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Footloose Global Value Chains:

How Trade Costs Make A Difference

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Abstract

The geography of global value chains (GVCs) depends crucially on trade costs between countries hosting various stages of production. Some stages might be more sensitive to trade costs than others. In this paper, we exploit a value-added decomposition of bilateral trade flows to distinguish low value-added GVC trade typically associated with production stages such as assembly, from high value-added GVC trade associated with stages such as R&D and design. We test the hypothesis that low value-added stages will more easily reroute given changes in trade costs between importing and exporting countries than high value-added stages. The intuition for this hypothesis is that trade costs accumulate with multiple border crossings and are larger relative to the profit margins in low value-added stages. Furthermore, high value-added stages often require larger fixed cost investments which are often highly relationship-specific and knowledge-intensive, making them harder to relocate. We find strong empirical support for our hypothesis. This observation has important implications for development policies and bilateral trade policies aimed at reducing imbalances by repatriating offshored production stages.

Keywords: value added trade, trade costs, organisation of production
JEL Classification: C23; L23; F13

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1 Introduction

International trade occurs increasingly within global value chains (GVCs), which combine raw materials, intermediate parts, and services, often in long sequences and complex production networks spanning multiple countries, into final products which are exported to consumers all over the world. Over the last decades, the increased fragmentation of the production process, enabled by technological innovations in manufacturing, communications, and transport, has led to increased international specialisation according to comparative advantage (Hummels et al., 1998, 2001). These developments have led to welfare gains through higher productivity and lower prices for consumers (Amiti and Konings, 2007; Caliendo and Parro, 2015; Kummritz, 2016; Caliendo et al., 2019). Furthermore, they have allowed developing countries to participate in global production according to their capabilities, resulting in increased incomes and positive knowledge spillovers (Beverelli et al., 2019).

These developments have also brought new prominence to trade policy. While trade costs for decades have come down due to trade liberalisation and technological innovation such as container shipping and airfreight, recent policy decisions have resulted in increased trade costs. In particular, the trade conflict between the United States and its major trading partners has driven up tariffs on a wide range of goods (Bown, 2019) and the decision of the UK to leave the European Union has raised uncertainty about future trade policy, which drives up expected future trade costs and acts as a barrier to exporter market entry (Crowley et al., 2019). The World Uncertainty Index, which uses country reports by the Economist Intelligence Unit and a methodology developed by Baker et al. (2016), has reached a record high in 2018 as a result of these events (Ahir et al., 2018). Both theory and empirical evidence point to trade policy uncertainty being an important component of overall trader costs (Dixit, 1989; Handley, 2014). As production networks have become complex and intricate, they have become increasingly exposed to such disruptions. Furthermore, theory tells us that under certain conditions even small shocks to sectoral productivity in interlinked production networks may have large macroeconomic consequences (Acemoglu et al., 2012).

Firms make decisions on sourcing inputs and locating final assembly stages according to the global trade policy landscape. In a world of GVCs trade costs have become more important than ever. With the fragmentation of production stages across borders, final goods embody the costs of tariffs that are imposed on semi-processed products several times during the production process. As a result, GVCs are associated with an accumulation of tariff-related costs that arise along the chain of production. Yi (2003) describes how this accumulation effect causes tariffs to have a nonlinear effect on trade by hampering GVCs. For instance, in the simple case where all countries impose tariffs of 5%, a traditionally (i.e. purely domesticlly) produced and exported final good has a total tariff incidence of 5%. A final good produced across 5 separate stages in 5 different countries, each of which add an equal amount of value, has a total tariff incidence of 16% since a 5% tariff has to be paid each time an intermediate input crosses a border, assuming the full value of the good at that stage is taxed.[1]

[1]Some countries make use of inward processing regimes which exempt imported inputs from customs duties, however, our benchmark results are significant even though we are not able to discern imports which fall under

