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Trade, productivity, and services input intensity

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Abstract

Using rich administrative microdata on Ugandan firms, we investigate the response of productivity to trade participation for firms in all sectors of the economy, and the moderating role of services input intensity. We find that companies that participate in trade, especially through importing, display a productivity premium. Firms that export are more productive only for a sub-sample spanning the manufacturing sector. We do not find evidence that using service inputs more intensively enhances the relationship between trade participation and firm productivity. Rather, we find some evidence that a higher share of spending on services inputs attenuates the positive relationship between trade status and productivity. This suggests that the quality of available services may not be up to the standard required to be internationally competitive.

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1 Introduction

A robust finding of the empirical trade literature is that exporting firms are more productive than non-exporters, and that greater openness is associated with total factor productivity performance as a result of induced competition, firm selection, inter and intra-industry resource reallocation, and access to intermediate inputs, technology and knowledge (Frankel & Romer, 1999; Winters, 2004; Wacziarg & Welch, 2008; Sampson, 2016). Such effects are in part associated with imports, including imports of intermediate inputs (Goldberg, Khandelwal, Pavcnik, and Topalova, 2010; De Loecker & Goldberg, 2014). Consistent with the broader literature on trade and national income, trade has also been found to be a driver of growth in Africa (Brueckner & Lederman, 2015).

As the role of services in the economy has expanded, a separate strand of the trade and development literature has focused on the role of (access to) services inputs as a potential determinant of the performance of downstream industries, focusing on whether services trade barriers and regulatory policies are a factor that may limit access to productivity-enhancing services inputs (Arnold, Mattoo, and Narciso, 2008; Arnold, Javorcik, and Mattoo, 2011; Arnold, Javorcik, Lipscomb, and Mattoo, 2016; Fernandes & Paunov, 2012; Beverelli, Fiorini, and Hoekman, 2017; Fiorini, Hoekman, and Quinn, 2023). Empirical studies analyzing the linkages between services trade policies and productivity find liberalizing services trade is associated with improved productivity and export performance of firms or industries (notably manufacturing) that are "downstream" in the supply chain. Services can help raise the productivity of firms involved in international trade by contributing to knowledge capital (R &D) (Lodefalk, 2014) or to operational efficiency (e.g., through supply-chain organization or management services) (Bloom & Van Reenen, 2010). Services can also help facilitate firm trade performance through transportation, communications, and logistics support (Pattnayak & Chadha, 2022; Hoekman & Shepherd, 2015).

In this paper we analyze the relationship between the intensity of services input use and firm productivity in Uganda, differentiating between firms that export, import or do both, and firms that do not engage in trade. Our objective is twofold. First, to determine if evidence from the heterogeneous firms literature highlighting productivity gains for firms that export, import and engage in two-way trade is observed in our sample of Ugandan enterprises, which encompass firms that are active across a range of sectors. This would thus allow to draw a comparison among firms in the manufacturing sector, which has been the focus of most studies, and non-manufacturing firms. Second, to investigate to what extent the use of services as inputs affects the estimated relationship between trade and firms productivity.[1] Our interest here is to explore whether the relationship between trade status and firm productivity performance is moderated by the extent to which firms rely on service inputs. The empirical analysis is based on a dataset combining data on firm-to-firm

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[1] Bamieh et al. (2020) and Liu et al. (2020) investigate the relationship between services input intensity and manufacturing performance at the industry level.

Table 1 Trade participation by sector

	Non Exporters	Exporters	Share that Exports	Non Importers	Importers	Share that Imports
Manufacturing	401	407	0.50	113	695	0.86
Primary	81	88	0.52	38	131	0.78
Construction	782	85	0.10	398	469	0.54
Utilities	100	31	0.24	37	94	0.72
Services	4810	924	0.16	2332	3402	0.59
Unknown	447	44	0.09	275	216	0.44
Total	6621	1579	0.19	3193	5007	0.61

The sample is split according to a firm's trading status and broad sector

transactions for Uganda, obtained from value added tax returns, with matched information on the value of imports and exports, their origin and destination and information on firm-level employment. The richness of the available data allow us to analyze the relationship between labour productivity, trade and the intensity of use of services as inputs into production at the level of each individual firm. Our data span both goods and services firms.

We find, consistent with the extant literature, that firms that engage in trade are more productive, with the relationship being stronger for imports than for exports. A positive association between exports and productivity is only found for firms in the manufacturing sector. Moreover, we find that services input intensity does not contribute positively to the productivity performance of exporters; instead, we find services input intensity has a negative, weakly significant relationship with the productivity performance of exporting firms. This suggests that firms in Uganda may not have access to the type or quality of services that could enhance their productivity, given that the literature has found that access to services inputs is a key factor affecting performance downstream. Our findings are robust to a battery of checks, including use of different definitions of the variables of interest, and cuts to the sample. This puzzling result suggests a need for further research that considers the trade and investment policy regime confronting foreign services suppliers, market structure and competition within modern services sectors, and disaggregates services by specific function and accounts more precisely for their features, including quality.

The paper proceeds as follows. Section 2 briefly discusses the data used for the analysis. Section 3 presents the empirical framework. Section 4 discusses the estimation results of analyzing the relationship between firm-level imports and exports, services input intensity and firm productivity. Section 5 concludes.

