Services Trade Restrictiveness and Manufacturing Productivity: The Role of Institutions*

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Abstract

We study the effect of restrictions on trade in services on manufacturing productivity for a broad cross-section of countries at different stages of economic development. Decreasing services trade restrictiveness has a positive indirect impact on the manufacturing sectors that use services as intermediate inputs in production. We identify a critical role of local institutions in importing countries shaping this effect: countries with high institutional capacity benefit the most from lower services trade restrictions in terms of increased productivity in downstream industries. We argue that this dependence on the quality of importing country institutions reflects the non-storability of many services and the associated need for some production to occur locally, and provide a theoretical framework to formalize our suggested mechanisms.

Keywords: services trade policy; tradability; institutions; productivity

JEL Classification: F14; F15; F61; F63

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1 Introduction

Increasing productivity is an essential ingredient of economic growth and development. A large fraction of such growth originates in the manufacturing sector (Van Ark et al., 2008). The productivity of manufacturing depends in part on the availability of high-quality inputs (Jones, 2011). These include machinery and intermediate parts and components, as well as a range of services inputs (Johnson, 2014). The average dependence on (use of) transport, telecommunications, finance and business services by US manufacturing industries is around 10%, with significant variation across industries, e.g. rising to 25% in ISIC sector 26 ('Manufacture of other non-metallic mineral products').[1]

Trade is an important channel through which firms can improve their access to services inputs. Trade may result in lower prices and/or increasing the variety of products that are available (see for instance Topalova and Khandelwal, 2011). Therefore, the extent to which policies restrict foreign access to upstream services markets is relevant for downstream productivity. The effect of reforms targetting services industries on the performance of manufacturing has been analyzed in a number of recent studies. Both studies using firm-level data[2] and studies using sector-level data[3] generally find an economically significant impact of services productivity (or firms' access to services) on productivity in manufacturing.[4]

While this literature has established the importance of the indirect linkage between services trade policy and economic performance of industries that are downstream in the relevant supply chain, less has been done to account for the specific characteristics of services production and exchange in shaping this relationship. The main contribution of this paper is to identify the role that economic institutions play as a determinant of the size of this indirect effect. Specifically, we estimate the impact of services trade restrictiveness on manufacturing productivity and demonstrate that the quality of institutions shapes the relationship between upstream services openness and downstream manufacturing productivity. We argue that this is a reflection of the characteristics of services and services

[1]These figures on input intensity reflect the share of total intermediate consumption. Appendix B provides more detail on the construction of this measure.

[2]See for example Arnold et al., 2008 (10 countries in Sub-Saharan Africa); Fernandes and Paunov, 2011 (Chilean data with a focus on inward FDI in services); Arnold et al., 2011 (data for the Czech Republic, also with a focus on services FDI); Forlani, 2012 (French data); Duggan et al., 2013 (Indonesian data with a focus on FDI regulations); Hoekman and Shepherd, forthcoming (119 developing countries); and Arnold et al., forthcoming (Indian data).

[3]Sector-level empirical studies in this literature include Barone and Cingano, 2011 (17 OECD economies in 1996); Bourlès et al., 2013 (15 developed economies during the period 1984-2007); Hoekman and Shepherd, forthcoming (gravity-based analysis of the impact of services trade openness on manufactured exports).

[4]Of course, the link between upstream and downstream performance is not limited to services. Blonigen (forthcoming) is a recent cross-country analysis of the impact of upstream policies in a non-services sector (the steel industry) on downstream economic outcomes.

trade. The nonstorability of many services often will require a foreign firm to invest or otherwise establish a physical presence in an importing market to provide a service. This in turn subjects the firm to local regulation and the prevailing business environment. We develop a simple theoretical model that embodies the key characteristics of services and services trade to illustrate why one should expect the observed moderating effect of institutions.

The paper is organised as follows. Section 2 motivates the analysis and briefly relates our approach to some of the literature. Section 3 turns to the econometric analysis, and presents the database, the specifications and the estimation results. In section 4 we develop a simple theoretical framework to rationalise the empirical finding that institutional quality and capacity of the importing country is a determinant of the magnitude of the positive effect of services trade openness on productivity in downstream industries. Section 5 concludes.

2 Motivation and Related Literature

Economic institutions and associated measures of the quality of economic governance such as control of corruption, rule of law, regulatory quality, contract enforcement, and more generally the investment and business climate are crucial determinants of economic development.[5] In the services literature, some studies introduce institutional quality as a determinant of the services trade policy stance (van der Marel, 2014a) and of the coverage of services policy commitments made in trade agreements (van der Marel and Miroudot, 2014). Building on the literature that identifies institutions as a trigger for comparative advantage in industries that are more sensitive to the institutional environment (notably complex industries with contract-intensive production processes)[6], van der Marel (2014b) argues that the ability of countries to provide complementary domestic regulatory policies accompanying services liberalization is a source of comparative advantage in downstream goods trade.

Institutional quality differs widely across countries. To provide an illustration, Figure 1 shows the global distribution of the variable 'control of corruption' reported in the World Bank's Worldwide Governance Indicators dataset.[7] A similar pattern of heterogeneous

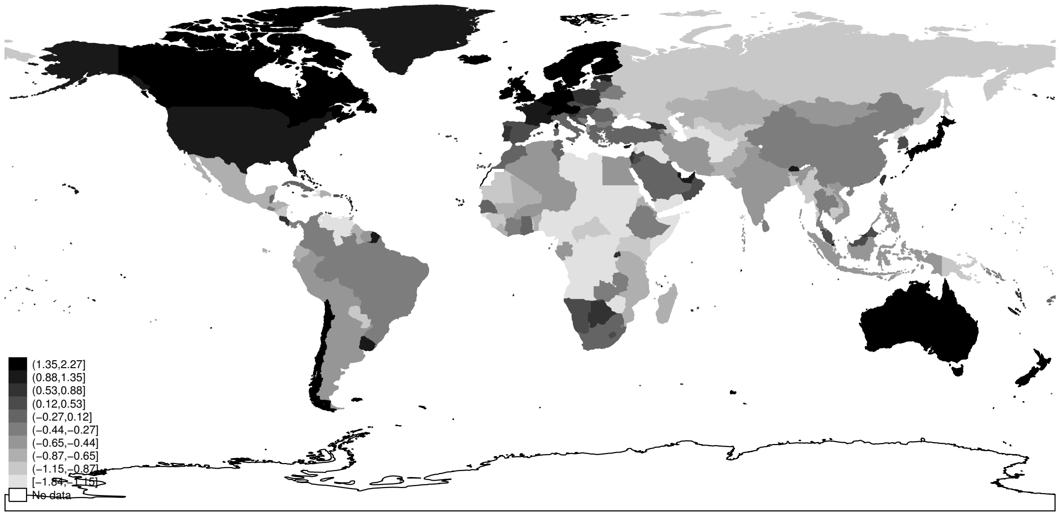
[5]See, among others, Acemoglu et al. (2001; 2005) and Rodrik et al. (2004). In the trade literature, a number of studies have looked at institutions as determinants of bilateral trade flows as well as offshoring and FDI decisions at the firm level. Anderson and Marcouiller (2002) build a gravity framework where imports depend on the institutional settings affecting the security of trade and show that weak institutions limit trade as much as tariffs do. Other topics in the institutions and trade literature are the effect of trade outcomes and policies on (endogenous) institutions and the role of informal institutions as social capital and trust. For a general review of the literature we address the reader to WTO (2013).

[6]See Nunn (2007); Levchenko (2007); Costinot (2009).

[7]The variable ranges from 2.41 (best performer) to -1.61 (worst performer).

performance applies for a host of business environment and economic governance indicators. Institutional heterogeneity not only is a direct driver of cross-country income differences, it conditions the impacts of economic reforms such as trade liberalization (Rodriguez and Rodrik, 2001; Winters and Masters, 2013). This conditioning role is also likely to apply in the case of services policies and policy reforms in terms of impacts on downstream industries. Indeed, this can be expected to be particularly important for services given that they often are intangible and non-storable. The former feature often motivates regulation of services providers, while the latter gives rise to a proximity burden, in that the agent performing the service must be in the same location as the buyer or consumer.[8] Accordingly, exporters of services often must perform some stages of their economic activity in the importing country, where they will be subject to local regulation and be affected by the quality of prevailing institutions.[9]

Figure 1: Control of corruption across the world



Source: World Development Indicators (latest available year)

Figure 2 presents some preliminary evidence in support of the conjecture that the quality of institutions conditions the effects of services trade policy on downstream industries. We plot productivity in manufacturing sectors (vertical axis) on a measure of services trade restrictiveness that takes into account the depth of input-output linkages between a given upstream service sector and a given downstream manufacturing sector ($CSTRI$, on the horizontal axis).[10] In the figure, light dots are manufacturing sectors in countries lying above the sample median of the variable control of corruption (the main proxy for institu-

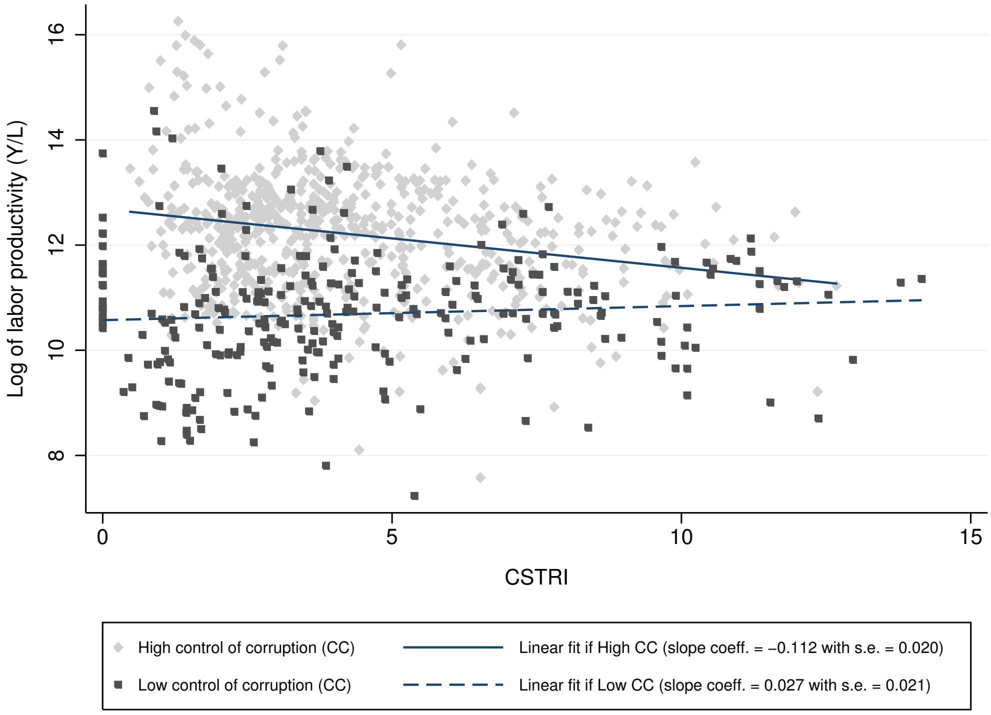
[8]See Parry et al. (2011) for a detailed discussion of the characteristics of services.