In this context, some stages of production may be more internationally footloose than others. GVCs do not only imply that tariffs are accumulated along the supply chain, making downstream production stages more cost sensitive, but their effect also gets magnified for production stages that add relatively little value compared to other stages. Baldwin et al. (2014) and WTO et al. (2019) describe the nonlinear patterns of value added along the production process with some stages adding most of the value and others relatively little. As tariffs are applied to the full value of the good and not just to the value added at a particular stage, the tariff rate in proportion to value added at any given stage can be very high for certain low value added production stages, and this is known as the magnification effect (Koopman et al., 2014; Diakantoni et al., 2017). Assume for instance that an assembly firm imports \$100 of inputs, assembles them and sells the final good for \$110, thus adding \$10 of value of which \$5 go towards labour costs and \$5 are profits. Then, introducing a tariff of 5% on the inputs completely absorbs the firms' profits. Production stages that add relatively little value to a good, such as assembly, are as a consequence more sensitive to trade costs relative to other stages. Koopman et al. (2014) find that due to the magnification effect, an additional production stage would increase trade costs faced by Vietnam in merchandise trade by an equivalent of 80% of the tariffs it is currently facing since it raises the value of its imported inputs relative to the value its own stages add. It also finds that in general emerging economies are more exposed to magnification than developed economies as they tend to specialise in tasks that add relatively little value.

Relatively footloose production stages typically do not require a skilled workforce and do not rely on tacit knowledge. They tend to involve simple and routine work processes which can be easily codified. As a result, they do not give rise to large fixed costs when setting up or closing down, making them more responsive to changes in trade costs. In contrast, stages that add more value such as R&D, design, or marketing, typically depend on a highly qualified and trained workforce that provides highly differentiated inputs and cannot easily be replaced by workers in a different country. The same logic applies to stages that rely on the particular comparative advantage of a country, for instance due to the presence of natural resources. Such stages are considerably less footloose.

In this paper we confirm and quantify this intuitive hypothesis and show that trade costs are relatively more consequential for stages which add little value to a good. Using industry-level data for 64 countries from 1995 to 2011 from the OECD-WTO Trade in Value Added (TiVA) database, we apply a standard gravity framework to estimate a differential impact of domestic value added to exports ratios on trade cost elasticities. We find that trade flows of industries which have low domestic value added to export ratios respond significantly more to changes in trade costs than industries with high ratios. These results are both statistically and economically significant. Our baseline specification implies that moving an industry from the bottom twenty-fifth percentile in terms of share of foreign value-added in exports (high domestic value added share) to the seventy-fifth percentile (low domestic value added share) increases its trade cost elasticity by 237%.

This is an important result because the elasticity of trade flows with respect to trade costs is a

these regimes in our data.

key parameter to quantify welfare gains from trade. Arkolakis et al. (2012) show that a broad class of the most prominent trade models in the literature that assume Dixit-Stiglitz preferences, one factor of production, linear cost functions, complete specialisation, iceberg trade costs, and either perfect competition (Anderson and Van Wincoop, 2003; Eaton and Kortum, 2002) or monopolistic competition (Melitz, 2003) share two common parameters that are sufficient for quantifying the welfare gains from trade: the import penetration ratio and the trade elasticity with respect to variable trade costs.

The policy relevance of this finding becomes apparent when viewed together with results from Jakubik and Stolzenburg (2018). The effects of import competition on labour markets differs based on the exporter's domestic value added share in gross export value, which reflects their inherent comparative advantage in producing the good. Jakubik and Stolzenburg (2018) show that exposure to imports from Chinese industries with a higher share of Chinese value added causes greater local labour market adjustments in the US. Since exports from these high domestic value added sectors are less sensitive to trade costs, our research suggest that raising bilateral trade barriers is unlikely to shield these labour markets effectively from import competition. Instead, it causes the low domestic value added assembly stages to shift out of China, but these stages do not contribute significantly to US labour market adjustment.

Our finding is also relevant from a development policy perspective. Many developing and emerging economies join GVCs by specialising in stages that add relatively little value. Since these are the most footloose stages, these countries are more exposed to the risks and uncertainties created by the current trade policy environment.

The most closely related research on this topic is recent and still unpublished, but provides important insights regarding the sensitivity of GVCs to trade costs. Heise et al. (2017) model the impact of trade policy changes on the formation of GVCs. They show that reductions in trade policy uncertainty will lead to the formation of Japanese-style just-in-time sourcing practices characterised by long-term buyer-supplier relationships which enhance operational efficiency and lead to substantial welfare gains. In the alternative, American-style production networks buyer choose the lowest-cost option for each order via competitive bidding without investing in the buyer-supplier relationship. The focus of their paper is on the impact of trade costs, specifically expected future trade costs, on the nature of global production networks, whereas we focus on the impact of trade costs on the relative sensitivity of the location of low-value added production stages as compared to high-value added production stages.