2 Data and descriptive statistics

We use anonymized firm-to-firm transaction records obtained from Value Added Tax (VAT) returns collected by the Uganda Revenue Authority (URA) for the period 2012–2018. The VAT accounts for over 30% of total national tax revenues
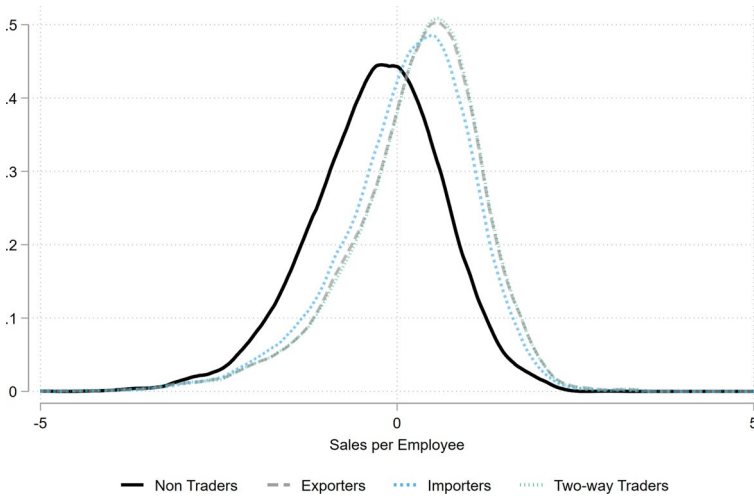
Fig. 1 Productivity by trading status. *Notes* The sample is split according to a firm's trading status. Two-way traders are firms that both export and import in a given year

in Uganda (Almunia, Hjort, Knebelmann, and Tian, 2021) . We focus on the post-2012 period because electronic reporting became compulsory for all registered firms in 2012.[2] Given that the new regulation was universally applied, our sample can be considered as a representative snapshot of all taxpaying firms (i.e. firms registered with the URA) in the formal sector in Uganda over the period considered.[3] Since there is no census reporting the full distribution of (formal and informal) firms in the country, we cannot report on how representative the sample is of the distribution of economic activity in the economy.

We aggregate all information at firm-year level, combining the records on sales and purchases with the firm characteristics included in the URA taxpayer registry. Firm transaction data are then mapped to Customs clearance data obtained from the Automated System for Customs Data (ASYCUDA), also provided by the URA. This enables us to retrieve information on export and import transactions, as well as the origin and destination of consignments for each firm. We use the customs information to identify importers and exporters and build an indicator of a firm's total sales by combining the value of yearly domestic transactions (from the VAT declaration) with the firm's annual exports. Note that because the customs clearance data do not include information on services trade, the total value of services inputs sourced by firms may be underestimated. The same observation pertains to our measure of productivity, which does not take into account exports of services firms.

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[2] We end our sample period in 2018, due to limitations in the employment data availability.

[3] URA records transactions for which at least one of the two parties involved is registered, based on its tax declaration.
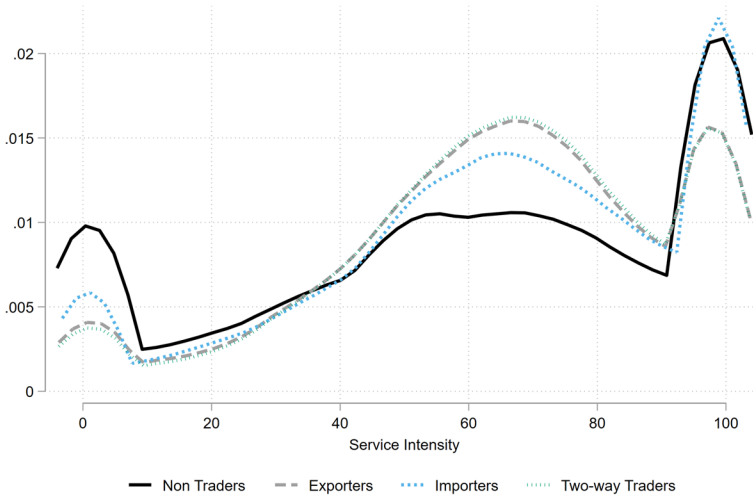
Fig. 2 Services input intensity by trade status. *Notes* The sample is split according to a firm's trading status. Two-way traders are firms that both export and import in a given year

Table 2 Trade status and services input intensity

	Exporters		Importers	
	ρ	*P*-val	ρ	*P*-val
Primary	− 0.007	0.84	0.037	0.30
Construction	− 0.007	0.57	− 0.006	0.62
Manufacturing	**0.097**	**0**	**0.108**	**0**
Utilities	− 0.048	0.14	**− 0.1**	**0.01**
Services	**0.035**	**0**	**0.099**	**0**
Aggregate	0.002	0.73	**0.062**	**0**

The table reports the overall and sector-wise unconditional correlation between service input intensity and the likelihood of being an exporter or an importer respectively. Values in bold are those for which the ρ is statistically significant at conventional levels

We combine the resulting dataset with matched firm-level data on employment, from the Pay-as-You-Earn (PAYE) form. This allows us to compute the total sales per employee (in logs), our measure of productivity (Eq.1).[4] As a robustness test, we also calculate Value-added per employee as an alternative measure of productivity. The associated findings are reported and discussed in Sect. 8 of the Appendix.[5]

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[4] Since we rely on VAT returns data, the number of observations for which sales are null is by construction negligible and likely due to reporting errors. For this reason, we drop all *firm × year* observations figuring null total sales.