[9]The proximity burden is reflected in the broad definition of trade in services used in the WTO General Agreement on Trade in Services (GATS), which includes sales of services through modes 3 ('commercial presence') and 4 ('presence of natural persons'). According to WTO estimates, modes 3 and 4 command a total share of 60% (respectively, 55% and 5%) of world exports of services. Mode 1 (cross-border supply) commands a share of 30% and mode 2 (consumption abroad) a share of 10%.

[10]Details on the construction of the productivity variable are provided in Appendix table A-1. We discuss the variable $CSTRI$ in more detail in Section 3.

tional quality in the empirical analysis); dark dots are manufacturing sectors in countries lying below this sample median. In the case of countries with high institutional quality, the (solid) regression line is negatively sloped, with a statistically significant coefficient of -0.112. Conversely, for countries with low institutional quality the slope of the (dashed) regression line is not statistically different from zero. These data suggest that institutional quality is a determinant of the potential gains from services trade liberalization.

Figure 2: *CSTRI* and manufacturing productivity across institutional regimes: descriptive evidence



We can think of two broad mechanisms through which institutions may condition the downstream effects of upstream services trade policy, assuming that foreign firms must establish some degree of commercial presence in an importing country to contest the market. First, for a given level of trade restrictiveness implied by policy, the institutional environment in a country may affect entry decisions of potential foreign suppliers, giving rise to a selection or ex-ante effect of institutions.[11] To illustrate this channel, consider a global provider of telecommunication services, Vodafone. This firm has a direct presence in 21 'local' markets, and an indirect presence in 55 'partner' markets.[12] Of these 76

[11] Theoretical models of multinational firms decisions in an international framework with country-level differences in contract enforcement institutions are developed in Antràs and Helpman (2004) and Grossman and Helpman (2005). Bernard et al. (2010) find that better governance in the destination countries is associated with a higher number of affiliates established by foreign multinationals. However, such a relationship is not found to be robust in Blonigen and Piger (2014).

[12] Vodafone data have been collected by the authors from the official Vodafone web page: `http://www.vodafone.com/content/index/about/about-us/where.html`.

markets, 19 (25%) are in countries with relatively low institutional quality (measured by the control of corruption variable being less than the sample median) while the other 57 (75%) are in countries with relatively high institutional quality (control of corruption above the sample median). If we consider the markets where Vodafone is not present, either directly or in partnership with a local provider, 87 out of 142 (61%) are in countries with relatively low institutional quality and 55 (38%) are in countries with relatively high institutional quality.[13] Regression analysis suggests that even after controlling for country size (level of GDP) and for the level of services trade restrictiveness in telecommunications, institutional quality has a positive and statistically significant effect on the probability of Vodafone entering a market by establishing a direct or indirect commercial presence.[14]

Second, conditional on entry, the quality of the exporters' output may depend on the institutional environment of the country where demand is located and the service is performed. A number of recent studies linking firm productivity with the institutional environment in which firms operate provide support for this hypothesis.[15]

Our empirical analysis differs from existing country-sector studies on the link between policies affecting upstream industries and downstream manufacturing productivity in several respects. Papers such as Barone and Cingano (2011) and Bourlès et al. (2013) focus on OECD countries, a relatively homogenous group of developed economies. Our sample of countries spans 27 nations classified as 'high income' by the World Bank, 16 upper middle income countries, 10 lower middle income countries and 4 low income economies. This allows to meaningfully test for heterogeneous effects across countries with very different institutional capacity. Moreover, both papers cited above measure prevailing services policies using the OECD Product Market Regulation (PMR) indicator for non-manufacturing industries. This variable has a strong focus on domestic policies and therefore does not capture the important dimensions of services trade outlined above. Hoekman and Shepherd (forthcoming) use the World Bank Services Trade Restrictiveness index (STRI) to assess the effects of services trade policy but focus only on developing countries. Their gravity analysis of the effect of services trade openness on manufacturing exports does not take into account input-output linkages between services and manufacturing.

This paper complements van der Marel (2014b), who investigates whether countries with a high level of regulatory capacity are better able to export in goods produced in industries that make relatively intensive use of services. While van der Marel uses a world-average STRI for each service sector (as the sector-level component of the country-sector inter-

[13] A test of equality of means rejects the null hypothesis that the probability of Vodafone's commercial presence is the same in the two groups of countries with low and high institutional quality (106 countries each), in favour of the alternative hypothesis that such probability is higher in the group of countries with high institutional quality.

[14] Regression results are available from the authors on request.

[15] See for example Gaviria (2002), Dollar et al. (2005), Lensink and Meesters (2014) and Borghi et al. (forthcoming).

action term representing regulatory capacity, in line with the methodology proposed by Chor, 2010), we use country-level STRI measures to identify and quantify the impact of services trade reforms on downstream productivity.

3 Empirics

3.1 Empirical model and identification strategy

The objective of the empirical analysis is to estimate the impact of service trade restrictiveness on productivity in downstream manufacturing industries, and how institutional quality affects such impacts.

We follow the approach pioneered by Rajan and Zingales (1998), assuming that the effect of upstream services trade policy on downstream productivity is a positive function of the intensity of services use as intermediate inputs into downstream sectors. Therefore, the regressor of interest is constructed by interacting a country-sector measure of trade restrictiveness in services with a measure of services input use by downstream industries derived from input-output data. Formally, for any country i and downstream manufacturing sector j, we define a composite services trade restrictiveness indicator ($CSTRI$) as follows:

$$CSTRI_{ij} = \sum_s STRI_{is} \times w_{ijs} \tag{3.1}$$

where $STRI_{is}$ is the level of services trade restrictiveness for country i and services sector s and w_{ijs} is a measure of input use of service s by manufacturing sector j in country i. We define w as the share of total intermediate consumption: w_{ijs} is the share associated to sector s in the total consumption of intermediate inputs (both domestically produced and imported) of sector j in country i.[16] The baseline productivity regression is then:

$$y_{ij} = \alpha + \beta CSTRI_{ij} + \boldsymbol{\gamma}'\mathbf{x}_{ij} + \delta_i + \delta_j + \epsilon_{ij} \tag{3.2}$$

where the dependent variable is a measure of productivity of downstream manufacturing sector j in country i; δ_i and δ_j are respectively country and downstream sector individual effects; and $\mathbf{x}_{ij}$ is the column vector of relevant regressors varying at the country-sector level. In the baseline regressions, this vector contains the variable Tariff, the logarithm of the effectively applied tariff by country i in sector j. In subsequent robustness checks, we add the variable $\widetilde{\text{Tariff}}$, the logarithm of the weighted average of tariffs effectively applied in manufacturing sectors $k \neq j$ (see Section 3.4 for a details on the construction of this variable).

[16]For the derivation of the shares of intermediate consumption from the IO tables, see Appendix B.

The coefficient β in model 3.2 is expected to be negative. A potential mechanism is the following. Consider a decrease in the variable $CSTRI$ as an inflow of a factor of production, services, from abroad. The Rybczinski theorem suggests that additional services will be absorbed by service-intensive industries, which will expand, attracting other factors of production (including domestic services) from less service-intensive industries. These industries will in turn contract, releasing factors of production to the expanding ones. At the same time, the average quality of services increases under a more open regime. Even keeping the factor input mix constant, therefore, the productivity of labor in service-intensive (expanding) industries will increase, because each worker will be endowed with the same amount of better-performing services.[17] The productivity of labor in less service-intensive (contracting) industries should in turn not be affected, as they do not absorb more productive services. In other words, in these industries each worker will be endowed with the same amount of equally-performing services as in the case of high $CSTRI$. Since β represents the average effect across expanding industries – where y should be negatively associated with $CSTRI$ – and contracting industries – where the association should be null – β is expected to be negative.

Building on the earlier discussion on the potential role of institutional variables in moderating the effect of services trade restrictiveness on downstream productivity, we allow for heterogeneous effects of the regressor of interest ($CSTRI$) across country-level measures of institutional quality. Accordingly, we propose the following interaction model:

$$y_{ij} = \alpha + \beta CSTRI_{ij} + \kappa(CSTRI_{ij} \times IC_i) + \boldsymbol{\gamma}'\mathbf{x}_{ij} + \delta_i + \delta_j + \epsilon_{ij} \tag{3.3}$$

where IC_i is a continuous proxy for institutional capacity in country i.[18] In this second specification, the impact of service trade restrictiveness is given by $\beta + \kappa IC_i$ and therefore varies at the country level depending on the institutional framework. In line with the theoretical mechanisms outlined in Section 1 and formalized in Section 4, the coefficient k should be negative (the negative effect of $CSTRI$ on y should be larger in countries with high institutional capacity).

