, with applications on both the manufacturing and agri-food sectors.
The first contribution (Section 3.1) aims at evaluating how the EU tariff structure impacts the exports of valueadded by and through the agricultural sector. To this end, it first considers gross exports in agriculture and highlights to what extent tariffs on imports affect the export competitiveness of some major EU economies. However, gross exports also embed imported intermediate inputs produced domestically or abroad. Consequently, whenever production is organized in sequential processing stages in different countries, traditional trade statistics double count the same value added. The diffusion of GVCs has therefore deepened the divergence between gross flows and the data on production and final demand as accounted in statistics based on value added (above all GDP).
It is worth emphasizing that the contribution of exports to the value added creation (i.e., remuneration of primary factors) in the agricultural sectors only partially depends on exports from the agricultural sectors sincea consistent portion of value added is embedded in other sectors' exports (i.e., indirect exports of value added).To evaluate if and to what extent the value added creation within the agricultural sectors is influenced by the common external tariffs, it is

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necessary to unpack forward and backward linkages that agriculture has with other sectors within the same economy as well as with foreign countries'. In this vein, we define different trade restrictiveness indexes based on both gross and value added metrics to highlight both direct and indirect linkages.

Relying on a general equilibrium framework, the new indexes provide a theoretically sound protection measurement in the context of GVCs. Trade protection is assessed by computing protection indexes on both gross exports and value added exports using the Global Trade Analysis Project (GTAP) computable general equilibrium model. It extends the set of trade restrictiveness indexes proposed initially by Anderson and Neary(2005) to assess the effects of trade policies on GVC-related trade and develop a measure of trade policy restrictiveness that captures the effects that the tariff structure has on export activities. These indexes are usedto investigate how the protection granted by the European Union (EU) tariff structure to the Italian, French and German economies affects their patterns of agriculture exports and their integration in global supply networks. The empirical analysis is performed using a modified version of the GTAP model, i.e. GTAP-VA (Antimiani et al. 2018a), calibrated to the MRIO Version 10 of the GTAP Data Base (https://www.gtap.agecon.purdue.edu/databases/utilities/v10.aspx). Results suggest that the use of the new trade metrics could improve the empirical information used to support policymaking (Koopman et al. 2013). Results show that EU tariffs impact the export performance of the EU countries under examination. The impactof the same EU trade policy is heterogeneous across member countries, depending on the structural characteristics of exporting economies. Germany is the most impacted country showing the highest index in both gross and VA terms (5.73% and 4.63%, respectively), while France seems to be the less affected (1.49%for gross exports and 1.29% for DVA). In all the cases under examination, the impact is lower for indirect exports of agricultural value added, that is the agri-food value added embedded in other sectors' exports.

The second contribution (Section 3.2) tests the theoretical predictions from the model of Blanchard, Bown, and Johnson (2021) regarding participation in Global Value Chains (GVCs), Preferential Trade Agreements (PTAs) and how GVC relationships change the government incentive to operate trade policy. There is a growing body of literature investigating how GVC participation affects trade policy. Most notably, Blanchard(2007, 2010), Ornelas and Turner (2008, 2012), and Antras and Staiger (2012) make initial theoretical contributions by examining the effect of offshoring and foreign direct investment (FDI) on optimal trade policy. However, the empirical literature that links GVCs to trade policy is limited – an issue mainly due to data availability. Blanchard, Bown, and Johnson (2017), Ludema, Mayda, Yu and Yu (2018), and Bown, Erbahar, and Zanardi (2020) are three relevant exceptions that reveal how the rise of GVC interlinks in international trade operations tend to reduce government incentives to rise trade protection, such as import tariffs on final goods.

Notably, the current empirical evidence focuses only on the manufacturing sector, where the development of GVCs has been particularly important. However, similar patterns of globalization, characterized by an increase in vertical specialization and trade in intermediate inputs, can be noticed also in the agricultural and food sectors (see Kowalski et al. 2015; Greenville et al. 2017a; World Bank, 2021). In addition, differently from the manufacturing

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sector, where tariffs are already quite low worldwide, tariffs and non-tariff measures in theagri-food sector represent the rule rather than the exception.

In the second contribution, we test predictions from the political economy model of Blanchard, Bown, and Johnson (2021), hereafter BBJ (2021). These authors extend the protection for sale model of Grossman and Helpman (1994; 1995) to trade in value added. While considering both domestic (DVA) and foreign value added (FVA), the authors emphasize how the national origin of the value-added content of traded goods affected final good tariffs. By exploiting information on bilateral tariffs and regulatory distance in NTMs, wenow shed light on whether the use of domestic intermediate inputs in third-country export (DVA) and the useof foreign inputs for a country's exports (FVA) play the predicted role in affecting the determination of final goods tariffs and NTM regulatory distance. We investigate this issue considering GVC linkages and trade policies for over 150 countries observed from 1995 to 2015.

Results for both the agricultural and the food sectors confirm the theoretical predictions. That is, country participation in GVCs reduces both bilateral tariffs and NTM regulatory distance, an effect particularly strong for DVA (forward participation). In line with theory, higher DVA negatively affects tariffs only outside free trade agreements (FTAs). On the other hand, when food standards are considered, domestic value added in foreign exports reduces NTMs regulatory distance both inside and outside of FTAs, a result that indirectly confirms the difficulty countries face in signing FTAs involving deep integration on behind-the-border barriers. However, within a sub-sample of deep FTAs involving specific SPS and TBT provisions, the impact of DVA on NTM regulatory distance works mainly outside FTAs, as predicted by theory.

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3. Contributions

3.1 An Assessment of Import Tariff Costs for Agri-Food Exporting Firms in Selected EU countries

AN ASSESSMENT OF IMPORT TARIFF COSTS FOR AGRI-FOOD EXPORTING FIRMS IN SELECTED EU COUNTRIES

Ilaria Fusacchia (UNIROMA3) and Luca Salvatici (UNIROMA3)

Abstract

Since production and trade are increasingly organized within global value chains (GVCs), assessing who effectively pays the cost of protection is not straightforward and since productive processes are internationally fragmented, quantifying the effects of trade policy requires an enhanced analytical framework that takes international input–output linkages into account to assess the implications trade costs have on competitiveness at national and sector levels. This paper defines a new synthetic measure of trade protection based on the value added in trade, capturing the effects that the tariff structure has on export competitiveness in the agricultural sector. The indexes, defined in a general equilibrium framework, provide a theoretically sound protection measurement in the context of GVCs. We assess trade protection by computing protection indexes on both gross exports and value added exports using the Global Trade Analysis Project computable general equilibrium model. These indexes are used to investigate the relationship between the European Union tariffs and export performances of major EU economies, namely Italy, France and Germany.

Keywords: Trade policies · Trade restrictiveness index (TRI) · Global trade analysis project (GTAP) · Global value chains (GVCs) · Value added trade
JEL Codes: F13 · F17 · D58

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Introduction

Although the quantification of the impact of trade policy on prices, economic activity and welfare has always been at the core of trade policy analysis, the complexity of today's trade relations raises new unprecedented challenges. In particular, the rise of global value chains (GVCs) requires the adoption of enhanced analytical frameworks that take the international input–output linkages into account. Since exports rely on imported inputs, the evaluation of trade policies requires the use of new trade metrics based on the value-added components to assess the implications of trade costs on competitiveness at national and sector levels.

This paper contributes to the growing line of research studying the effects of trade policy on GVCs which has been fuelled by the rapid progress in data and methods for measuring sectoral and country linkages, and provides new evidence on how trade policy changes shape the global value chains. In particular, this article introduces different analytical tools to evaluate how trade costs on imports impact the export performance by defining a new protection index framework specifically suitable for the agricultural sector.

Our framework builds on global input-output accounting and trade in value added (VA). In multi-country production chains, fragments of value added from different locations are combined to form final goods. Therefore, the empirical assessment of trade policy must acknowledge which country is the source of the value that is embedded in trade. This information can be used to determine who is effectively paying the cost of protection. For instance, firms that require a large share of intermediate imports to export pay higher tax rates in terms of value added (Cusolito et al., 2016).

From a national account perspective, what is internationally traded is VA and the adequate measure of trade distortion is no longer the nominal tariff structure on the output, but the protection on value added. Based on a VA metric, we unpack gross exports, also embedding imported intermediate inputs produced domestically or abroad. Thus, when evaluating trade policy, we can take into account the divergence between gross flows and the data on production and final demand linkages as accounted in statistics based on value added (above all GDP).

The contribution of exports to the value added creation (i.e., remuneration of primary factors) in the agricultural sectors only partially depends on exports from the agricultural sectors since a consistent portion of value added is embedded in other sectors' exports (i.e., indirect exports of value added). Accordingly, to evaluate if and to what extent the value added creation within the agricultural sectors is influenced by tariffs on imports, it is necessary to unpack forward and backward linkages that agriculture has with other sectors within the same economy as well as with foreign countries'.

In this vein, we define different trade restrictiveness indexes based on both gross and value added metrics to highlight both direct and indirect linkages, and show how they can be operationalized for quantitative trade policy analysis.

These indexes are used to investigate how the protection granted by the European Union (EU) tariff structure to the Italian, French and German economies affects their patterns of agriculture exports andtheir integration in global supply networks. The empirical analysis is performed using a modified version of the GTAP model, i.e. GTAP-VA (Antimiani et al. 2018a), calibrated to the

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MRIO Version 10 of the GTAP Data Base (https://www.gtap.agecon.purdue.edu/databases/utilities/v10.aspx).

Our findings suggest that the use of the new trade metrics could improve the empirical information used to support policymaking (Koopman et al. 2013). Results show that EU tariffs impact the exportperformance of the EU countries under examination. The impact of the same EU trade policy is heterogeneous across member countries, depending on the structural characteristics of exporting economies. Germany is the most impacted country showing the highest index in both gross and VA terms (5.73% and 4.63%, respectively), while France seems to be the less affected (1.49% for gross exports and 1.29% for DVA). In all the cases under examination, the impact is lower for indirect exports of agricultural value added, that is the agri-food value added embedded in other sectors' exports. This contribution is organized as follows. In the next section, we discuss the EU trade policyand the methodological challenges in its evaluation. Then we present the model and the protection indexes (section 3) as well as the database used for the empirical application (section 4). In section 5,we discuss the results. Section 6 concludes.

Trade policies influencing global value chains (GVCs)

We focus on the most traditional trade barriers—i.e., tariffs—starting with those agreed upon at the multilateral level in compliance with the MFN tariffs that were included in the General Agreement on Tariffs and Trade (GATT)/World Trade Organization (WTO) schedule at the end of the UruguayRound. Applied rates are generally identical to the WTO bindings and the EU has bound 100% of tariff lines.

Agricultural tariffs stand out from industrial tariffs for several reasons: significantly higher rates, about three-fold; a higher percentage of non-ad valorem rates; and several tariff lines for the implementation of TRQs. On average, bound tariffs on agricultural products remain higher (14.1%) than on non-agricultural products (4.3%) and vary considerably from one agricultural product to another with a standard deviation of 23.7 compared to 4.4 for non-agricultural products. About 25% of tariff lines were duty free in 2014: the sectors with the highest percentages of duty-free lines are for cotton, wood and paper, minerals and metals, and other agricultural products (WTO, 2017).

The EU maintains preferential tariffs for imports from certain countries under its reciprocal or preferential agreements. The EU is the largest trading partner for many low- and middle-income countries and trade preferences make up one of the central policies aimed at improving integration between the EU and these countries. The EU was the first high income importer to introduce preferential policies. Since the 1971 Generalised System of Preferences (GSP), the tide of preferentialschemes has continued to rise, significantly widening the number of countries and products covered.Imports of agricultural products from many countries can enter the EU at zero or reduced tariffs underthe EU's everything-but-arms initiative, its GSP and GSP+ schemes, and its network of trade agreements.

There are two main methodological challenges in the evaluation of any type of trade policy: measurement and aggregation (Cipollina and Salvatici, 2008). As far as the former is concerned, measurement of trade policy is perhaps one of the toughest issues faced in the evaluation of

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trade policy, especially in cases where non-tariff measures (NTMs) are the primary trade policy instrument. However, the problem also arises in the case of non-ad valorem tariffs which constitute about 11% of EU tariff lines and comprise specific, combined, mixed, and other complex forms.

NTMs represent the range of laws, regulations and requirements that influence the flow of goods across borders. They include measures such as sanitary and phytosanitary (SPS) requirements, technical barriers to trade (TBT) along with customs procedures as well as trade requirements such as pre-shipment inspections. The share of tariff lines covered by NTMs averages about 40 percent forthe least developed and developing countries and more than 60 percent for developed. The ad valoremequivalents of NTMs are on average significantly greater than those of tariffs. For most agri-food sectors, SPS and TBT measures have the greatest impact on trade. Recent estimates suggest that theyhave significant impacts both on agri-food trade in general (Cadot et al., 2018) and on agri-food supply chains in particular (Baliè et al., 2019). In this respect, it is worth recalling that (at least) someNTMs are in place to achieve many legitimate regulatory goals, and indeed their effects are both tradeenhancing and trade distorting (for example, see Disdier, Fontagné and Mimouni, 2008; and Li and Beghin, 2012).

As far as the second challenge is concerned, even when trade restriction quantification is readily available, as is the case with import tariffs, the information comes at a highly disaggregated level while global economic models require to aggregate the information to a higher level (for example, industry, region, or country). The EU's tariff schedule, for instance, includes 9,414 tariff lines.

Anderson and Neary (1996, 2005) develop a tariff index theory defined in a general equilibrium framework, taking interdependence between sectors into account, allowing relative prices to adjust and factors to be reallocated across sectors and admitting substitution effects in production and consumption both within and across countries (Ferrarini and Hummels, 2014). Their theoretical model provides a consistent aggregation procedure that solves the endogeneity problem affecting a- theoretical weighting schemes (Cipollina and Salvatici, 2008; Anderson et al., 2013; Laborde et al., 2017). These theoretically sound measures provide indexes that are equivalent to the original data interms of the variable of interest.

Anderson and Neary (1994) assess the effect of the structure of trade policy on national welfare, defining the Trade Restrictiveness Index (TRI) as the uniform tariff that yields the same welfare as the original differentiated tariff structure. Anderson (1998) defines a Distributional Effective Rate ofProtection (DERP) as the uniform tariff that yields the same sector specific factor income as the actualtariff structure. This can be used to measure the extent to which the level of protection is translated into sector-specific factor income. Anderson and Neary (2003; 2005) focus on import flows and define the Mercantilist Trade Restrictiveness Index (MTRI) as the uniform tariffs that maintain the value of gross imports at world prices.

The large diffusion of international networks and the increase in geographical fragmentation of productive processes through GVCs imply that intermediate goods cross borders several times and this implies that even small tariffs may have a significant cumulative impact. In a world where more than half of trade is represented by intermediate exchanges, the empirical assessment of trade policymust acknowledge which country is the source of the value that is embedded in trade. For instance, an economy that requires a large share of intermediate

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imports to produce its exports faces higher protection in terms of value added as it has long been highlighted by the literature on the effective rate of protection (Cipollina and Salvatici, 2008). Moreover, tariffs faced in the destination market have ripple effects on the production activities that are linked to the GVC and span across different countries: this is the cumulated protection embedded in imports (Diakantoni et al., 2017).

