The World Economy (Forthcoming)

Services Productivity, Trade Policy, and Manufacturing Exports

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February 2, 2015.

Abstract: This paper analyzes the linkage between services and manufacturing productivity performance, using firm-level data for over 100 developing countries. We find strong evidence for such a linkage, although the effect is small: at the average rate of services input intensity, a 10% improvement in services productivity is associated with an increase in manufacturing productivity of 0.3%. Services trade restrictiveness indices (STRI) are found to be a statistically significant determinant of manufactured exports performance, a finding that is robust to the inclusion of the overall level of trade restrictiveness that is applied against manufactured exports directly. The main channel through which services trade restrictions negatively affect manufactured exports is through FDI, a finding that is consistent with the stylized fact in the literature that FDI is a key channel for trade in services and an important vehicle through which services technology and know-how is transferred across countries. At the sectoral level, restrictions on transport and retail distribution services have the largest negative impact on exports of manufactures.

JEL Codes: F14, D24, L80.

Keywords: trade, productivity, services, manufacturing, competitiveness.

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1 INTRODUCTION

Many services are inputs into the production of other services and goods. As a result, their cost and quality impacts on the growth performance of the economy (Francois and Hoekman, 2010). An efficient, competitive financial sector is critical in ensuring that capital is deployed where it has the highest returns. Lower cost and higher quality telecommunications will generate economy-wide benefits, as this service is both an intermediate input and a "transport" mechanism for information services and other products that can be digitized. Similarly, transport services contribute to the efficient distribution of goods within and between countries and are the means through which services providers move to the location of clients (and vice versa). Business services such as accounting and legal services reduce transaction costs associated with the operation of financial markets and the enforcement of contracts. Retail and wholesale distribution services are a vital link between producers and consumers, with the margins that apply in the provision of such services influencing the competitiveness of firms on both the local and international market.

An important economic characteristic of many services is their "intermediation" role: a variety of producer services support the process of ever-finer specialization associated with economic development (Francois, 1990). Producer services are both ever more differentiated intermediate inputs into production, but perform an important function in coordinating production processes, both within, and increasingly, across countries. Thus they play a critical role in the operation (feasibility) of global value chains. Productivity gains in producer services activities should therefore affect both the productivity of firms that use services and their export performance.

Starting in the 1980s, governments around the globe have greatly reduced tariffs and discriminatory barriers against imports of goods and services. However, international flows of goods and services continue to be impacted by high trade costs (e.g., Anderson and van Wincoop, 2003). Research has shown that such costs are a factor reducing investment and growth (WEF, 2013). An important dimension of these costs revolves around the availability, quality and cost of services inputs needed by firms. Thus, transport and logistics account for a share of the trade costs that confront firms, while the costs of many other services impact directly on firm profitability. The trade and transactions costs that firms must incur are in large part a reflection of the domestic business environment and policies of a regulatory nature that act to segment markets, although more traditional discriminatory barriers to market access also play a role, especially for specific sectors. Recent research has shown that barriers to trade in services are often significant (Borchert, Gootiiz and Mattoo, 2014; OECD, 2014).

To a significant extent the trade cost reduction agenda revolves around improving the performance of services sectors: reducing the costs of service inputs for firms and increasing the variety and quality of producer and backbone services such as transport (Hoekman and Mattoo, 2012). Recent research has shown that sector-level measures of services trade and FDI policies are negatively associated with manufacturing productivity and exports, and that liberalization episodes in a number of countries had positive impacts on downstream industries performance.[1] Such findings are intuitive, given that on average services inputs account for over 40 percent of the gross value of manufactured exports for countries for which such data are available in the Organisation for Economic Cooperation and Development (OECD) and the World Trade Organization (WTO) database on trade in value added (TiVA).[2]

[1] Francois and Hoekman (2010) survey much of the extant literature in this area.

[2] At http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_OECD_WTO.

In this paper we use data from the World Bank Enterprise Surveys to analyze how services productivity impacts on productivity of manufacturing firms and the relationship between the latter and firm-level level export performance, i.e., we focus on the indirect impact of services productivity on manufacturing export performance. The World Bank Enterprise Survey data span over 58,000 firms across 119 countries for the period 2006-2011. These data are used to calculate average measures of firm-level services productivity at the level of sub-national regions. We then to relate these data to productivity of manufacturing firms, controlling for firm characteristics such as the intensity of services input use and other firm-level variables that may affect performance. In a second stage, we then relate manufacturing firm productivity to firm-level exports, taking into account the first stage determination of that variable. Finally, we analyze the effects of services trade policies on manufactures exports at the product-country level, controlling for standard determinants of trade performance used in the gravity literature, including merchandise trade barriers.