All regressions are estimated including country fixed effects and sector dummies. This neutralizes the risk of estimation bias coming from omitted variables varying at the country or sectoral level. What remains is the variability at the country-sector level. In particular we need to control for those variables that, varying at the country-sector level, are potential determinants of productivity and that can be correlated with services trade restrictiveness. The most relevant candidate is a measure of the restrictiveness of trade

[17] The same reasoning would also apply to total factor productivity, TFP, because higher-quality services would raise the productivity of all other factors.

[18] We do not include the main effect of IC_i in equation (3.3) as it is accounted for by the country specific effects.

policy for goods (imports). Accordingly, we always include, as a control, the tariff variable(s) described above.

A second omitted variable which requires discussion is the productivity of the domestic services sectors. This is likely to have an effect on the price and quality of domestic services inputs and thus on the productivity of downstream industries. Moreover, domestic services providers might have the incentives to coalesce into a lobby to obtain protection from foreign competitors in the form of higher barriers to services trade (Fiorini and Lebrand, 2015). Given that high productivity service firms have the greatest interest and capabilities to exert lobbying pressure, variability across the manufacturing sector dimension does not matter for this impact channel and therefore the potential effect of domestic services productivity is controlled for by the country fixed effect.

This is not the case if the impact channel from the productivity of domestic services sectors to services trade policy goes through lobbying by the manufacturing industries, and therefore varies with the degree of services input intensity. In particular, in countries where the domestic services sector is characterized by low productivity, it is plausible to assume that services intensive manufacturing industries will lobby for less restrictions to services trade. This implies a negative sign for the omitted variable bias and therefore an overestimation bias of the negative effect of upstream trade restrictiveness on downstream productivity. Lacking the right data to measure services sectors productivity across a wide range of countries, this potential source of endogeneity for our regressor of interest calls for an alternative solution.

Moreover, downstream productivity – or lack thereof – could affect the degree of trade liberalization for upstream industries through lobbying, generating a problem of reverse causation. If low productivity industries downstream are the ones lobbying for deeper upstream liberalization, our results would have to be interpreted – at worst – as a lower bound for the impact of services trade openness on manufacturing productivity, conditional on downstream lobbying (this argument is discussed in Bourlès et al., 2013). If instead high productivity manufacturing industries are the ones with the right incentives and capabilities to exert effective lobbying pressure for services trade openness, our empirical strategy would suffer again from an overestimation bias of the negative effect of $CSTRI$ on y.

To account for both the omitted variable and the reverse causation endogeneity problems, we propose an instrument for services trade restrictiveness. Section 3.3.1 discusses the construction of the instrument and the results of IV regressions.

Finally, the intensity of services consumption by a downstream manufacturing sector may be affected by the degree of services trade restrictiveness (less restricted services trade enhancing downstream intermediate consumption) and the productivity in the manufacturing sector itself (more productive manufacturing sectors being able to consume more differentiated services). In the first case the number of manufacturing industries for which the 'treatment' (lower trade restrictiveness in the services sector) is likely to have more bite would be increasing with the treatment itself. In the second case we would have an issue of reverse causality. Killing two birds with one stone, we measure w_{ijs} of any country i with the input penetration of service s into industry j for country $c \neq i$. We follow here the assumption widely adopted in the literature originating from Rajan and Zingales (1998), taking the United States' input-output coefficients as representative of the technological relationships between industries. We therefore set c = US and remove the US from the sample.

3.2 Data

Given the focus on the role of institutions in shaping the indirect effect of services trade policy, data comprising the maximum variability in country level institutional capacity is needed. The World Bank's Services Trade Restrictiveness Database offers a unique country coverage (103 economies) for services trade policies affecting imports. These include measures on market access; national treatment provisions; and domestic regulation that have a clear impact on trade. The Services Trade Restrictiveness Indexes cover five services sectors – financial services (banking and insurance), telecommunications, retail distribution, transportation and professional services (accounting and legal) – and the most relevant modes of supplying the respective service. These are commercial presence or FDI (mode 3) in every sub-sector; in addition, cross-border supply (mode 1) of financial, transportation and professional services; and the presence of service supplying individuals (mode 4) only for professional services (see Borchert et al., 2012 for a detailed description of the database). In the empirical analysis, we alternatively use the STRI aggregated across all available modes or the mode 3 STRI. Since we consider the role of importing countries' institutions, the absence of information on mode 2 (consumption abroad) in the STRI data is harmless. STRI data does not vary over time. It captures the prevailing policy regimes in the mid-2000s.

Data on input penetration comes from the mid-2000s OECD STAN IO Tables, where sectors are mapped to the ISIC Rev. 3 classification and aggregated at the 2 digit level. Productivity measures are constructed using data from the UNIDO Industrial Statistics Database. The data varies across countries, years and manufacturing sectors (ISIC Rev. 3). The key feature of the UNIDO database is that it provides the widest country coverage with respect to possible alternative sources, such as EU KLEMS or OECD STAN.[19] We use

[19]The EU KLEMS database covers Australia, Japan, the US and 25 UE countries (O'Mahony and Timmer, 2009). The OECD STAN database covers 33 OECD countries.

labor productivity as a proxy for industry productivity.[20] Data on institutional capacity is from the World Bank's Worldwide Governance Indicators. Tariff data is from UNCTAD TRAINS.

The estimation sample includes 57 countries and 18 manufacturing sectors (listed in Appendix table A-2). A description of all the variables used in the estimations, including the data sources, is in Appendix table A-1. Descriptive statistics are in Table 1.

Table 1: Summary statistics

Variable	mean	median	sd	min	max
Productivity	11.76	11.72	1.36	7.23	16.26
CSTRI	4.35	3.61	2.92	0.00	22.62
IC	2.92	2.73	1.01	1.26	5.03
Tariff	0.85	0.92	0.38	0.00	1.61
$\widetilde{\text{Tariff}}$	0.88	0.95	0.31	0.23	1.54

From estimation sample of column (8) of Table 8

IC = control of corruption

3.3 Results

The main estimation results for the baseline specification (3.2) and the interaction model (3.3) are given in Table 2. The first two columns use the STRI measure aggregated across all modes of supply, while the last two columns focus on measures relevant only for trade through commercial presence (Mode 3).

The estimated coefficient of the composite measure of services trade restrictiveness has the expected negative sign in the baseline specification for both All modes in column (1) and Mode 3 in column (3): less restrictive policy environments are associated with higher productivity in downstream manufacturing. In the first case, however, the estimate is not statistically different from 0, while in the second case (mode 3) it is only weakly statistically significant (0.1 level). Moving to the interaction model, we find a statistically significant, negative coefficient for the interaction term. Lower services trade restrictiveness is associated with higher downstream manufacturing productivity, with the estimated effect increasing with country-level institutional capacity. The results of the interaction model suggest that the weak or no significance of the baseline specification is

[20] To the best of our knowledge there exists no dataset providing more refined measures of industry productivity, such as TFP, for a large and heterogeneous cross-section of countries. As is common to other studies where the research interest lies in wide country coverage (see for instance Rodrik, 2013) we are constrained to focus on labor productivity.

Table 2: Baseline and Interaction Model Estimation

	All modes		Mode 3	
	(1)	(2)	(3)	(4)
$CSTRI$	-0.025	0.065	-0.038*	0.052
	(0.024)	(0.038)	(0.021)	(0.032)
$CSTRI \times IC$		-0.041***		-0.039***
		(0.014)		(0.012)
Tariff	-0.120	-0.110	-0.323*	-0.304
	(0.084)	(0.083)	(0.186)	(0.185)
Observations	912	912	912	912
R-squared	0.522	0.526	0.524	0.528

Robust (country-clustered) standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Country fixed effects and sector dummies always included
IC = control of corruption

driven by a composition effect. The role of institutions based on the estimation of the Mode 3 case is further illustrated in Figure 3.[21]

For approximately 95% of our sample the effect of $CSTRI$ has the expected negative sign and, for approximately 60% of the observations (those with a level of control of corruption higher that 2.5), the effect is statistically significant at the 0.05 level. The positive effect of lower trade restrictiveness in upstream services sectors increases with institutional capacity. The effect is not statistically different from zero for low levels of institutional capacity (approximately 40% of our sample).

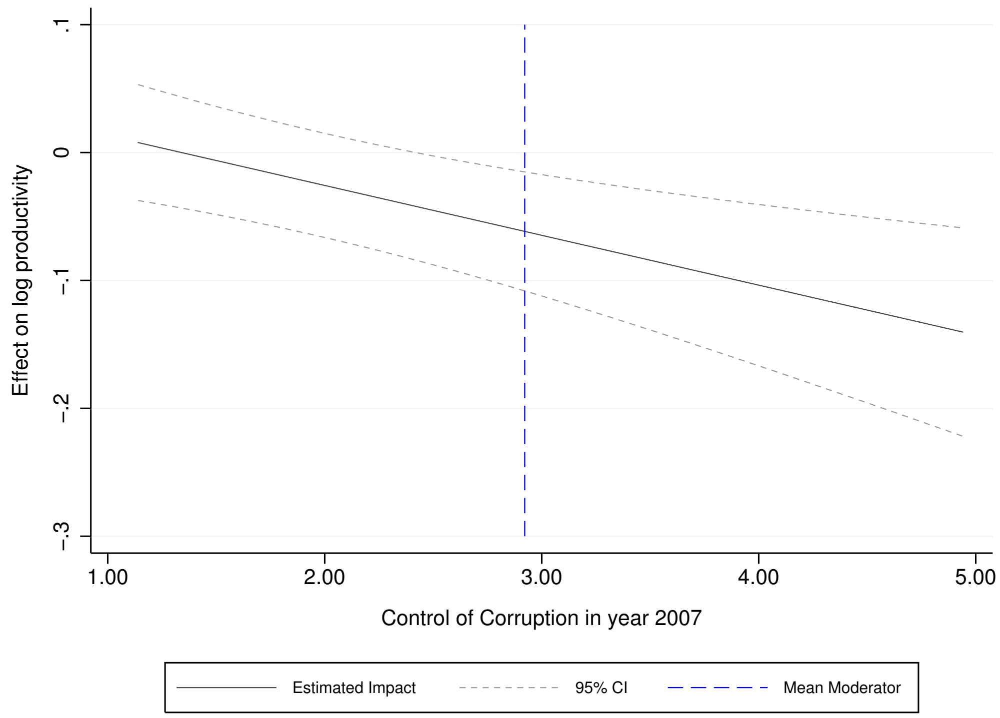
To get a sense of the economic relevance of this result consider the following quantification exercise. Take four countries with similar mean values of the composite measure of services trade restrictiveness $CSTRI$ for Mode 3: Austria, Canada, Italy and Tanzania.[22] Although STRIs are similar, these countries have very different institutional performance. Austria and Canada rank respectively 6$^{\text{th}}$ and 7$^{\text{th}}$ in terms of control of corruption in the sample, while Italy ranks 25$^{\text{th}}$ and Tanzania 43$^{\text{rd}}$. Assuming that the four economies adopt the less restrictive services trade regime observed in the UK,[23] productivity in downstream manufacturing increases by 18.2% in Austria, 16.7% in Canada, 7.3% in Italy and only

[21] The figure reports marginal effects evaluated at 39 values of the control of corruption variable and 95% confidence intervals. The latter are calculated using the Delta method.