The dynamics of importer-to-exporter relationships are also studied by Monarch (2014), who estimates the that switching costs between firms from US and China have significant implications for import prices. In the presence of these switching costs and taking into account further linkages in the production network, Huneeus (2018) estimates that the effects on output of the international trade shocks facing Chile due to the Great Recession were significantly amplified due to the switching costs. In the context of our finding that low-value added production stages are more footloose, further research is needed to understand how these production stages are impacted by international trade shocks and switching costs, since these costs represent a larger share of profits and may lead to larger markups or output losses for low-value added production stages.

Johnson and Moxnes (2019) offer a different argument for how trade costs shape value chains based on a quantitative model.[2] In their model, as the level of trade costs falls, value chains reorganise endogenously. Distance becomes a more dominant force under lower trade costs so spatial clustering increases, as does the prominence of so called export platforms, which can be viewed as final assembly stages, since these stages endogenously locate to places with relatively low iceberg trade costs. Moreover, the proportion of input trade to final goods trade increases, which could be viewed as a proliferation of GVCs, and input trade is more trade cost elastic. Therefore, bilateral gross trade becomes overall more elastic to trade costs.

Antràs and De Gortari (2017) use a general equilibrium model to study the specialisation of countries within GVCs. In addition to the marginal cost of producing a given stage in a given country, spatial proximity to upstream and downstream stages matters. An important insight from their model is that, since trade costs at each stage of production will compound along the value chain, they will erode more value in downstream relative to upstream stages. The upshot is that trade cost elasticities are stage specific, and will increase further down the value chain. They use the WIOD and EORA datasets to provide some suggestive evidence for this observation. First they note that countries tend to rely on foreign sources more prevalently for inputs than for final goods which is consistent with the notion that trade costs are more detrimental for downstream versus upstream stages. As further evidence, they compare the trade elasticities of distance in a standard bilateral aggregate trade gravity framework and find that this is larger for final goods than for intermediate inputs. They conclude that trade barriers impede trade more severely in downstream stages than upstream stages, with the caveat that their gravity specification does not take into account third-country effects in the form of multilateral resistance. These results taken together are suggestive evidence to motivate their theoretical assumptions. They then estimate the elasticities in their structural model using WIOD data and perform counterfactual exercises to study how changes in trade costs will impact countries' GVC participation. Rather than looking at differences in intermediate and final goods trade, or upstream versus downstream stages more generally, our hypothesis is that an industry's ratio of domestic value added to exports determines the sensitivity of exports in that industry to trade costs, which requires a detailed country-sector value-added decomposition of bilateral trade flows.

The rest of this paper is organised as follows. Section 2 discusses the data and Section 3 provides descriptive statistics. Section 4 discusses the empirical strategy, Section 5 presents the results, and Section 6 concludes.

2 Data

For our analysis we use data from the OECD-WTO Trade in Value Added (TiVA) database, which contains data on gross bilateral exports for 34 industries and 64 countries from 1995 to 2011. In addition, the database contains information on the foreign and domestic value added

[2] Their model is not compatible with a gravity representation.

content of gross exports for each industry. Following a methodology proposed in Wang et al. (2013) gross trade flows can be further decomposed at the bilateral-industry level, generalising the bilateral level decomposition in Koopman et al. (2014), which allows us to isolate the value added by the domestic exporting industry by accounting for domestic value added by other domestic industries upstream in the production process.

The wide coverage of developing and developed countries in the OECD-WTO TiVA database makes it suitable to study the effects of trade costs on GVC exports with varying degrees of domestic value added contribution. Alternative data sources include the World Input–Output Database (WIOD) which has more sectors but country coverage is limited to mostly advanced economies, and the EORA Multi-Region Input–Output (MRIO) database which has an extensive country coverage but relies on approximation for missing national I–O tables. The OECD Inter-Country Input-Output (ICIO) Tables also make some adjustments for analytical purposes and symmetry, but imputation of missing trade flows is only a concern for services.

Our data on bilateral time-invariant gravity variables such as distance, contiguity, colonial relationships, and common language and legal system, are taken from CEPII (Head and Mayer, 2014). Data on bilateral time-varying tariffs come from the World Bank's World Integrated Trade Solution (WITS) database.