[5] We limit the discussion of the results for the alternative measure of productivity to the appendix, given an approximate 40% reduction in sample size (due to the lack of data on either import, export, or domestic purchases) needed for calculating the alternative measure.

$$\text{Productivity} = \text{Sales per Employee} = \frac{\text{Domestic Sales} + \text{Exports}}{\text{Number of Employees}} \qquad (1)$$

The final dataset consists of 8200 reporting firms, unevenly distributed across five sectors: Construction (867), Manufacturing (808), Primary (169), Services (5734), and Utilities (131).[6]

2.1 Descriptives

Table 1 reports the number of registered Ugandan firms engaging in international trade during the period covered in the sample. Looking at exports and imports separately, slightly less than one-fifth of the firms in our sample declared positive exports at least once over the period 2012–2018, whereas 61% of the firms purchased inputs or final goods from abroad.

The aggregate figures mask some sectoral heterogeneity. The share of exporting firms is over 50% in the manufacturing and primary sectors, while only 10%, 16% and 24% of firms in the construction, services, and utility sectors, respectively, engage in exports. This variation reflects the more limited tradeability of many services. The difficulty in measuring services trade could therefore explain the heterogeneous export behavior across sectors.[7] The pattern for imports is more balanced, since at least half of the firms in each sector purchase inputs from abroad.

Heterogeneous firms trade theory (starting from Melitz, 2003) suggests that the most productive firms are not only able to face competition from cheaper/higher quality imports but, beyond a certain productivity threshold, also may start exporting. Looking at the distribution of productivity across registered Ugandan firms (Fig. 1), we replicate the stylized fact in the literature that trading firms are more productive than firms that do not engage in international trade.

2.2 Trade and services input intensity

Figure 2 reports the distribution of firms according to the share of services in their input mix,[8] distinguishing between firms according to their trading status. While firms that engage in international trade on average use a higher share of services as inputs, non-trading firms exhibit higher variability in terms of their services input mix.

Table 2 reports the coefficient estimates for the unconditional probability of a firm being an exporter or an importer, respectively, as a function of its service input intensity. We estimate this both for all firms in the sample (Aggregate) and

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[6] An additional 491 firms did not report the main activity. The final dataset includes a total of 68814 firm-year observations.

[7] When discussing sectoral heterogeneity we therefore focus on the Manufacturing and Agricultural sectors, and pool construction, utilities, and services sectors. See Table 16 in the Appendix.

[8] We use bilateral VAT data to identify the share of total purchases by an enterprise from all firms in the services sector in a given year.

for groups of firms based on their main sector of activity. Higher services intensity in the overall input mix is positively correlated with being an importer. The very small positive correlation with exports is not statistically significant. Differentiating firms by sector, services input intensity is positively correlated with the probability of both being an exporter or being an importer in the manufacturing and the services sectors. These results provide suggestive evidence that services input intensity may be associated with the performance of firms that engage in trade.

3 Empirical framework

In our empirical analysis, we assess if Ugandan firms that engage in international trade enjoy a productivity premium, and whether the intensity of use of services as inputs affects the association between trade and productivity.

3.1 Trade and productivity

We estimate the link between trade participation and productivity using the following equation:

$$Y_{it} = \beta_1 Trade_{it} + \lambda_i + \theta_{st} + \varepsilon_{it} \tag{2}$$

where Y_{it} captures a firm's productivity (as defined in Eq. 1).[9] Our explanatory variable of interest, $Trade_{it}$, is a binary variable measuring whether a firm participates in international trade. We measure participation in trade in three ways, depending on whether a firm exported, imported, or engaged in two/way trade (export and import) in year t.[10] λ_i and θ_{st} capture firm fixed effects and sector-specific time trends, respectively. Firm fixed effects account for firm-specific unobserved factors, while the addition of sector-specific trends accounts for time-varying industry-specific factors that may influence the relationship between participation in international trade and firm performance. Standard errors are clustered at the firm level.

The coefficient β_1 in Eq. (2) is our coefficient of interest. It identifies the extent to which a within-firm change in involvement in international trade is associated with changes in productivity. The related literature on trade and productivity highlights a positive association between productivity and participation in international trade. Looking at exports, the heterogeneous firms literature suggests the relationship going from productivity to internationalization: the most productive firms are expected to not only be able to confront competition in the domestic market but also start competing abroad (Bernard & Jensen, 1999a, b; Melitz, 2003). On the other hand, becoming an exporter can potentially turn into a learning opportunity for firms that are already productive. This learning-by-doing mechanism might eventually

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[9] As an additional set of results, we also use a measure of productivity that does not include exports, to reduce the potential endogeneity that might arise from our empirical exercise. Results, available upon request, do not change significantly.

[10] In Appendix Sect. 2 we present results with measures of trade participation at the intensive margin.