[22] Tanzania has relatively low levels of services trade restrictiveness among the developing countries in our sample, reflecting significant trade reforms implemented by the government in the last decade.

[23] Such a shift entails a reduction in the $CSTRI$ by approximately 45% of a sample standard deviation for each of the 4 selected countries.

Figure 3: Impact of one unit increase in $CSTRI$ (Mode 3) on the downstream log productivity y



3.9% in Tanzania.

Finally, the coefficient on Tariff is negative, although not statistically significant, indicating that more protected sectors are also the least productive ones.[24]

3.3.1 Instrumenting for the services trade restrictiveness measure

As noted above, there are reasons one might be concerned with endogeneity of the $STRI$ measures. In the spirit of Arnold et al. (2011; forthcoming), we instrument for $STRI_i$ using the weighted average of $STRI$ in other countries $c \neq i$:

$$STRI_{is}^{IV} \equiv \sum_{c} STRI_{cs} \times SI_{ci} \tag{3.4}$$

where $SI_{ic} \equiv 1 - \left\{\frac{pcGDP_i}{pcGDP_i + pcGDP_c}\right\}^2 - \left\{\frac{pcGDP_c}{pcGDP_i + pcGDP_c}\right\}^2$ is a similarity index in GDP per capita between the two countries i and c.[25] Such weights should reflect similar trade policy motives, assuring the relevance of the instrument. One might argue that the SI weights also reflect unobserved determinants of productivity and therefore their applica-

[24] We make no attempt to claim a causal link between tariff protection and sectoral productivity, as this is beyond the scope of this paper.

[25] We take the definition of the similarity index from Helpman (1987).

tion might create a link between the instrument and the dependent variable which does not go through our regressor of interest. This would result in a violation of the exclusion restriction. While the application of the SI weights is our preferred approach, the results presented below (Table 3) remain remarkably robust when the SI-weighted average is replaced by an unweighted average.[26] Moreover, to satisfy the exclusion restriction, the c countries are taken from geographical regions different from that of country i. This minimises the potential linkages between services trade regimes in the c countries and the lobbying activity of i's manufacturing sector (see section 3.3.1).

The results are presented in Table 3. The instrument passes the standard tests. The results are, however, quantitatively very similar to the baseline results of Table 2, suggesting we do not need to be concerned with endogeneity of the services trade restrictiveness measure.

3.3.2 Random services trade restrictiveness

To ensure that our results can be given a clear economic interpretation, we perform a Placebo experiment in which the 'treatment' (services trade restrictiveness), rather than being constructed from real data, is randomly assigned. We construct the variable $\widetilde{CSTRI}_{ij} = \sum_s \widetilde{STRI}_{is} \times w_{ijs}$, where $\widetilde{STRI}_{is}$ is a random draw from a uniform distribution with support $[0, 100]$. We then perform 100,000 regressions of model (3.3), each with a different, randomly constructed $\widetilde{CSTRI}_{ij}$, and we estimate the marginal effects. As in the baseline case, we evaluate the marginal effects at 39 values of the control of corruption variable. The resulting dataset, therefore, contains 3,900,000 estimated marginal effects. Out of those, 83% are not statistically different from zero.

Figure 4 graphically represents the marginal effects with the confidence intervals – averaged across all the 100,000 regressions. It is apparent that the marginal effects are never statistically different from zero. Our results, therefore, cannot be obtained with random services trade restrictiveness measures.[27]

[26] When the instrument is constructed using unweighted averages the estimated coefficient for the interaction term become -0.046 (s.e.=0.019) for the All modes case and remains equal to -0.044 (s.e.=0.017) for the Mode 3 case.

[27] The same results are obtained if the median is used instead of the average. Note that we do not exclude the United States from the sample – although the results are the same when doing so. Confidence intervals for each regression are computed using the Delta method.

Table 3: Instrumental variable regressions

	All modes		Mode 3	
	(1)	(2)	(3)	(4)
$CSTRI$	-0.124*	0.028	-0.027	0.048
	(0.072)	(0.061)	(0.052)	(0.058)
$CSTRI \times IC$		-0.053***		-0.044***
		(0.019)		(0.017)
Tariff	-0.114	-0.103	-0.120	-0.109
	(0.075)	(0.073)	(0.075)	(0.073)
Observations	912	912	912	912
R-squared	0.515	0.523	0.522	0.526
First-stage F statistics				
$CSTRI$	44.56	55.17	68.59	34.53
(p-value)	0.00	0.00	0.00	0.00
$CSTRI \times IC$		39.13		46.68
(p-value)		0.00		0.00
Underid SW Chi-sq statistics				
$CSTRI$	45.58	219.92	70.15	145.24
(p-value)	0.00	0.00	0.00	0.00
$CSTRI \times IC$		186.81		244.07
(p-value)		0.00		0.00
Weak id SW F statistics				
$CSTRI$	44.56	214.78	68.59	141.85
$CSTRI \times IC$		182.44		238.36
Stock-Wright LM S statistics				
Chi-sq	3.87	9.01	0.33	8.21
(p-value)	0.049	0.011	0.566	0.016

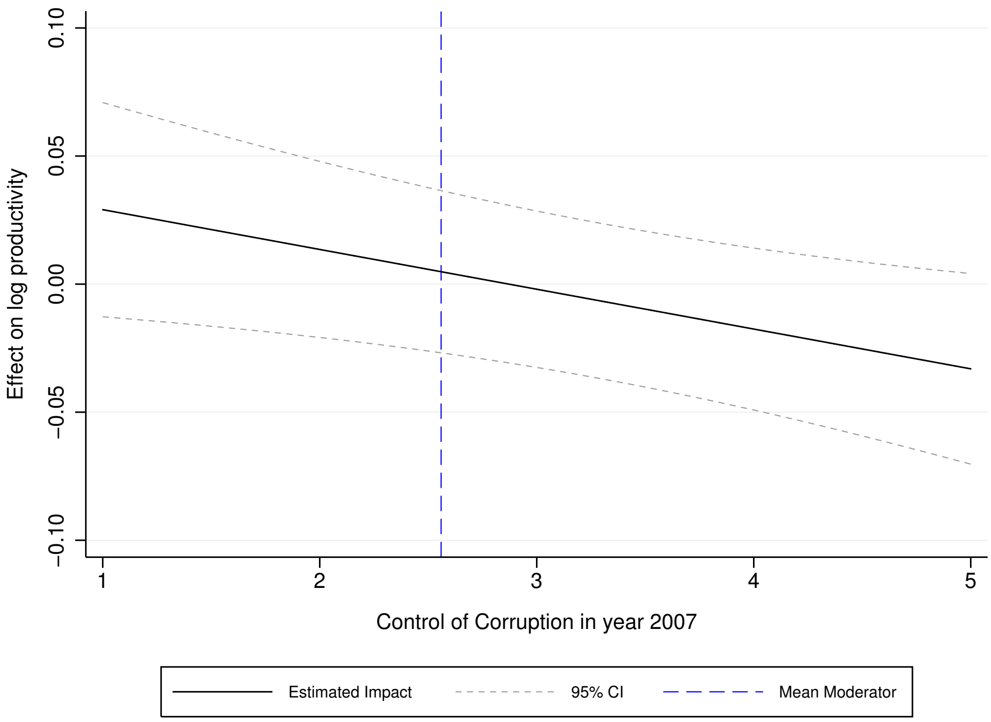
Robust (country-clustered) standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Country fixed effects and sector dummies always included
"SW" refers to Sanderson and Windmeijer (forthcoming)
Instrument for $CSTRI_i$: weighted average of $CSTRI_k$ (see Section 3.3.1)
IC = control of corruption

3.4 Robustness checks

3.4.1 Different moderator variables

As a robustness check we estimate the interaction model (3.3) with alternative institutional variables (M) instead of control of corruption. Table 4 shows the results for two alternative measures of institutional capacity and for GDP per capita as a proxy for eco-

Figure 4: Impact of one unit increase in $CSTRI$ (Mode 3) on y: Random assignement of $STRI$



nomic development. When M is defined as an indicator of the quality of institutions such as the rule of law or a measure of regulatory quality, the moderating effect remains unchanged. However, it is not statistically different from zero if we use per capita GDP. The latter finding suggests that it is not differences in average per capita incomes (wealth) that shape the impact of services trade policies on downstream productivity, but that what matters are the institutional dimensions of the business environment that prevails in a country.

