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RESEARCH PAPER

Evaluating the Impact of the US–China Trade War on Euro Area Economies: A Tale of Global Value Chains

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Abstract
The US–Sino trade war will have significant repercussions on the global trade system. This study assesses the implications of the successive rounds of tariff hikes implemented by the US and Chinese governments on global value chains, with a focus on the major European Union economies. The evaluation is based on a computable general equilibrium model which incorporates a decomposition of trade in a value-added basis and allows to identify how changes in the conditions under which US–China trade is conducted affect the value contributed by different countries and to what extent. I find that US integration within GVCs contracts whereas China increases its participation mainly as a seller to global networks. The EU countries strengthen their linkages with the US and EU regional integration increases as a consequence of the tariff war between the US and China.

Keywords Trade war · Global value chains · Trade in value added · Computable general equilibrium model · Trade policy

JEL Classification F14 · F17

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1 Introduction

The Trump administration's offensive unilateralism enacted last year has brought protectionism back onto the global agenda and old-fashioned protectionist instruments, i.e., tariffs, back to the attention of trade analysts. Starting in spring 2018, the US implemented several waves of sanctions in the form of tariff increases mostly targeting China. To date, the US has increased tariffs on about 11,000 products imported from China, amounting to approximately $250 billion. For its part, Beijing's retaliation has increased tariffs on about 2000 US goods, amounting to approximately $110 billion. More than half of the bilateral trade between the two economies has been hit. Whether it is "the biggest trade war in economic history so far"—as declared by the China's Ministry of Commerce—or not, it is clear that the increase in trade barriers between key players in the global trade system has repercussions that go well beyond their national borders. The world economy is likely to be impacted.

Since global production is increasingly organized within global value chains (GVCs) and trade in intermediates is a dominant feature of global trade, shaping countries' backward and forward linkages within global production networks, the question of who bears the burden of trade tariffs and who gains from them is less straightforward than it would be in a Ricardian world in which countries only trade final goods produced domestically. Since the income generation role of exports strongly depends on international exchanges of intermediates and services which are required to produce final goods, increased tariffs on imports can 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), also impacting domestic firms exporting intermediate inputs processed abroad and then imported back. Moreover, tariffs faced in the destination market have ripple effects on the production activities linked to GVCs, spanned across different countries (Baliè et al. 2017; Antimiani et al. 2018a). Given the size of the US and Chinese economies, it is likely that trade measures negatively impacting those countries will significantly affect suppliers of intermediate goods and services wherever they are located.

This study deals with the complexity of global trade relations and assesses the implications of the successive rounds of tariff hikes implemented by the US and China's governments on global trade linkages, with a focus on the major European Union (EU) economies, namely Italy, France and Germany. The evaluation is based on computable general equilibrium (CGE) modelling. Since the aim is to estimate the impacts of the changes in trade policy on GVC-related trade, the key aspect of the approach used in this analysis is that the global CGE model incorporates a decomposition of trade in value added (VA) metrics. This allows us to capture indirect effects due to GVCs by identifying which countries create the value that is embodied in US–China trade flows as traditionally measured, and hence to identify how changes in the conditions under which such trade is conducted will affect the value contributed by different countries and to what extent.

Trump's 'America First' mantra has fuelled several research projects aimed at providing counterfactual evaluations of the potential impacts of trade war triggered by the current US trade policy. Earlier studies focused on the optimal US bilateral tariffs imposed on the main target partners and the partners' optimal responses[1] (Balistreri and Hillberry 2017; Bouët and Laborde 2017; Aizenberg et al. 2018) and found relatively modest optimal US tariff rates vis-à-vis China. The optimal tariffs could be lower once supply chains linkages are taken into account. Blanchard et al. (2016) demonstrate that when foreign content in domestic goods is high, some of the benefits of protection are passed back up the supply chain to foreign suppliers, thus lowering optimal tariffs. Caliendo and Parro (2015) show that the optimal tariff may in fact be negative once production linkages and intermediate goods are taken into account.

As US tariffs went into effect, empirical studies have mostly focused on the quantification of the effects of the implemented tariff increases and further announced tariff changes (for example, Balistreri et al. 2018; Fajgelbaum et al. 2019; Guo et al. 2018; Li et al. 2018; Charbonneau and Landry 2018; Bollen and Rojas-Romagosa 2018). Three main arguments of convergence among these analyses can be found. First, there is agreement on the fact that current trade policy is costly for the countries imposing import protection, as well as for the world as a whole; the welfare cost for the global economy is higher when scale economies and variety effects are considered (Balistreri et al. 2018). Second, the tariff hikes produce a reallocation among sectors, but sectoral gains are small, to the detriment of other sectors, and mostly offset by retaliation. Finally, since bilateral trade is strongly reduced, there may be economic benefits for other regions through trade diversion. These studies mostly have a domestic focus, that is, they mainly look at the consequences for the US and China. Bolt et al. (2019), on the other hand, focus on the effects of the bilateral trade war on a third country. They find benefits for the EU, getting access to cheaper imports from China which are diverted from the US and gaining competitiveness in the US in response to tariffs imposed on Chinese products. Third country effects are also central to this paper, but the way of looking at trade is different. My main contribution is to evaluate "GVC-related effects", that is, the variation in the output which is required to produce traded goods wherever the production of each ring within the chain takes place, in addition to standard trade diversion effects (that is, countries that are not directly affected by the increased tariffs may intensify trade with the belligerent countries).

The bulk of the empirical literature which aims to quantify the impacts of Trump's trade policy relies on a general equilibrium framework. Although based on

[1] The literature on optimal trade policy dates back to the seminal contribution by Johnson (1953), who first conceptualized the beggar-thy-neighbour motive behind increases in tariffs and showed that in a trade war a country can gain by imposing an optimal tariff even when others retaliate. The case in which all trading partners lose from a trade war has been considered more probable in the literature (for example, Ossa 2014; Kutlina-Dimitrova and Lakatos 2017), and even under the "Johnson case", world welfare is decreased (Bouët and Laborde 2017).

different model specifications,[2] all the models that have been used (e.g., GTAP-class CGE models, or the so-called New Quantitative Trade models) feature domestic and imported intermediate inputs in the production functions. However, the implications of the back-and-forth of intermediate goods across borders are barely addressed. Charbonneau and Landry (2018) use the Caliendo and Parro (2015) model and explicitly incorporate trade in intermediate goods with the aim of capturing global value chains and understanding the impact of tariff changes on key systemic sectors of the economy. Using intermediate trade as a rough proxy for GVCs, they find that the US–China trade tensions ripple through the global economy, especially among Canadian, Mexican and other Asian economies that either are part of the global supply chain affected by the tariffs or offer close substitutes to Chinese and US exports. However, their analysis is based on standard (that is, gross) trade data and national input–output tables and does not consider the value-added content of trade. Similarly, UNCTAD (2019) assesses the effects of the US and Chinese retaliatory tariffs on the reallocation of assembly processes away from the US and China, as well as the effects on direct suppliers to those assembly lines. The report finds that both the North American and East Asian value chains will be negatively affected by the US and Chinese tariffs, whereas other countries, in particular in the EU, will attract some trade related to value chains. Even in this case, since the estimations are based on gross trade data, the analysis only considers the impacts on direct suppliers, that is, on the demand for foreign inputs, but does not reallocate the value added along the global chains.

The main contribution of the analysis presented here is that the impacts of the US–Sino tariff war are assessed by disentangling the value added embedded in gross flows, which allows the effects on the domestic value-added content of exports to be followed across borders, and through the backward and forward trade linkages. In other words, a trade in VA perspective is assumed. The approach used in this study is linked to the literature aimed at decomposing gross trade flows.[3] This line of research, which started with the pioneering work of Hummels et al. (2001), who provided the first indicator of vertically integrated trade, mostly refers to the contribution made by Koopman et al. (2014), who provide a unified framework for decomposing total gross exports into three main components: domestic value added, foreign value added, and 'reflected' value added., i.e., the domestic content in intermediate exports that finally returns home. Each of these components can be further split by taking into account the intermediate or final use of the exported goods. Furthermore, they quantify double counted

[2] See Balistreri et al. (2018) for a structural sensitivity analysis which considers three alternative microeconomic foundations of international trade: Armington, Krugman, and Bilateral representative firms.