Table 3 Baseline results: trade and productivity

	Sales per employee		
	(1)	(2)	(3)
Exporter	0.0383		
	(0.0371)		
Importer		0.279***	
		(0.0308)	
2-Way trader			0.0616*
			(0.0373)
Observations	26617	26617	26617
Adjusted R^2	0.736	0.738	0.736
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

lead to further gains in productivity (see for instance Bernard et al., 2003; Martins & Yang, 2009).

Access to foreign inputs, irrespective of whether they are perfect substitutes for inputs available domestically, is also a driver of firms' productivity (see for instance Halpern et al., 2015; Kasahara & Rodrigue, 2008; Kasahara & Lapham, 2013; Vogel & Wagner, 2010). Self-selection of the more productive firms into importing (that are the only able to sustain the costs associated to sourcing information and pay up-front for custom tariffs) appear to be stronger in developing countries (see for instance Amiti & Konings, 2007; Sharma & Mishra, 2015)

In light of the existing evidence, we therefore expect the coefficient β_1 to be positive, irrespective of how firms participate in international trade. We are circumspect about the direction of causality since more productive Ugandan firms may self-select into international trade.[11]

3.2 The mediating role of services input intensity

We estimate the mediating role of service inputs on productivity of firms involved in international trade using the interaction model in Eq. (3), where Service input intensity is measured as the average use of service inputs by firm i as a share of total inputs over the sample period.:

$$Y_{it} = \beta_1 Trade_{it} + \beta_2 (Trade_{it} \times Service\,intensity_i) + \lambda_i + \theta_{st} + \varepsilon_{it} \qquad (3)$$

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[11] In Appendix Sect. 5 we use an event-study analysis to assess the potential participation of more productive firms in international trade. This suggests more productive firms are not more likely to participate in international trade.

Table 4 Trade, productivity and service intensity

	Sales per Employee		
	(1)	(2)	(3)
Exporter	0.246**		
	(0.116)		
Exporter × service intensity	− 0.00311*		
	(0.00168)		
Importer		0.355***	
		(0.0972)	
Importer × service intensity		− 0.000882	
		(0.00137)	
2-Way trader			0.237**
			(0.117)
2-Way trader × service intensity			− 0.00261
			(0.00171)
Observations	24880	24880	24880
Adjusted R^2	0.732	0.733	0.732
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficient of interest, β_2, measures the productivity difference from participating in international trade that corresponds to different levels of service input use. Assuming that sufficient high-quality services are available domestically we would expect service input use to magnify the productivity premium from participating in international trade.

By using average services input intensity for each firm in our interaction model (Eq. 3) we assume that firms do not significantly change their production function during the sample period. This is borne out in data. Within firm variation in services input intensity is limited, making the estimation of such variable imprecise (see Appendix 4). In Appendix Fig. 5 we check if firms switching into exporting and importing has implications for the share of services in their overall input mix. We show that there is no change in services input intensity when a firm starts exporting or importing.

4 Results

We first report results on the relationship between the different forms of participation in international trade and firm performance. Column 1 in Table 3 indicates that exporting firms are not significantly more productive than non-exporting firms. Column 2 in contrast shows that compared to firms that do not import, importing firms are significantly more productive. The point estimate implies that being an importer

Table 5 Trade, productivity and service i

	Sales per employee		
	(1)	(2)	(3)
Exporter	0.236**		
	(0.118)		
Exporter × service intensity low	− 0.00273		
	(0.00182)		
Exporter × service intensity high	− 0.00393		
	(0.00252)		
Importer		0.312***	
		(0.0991)	
Importer × service intensity low		0.000543	
		(0.00153)	
Importer × service intensity high		− 0.00299*	
		(0.00167)	
2-Way trader			0.236**
			(0.118)
2-Way trader × service intensity low			− 0.00257
			(0.00183)
2-Way trader × service intensity high			− 0.00269
			(0.00265)
Observations	24880	24880	24880
Adjusted R^2	0.732	0.733	0.732
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

is associated with a 28% increase in productivity. Firms that both export and import tend to be more productive (Column 3), although the estimate is only significant at the 10 percent level. A similar pattern emerges if we differentiate between firms based on the origin and destination of imports and exports, respectively. Columns 1 and 2 of Appendix Table 12 show that the destination of exports does not affect firm productivity. Similarly, Columns 3 and 4 indicate that importing firms are more productive than non-importing firms, irrespective of whether they source from within or outside Africa. Columns 5 and 6 of Appendix Table 12 show that firms that are involved in international trade through both exports and imports are more productive, independent of where their partners are located.

The literature on exports and productivity focuses mostly on the manufacturing sector, whereas our sample includes a large number of firms in other sectors, especially in services. We therefore conduct a sub-sample analysis on the link between trade status and productivity, differentiating by firms' sector of activity. Results reported in Appendix Table 16 reveal that exporting firms in the manufacturing

sector are significantly more productive than non-exporting firms. The productivity premium for exporters is not evident in any other sector.[12]

4.1 Trade, productivity, and services

Turning to the potential mediating role of services input intensity on productivity for firms that participate in international trade, Table 4 reports the results of estimating Equation (3). We now obtain a positive and significant coefficient estimate for exporters, after accounting for heterogeneity in services' input use. Column (1) suggests that higher service input use moderates the positive productivity gains from exporting. Panel (a) of Appendix Fig. 6 plots the marginal effect of exporting on productivity at different levels of services input intensity, revealing that exporters that use service inputs up to a certain threshold are more productive than non-exporters. Exporters for which services input intensity is greater than 60% of their total inputs tend not to be more productive than non-exporters. Coefficient estimates for importers are larger and remain statistically significant, when we account for heterogeneity in service input use, while those for two-way traders also increase in both magnitude and significance.