Table 4: Interaction model estimation with alternative moderator variables

Moderator (M)	Rule of Law		Reg. Quality		GDP per capita	
	All Modes	Mode 3	All Modes	Mode 3	All Modes	Mode 3
	(1)	(2)	(3)	(4)	(5)	(6)
$CSTRI$	-0.032	-0.039*	-0.034	-0.040*	-0.015	-0.027
	(0.024)	(0.021)	(0.025)	(0.021)	(0.024)	(0.020)
$CSTRI \times M$	-0.046***	-0.046***	-0.044***	-0.045***	-0.000	-0.000
	(0.014)	(0.012)	(0.014)	(0.012)	(0.000)	(0.000)
Tariff	-0.532*	-1.498**	-0.303	-1.252**	-0.800**	-1.826**
	(0.287)	(0.733)	(0.184)	(0.619)	(0.399)	(0.860)
Observations	912	912	912	912	912	912
R-squared	0.527	0.530	0.525	0.529	0.525	0.526

Robust (country-clustered) standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Country fixed effects and sector dummies always included

3.4.2 Alternative input penetration measures

The services input penetration measure adopted in this paper is the ratio between the cost of services inputs and the value of total intermediate consumption of downstream manufacturing industries. This measure differs from the definition of IO technical coefficients, which represent the ratio between services inputs and total output of a downstream sector.[28] Our definition does not embed differences in value added across manufacturing sectors, representing therefore a better proxy for technological differences in intermediate input consumption. To test the robustness of our preferred measure of input penetration, we replicate the estimation using both US technical coefficients and the coefficients derived from the US Leontief inverse matrix, which captures also the indirect linkages between upstream and downstream industries.[29] Estimation results are given in Table 5.

Table 5: Estimation with Technical and Leontief IO coefficients

IO weights	Technical				Leontief			
	All modes		Mode 3		All modes		Mode 3	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CSTRI	-0.068	0.131	-0.087**	0.111	-0.080	0.172	-0.103	0.176
	(0.052)	(0.081)	(0.043)	(0.075)	(0.082)	(0.133)	(0.062)	(0.144)
$CSTRI \times IC$		-0.093***		-0.085***		-0.116***		-0.119**
		(0.027)		(0.026)		(0.042)		(0.049)
Tariff	-0.122	-0.085	-0.330*	-0.260	-0.126	-0.078	-0.344*	-0.241
	(0.084)	(0.084)	(0.186)	(0.186)	(0.085)	(0.087)	(0.187)	(0.197)
Observations	912	912	912	912	912	912	912	912
R-squared	0.523	0.529	0.525	0.531	0.522	0.527	0.525	0.529

Robust (country-clustered) standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Country fixed effects and sector dummies always included
IC = control of corruption

The sign and statistical significance of the estimated coefficients is robust across all measures of input penetration. Given the smaller size of technical and Leontief IO weights with respect to the shares of total intermediate consumption, the higher coefficient estimates in Table 5 generate economic effects that are similar in magnitude.

Given the heterogeneity of the countries in our sample, one can question the representativeness of the US as the baseline country for the IO linkages. In Table 6 we present results using the services shares of manufacturing intermediate consumption derived from China's 2005 IO accounting matrix. China was classified as lower middle income country by the World Bank in 2006.[30] Therefore it represents a more representative baseline

[28] The ratio between the cost of services inputs and the value of the downstream industry output is the proxy for direct input penetration usually adopted in the empirical literature on the indirect effect of services policies on manufacturing (see for example Barone and Cingano, 2011).

[29] For a derivation of those alternative input penetration measures from the IO Table, see Appendix B.

[30] In 2006 China had a per capita GNI (Atlas method) of 2,050 US dollars. For that year the GNI per

for our estimation sample which includes both middle and low income countries. The sign and statistical significance of the coefficient estimates are not affected by the use of China's data. The higher values of the coefficients using Chinese IO data suggests that the use of US data is a conservative choice for the economic quantification of the results.

Table 6: Estimation with Chinese input penetration measures

	All modes		Mode 3	
	(1)	(2)	(3)	(4)
CSTRI	-0.081	0.135	-0.099**	0.083
	(0.050)	(0.090)	(0.043)	(0.083)
CSTRI × *IC*		-0.094***		-0.078**
		(0.032)		(0.030)
Tariff	-0.085	-0.084	-0.277	-0.270
	(0.086)	(0.084)	(0.188)	(0.187)
Observations	912	912	912	912
R-squared	0.526	0.529	0.528	0.531

Robust (country-clustered) standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Country fixed effects and sector dummies always included
China excluded from the estimation sample
IC = control of corruption

Barone and Cingano (2011) argue that country-specific measures of input intensity carry an idiosyncratic component which is likely to be related to the trade restrictiveness regime. In that case the sign of the estimation bias would be ambiguous, requiring a robustness check which does not rely on country-specific weights (Ciccone and Papaioannou, 2006). We follow the approach adopted by Barone and Cingano (2011) and instrument the US shares of services s in total intermediate consumption with:

$$w_{js}^{IV} \equiv \hat{\delta}_j + \hat{\gamma}_j STRI_{\bar{c}s} \quad \forall s \tag{3.5}$$

where $\hat{\delta}_j$ and $\hat{\gamma}_j$ are estimates from the following sector s-specific regression in which country $\bar{c}$ has been excluded from the sample:[31]

$$w_{ijs} = \delta_i + \delta_j + \gamma_j STRI_{is} + \epsilon_{ij} \quad \forall s \tag{3.6}$$

The input intensity measures derived in (3.6) minimise by construction the idiosyncratic component present in any country-specific proxy. Consistently with the literature, we chose country $\bar{c}$ to be equal to the US.[32] We also perform this IV exercise by setting $\bar{c}$

capita interval for lower middle income countries was fixed by the World Bank at 906-3,595 US dollars.

[31] This methodology was introduced by Ciccone and Papaioannou (2006) to instrument US industry capital growth. Our estimates are obtained accounting for the fact that the dependent variable in (3.6) is fractional, applying the specification suggested in Papke and Wooldridge (1996).

[32] A rationale for this is that the US is one of the least regulated countries in a historical perspective (Barone and Cingano, 2011).

equal to Sweden, the country with the lowest average STRI values across services sectors (both for Mode 3 and for All modes) of the countries in the sample used for equations (3.6).[33] The results are presented in Table 7.

Table 7: Non country-specific input penetration: IV regressions

Country $\bar{c}$	United States				Sweden			
	All modes		Mode 3		All modes		Mode 3	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$CSTRI$	-0.053$^{\#\#}$	0.013	-0.051$^{\#\#}$	0.019	-0.050$^{\#}$	0.001	-0.044$^{\#}$	0.008
	(0.035)	(0.054)	(0.032)	(0.049)	(0.035)	(0.055)	(0.031)	(0.048)
$CSTRI \times IC$		-0.030$^{\#}$		-0.030$^{\#\#\#}$		-0.024		-0.023$^{\#}$
		(0.021)		(0.018)		(0.022)		(0.018)
Tariff	-0.088	-0.081	-0.089	-0.082	-0.088	-0.082	-0.089	-0.084
	(0.074)	(0.073)	(0.074)	(0.073)	(0.074)	(0.073)	(0.074)	(0.073)
Observations	930	930	930	930	930	930	930	930
R-squared	0.526	0.529	0.527	0.531	0.526	0.529	0.528	0.531
First-stage F								
$CSTRI$	460.67	251.95	367.65	222.42	341.13	181.57	303.24	177.45
(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$CSTRI \times IC$		303.94		243.94		186.83		189.05
(p-value)		0.000		0.000		0.000		0.000
Underid SW Chi-sq								
$CSTRI$	470.93	253.35	375.84	194.00	348.73	177.88	309.99	171.21
(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$CSTRI \times IC$		346.70		279.28		191.29		217.86
(p-value)		0.000		0.000		0.000		0.000
Weak id SW F								
$CSTRI$	460.67	247.54	367.65	189.55	341.13	173.80	303.24	167.28
$CSTRI \times IC$		338.75		272.87		186.90		212.86
Stock-Wright LM S								
Chi-sq	2.50	4.77	2.68	5.40	2.14	3.33	2.14	3.96
(p-value)	0.114	0.092	0.102	0.067	0.143	0.190	0.143	0.138

Robust (country-clustered) standard errors in parentheses
$^{\#}$ p<0.20, $^{\#\#}$ p<0.15, $^{\#\#\#}$ p<0.11, * p<0.10
Country fixed effects and sector dummies always included
US not excluded from the estimation sample
Instrument for $CSTRI_{ij}$: $\sum_s STRI_{is} \times w^{IV}_{js}$ (see Section 3.4.2)
IC = control of corruption

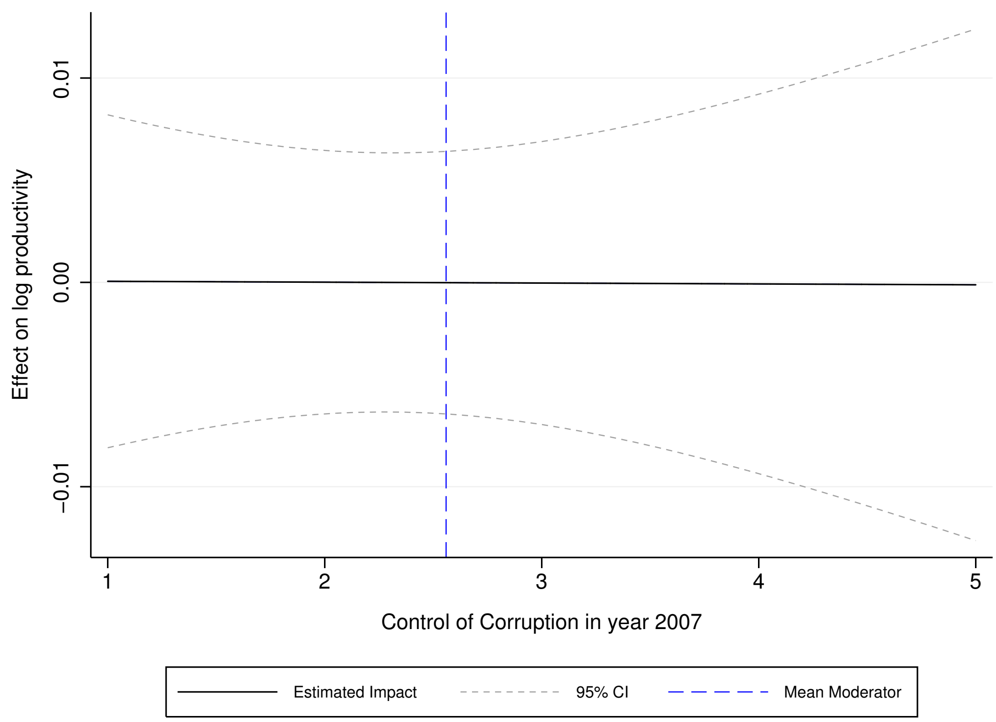
Although the statistical significance of the estimated coefficients is reduced (especially in the case where $\bar{c}$ is set equal to Sweden), their signs and magnitudes are in line with the baseline results.