[3] Others macro-approaches include the decomposition of final goods as in Johnson and Noguera (2012), who measure inter-country production sharing as the ratio of value added to gross exports (VAX), where value-added exports are defined as the value added produced in one country, but absorbed in final demand by another. A complementary perspective in decomposing final goods looks at the production side and consists in allocating the value added generated in the production of final goods back to the countries in which that income is generated. This "GVC Income" approach traces the value added for all labour and capital which is directly and indirectly needed for the production of final manufacturing goods (Timmer et al. 2013, 2014; Los et al. 2016).

items from standard trade statistics. This framework has been extended by Wang et al. (2013) and Borin and Mancini (2017) to provide a breakdown of bilateral exports at the sector level.

Antimiani et al. (2018b) follow this strand of the literature and integrate the VA decomposition of gross bilateral trade into a CGE model. They provide the VA module for the Global Trade Analysis Project (GTAP) model used in this study. The incorporation of trade in VA decomposition in a CGE context allows us to consider all the implications that the tariff war may have on the complex set of general equilibrium interdependencies between countries (and sectors), reflecting a combination of preferences, technology, endowments, and policy (Walmsley et al. 2014), that shape the GVCs. The GTAP-VA model has two important features. First, it implements a novel decomposition of bilateral gross trade balances that accounts for the differences between gross and VA concepts. Accordingly, I am able to identify the trade flow in which value added is actually recorded for the first time in international trade statistics. Second, it provides a distinction between VA due to demand of the direct trading partner and VA due to demand in third countries. In the case of a bilateral tariff war, as bilateral trade between the two belligerent economies becomes more costly, it is likely that more value would be exported multilaterally, that is, through other countries in the global trade system whose trade costs have not been changed.

This analysis finds restructuring effects on regional and global value chains due to the increased costs of trading between the US and China. First, I find a contraction in the backward integration into GVCs of both the US and China: the increased import tariffs raise the cost of importing intermediate inputs, pushing belligerent countries to rely more on domestic providers, and thus lowering the import content of their exports. An opposite trend is found for the EU countries under examination, which increase the degree of backward linkages. Second, the disruption of trade between the US and China impacts their demand for foreign inputs, affecting suppliers of intermediates. Germany and, to a lesser extent, Italy strengthen their linkages as providers of intermediates with the US while contracting linkages with China. France is the less affected country. Third, more Chinese VA is exported multilaterally to the US, that is, through other countries' exports. EU countries, and Italy in particular, are important platforms in this kind of trade. Finally, EU regional integration increases as a consequence of the tariff war, mainly due to the strengthening of the relationships with the US market.

The remainder of this paper is structured as follows. Section 2 introduces the methodology and describes the data. Section 3 provides a characterization of bilateral trade and GVC-related trade between the US and China, and among them and the three major European economies. Section 4 describes the tariff profiles and the trade war scenarios. Section 5 presents and discusses the findings. Finally, Sect. 6 concludes.

2 Methodology and Data

The methodology adopted to conduct the quantitative evaluation of the impacts of the US–Sino trade war is based on a counterfactual approach using the GTAP model, a perfectly competitive comparative static computable general equilibrium model. It is built on general equilibrium theory and designed to assess the interregional, 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 complete and consistent coverage of all bilateral trade flows.

The model underlying our analysis has a symmetric structure; consequently, the treatment of production and utility functions is homogeneous across regions and products. This implies that the only differences in regional behavior in the model are those arising from differences in the relative importance of economic flows and from differences in the model parameters related to consumer demand 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 aggregation made 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 common approach 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 in fixed proportions (fixed coefficient function of the Leontief type). In the intermediate input side, imported intermediates are assumed to be separable from domestically produced intermediate inputs. The import demand is modelled following the Armington aggregation structure, with an exogenously differentiation scheme given by the geographical origin of homogeneous products. That is, under Armington trade, the output of each sector is assumed to be a region-specific variety. Consumer and 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. Transaction costs are also accounted for in the model since transport services are explicitly considered among the activities in the economy.

As for the effects caused by a variation of tariff barriers on the importing country, the mechanism operating in the GTAP model implies a change in the price of imports and a consequent change in the sourcing decisions of agents in the economy. In the case of an increase in the bilateral trade costs, imports in the country imposing protection become more expensive, thus inducing domestic users to substitute away from those bilateral imports. The extent of this effect depends on the parameter for the Armington elasticity. As the composite price for imports also increases, the aggregate demand for imports is reduced.

The GTAP model also computes a measure of the change in each region's welfare. The change in welfare for each region is the "equivalent variation," i.e., the change in money income that would produce the same effect on the region's utility as the policy shock. Figure 1 illustrates the economic effects of a tariff on a large economy, where D and S represent demand and supply, respectively. In the initial

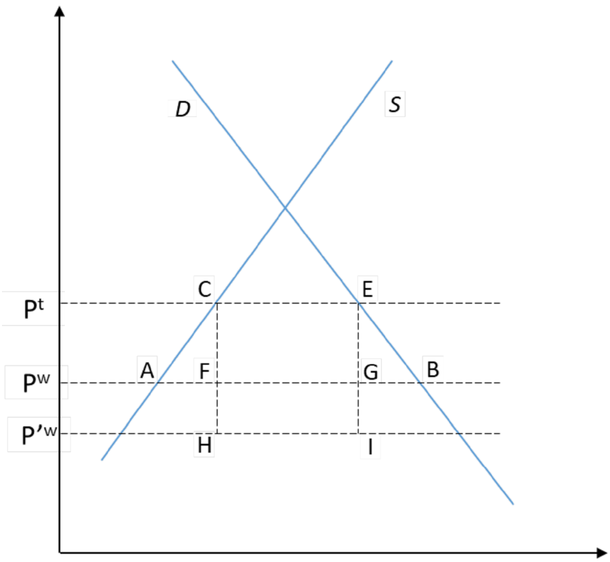

Fig. 1 Effects of an import tariff on the importer

market equilibrium, the world price is P^w and imports correspond to AB. The imposition of a tariff increases domestic prices up to P^t, which increases the supply from A to C and decreases the demand form B to E. In the new equilibrium, the quantity of imports is reduced to CE. The loss in consumers' welfare is represented by the trapezoid P^tEBP^w whereas producers gain P^tCAP^w. The area CEGF is the amount of tariff revenue paid by consumers to the government. Then, the overall loss for the economy is given by the sum of the two triangles CFA and EBG, representing allocative efficiency losses. If the economy is large enough to influence world prices, the increase in domestic is lower than the full amount of the tariff. This causes a terms-of-trade gain for the importer, represented by the area FGIH. As for the world as a whole, it is easy to verify that the imposition of a tariff diminishes global welfare.[4]

In this study, the static version of the model is used. As there is no time dimension, there is also no dynamics for savings and investments.[5] This implies that the impacts of the policy shock on investments are not taken into account.

For this application I have adopted the extension made by Antimiani et al. (2018b), that is, the GTAP-VA module for the GTAP model that introduces GVCs analysis into a CGE, and enables to carry out a post-simulation decomposition/analysis of the sources of value added. This framework allows to assess the effects of policy changes on the global structure of GVCs, taking into account the

4 The loss in global welfare is the sum of all countries' efficiency losses.

5 The model features a "global bank" collecting funds from regions that are net savers and investing them in regions that are net investors until the marginal investment equates the expected rates of return from all regions (Plummer et al. 2010).

interdependence between sectors, allowing relative prices to adjust and factors to be reallocated across sectors, as well as admitting substitution effects in production and consumption both within and across countries (Walmsley et al. 2014; Ferrarini and Hummels 2014).