We find a strong linkage between services and manufacturing performance. Consistent with what has been found in country-specific studies, the linkage between services productivity and manufacturing productivity is stronger for firms that use services inputs more intensively. At the average rate of services input intensity, a 10% improvement in services productivity is associated with an increase in manufacturing productivity of 0.3% and a resulting increase in exports of 0.2%. We also find that services trade restrictiveness index (STRI) measures of prevailing services trade policies are a statistically significant determinant of manufactured exports, and that this result is robust to the inclusion of a measure of the level of trade restrictiveness that is applied against manufactured exports directly. A disaggregation of the overall STRI across the modes of supply affected – cross-border trade and FDI – indicates that the main channel through which services trade policy negatively affects manufactured exports is through FDI – not surprising given that FDI is a key channel for trade in services and the research showing that it is an important vehicle through which services technology and know-how is transferred across countries (Francois and Hoekman, 2010). At the sectoral level, restrictions on transport and retail distribution services have the largest negative impact on goods export performance.

The plan of the paper is as follows. We start in Section 2 with a brief review of the literature. Section 3 presents the results of the empirical analysis using firm-level data. Section 4 analyzes the effects of services trade policies on manufactured export performance using a gravity model approach. Section 5 concludes.

2 SOME STYLIZED FACTS AND RELATED LITERATURE

Services have grown from roughly 55% of global GDP in the mid-1970s to some 70% today. The share of services output that is traded is often in the range of 20 percent or less, compared with openness (trade/output) ratios on the order of 60 percent or more for many countries. The reason is that notwithstanding advances in information and communication technologies, many services remain non-tradable. Trade in services often occurs indirectly, embodied in people, tangible products or capital – FDI (Grubel, 1987). Indeed, much of the value of goods reflects the value of the services that go into producing them. The increasing share of services in GDP as countries become richer is accompanied by a growing share of the value of all products constituted by services inputs: business, intermediation and knowledge services (R&D, design, engineering, etc.), transport and logistics, financial services, and so forth (Francois and Woertz (2008).

Although modern information technologies allow ever more cross-border, 'disembodied' trade in services to occur, the share of services in global trade has been remarkably constant since the 1980s, varying between 20% and 25%. In large part this is because of the growth in supply chain trade.

While services trade has increased rapidly, so has trade in merchandise. The growth in trade in manufactures has been driven by a great increase in trade in intermediate inputs, components and services of many types, reflecting the ability and incentives for firms to splinter their 'production lines' geographically, operating supply chains that allocate different parts of the production process to firms in different countries, with value being added in multiple countries that are part of the system (Baldwin and Lopez-Gonzalez,, 2014).

One result of the increase in supply chain trade is that imports make up an increasing share of the total value embodied in a given product – ranging from 25% to 40 % or more for small open economies that are integrated into supply chains. An implication is that the costs of imposing trade barriers or pursuing industrial policies that make it difficult and more costly to import inputs may prevent firms from being able to participate. The same is true if needed services are not available in a location or are inefficient/costly.

Data compiled by the OECD and WTO to account for the value added by services in the production and trade of goods show that the services sectors are responsible for more than half of total exports in the United States, the United Kingdom, France, Germany and Italy. In 2009, 43% of the gross value of total goods exports was accounted for by services value added (33% domestic value added, 10% foreign). Services are therefore a key determinant of competitiveness. The ability of firms to compete and grow depends on their access to telecommunications, transportation, financial services and other business services such as accounting and legal services. High-cost or low-quality services act as a tax on exporters. Services are thus a vital input into manufactured goods trade. Global value chains cannot function without services.[3] As a result, services productivity is vital to manufacturing productivity and exports. Policy measures that reduce services productivity, such as trade restrictions, can potentially impact negatively on goods manufacturing and exports.

The literature on trade in services has been expanding very rapidly in recent years, reflecting both the emergence of new data such as the OECD-WTO TiVA database and firm-level data that includes service-producing companies, including enterprises that are classified as manufacturers. Such firms have always sold services that were embodied in their products or that were complements – e.g., service and maintenance. The data reveal that many firms in manufacturing engage in so-called servitization (also denoted as servification or servicification): a shift into or increasing the production and sale of services. A shift into services is an element of a strategy to increase productivity and move "up the value chain" in response to competition from imports and decisions to offshore tasks that can be done more cheaply elsewhere.[4]

The analysis that follows builds on papers analyzing the effects of services policies and policy reform on downstream productivity. These papers include Arnold et al. (2011, 2014), who use firm-level data for the Czech Republic and India, respectively, to show that sector-level measures of services liberalization are positively associated with manufacturing productivity. Both papers focus on services liberalization, but an intermediate step in this mechanism must be that liberalization boosts

[3] On the importance of services for the operation of international supply network, see, e.g., Kelle (2013), Debaere, Görg and Raff (2013), Hoekman (2014a) and Saslavsky and Shepherd (2014)

[4] This has been the focus of much recent analysis. See, e.g., Baines et al. (2009), Breinlich and Criscoulo (2011), Breinlich, Soderbery, and Wright (2014), Crozet and Milet (2014), Lodefalk (2013, 2014).

service sector productivity, which in turn boosts manufacturing productivity because services are important inputs into many manufacturing processes.[5] This is the focus of the present paper.