A recent strand of literature has emerged, the aim of which is to investigate the conceptual and analytical consequences of the increased complexity of international trade patterns for trade policy analysis. As first noted by Yi (2003), the cost of vertical trade is more sensitive to tariff duties than traditional trade in final goods due to tariff amplification effects: tariffs are incurred several times along the chain and are applied on the full value of exports, including tariffs paid previously. In otherterms, multistage production magnifies the effects of trade costs on world trade and can generate a magnified as well as non-linear response to trade liberalizations.

There are two separate magnification forces. The first exists because tariffs are applied to gross imports, even though the value added by the direct exporter may be only a fraction of this amount. Generally speaking, the magnification effect is stronger, the lower the domestic market share in exports.

The second exists because goods that cross national borders many times incur multiple tariffs and transportation costs. When tariffs fall the 'reverse magnification' will amplify the response of trade along with the intensive as well as the extensive margin: as a consequence, the vertical specializationwill start occurring in cases where it was previously not profitable due to high trade costs. Indeed, trade in intermediate goods (parts and components and semi-finished goods) expanded, and entirely new products entered global trade. The trade in new products has grown dramatically. In 2017, 65 percent of trade was in categories that either did not exist in 1992 or were modified to better reflect changes in trade (World Bank, 2020).

A deeper understanding of the interactions within GVCs shows that protection policies negatively affect domestic producers' competitiveness in international markets since they reduce access to the most efficient inputs (Taglioni and Winkler, 2014). OECD (2016) found that the greatest effects werefound to be on trade in intermediates for developing countries and it was suggested that these policiesare likely to be hampering the development of GVCs among developing countries. In particular, tariffschedules that place higher duties on processed goods than on unprocessed goods – a feature knownas tariff escalation – have particularly negative effects on developing countries in GVCs. Escalation acts as a barrier preventing developing countries from upgrading to higher value added segments of the value chain, potentially locking them into lower-value, limited-processing activities. High tariffson raw materials in low-income countries can prevent them from joining the later stages of supply chains. By contrast, middle- and high-income countries tend to have high tariffs on processed non- agricultural and agricultural goods, preventing other countries from accessing their markets. On the one hand, developing countries suffer a self-inflicted wound from the relatively high domestic tariffson raw materials and the semi-finished goods needed for the production of most final goods. On the other, if they are able to produce final goods, their exports face higher levels of protection abroad.

Overall, simulations confirm that in the age of GVCs, protectionism, is likely to have significant costs(also) on agri-food sectors (World Bank, 2020). Rouzet and Miroudot (2013) compute the

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'cumulativetariff' (i.e. the accumulated burden of upstream tariffs for a given importer) which quantifies the total cost-push effect of direct and indirect tariffs, taking into account the upstream GVC structure. Muradov (2017) extends the concept to account for indirect bilateral trade flows and proposes two alternative measures to account for the related costs, the cumulative tariff at origin and destination. Cappariello et al. (2018) use these measures to provide an assessment of the indirect costs of Brexit estimating both the cost-push effect of tariffs and the cumulative resistance of export flows.
Diakantoni et al. (2017) argue that after falling into relative obscurity, at least from a normative perspective, effective protection rates (EPRs) may return to the central stage as international trade moves from "trade in (final) goods" to "trade in tasks". Several contributions (Diakantoni and Escaith, 2012; Rouzet and Miroudot, 2013; Chen et al., 2016) consider multiple border crossings in the traditional definition of the effective protection rate. More recently, Feenstra (2017) and Diakantoni et al. (2017) extend the concept of effective protection to reflect the impact of import tariffs on the foreign value added in an industry's exports.
From a national account perspective, what is internationally traded is the value added (the primary inputs) and the adequate measure of trade distortion is no more the nominal tariff structure on the output, but the effective rate of "protection" on value added. Feenstra (2017) extends the concept of effective protection to reflect the impact of import tariffs on the foreign value added in an industry's exports. Antimiani et al. (2018b) define different benchmarks against which to measure restrictiveness, according to where the value added originates: the resulting Value Added Trade Restrictiveness Indexes are equivalent to the actual protection policies in terms of the impact on domestic or foreign (direct or indirect) value added embedded in imports. Then, using the GTAP-VAmodel, the authors simulate uniform tariff equivalent rates (please see the paper for further details). More recently, Fusacchia et al. (2021) define a restrictiveness index capturing the effects of tariffs onimports of intermediates used to produce exports (FVATRI) and assess the impact of the Common External Tariff on the Italian and German exporting firms relying on foreign intermediate inputs. In this contribution, on the one hand, we focus on the primary sector which is the main object of the BATModel Project; on the other hand, and more importantly, we extend the theoretical framework and provide measures on a value added metric specifically designed to evaluate the effects of a country's tariffs on agricultural exports and value added creation.

The CGE model for value-added analysis and the trade policy indexes

The economic assessment of trade restriction is performed through a modified version of the standardGTAP model, GTAP-VA, a perfectly competitive comparative static global computable general equilibrium (CGE) model incorporating the deconstruction of the gross trade flows to reallocate the value added generated in the production of goods and services back to the countries in which that income is generated (Antimiani et al., 2018a). It is built on general equilibrium theory and designed to assess the inter-regional, economy-wide incidence of economic policies (Hertel and Tsigas, 1997).The main advantages of the CGE approach are its solid micro-theoretical underpinning and its economy-wide scope, as well as its detailed inter-

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sector linkages for each of the economies represented and the complete and consistent coverage of all bilateral trade flows.

The GTAP model underlying our analysis has a symmetric structure, with production and utility functions homogeneous across regions. Utility functions differ by sector, however, and regions differ because the shares of different products in their outputs vary according to local characteristics. The model parameters are mostly drawn from the literature (Hertel, 2013). The model assumes the presence of a representative regional household that receives the factor rewards and allocates regional income (through a Cobb-Douglas utility function) between private consumption, government consumption and saving to maximize its utility. The utility function is nested, with a first aggregationmade over distinct goods or sectors and in the latter, a choice is made between domestic or imported quantities.

As for the production side, separable, constant returns-to-scale technologies are assumed. A commonapproach in CGE literature is to model the production side through a sequence of nested Constant Elasticity of Substitution (CES) functions that aims to re-produce the substitution possibilities across the full set of inputs. The firms' conditional demand for components of value added depends on the relative prices of factors of production whereas composite value added and intermediates are used infixed proportions (a fixed coefficient function of the Leontief type). On the intermediate input side, imported intermediates are assumed to be separable from domestically produced intermediate inputs. However, in the standard GTAP framework, the elasticity of intermediate input substitution is usuallyset to 0, i.e. no substitution is allowed in the production intermediates mix which becomes a limit forour analysis. Following Antimiani and Cernat (2018), we introduce a further nest for the intermediate bundle, with a positive value for the elasticity of substitution among intermediates (Corong et al, 2017). Based on the assumption used in the Mirage model (http://www.cepii.fr/anglaisgraph/models/mirage.htm), we applied a uniform value of 0.425.

The import demand is modelled following the Armington aggregation structure, with an exogenous differentiation scheme given by the geographical origin of nationally homogeneous products. That is,under Armington trade, the output of each sector is assumed to be a region-specific variety. Consumerand intermediate goods are a CES composite of domestic and trade partner varieties. This specification explains the cross-hauling of similar products and makes it possible to track bilateral trade flows.

The GTAP model is based on a complete IO accounting framework that takes into account all sourcesand uses of each economic good and all inputs into production. However, it requires some manipulations to perform GVC analysis.

First, in the standard GTAP model, the sourcing of imports occurs at the border, providing information on total purchases of intermediate inputs by firms (domestic and imported), and total purchases of final goods by households, government and for investment (domestic and imported), but not attributing bilateral trade to the consuming agent (e.g., firms or final consumption). This amountsto applying a proportionality assumption which is not realistic. To overcome this limitation of existingmodels, we consider a richer input-output structure across countries and sectors that we can match with the actual structure reported in input-output tables. We link the import demand for each specificagent to the sourcing country/sector by applying Broad Economic Categories (BEC)-informed sharesto bilateral trade (see Section 4).

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Second, value added multipliers are obtained from the cost structure of firms. They combine the sectoral VA shares in each country with the direct and indirect intermediate usage in the productive process. The multipliers are applied to trade which allows the entire value structure underlying grosstrade to be retrieved, thus disentangling each country's contribution, in terms of income, in the production of traded goods. This enables us to define the benchmark for the value-added trade restrictiveness index within the GTAP framework. Finally, to compute the uniform tariffs, we definea new variable, tr(s), as the product-generic tariff levied on imports into region s.

We consider trade in intermediate goods and allocate the value added therein contained according toits geographical origin. This enables us to distinguish different portions of value in a country's exportsaccording to the country and sector of origin of value added. Specifically, we decompose gross exports into two main components, domestic value added (originated in the exporting country) and foreign value added (originated in other countries). Furthermore, in the domestic component we distinguish between the sector of exports and the sector of origin of the value added.

In what follows, we specify theory-consistent indexes of trade restrictiveness on both gross and VA bases. First, we provide a decomposition of gross imports based on an input-output framework.

Let s and t denote countries and i and j sectors. Define L as the matrix of the Leontief coefficients and V as the diagonal matrix with elements equal to the share of direct domestic value added in totaloutput in each sector of each country. The total value-added content of trade flows can be computed

using the total value-added multiplier, VL, in which the typical element $v_i^t l_{ij}^{ts}$ gives the share of country s' value added originated in sector i of goods produced by country r sector j. The multiplier matrix provides a breakdown of the flows of value added across country/sector of production since diagonal (off-diagonal) sub-blocks represent domestic (foreign) value added in domestic production.Also, define VXE^{s*} as the vector of the country s' total exports.[1] Then, the value-added which originates (in sector i) of country t and is embedded in country s' exports (in sector j) (TVA^{ts*}) is given by:

$$TVA_{ij}^{ts*} = \hat{V}_i^t L_{ij}^{ts} * VXE_j^{s*} \quad (1)$$

Equation (1) allows to unpack, within the value of a traded good, the value added embedded in eachinput sourced locally or imported. Accordingly, we can decompose country s' exports as follows:

$$VXE_j^{s*} = \sum_i \sum_t TVA_{ij}^{ts*}$$
$$= \underbrace{\sum_i \hat{V}_i LOC_{ij}^{ss} * VXE_j^{s*}}_{DVA_j^{s*}} + \underbrace{\sum_i \sum_{t \neq s} \hat{V}_i L_{ij}^{ts} * VXE_j^{s*} +}_{FVA_j^{s*}} \quad (1)$$

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$$\sum_{i} \hat{V}_i (L^{ss}_j - LOC^{ss}_{ij}) * VXE^{s*}_j$$

$$DDC^{s*}_j \qquad (2)$$

---

[1]*In the case of a region, it excluds intra-regional trade.*

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where the first component (DVA^{s*}) represents the domestic value added, giving the value originatingin in all sectors of the exporting country s which is embedded in sector j's exports. The second component (FVA^{s*}) is the foreign value added, which gives the value of imported intermediate inputsembodied in country s's exports in sector j. The last term (DDC^{s*}) is a double counted component that accounts for the portion of domestic value that has previously crossed international borders. Thedomestic value-added content of exports gives a measure of the actual contribution a given export makes to an economy's income, the remainder being the value of imported inputs representing the import content of exports (i.e., the vertical specialization component).
Next, within the domestic value-added component, we compute the sector of origin of value added, assuming that the country of origin coincides with the exporting country. Accordingly, the aggregatedomestic value-added component can be split by distinguishing between a) the value originating in the domestic exporting sector (DVA_dir), and b) the value that originated in other domestic sectors providing intermediate inputs to the domestic exporting sector (DVA_indir):

$$\sum_j DVA_j^{s*} = \underbrace{\sum_i \hat{V}_i LOC_i^{ss} * VXE_i^{s*}}_{DVA\_dir_i^{s*}} + \underbrace{\sum_i \sum_{j \neq i} \hat{V}_i LOC_{ij}^{ss} * VXE_j^{s*}}_{DVA\_indir_i^{s*}} \quad (3)$$

where LOC_{ij}^{ss} is the local (or domestic) Leontief inverse ($LOC_{ij}^{ss} = (I - A_{ij}^{ss})^{-1}$), which is computed on the domestic block of the technical coefficients matrix, thus representing intra-country processing only.

We turn now to the trade restrictiveness indexes ($TRIs$). First, we define an index of tariffs whichequals the uniform tariff that yields a constant volume of gross exports of sector i as:

$$x\_tri^s: VXE_i^{s*}[(1 + T_i^{(\mu)ts})p^I(T), b^0, \omega] = VXE_i^{s*}[p^0, p^I(T), b^0, \omega]. \quad (4)$$

Next, using the decomposition in Equation 3), we define the protection index for the domestic valueadded embedded in exports:

$$dvat\_tri_i^s: DVA_i^{s*}[(1 + T^{(\mu)ts})p^I(T), b^0, \omega] = DVA_i^{s*}[p^0, p^I(T), b^0, \omega].$$

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Finally, we define the uniform tariff that, if imposed on imports instead of the existing structure of protection, would leave the direct (6) and indirect (7) domestic value added at its current levels. Following the definition provided in Equation (3), it is given by:

$$dvad\_tri_i^s: DVA\_dir_i^{s*}[(1 + \text{T}^{(\mu)ts})p^I(T), b^0, \omega] = DVA\_dir_i^{s*}[p^0, p^I(T), b^0, \omega], \text{ and} \quad (6)$$

$$dvai\_tri_i^s: DVA\_indir_i^{s*}[(1 + \text{T}^{(\mu)ts})p^I(T), b^0, \omega] = DVA\_indir_i^{s*}[p^0, p^I(T), b^0, \omega]. \quad (7)$$

In equations (4), (5), (6), and (7), superscript 0 refers to the reference period so that b^0 expresses theequilibrium at the point of reference which has to be maintained once the uniform tariff replaces theinitial tariff structure and p^0 are the initial prices. International prices (p^I) are expressed as a functionof the tariff vector (T) to allow for endogenous world prices thus dropping the small country assumption (Salvatici, 2001; Antimiani and Salvatici, 2005). The right-hand side in both equations is, respectively, the total value of imports and the foreign value used to export embedded in bilateralimports at the initial non-uniform tariffs. The left-hand side maintains the same values when applyinga uniform (product-generic) tariff ($\text{T}^{(\mu)}$).

The MRIO GTAP Data Base

Data are taken from version 10 of the GTAP Data Base for a baseline of consistent data on consumption, production and trade (Aguiar et al., 2019) in its MRIO version (Carrico et al., 2020). The GTAP Data Base is a fully documented global database that provides comprehensive and balanced data on production, bilateral trade, transport and trade policies, covering 121 countries (representing 98% of world GDP and 92% of the world population) and 20 aggregate regions for 65commodities.
The advantage of using the GTAP Data Base for a trade in value added analysis is that it reconciles data from different sources and puts them into one consistent database with a broad sectoral and regional coverage. However, to implement the indexes on value added, a four-dimensional information level on the source and destination country-sector is required. At the same time, the database itself does not account for how imported intermediate products are used. Within the GTAPframework, imports of intermediates from all countries are aggregated at the product level at the border into a composite imported good. This composite good is then allocated across sectors and usesbased on relative demands and shares. Using this approach, we cannot trace exports of intermediates from one country into the production processes of another, and following on from that, into their contributions to other countries' exports. Furthermore, we cannot directly identify the industry-to- industry trade required for the construction of ICIO data, neither can we link trade flows directly fromproducers in each region to importing firms and consumers in all other regions, which is required to implement the above imports

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decomposition. Different methods exist in which supplementary information is used to distinguish between countries of origin on an industry-use basis. A commonlyused approach is to apply proportionality, e.g., using the shares of imports used by firms on the totalcountry's imports and applying them to bilateral trade. The key problem with this method is that it ignores differences in the types of imports from different regions. For a given product, some countries' exports may target final demand whereas others may target intermediate demand. In this analysis, we rely on a more refined method using a series of concordances from the United Nations Statistics Division (UNSD) to obtain BEC-informed shares that are needed to attribute bilateral imports in the GTAP Data Base at the agent level (i.e., firms, government, private households).