In Table 5 we further distinguish between the type of services that firm use. We identify service inputs as high-skill or low-skill based on the classification of services sectors by Nayyar et al. (2021).[13] Results presented in Column (2) suggest that using a high proportion of high-skill services as inputs moderate the productivity gains for importers. These results are confirmed visually in Panel (b) of Appendix Fig. 6 which shows that importing firms that tend to use more than 60% of their inputs in high-skill services tend to be no more productive than non-importers.[14]

Up to this point, we have assumed that the mediating role of services input intensity on productivity of firms that engage in trade is incremental. In Appendix Tables 19 and 20 we check for a possible non-linear relationship between service input intensity and productivity of trading firms. Accordingly, we add an additional control variable that interacts with the trade participation indicator with a square of the average service intensity measure (and the corresponding squared terms of low-skill and high-skill service intensity respectively). Results presented in Appendix Table 19 suggest that there is no significant non-linear relationship between services

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[12] Appendix Table 16 also reports sector-wise correlations for importers and two-way traders. Being an importer affects productivity in both manufacturing and agriculture, as well as in all other sectors (lumped together). The relationship between being a two-way trader and productivity appears to be dominated by being an exporter in the first place.

[13] Low skill services include: "Transportation and storage", "Wholesale and retail trade, repair services","Accommodation and food service activities", "Administrative and support service activities", "Arts, entertainment and recreation", "Other service activities", "Activities of households as employers" and "Real estate activities". High skill services include: "Professional, scientific and technical activities", "Information and communication", "Financial and insurance activities", "Education", "Human health and social work activities" and "Public administration and defense".

[14] In Appendix Tables 10 and 11 we estimate the effect of service input intensity (overall and low vs. high-skill) excluding services that correspond to "Public administration and defense". The moderating effect of overall services input intensity for exporters continues to be statistically significant, while the moderating effect of high-skill services for importers loses significance. In the appendix we also report results for a sub-sample that excludes firms reporting only inputs of services, i.e., with a services input intensity of 100. The estimates reported in Tables 17 and 18 are in line with our baseline.

input intensity and productivity in firms that engage in trade. Instead, the results in Appendix Table 20 suggest that using a larger share of low-skill service inputs enhances productivity for both importers and two-way traders.[15]

Overall, these results indicate that high levels of services input intensity hinders the performance of Ugandan firms involved in international trade.This may reflect difficulties in procuring appropriately tailored or high-quality services. This supposition is consistent with the suggestive evidence obtained when allowing for non-linear relationships between low-skill services intensity and productivity performance of Ugandan firms that import and those that engage in two-way international trade.

5 Conclusion

In this paper, we exploit information from a rich administrative dataset on the universe of Ugandan firms included in the tax registry. The dataset includes information on firms' participation in trade, their transactions, in terms of input–output linkages, with all other firms in the country, and number of employees. We use these data to investigate the role of services input intensity as a factor that may moderate the firm-level trade-performance nexus.

Our findings highlight that Ugandan firms that participate in trade, especially through importing, display a productivity premium. Firms that export are more productive only for the sub-sample of enterprises engaged in manufacturing, a finding that is in line with most of the heterogeneous firms empirical trade literature. We do not find evidence of services input intensity positively moderating the relationship between participation in international trade and firm productivity. Rather, we find some evidence that a higher share of total expenditures on services inputs attenuates the positive relationship between trade status and productivity. As most of the services inputs we observe in the data are of domestic origin, this could indicate the possibility that the quality of available services is not up to the standard required to be internationally competitive.

These findings suggest future research to further "unpack" the role played by services as a determinant of productivity of downstream firms. One avenue for further research is to explore the relationship between productivity and different types of services, as opposed to the focus in much of the literature—and in our analysis—on differentiating between low and high skill services categories. Our focus on overall services input intensity is motivated by the debates on the implications of the rapid servicification of low-income economies for development, i.e., whether an increasing share of services in total employment and economic activity is associated with lower productivity performance. Beyond this, the question is whether some services matter more than others for downstream performance and whether this differs for firms that engage in trade and those that do not. Our findings reveal a need for more analysis on the role of services using microdata spanning a range of countries that differ in levels of per capita incomes, endowments, institutions, and geographic location.

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[15] The moderating effect on productivity for firms that rely on high-skill services is also confirmed in Sect. 13 of Appendix, where we further differentiate the high/low-skill services by their content. These disaggregated results suggest that exporters that rely more on services related to innovation experience a decline in productivity, while importers that rely more on professional services experience a decline in productivity compared to domestic firms.

Appendix

1. Descriptive statistics

See Table 6.