In the GTAP-VA the gross trade flows are decomposed to reallocate the value added generated in the production of goods back to the countries in which that income is generated. The value added is defined as the difference between the value of output and the total value of purchased intermediate inputs, and includes compensation for labour and capital and taxes.

The main indicators related to the value added in an exported good or service which are used in this analysis are the following[6]:

(i) Bilateral domestic value added (DVA)

This corresponds to the value originated in all sectors of the exporting country which is embedded in a domestic sector's exports. The DVA in exports gives a measure of the real contribution a given export makes to an economy's income. Within the DVA, two components can be further distinguished: the DVA directly absorbed by the importer, and the DVA embedded in intermediates goods used by the importer in the production of exports (DVA re-exported). As for the latter, it is also referred to as forward GDP (see Borin and Mancini 2019).

(ii) Multilateral domestic value added (DVAM)

This is defined as the domestic value added contained in intermediate goods and services that is exported to a partner country which then re-exports it to the final market, now embodied in other goods or services. DVAM, also referred to as "triangular" production chain (Johnson and Noguera 2012), provides a measure of the forward linkages a country has in selling in international VCs.

Both the DVA and the DVAM indicators are adjusted for double-counting, meaning that the domestic value added embodied in an export that has previously crossed the international border, and hence has already been counted as domestic value added, is netted out.[7]

(iii) Foreign value added (FVA)

This is the value of imported intermediate inputs embodied in a country's exports. It is sometimes referred to as backward linkages in global production networks because it reflects linkages back up the value chain towards its origin. Within FVA, a portion can refer to trade that is exported back to the country of origin of the value added (circular trade).

[6] In Table A1 in the Online Appendix a correspondence table with TiVA indicators is provided.

[7] The treatment of the double counting adopted in this study is based on the source method introduced by Nagengast and Stehrer (2014), implemented by Borin and Mancini (2017), and refined by Antimiani et al. (2018b), who introduce double counting related to multilateral exports to a trade partner.

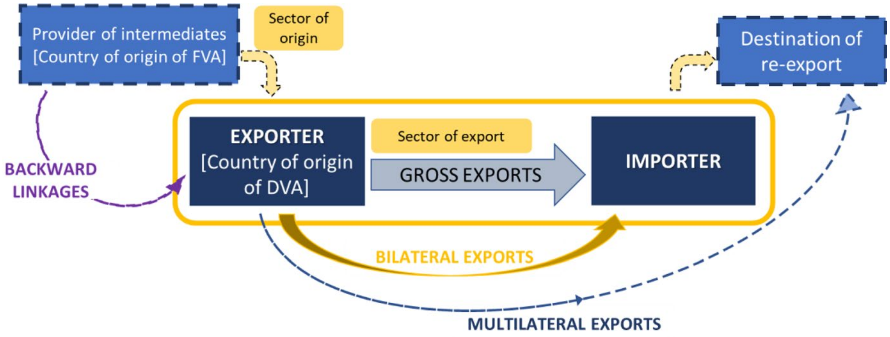

Fig. 2 Gross and GVC-related trade

Figure 2 gives a graphical representation of standard gross trade and GVC-related linkages. Standard, or Ricardian, trade involves an exporter and an importer, and assumes that the entire production process occurs in the exporting country which ships the final good to the importing country which finally consumes it. The exchange within the yellow rectangle exhausts standard trade. Instead, GVC-related trade is related to goods and services crossing more than one border, thus involving at least two production stages located in different countries before the final product reaches the destination market (Borin and Mancini 2017). Thus, it implies a third country (country of origin of the FVA), providing intermediate inputs to the exporter and backwardly linked to the international value chains. Moreover, the importer may not consume the imported good or service but perform a further processing phase before re-exporting it to the destination country.

Measuring these linkages requires a huge amount of data, gathering national accounts and bilateral trade data on goods and services into a consistent statistical framework, tracing transactions in final and intermediate goods both within and between countries, and finally allowing trade to be (indirectly) measured on a value-added basis. The current standard for GVC analysis relies on an inter-country input output (ICIO) table, which harmonizes national input–output tables for multiple regions and links trade flows directly from producers in each region to importing firms and consumers in all other regions. Various research initiatives have undertaken the development of different versions of an ICIO table. Among the most well-known are the world input output database (WIOD), trade in value added (TiVA) as well as the Global Trade Analysis Project (GTAP) Data Base.

In this study, data are drawn from the (pre-released) version 10 of the GTAP Data Base, a baseline of consistent data on consumption, production, and trade updated to 2014 (Aguiar et al. 2019). 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 world population) and 20 aggregate regions for all the 57 GTAP commodities for 2014.[8] It has been extensively used to perform economic analysis of TVA, mainly due to its consistency, full global coverage, and the large country and sectoral details it provides. The advantage of using the GTAP Data Base for GVC analysis is that it reconciles data from different sources and puts them into one consistent database with a broad sectoral and regional coverage. However, the database itself does not account for how imported intermediate products are used. Within the GTAP framework, 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 uses based on relative demands and shares. In this way, we cannot trace exports of intermediates from one country into the production processes of another, and following on from that, into their contributions to the other countries' exports. That is to say, we cannot directly identify the industry-to-industry trade required for the construction of ICIO data, harmonizing input–output tables for multiple regions and linking trade flows directly from producers in each region to importing firms and consumers in all other regions, which is required to implement the above GVC indicators.

In order to distinguish between countries of origin on an industry-use basis, the approach used in this study, as well as in others using the GTAP Data Base (for example, Daudin et al. 2011; Johnson and Noguera 2012; Lejour et al. 2014; Greenville et al. 2017), applies proportionality assumption to allocate the imports of products from any given country between final demand and intermediates, and then within intermediates, between the intermediate usage by individual production commodities.[9] The key problem with this method is that it ignores differences in the types and quality of imports from different regions. For a given product, some country exports may target final demand, while others may target intermediate demand. Downward bias associated with the assumption implies that estimates in this study are conservative indicator of the actual GVC linkages (de Gortari 2019). The underestimation may be particularly relevant in the case of Chinese exports due to the presence of processing exports (Koopman et al. 2012).

The multi-region general equilibrium is calibrated to GTAP10 Data Base. The simulation is performed on a geographic and sectoral disaggregation that includes 23 countries/regions and 43 sectors. For expositional purposes, results are shown for 13 aggregated sectors (see Table A2 in the Online Appendix).

[8] The definitive version of the GTAP 10 Data Base expands the sectoral coverage in manufactures and services sectors, beyond the traditional 57 sectors, up to 65 products and services.

[9] To illustrate this, we know from direct data collection what proportion of the value of cars is accounted for by steel. We have to assume that this is the same for cars produced for the domestic and all export markets. We also know how much of a country's steel comes from each country (including that country) and we have to assume that each use of steel is spread over sources in exactly those same proportions.

Table 1 US and China bilateral trade (billions of US dollars). Source: Author's calculation based on the GTAP Data Base (2014 baseline)

	US exports to China	US imports from China	Trade balance
Gross trade	173.4	470.1	−296.7
VA trade	143.9	368.5	−224.5

Table 2 Composition of US–China bilateral trade, by sector. Source: Author's calculation based on the GTAP Data Base (2014 baseline)

	US exports to China		China exports to the US	
	DVA share[a]	Sector share[b]	DVA share[a]	Sector share[b]
Aggregate	83.0	100.0	78.4	100.0
Sector				
Agriculture	90.3	13.3	94.4	0.3
Food	87.8	4.3	88.9	1.2
Extraction	93.4	1.3	88.8	0.1
Textiles	83.6	1.2	86.1	15.2
Wood and paper product	90.5	3.7	84.3	1.9
Petroleum and coal products	42.9	1.2	48.6	0.2
Chemicals	81.3	11.3	80.8	6.5
Minerals and metals	79.8	6.7	81.8	6.0
Motor vehicles and transport equipment	80.1	20.7	79.6	2.9
Electronics	72.8	13.5	68.0	33.5
Machinery and equipment nec	87.3	8.7	79.6	16.6
Manufactures nec	83.6	2.8	87.3	7.6
Services	91.0	11.2	88.6	7.8

[a]DVA share on gross exports

[b]Sector weight on total bilateral exports

3 Patterns of Trade

In this section, I provide a characterization of standard and GVC-related trade between the US and China, and between them and the three major European economies, namely, Germany, France and Italy.