Protection data in the GTAP Data Base are sourced from the Market Access Maps (MAcMap). It provides a set of consistent and exhaustive ad valorem equivalents of applied border protection worldwide. However, one caveat is that it does not include information about tariff exemptions granted in export processing zones and through inward and outward processing trade regimes. Theseregimes introduce a differential tariff treatment of imports depending on the sectors and the firms towhich they are destined since imported goods that enter into the production of exports are not subjectto import duties. They are particularly relevant in the case of China trade flows (Yu and Tian, 2012).

We aggregate the GTAP Data Base in 13 countries and regions, identified in terms of their relevanceas Italy's suppliers of goods and services imports in 2014, the benchmark of the dataset. Together, theextra-EU countries considered in our aggregation account for more than 50% of extra-EU Italy's imports. In the discussion of our findings, we do not present results for Russia (because of the extremeconcentration of the extractive sector) or for Switzerland and Turkey (due to the extremely low levelof tariffs they face in the EU). The sectoral aggregation consists of 30 sectors: the protection indexes will be computed for the aggregation regarding the agricultural sectors. Details on the aggregation are reported in Table 1.

Figure 1 records the tariff rates applied by the EU to the trade partner considered in our analysis. EU tariffs are more relevant for the agricultural and food sectors. For these sectors, tariffs can be higher than 50%, as for sugar. On the contrary, manufacturing sectors tariffs are more homogeneousand show lower peaks given that the highest rates never reach 12%.

Results

In this section, we first provide a summary description of domestic and global backward and forwardlinkages for the three EU economies under consideration. This helps us to shed some light on the discussion on the different impact the EU trade policy has on agricultural exports from the selected EU countries in terms of total flows and in terms of value added which is exported both directly andindirectly.

Gross exports, foreign and domestic value added in exports

In Table 2, we show the composition of total exports (i.e., both intra and extra-EU), where columns refer to the exporting sectors while rows refer to the origin of the VA.

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We first look at gross exports and we observe that only a portion of the value is originated in the exporting sector. In the case of agriculture, the highest share is registered in Italy's (5,212/8,715 = 60%), the lowest in Germany (6,416/12,859 = 50%), and the rest is the value of foreign intermediate inputs and the domestic value added generated in sectors different from agriculture. As far as the latter is concerned, most of the non-agricultural VA embodied in agricultural exports is supplied by Services, which is a sector that is not affected by import tariffs. Looking at Table 2 by row, it is apparent the relevance of value created within agriculture and (indirectly) exported by the other sectors, mostly food products. Indirect agricultural VA exports arevery relevant ((4,949 +513+155)/12,033 = 47%) for Germany but still significant (more than 30%) in the case of France and Italy.

The protection on gross and value-added trade

To quantify the protection granted by the EU tariffs, we keep constant total agricultural exports in both gross or VA terms. Uniform tariff equivalents are then obtained by setting bilateral tariffs to zero and replacing them with the uniform one that keeps constant exports either in gross value or in value added.

Table 3 reports the uniform tariff equivalents on total gross exports (x_tri) and domestic agriculturalvalue added ($dvat\_tri$) exported through the agricultural sector ($dvad\_tri$) and the other domestic sectors ($dvai\_tri$). The comparison of the indexes among selected EU economies allows us to showthe extent to which the same trade policy, namely the Common External Tariff (CET) of the EU, leads to different outcomes according to the structural features of the economy is applied to.

Germany is the most impacted country showing the highest index in both gross and VA terms (5.73%and 4.63%, respectively), while France seems to be the less affected (1.49% for gross exports and 1.29% for DVA). Interestingly, the index for the direct DVA ($dvad\_tri$) coincides with the index for gross values (x_tri). To explain such a coincidence it is worth recalling the 3 components of agricultural gross exports:

- direct DVA, i.e. agricultural income generated by agricultural exports;
- indirect DVA, i.e. non-agricultural income generated by agricultural exports through the purchase of domestic intermediate inputs;
- FVA, i.e. foreign income generated by agricultural exports through the purchase of importedintermediate inputs.

The second component, indirect DVA, does not play a significant role it mostly involves Services, which is a sector that is not affected by tariff protection. As a consequence, the two remaining components play a complementary role and the same tariff equivalent would apply to both. The bottom line is that German agricultural exports are hurt the most by the CET. This may be explained by the larger FVA share with respect to Italy (17.8% vs. 13.7%) but the least affected country, France, has an even larger FVA share (19.9%): this implies that German agricultural exporters use foreign inputs paying higher tariffs.

Sector exports are relevant from a 'mercantilistic' point of view but if we adopt a 'political economy'point of view what matters is the size of the sectoral income exported in total, that is

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considering all exports as export channels. In this case, the relevant index is the $dvat\_tri$ which is by construction a(weighted) average of the protection faced in terms of direct ($dvad\_tri$) and indirect VA exports ($dvai\_tri$). The values for the total index ($dvat\_tri$) are always lower than those for the direct component ($dvad\_tri$) and present a smaller range of variation across the EU countries considered. This is due to lower protection faced by downstream exports ($dvai\_tri$) and it is consistent with thewell-known tendency to tariff escalation. The difference between direct and indirect protection is larger in the case of Germany both in absolute (2.1 percentage points) and relative terms (37% lower):the agricultural factors of production are less negatively affected by the CET if we take into accounttheir role as input providers to other sectors.

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Conclusion

This paper defines a new protection index framework to evaluate the effects of trade policies on exports competitiveness and value added creation at the sectoral level. It then shows how they can beoperationalized for quantitative trade policy analysis. In the empirical application, we provide an assessment of the different patterns through which the EU CET impact on the one hand theagricultural exports, on the other hand the remuneration of agricultural factors of production.

Results show that the CET negatively affects the export performance of the agricultural sectors for the EU countries considered. The impact of the same EU trade policy is heterogeneous across member countries, depending on the structural characteristics of exporting economies. German agricultural exports face the highest 'export tax' (5.73%) while France is the least affected (1.49% tariffequivalent). The ranking is confirmed if we look at the agricultural VA totally exported though the values are systematically lower.

We presented a first application of the new indexes. We plan to extend the analysis in 3 main directions:

1. Computation of the indexes for various sectors to provide a comparison between agricultureand food as well as between agri-food and manufacturing sectors.
2. Quantification of the contribution of different tariffs to the overall indexes. This allows us toassess on the one hand what is the role played by agri-food tariffs in the protection faced by each sector as well as the role played by non-agri-food tariffs in the protection by agri-food exports.
3. Computation of the indexes distinguishing intra and extra-EU exports to assess whether the CET has a differentiated impact on export competitiveness according to the export destination.

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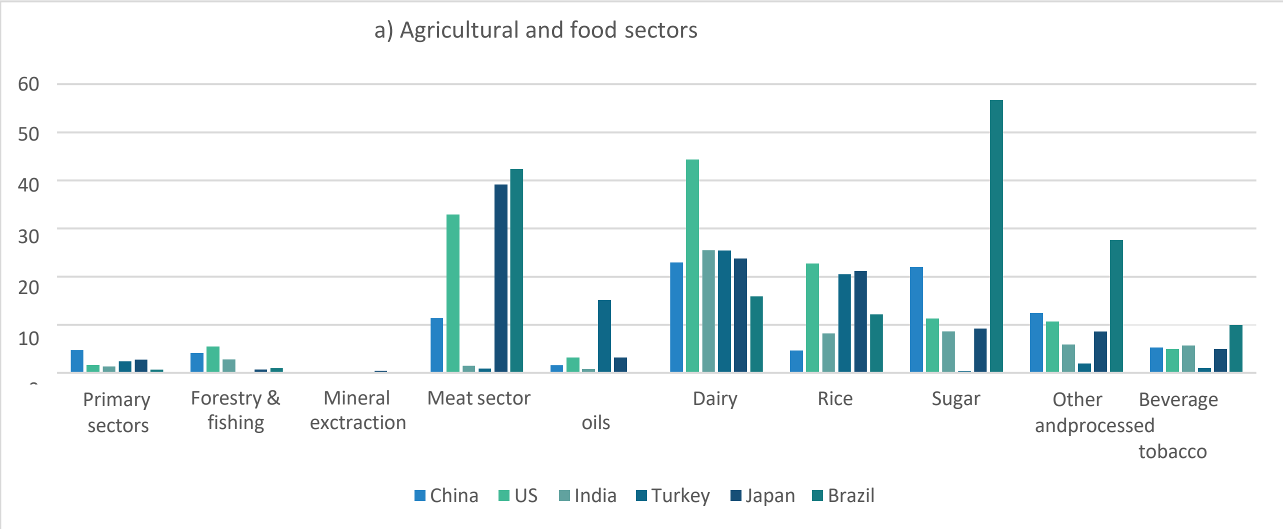
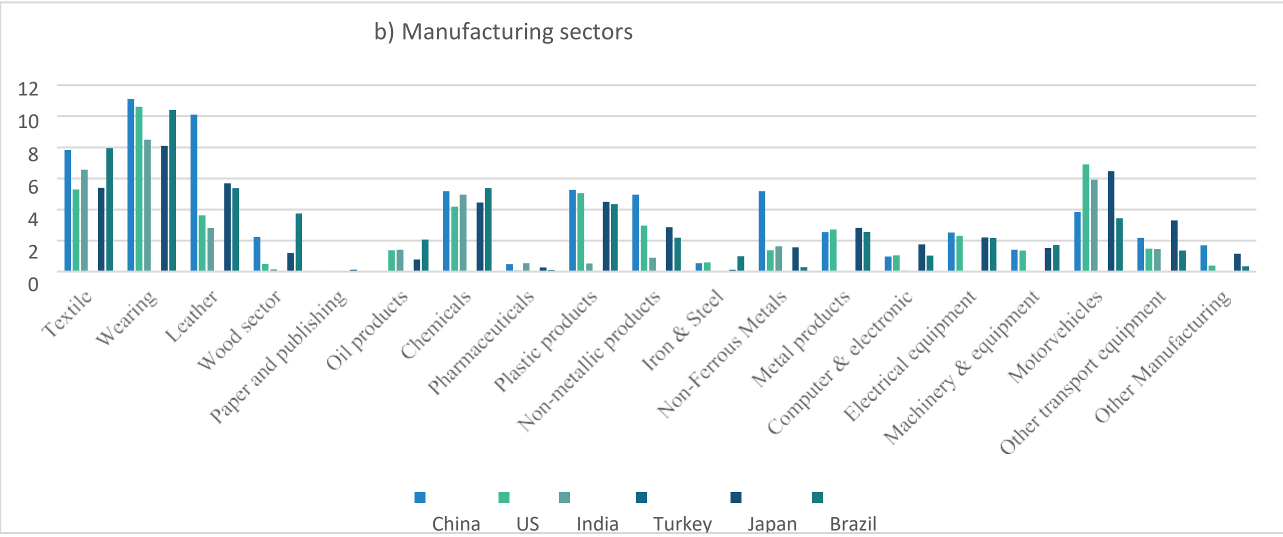
Figura 1: *EU's tariffs (%, 2014)*





Source: GTAP 10 Data Base.

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Table 1. Database aggregation

Countries and Regions	
Italy	US
France	Switzerland
Germany	India
Rest of EU28	Turkey
China	Japan
Russia	Brazil
	RoW

Commodities and Activities	GTAP code (https://www.gtap.agecon.purdue.edu/databases/v10/index.aspx)
Agriculture	pdr, wht, gro, v_f, osd, c_b, pfb, ocr, ctl, oap, rmk, wol
Food	
Meat sector	cmt, omt
Vegetable oils	vol
Dairy	mil
Rice	pcr
Sugar	sgr
Other processed food	ofd
Beverage and tobacco	b_t
Other goods	
Forestry & fishing	frs, fsh
Mineral extraction	coa, oil, gas, oxt
Textile	tex
Wearing	wap
Leather	lea
Wood sector	lum
Paper and publishing	ppp
Oil products	p_c
Chemicals	chm
Pharmaceuticals	bph
Plastic products	rpp
Non-metallic products	nmm
Iron & Steel	i_s
Non-Ferrous Metals	nfm
Metal products	fmp
Computer & electronic	ele
Electrical equipment	eeq

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Machinery & equipment	ome
Motorvehicles	mvh
Other transport equipment	otn
Other Manufacturing	omf
Services	ely, gdt, wtr, cns, trd, afs, otp, wtp, atp, whs, cmn, ofi, ins, rsa,obs, ros, osg, edu, hht, dwe

Source: GTAP 10 Data Base.

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Table 2. VA composition of exports, selected EU countries (2014, USD million)

a) Italy

	Agriculture	Food	Other goods	Services	VA exports
Agriculture	5,212	1,906	342	146	7,606
Food	297	10,732	819	412	12,260
Other goods	446	1,545	184,623	3,780	190,393
Services	1,541	11,994	115,817	76,653	206,005
FVA	1,211	10,686	145,663	9,427	
DDC	8	85	1,659	75	
Gross exports	8,715	36,863	447,263	90,417	

b) France

	Agriculture	Food	Other goods	Services	VA exports
Agriculture	10,040	3,537	523	173	14,273
Food	598	20,780	2,216	817	24,411
Other goods	696	2,303	179,859	3,967	186,826
Services	2,685	15,373	103,108	137,139	258,305
FVA	3,524	12,747	179,517	18,888	
DDC	39	147	2,647	199	
Gross exports	17,583	54,739	465,223	160,985	

c) Germany

	Agriculture	Food	Other goods	Services	VA exports
Agriculture	6,416	4,949	513	155	12,033
Food	247	19,668	1,445	415	21,776
Other goods	403	3,042	541,892	7,006	552,342
Services	3,424	22,217	263,578	195,951	485,170
FVA	2,294	21,815	460,753	28,541	
DDC	74	563	19,609	693	
Gross exports	12,859	71,692	1,268,181	232,068	

Source: Authors' elaborations based on the GTAP-VA model.

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Table 3. Uniform tariff equivalent rates

	x_tri	$dvat\_tri$	$dvad\_tri$	$dvai\_tri$
Italy	2.86	2.70	2.86	2.41
France	1.49	1.29	1.49	0.97
Germany	5.73	4.63	5.73	3.60

Source: Authors' simulations using the GTAP-VA model

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3.2 Global Value Chains and Trade Policy in the Agri-food Sector

Global Value Chain, Tariffs and Food Standards

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Abstract.

We study to what extent countries' and sectors' participation in Global Value Chains (GVCs) reduced governments' incentives to raise trade barriers, as predicted by the model of Blanchard, Bown, and Johnson (2021). We work with a large sample of over150 countries observed from 1995 to 2015, while considering both tariffs and non-tariff measures (NTMs) in the agricultural and food sectors. Using estimates of domestic and foreign value-added incorporated in final goods, we find that especially the former exertsa strong negative effect on both tariffs and NTM regulatory distance. Consistent with theory, the GVC effect on tariffs works only outside regional trade agreements (FTAs). We find similar results also for NTM regulatory distance, but only for a sub-set of bilateral agreements involving, legally enforceable, deep SPS and TBT provisions.