Table 6 Summary statistics

Statistics	Count	Mean	Std. Dev	MIN	MAX
Exporters					
Domestic Sales	4310	27717.17	111742.7	0	1911503
Productivity: Sales per Employee	3448	3.75E+08	2.14E+09	0.02	6.92E+10
Exports	4310	14798.88	188971.6	0.00	6519991
Imports	4310	23496.56	104235	0	4776926
Service Intensity (Aggregate)	4310	0.52	2.32	0	48.79
Service Intensity (High Skill)	4310	10.21	16.62	0	100
Service Intensity (Low Skill)	4310	53.54	24.70	0	100
Number of Employees	3448	157.73	519.15	1	8031
Importers					
Domestic Sales	21694	9088.78	61946.51	0	2020374
Productivity: Sales per Employee	13112	3.17E+08	1.94E+09	0	1.25E+11
Exports	21694	2612.41	72236.32	0	6519991
Imports	21694	7082.67	58675.44	0	4776926
Service Intensity (Aggregate)	21694	0.45	3.07	0	100
Service Intensity (High Skill)	21694	8.93	17.72	0	100
Service Intensity (Low Skill)	21694	57.00	28.44	0	100
Number of Employees	13112	78.16	340.96	1	8031
Two-way Traders					
Domestic Sales	3894	30342.24	117122.2	0	1911503
Productivity: Sales per Employee	3194	3.70E+08	2.18E+09	0.02	6.92E+10
Exports	3894	14554.09	170008.7	0.00	6519991
Imports	3894	26006.72	109364.8	0.03	4776926
Service Intensity (Aggregate)	3894	0.53	2.15	0	30.81
Service Intensity (High Skill)	3894	10.19	16.10	0	100
Service Intensity (Low Skill)	3894	54.06	23.94	0	100
Number of Employees	3194	168.83	537.64	1	8031
All Firms (including non traders)					
Domestic Sales	53766	4101.795	39681.28	0	2020374
Productivity: Sales per Employee	24155	2.54E+08	1.53E+09	0	1.25E+11
Exports	53766	1186.31	53648.4	0	6519991
Imports	53766	2857.78	37432.23	0	4776926
Service Intensity (Aggregate)	53766	0.44	4.14	0	100
Service Intensity (High Skill)	53766	8.82	19.79	0	100
Service Intensity (Low Skill)	53766	54.80	31.22	0	100
Number of Employees	24155	49.74	257.58	1	8031

Sales and Trade statistics are reported in Million UGX

2. Intensive margin of trade

This section reports results with trade participation defined by the intensive margin (Tables 7, 8, 9).

Table 7 Baseline results: trade and productivity (intensive margin)

	(1)	(2)	(3)
Log exports	0.00198		
	(0.00227)		
Log imports		0.0196***	
		(0.00181)	
Two-way trade			0.0762*
			(0.0410)
Observations	26617	26617	26617
Adjusted R^2	0.736	0.738	0.792
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8 Trade, productivity and service intensity (intensive margin)

	(1)	(2)	(3)
Log exports	0.0156**		
	(0.00703)		
Log exports × service intensity	− 0.000206**		
	(0.000103)		
Log imports		0.0207***	
		(0.00554)	
Log imports × service intensity		− 0.00000277	
		(0.0000796)	
Log 2-way Trade			0.280**
			(0.141)
Log 2-way Trade × service intensity			− 0.00300
			(0.00197)
Observations	24880	24880	24880
Adjusted R^2	0.732	0.734	0.787
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9 Trade, productivity and service intensity (intensive margin)

	(1)	(2)	(3)
Log exports	0.0147**		
	(0.00708)		
Log exports × service intensity low	− 0.000172		
	(0.000110)		
Log exports × service intensity high	− 0.000288		
	(0.000176)		
Log imports		0.0180***	
		(0.00562)	
Log imports × service intensity low		0.0000880	
		(0.0000871)	
Log imports × service intensity high		− 0.000159	
		(0.000103)	
Log 2-way Trade			0.276**
			(0.140)
Log 2-way Trade × service intensity low			− 0.00286
			(0.00202)
Log 2-way Trade × service intensity high			− 0.00326
			(0.00333)
Observations	24880	24880	24880
Adjusted R^2	0.732	0.734	0.787
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3. Excluding public administration and defence services

This section reports results after excluding services targeting "Public Administration and Defence", or delivered by Government Bodies and Government Funded Programmes (Tables 10 and 11).

Table 10 Trade, productivity and service intensity (excluding public administration)

	(1)	(2)	(3)
Exporter	0.238**		
	(0.115)		
Exporter × service intensity	− 0.00302*		
	(0.00167)		
Importer		0.306***	
		(0.0969)	
Importer × service intensity		− 0.000141	
		(0.00138)	
2-Way trader			0.242**
			(0.115)
2-Way trader × service intensity			− 0.00271
			(0.00169)
Observations	24880	24880	24880
Adjusted R^2	0.732	0.733	0.732
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4. Variation of services input intensity over time

Services input intensity varies across firms and sectors (between variation), whereas services intensity within firms over time shows limited variation (cfr. Fig. 3)

Since we are only interested in estimating the effect of services input intensity as mediated by trade, and given the limited within firm variability in services input intensity, we use average services input intensity to estimate Eq. (3). Using a firm-specific constant level of services input intensity means that we are not able to estimate its direct effect on productivity, which is absorbed by the set of fixed effects included in the estimation.