Table 1 displays US exports to and imports from China, both in gross and VA metrics.

We can observe that the $296.7 billion US trade deficit with China (the value of exports less the value of imports) is scaled down by more than 20% (about $72 billion) in terms of DVA embedded in trade flows, that is, once the remuneration of domestic factors of production for the two trading partners is considered. This reflects the higher DVA content of US exports (accounting for 83% of gross exports)

Table 3 Breakdown of bilateral trade, billions of US dollars (share). Source: Author's calculation based on the GTAP Data Base (2014 baseline)

Exporter:	Italy	France	Germany
(a) US imports			
Gross exports	**48.5**	**54.6**	**134.2**
Standard trade			
DVA directly absorbed	**29.6**	**29.9**	**74.9**
(share of gross exports)	(61.0)	(54.7)	(55.8)
GVC-related trade			
DVA re-exported	**4.6**	**6.0**	**13.8**
(share of gross exports)	(9.5)	(11.0)	(10.3)
(of which to China)	*(10.5)*	*(11.0)*	*(10.8)*
FVA in exports	**14.2**	**18.4**	**43.5**
(share of gross exports)	(29.2)	(33.8)	(32.4)
of which			
originated in China	*(8.4)*	*(7.3)*	*(8.9)*
originated in the US	*(6.1)*	*(10.2)*	*(8.4)*
originated in the EU	*(45.5)*	*(44.6)*	*(48.1)*
Double counting	**0.2**	**0.3**	**2.0**
(b) China's imports			
Gross exports	**20.4**	**32.5**	**121.0**
Standard trade			
DVA directly absorbed	**8.4**	**13.4**	**55.2**
(share of gross exports)	(41.3)	(41.2)	(45.6)
GVC-related trade			
DVA re-exported	**5.7**	**7.8**	**23.1**
(share of gross exports)	(28.1)	(24.1)	(19.1)
(of which to the US)	*(19.9)*	*(19.6)*	*(19.9)*
FVA in exports	**6.2**	**11.1**	**40.9**
(share of gross exports)	(30.2)	(34.1)	(33.8)
of which			
originated in China	*(10.0)*	*(8.6)*	*(10.5)*
originated in the US	*(6.2)*	*(10.9)*	*(8.1)*
originated in the EU	*(47.3)*	*(49.3)*	*(47.6)*
Double counting	**0.1**	**0.2**	**1.9**

Bold values represent the trade components and billions of US dollars

Italics values represent the share on the total of the trade component

compared to that of China in exporting to the US market (accounting for 78% of gross exports).[10]

[10] It should be noticed that the DVA content in Chinese exports has consistently increased in the last decade (up to 10% more if compared with 2005 data; see also TiVA, 2018, available at: https://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2018_C2). This suggests that the country is no longer a final assembler of parts and components coming from abroad, but has significantly increased its specialization in high value-added phases of production (see, for example, Lall and Albaladejo 2004; Giovannetti et al. 2018).

Table 4 Multilateral exports to the US and China, billions of US dollars (share). Source: Author's calculation based on the GTAP Data Base (2014 baseline)

Exporter	Italy	France	Germany
Multilateral exports to the US	**13.9**	**17.9**	**38.7**
(share on gross exports)	(28.7)	(32.8)	(28.9)
of which			
through China	*(8.2)*	*(8.6)*	*(11.8)*
through EU	*(47.4)*	*(50.8)*	*(42.3)*
Multilateral exports to China	**10.7**	**13.6**	**27.3**
(share on gross exports)	(52.6)	(41.8)	(22.6)
of which			
through the US	*(4.5)*	*(4.9)*	*(5.4)*
through EU	*(44.2)*	*(45.0)*	*(36.5)*

Bold values represent the trade components and billions of US dollars

Italics values represent the share on the total of the trade component

Considering the structure of bilateral exports (Table 2), we can observe that almost half of Chinese exports to the US is represented by electronics and machinery and equipment (together accounting for 50.1% of exports), sectors which are relatively more intensive of foreign inputs, and where only 68% and 79.6% respectively represent Chinese domestic value added. The US shows a more diversified export structure. Beside sectors whose exports strongly rely on foreign providers of inputs, such as motor vehicles and transport equipment, electronics, and chemicals (representing 20.7%, 13.5%, and 11.3% of US exports to China, respectively), two more macro-sectors, that is, agriculture and services (together accounting for almost one quarter of those exports), show a higher DVA share (90.3 and 91%, respectively).

Table 3 displays a breakdown of European countries' exports to (a) the US and (b) China, accordingly to the origin, domestic (DVA) or foreign (FVA), of the embedded value added. Furthermore, drawing on the conceptual framework to decompose bilateral trade relationship proposed by Borin and Mancini (2019), I distinguish between "standard" and "GVC-related" trade. Standard trade includes that portion of exports which is produced at home (using domestic primary factors) and ends in the importing market without additional shipments (DVA directly absorbed); GVC-related trade, instead, implies at least two international border crossings, thus including re-exports by the importer (DVA re-exported) and the value of imported inputs used by the exporter (FVA in exports).[11]

A significant share of the EU countries' bilateral exports which are analysed is related to GVCs. On average, more than 40% of the three countries' gross exports to the US are either re-exported (around 10%) or produced with foreign intermediate inputs (slightly more than 30% on average). The share of GVC-related trade reaches nearly 60% on average in EU exports to China. While the US is mostly a final market for EU countries exports of DVA, in the case of China the re-exported

[11] The double counting, caused by the back-and-forth of intermediates, is also included in the GVC-related trade categorization.

DVA component plays a major role: around 40% of DVA in EU exports is not consumed in China, entering instead in Chinese production of exports. Among the final destinations, the US is an important market for Chinese exports of EU value added, accounting for around 20% of total Chinese re-exports. Italy shows the highest level of forward integration with China; in fact, almost half of Italian DVA exports to China only passes through China before being consumed in other countries.

The analysed EU economies significantly rely on foreign inputs, especially from regional trade partners, which provide around half of foreign intermediate inputs used by the three EU countries in order to export in the US and China. China is also an important provider of intermediate inputs to the EU economies, furnishing almost 10% of total FVA. Its share is higher for the so called ‘circular trade’, that is for inputs which are imported back as embedded in EU exports. In terms of cross-country variability, we observe that Italy shows the lowest foreign value-added share, which accounts for around 30% of its exports to the two countries.

Next, multilateral exports of value added from the analysed EU countries to the US and China are considered. Table 4 shows for each EU country considered the value added which is absorbed by the US and China as embedded in other countries' exports to the two importers.

If we relate gross bilateral exports and multilateral exports, we can observe that for both Italy and France multilateral linkages with China are relatively more important than with the US, whereas for Germany the US market is more relevant than the Chinese market as final destination for other countries' exports of German VA.

The forward connections linking the EU countries with both the US and China are characterized by a strong degree of regional integration, as can be deduced from the fact that more than 40% of multilateral exports passes through another EU country before reaching the final destination. This share is still higher for the multilateral exports to the US, where the EU platform accounts for 47% on average against the 42% in multilateral exports to China.

The role of China as a platform for the EU VA reaching the US market is more relevant than that the US has in shipping EU VA to China. In this latter case, Asian regional partners play the biggest role.

The global input–output framework underlying this study allows us to explicitly consider the linkages between different sectors within the global trade system. I use this information in order to provide a picture of the US and China sectoral GVC-linkages with the three analysed EU economies. In Fig. 3, the value of EU intermediate inputs provided to the US (a) and Chinese (b) production of exports is shown at the sector level. Sectors are ordered according to their importance in terms of overall value.