3 FIRM-LEVEL ANALYSIS

Given that services are an important input into the manufacture and export of goods, services and manufacturing productivity are interlinked, and as a result, measures that restrict trade in services—and thus reduce services productivity—have negative effects for manufactured goods exports. In what follows we therefore test two hypotheses: first, that services sector productivity is positively associated with manufacturing productivity due to the fact that manufacturing firms use services as inputs; and second, that through that mechanism, services productivity influences the export of goods, which is known to depend on firm-level manufacturing productivity.

This section proceeds in two parts. The first subsection examines the contention that services and manufacturing productivity are interlinked using firm level data; the second then explores the impact on manufacturing exports.

3.1 Productivity linkage

This subsection uses firm-level data for a wide cross-section of developing countries to examine the contention that higher levels of productivity in services are reflected in higher levels of productivity in manufacturing, which in turn translate into stronger exports. The data source is the World Bank Enterprise Surveys (Annex Table 1). That project covers over 130,000 firms in 135 countries. We use the current standardized version of the dataset, which includes data from firms in 119 countries over the period 2006-2011. No high income countries are included, so the dataset is limited to developing countries only. After cleaning to remove unreliable observations, it covers a total of 58,875 firms in manufacturing and services. Firm activities are identified at the ISIC 2 digit level, with 23 manufacturing sectors and 26 services sectors.

Each survey covers a cross-section of firms for a single year of data in a given country, with firms selected by stratified random sampling. Some countries are surveyed over multiple years, but it is not possible in the standardized dataset to determine whether or not individual firms are included multiple times due to the way in which the World Bank assigns anonymous identifiers to firms in each survey. It is therefore not possible to observe entry or exit, or to estimate TFP using techniques that require the availability of true panel data at the firm level. Productivity is therefore measured as labor productivity (sales per employee).

The first model we estimate has labor productivity (sales per worker) in manufacturing, measured at the firm level, as the dependent variable as. To construct the main independent variable, we calculate firm-level labor productivity in services sectors, and then take the average by sub-national region. The relationship we are interested in is between a given manufacturing firm's productivity and the average productivity of services firms in the same sub-national region. This approach implies a focus on local linkages, and allows the inclusion of country-sector-year fixed effects in the regressions to control for outside influences.

The second independent variable of interest is a measure of the intensity with which manufacturing firms use services inputs. Services intensity is defined as the percentage of total costs accounted for

[5] Other country-specific papers that come to similar conclusions as Arnold et al. include Fernandes and Paunov (2012) and Duggan, Raharda and Varela (2103), who focus on Chile and Indonesia, respectively.

by electricity, communications, transport, and water services.[6] We expect to observe a positive interaction effect, which would indicate that the link between services productivity and manufacturing productivity is stronger for firms that use services inputs more intensively. A positive and statistically significant interaction term would provide a strong indication that the effect identified is indeed a productivity linkage due to the input relationship, and not an artifact of some omitted factor.

We use OLS to estimate an econometric model of the following form:

$$(1)\ \log\left(Labor\ Productivity_{fcsrt}\right) = b_1 \log(Services\ Productivity_{csrt}) + b_2 \log(Services\ Productivity_{csrt}) * Services\ \%\ Inputs_{fcsrt} + b_3 Services\ \%\ Inputs_{fcsrt} + \sum_i b_i X^i_{fcsrt} + \sum_j d_{cst} + e_{fcsrt}$$

where *f* indexes firms, c indexes countries, *r* indexes sub-national regions, and *t* indexes time. Labor productivity in manufacturing and services is measured as described above. The *X* variables refer to firm-level controls. The first group includes size (number of employees), capital intensity, and dummy variables for different types of firm organization. The second group consists of a dummy for foreign-owned firms. The third group includes data on capacity utilization and the top manager's number of years of experience in the sector as proxies for management competence. Finally, the *d* terms refer to a full set of country-sector-year fixed effects.

Estimation results for this first model are in Table 1. Column 1 is a simple bivariate regression, which shows that the association between services productivity and manufacturing productivity is positive and statistically significant at the 1% level. The second column introduces the interaction term with services intensity in input use. The coefficient on services productivity remains positive and 1% statistically significant, as expected. The interaction term also has a positive coefficient, and it is statistically significant at the 1% level. The sign and significance of the interaction term confirm that the association that the regression is picking up between services productivity and manufacturing productivity results from the use of services inputs in manufacturing, in line with the mechanism put forward at the outset of the paper.

[6] The classification of water and electricity as services can be problematic. However, our results do not hinge on their inclusion. Regression results are identical in terms of sign and statistical significance if water and electricity are excluded from the services intensity calculation.