3 Descriptive statistics

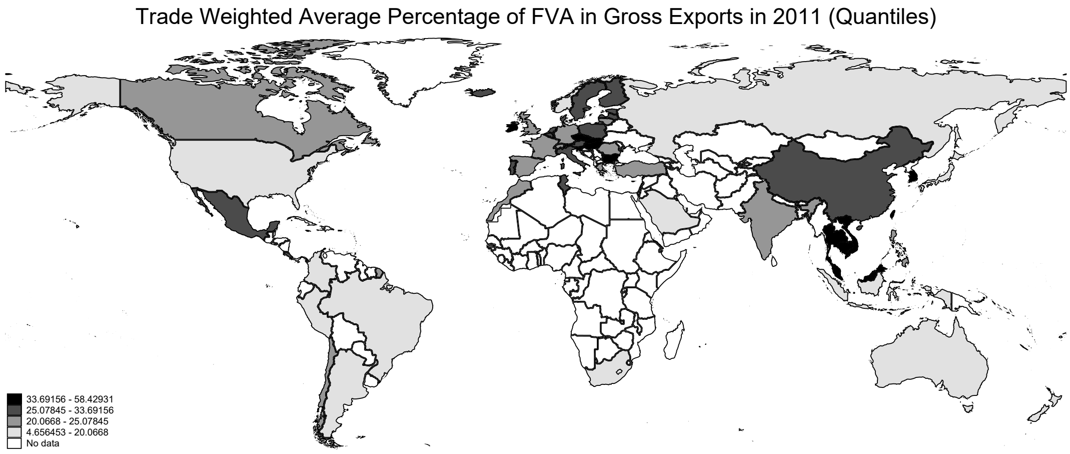
We use the foreign value added in exports ratio ($\%FVAX$) as our proxy to measure whether a particular country-industry pair is specialised in stages that add relatively little value to a good. If the ratio is high, the value added by the country-industry pair is relatively low compared to the total value of the good while the opposite is true if the ratio is low. Therefore, it is a suitable indicator for the exercise we undertake.[3]

Figure 1 plots information on the geography of the foreign value added to gross exports ratio or $\%FVAX$ in our most recent sample year (weighted by industry exports). This highlights that many of the countries we hypothesise to host footloose production stages (low domestic value added content) are concentrated in East Asia and Central and Eastern Europe. Mexico has also above median foreign value added content. Countries whose exports consist mostly of natural resources, as well as those with highly sophisticated manufacturing industries, and the least developed countries that are not integrated into GVCs tend to fall in the lower quartiles of $\%FVAX$.

Figure 2 illustrates how $\%FVAX$ has evolved during the period spanned by our data. There is a marked trend in countries increasing their $\%FVAX$ share, which is particularly strong in emerging economies. Table 1 lists the ten country-industry pairs (excluding petroleum), with the highest $\%FVAX$ in order to illustrate the typical industries and locations which extensively rely

[3] Having more precise information on the nature of the production stages country-industry pairs are specialised in would be clearly preferable, however such data is not available. Given the absence of more detailed value added trade data we consider our econometric approach as a good approximation to the true nature of production stages a country-industry pair is specialised in, i.e. whether these stages add significant value or not.

Figure 1



on foreign inputs in their exports. Countries that are known for being assembly hubs for nearby high-tech nations, such as Hungary, Viet Nam, or Chinese Taipei dominate the top end of the $\%FVAX$ distribution confirming that the variable is a good proxy for countries' specialisation patterns within GVCs.