Finally, to show how important input-output relationships between upstream services

[33] Estimation of the models (3.6) requires country specific input intensity measures (w_{ijs}) and services trade restrictiveness measures ($STRI_{is}$). The sample size therefore is determined by the intersection of the country coverage of the OECD STAN IO Database and that of the World Bank STR Database. This intersection includes 32 countries: Australia, Austria, Brazil, Bulgaria, Canada, Chile, China, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, South Korea, Lithuania, Mexico, Netherlands, Poland, Portugal, Romania, South Africa, Spain, Sweden, Turkey, United Kingdom and United States. This limited intersection in the country coverage of the two databases does not allow to perform a robustness check that makes use of the shares of intermediate consumption specific to each country (the baseline estimation sample counts 57 countries plus the US). In any event, the endogeneity issues associated with country-specific input intensity measures would have made this particular robustness check quite problematic (see Section 3).

and downstream manufacturing are, we have performed a counterfactual Placebo analysis with randomly generated input penetration coefficients. The procedure is similar to the one adopted by Keller (1998). In a regression in which a country's R&D is affected by a weighted average of foreign countries' R&D – with weights given by bilateral import shares – Keller replaces bilateral import shares from trade data with random shares, drawn from a uniform distribution with support $[0, 1]$. Likewise, we create the variable $\widehat{CSTRI}_{ij} = \sum_s STRI_{is} \times \widetilde{w}_{ijs}$, where $\widetilde{w}_{ijs}$ are random draws from a uniform distribution with support $[0, 100]$. As in Section 3.3.2, we perform 100,000 regressions and estimate 3,900,000 marginal effects, with a 95% confidence interval. Out of the estimated marginal effects, 79% are not statistically different from zero. Marginal effects with the confidence intervals – averaged across all the 100,000 regressions – are presented in Figure 5. They are never statistically different from zero. Our results, therefore, cannot be obtained with random input penetration measures.

Figure 5: Impact of one unit increase in $CSTRI$ (Mode 3) on y: Random assignement of w



3.4.3 Additional tariff controls

Import protection for other manufacturing sectors $k \neq j$ should also matter – as shown, among others, by Goldberg et al. (2010). To control for this, we augment model (3.3) with the variable $\widetilde{\text{Tariff}}$, constructed as:

$$\widetilde{\text{Tariff}} = \sum_k \tau_{ik} \times w_{jk} \tag{3.7}$$

where τ_{ik} is the log of effectively applied tariffs by country i in manufacturing sector $k \neq j$ and the weights w_{ijk} are the input penetration coefficients of k in j from the US IO table.

The results are in Table 8. The variable $\widetilde{\text{Tariff}}$ has always the expected negative sign (higher tariffs in upstream manufacturing sectors reduce productivity in downstream manufacturing) and it is statistically significant when the variable Tariff is excluded from the estimations (columns (1)-(2) and (5)-(6)). Most importantly, the coefficients on the interaction term between $CSTRI$ and the institutional capacity variable (control of corruption) are the same as in the corresponding baseline regressions of Table 2.

Table 8: Estimation with tariffs in other manufacturing sectors

	All modes				Mode 3			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$CSTRI$	-0.024	0.063*	-0.024	0.063	-0.038*	0.053	-0.038*	0.052
	(0.024)	(0.038)	(0.024)	(0.038)	(0.021)	(0.032)	(0.021)	(0.032)
$CSTRI \times IC$		-0.041***		-0.041***		-0.039***		-0.039***
		(0.014)		(0.014)		(0.012)		(0.012)
Tariff			0.002	0.013			-0.220	-0.204
			(0.139)	(0.140)			(0.371)	(0.377)
$\widetilde{\text{Tariff}}$	-0.246*	-0.232*	-0.248	-0.252	-0.565*	-0.534*	-0.223	-0.217
	(0.136)	(0.133)	(0.216)	(0.214)	(0.297)	(0.289)	(0.599)	(0.601)
Observations	912	912	912	912	912	912	912	912
R-squared	0.523	0.526	0.523	0.526	0.524	0.528	0.524	0.528

Robust (country-clustered) standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Country fixed effects and sector dummies always included
IC = control of corruption

3.4.4 Variations in country and industry coverage

The baseline and interaction models were re-estimated excluding each of the 57 countries in the estimation sample at a time. Results are extremely robust in terms of magnitude (variations smaller than 20%) and statistical significance of the coefficients. Results remain quite robust when dropping each of the 18 manufacturing sectors at a time: the signs of the key coefficients are unchanged, although in a few cases the coefficient of the interaction term varies more than 20% (never more than 50%). Results of these 300 regressions (57 plus 18 for Mode 3 and All modes, both with the baseline specification and the specification with interaction) are available upon request.

4 Theory

In this section we propose a theoretical framework that provides some insights into the empirical finding that institutional quality is an important moderator variable for the positive effect of services trade openness on productivity in downstream industries. The framework proposes two different channels through which institutions can have an impact. The first channel centers on the trade decision (ex ante). The second channel operates conditional on engaging in exports. A key feature of the framework is to recognize that the proximity burden means that foreign suppliers must perform some part of the service in the destination (importing) country. As a result, the institutional environment in the destination country is a determinant of an exporter's payoff. If institutions are not perfectly observable for firms that are located abroad, the ability to identify countries with higher quality institutions will be one parameter differentiating firms: only the best firms, those providing higher quality services, will have the capacity and the resources to detect the best countries. Countries with high quality institutions will attract foreign firms that provide on average better services than foreign firms in countries with weaker institutions. As a consequence, the downstream industries in countries with high institutional capacity will benefit more from services trade openness. This 'selection effect' is complemented by a second channel which is active given an export decision (ex post). Both the exporters' payoff and the quality of their services performance is sensitive to the institutional environment in which they have decided to operate. Thus, for any level of exporters' productivity, the average quality of foreign services performance in an institutionally weak environment will be less than in countries with robust institutions.

4.1 The setup

The economy consists of two countries indexed by $i \in \{1, 2\}$. The two countries have an identical economic structure while they differ in terms of institutional setting, which we define as the capacity of a country to minimise the exposure of the economic agents active within its territory to harmful unexpected changes in the operating environment. This definition captures the different dimensions of institutional capacity explored in our empirical exercise: from control of corruption, to rule of law, to regulatory quality.[34] Each country is characterised by a single industry - denoted by Y - where production uses intermediate input x. We take a reduced form approach assuming that the average productivity in the downstream industry of country i is a function of the average quality q of the intermediate input x available in the country. Denoting average productivity in

[34]Examples include unexpected corruption episodes, restrictions on key complementary investments or movement of personnel, sudden changes in the authorizing regulatory framework.

Y with y, we have that

$$y_i = f(q_i) \quad \forall i \tag{4.1}$$

with f strictly positive, increasing and concave and $q_i \in [0,1]$ $\forall i$. We assume that each country has a minimum-quality domestic supply of x, such that, if the countries are closed to international transactions in x the productivity of the downstream sector is $y_i = f(0)$ $\forall i$.

The international supply of x consists of a continuum of heterogeneous exporters located outside the two-country system described above and indexed by φ, which corresponds to a productivity parameter varying on the support $[0,1]$ such that exporter $\varphi = 0$ has a minimum productivity while exporter $\varphi = 1$ is the most productive. Exporters have to choose where to export x among the potential destination countries. Once the destination country is chosen, trade takes place. However, because of the proximity burden, this often will involve a stage in which the foreign firm must undertake activities in the territory of the selected destination country. To capture this, we introduce an intangibility parameter $\tau \in [0,1]$ that determines the relative importance of this 'performance stage'. This allows x to range from being fully tangible (all production occurs in the exporting country) to fully intangible (all activities must be performed in the importing nation). If it is fully tangible the product is called a 'good'. In all other cases it is a 'service'. In the latter case, during the stage of services performance in the importing country i, the foreign firm confronts unexpected shocks in the operating environment that follow a homogeneous Poisson process with rate parameter θ_i. For each unexpected event the foreign firm incurs a unitary cost which does not vary across destination countries. The expected payoff of exporting the intermediate service input x with intangibility τ to country i is given by:

$$E[\pi_i(\varphi)] = g(\varphi) - \theta_i \tau \tag{4.2}$$

with g positive, increasing and concave. To restrict the analysis to exporters – i.e. to firms that get non negative payoffs by exporting – we assume that $g(0) > 1$. θ captures the institutional setting in country i with high values of θ being associated with fragile institutions. For simplicity we restrict[35] the support of θ to the interval $(0,1]$. Similarly, we assume that the quality of exporters' output depends positively on their productivity and negatively on the θ parameter of the selected destination country in instances where x possesses some degree of intangibility: unexpected negative events not only affect exporters' payoffs but also the quality of their output x. Formally,

$$E[q_i(\varphi)] = k(\varphi) - \theta_i \tau \tag{4.3}$$

with k positive, increasing and concave. We assume that $k(0) > 1$ to focus on foreign