Table 1. Impact of services productivity on manufacturing productivity

	(1)	(2)	(3)	(4)	(5)	(6)
Log(Services Productivity)	0.067***	0.044***	0.032**	0.028**	0.026*	0.026*
	(0.000)	(0.001)	(0.017)	(0.034)	(0.057)	(0.063)
Log(Services Productivity) * Services % Inputs		0.107***	0.051	0.068*	0.077*	0.084**
		(0.005)	(0.131)	(0.083)	(0.051)	(0.030)
Services % Inputs		-2.870***	-2.369***	-2.688***	-2.841***	-2.921***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Employees)			0.131***	0.113***	0.106***	0.078***
			(0.000)	(0.000)	(0.000)	(0.000)
Log(Capital Intensity)			0.242***	0.236***	0.236***	0.232***
			(0.000)	(0.000)	(0.000)	(0.000)
Foreign				0.419***	0.425***	0.416***
				(0.000)	(0.000)	(0.000)
Log(Capacity Utilization)					0.193***	0.196***
					(0.000)	(0.000)
Log(Manager's Experience)					0.022*	0.021*
					(0.070)	(0.077)
Privately Held Company						0.008
						(0.911)
Sole Proprietorship						-0.010
						(0.858)
Partnership						-0.320***
						(0.000)
Limited Partnership						-0.192***
						(0.005)
Other						-0.088
						(0.190)
Observations	35939	31899	23838	23479	22518	22498
R2	0.556	0.246	0.645	0.640	0.640	0.628
First Stage F-Test	23.26***	51.93***	115.08***	71.26***	76.85***	80.56***

*Note: The dependent variable is labor productivity in all cases, and the estimation sample is limited to manufacturing firms. Estimation is by OLS with robust standard errors clustered by country-sector-year. All models contain fixed effects by country-sector-year. P-values are in parentheses below the parameter estimates. Statistical significance is indicated by * (10%), ** (5%), and *** (1%).*

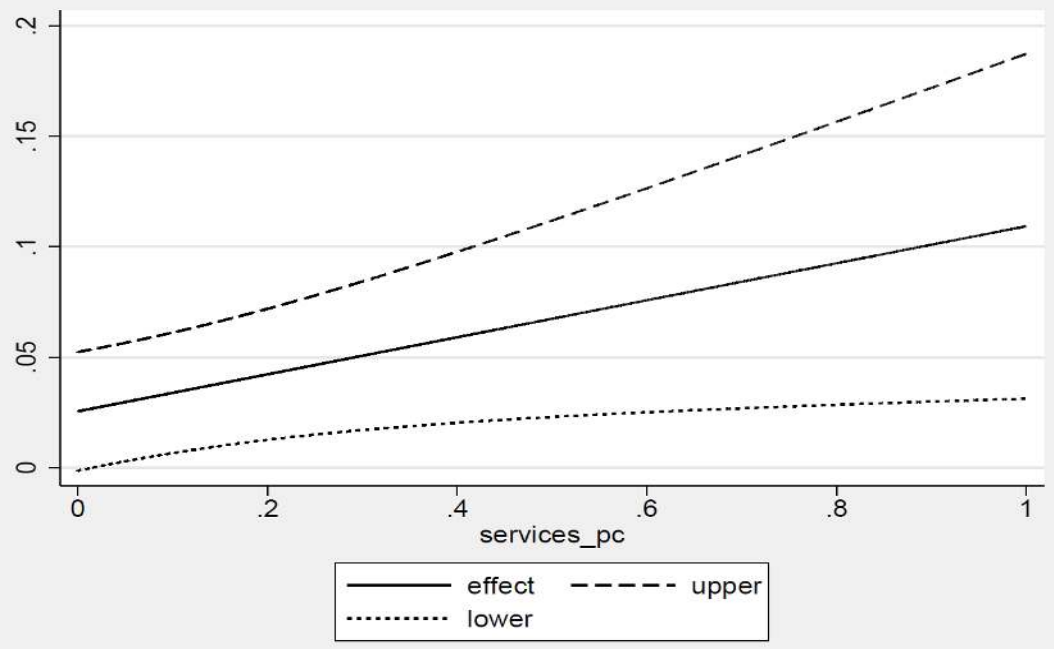
The remaining columns of Table 1 progressively introduce firm-level control variables. Column 3 includes size (number of employees) and capital intensity, both of which have positively signed and 1% statistically significant coefficients, as expected. Column 4 includes a dummy for foreign ownership, which, as expected, indicates that firms with FDI tend to be more productive than other firms (1% statistically significant). Column 5 adds two additional variables to account for management competence, namely the capacity utilization rate, and the number of years' experience of the top manager. Both have the expected positively signed coefficients, which are statistically significant at the 1% and 10% levels respectively. Finally, column 6 adds dummies for different types of firm organization, on the assumption that legal form can affect productivity. Results are mixed

for these variables, but the general tendency is that partnerships tend to be less productive than other firms.

With the sequential addition of all of these variables, the two variables of primary interest—local services productivity and its interaction with firm level services intensity in input use—retain their expected positive signs and statistically significant coefficients. In the final specification (column 6), the former is 10% statistically significant, and the interaction term is 5% statistically significant. The coefficient on services intensity in input use is negative and 1% statistically significant in all specifications. The net result of this set of regressions is that we can safely conclude that the productivity of local services suppliers has a positive impact on the productivity of manufacturing firms.