We can observe that the EU countries here considered are more backwardly linked to China than to US in all sectors. There is a great variation in the degree of backward linkages among the three EU countries: Germany is the major provider of inputs to both the US and China, whereas Italy is less integrated with both countries overall. Both the US and China mainly use EU services in order to produce their exports. They represent around half of the total value of EU inputs provided to the two countries. Other relevant EU sectors are chemicals, machinery and equipment, minerals and metals, electronics, motor vehicles and transport equipment. Chinese firms also demand textiles, mainly from Italy.

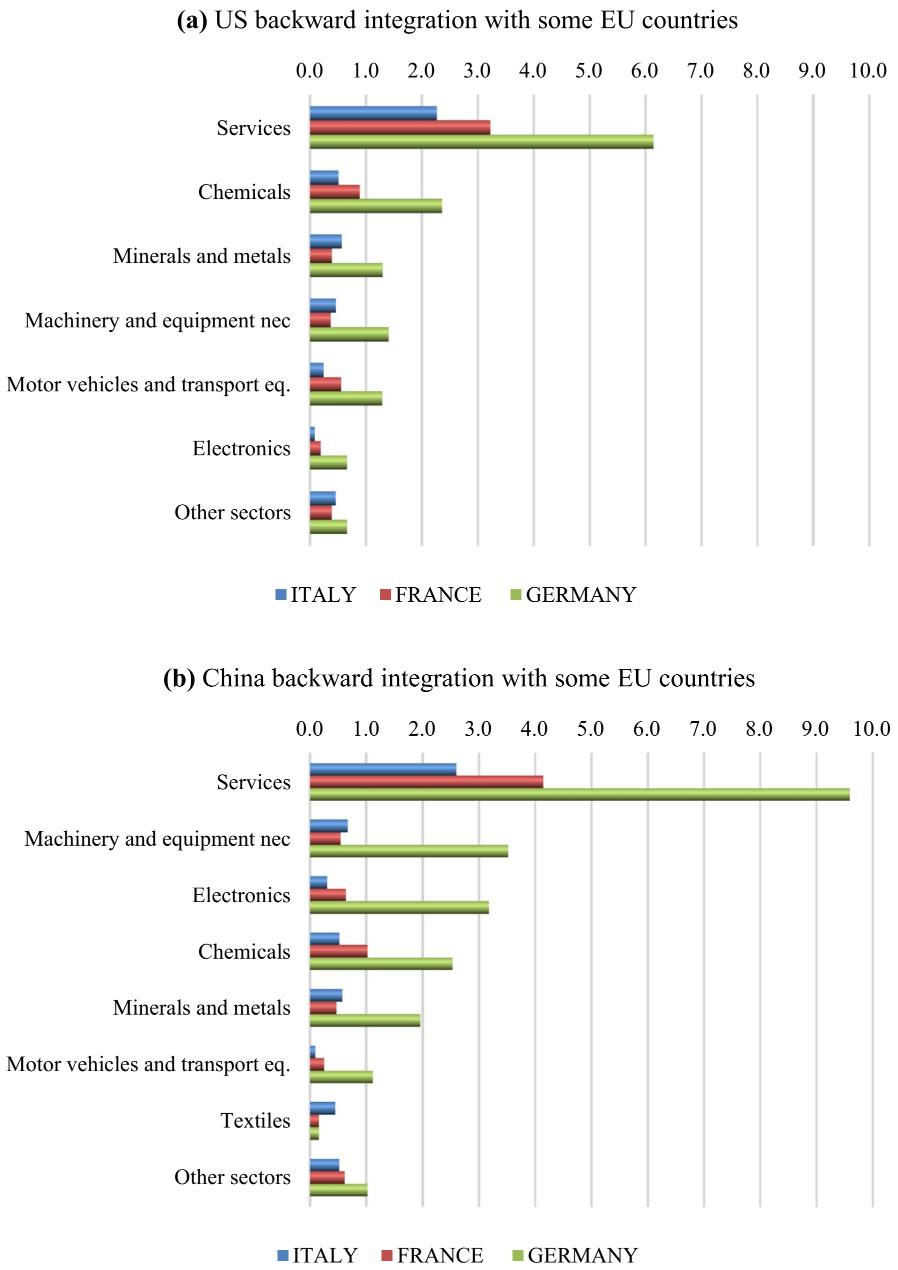

Fig. 3 US and China backward linkages with Italy, France and Germany, by sector of origin of FVA (billions of US dollars). Source: Author's calculation based on the GTAP Data Base (2014 baseline)

It is worth noticing that even if the EU countries' sectors providing intermediates to both the US and China are very similar (the only exception being textiles),

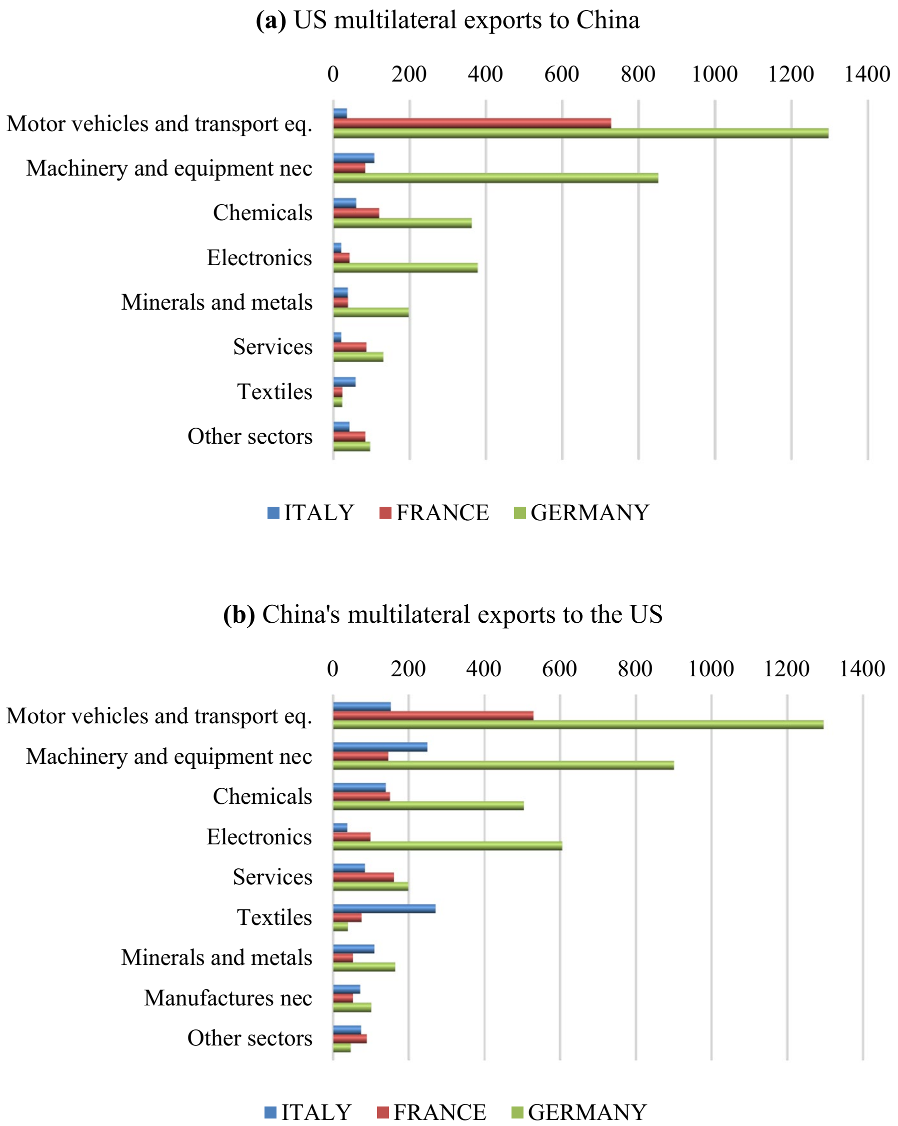

Fig. 4 Importance of some EU countries' sectors in multilateral trade between US and China (millions of US dollars). Source: Author's calculation based on the GTAP Data Base (2014 baseline)

the type of linkages are different between the US and China. When considering which sector in the exporting country (i.e., US or China) demands European inputs, we observe that in the case of US firms, they mostly demand intra-sector inputs, that is inputs from the same sector in EU countries. This is the case of chemicals, electronics and motor vehicles and transport equipment. As for China, we observe less intra-sector trade. For example, Chinese textiles sector mostly