Figure 2

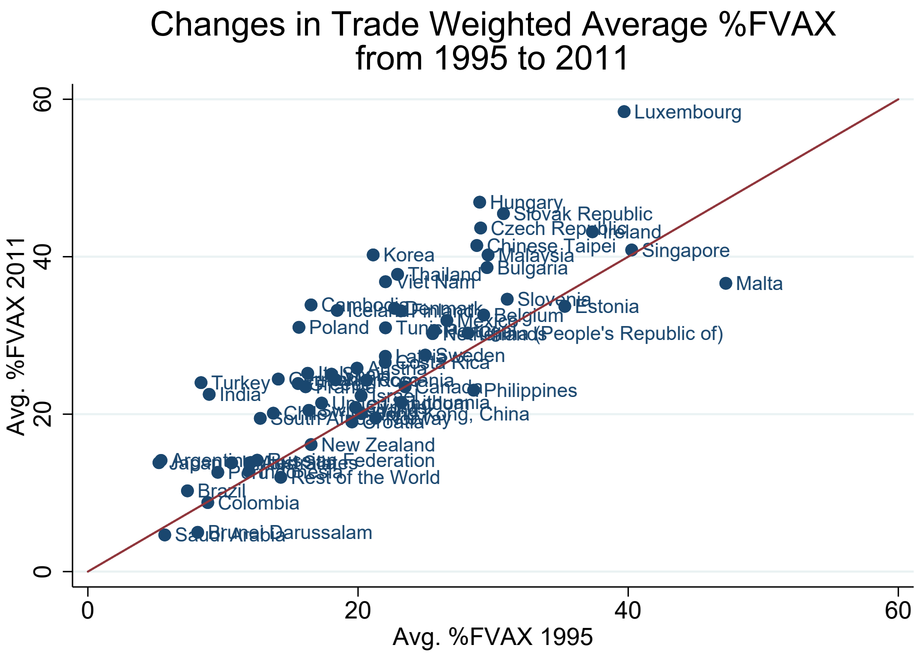


Table 1: Top 10 Industries with highest $\%FVAX$

Country	Industry	$\%FVAX$
Hungary	Computer, Electronic and optical equipment	74.09
Viet Nam	Machinery and equipment, nec	71.1
Singapore	Basic metals	70.99
Viet Nam	Computer, Electronic and optical equipment	70.4
Viet Nam	Basic metals	68.39
Czech Republic	Computer, Electronic and optical equipment	67.08
Malaysia	Computer, Electronic and optical equipment	66.83
Chinese Taipei	Mining and quarrying	66.58
Viet Nam	Electrical machinery and apparatus, nec	66.39
Thailand	Computer, Electronic and optical equipment	65.25

Notes: For illustrative purposes we exclude countries with population under 1 million. In the absence of an industrial base, these countries are by default reliant on imported inputs. Our results are robust to the inclusion of these countries.

4 Empirical Strategy

In order test the hypothesis that low value-added GVC production stages are relatively more sensitive to trade costs we use a structural gravity framework. Formally, we wish to test whether the marginal effect of trade costs on gross bilateral exports depends on the exporting sector's share of domestic value added, that is, the value it adds relative to the total value of an exported product. The structural gravity model is a powerful and robust tool, widely used in the empirical analysis of international trade policy and resting on strong theoretical foundations (Anderson and Van Wincoop, 2003; Eaton and Kortum, 2002).[4]

To control for observed and unobserved heterogeneity across countries and pairs, and to address endogeneity, we use exporter-sector-time and importer-sector-time fixed effects. These fixed effects also account for the industry specific characteristics which determine whether an industry inherently has a high or low value added contribution to production. Therefore, our estimates capture the effects of variation in domestic/foreign value added share of gross exports at the exporter-sector-time level (we use the variable foreign value added share of exports $\%FVAX_{ist}$) which is indicative of whether a given country i is specialised in low or high value-added stages of production within the exporting industry s.

Endogeneity of trade policy to trade flows is a well known concern in the gravity literature, since countries that trade more may also be inclined to reduce bilateral trade barriers. Estimates of our coefficient of interest are robust to including country-pair fixed effects. Baier and Bergstrand (2007) argue that using panel data with country-pair fixed effects effectively addresses endogeneity concerns since the problem is largely due to time-invariant unobserved heterogeneity between country pairs. We use the Poisson pseudo maximum likelihood (PPML) estimation method to account for heteroskedasticity in the trade flow data which can lead to inconsistent estimates when using log-linearised OLS (Silva and Tenreyro, 2006).

Our baseline estimating equation is:

[4] Yotov et al. (2016) provide an up to date overview and practical guide to gravity estimation.

$$X_{ijst} = \exp[\beta_0 + \beta_1 \tau_{ijts} + \beta_2 \tau_{ijts} \times \%FVAX_{ist} + \beta_3 lnDist_{ij} + \beta_4 Colony_{ij} + \beta_5 Contig_{ij} + \beta_6 Lang_{ij} + \beta_7 Legal_{ij} + \delta_{ist} + \delta_{jst}] \times e_{ijst}. \quad (1)$$

In an alternative specification we include country-pair-sector fixed effects to assess the robustness of our results:

$$X_{ijst} = \exp[\beta_0 + \beta_1 \tau_{ijts} + \beta_2 \tau_{ijts} \times \%FVAX_{ist} + \delta_{ist} + \delta_{jst} + \delta_{ijs}] \times e_{ijst}. \quad (2)$$

Summary statistics for the main variables used in the estimation are reported in Table 2.[5]

Table 2: Summary statistics for the main variables

Variable	Mean	sd	Min	Max
τ_{ijst} (Applied)	0.0361145	0.0646598	0	1.709591
τ_{ijst} (MFN)	0.0378698	0.0653386	0	1.709591
τ_{ijst} (UNESCAP)	175.1939	102.2959	.6436082	1382.638
$\%FVAX_{ist}$	30.52699	14.09639	2	88.36
$Log(Distance)_{ij}$	8.053596	1.101345	4.087945	9.842742
$Colony_{ij}$	0.0397583	0.1953911	0	1
$Contiguous_{ij}$	0.0577525	0.2332751	0	1
$CommonLanguage_{ij}$	0.0498917	0.2177215	0	1
$CommonLegalSystem_{ij}$	0.2281222	0.4196224	0	1