Taking the results in Table 1 column 6 as a benchmark, data on input intensity can give an indication of the quantitative impact of services productivity on manufacturing productivity. The average proportion of total costs accounted for by services as defined in the dataset is 12%. Plugging that figure into the coefficients from the regression suggests that a 10% improvement in services productivity is associated with an increase in manufacturing productivity of 0.3%. Although relatively small, this effect is nonetheless economically and statistically significant. Figure 1 shows the direction and strength of the interaction effect for Table 1 column 6 over the full distribution of services input intensity. The effect of local services productivity on manufacturing productivity is positive from the 20th percentile (1.5% of total costs) onwards.

Figure 1: Manufacturing productivity impact and intensity of services use



3.2 Trade effects

To estimate the effects of services performance on manufactured exports we use a different approach. The dependent variable is firm-level exports, and the independent variables are the same as in the first stage, except that services productivity is replaced with each firm's own level of productivity (sales per worker), and the interaction term is dropped. Thus, the econometric approach instruments manufacturing productivity by services productivity and the interaction

between that variable and the intensity with which each firm uses services inputs, as well as use of services inputs in levels. We use two-step GMM to estimate that model, because it is more efficient than the more familiar two stage least squares approach.

Concretely, the second econometric model takes the following form:

$$(2)\ \log\left(Exports_{fcsrt}\right) = b_1 \log(Productivity_{fcsrt}) + \sum_i b_i X^i_{fcsrt} + \sum_j d_{cst} + e_{fcsrt}$$

where variable definitions and subscripts are the same as above, and productivity is each manufacturing firm's own level of sales per worker appropriately instrumented.

Although GMM estimation does not in fact involve a first stage of estimation, like two stage least squares, it is still important to show that the proposed instruments are in fact strongly correlated with the instrumented variables. F-tests of the hypothesis that the services variables have coefficients that are all equal to zero are all rejected at the 1% level in every model reported in Table 2. We therefore conclude that the instruments are sufficiently strongly correlated with the instrumented variable to justify their use in testing the second hypothesis using GMM. Of course, it is also necessary for the instruments to be genuinely exogenous to the model. We test this additional assumption below.

Results are in Table 2. All control variables have the expected signs, and the most important ones are highly statistically significant. The main variable of interest is firm-level labor productivity, instrumented by the local services variables: it has a positive and 1% statistically significant coefficient, in line with expectations. This result together with the results reported in subsection 3.1 strongly supports the contention that the productivity of local services firms positively affects the productivity of firms in manufacturing, which consequently results in higher exports of manufactured goods. Quantitatively, a 10% increase in the productivity of local service providers increases manufacturing exports by about 0.2%. Again, the number is not particularly large, but it is statistically and economically significant.

Of course, these estimation results are only valid if the instruments chosen are valid. We have already shown that they are strongly correlated with the instrumented variable, which is one requirement. The second requirement is that they be genuinely exogenous to the model, which implies that they only influence exports through the manufacturing productivity link (input use). Intuitively, this proposition seems plausible. The productivity of local services firms should not directly affect the manufacturing exports of firms that do not use services as inputs. However, intuition is not conclusive. We therefore report the results of Hansen's J test. The test statistic is not statistically significant, which indicates that the instruments are indeed valid choices. Combining this result with the first stage F-tests suggests that the two models provide strong support for the hypotheses that services productivity is a determinant of manufacturing productivity.

Table 2: Manufactured exports (firm-level data with instrumented manufacturing productivity)

	(1)
Log(Labor Productivity)	0.739***
	(0.002)
Log(Employees)	2.455***
	(0.000)
Log(Capital Intensity)	0.163**
	(0.024)
Foreign	2.778***
	(0.000)
Log(Capacity Utilization)	0.011
	(0.930)
Log(Manager's Experience)	0.112
	(0.123)
Privately Held Company	-0.241
	(0.602)
Sole Proprietorship	-0.071
	(0.856)
Partnership	-0.806**
	(0.045)
Limited Partnership	-0.577
	(0.203)
Other	-0.723
	(0.118)
Observations	21901
R2	0.269
Hansen's J	1.878

*Note: The dependent variable is log(exports) in all cases, and the estimation sample is limited to manufacturing firms. Estimation is by two step GMM with robust standard errors clustered by country-sector-year. Log(Labor Productivity) is instrumented by Log(Services Productivity), Services % Inputs, and their interaction. All models contain fixed effects by country-sector-year. P-values are in parentheses below the parameter estimates. Statistical significance is indicated by * (10%), ** (5%), and *** (1%).*

4 GRAVITY MODEL

The previous section extended previous empirical research that has focused on specific countries to demonstrate a clear link between productivity in services and manufacturing, depending in part on the intensity with which services are used in production of manufactured goods. There is already evidence showing that restrictions on trade in services, or other measures that increase services trade costs, tend to decrease service sector productivity (Arnold et al., 2011, 2014; Miroudot, Sauvage and Shepherd, 2012; Miroudot and Shepherd, forthcoming). This section goes one step further by examining a subsequent link in the causal chain: export performance using a gravity model to analyze the effects of restrictive services trade policies on manufactured goods exports at the country level.