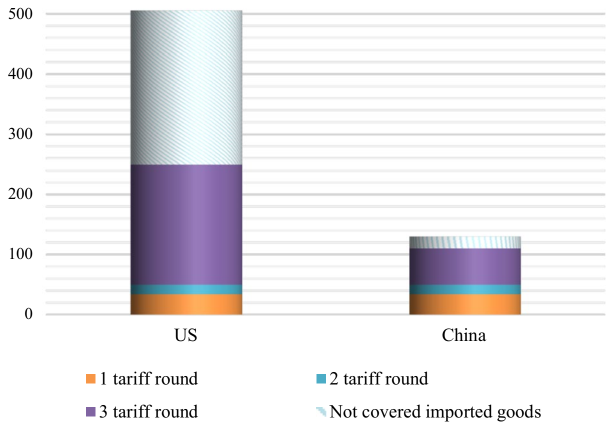

Fig. 5 The three rounds of bilateral tariffs: total value of imports affected (US$ billion). Source: USTR trade data for 2017

demands intermediate goods from EU chemicals (see Table A3 in the Online Appendix for details on inter-sectoral exchanges).

Finally, we look at the Italian, French and German sectors involved in multilateral trade between US and China (Fig. 4).

Even if, in relative terms, the EU platform is more relevant for the US than for China, in terms of re-exported value, the selected EU countries are more involved in Chinese forward linkages with the US than vice versa. This is explained by the higher value of Chinese multilateral exports to the US (almost $73 billion, against the overall 46 billion multilaterally exported by the US to China). As for sectors, motor vehicles and transport equipment, machinery and equipment, chemicals and electronics are the main sectors embedding US (Chinese) VA in EU countries' re-exports to China (US).

4 Scenario Design

This study simulates the trade war between the US and China that has arisen from sanctions implemented by the US government and the tit-for-tat strategy adopted by Beijing. Specifically, I consider the different rounds of reciprocal increases in tariffs as of March 2019. The total US tariffs on goods applied exclusively to China amount to approximately $250 billion, and the total Chinese tariffs applied exclusively to the US amount to $110 billion. The relatively lower amount of trade affected by Chinese duties reflects its large bilateral trade surplus with the United States. Overall, more than half of their bilateral trade is hit by the tariff war (Fig. 5).

The first step in the trade dispute dates back to March 2018, when the Trump administration imposed a 25% additional tariffs on all steel imports and a 10% tariff on all aluminum imports. These measures, undertaken under Section 232 national security justifications,[12] were introduced not only vis-à-vis China (for $2.8 billion of imports), but also towards the majority of third countries. China answered by imposing tariffs between 15 and 25% on 128 US products (including fruit, wine, steel, pork meat, and aluminium), which together totalled $2.4 billion of imports. Chinese retaliation was proportional to the suffered loss.

A few months later, unilateral duties applied specifically against China began. In July, the first round of US tariffs entered into force, imposing additional 25% duties on 818 tariff lines valued at $34 billion imports of Chinese products. This has been the first stage of the two-stage plan announced by the US Trade Representative (USTR) to impose 25% ad valorem tariffs on $50 billion worth of Chinese imports (an annual trade value considered commensurate with the harm caused to the US economy by China's unfair policies), as the results of the investigation undertaken under Section 301[13] into the government of China's acts, policies, and practices related to technology transfer, intellectual property, and innovation. The second round of tariffs went into effect on August 23, covering 279 tariff lines with a value of $16 billion of imports from China. The measures covered a broad range of products including minerals, chemicals, metals, machinery and motor vehicles.

In parallel to US tariffs, China implemented comparable countermeasures on US products. Beijing took the first retaliatory measures by imposing a 25% tariff on 545 tariff lines of goods originating from the US (worth $34 billion), including agricultural products and motor vehicles. The second Chinese list concerned 333 products from the US (worth $16 billion), including agricultural and food products, minerals and electronics.

Chinese responses caused the modification of the prior USTR's action taken in the investigation by imposing additional 10% duties on products from China classified under 5745 tariff subheadings with an approximate trade value of $200 billion.[14] Again, China raised tariffs (by 5% and 10%) on $60 billion worth of imports from the United States.

The procedure to simulate the implemented tariff hikes between the US and China starts from governmental lists with a Harmonized System (HS) 8-digit tariff code.[15] The HS 8-digit codes have been attributed to the corresponding HS 6-digit codes in order to calculate the trade-weighted average applied tariffs to be converted to a GTAP sector code, using the correspondence table from the World Bank-World Integrated Trade Solution (WITS).

[12] The Section 232 of the Trade Expansion Act of 1962 authorizes the President to impose import restrictions to protect US national security. Tariffs (or other means) can be imposed to adjust the imports from other countries if it is deemed that the quantity or circumstances surrounding those imports threatens national security.

[13] Section 301 of the Trade Act of 1974 is a key enforcement tool for addressing a wide variety of unfair acts, policies, and practices by US trading partners.

[14] The rate of the additional duty was scheduled to increase to 25% ad valorem on March 2, 2019, but this increase is currently delayed.

[15] US tariff lists have been downloaded from the USTR, whereas the English version of Chinese lists has been obtained from the Peterson Institute for International Economics website.

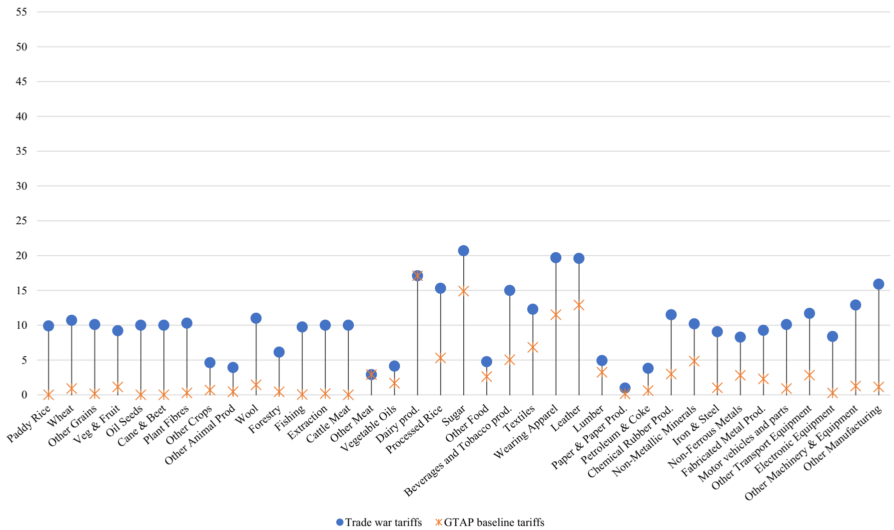

Fig. 6 Comparison between baseline and simulated tariffs for China. Source: Author's calculation based on WITS