5. Self-selection of productive firms into international trade

According to trade theory, participation in international trade can improve firm performance. Alternatively, more productive firms can also be more likely to participate in international trade. We perform an event-study analysis to compare the evolution of productivity between firms that participate in international trade and the firms that do not. We modify Eq. 2 and regress the productivity measure on dummies for the years before, the year of, and the years after the time a firm enters international trade.

Figure 4 plots the evolution in a firm's productivity as it starts to participate in international trade, controlling for firms and sector×year FE. The Figure suggests that more

Table 11 Trade, productivity and service intensity (excluding public administration)

	(1)	(2)	(3)
Exporter	0.168		
	(0.153)		
Exporter × service intensity low	− 0.00163		
	(0.00232)		
Exporter × service intensity high	− 0.00240		
	(0.00244)		
Importer		0.237**	
		(0.0992)	
Importer × service intensity low		0.000853	
		(0.00157)	
Importer × service intensity high		− 0.000655	
		(0.00132)	
2-Way trader			0.206
			(0.152)
2-Way trader × service intensity low			− 0.00194
			(0.00230)
2-Way trader × service intensity high			− 0.00208
			(0.00251)
Observations	18605	18605	18605
Adjusted R^2	0.740	0.741	0.740
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

productive firms are not likelier to participate in international trade, irrespective of the way they participate in international trade.

6. Participation in trade and services input intensity

Figure 5 plots the change in a firm's use of services as inputs as it starts to participate in international trade, controlling for firms and sector×year FE. The Figure suggests that there is no change in service input intensity as firms start to trade internationally.

7. Trade and productivity by partner location

This section shows the link between participation in trade and firm productivity, differentiating firms by the location of their trading partners. Exporters are no more productive than non-exporters, irrespective of the destination of exports.
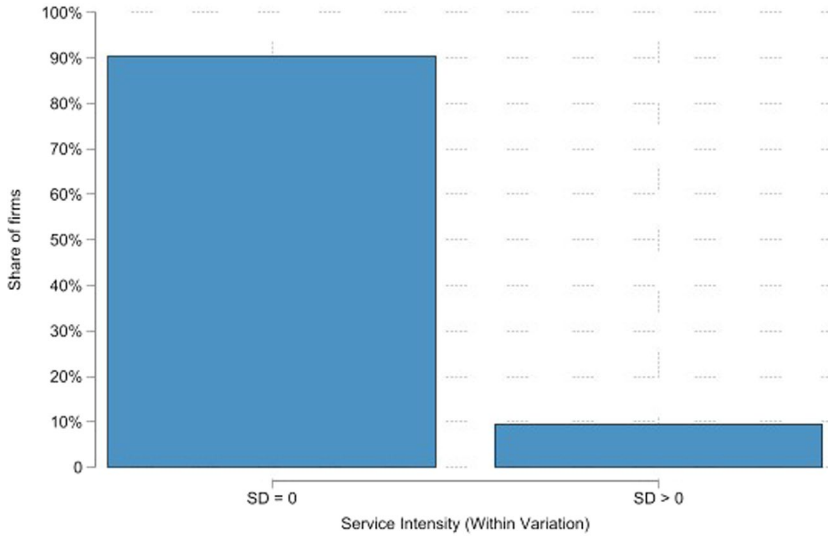
Fig. 3 Firm trading status and productivity. *Notes* Distribution of standard deviation of services intensity within firms over the period of interest. The graph shows the disproportion between firms reporting no variations in and those who reported changes in services input intensity. Firms for which no services inputs are reported (missing information) are left out
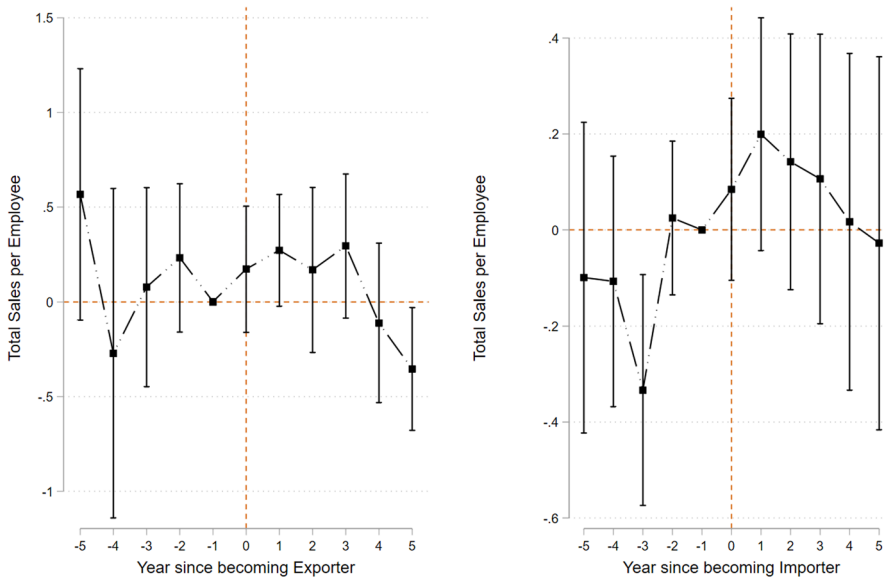

Fig. 4 Firm trading status and productivity. *Notes* The figures plot the evolution of productivity around the time that a firm first started **a** exporting and **b** importing. The model includes 5-year leads and lags and it is estimated using an OLS. Firm and Sector×Year FE are included in the estimations. The year-1 is treated as the reference year and it is set to zero. The vertical bars indicate the 90% confidence intervals

Importers on the other hand are more productive than non-importers, and this association is independent of where they source inputs from. Finally, two-traders are also more productive, independent of their partners' location, even if the effect is likely to be driven by the fact of being importers in the firs place (Table 12).