Trade theory and empirics strongly support the proposition that firm-level productivity is a key determinant of export market entry and performance (e.g., Melitz, 2003). As a result, we expect policy measures that tend to reduce manufacturing productivity to be negatively associated with export performance. A relevant example of this proposition in practice is examined by Goldberg at al. (2010). They use the case of India's trade liberalization to show that trade reforms affecting input markets can have such effects. They find that when India liberalized its tariff regime, manufacturing firms were able to access a greater range of intermediate goods at lower overall prices, which in turn made them more productive. Although subsequent export performance is not directly investigated in that paper, it seems clear that Indian manufacturers' exports should have correspondingly increased.

Based on that reasoning, we examine the case of services inputs. As discussed in Section 2, services are an important source of intermediates in goods exports. As a result, measures that restrict services trade—by analogy with India's trade restrictions in input markets prior to liberalization—are expected to be negatively associated with goods exports. To examine this contention, we use a gravity model of bilateral trade, augmented to include data on the restrictiveness of services trade policies.

Data and sources are set out in Annex Table 2, and are largely standard. The only one that requires elaboration is our measure of services trade restrictiveness: the World Bank's Services Trade Restrictiveness Index (Borchert et al., 2012; and Borchert et al., 2014). The STRI compiles data on services trade policies for 103 developed and developing countries, and five sectors. As appropriate based on sectoral realities, it covers pure cross-border trade in services (GATS Mode 1), sales of foreign affiliates (GATS Mode 3), and temporary movement of service providers (GATS Mode 4). The data upon which the various STRIs are based come from surveys administered in developing countries, and data collected from OECD countries. The World Bank STRI has the broadest country coverage of any indicator of applied services trade policy, and has been validated in empirical work such as van der Marel and Shepherd (2013), where the authors show that it is generally negatively associated with bilateral services trade, although sectoral specificities are also evident.

The gravity model used for this part of the empirical analysis is based on the standard Anderson and Van Wincoop (2003) framework. However, the STRI is an importer-specific variable, so it cannot be separately estimated using the standard approach of including exporter and importer fixed effects to control for multilateral resistance. Baier and Bergstrand (2009) provide a solution to the problem by deriving a Taylor series approximation of multilateral resistance.

Based on the Baier and Bergstrand (2009) approach, the model estimated here is:

(3)
$$\ln Trade_{ij} = b_0 + b_1 \ln STRI_i^* + b_2 OTRI_i^* + b_3 RTA_{ij}^* + b_4 \ln Distance_{ij}^* + b_5 Contiguous + b_6 colony_{ij}^* + b_7 common\ colonizer_{ij}^* + b_8 common\ language_{ij}^* + b_9 \ln GDP_i + b_{10} \ln GDP\_j + e_{ij}$$

where: *i* indexes exporters, and *j* indexes importers; *STRI* is the World Bank services trade restrictiveness index in the importer; *OTRI* is the World Bank Overall Trade Restrictiveness Index (Kee et al. 2009), as a proxy for tariff and non-tariff measures affecting manufactured goods trade directly; *RTA* is a dummy equal to one if the exporter and the importer are in the same RTA; *Distance* is the geodesic distance between the exporter and the importer; *Contiguous* is a dummy equal to one if the countries in a dyad share a common land border; *colony* is a dummy equal to one if one

of the countries in the pair was once a colony of the other; *common colonizer* is a dummy equal to one if the countries in the pair were once colonized by the same power; *common language* is a dummy equal to one if the countries in the pair share a common language (ethnographic basis); *GDP* is gross domestic product in the importer and the exporter, respectively; and *e* is an error term.

Variables with a star are transformed using the Baier and Bergstrand (2009) transformation to account for multilateral resistance. The transformation is as follows:

$$(4)\ v_{ij}^{*} = v_{ij} - \sum_{j=1}^{N} \frac{GDP_j}{GDP_w} v_{ij} - \sum_{i=1}^{N} \frac{GDP_i}{GDP_w} v_{ji}$$

where the *w* subscript indicates total world GDP. Note that the third multilateral resistance term derived by Baier and Bergstrand (2009) is constant across all country pairs, and therefore can be included in the regression constant.

In addition to the model setup, recent research has shown that the choice of econometric method is important in ensuring that results are reliable and consistent. Santos Silva and Tenreyro (2006) argue that log-linearized models like gravity can be subject to inconsistent estimation under OLS if an empirically relevant form of heteroskedasticity is present. The parameter estimates as well as the estimated standard errors suffer from this problem. In addition, application of OLS to the log-linearized model drops observations for which no trade is observed, thus resulting in sample selection bias (Helpman et al., 2008). With these points in mind, we adopt the Poisson Pseudo Maximum Likelihood estimator (PPML) approach proposed by Santos Silva and Tenreyro (2006). It is consistent under weak assumptions, and does not require that the data be distributed according to a particular law. It has also been shown to be robust in the presence of large numbers of zeros in the trade matrix (Santos Silva and Tenreyro (2011).