Key Words: Global value chain; Tariffs, Food standards, Political economy, Agri-food sector.

JEL Codes: F1, F13, F68, Q17.

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Introduction

Recent years have shown important changes in worldwide trade and trade policy. First, global valuechain (GVC) participation (i.e. how much an economy is connected to GVCs for its foreign trade) has become increasingly more complex, and so has trade in intermediate inputs, whose internationalvolumes have strongly risen over the past decades. Second, there has been a remarkable increase in the countries' propensity to sign preferential trade agreements (PTAs), covering not just tariffs but also additional policy areas that are not necessarily related to trade (Ruta, 2017). In the agri-food sector, the expansion of the production networks has been dominated by modern food processors and retailers that have become progressively more vertically integrated (Bailè et al. 2018). At the same time, since tariff cuts alone have generally proved insufficient in providing genuine economic integration, non-tariff measures (NTMs) gained further attention through specific provisions in bilateral agreements, such as mutual recognition and harmonization of food standards.

These important changes lead to the two fundamental questions: are these stylized facts inter-related,and does GVC participation change government incentives over trade policy?

Focusing on the agricultural and food sectors, in this paper we study the effects of global value chain participation on the government incentive to rise trade policy. There is a growing body of literature investigating how GVC participation affects trade policy. Most notably, Blanchard (2007, 2010), Ornelas and Turner (2008, 2012), and Antras and Staiger (2012) make initial theoretical contributions by examining the effect of offshoring and foreign direct investment (FDI) on optimal trade policy. However, the empirical literature that links GVCs to trade policy is limited – an issue mainly due to data availability. Blanchard, Bown, and Johnson (2017), Ludema, Mayda, Yu and Yu(2018), and Bown, Erbahar, and Zanardi (2020) are three relevant exceptions that reveal how the riseof GVC interlinks in international trade operations tend to reduce government incentives to rise tradeprotection, such as import tariffs on final goods.

The current empirical evidence focuses largely on the manufacturing sector, where the development of GVCs has been particularly important. However, similar patterns of globalization, characterized by an increase in vertical specialization and trade in intermediate inputs, can be noticedalso in the agricultural and food sectors (see Kowalski et al. 2015; Greenville et al. 2017a; World Bank, 2021). Given that the agri-food sector employs over a quarter of world total employment (ILOSTAT, 2021), and for several other reasons, investigating to what extent the growth in GVC operations affects trade policy in these sectors is therefore fundamental. In addition, differently fromthe manufacturing sector, where tariffs are already quite low worldwide, tariffs and non-tariff measures in the agri-food sector represent the rule rather than the exception.

Recent evidence correlates agri-food trade policy with the country-sector GVC participation, showing that border protection negatively affects the participation of countries and different sectors involved in GVCs (see Greenville et al. 2017b; Bailè et al. 2018). However, these contributions do not focus on the political economy implications of trade in value added. Thus, to date, we lack of anindebt political economy analysis of the role played by GVC participation as determinants of trade policy in the agricultural and food sectors.

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In other words, what does GVC participation and how we execute this specific large-scale, country-sector division of activities and tasks involved in GVCs entail for the future of trade policy?Our paper starts to fill this gap, testing to what extent GVC backward and forward linkages affect bilateral tariffs and NTMs.

We test predictions from the political economy model of Blanchard, Bown, and Johnson (2021), hereafter BBJ (2021). These authors extend the protection for sale model of Grossman and Helpman(1994; 1995) to trade in value added. While considering both domestic (DVA) and foreign value added (FVA), they emphasize how the national origin of the value-added content of traded goods affected final good tariffs. By exploiting information on bilateral tariffs and regulatory distance in NTMs, we shed light on whether the use of domestic intermediate inputs in third-country export (DVA) and the use of foreign inputs for a country's exports (FVA) play the predicted role in affectingthe determination of final goods tariffs and NTM regulatory distance. We investigate this issue considering GVC linkages and trade policies for more than 150 countries observed in the period from1995 to 2015.

Results for both the agricultural and the food sectors confirm the theoretical predictions. That is, country participation to GVCs reduces both bilateral tariffs and NTM regulatory distance, an effectparticularly strong and robust for DVA (forward participation). In line with theory, higher DVA negatively affects tariffs only outside free trade agreements (FTAs). On the other hand, when food standards are considered, domestic value added in foreign exports reduces NTMs regulatory distanceboth inside and outside of FTAs, a result that indirectly confirms the difficulty countries face in signing FTAs involving deep integration on behind-the-border barriers. However, within a sub- sample of deep FTAs involving specific SPS and TBT provisions, the impact of DVA on NTM regulatory distance works mainly outside FTAs, as predicted by theory.

Our contribution to the literature, other than the first application ever to test recent theoretical predictions on the agricultural and food sectors, is to consider explicitly the level of protection heterogeneity induced by the diffusion of food standards, i.e. Sanitary and Phytosanitary Standards (SPS) and Technical Barriers to Trade (TBT). This is important for several reasons. First, because standards, other than acting like tariffs through rent-shifting effects, could alter market competition by reinforcing the market power of surviving firms (Asprilla et al. 2019; Curzi et al. 2020), and couldeven increase import volume when food standards address information-related problems (Beghin et al. 2015; Cadot et al. 2018). Second, because governments have more degree of freedom to set their own domestic regulations when NTMs are concerned, as opposed to tariffs where governments are bound by WTO rules. This could potentially be important for trade policy, since the BBJ (2021) theoretical propositions and the derived optimal tariff formula are actually the result of a non- cooperative Nash equilibrium, raising some empirical identification issues when tested only on tariffsand within WTO countries.[2] Finally, while tariffs could be discriminatory as an effect of regional trade agreements (RTAs), whilst food standards are not because they are largely set as non-discriminatory domestic regulation. As shown below, these differences between tariffs and NTMs have some interesting empirical content.

Finally, this paper is also related to an extensive political economy literature on the determinants of agricultural and food policy, recently survey by Swinnen (2018). From this perspective, the main departure of the current paper, other than the focus on GVCs, is to exploit

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bilateral variation in trade policy outcomes (tariffs and NTMs), instead of focusing on cross-country(e.g. Olper and Raimondi, 2013; Olper at al. 2014), or cross-industry (Gawanda and Hoekman 2006; Lopez, 2006) variation. This is an important departure from previous applications, directly linked tothe BBJ (2021) model, that significantly extend previous effort to understand the relevant economic and political forces driving government policy decisions in this complex area.[3]

The paper is structured as follows: Section 2 discusses the relevant literature considering both the GVCs role in the agriculture and food sector, and the emerging theoretical and empirical literatureregarding the interlinks between GVCs and trade policy. Section 3 summarizes the main prediction of the BBJ (2021) political economy model that will inform our empirical application. Section 4 presents the data, the empirical model, and potential identification issues. Section 5 discusses the main results and checks for the robustness of the results, and Section 6 concludes.

Related Literature

The expansion of global value chains in recent decades is transforming not just the economics of production and trade exchanges, but also the political economy of agricultural and food policies. Interest groups beyond borders have always played a role in agricultural and food policy. For example, in the 1990s, US company Monsanto actively lobbied the European governments to allow GMOs in Europe (Swinnen et al. 2021). Another example from the late 20th century is lobbying by foreign farm associations and agribusiness companies when agricultural policies with high import tariffs and export subsidies were distorting international agricultural markets. This contributed to significant reforms in the 1990s as part of the WTO's "Uruguay Round Agreement on Agriculture" (URAA) (Josling, 2015).

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[2] The most relevant empirical tests of the Grossman and Helpman (1994) theory used indeed 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).

[3] 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, more recently a simple extension of the Grossman and Helpman model by Cadot et al. (2006) reconciliated this potential ambiguity. For an indebt test of the Grossman and Helpman model to the US agricultural protection, see Gawanda and Hoekman (2006), for a test on the US food industry, see Lopez (2006).

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With the growth of GVCs, the distinction between "domestic interests" and "foreign interests" are no longer as obvious when studying the determination of trade policy (Antras, 2015). Hence, it becomes increasingly more relevant to integrate these GVC linkages more explicitly in political economy models. For example, if companies are sourcing inputs from foreign subsidiaries or contracting with foreign farms or companies for raw materials and intermediate inputs, the policy interests of these (domestic) companies may be aligned with their (foreign) input suppliers (Swinnenet al. 2021).

Standard trade and political economy models do not accurately capture these effects since they (implicitly) assume costless switching between different producers and consumers if prices or costs change. However, in a world with extensive and elaborate product and process standards, such switch can imply significant transaction costs. For this reason and because of local imperfections in knowledge and capital market, trading is increasingly integrated in global value chains with elaborateand sophisticated forms of vertical coordination (Antras, 2015; Nunn 2007; Sexton, 2012; Swinnen,2007; Baldwin and Lopez-Gonzalez 2014; Fałkowski et al. 2018). This growth and integration of production and exchange in global value chains could significantly change the incentives of various agents in the value chains to lobby for or against import protection and integration in international trade agreements (Blanchard and Matchke, 2015).

These crucial changes in the global organization of production trigger a new wave of political economy models with the aim of incorporating these GVC linkages in standard model of trade policydetermination (see Author and Chor, 2021, for a recent survey of this rapidly expanding literature). First, studies start to address how GVCs links may affect trade agreements. In a seminal contributionon the impact of GVCs on trade agreements, Antràs and Staiger (2012) argue that in the presence ofGVCs, international prices are more likely to be determined by bilateral bargaining, and not by market clearing conditions. With offshoring and buyer-seller relationships, optimal global policy cooperation changes because actual WTO rules (non-discrimination and reciprocity) cannot account well for trade externalities due to GVCs links (which are costly to break down). They argue that deep regional tradeagreements could be more suited to manage the trade externalities induced by GVCs.

Orefice and Rocha (2014) show empirically that there is indeed a two-way relationship between deep RTAs and GVC interlinks. They find that signing deep RTAs increases trade in production networks between member countries and that higher levels of trade in production networks increase the likelihood of signing deeper preferential trade agreements. The second result is consistent with findings of Blanchard and Matschke (2015) who combine firm level data on US foreign affiliate activities with US trade policy (duty preferences), to study the relation between offshoring and preferential market access. They find that a 10% increase in US foreign affiliate export to the US isassociated with 4% points increase in the rate of preferential duty-free access. This effect is strongerfor developing countries-based US foreign affiliate with GSP preferences.

Other relevant studies focused on the impact of GVCs on trade policy. To model the GVC impact on tariffs from a political economy logic, Blanchard et al. (2021), explicitly modelled the foreign component of domestic goods (FVA), and the domestic component of foreign goods (DVA)and use these trade links to extend the well-known Grossman and Helpman (1994, 1995) benchmark protection for sale model.

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The Blanchard et al. (2021) model predicts (1) that the higher the foreign component of domestic products, the lower the final good tariffs and (2) that the higher the domestic component offoreign products, the lower the import tariffs of final goods. Empirical findings confirm these hypotheses, showing that bilateral tariffs are indeed lower when the domestic content of foreign finalgoods is higher and (vice versa) for foreign content of domestically produced goods, but only outsideRTAs. In other words, the integration of economies and companies in global value chains tends to dampen the incentives for policies that hurt trade.

Other relevant empirical contributions are Ludema, Mayda, Yu and Yu (2018), and Bown, Erbahar, and Zanardi (2020). The former studies the influence of upstream and downstream domesticproducers on the level of protection against downstream imports and examined detailed discriminatory trade policies of 27 countries plus the EU toward China.[4] The key innovation is to useChinese transaction-level processing trade data to construct a firm-level measure of domestic value added (DVA) and a measure inputs customization. Key findings show that both upstream and downstream political organization increase downstream trade protection, but the effect of the formeris smaller when DVA, as a share of final imports from China, is larger, according with the predictionof the BBJ (2021) model. Importantly, they show that this result is further contingent upon the industries' political power as well as the customization of inputs.

Bown et al. (2020) adopted instead a new instrumental variables strategy to identify the causal effect of GVC integration on the likelihood that a trade barrier is removed. To this end, they used a

[4] *Early contributions on political competition between upstream-downstream suppliers over protection against imported intermediates include Cadot, de Melo, and Olarreaga (2004), Gawande, Krishna, and Olarreaga (2012).*

newly constructed dataset of protection removal decisions involving 10 countries, 41 trading partners, and 18 industries over 1995–2013. Findings show that bilateral industry-specific domestic value- added growth in foreign production significantly raises the probability of removing a duty.[5]

There are only a couple of papers that formally correlated the GVC participation with agri-food trade policy. Greenville et al (2017b) find that border protection (like tariffs and restrictive SPS measures), negatively affects country-sectors participation in agri-food GVCs. Balié et al. (2018) have similar findings: using a structural gravity model where the dependent variable is trade in valueadded for agriculture and food sectors, they show that bilateral trade policies are key determinants ofboth backward and forward GVC participation in the food sector and, to a lesser extent, in the agricultural sector.

Our contribution differs from the two papers above and moves on to propose a first political economy investigation building on the theoretical model of Blanchard et al. (2021). Importantly, in doing that, other than focusing on the contribution of GVCs on bilateral tariffs, we consider

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explicitlyto what extent forward and backward participations affected the (bilateral) regulatory distance in SPSand TBT food standards. This distinction is essential for several reasons. First, NTMs standards playa central role in the current debate over trade policy in the agricultural and food sectors. Second, working with a (bilateral) measure of standards regulatory distance helps us shed some new light ontothe complex problem of NTM deep provisions in bilateral trade agreements. Specifically, we show that, when SPS and TBT are concerned, GVCs reduce regulatory distance both inside and outside FTAs, unlike tariffs that are affected by GVC links only outside FTAs. This result confirms that, on average, current trade agreements still fail to account for (bilateral) heterogeneity in domestic food standards. However, within a sub-sample of deep FTAs involving specific SPS provisions, there is evidence that the impact of DVA on SPS regulatory distance works largely only outside FTAs, *ceterisparibus*.