5 Results

5.1 Benchmark Specification

Our empirical results confirm our hypothesis that the trade cost elasticity of trade flows is heterogenous in the exporting industry's ratio of domestic value added to gross exports. We find that trade flows of industries that have low domestic value added (or equivalently, high foreign value added) to export ratios, and thus add relatively little value to their exported products, respond significantly more to changes in trade costs than industries with high ratios.

These results are both statistically and economically significant. Our baseline specification in Table 3, column (1) implies that that moving an industry from the bottom twenty-fifth percentile of share of foreign value-added in exports (high domestic value added share) to the seventy-fifth percentile (low domestic value added share) more than doubles the trade cost elasticity from 1.46 to 3.46, an increase of 237%.[6]

The results are robust to using MFN tariffs instead of applied tariffs (columns 2, 4, and 6), and remain significant for both agriculture and manufacturing sectors when analysed separately.

[5] $\tau_{ijst} = log(1 + tariff_{ijst}/100)$ when tariffs are used as trade costs.

[6] In our specification the trade cost elasticity is estimated to be $-[0.810 + (-0.111) \times \%FVAX]$

MFN tariffs may be better suited to capture trade costs due to uncertainty since applied rates are in practice often below the MFN bound rates but can be increased at any time up to these levels under WTO rules. We separate manufacturing and agriculture because agriculture is known to be less GVC intensive and less footloose than manufacturing. We observe a larger interaction term for agriculture (columns 3 and 4) than for manufacturing industries (columns 5 and 6).

Table 3: Benchmark Gravity Estimates

	PPML					
	(1 - ALL) Applied	(2 - ALL) MFN	(3 - AG) Applied	(4 - AG) MFN	(5 - MANUF) Applied	(6 - MANUF) MFN
τ_{ijst}	0.810	0.698	2.003**	2.031**	0.654	0.531
	(0.770)	(0.773)	(0.904)	(0.924)	(0.852)	(0.847)
$\tau_{ijst} \times \%FVAX_{ist}$	-0.111***	-0.0981***	-0.201**	-0.202**	-0.108***	-0.0941***
	(0.0355)	(0.0347)	(0.0929)	(0.0936)	(0.0368)	(0.0359)
$Log(Distance)_{ij}$	-0.742***	-0.748***	-0.876***	-0.876***	-0.738***	-0.745***
	(0.0297)	(0.0295)	(0.0606)	(0.0609)	(0.0301)	(0.0298)
$Colony_{ij}$	-0.0696	-0.0764	(0.182)	-0.139	-0.0669	-0.0743
	(0.101)	(0.100)	0.866***	(0.182)	(0.100)	(0.100)
$Contiguous_{ij}$	0.463***	0.468***	0.866***	0.865***	0.451***	0.456***
	(0.0866)	(0.0874)	(0.161)	(0.161)	(0.0864)	(0.0873)
$CommonLanguage_{ij}$	0.0141	0.0135	-0.745***	-0.743***	0.0293	0.0286
	(0.118)	(0.118)	(0.231)	(0.231)	(0.118)	(0.118)
$CommonLegalSystem_{ij}$	0.257***	0.259***	0.234**	0.235**	0.258***	0.260***
	(0.0634)	(0.0635)	(0.108)	(0.108)	(0.0639)	(0.0640)
$Constant_{ijst}$	13.23***	13.28***	12.67***	12.67***	13.25***	13.30***
	(0.242)	(0.240)	(0.516)	(0.519)	(0.244)	(0.242)
Observations	374,010	374,010	24,960	24,960	349,050	349,050
Pseudo R-squared	0.929	0.929	0.863	0.863	0.930	0.930
Exporter-Sector-Time FE	YES	YES	YES	YES	YES	YES
Importer-Sector-Time FE	YES	YES	YES	YES	YES	YES
Exporter-Importer-Sector FE						

Notes: Robust standard errors in parenthesis, clustered by exporter-importer pairs. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

As shown in Table 4, the benchmark results remain statistically significant after including exporter-importer-sector fixed effects to address endogeneity concerns arising from time-invariant unobserved heterogeneity between country pairs. Columns (3) to (6) show that when analysed separately, the interaction term loses significance for agriculture, but remains significant for manufacturing sectors, in line with the fact that agricultural is relatively less integrated into GVCs. In this specification there is also less variation from which to identify the coefficient of the interaction and the estimates of trade cost elasticities are smaller.