One possible concern with the model in equation (3) is that the STRI might be endogenous with respect to trade flows. The argument would be that because of the large amount of services inputs embodied in goods trade, countries have an interest in liberalizing the corresponding services sectors. If that point were true, we would expect to see a strong correlation between the STRI and the OTRI, which captures trade policies that directly affect manufactured goods, such as tariffs and non-tariff measures. However, that is not what is observed in the data. The correlation coefficient of the variables in logarithms is only 0.212, which means that trade protection measures affecting goods directly (or conversely, goods market liberalization) only accounts for around 4.5% of the observed variation in the STRI. It is therefore unlikely that endogeneity is an issue in this dataset.

Results for the gravity model appear in Table 3. Column 1 uses an STRI that aggregates trade restrictions across all sectors and modes. It has a negative and 1% statistically significant coefficient. Its magnitude is sensible, and suggests that a 10% increase in the restrictiveness of services trade policies is associated with a 5% decrease in bilateral trade in manufactured goods, before accounting for general equilibrium effects. We can be confident that this result is indeed capturing the effect of applied services trade policies, because the OTRI and the RTA dummy separately account for trade liberalization affecting manufactured goods directly. The gravity model controls generally have coefficients with the expected signs and magnitudes, but only distance and the GDP terms have statistically significant coefficients.

Table 3: Gravity model regression results (aggregate STRI)

	(1)	(2)	(3)
Ln(Overall STRI)	-0.494***		
	(0.001)		
Ln(Mode 1 STRI)		-0.158*	
		(0.062)	
Ln(Mode 3 STRI)			-0.436***
			(0.001)
Ln(1+OTRI)	-2.954***	-3.380***	-3.540***
	(0.000)	(0.000)	(0.000)
RTA	0.315	0.282	0.320
	(0.183)	(0.237)	(0.170)
Ln(Distance)	-0.467***	-0.483***	-0.465***
	(0.002)	(0.001)	(0.001)
Contiguous	0.325	0.301	0.329
	(0.316)	(0.397)	(0.311)
Colony	0.310	0.349	0.303
	(0.185)	(0.163)	(0.181)
Common Colonizer	0.0833	0.0505	0.0842
	(0.892)	(0.931)	(0.892)
Common Language	0.255	0.299	0.273
	(0.382)	(0.323)	(0.352)
Ln(Importer GDP)	1.177***	1.151***	1.184***
	(0.000)	(0.000)	(0.000)
Ln(Exporter GDP)	1.270***	1.229***	1.263***
	(0.000)	(0.000)	(0.000)
Constant	-66.02***	-63.38***	-65.90***
	(0.000)	(0.000)	(0.000)
Observations	6426	6426	6307
R2	0.655	0.629	0.649

*Note: The dependent variable is trade in all cases. Estimation is by PPML with robust standard errors clustered by country pair. P-values are in parentheses below the parameter estimates. Statistical significance is indicated by * (10%), ** (5%), and *** (1%). All trade cost proxies are transformed as per Baier and Bergstrand (2009).*

The literature on services has stressed the importance of heterogeneity across services industries (Francois and Hoekman, 2010). Thus, policies in different areas and sectors may have different effects as regards the links between services policies and trade in manufactured goods. To investigate this hypothesis, columns 2-3 of Table 3 use STRIs that still aggregate across all sectors, but cover only GATS Mode 1 and Mode 3 respectively. It is immediately apparent that although restrictions in both modes of supply are important, Mode 3 has a considerably larger coefficient in absolute value. This finding provides some evidence that restrictions to services-related foreign investment might have a larger trade restrictive effect on trade in manufactured goods than restrictions on pure cross border services trade. However, the difference between the two coefficients needs to be kept in perspective, as it is not statistically significant.

An additional dimension of potential heterogeneity relates to the sectoral impact of services trade restrictions: it is possible that trade restrictions in some sectors constrain trade in manufactured goods more than those in other sectors. To investigate this hypothesis, Table 4 presents regression results using STRIs that aggregate across all policy measures for particular sectors only. All sectors included in the STRI are considered.

Table 4: Gravity model regression results (sectoral STRI)