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[5] *Other contributions are 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 that began in 2018 between US and China gave rise to papers by Amiti, Redding, and Weinstein (2019), Bellora and Fontagné (2019), Flaaen and Pierce (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. On this topic, see also the theoretical contribution of Ornelas et al. (2020) and Grossman and Helpman (2020) who studied how increasing intermediate inputs tariffs, in a world with GVC relationship-specific investment (and incomplete contracts), and/or with hold-up problems and stickiness in place, changes the mapping between tariff and welfare. See Antras and Chor (2021) for an update review of the GVC literature.*

Theoretical Considerations

Blanchard et al. (2021) address two main questions: how do global value chain linkages modify countries' incentives to impose import protection? Are these linkages empirically important determinants of trade policy in practice? To this aims they develop a specific-factors trade model with a stylized representation of the production process to capture two essential features of global value chains. First, both domestic and foreign factors of production are used to produce output in a GVC. Second, GVCs often feature a high degree of input specificity and lock-in between buyers and suppliers (Antras and Staiger 2012). In the model this lock-in is manifest as factor specificity and frictions in factors substitution. The baseline GVC model is then incorporate into a political economymodel following the standard Grossman and Helpman (1994) approach, to characterize unilaterally optimal bilateral tariffs on final goods.
Within this framework, they add an important contribution showing how the value-added content of trade in the production process changes the mapping from prices to income, altering government incentives over trade policy. More formally, BBJ (2021) show that the non-

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cooperative optimal bilateral tariff, t^i_{xj}, set by country *i* toward country *j* final goods *x*, can be represented by the following extension of the Grossman and Helpman (1994; 1995) tariff formation function:[6]

$$t^i_{xj} = \frac{1}{\sigma^i_{xj}}\left(1 + \frac{\delta^i_x q^i_x}{|\lambda^i_{xj}| M_{xj}} - (1+\delta^*_{xi}) \frac{\varepsilon^{rj}_{xi} DVA^j_{xi}}{p^j_x M_{xj}} - \frac{(1+\delta^i_{x*}) s^{rj}_{x*} FVA^i_{x}}{|\lambda^i_{xj}| p^j_x M_{xj}} - \tilde{\Omega}_{xj}\right) \quad (1)$$

Where $\lambda^i_{xj} \equiv \frac{dp^j_x}{dc} / \frac{dp^i_x}{dc} < 0$ and Ω_{xj} captures any potential third-country effects of trade diversion.

There are four main terms in equation (1). The first two are well-known and correspond to the inverse export supply elasticity $\frac{1}{\sigma^i_{xj}}$ and the inverse of import penetration $\frac{\delta^i_x q^i_x}{|\lambda^i_{xj}| M_{xj}}$ of the original Grossman and Helpman "protection for sale" model. The inverse export supply elasticity captures the familiar terms-of-trade motive for tariffs; the inverse import penetration ratio captures, instead, the influence of domestic political economy concerns, whereby the government trades off the interests of import-competing domestic producers of good *x* against social welfare (Grossman and Helpman, 1994).

The third term is new and captures the impact of domestic value added (DVA) in foreign production. When DVA^j_{xi} is high, the government optimally sets a lower bilateral tariff, i.e. $\Delta t^i_{xj} / \Delta DVA^j_{xi} < 0$, because lowering the tariff raises the price of foreign final goods and some of this price increase is passed back to the home country in the form of higher prices for domestic value- added inputs. Note, this mechanism drives down the optimal tariff even when the domestic government values only national income, namely when the domestic input producers political weight

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[6] *As discussed by Blanchard et al. (2021), equation (1) focused on the direct price effect of tariff on the price of i's value- added used by the country (j) on which the tariff is imposed. The strength of this direct effect is governed by the elasticity $\varepsilon^{rj}_{xi} \geq 0$. Instead, indirect price effects, namely how the tariff impacts the price of i's value-added inputs used in third countries, is not considered.*

is zero, $\delta^*_{xi} = 0$. Clearly this effect will be stronger to the extent to which domestic governments value more the interest of domestic input producers (i.e. $\delta^*_{xi} > 0$)

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The fourth element of equation (1) captures the role of foreign value added (FVA) in domestic production, $\mathrm{FV}\,A_x^i$. Foreign value added affects the optimal tariff because it induces an international cost-shift of trade liberalization effects, from import-competing industry to foreign inputs suppliers to that industry. Basically, when $FV\,A_x^i > 0$, the negative income effect of trade liberalization sufferedby import-competing sectors is partially shift upstream to foreign input suppliers, driving down the

optimal (domestic) bilateral tariff. Thus, again the prediction is that $\Delta t_{xj}^1/\Delta FVA_x^t < 0$, *ceteris paribus. Note that, when the government assigns positive political weight to the interests of foreign value-added input suppliers* $\delta_{x*}^i > 0$, *relative to consumer welfare, this effect is attenuated or even reversed.*[7]

Finally, the influence of trade in value added in shaping optimal tariffs is partially governed by the terms ε_{xt}^{rj} and ε_{xt}^{rj}, which represent value-added elasticities that capture to what extent changes in final goods prices are passed through to value-added input prices. Empirically, the strength of these effects will be embedded in coefficient estimates together with political welfare weights and overalltrade elasticities.

Discussion and Implications

One of the crucial aspects of the BBJ (2021) model is that home (foreign) supply of inputs dampensthe terms-of-trade motive for a tariff on final good. Importantly, this result does not rely on special interest politics, as they include political weights on profits in their model, but the strength of the tariff DVA dampening effect is shown to increase with the political clout of the domestic input suppliers. This interaction between political economy and terms-of-trade motives for protection is unusual in the literature (see Ludema et al. (2018)), especially since Grossman and Helpman (1995) have shown that the two motives for protection are additively separable. Yet, the increasing complexity of GVC participation and trade agreement stipulations in the past two decades might showa different story.

Furthermore, an interesting feature of the BBJ (2021) model is that it does not require data on politicalorganization to be tested empirically. This is an important advantage given difficulty to collect data on the political organization for many countries and sectors.

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[7] *Additionally, note that DVA and FVA in equation (1) are both scaled by bilateral imports ($\mathcal{M}i$), just as the import penetration ratio term of the Grossman and Helpman baseline model. As discussed in BBJ (2021), this scaling is necessary because the political and value-added terms act as counterweights to the standard terms-of-trade effect, whose strength is related to the level of bilateral imports.*

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As discussed in BBJ (2021), there are several additional implications when testing empirically equation (1). First, the most-favoured-nation (MFN) rule suggests that WTO members may not discriminate across their WTO-member trading partners. Also, any deviations from MFN tariff, within preferential or regional trade agreements, must involve downward adjustment in applied tariffs. Thus, MFN tariff rates represent an upper bound on applied bilateral tariffs. For this reason, the focus of the empirical application is on bilateral tariff *deviations* from MFN tariff.[8]
Moreover, several tariffs that are currently in effect are the result of bilateral regional trade agreements, but it is sensible to assume that the degree of cooperation between RTA members could*de facto* change the relationship between value-added content and applied tariffs for countries withinand outside an RTA. This is because negotiating an RTA tends to eliminate or soften the terms-of- trade motive for protection. If so, then the off-setting effect of DVA – that works through foreign local price – tends to be automatically neutralized (see Blanchard et al. 2021). Thus, the expectationis to find heterogenous effects of DVA inside and outside of RTAs and, more precisely, DVA is expected to affect the tariff formation function particularly for countries outside RTAs, and not the other way around.
However, the above predicted heterogeneous effect of DVA on the optimal tariff in countries inside and outside of RTAs does not apply directly to NTMs, as NTMs are largely set as non-discriminatory behind-the-border domestic regulations. In addition, NTMs other than acting like tariffs – i.e. inducing a profit-shifting from foreign to domestic firms by affecting the unit price of exported goods – could also have positive effects on import volumes, through market-creating effectswhen they address information-related problems (Beghin et al. 2015; Cadot et al. 2018; Gourdon et al. 2020).[9] Also, despite growing evidence showing that deep-integration clauses in regional trade agreements reduce the price-raising effect of NTMs (see Cadot and Gourdon, 2016; Santeramo, 2020), current PTAs do not systematically have legally enforceable provisions concerning (domestic)regulatory convergence, mutual recognition or harmonization rules (see Grossman et al. 2020; WorldBank, 2020; Fernandez et al. 2021). Hence, the DVA effect on NTMs inside or outside an RTA is difficult to predict a priori, and represents an interesting research question, which we address through

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[8] Current MFN tariffs in the agri-food sector were set under the 1994 Uruguay Round, the first multilateral trade agreement that involved this sector. This coincides with the starting date of our sample period and, importantly, 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 away MFN tariff in our empirical specifications, at least when import-sector-time fixed effects are controlled for (see the next section).

[9] Gourdon et al. (2020) showed that the price versus the quantity trade effect of SPS and TBT standards, largely depends by their typology, i.e. "Restrictions" vs "Regulations" vs "Conformity". SPS and TBT restrictions have always large price effects and negative

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quantitative trade effects; SPS and TBT conformity assessments work similarly but the price effect especially for SPSs are significantly lower; instead for SPS and TBT regulations the quantity trade effect is always positive, though the price effect could be relevant for TBTs.

a (bilateral) measure of regulatory distance in SPSs (TBTs), and by accounting also for SPS and TBT provisions in a sub-sample of deep PTAs.
Moving to the effect of FVA outside or inside RTA, the prediction from BBJ (2021) model is less straightforward. This is because the mechanism through which FVA affects tariff (and possible NTMs) in the model works through a domestic (local) price externality, and there is little evidence on the potential for cooperative agreements to mitigate behind-the-border externalities. For example,the recent political economy model of Bouet et al. (2020), inspired by the complexity of border and domestic behind-the-border policy in agriculture, suggests that in presence of asymmetric information, eliminating those instruments by means of a trade agreement may become impossible once the domestic government has also private information on its redistributive concerns.

Data, Variables and Empirical Specification

In this section we present the data used to build our GVC variables, tariffs and non-tariff measures, as well as the empirical specifications to test the model's predictions discussed above.

GVC Data and Measures

Measures of the 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 from1990 to 2015. We focus on agriculture, and the food and beverage sectors (ISIC codes 1,15-16).[10]
The gross exports flow decomposition is performed with the R decompr package (Quast and Kummritz, 2015), which together with the Wang et al. (2013) decompositions algorithms allow to split bilateral gross exports into 16 value-added components. We use this export decomposition and follow Bailé et al (2018) to construct the two measures of GVC participation: Forward and Backward GVC participation by country. The former, domestic value added (DVA), measures the exports of intermediate goods used as inputs in the production of other countries' exports, and indicates the extent of involvement in GVC for relatively upstream industries.[11] The latter considers the value added in intermediate inputs imported from abroad used in the production of a country's exports (FVA), and captures the extent of involvement in GVC for relatively downstream industries.[12] Finally, using the same Eora database, we also measure domestic final goods production scaled by bilateral imports to proxy for the inverse of import

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penetration in final goods (FG). Specifically, we use domestic value-added content in final goods' exports as a proxy of importer industry domestic final goods production.

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[10] We measure also forward GVC for sector "Education, Health and Other Services", used as instrument in the IV regressions.
[11] It is measured 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.
[12] Backward GVC is obtained adding the five exports components involving foreign value added in final and intermediate good exports, and pure double counting due to the direct imported exports production.

In computing the GVC participation variables we considered all the countries with data, but the sample excluded within EU trade in value added. EU 27 members are reported as individual countriesin the dataset. We compute value added content using the fully disaggregated country data, and thenwe aggregate value-added contents across EU countries to form the EU composite value added.
Figure 1 reports the evolution of DVA and FVA in the whole sample from 1990 to 2015. Considering the agri-food sector, the (log) of DVA and FVA growth systematically from 1990 until of around 2010. After the financial crisis, similarly to what happened in the manufacturing sector (seeWorld Bank, 2020), the growth in GVC participation stopped, and even degreased somewhat for DVA. Within the two considered sector, agriculture and food industry, although the time patterns aresimilar, there are important level difference in the degree of GVC participation. On average, in agriculture backwards (FVA) links are significantly lower than forwards links (DVA). This huge difference is significantly lower and reverted in the food industry, with FVA links slightly higher than DVA links. The average patterns of GVC participation in the agri-food, confirm previous decomposition made by other authors (see, e.g. Bailé et al. 2018).

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Trade Policy Variables

As for tariff data, we use both bilateral applied tariffs and multilateral MFN applied tariffs, sourced from UNCTAD-TRAINS database and WTO database, respectively. To identify final goods' tariffs in the data, we use the Broad Economic Categories (BEC) classification, keeping HS 6-digitcategories classified as "Mainly for household consumption", and discarding both mixed use and intermediate input categories. 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 simple average of HS product tariffs within each industry. Using this procedure, we measure both industry-level applied bilateral tariffs and multilateral MFN tariffs.

Finally, following BBJ (2021), we obtain the bilateral tariff preferences as the (negative) deviation from MFN tariffs: $tp_{ijt}^{s} = t_{ijt}^{s} - tMFN_{jt}^{s}$, Thus, the larger bilateral tariff preferences $(tp^{s})_{ijt}$ granted by country *i* to country *j* in sector *s* at year *t*, the more negative bilateral tariff levels betweencountries (t_{ijt}^{s}). Figure 2 gives a picture of the evolution in the two sectors of bilateral tariffs and bilateral preferential tariffs in the observed period. Tariffs are lower in agriculture vis-à-vis the foodindustry, confirming the existence of tariff escalation. When agricultural tariffs are concerned, from 1995 until 2000 the data show an increase in average tariffs from about 9% to 11%. Next, they sharply degrease reaching around 7.5% in 2015. In the food industry, instead, average tariffs degrease in theobserved period from about 14% in 1995, to about 10.5% in 2015.

NTM regulatory distance (*RD*) was constructed following Cadot et al. (2015) approach, using wiiw NTM Database – a compilation of WTO official notification at HS 6-digit level, recently classified by Ghodsi et al. (2017). The wiiw NTM Database includes 134 importers and over 5,000 products (HS) for the period 1995-2019, and reports the number of notifications aggregated in the main types of NTMs (e.g. Antidumping, Quantitative restrictions, Safeguards, and so on). Sanitary and Phytosanitary Measures (SPS) and Technical Barriers to Trade (TBTs) are, by large, to most frequent and constraining measures for agri-food products. Thus, we measure *RD* considering only SPS and TBTs, separately. The distance in regulatory NTM structures between country *i* and country*j* in sector *s* is:

$$RD_{ijt}^{s} = \frac{\sum_{z \in s} |NTM_{it}^{z} - NTM_{jt}^{z}|}{N}$$

Where NTM_{it}^{z} (NTM_{jt}^{z}) is a dummy variable that takes value 1 when country *i* (*j*) imposes a NTM on product *z* (of sector *s*) at the time *t* and zero otherwise; *N* denotes the number of products *z* (HS 6-digit) in sector *s* (ISIC 2 digit) where at least one of the two countries (*i* or *j*) applies the NTM in year
t. Regulatory distance ranges between 0 and 1, meaning that the lower the value of the index, the more similar (or less heterogeneous) the regulatory frameworks of two countries are.

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Furthermore, to be able to take account of the relevant information concerning not only the presence but also the number of NTM imposed on product *z* by each country, we propose an alternative measure of distance in regulatory structure (*nRD*) obtained as:

$$nRD_{ijt}^{s} = \frac{\sum_{z \in s} \frac{|nNTM_{it}^{z} - nNTM_{jt}^{z}|}{nNTM_{it}^{z} + nNTM_{jt}^{z}}}{N}$$

Where $nNTM_{it}^{z}$ $(nNTM_{jt}^{z})$ is the number of notifications on NTM measures (SPS/TBT) applied by country *i* (*j*) on product *z* in year *t*. *nRD* normalizes the absolute difference between the number of measures applied in the two countries with their sum. This normalization gives value 0 when both countries impose the same number of NTM measures, 1 when only one country imposes measures, and ranges within 0 and 1 when both countries present NTM notifications on the same product *z* in year *t* but differ in the number of notifications. Figure 3 displayed the evolution of the two regulatorydistance indicators, considering SPSs[13]. The time pattern of the two indicators is slightly different.
RD_{ijt}^{s} tend to be decreasing at both aggregate level and for the agricultural and food sectors, suggesting a process of "harmonization" in bilateral regulatory distance. Differently, nRD_{ijt}^{s} rise from 1995 until 2007, and then decrease, particularly in the agricultural sector.