[35] This restriction makes the number of unexpected shocks a fraction instead of an integer without modifying the economic meaning of the payoff function.

firms that produce higher quality than domestically supplied intermediate inputs. This assumption reflects the usual new trade theory implication that exporting firms have superior properties than non-exporting ones. This framework makes the exporter's payoff as well as the quality of the exported output a function of the institutional quality of the selected destination country in all cases where a product has some degree of intangibility.[36]

Finally, we assume that the institutional capacity of potential destination countries is not perfectly observable and that the productivity φ determines the precision with which an exporter can estimate the true value of θ. For each potential destination country i, exporters observe a signal ϑ_i instead of θ_i. The signals are independently distributed according to the following uniform probability density functions:

$$\vartheta_i \sim U[q_1(\theta_i, \varphi), q_2(\theta_i, \varphi)] \quad \forall i \tag{4.4}$$

where $q_1 = \theta_i \varphi$ and $q_2 = (\theta_i - 1)\varphi + 1$. This specification implies that an exporter with maximum productivity ($\varphi = 1$) observes – for each potential destination country – a signal which is equal to the true institutional capacity with probability 1. In contrast, the signal observed by an exporter with 0 productivity can take any value in the support of the institutional capacity parameter with equal probability. In between those two extrema, the size of the interval upon which the signal is uniformly distributed is a decreasing function of the exporter's productivity type.[37]

4.2 Closed and open regimes: the role of institutions

We can now study - under two different institutional environments - the effect of upstream trade openness on downstream productivity. We assume without loss of generality that country 1 has a higher institutional capacity than country 2, i.e. $\theta_1 < \theta_2$. We denote with δ the difference $\theta_2 - \theta_1$. If the two countries are closed to international transactions in x the productivity of the downstream sector is $y_i = f(0)\ \forall i$. We consider now the case where the two countries open their economies, creating a pool of potential destinations for international exporters. Given φ and τ, each exporter has to decide its destination country based on the realization of the signals ϑ_1 and ϑ_2. If x is fully tangible ($\tau = 0$),

[36] The type of activity associated with intangibility, mode 3 / FDI, also is used to produce tangible items (goods). A similar framework may well apply to FDI more generally but the mechanism modelled here is qualitatively different because firms producing goods have a choice between exporting and FDI. In the services context the proximity burden requires FDI and / or mode 4 cross-border movement, whereas in the case of goods the export versus FDI decision will take into account the institutional environment and result in more exports relative to FDI than what would be optimal absent the institutional factors. In the case of services it is not feasible to produce in the exporting country and thus the process of performing a service is more sensitive to the institutional environment in the importing country.

[37] A more parsimonious specification for an equivalent signalling technology is given by q_1 and q_2 satisfying the following properties: $q_1 : (0,1] \times [0,1] \to [0, \theta_i]$ with $q_1(\theta_i, 0) = 0$, $q_1(\theta_i, 1) = \theta_i$, $\partial q_1 / \partial \theta_i \geq 0$, $\partial q_1 / \partial \varphi \geq 0$ and $q_2 : (0,1] \times [0,1] \to [\theta_i, \bar{\theta}]$ with $q_2(\theta_i, 0) = 1$, $q_2(\theta_i, 1) = \theta_i$, $\partial q_2 / \partial \theta_i \leq 0$, $\partial q_2 / \partial \varphi \leq 0$.

institutional capacities do not affect the payoffs by construction and the exporters choose each country with equal probability. If instead $\tau > 0$, an exporter with productivity φ chooses country 1 if and only if:[38]

$$g(\varphi) - \vartheta_1\tau \geq g(\varphi) - \vartheta_2\tau \iff \vartheta_1 \leq \vartheta_2 \tag{4.5}$$

Denote with $\Pi(i|\varphi,\delta)$ or simply $\Pi(i)$ the probability of choosing country i given productivity φ and institutional difference δ. The properties of the probabilistic structure embedded in the exporters' decision problem are given in the following Lemma.

Lemma 1 *If x possesses some degree of intangibility ($\tau > 0$),*

(i) $\forall\delta > 0$ *and* $\varphi > 0$*,* $\Pi(1) > \Pi(2)$*. If* $\varphi = 0$*, then* $\Pi(1) = \Pi(2)$*;*

(ii) the probability of choosing the best (worst) country is a non-decreasing (non-increasing) function of both the exporters' productivity φ and the difference in institutional capacity δ.

Proof. See Appendix C.

Lemma 1 point (i) states that, if the two countries are not identical, at any non-zero level of productivity the probability of choosing the best country is higher than the probability of choosing the worst country. Moreover, Lemma 1, point (ii) formally restates the selection mechanism of our framework: better exporters gets more precise signals about the institutional capacity of potential destination countries and therefore choose to export to the best country with a higher probability. Furthermore, given our specification, the institutional difference between the two countries positively affects the precision of the signal at any level of productivity. The probabilistic structure described in Lemma 1 determines the expected average quality of the intermediate input available in each country, which corresponds to the weighted average of the output's expected quality across exporters, with weights given by the probability of exporting to country i. Formally,

$$q_i = \int_0^1 E[q_i(\varphi)] \times \Pi(i)\mathrm{d}\varphi \tag{4.6}$$

An immediate corollary of Lemma 1 is given by the following

Corollary 0 *If x possesses some degree of intangibility ($\tau > 0$), then $y_1 > y_2 > f(0)$.*

Proof. See Appendix C.

Openness to trade in the non-fully-tangible intermediate input x increases downstream productivity above its closed economy benchmark everywhere. This effect is higher in the

[38] Having a weak inequality in the choice condition reflects our implicit assumption that, when the exporter receives two identical signals, it is 'lucky' and chooses the best country.

country with a better institutional framework. When comparing the weighted average of the expected quality q_i of output in the two countries, we can identify the two impact channels discussed at the beginning of this section. The difference between the probability of choosing the best country and the probability of choosing the worst, reflects the ex-ante impact channel of institutional capacity. This difference is a function of exporters productivity. The difference between $E[q_1(\varphi)]$ and $E[q_2(\varphi)]$ is constant for any given level of productivity and reflects the ex-post impact channel of institutions.

5 Conclusions

Services trade policy reform is an important ingredient for economic development, because services are essential inputs into modern manufacturing. Due to the specificities of services and services trade, however, reducing the restrictiveness of services trade policy may not be a sufficient condition for the expected positive effect of liberalised service trade on downstream industries.

Using an empirical model that identifies the causal link between services liberalisation and downstream manufacturing productivity, we show that this conjecture is supported by the data. Our estimates imply that the same reduction in services trade restrictiveness would increase manufacturing productivity by 16.7% in a country with high institutional capacity such as Canada, as compared to only 3.9% in a country with low institutional capacity such as Tanzania. Analogous differences hold for countries at equivalent stages of economic development and with similar per capita incomes, like Austria and Italy.

We formalize these empirical results with a theoretical framework that incorporates the specific characteristics of services and services trade – namely, exporting services firms must to a greater or lesser extent engage in economic activity within importing countries. When international services transactions are liberalised, cross-country differences in institutional capacity generates both a selection effect at the level of the decision whether to engage in trade, and a performance effect that operates once trade decisions have been taken. The interaction of the two factors allows manufacturing firms in countries with good institutions to source higher quality services inputs. Our empirical exercise captures both of these effects at the same time. An empirical quantification of the two effects requires firm-level data for a broad cross-section of countries and is left for future research.

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Appendices

A Appendix tables

Table A-1: Variables list

Variable	Description	Data source
$\mathrm{Productivity}_{\mathrm{ij}}$	Log of Labor productivity (output per worker) in manufacturing sector j in country i	UNIDO INDSTAT4, Rev. 3
$\mathrm{STRI}_{\mathrm{is}}$	Trade Restrictiveness Index in service sector s in country i	World Bank's Services Trade Restrictions Database
w_{ijs}	Input penetration of service s into manufacturing sector j of country i	OECD I-O Tables (mid-2000)
IC_{i}	Control of corruption, rule of law, regulatory quality in country i	World Bank's Worldwide Governance Indicators
GDP per $\mathrm{capita}_{\mathrm{i}}$	GDP per capita (current US$) in country i	World Bank's World Development Indicators
Tariff	Log of effectively applied tariff in manufacturing sector j in country i	UNCTAD TRAINS
$\widetilde{\mathrm{Tariff}}$	Log of weighted average of effectively applied tariffs in manufacturing sectors $k \neq j$ in country i (weights = input penetration of k into j)	UNCTAD TRAINS and OECD I-O Table of the US (mid-2000)

Table A-2: List of countries and sectors in the estimations

Country		Sector
Albania	Kyrgyz Rep.	15-16
Austria	Lebanese Rep.	17-19
Belgium	Lithuania	20
Botswana	Malawi	21-22
Brazil	Malaysia	23
Bulgaria	Mauritius	24
Burundi	Mongolia	25
Canada	Morocco	26
Chile	Netherlands	27
China	New Zealand	28
Colombia	Oman	29
Czech Republic	Peru	30
Denmark	Poland	31
Ecuador	Portugal	32
Ethiopia	Qatar	33
Finland	Romania	34
France	Saudi Arabia	35
Georgia	South Africa	36-37
Germany	Spain	
Greece	Sri Lanka	
Hungary	Sweden	
India	Tanzania	
Indonesia	Turkey	
Ireland	Ukraine	
Italy	United Kingdom	
Japan	Uruguay	
Jordan	Viet Nam	
Korea, Rep.	Yemen	
Kuwait		

Sectors are ISIC Rev. 3 manufacturing industries

B Input Penetration Measures

Shares of intermediate consumption

Shares of intermediate consumption are derived from the first quadrant of the Input-Output (IO) matrix, i.e. the intermediate demand matrix M. M is a square matrix of dimension n where rows – indexed by r – are the supplying industries (domestic and international) and the columns – c – the using (domestic) industries. The number of industries in the IO table is equal to n. A generic element m_{rc} of the matrix M is the cost borne by sector c for the output produced by sector j (domestic production plus imported foreign production) and used as intermediate input into c. For each services-manufacturing sector pair (s, j), s' share of j's total intermediate consumption is equal to:

$$w_{js} \equiv \frac{m_{sj}}{\sum_{r=1}^{n} m_{rj}} \tag{B-1}$$

IO technical coefficients

IO technical coefficients are the elements of the square matrix A, defined as:

$$A \equiv YM \tag{B-2}$$

where Y is a dimension n square matrix of zeros, except along the main diagonal, that includes the inverse output of each industry. For each services-manufacturing sector pair (s, j), the IO technical coefficient is the element a_{sj} of matrix A and it gives the cost of the intermediate inputs from services sector s for one dollar of total production of manufacturing sector j.