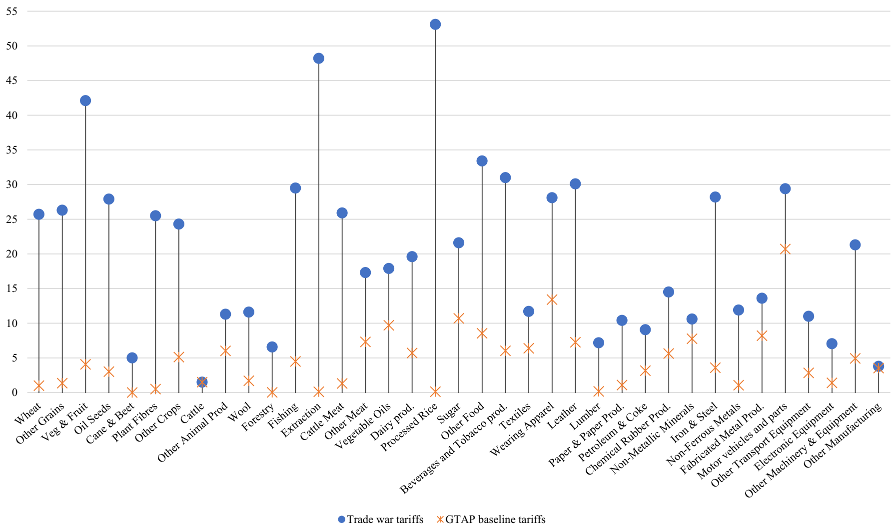

Fig. 7 Comparison between baseline and simulated tariffs for US. Source: Author's calculation based on WITS

The outcome of this procedure is reported in Figs. 6 and 7, where the baseline tariff levels and the percentage variation due to the trade war in, respectively, US and Chinese bilateral tariffs are shown. US tariff hikes hit mainly manufacturing products, machinery and equipment, motor vehicles and other transports, chemicals and electronics. These products represent the principal US imports from China (see Table 2). Beijing's retaliations heavily increased duties on agricultural and food products (for which China represents the second largest export market), notably vegetable and fruit, meat, oil seeds and beverage products. Extractive, machinery and equipment, chemicals and motor vehicles were also hit by China's measures.

Given the uncertainty and repeated reversals still characterizing US–China trade negotiations, as well as Trump's reiterated threats of imposing tariffs on the rest of US imports from China not yet targeted with his Section 301 tariffs, I consider a second hypothetical scenario of a full-blown trade war, in which tariffs on all US–China goods trade increase by 25%, reciprocally.

5 Results

This section discusses the results of the simulated trade war scenarios between the US and China. The assessment is focused on trade patterns and is performed considering both gross values and value-added trade flows.[16] This allows us to evaluate the effects on countries' GDP due to the variation in trade and to capture the impacts on the forward and backward linkages of all the players in world trade. The focus is on the three major European Union countries (Italy, France, Germany) and their GVC-trade relationships with the two belligerent countries.

First of all, the implications of the tariff war for the US trade balance, the main preoccupation of the Trump administration, are considered. Table 5 presents the effects on the overall US account balance[17] and the bilateral balance with China and all countries except China.

The strong contraction in bilateral trade between the US and China due to the increase in tariffs reduces the US deficit with China by 28.9% ($85.7 billion). Overall, the US trade deficit is reduced by 4.1 percentage points (corresponding to $30.4 billion), under the implemented tariffs scenario.

The impact on US trade balance with China is less pronounced in terms of value added relatively to gross values (27.5%), while the opposite is true for US overall VA trade, whose amelioration corresponds to 9.3%. This is explained by two factors. First, US overall imports (which rely more on foreign intermediates) contract relatively more than exports (which are more intensive of domestic value added), whereas US imports from China decrease relatively less than US exports to China. Second, the increased import tariffs raise the cost of importing intermediate inputs, pushing belligerent countries to rely more on domestic providers. Consequently, the domestic value-added content of traded goods tends to decrease less then gross values (and foreign value added), thus contracting the integration into GVCs. Conversely, third countries facing unchanged tariff profiles will find more convenient to source intermediate inputs from abroad (being less expensive because of the increased availability in supply), which explains why the domestic value added embedded in their exports to the US diminishes relatively more than their gross exports.

[16] Additional results on other standard macroeconomic effects are included in Table A4 in the Online Appendix.

[17] In the GTAP model, the balance of trade is determined by the relationship between regional investments (based on equating expected rates of return) and savings (driven by net national income). The standard closure, which is the one adopted here, allows flexibility of the current account.

Table 5 US–China trade war scenarios: US trade (absolute and percentage change). Source: Author's simulation using the GTAP-VA model

	Scen. 1: implemented tariffs					
	China		World (less China)		Total	
	Gross trade US$ B *(%)*	VA trade US$ B *(%)*	Gross trade US$ B *(%)*	VA trade US$ B *(%)*	Gross trade US$ B *(%)*	VA trade US$ B *(%)*
Exports	− 67.4 *(− 38.9)*	− 55.5 *(− 38.6)*	19.5 *(1.2)*	22.7 *(1.6)*	− 47.9 *(− 2.6)*	− 32.8 *(− 2.2)*
Imports	− 153.1 *(− 32.6)*	− 117.3 *(− 31.8)*	74.8 *(3.5)*	46.3 *(3.0)*	− 78.4 *(− 3.0)*	− 71.1 *(− 3.7)*
Trade bal.	85.7 *(28.9)*	61.8 *(27.5)*	− 55.3 *(− 12.2)*	− 23.6 *(− 12.6)*	30.4 *(4.1)*	38.2 *(9.3)*
	Scen. 2: full− blown trade war					
	China		World (less China)		Total	
	Gross trade US$ B *(%)*	VA trade US$ B *(%)*	Gross trade US$ B *(%)*	VA trade US$ B *(%)*	Gross trade US$ B *(%)*	VA trade US$ B *(%)*
Exports	− 112.6 (− 64.9)	− 91.6 (− 63.6)	36.1 (2.1)	41.5 (3.0)	− 76.5 (− 4.1)	− 50.1 (− 3.3)
Imports	− 309.8 (− 65.9)	− 237.8 (− 64.5)	169.9 (8.0)	105.5 (6.7)	− 139.9 (− 5.4)	− 132.3 (− 6.8)
Trade bal.	197.2 *(66.5)*	146.2 *(65.1)*	− 133.8 *(− 29.5)*	− 64.0 *(− 34.1)*	63.3 *(8.4)*	82.2 *(19.9)*

The trade balance can be either positive or negative, consequently, the sign of the percentage changes depends on whether the original position is in surplus or deficit. To facilitate the interpretation, in Table 5, absolute values are considered, meaning that the percentage change is positive if the existing deficit has become smaller, and vice versa

Italics values represent the percentage change

These effects would be strongly amplified under a full-blown trade war regime.

The impacts on sectors are shown in Fig. 8, where we look at the effects on a) US and b) China's gross imports at the sector level.

In the US market, due to the implemented tariff increase, Chinese exports mostly contract in electronics (−$54 billion), machinery and equipment (−$39 billion), manufactures (−$19 billion) and textiles (−$17 billion), those being the sectors for which tariffs increase the most (refer to Fig. 6). Hypothesizing a homogeneous increase by 25% on all exported goods (full-blown trade war), the effects in absolute terms on textiles (−$46 billion) would be more noticeable than that on other manufactures (−$25 billion). The EU countries succeed in substituting for Chinese products, gaining market shares in the US in all these four sectors, under both the scenarios.