Data on 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 WorldTrade Organization from 1950 to 2015[14]. Finally, deep preferential trade agreements (PTAs), with specific information on, legally enforceable, SPS (and TBT) provisions, such as mutual recognition and harmonization, are taken from the World Bank deep trade agreements dataset (see Hofmann et al. 2019). Following, Laget et al (2020) we classify a PTA as deep when the number of SPS or TBTprovisions between country *i* and *j* in year *t* is higher than 5 or 10, respectively[15].
Finally, we also collect standard gravity variables to conduct some robustness checks from CEPII (Centre d'Etude Prospectives et d'Informations Internationales), such as language, contiguity, colonial origin, and bilateral distance between countries. Our final dataset includes bilateral data on 129 importing/exporting countries observed in the agricultural and food GVC sectors over the period1995-2015.[16]

Empirical Specifications

To test empirically equation (1) we start from a reduce form equation focusing on the impact of domestic value added in foreign production (DVA), isolating the other terms in equation (1) throughfixed effects. Formally, we estimated the following specification:

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$$t^{i}_{xjt} = \Phi_{xit} + \Phi_{xjt} + \beta \ln(DVA^{j}_{xit}) + \nu_{xijt}, \quad (2)$$

where the dependent variable t^{i}_{xjt} is, alternatively, the minimum between the preferential or MFN tariff, $\min\{t^{i,p}_{xjt}, t^{i,MFN}_{xt}\}$, or the SPS (TBT) regulatory distance, $RD^{i,sps}_{xjt}$ ($RD^{i,tbt}_{xjt}$); Φ_{xit} and Φ_{xjt} are

[13] *The pattern of the two indicators when TBTs are concerned, is very close.*

[14] *We treat Free Trade Agreements (FTAs), as defined in Paragraph 8(b) of Article XXIV of GATT 1994, as potentially cooperative bilateral or regional trade agreements. In the paper we consider mainly FTA defined as above (see later), though we use the acronymous FTA and RTA as interchangeable.*

[15] *These thresholds coincide with the median of the sum of provisions concerning SPS and TBT areas in the deep PTA dataset of the World Bank.*

[16] *Variable statistics and country list are reported in the Appendix.*

importer-industry-year and exporter-industry-year fixed effects. Our right-hand side variable of interest is $In(DVA^{j}_{xit})$[17] with coefficient sign prediction $\beta < 0$.

Equation (2) is applied to the agricultural and food sectors pooled together or considered separately, with the aim of investigating possible heterogeneity of the DVA effect in the two sectors.Thus, the importer-industry-year and exporter-industry-year fixed effects, in this second case, will collapse to importer-year and exporter-year fixed effects. The inclusion of these fixed effects is crucial for identification because they should absorb the (omitted) inverse export supply elasticity $\frac{1}{e^{i}_{xj}}$, the inverse of import penetration and the foreign value added (FVA), all factors affecting the appliedequilibrium tariff in Eq. (1). Thus, the identification hypothesis is that the inclusion of these fixed effects could properly account for these omitted terms, minimizing the correlation between $In(DVA^{j}_{xit})$ and the error term ν_{xijt} in Eq. (2).
Consequently, to render this identification hypothesis more credible and to address also possible endogeneity due to reverse causation between DVA and tariffs, we also test the robustness of the results using an instrumental variable approach, where agriculture and food DVA is instrumented byDVA in the service sectors.
To study empirically the impact of foreign value added (FVA) on trade policy (and the other terms of Eq. 1) it is necessary to change the model specification, because an important component ofFVA operates at the multilateral level. Following BBJ (2021), we replace the importer-industry-yearfixed effects with importer-industry (or importer) and importer-year (or year) fixed effects, dependingby the specification considered, i.e. when pooling agriculture and the food industry together, or when the two sectors are considered in isolation. In this specification, coherently with Eq. (1), all the determinants of equilibrium trade barrier enter as a share (*sh*) of bilateral final imports:

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$$t^{i}_{xjt} - t^{i,MFN}_{xt} = \Phi_{xi} + \Phi_{it} + \Phi_{xjt} + \beta^{IP}\ln(FG^{i\_sh}_{xt}) + \beta^{FVA}\ln(FVA^{i\_sh}_{xt}) +$$

$$+ \beta^{DVA}\ln(DVA^{j\_sh}_{xit}) + \omega_{xijt}, \qquad (3)$$

Where $FG^{i\_sh}_{xt}$ is the domestic final goods production scaled by bilateral imports, i.e. the inverse of import penetration ratio capturing domestic political motives for protection. Similarly, $FVA^{i\_sh}_{xt}$ and $DVA^{j\_sh}_{xit}$ are taken as shares of bilateral final goods imports. The other terms in Eq. (3) are fixed effects and the error term. The expected signs are $\beta^{IP} > 0$, $\beta^{DVA} < 0$ and $\beta^{FVA} < 0$ (at least if the political weight of foreign value added is not too high). Note that, the dependent variable is now

[17] *Following BBJ (2021), DVA enters in logarithm form in Eq. (2) to account for the fact that, by omitting bilateral imports from the denominator (see equation 1), the effect of DVA on tariff could be heterogeneous, namely an increase in DVA at low level could be more influential than an increase of DVA at high level. In this specification, indeed, bilateral import is subsumed in the estimated DVA coefficient β.*

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).
As discussed in the theory section, the theoretical model predicted that the DVA effect on tariffs – and under certain conditions also the FVA – should work only outside FTAs. To test this heterogeneity, Eq. (2) and (3) will now include also interaction terms between DVA (and FVA) variables and an FTA dummy, equal to 1 (0 otherwise) for countries signing an FTA in year *t* onward,and with an indicator variable equal to (1 – FTAs) for countries outside FTAs.[18] As better discussedbelow, when we work with NTMs we also consider to what extent the FTA is deep in terms of SPS (TBT) specific provisions.

Results

We start by estimating how bilateral applied tariffs respond to domestic value added in foreign production using Eq. (2). We then turn to the effect on the SPS (TBT) regulatory distance. Next, wefocus our attention to the alternative specification (3) to investigate how foreign value added, and domestic political motives, affect tariffs and NTMs. Finally, we extend our analysis on the impact ofDVA on NTM regulatory distance, considering carefully deep PTAs.

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Domestic Value Added and Tariffs

Table 2 reports our baseline estimates of Eq. (2) with bilateral applied tariffs as the dependent variable. Columns 1-3 focus on the pooled agri-food sector. The coefficient of log (DVA) is always negative and statically significant at 1% level. Column 2 adds the RTA dummy to the specification. Its estimated coefficient is negative and significant, confirming that, on average, countries inside RTAs have lower bilateral tariffs. When controlling for RTAs, the magnitude of the coefficient of domestic value-added shrink substantially, going from –0.20 to –0.10, but the estimated effect remains highly statistically significant.

Quantitatively, the magnitude of the estimated DVA coefficient (–0.10 in column 2) means that moving from low to high DVA in our sample induces a tariff reduction of about 13 percent.[19] In comparison, BBJ (2021) working on 14 developed and emerging countries, found a 30 percent tariffreduction in the manufacturing sector. Hence, apparently, the reduction in the optimal tariff inducedby DVA in the agri-food is smaller than in the manufacturing sector, *ceteris paribus*. However, as better discussed below this is partially the consequence of the endogeneity of DVA to tariffs.

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[18] *In this specification, we always include an indicator variable for FTAs with the aim to capture level differences in tariffs and DVA (FVA) inside and outside preferential trade agreements.*

[19] *In our sample, the median variation of log DVA (from min to max value) is about 9 log points, thus moving from low to high DVA yields a reduction of tariffs of about 0.9% points. Since the median tariff in our sample is around 6.7%, this represents a 13.4% reduction in the typical tariff level.*

In column (3), by estimating two separate DVA coefficients, we test the model predictions onthe heterogeneity of the DVA effect on tariffs inside and outside RTAs. Results support this prediction and show that the coefficient of DVA is significant and negative only outside RTAs, whileit is zero within RTAs.

Columns 4-6 and 7-9 repeat this battery of regressions by splitting the sample in Agriculture and Food products, respectively. Overall, the results hold true in both cases, but the magnitude of theestimated (absolute) coefficients is from 1.5 to 2 times higher in the food industry.

Endogeneity and Robustness Checks

A crucial issue resulting from the estimates above is that domestic value-added possibly responds endogenously to tariffs. On this note, the model suggests that tariffs tend to push

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down the price of the value-added inputs of country *i* supplies to the production in country *j*. Additionally, related evidence shows that bilateral tariffs negatively affect country participation in agriculture, andparticularly in food global value chains (see Bailé et al. 2018).
Accordingly, we move onto performing an instrumental variable regression to address this endogeneity concern. We adopt the same strategy of BBJ (2021) by instrumenting ln (DVA) in equation (1) with the respective DVA of country *i* used in the service sector in country *j*. This instrument should be correlated with DVA in the agri-food sector, as there are common supply-factorsthat render country *i* an attractive inputs' supplier for country *j* in different sectors. At the same time,the instrument should satisfy the exclusion restriction, since it is difficult 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*.
Table 3 reports IV estimates. Given the results above, we focus exclusively on the sub-sampleof data with FTA = 0. The results are interesting, showing that IV estimates do not only corroborate OLS ones, but they also suggest that the true impact of DVA on tariffs is significantly larger. The DVA coefficient in IV regressions double in comparison to the OLS counterpart. Overall, we got thesame results for both agriculture (column 4) and the food sector (columns 6).
Quantitatively, the magnitude of the IV estimated DVA coefficient (–0.3 in column 2, Table 3) means that moving from low to high DVA in our sample induces a tariff reduction of about 30%, hence a relevant economic effect.[20] This typical effect in the agri-food sector masks some heterogeneity when measured in the agriculture vs. the food sector, where the effect is, respectively
–42% and –26%, *ceteris paribus*. Note in addition that, our IV results clearly showed that OLS estimated coefficients tend to be bias downward. This consideration is important because, when we run Eq. (3) to estimate the FVA (and FG) effects together with DVA, we are no longer able to implement properly IV regressions, due to lack of reliable instruments.

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[20] *In the FTA = 0 sample, the median variation of log DVA (from min to max value) is about 8.1 log points, thus moving from low to high DVA yields a tariff reduction of about -0.3*8.1 = -2.4% points. Since the median tariff in this sample is around 7.9%, this represents a 30% reduction in the typical tariff level.*

Finally, Table 4 considers additional robustness checks on the pooled agri-food sector, as we control for traditional gravity variables, such as distance, common colony, language, and contiguity.The inclusion of these variables slightly reduces the estimated coefficient of DVA in the OLS regressions that retain its negative effect but lost somewhat level of precision, at least when we control for distance. However, when we run IV regressions (columns 5-8) by instrumenting Log (DVA) withthe DVA in services, the estimated effect returns to be highly significant with coefficient estimates similar to those in Table 3. In addition, only the contiguity variable remains significantly different from zero. Thus, we conclude that domestic value added

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has a robust and strong negative causal effecton tariffs outside RTAs, a result fully consistent with the BBJ (2021) model prediction.

Domestic Value Added and non-Tariff Measures

More notably, we now address to what extent domestic value added also affects the bilateral distancein SPS and TBT agri-food standards. This question is relevant not just because NTMs are pervasive in the agri-food sector, but also because it offers an additional opportunity to validate to what extentthe mechanism suggested by the BBJ (2021) model is driving the results.

As previously discussed, when considering NTMs, results are intricate and could differ as many RTAs do not provide specific provisions on SPS and TBT regulatory standards (see World Bank, 2020).[21] Thus, in the baseline specification we should expect that DVA affects NTMs both inside andoutside the RTAs, *ceteris paribus*. We test this by incorporating two different indicators of NTM

bilateral distance, respectively RD^s and nRD^s (see Section 4). However, because results obtained by the two indictors are qualitatively and quantitatively similar, to save space we focus on the first NTM indicator (the other results are available from the authors upon request).

Table 5, Column 1 reports our benchmark OLS results for SPS regulatory distance. Note that, in all specifications involving NTMs as dependent variable, the log of DVA (or FVA) always enter the equation as five-year lags, to account for the fact that NTM regulatory distances tend to be stockvariables and, as such, could be endogenous by construction to DVA (FVA).

The impact of domestic value added on SPS regulatory distance is negative and significant at a 1% level (Column 1). Controlling for FTAs in Column 2 does not affect at any degree the DVA

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[21] *For example, the recent World Bank (2020) report on deep PTAs, shows that when deep TBT provisions are concerned, the percentage of PTA that can be classify as deep, involve 25% of TBT standards, 45% of technical regulation, 57% of conformity assessment, and only 44% have a dispute settlement mechanism. This coverage is even lower when deep SPS provisions are considered. See World Bank (2020) and Fernandez at al. (2021), for additional evidence about the coverage in existing PTAs of SPS and TBT provisions.*

coefficient, while the FTA estimated effect is negative, as expected, but not different form zero. Thissuggests that joining a FTA, on average, does not affect the level of convergence in SPS standards, *ceteris paribus*[22]. Column 3 tests for the heterogeneity of the effect for countries inside and outside FTA. Interestingly, the negative impact of DVA on SPS regulatory distance is significant and virtually of the same order of magnitude both for the FTA and non-FTA sample.[23] Columns 4 and 5 run two alternative IV regressions by using the DVA in services as instrumentfor DVA in the first stage. The results are robust to this specification. Similar to tariffs, when we isolate the exogenous component of DVA, the (absolute) magnitude of the estimated DVA effect

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doubles, also implying that OLS results tend to bias the estimated coefficient toward zero. Quantitatively, the estimated coefficient of –0.031 in column 4 suggests that moving from a low to ahigh DVA value in our sample induces a reduction in SPS bilateral distance of about –31%, thus a relevant economic effect.

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 SPS regulatory distance is always negative and significant at 1% level and does not show any heterogeneity of the impact between the FTA and non-FTA sample. The only difference between agriculture and food lies in the magnitude of the estimated DVA coefficients, just like our findings for tariffs.

Table 6 addresses whether these results hold when we consider other important NTMs, such as TBT standards. In this case, we still find that domestic value added negatively affects TBT regulatorydistance, and this effect is similar in magnitude to what we find for SPS standards. Additionally, and in line with the discussion in Section 3.1, we do not find any robust heterogeneity effects of DVA inside or outside FTAs.

To sum up, this section's findings are strikingly consistent with the BBJ (2021) model predictions, though we use an admittedly more sensitive trade policy instrument, i.e. NTMs. Domesticvalue-added negatively affects the country' incentive to rise NTM heterogeneity vis-à-vis trading partners – a result robust across different type of standards (SPS and TBT), and sizable from an economic point of view. Overall, results imply that accounting for GVCs inter-linkages when investigating the determinants of trade policy is highly relevant.

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[22] *When nRD^{s}_{ijt} is used as indicator variable, sometime the FTA estimated coefficient is even positive and significant suggesting that, if anything, joining an FTA decrease and does not increase regulatory convergence, a result that deserve further investigation in future work.*

[23] *F tests for the equality of the DVA coefficients inside and outside FTA, for regressions in columns 3 and 5 of Table 5, are never statistically significant.*

Foreign Value Added and Trade Policy

We now move to estimating the other terms in equation 1 and, particularly, to what extent foreign value added also affects trade policy. As discussed in the Section 4, testing this hypothesis would require relaxing the fixed effects specification since foreign value added (FVA^{ish}_{xt}) does not display bilateral-industry-time variation but only country-industry-time variation. As shown in equation (3),we subsequently substitute importer-industry-year fixed effects with importer-year and industry-yearfixed effects. An interesting feature of specification (3) is that now we can also address the impact ofdomestic political motives for protection

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through the domestic final goods production scaled by bilateral imports ($FG_{xt}^{i_{sh}}$), i.e. the inverse of import penetration ratio.