Table 4: Gravity Estimates with Country Pair Fixed Effects

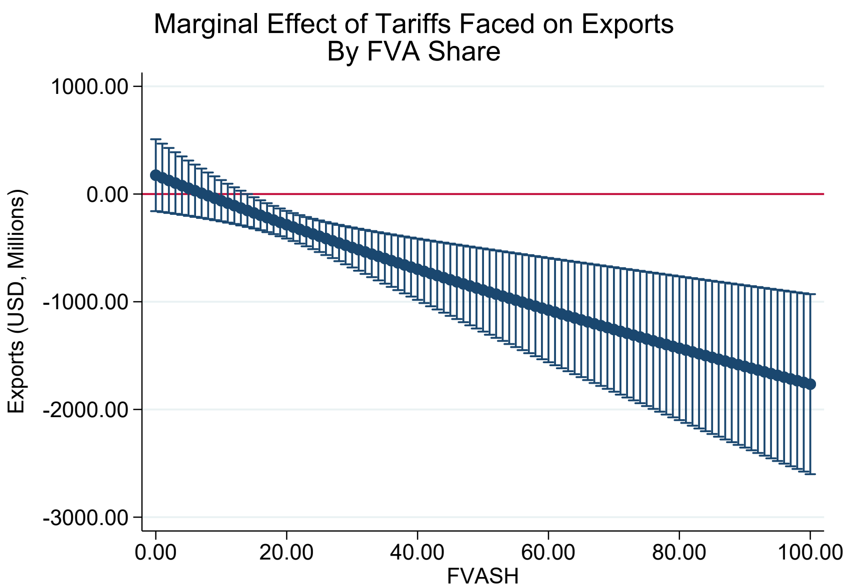
	PPML					
	(1 - ALL) Applied	(2 - ALL) MFN	(3 - AG) Applied	(4 - AG) MFN	(5 - MANUF) Applied	(6 - MANUF) MFN
τ_{ijst}	0.468**	0.483**	1.703***	1.696***	0.350*	0.367*
	(0.206)	(0.204)	(0.547)	(0.569)	(0.204)	(0.203)
$\tau_{ijst} \times \%FVAX_{ist}$	-0.0223**	-0.0233***	-0.0535	-0.0552	-0.0196**	-0.0207**
	(0.00891)	(0.00892)	(0.0353)	(0.0369)	(0.00907)	(0.00909)
$Constant_{ijst}$	7.776***	7.777***	6.352***	6.350***	7.811***	7.813***
	(0.00196)	(0.00242)	(0.0178)	(0.519)	(0.00188)	(0.00230)
Observations	364,314	364,314	24,384	24,384	339,930	339,930
Pseudo R-squared	0.989	0.989	0.978	0.978	0.989	0.989
Exporter-Sector-Time FE	YES	YES	YES	YES	YES	YES
Importer-Sector-Time FE	YES	YES	YES	YES	YES	YES
Exporter-Importer-Sector FE	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors in parenthesis, clustered by exporter-importer pairs. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5.2 Marginal Effects

Based on our benchmark specification from Table 3 column (1), Figure 3 illustrates how the marginal effects of time varying trade costs, specifically the tariffs faced, on exports are heterogenous in the share of foreign value added. For industries that rely heavily on domestic value added in their exports, tariffs are only a minor impediment, but as the share of foreign value added increases, exports from these industries become more sensitive to trade costs, confirming our hypothesis.

Figure 3



Notes: A one unit increase in trade costs in our benchmark specification is equivalent to doubling of applied tariffs faced. The dependent variable is annual bilateral sectoral exports.

5.3 Robustness

In this section, to assess the robustness of our results we use a different source of trade costs, the UN ESCAP-World Bank Trade Cost Database (Arvis et al., 2013). These costs are obtained using a methodology developed by Novy (2013) and are all-inclusive, capturing all elements of trade costs. They capture determinants of trade costs such as the speed of customs clearance and amount of red tape as well as tariffs. The trade costs are bilateral, with a country coverage of 180 countries and both agriculture and manufacturing industries covered from 1995 to 2016. From this exercise we conclude that out benchmark results are robust to a wider definition of trade costs, since under both a traditional gravity specification and with country-pair fixed effects the coefficient of trade costs as well as the interaction term are negative.