Due to the implemented additional duties (full-blown trade war), China imports from the US $13 billion ($26 billion) less in motor vehicles and transport equipment, $10 billion ($12 billion) less in machinery and equipment, and $10 billion

Fig. 8 US–China trade war scenarios: US and China bilateral import, by sector and exporter (percentage change). Source: Author's simulation using the GTAP-VA model

($11 billion) less in agriculture. Under the full-blown trade war, other relevant decreases are found for electronics (−$20 billion) and chemicals (−$15 billion), sectors which have been relatively less impacted by the already implemented rounds of tariff increases. As we will discuss later, the ability of EU countries to substitute for

Table 6 US–China trade war scenarios: US and China bilateral imports (percentage change). Source: Author's simulation using the GTAP-VA model

Exporter	Italy		France		Germany	
Scenario	Scen. 1	Scen. 2	Scen. 1	Scen. 2	Scen. 1	Scen. 2
(a) US imports						
Gross exports	5.8	13.5	3.2	6.9	4.7	9.6
Standard trade						
DVA directly absorbed	6.4	14.5	4.2	8.6	5.4	10.8
GVC-related trade						
DVA re-exported	0.0	1.3	− 1.3	− 1.3	− 0.4	0.6
to China	− 37.8	− 68.6	− 37.9	− 69.8	− 37.7	− 69.6
FVA in exports	6.5	15.4	3.2	7.0	5.1	10.6
originated in China	14.2	34.3	9.3	20.7	12.7	26.9
originated in the US	6.9	15.4	3.2	6.5	5.1	10.4
originated in the EU	6.1	14.2	3.1	6.7	4.1	8.4
(b) China's imports						
Gross exports	− 1.2	− 2.8	2.3	4.9	− 0.3	− 0.6
Standard trade						
DVA directly absorbed	0.0	− 0.4	3.5	7.2	0.5	1.0
GVC-related trade						
DVA re-exported	− 2.9	− 6.3	− 2.4	− 4.8	− 2.5	− 5.0
to the US	− 34.0	− 69.1	− 34.0	− 68.9	− 34.9	− 69.8
FVA in exports	− 1.1	− 2.8	4.0	8.9	− 0.1	− 0.1
originated in China	3.4	6.0	8.4	17.9	4.3	8.2
originated in the US	− 0.8	− 2.1	7.6	17.3	0.4	1.0
originated in the EU	− 1.8	− 4.0	3.5	7.9	− 0.6	− 1.2

US products in China is much lower and mostly limited to one sector, motor vehicles and transport equipment.

The repercussions of the US–Sino tariff war on third countries' GVC-related trade are then assessed. Table 6 records the impact on bilateral trade of the three major European economies with both the US and China.

As bilateral trade between the US and China declines, we observe a replacement by trade with the EU. In the simulated scenarios, the three European countries under examination intensify their exports to the US, although the impact is heterogeneous among them. Both Italy and Germany seem to take advantage of the US–China trade war, being able to substitute for Chinese products in the US. This result is consistent with studies that find a high similarity between China and EU structures of exports, especially to developed countries (see, for example, Wang and Liu 2015). Italy gains more than other EU countries in the US market due to its export composition seemingly benefiting from the competitive effect between Chinese and Italian exports, both concentrated on low tech, traditional products (Giovannetti et al. 2018). For example, the competitiveness of Italian textiles in the US—a sector which represents

Table 7 US–China trade war scenarios: multilateral exports to the US and China (percentage change). Source: Author's simulation using the GTAP-VA model

Exporter	Italy		France		Germany	
Scenario	Scen. 1	Scen. 2	Scen. 1	Scen. 2	Scen. 1	Scen. 2
Multilateral exports to the US	0.9	2.4	0.6	1.9	− 0.5	− 0.3
through China	− 34.0	− 69.1	− 34.0	− 68.9	− 34.9	− 69.8
hrough the EU	4.4	9.1	4.0	8.6	4.5	9.5
Multilateral exports to China	− 2.8	− 5.5	− 3.1	− 5.9	− 2.9	− 5.5
through the US	− 37.8	− 68.6	− 37.9	− 69.8	− 37.7	− 69.6
through the EU	− 0.4	− 0.8	− 0.8	− 1.4	0.3	1.0

10% of Italian exports to the US and faces high protection in that market—increases as a consequence of the increased costs of Chinese textiles caused by the tariff hikes.

The boost in gross exports to the US is scaled down in value added terms since the DVA increases relatively less, and, specularly, the FVA grows relatively more. This is a common pattern among the selected EU countries, reflecting a stronger EU reliance on foreign inputs to produce exports. As already discussed, this is explained by the fact that the decreased costs in buying inputs from abroad (namely, from China) make EU firms relying more on foreign providers, thus increasing their backward integration in GVCs. China would strongly increase its role as a provider of intermediate inputs, which are diverted away from the US and toward EU countries. The more expensive trade with the US becomes, the more intense this effect would be and EU demand for Chinese intermediates would increase. The increase in the EU countries' exports to the US also pulls their demand for intermediates from regional partners. Due to the contraction in US exports (see Table 5), we observe only a small increase in the Italian and the German DVA re-exported by the US, whereas France would experience a loss in terms of providing intermediate inputs to the US exports. Most of the EU's DVA would be directly absorbed into the US market.

Among the three EU countries, only France would increase its exports to China, whereas neither Italy nor Germany would replace US products in China.

EU's DVA absorbed by China slightly increases, suggesting that GVCs would become shorter due to the increased trade costs. In the same direction, we find that re-exports from China are negatively impacted by the US–China trade war. Italy, which shows in the baseline the highest level of forward integration with China, is the country most impacted by the contraction of China's re-exports. Regardless of the sign of the change in EU gross exports to China, Chinese providers would still experience an increase in the demand of inputs from the EU countries under consideration.

Finally, we assess the repercussions on EU multilateral exports to the two belligerent countries (Table 7).

The increased importance of the US market for Italian exports is confirmed also when looking at multilateral exports, that would rise by 0.9 percentage points under the first scenario and by 2.4% under the full-blown trade war scenario. A similar pattern is found for France, whereas Germany would experience almost no impact on its VA exports reaching the US through other countries. This result is explained by the relatively higher importance of China in exporting German VA to the US if compared with Chinese re-exports of Italian and French VA (see Table 4).

China, suffering the increased costs in exporting to the US due to the higher tariff barriers, would reduce its importance as a bridge for EU VA reaching the US. Conversely, the EU platform would intensify its role suggesting that EU regional integration would increase due to the strengthening of relationships with the US market.

EU multilateral exports of VA to China would fall overall, a result which is in line with the finding that trade war with the US would strongly reduce Chinese imports (IMF 2019).[18]

6 Concluding Remarks

In this paper, I have analysed the impacts of the 2018 US–Sino trade war as well as of a hypothetical scenario of a full-blown trade war on global trade networks. Using value-added metrics in a computable general equilibrium framework, I have evaluated the "GVC-related effects" of the implemented rounds of tariff hikes and the further increases which have been threatened by the US administration on both belligerent countries and on the euro area. I have found that the disruption of trade between the US and China affects countries' participation in global production networks and acts as a restructuring force for regional and global value chains, often inducing firms to shorten their global supply linkages. The extent to which increased bilateral tariffs impact countries' GVC integration depends on the kind of linkages they have. Since the increased import tariffs raise the cost of importing intermediate inputs, both the US and China are pushed to rely more on domestic providers and to substitute for imports from other providers. This effect is particularly strong for the US because China is the main provider of foreign intermediate inputs for US firms. Consequently, US integration in GVCs contracts. As for China, the reduction in backward participation is more than compensated for an increase in forward integration with its most important end market, i.e., the US. In this vein, initiatives such as the "One Belt One Road" can be seen as an attempt to diversify supply and end markets thus reducing Chinese dependence on the US market. European countries are important players in GVC-related trade with the US and China. I have demonstrated that the increased linkages of the euro area with the US strengthen European regional integration, while the opposite holds for GVC-related trade with China, the only exception being France.

I conclude with a few reflections on future work in this area. First, I have developed the analysis using an Armington structure for imports, thus ignoring scale economies and variety effects. In future work, I plan to extend the analysis to

[18] Results on imports under the two explored scenarios can be found in Table A4 in the Online Appendix.

different trade assumptions (e.g., Krugman and Melitz). Second, I have applied a proportionality assumption that has allowed me to recover data on industry-to-industry trade. The UN Broad Economic Categories (BEC)-influenced sourcing shares for intermediate and final demand are a more refined categorization method that could improve the estimations. Finally, in this paper I have considered only tariffs and used weighted average schemes for the aggregation. Since trade protection concerns different policy instruments applied over thousands of commodities, a more refined method of aggregation could improve the measurement of trade policy. For example, trade restrictiveness indexes based on a value-added basis could give a synthetic and theoretically sound measurement of the overall protectionist stance on the different segments of the GVCs. This is an area which could be worth further exploring.

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