Table 7 reports the OLS estimates of equation (3). Note, for this admittedly more elaborated specification, we cannot run an IV regression, simple because there are several endogeneous variables(DVA, FVA, FG, and bilateral import). However, to the extent to which our OLS results are bias downward, as showed in previous reduce form equation, then OLS results reported below should be still considered informative because they are lower bound of the "true" estimated" effects.

Results from column (1) suggest that the estimated coefficient of log FVA share is negative, as expected, but significant only at a 10% level. The inverse of import penetration is positive and strongly significant, suggesting that domestic political motives are a relevant determinant of tariffs, as predicted by the Grossman and Helpman (1994) model. However, when the equation is estimatedwith this set of fixed effects, the log of DVA share of bilateral imports is positive, though not statistically significant. Failure to find a robust (negative) DVA effect with this specification can be attributable to additional endogeneity concerns coming from omitted variable bias which, summed tothe (positive) bias induced by reverse causality as shown above, results in a positive, though, insignificant impact. To test if this is the case, column (2) reintroduces importer-industry-year fixed effects. Notice that with this specification we can only identify the FVA effect together with domestic political motives, FG. Results are reassuring, confirming that the log of DVA share negatively affectsthe optimal tariff (preference).

Table 8 tests for the heterogeneity of the effect inside and outside FTA. Surprisingly, the log of FVA share is negative and significant at a 1% level only inside FTA, a result somewhat at odd with the model prediction. Note, however, that also BBJ (2021) find similar results. The impact of the logFG share is significant and positive only outside FTA, implying that at least in the agri-food sector free trade agreements contribute to internalize domestic political motives. In this specification that includes importer-year and industry-year fixed effects, the log of DVA share is again positive and significant inside FTA, a result different from previous findings. Thus, in column (2), we reintroduceimport-industry-year fixed effects – an admittedly more demanding specification – to test if the DVAaffects tariffs only outside FTA, as showed in our reduce form equation. Results strongly confirm thismodel prediction, showing that both DVA and FG shares of bilateral imports affect tariffs only outside FTA. Results hold also when restricting the analysis to the sample where FTA=0 (columns 3 and 4).

Finally, Tables 9 and 10 display NTMs results. Starting from SPS regulatory distance, Column1 in Table 9 runs a specification with importer-year and industry-year fixed effects (plus exporter-industry-year), where the log of DVA share has the expected negative and significant effect in line with section 5.3 findings. The log of FVA share has a positive and non-significant effect also on SPSregulatory distance a result that can be eventually accommodate only if the weight government attached to foreign inputs producers is positive, δ_{x*}^{i}> 0. Instead, the log of FG share retrieves the (expected) positive and significant effect. These results are robust to the introduction of importer- industry-fixed (see column 2). Finally, note that in all these specifications the level effect of FTA is negative but insignificant, suggesting that NTM regulatory distance, on average, is not lower within bilateral free trade agreements, *ceteris paribus*.

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Columns 3 and 4 in Table 9 run the same specification in columns 1 and 2, but now test for the heterogenous effect inside and outside FTAs. As with tariffs, the log of FVA share is negative and significant only within FTAs but not significant and positive outside. The log of FG share has the expected positively effect on SPSs irrespective of the existence of an FTA. We find similar results also for the log of DVA share, at least in the more demanding specification of column 4 that includeimporter-industry-year fixed effects. Thus, domestic political motives and DVA have a positive, respectively negative, impact on NTMs both inside and outside FTA, as per the theoretical predictions and with results discussed in the previous section. Overall, when we consider regressions with TBT regulatory distance as a dependent variable, the results are similar (see Table 10).

Are deep PTAs different?

In this final section we test to what extent considering deep SPS and TBT provisions in bilateral trade agreements, change the estimated impact of DVA inside and outside FTAs. The BBJ (2021) model predicts that the effect of DVA on a country's protection level should be close to zero, or smaller in absolute magnitude, when the terms-of-trade motive for protection is (cooperatively) addressed within trade agreements. In the previous section we showed that this prediction holds truefor tariffs, but not for NTMs.

One possible interpretation is that governments do not have enough economic and/or political incentives to sign bilateral agreements that account effectively for provisions concerning domestic regulatory convergence, such as mutual recognition and harmonization (see Grossman et al. 2020; Bouet et al. 2020). However, there is growing evidence showing that deep-integration clauses in preferential trade agreements reduces the price-raising effect of NTMs (see Cadot and Gourdon, 2016; Gourdon et al. 2020). If this is the case, then PTAs involving deep SPS or TBT provisions should matter for final results.

Table 11 tests this prediction for SPS and TBT regulatory distance, and estimates four different DVA coefficients accounting for: the effect outside both FTAs and deep PTAs (first line);[24] the effectoutside FTAs but inside deep PTAs (second line); the effect inside FTAs but outside deep PTAs (thirdline); and, finally, the effect inside both FTAs and deep PTAs (four lines). Following Laget et al. (2020), we measure to what extent a PTA is *deep* by means of the number of legally enforceable provisions for SPS and TBT, respectively.[25] Then, starting from the median number of SPS and TBTenforceable provisions in the World Bank dataset (equal to 5 and 10 for SPS and TBT, respectively),we build a deep PTA dummy equal to 1 (0 otherwise) when the number of provisions is higher than the respective median value.[26]

Overall, the results are stark and interesting. When it comes to SPS and TBT regulatory distance, there is indeed a robust evidence showing that moving from outside FTA and deep-PTA (first line) to a situation inside FTA with deep-PTA involving legally enforceable SPS/TBT provisions (four line), the estimated impact of DVA is indeed significantly lower, and neverstatistically significant both in agriculture and food industry (see columns 1-3 for SPS and 4-6 for TBT). This result is backed by F-tests reported at the bottom of the table, showing that for both SPSand TBT regulatory distance, the estimated coefficients inside FTA with deep-PTA provisions are significantly different than the benchmark coefficient outside FTA and deep-PTA.[27] Interesting,

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thiseffect does not appear to be driven only by deep SPS (TBT) provisions in PTAs, but it is the concomitant presence of deep provisions within a FTA that do matter.

The finding that a rise in DVA reduces the regulatory heterogeneity only within PTAs that account for deep and legally enforceable SPS and TBT provisions, represent a further important confirmation that the mechanism suggested by the Blanchard et al. (2021) model, is a distinctive feature of the data.

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[24] Note: our deep PTA dummy does not just cover a sub-sample of FTAs, because there are other bilateral trade agreements involving deep SPS and TBT provisions that are different from FTAs, such as Custom Unions and other preferential trade agreements.
[25] In the World Bank Deep PTA database, the legally enforceability of PTA provisions are coded according to the language
used in the text of the agreements, and to the existence of a mandatory dispute settlement. In short, commitments expressed with a clear, specific, and imperative legal language has been classify as legally enforceable because can more successfully be invoked by a complainant in a dispute settlement proceeding.
[26] We experiment others definition of "deep" PTAs, for example considering if cooperation on "mutual recognition" and "harmonization" are in place. Overall, the results are qualitatively similar for SPS but not for TBT regulatory distance, where the only definition of deep provision that works satisfactory is the one considering legally enforceable TBT provisions, as describe in the main text. These additional results are available to the authors upon request.
[27] F-tests (bottom of the Table 11) test the equality of the coefficients between line 4 (inside FTA with deep PTA) against the baseline in line 1 (outside both FTA and deep PTA).

Conclusions

This paper tests predictions from the Blanchard, Bown, and Johnson (2021) model concerning the impact of GVC participation on agri-food trade policy. GVCs erode the link between the locationin which a good is produced and the nationality of the value-added content embodied in that good. Therefore, because tariffs and NTMs are applied based on the location where goods are made, GVCsmodify optimal trade policy. Specifically, when domestic content in foreign final goods is high, governments have less incentive to manipulate the terms-of-trade, leading to lower trade protection. We test this logic on the agriculture and food sectors, where both tariffs and NTMs play a crucial role. Special attention has been given to the impact of GVC participation on NTMs regulatory distance, admittedly one of the most debated and complex issues in the agri-food sector.
Using different estimators (OLS and IV) and identification strategies, we document an important role played by forward linkages (DVA) as determinant of government optimal trade policy.The domestic value added exerts a strong dampening effect on both bilateral tariffs and NTMs regulatory distance in final products, which is not only statistically robust but also economically meaningful. We show that moving from low to high DVA in our sample induces a reduction of tariffsand NTM regulatory distance of about 30%.
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, such that this mechanism is logically attenuatedfor tariffs within FTAs. Consistently with this prediction, we show that the dampening effect of DVAon bilateral final tariffs works only outside FTAs. However, and interesting, the last result does not apply to NTM regulatory distance. This is probably the result of the actual

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complexity and government motivations behind NTMs. Yet, when NTMs are concerned, we also showed that withina sub-set of FTAs involving specific (legally enforceable) deep NTM provisions, the impacts of DVAon SPS and TBT regulatory distance work only outside FTAs. The last finding gives a further confirmation that the mechanism on which the BBJ (2021) model is based is effectively relevant when assessing the impact of DVA on trade protection. In addition, this result appears also consistentwith the recent contribution on the economics of trade agreements by Grossman et al. (2020) who highlighted that in presence of consumption externalities, even the ones that do not cross internationalborders, the requirements for (multilateral) cooperation are more severe, so that “old bilateral trade agreements” cannot account for this externality efficiently through specific provisions, such as mutualrecognition or harmonization of domestic regulations.

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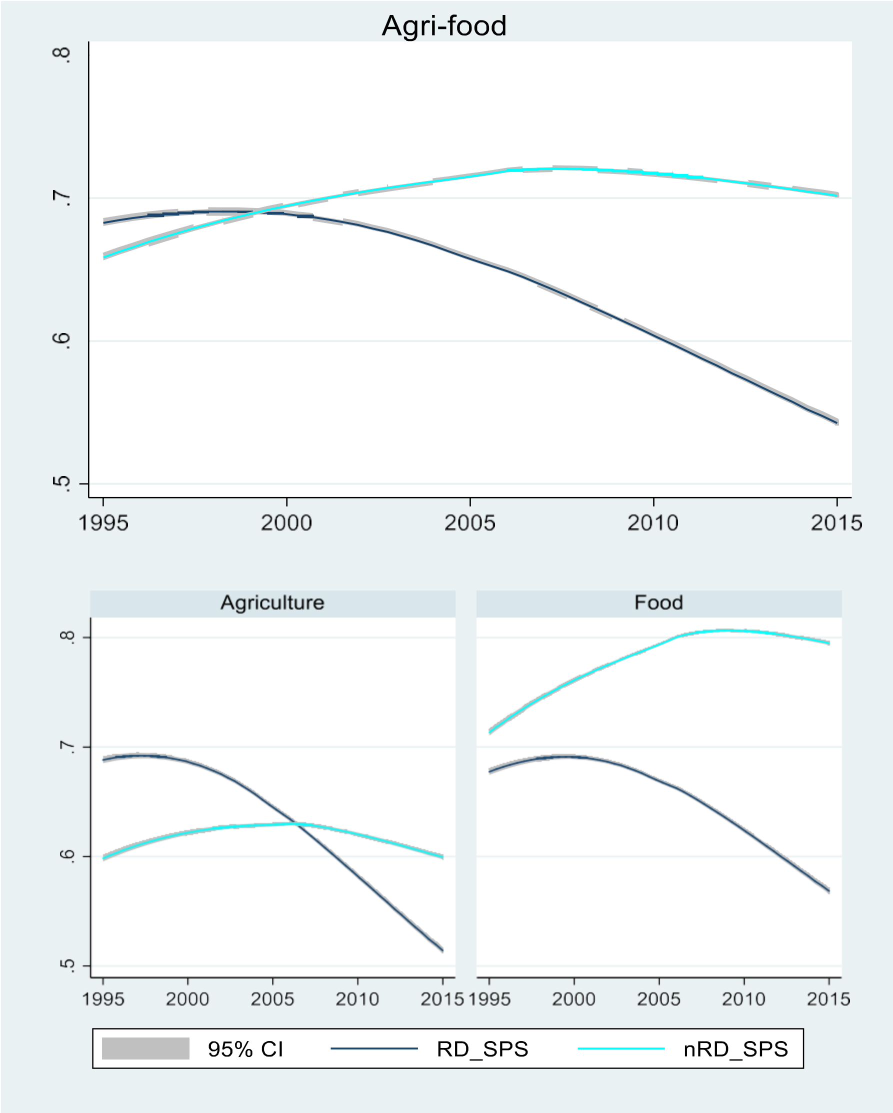
Figure 3. SPS regulatory distance in the observed period



Source: Authors' analysis based wiiw NTM Database (see Ghodsi et al. (2017). RD_SPS is the distance in regulatory SPS structures between country *i* and country *j* in sector *s* (agriculture and food industry, ortheir aggregation) measured without accounting for the number of SPS in each HS 6-digit tariff line; Differently, nRD_SPS account for the number of country SPS notification in each HS 6-digit tariff line. See text for details.

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Tab 2. Bilateral tariffs and DVA: Baseline regressions

	Agri-food industry			Agriculture			Food		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ln DVA	-0.204***	-0.100***		-0.132***	-0.070***		-0.252***	-0.118**	
	(0.032)	(0.032)		(0.029)	(0.029)		(0.047)	(0.048)	
RTA		-2.306***	-2.587***		-1.491***	-1.577***		-2.772***	-3.169***
		(0.188)	(0.382)		(0.143)	(0.218)		(0.282)	(0.597)
Ln DVA x RTA			-0.056			-0.057			-0.055
			(0.065)			(0.039)			(0.104)
Ln DVA x (1-RTA)			-0.114***			-0.074**			-0.138***
			(0.030)			(0.031)			(0.044)
Fixed effects									
Imp-Ind-Year	Yes	Yes	Yes	No	No	No	No	No	No
Exp-Ind-Year	Yes	Yes	Yes	No	No	No	No	No	No
Imp-Year	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Exp-Year	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	284945	284945	284945	106386	106386	106386	178559	178559	178559
R-Sq	0.596	0.598	0.598	0.7123	0.7132	0.7132	0.5429	0.545	0.5451

Notes: OLS regressions. The dependent variable is bilateral applied tariffs. Standard errors (in parentheses) are clustered by importer-exporter pair.

Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

Tab 3. Bilateral tariffs and DVA: IV regressions

	Agri-food		Agriculture		Food	
	FTA=0		FTA=0		FTA=0	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
ln DVA	-0.1248***	-0.3046***	-0.0713*	-0.2535***	-0.1593***	-0.3342***
	(0.0381)	(0.0707)	(0.0387)	(0.0810)	(0.0550)	(0.0920)
No. of obs.	182012	182012	68150	68150	113862	113862
R-Sq	0.6265	0.6262	0.7259	0.7255	0.5725	0.5723

Notes: The dependent variable is bilateral applied tariffs. 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. First stage results available from the authors upon request. Standard errors (in parentheses) are clustered by importer-exporter pair.

Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

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Tab 4. Bilateral tariffs and DVA: Additional robustness checks

	FTA=0							
	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln DVA	-0.0687*	-0.1293***	-0.0731*	-0.0551	-0.2717***	-0.3171***	-0.2829***	-0.2620***
	(0.0388)	(0.0389)	(0.0391)	(0.0403)	(0.0943)	(0.0733)	(0.0961)	(0.0994)
Ln distance	0.3370***		0.3438***	0.1979*	0.1074		0.1117	0.0004
	(0.1068)		(0.1083)	(0.1159)	(0.1449)		(0.1451)	(0.1446)
Colony		0.2452	0.2948	0.3726		0.4247	0.4256	0.4697
		(0.2921)	(0.2949)	(0.2925)		(0.3015)	(0.3014)	(0.2968)
Language				-0.2036				-0.1090
				(0.1615)				(0.1672)
Contiguity				-1.6553***				-1.4376***
				(0.4820)				(0.4887)
No. of obs.	182012	182012	182012	182012	182012	182012	182012	182012
R-Sq	0.6266	0.6265	0.6266	0.6267	0.6263	0.6262	0.6263	0.6265

Note: The dependent variable is bilateral applied tariffs. 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. First stage results available from the authors upon request. Standard errors (in parentheses) are clustered by importer-exporter pair.

Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Tab 5. SPS regulatory distance and DVA: OLS and IV regression results

	Panel A: Agri-food Sector				
	OLS (1)	OLS (2)	OLS (3)	IV (4)	IV (5)
L5.lnDVA	-0.0134***	-0.0120***		-0.0227***	
	(0.0011)	(0.0011)		(0.0024)	
FTA		-0.0269***	-0.0420***	-0.0122*	-0.0299***
		(0.0062)	(0.0068)	(0.0068)	(0.0074)
L5.lnDVA_FTA=1			-0.0084***		-0.0190***
			(0.0014)		(0.0025)
L5.lnDVA_FTA=0			-0.0131***		-0.0250***
			(0.0011)		(0.0025)
No. of obs.	190909	190909	190909	190909	190909
R-Sq	0.6519	0.6522	0.6524	0.6508	0.6508
	Panel B: Agriculture				
	OLS (6)	OLS (7)	OLS (8)	IV (9)	IV (10)
L5.lnDVA	-0.0099***	-0.0093***		-0.0161***	
	(0.0013)	(0.0014)		(0.0028)	
FTA		-0.0145*	-0.0331***	-0.0056	-0.0221**
		(0.0075)	(0.0085)	(0.0081)	(0.0091)
L5.lnDVA_FTA=1			-0.0049***		-0.0129***
			(0.0017)		(0.0029)
L5.lnDVA_FTA=0			-0.0106***		-0.0182***
			(0.0014)		(0.0029)
No. of obs.	70936	70936	70936	70936	70936
R-Sq	0.6762	0.6763	0.6765	0.6757	0.6758
	Panel C: Food				
	OLS (11)	OLS (12)	OLS (13)	IV (14)	IV (15)
L5.lnDVA	-0.0156***	-0.0138***		-0.0267***	
	(0.0012)	(0.0013)		(0.0025)	
FTA		-0.0334***	-0.0463***	-0.0150**	-0.0329***
		(0.0065)	(0.0072)	(0.0072)	(0.0079)
L5.lnDVA_FTA=1			-0.0106***		-0.0229***
			(0.0015)		(0.0026)
L5.lnDVA_FTA=0			-0.0147***		-0.0290***
			(0.0013)		(0.0026)
No. of obs.	119973	119973	119973	119973	119973
R-Sq	0.6365	0.6370	0.6371	0.6350	0.6349

Notes: The dependent variable is SPS regulatory distance. 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. DVA enters in each regression with a five years lag. First stage results available from the authors upon request. Standard errors (in parentheses) are clustered by importer- exporter pair.

Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

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Tab 6. TBT regulatory distance and DVA: OLS and IV regression results

	Panel A: Agri-food Sector				
	OLS	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)	(5)
L5.lnDVA	-0.0130***	-0.0120***		-0.0231***	
	(0.0012)	(0.0012)		(0.0026)	
FTA		-0.0198***	-0.0297***	-0.0045	-0.0172**
		(0.0074)	(0.0081)	(0.0078)	(0.0088)
L5.lnDVA_FTA=1			-0.0097***		-0.0205***
			(0.0017)		(0.0028)
L5.lnDVA_FTA=0			-0.0128***		-0.0248***
			(0.0012)		(0.0026)
No. of obs.	190909	190909	190909	190909	190909
R-Sq	0.6174	0.6175	0.6176	0.6163	0.6162
	Panel B: Agriculture				
	OLS	OLS	OLS	IV	IV
	(6)	(7)	(8)	(9)	(10)
L5.lnDVA	-0.0118***	-0.0107***		-0.0195***	
	(0.0015)	(0.0016)		(0.0032)	
FTA		-0.0239***	-0.0283***	-0.0124	-0.0223**
		(0.0091)	(0.0102)	(0.0095)	(0.0107)
L5.lnDVA_FTA=1			-0.0097***		-0.0176***
			(0.0020)		(0.0034)
L5.lnDVA_FTA=0			-0.0110***		-0.0208***
			(0.0016)		(0.0033)
No. of obs.	70936	70936	70936	70936	70936
R-Sq	0.5819	0.5821	0.5821	0.5812	0.5811
	Panel C: Food				
	OLS	OLS	OLS	IV	IV
	(11)	(12)	(13)	(14)	(15)
L5.lnDVA	-0.0138***	-0.0129***		-0.0252***	
	(0.0014)	(0.0014)		(0.0027)	
FTA		-0.0172**	-0.0303***	0.0004	-0.0142
		(0.0077)	(0.0087)	(0.0082)	(0.0093)
L5.lnDVA_FTA=1			-0.0097***		-0.0222***
			(0.0019)		(0.0029)
L5.lnDVA_FTA=0			-0.0139***		-0.0271***
			(0.0014)		(0.0027)
No. of obs.	119973	119973	119973	119973	119973
R-Sq	0.6361	0.6362	0.6363	0.6348	0.6347

Notes: The dependent variable is TBT regulatory distance. 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. DVA enters in each regression with a five years lag. First stage results available from the authors upon request. Standard errors (in parentheses) are clustered by importer- exporter pair.
Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

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Tab 7. Tariff preferences and FVA: Baseline regression results

	(1)	(2)
ln DVA_sh	0.1657	-0.1859**
	(0.1283)	(0.0734)
ln FVA_sh	-0.2020*	
	(0.1191)	
ln FG_sh	0.1586***	
	(0.0402)	
ln FVA_FG		0.1483***
		(0.0390)
FTA	-2.0318***	-2.1197***
	(0.2373)	(0.2288)
Fixed effects		
Importer-year	Yes	No
Industry-year	Yes	No
Importer-industry-year	No	Yes
Exporter-industry-year	Yes	Yes
No. of obs.	185742	185732

Notes: The dependent variable is tariff preferences. Standard errors (in parentheses) are clustered by importer-exporter pair. DVA, FVA and Final Goods (FG) enter as a share of (bilateral) imports. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

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Tab 8. Tariff preferences and FVA: Heterogeneity inside and outside FTA

Dependent variable			FTA = 0	
Tariffs preferences	(1)	(2)	(3)	(4)
ln DVA_sh			0.0502	-0.2194***
			(0.1261)	(0.0717)
ln FVA_sh			-0.0831	
			(0.1154)	
ln FG_sh			0.1860***	
			(0.0436)	
ln FVA_FG_sh				0.1843***
				(0.0409)
lnDVA_sh FTA = 1	0.5319**	-0.1096		
	(0.2208)	(0.1785)		
lnDVA_sh FTA = 0	0.1055	-0.2269***		
	(0.1264)	(0.0688)		
ln FVA_sh FTA = 1	-0.7415***			
	(0.2100)			
ln FVA_sh FTA = 0	-0.1063			
	(0.1172)			
ln FG_sh FTA = 1	0.0606			
	(0.0965)			
ln FG_sh FTA = 0	0.1904***			
	(0.0423)			
ln FVA_FG_sh FTA = 1		-0.0450		
		(0.0792)		
ln FVA_FG_sh FTA = 0		0.2087***		
		(0.0396)		
FTA	-1.5847*	-0.7986		
	(0.8385)	(0.7224)		
Fixed effects				
Importer-year	Yes	No	Yes	No
Industry-year	Yes	No	Yes	No
Importer-industry-year	No	Yes	No	Yes
Exporter-industry-year	Yes	Yes	Yes	Yes
No. of obs.	185742	185732	154663	154644
R-Sq	0.8708	0.8954	0.8548	0.8827

Notes: The dependent variable is tariff preferences. Standard errors (in parentheses) are clustered by importer-exporter pair. Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01.

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Tab 9. SPS regulatory distance and FVA: Heterogeneity inside and outside FTA

Dependent variable: *SPS regulatory disance*	(1)	(2)	(3)	(4)
FTA	-0.0085	-0.0122	-0.0099	-0.0068
	(0.0081)	(0.0081)	(0.0087)	(0.0087)
Lag 5. ln DVA share	-0.0134***	-0.0288***		
	(0.0036)	(0.0022)		
Lag 5. ln FVA share	0.0029			
	(0.0033)			
Lag 5. ln FG share	0.0190***			
	(0.0013)			
Lag 5. ln FVA_FG share		0.0183***		
		(0.0012)		
Lag 5. ln DVAsh_FTA=1			0.0028	-0.0266***
			(0.0060)	(0.0031)
Lag 5. ln DVAsh_FTA=0			-0.0149***	-0.0289***
			(0.0036)	(0.0022)
Lag 5. ln FVAsh_FTA=1			-0.0130**	
			(0.0057)	
Lag 5. ln FVAsh_FTA=0			0.0043	
			(0.0033)	
Lag 5. ln FGsh_FTA=1			0.0193***	
			(0.0017)	
Lag 5. ln FGsh_FTA=0			0.0190***	
			(0.0013)	
Lag 5. ln FVA_FG_FTA=1				0.0174***
				(0.0017)
Lag 5. ln FVA_FG_FTA=0				0.0183***
				(0.0012)
Fixed effects				
Importer-year	Yes	No	Yes	No
Industry-year	Yes	No	Yes	No
Importer-industry-year	No	Yes	No	Yes
Exporter-industry-year	Yes	Yes	Yes	Yes
No. of obs.	326,194	326,194	326,194	326,194
R-Sq	0.6362	0.6440	0.6364	0.6440

Notes: OLS regressions. The dependent variable is SPS regulatory distance. Standard errors (in parentheses) are clustered by importer-exporter pair.

Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Tab 10. TBT regulatory distance and FVA: Heterogeneity inside and outside FTA

Dependent variable: TBT regulatory distance	(1)	(2)	(3)	(4)
FTA	-0.0187**	-0.0215**	-0.0125	-0.0047
	(0.0095)	(0.0096)	(0.0102)	(0.0104)
Lag 5. ln DVA share	-0.0146***	-0.0260***		
	(0.0038)	(0.0023)		
Lag 5. ln FVA share	0.0050			
	(0.0034)			
Lag 5. ln FG share	0.0169***			
	(0.0014)			
Lag 5. ln FVA_FG share		0.0165***		
		(0.0013)		
Lag 5. ln DVAsh_FTA=1			0.0134*	-0.0182***
			(0.0073)	(0.0035)
Lag 5. ln DVAsh_FTA=0			-0.0171***	-0.0264***
			(0.0037)	(0.0023)
Lag 5. ln FVAsh_FTA=1			-0.0192***	
			(0.0069)	
Lag 5. ln FVAsh_FTA=0			0.0071**	
			(0.0033)	
Lag 5. ln FGsh_FTA=1			0.0164***	
			(0.0019)	
Lag 5. ln FGsh_FTA=0			0.0168***	
			(0.0013)	
Lag 5. ln FVA_FG_FTA=1				0.0141***
				(0.0019)
Lag 5. ln FVA_FG_FTA=0				0.0164***
				(0.0013)
Fixed effects				
Importer-year	Yes	No	Yes	No
Industry-year	Yes	No	Yes	No
Importer-industry-year	No	Yes	No	Yes
Exporter-industry-year	Yes	Yes	Yes	Yes
No. of obs.	326,194	326,194	326,194	326,194
R-Sq	0.6141	0.6223	0.6145	0.6224

Notes: OLS regressions. The dependent variable is TBT regulatory distance. Standard errors (in parentheses) are clustered by importer-exporter pair.
Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Tab 11. SPS and TBT regulatory distance and (legally enforceable) Deep SPS (TBT) provisionsin bilateral trade agreements

Dependent variable:	SPS regulatory distance			TBT regulatory distance		
	Agri-food (1)	Agriculture (2)	Food (3)	Agri-food (4)	Agriculture (5)	Food (6)
L.5 lnDVA; FTA=0, Deep=0 (1)	-0.0172***	-0.0155***	-0.0187***	-0.0147***	-0.0124***	-0.0167***
	(0.0011)	(0.0013)	(0.0013)	(0.0012)	(0.0014)	(0.0014)
L.5 lnDVA; FTA=0, Deep=1 (2)	-0.0094***	-0.0098***	-0.0092**	-0.0122***	-0.0140***	-0.0104***
	(0.0032)	(0.0033)	(0.0038)	(0.0028)	(0.0030)	(0.0033)
L.5 lnDVA; FTA=1, Deep=0 (3)	-0.0108***	-0.0077***	-0.0138***	-0.0122***	-0.0125***	-0.0118***
	(0.0023)	(0.0025)	(0.0025)	(0.0030)	(0.0032)	(0.0035)
L.5 lnDVA; FTA=1, Deep=1 (4)	-0.0056	-0.0096	-0.0027	-0.0093	-0.0077	-0.0021
	(0.0062)	(0.0065)	(0.0073)	(0.0061)	(0.0059)	(0.0091)
FTA=1	-0.0066	-0.0016	-0.0098	-0.0439**	-0.0333*	-0.0528***
	(0.0146)	(0.0158)	(0.0163)	(0.0173)	(0.0190)	(0.0199)
Deep=1	-0.1218***	-0.1179***	-0.1247***	-0.1685***	-0.1478***	-0.1874***
	(0.0199)	(0.0194)	(0.0248)	(0.0211)	(0.0228)	(0.0250)
FTA=1, Deep=1	-0.1077***	-0.0447	-0.1572***	0.2656***	0.3111***	0.1732**
	(0.0411)	(0.0415)	(0.0522)	(0.0537)	(0.0538)	(0.0779)
F-test for the equality of coefficients (p-value)						
(4) vs. (1) Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
No. of obs.	421602	201441	220161	421602	201441	220161
R-Sq	0.6058	0.6216	0.5910	0.5821	0.5633	0.5981

Notes: OLS regressions. The dependent variable is SPS (TBT) regulatory distance. Standard errors (in parentheses) are clustered by importer-exporter pair.

Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4. Conclusion

Overall, the contribution in Section 3.1 addresses the deliverable by constructing a new measure of trade protection based on the value added in trade, capturing the effects that the tariff structure has on exporting firms that rely on imported intermediate inputs. Furthermore, the contribution in Section 3.2 directly assessesthe objectives in the deliverable by running an empirical analysis to test the theoretical predictions from currentleading models of trade policy, and focuses on how GVC relationships change the government incentive to operate trade policy. In doing so, the model in Section 3.2 decomposes value added into foreign value added (FVA) and domestic value added (DVA) and observes heterogeneity in the effects which in turn creates spacefor policy action.

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