	(1) Banking	(2) Insurance	(3) Professional	(4) Retail	(5) Telecom	(6) Transport
Ln(Sectoral STRI)	-0.106*	-0.0239	-0.182	-0.783***	0.386***	-0.270***
	(0.076)	(0.693)	(0.275)	(0.000)	(0.001)	(0.001)
Ln(1+OTRI)	-3.828***	-4.025***	-4.219***	-0.139	-2.408***	-3.479***
	(0.000)	(0.000)	(0.000)	(0.865)	(0.001)	(0.000)
RTA	0.396	0.290	0.301	0.0156	0.129	0.302
	(0.135)	(0.223)	(0.218)	(0.955)	(0.512)	(0.185)
Ln(Distance)	-0.424**	-0.477***	-0.466***	-0.879***	-0.732***	-0.501***
	(0.012)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)
Contiguous	0.306	0.314	0.315	-0.577*	-0.0865	0.280
	(0.404)	(0.391)	(0.375)	(0.052)	(0.786)	(0.411)
Colony	0.104	0.347	0.345	0.000558	0.511***	0.326
	(0.696)	(0.148)	(0.156)	(0.999)	(0.002)	(0.167)
Common Colonizer	0.0691	0.0150	0.0288	-0.0268	-0.306	0.0542
	(0.904)	(0.980)	(0.962)	(0.952)	(0.559)	(0.928)
Common Language	0.345	0.343	0.332	0.651**	0.529**	0.265
	(0.288)	(0.265)	(0.274)	(0.040)	(0.033)	(0.379)
Ln(Importer GDP)	1.133***	1.121***	1.157***	1.287***	0.979***	1.113***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Exporter GDP)	1.192***	1.207***	1.231***	1.332***	1.237***	1.247***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-61.05***	-61.50***	-63.70***	-72.70***	-60.29***	-63.21***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	5355	6426	6426	2380	5117	6426
R2	0.607	0.610	0.613	0.768	0.712	0.650

*Note: The dependent variable is trade in all cases. Estimation is by PPML with robust standard errors clustered by country pair. P-values are in parentheses below the parameter estimates. Statistical significance is indicated by * (10%), ** (5%), and *** (1%). All trade cost proxies are transformed as per Baier and Bergstrand (2009).*

The strongest STRI impact is found in the retail sector. To understand this result, it is important to note that the retail STRI is de facto correlated with restrictions on trade in distribution services. Distribution, and related sectors like logistics, are key to the production and movement of goods, both within and across borders. Modern business models that rely on international production networks and supply chain trade simply cannot function without efficient distribution and logistics services (e.g., WEF, 2013; Saslavsky and Shepherd, 2014). It is therefore unsurprising that the impact of trade restrictions affecting retail services should have an impact larger than that of any other sector considered in Table 4, and larger than the overall results reported in Table 3.

Similarly, transport is also vital to the production and export of goods. Trade restrictions that reduce transport sector productivity can therefore be expected to have a particularly significant impact on exports of manufactured goods. This fact is reflected in the finding that such measures have the next most negative impact on exports of manufactured goods after retail services.

Close behind the transport sector comes financial services (banking). Again, modern business models of geographically separated production processes cannot survive without credit, and many value chains could not get underway without financing for investment obtained from debt and equity markets.

The only sector with an unexpected positive coefficient is telecommunications. One possible reason for this result that is deserving of further investigation in future work is substitution effects between goods and services trade. Freer trade in telecommunication services makes it possible to trade services virtually, rather than embodied in goods, as is often the case. It is therefore plausible that trade restrictions in this sector make it more likely that such services are packaged into goods in order to be sent abroad, rather than being traded directly.

The two remaining sectors, insurance and professional services, do not have statistically significant coefficients. Based on these data and this model, it therefore appears that the overall effect of services trade restrictions on exports of manufactured goods is associated primarily with measures in other sectors, such as those just discussed.

5 CONCLUSION

Consistent with what has been found in country-specific empirical studies (Arnold et al., 2011, 2014; Fernandes and Paunov, 2012; Duggan et al. 2013), we find a strong linkage between services and manufacturing performance. Although the effect is small – at the average rate of services input intensity, a 10% improvement in services productivity is associated with an increase in manufacturing productivity of 0.3% and a resulting increase in exports of 0.2%, – the result is statistically significant. We also find that services trade restrictiveness indices are negatively correlated with manufactured exports, and play an independent (additional) role to merchandise trade barriers as a determinant of export performance.

Our findings that policies restricting access to services markets through FDI and that impact on transport and distribution services have the largest negative effects on manufactured export performance are consistent with both theory and evidence on the drivers of supply chain trade and international integration (Baldwin and Lopez-Gonzalez, 2014; Saslavsky and Shepherd, 2014). Insofar as an increasing share of global trade in manufactures is organized through supply chains, with inputs being processed and value added by specialized firms located in different countries that require access to a variety of producer services (including in particular efficient transport, distribution, and logistics services), the productivity of such services will be a determinant of the ability of companies to participate in international production (Hoekman, 2014a).

The policy implications of our findings are clear. Governments should consider carefully the effects of prevailing policies and regulation on the efficiency of producer services industries, including measures that restrict the ability of foreign-owned suppliers to provide services. This pertains in particular to restrictions on establishment through FDI, which in practice continues to be a key channel through which to contest foreign markets and to serve clients. While there is today a much greater awareness among policymakers of the importance of reducing trade costs for firms located in their jurisdictions, the focus of attention is mostly on trade facilitation: improving the customs

clearance process and reducing red tape at the border. The recent WTO Agreement on Trade Facilitation is an example. This is appropriate and consistent with the extensive body of research documenting the negative impact of border-related trade costs on firm-level competitiveness and incentives to invest in export production. It is however important to take a broader perspective and include a focus on removing trade-restrictive services policies in parallel with efforts to facilitate trade. As discussed in Hoekman (2014b) a first step could be to consider transport logistics and distribution-related policies as a core element of any trade facilitation effort.

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