Table 5: Gravity Estimates with UNESCAP Bilateral Trade Costs

	PPML					
	(1 - ALL)	(2 - AG)	(3 - MANUF)	(4 - ALL)	(5 - AG)	(6 - MANUF)
τ_{ijst}	-0.0220***	-0.0158***	-0.0233***	-0.0102***	-0.00526***	-0.0118***
	(0.000745)	(0.00101)	(0.000828)	(0.000530)	(0.000674)	(0.000646)
$\tau_{ijst} \times \%FVAX_{ist}$	-6.85e-05***	-0.000162***	-4.87e-05***	-5.50e-05***	-0.000167***	-3.66e-05**
	(1.80e-05)	(5.53e-05)	(1.87e-05)	(1.38e-05)	(3.59e-05)	(1.45e-05)
$Log(Distance)_{ij}$	-0.221***	-0.229***	-0.211***			
	(0.0210)	(0.0335)	(0.0218)			
$Colony_{ij}$	-0.0602	-0.158**	-0.0568			
	(0.0456)	(0.0801)	(0.0459)			
$Contiguous_{ij}$	0.219***	0.363***	0.212***			
	(0.0375)	(0.0757)	(0.0377)			
$CommonLanguage_{ij}$	0.0455	-0.0464	0.0476			
	(0.0392)	(0.0706)	(0.0398)			
$CommonLegalSystem_{ij}$	0.0973***	-0.0270	0.0965***			
	(0.0260)	(0.0497)	(0.0264)			
$Constant_{ijst}$	10.56***	9.872***	10.54***	8.110***	6.958***	8.210***
	(0.143)	(0.250)	(0.147)	(0.0322)	(0.0625)	(0.0374)
Observations	968,191	49,241	918,950	887,958	48,061	839,897
Pseudo R-squared	0.946	0.915	0.947	0.985	0.971	0.985
Exporter-Sector-Time FE	YES	YES	YES	YES	YES	YES
Importer-Sector-Time FE	YES	YES	YES	YES	YES	YES
Exporter-Importer-Sector FE				YES	YES	YES

Notes: Robust standard errors in parenthesis, clustered by exporter-importer pairs. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6 Conclusion

International trade flows to a large extent through GVCs. Although overall trade costs have been declining, the fragmentation of production across firms and plants located in different countries and organised within GVCs has brought renewed attention to the role of trade costs. Whether they are tariffs or administration and transportation-related costs, trade costs are incurred again and again with each border crossing of semi-processed goods. Moreover, the trend of declining trade costs has recently stopped and reversed, at least for the portion of costs due to policy barriers. It is therefore important to better understand the interaction of trade costs with the spatial structure of GVCs.

In this paper we show that trade costs are not just important for the volume of trade flows within GVCs but also for the spatial organisation of GVCs. To be precise, we find that certain stages of GVCs are more sensitive to trade cost changes than others. Stages that add little value to a good and are thus characterised by a high foreign value added to total gross value added ratio respond significantly more to trade cost changes than stages that contribute more domestic value added. Examples of such stages are assembly or packaging.

Our findings reflect the magnification effect of trade costs generated by GVCs. As many trade costs apply to the full value of an exported final or intermediate good, not only the additional value that was created in the latest stage of production in the exporting country, the share of trade costs to value added is higher for stages that add less value. Since these trade costs have to be paid for by the additional profit that is generated by locating a given stage in a given country, the margins of low value added stages are smaller and, consequently, these stages will be relatively more footloose as they are more exposed to trade costs changes.

The empirical results have important implications for policy. First, countries that host stages that contribute only little value within value chains (Figure 1 and Table 1) should pay special attention to the trade costs that they have control over such as tariffs or customs procedures. As many of these countries are developing countries, multilateral and bilateral agreements that lower trade costs for these countries, such as the WTO Agreement on Trade Facilitation, are especially promising complementary instruments to promote GVC integration. Second, raising bilateral trade costs between two countries by increasing tariffs or imposing quantitative restrictions will shift some trade flows more than others. Our findings indicate that raising bilateral trade costs through policy means will dislocate (and not necessarily repatriate) mostly low value added stages. Previous work has shown that low value added stages are not primarily responsible for labour market adjustment in the US due to Chinese import competition (Jakubik and Stolzenburg, 2018). Therefore, our work highlights the need to account for the heterogenous impact on production stages in GVCs when evaluating the effects of trade policy.

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