Leontief coefficients

The third input penetration measure used in the paper consists of the coefficients derived from the Leontief inverse matrix. The input penetration of services sector s into manufacturing sector j that takes into account the indirect linkages between the supplying and the using sectors is given by the element l_{sj} of matrix L, defined as:

$$L \equiv VB \tag{B-3}$$

where V is a dimension n square matrix of zeros, except along the main diagonal, that includes the value added-output ratios of each industry. B is the Leontief inverse $(I - A)^{-1}$, with A defined in equation (B-2) above.

C Proofs

Proof of Lemma 1. We assume WLOG that $\theta_1 < \theta_2$. The probability of choosing the best country $\Pi(1)$ is given by:

$$\Pi(1) = Pr(\vartheta_1 \leq \vartheta_2) = Pr(\vartheta_1 - \vartheta_2 \leq 0) = F_Z(0) \tag{C-1}$$

where Z is the random variable function of the two signals, $Z \equiv \vartheta_1 - \vartheta_2$, and F_Z is its cumulative distribution function. In order to derive the analytical expression for $F_Z(0)$ we need to integrate the joint distribution of the two independent random variables ϑ_1 and ϑ_2 over the area in the joint support on the $(\vartheta_1,\ \vartheta_2)$-plane where $\vartheta_2 \geq \vartheta_1$. The joint pdf $p(\cdot,\cdot)$ of two independent random variables is the product of their distributions, therefore:

$$p(\vartheta_1, \vartheta_2) = \frac{1}{q_2(\theta_1,\varphi) - q_1(\theta_1,\varphi)} \times \frac{1}{q_2(\theta_2,\varphi) - q_1(\theta_2,\varphi)} \tag{C-2}$$

and, given our specification of the functions $q_1(\theta_i,\varphi)$ and $q_2(\theta_i,\varphi)$:

$$p(\vartheta_1, \vartheta_2) = \frac{1}{(1-\varphi)^2} \tag{C-3}$$

Notice that the condition $\theta_1 < \theta_2$ plus our specification of $q_1(\theta_i,\varphi)$ and $q_2(\theta_i,\varphi)$ imply the following two inequalities:

$$q_1(\theta_1,\varphi) = \theta_1\varphi < \theta_2\varphi = q_1(\theta_2,\varphi) \quad \forall \varphi > 0 \tag{C-4}$$

$$q_2(\theta_1,\varphi) = (\theta_1 - 1)\varphi + 1 < (\theta_2 - 1)\varphi + 1 = q_2(\theta_2,\varphi) \quad \forall \varphi > 0 \tag{C-5}$$

that become identities for $\varphi = 0$. (C-4) and (C-5) imply that the two points $(q_1(\theta_1,\varphi), q_1(\theta_2,\varphi))$ and $(q_2(\theta_1,\varphi), q_2(\theta_2,\varphi))$ lie always above the 45 degree line in the $(\vartheta_1,\ \vartheta_2)$-plane. In order to identify the area in the joint support of ϑ_2 and ϑ_1 where $\vartheta_2 \geq \vartheta_1$ we just have to distinguish the following two cases:

1. if $q_2(\theta_1,\varphi) > q_1(\theta_2,\varphi)$ which, given our specifications is equivalent to the condition $\varphi < 1/(1+\delta)$, the area where the joint pdf has to be integrated is given in Figure C-1;

2. if instead $q_2(\theta_1,\varphi) \leq q_1(\theta_2,\varphi)$, which means $\varphi \geq 1/(1+\delta)$, we have that the area where the joint pdf has to be integrated is given in Figure C-2.

We have now all the ingredients to write the following expression for $F_Z(0)$:

$$F_Z(0) = \begin{cases} \int_{q_1(\theta_1,\varphi)}^{q_1(\theta_2,\varphi)} \int_{q_1(\theta_2,\varphi)}^{q_2(\theta_2,\varphi)} p(\vartheta_1,\vartheta_2)\mathrm{d}\vartheta_2\mathrm{d}\vartheta_1 + \int_{q_1(\theta_2,\varphi)}^{q_2(\theta_1,\varphi)} \int_{\vartheta_1}^{q_2(\theta_2,\varphi)} p(\vartheta_1,\vartheta_2)\mathrm{d}\vartheta_2\mathrm{d}\vartheta_1 & \text{if } 0 \leq \varphi < \frac{1}{1+\delta} \\ \int_{q_1(\theta_1,\varphi)}^{q_2(\theta_2,\varphi)} \int_{q_1(\theta_2,\varphi)}^{q_2(\theta_2,\varphi)} p(\vartheta_1,\vartheta_2)\mathrm{d}\vartheta_2\mathrm{d}\vartheta_1 & \text{if } \frac{1}{1+\delta} \leq \varphi \leq 1 \end{cases} \tag{C-6}$$

Plugging the expressions for the joint distribution $p(\vartheta_1,\vartheta_2)$, for $q_1(\theta_2,\varphi)$, for $q_2(\theta_2,\varphi)$ and rearranging we get:

$$\Pi(1) = F_Z(0) = \begin{cases} \frac{1}{2} + \frac{\delta\varphi}{1-\varphi}\left[1 - \frac{1}{2}\frac{\delta\varphi}{1-\varphi}\right] & \text{if } 0 \leq \varphi < \frac{1}{1+\delta} \\ 1 & \text{if } \frac{1}{1+\delta} \leq \varphi \leq 1 \end{cases} \tag{C-7}$$

The probability of choosing country 2 is then:

$$\Pi(2) = 1 - F_Z(0) = \begin{cases} \frac{1}{2}\left[\frac{\varphi(1+\delta)-1}{(1-\varphi)^2}\right]^2 & \text{if } 0 \leq \varphi < \frac{1}{1+\delta} \\ 0 & \text{if } \frac{1}{1+\delta} \leq \varphi \leq 1 \end{cases} \tag{C-8}$$

Point (i) and (ii) easily follow from the study of $\Pi(1)$ and $\Pi(2)$. ■

Proof of Corollary 0. if $\tau > 0$, by construction we have that $E[q_1(\varphi)] > E[q_2(\varphi)] > 0$ $\forall\varphi > 0$ and $E[q_1(\varphi)] = E[q_2(\varphi)] > 0$ for $\varphi = 0$. Moreover, from point (ii) of Lemma 1 we know that $\Pi(1) > \Pi(2)$ $\forall\varphi > 0$ and $\Pi(1) = \Pi(2)$ for $\varphi = 0$. Finally, again from Lemma 1 we know that there are many values of φ and δ for which both $\Pi(1)$ and $\Pi(2)$ are strictly positive. It follows that:

$$q_1 = \int_0^1 E[q_1(\varphi)] \times \Pi(1)\mathrm{d}\varphi > \int_0^1 E[q_2(\varphi)] \times \Pi(2)\mathrm{d}\varphi = q_2 > 0 \tag{C-9}$$

The result follows by construction given that $y_i = f(q_i)$ with f strictly positive and increasing. ■

Figure C-1: area in the joint support where $\vartheta_2 \geq \vartheta_1$ (case 1)

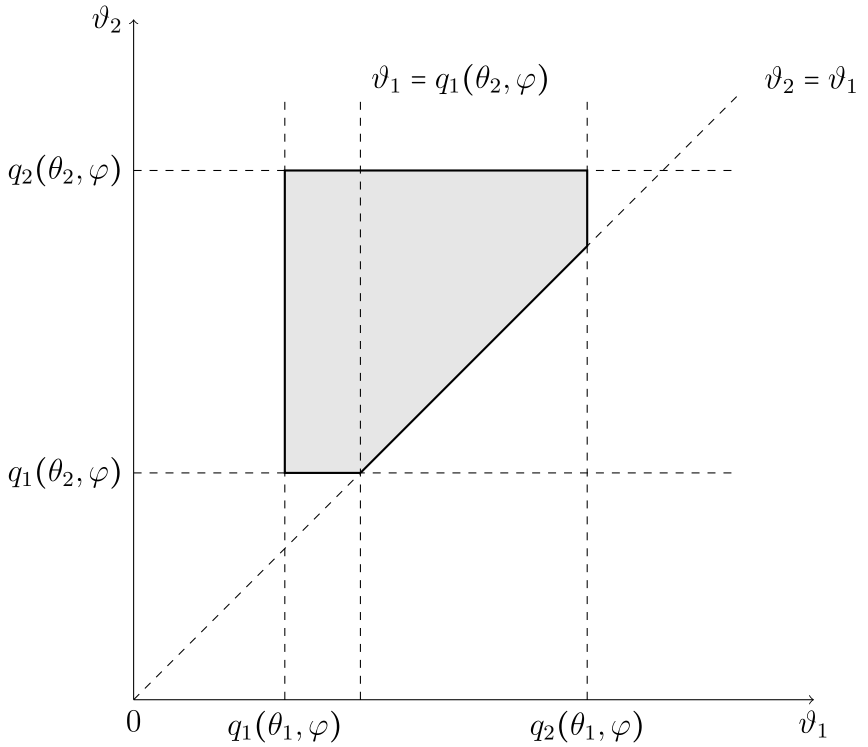

Figure C-2: area in the joint support where $\vartheta_2 \geq \vartheta_1$ (case 2)