8. Value added per employee as an alternative measure of productivity

Output-to-labour is a commonly used measure, but it is not always the best tool to estimate labor productivity. For instance, in the case of the importer premium, a firm that imports a significant amount of inputs without much transformation, may only need a few workers. Using output-per-worker instead of value added-per-worker may thus lead to an overestimation of labour productivity for such firm, and in general for firms in those sectors that import many inputs with little transformation.

Using VAT data, we constructed a measure of VA as:

$$VA = (DomesticSales + Export) - (DomesticPurchase + Import)$$

Since (i) the results are comparable both in terms of magnitude and direction; and (ii) the number of firms for which the import data were missing causes a loss of about 11k observations, we maintained Sales per Employee (in logs) as our preferred outcome variable.[16] Results for this additional robustness test are available in Tables 13, 14 15 below.

9. Trade and productivity by sector

This section shows the link between participation in trade and firm productivity, differentiating firms by their sector of activity (the remaining sectors—construction, services and utilities—are lumped together). Results suggest that within the manufacturing sector exporting firms are more productive than non-exporters. The relationship is non-existent for other broad sectors. Conversely, importers tend to be more productive than non-importers in manufacturing as well as in agricultural and in the other sectors taken together (Table 16).

10. Marginal effects of services input intensity on trading firms' productivity

This section shows the marginal effects of service input intensity on trading firms that correspond to the statistically significant coefficients from Tables 4 and 5. Panel (a) shows that the use of service inputs below a threshold augments the productivity gains for exporters. Panel (b) shows that for importing firms using service inputs below a certain threshold augments the productivity benefits.

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[16] The only exception being the statistical significance of the interaction coefficient between Services Intensity and Export.
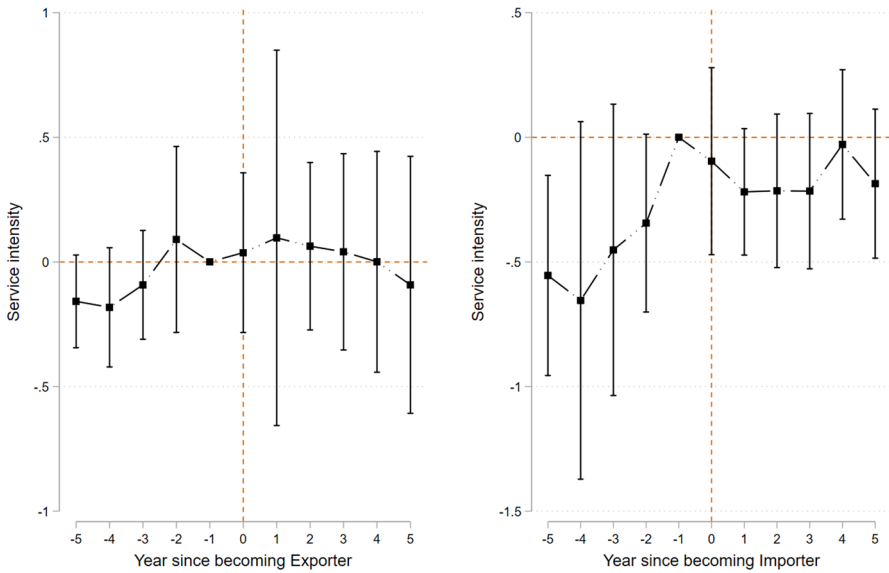
Fig. 5 Timing of trade participation and services input intensity. *Notes* The figures plot the evolution of productivity around the time that a firm first started **a** exporting and **b** importing. The model includes 5-year leads and lags and it is estimated using an OLS. Firm and Sector×Year FE are included in the estimations. The year-1 is treated as the reference year and it is set to zero. The vertical bars indicate the 90% confidence intervals

Table 12 Trade and productivity: by location of trading partner of trade

	Sales per employee					
	(1)	(2)	(3)	(4)	(5)	(6)
Exporter Africa	0.0371					
	(0.0392)					
Exporter non-Africa		0.0767				
		(0.0642)				
Importer Africa			0.227***			
			(0.0307)			
Importer non-Africa				0.266***		
				(0.0295)		
2-Way trader Africa					0.0970**	
					(0.0426)	
2-Way trader non-Africa						0.133**
						(0.0626)
Observations	26617	26617	26617	26617	26617	26617
Adjusted R^2	0.736	0.736	0.737	0.738	0.736	0.736
Firm FE	✓	✓	✓	✓	✓	✓
Sector×Year FE	✓	✓	✓	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13 Baseline results: trade and productivity

	Sales per employee		
	(1)	(2)	(3)
	Value added per employee		
Exporter	0.257***		
	(0.0630)		
Importer		0.184***	
		(0.0400)	
2-Way trader			0.216 ***
			(0.0623)
Observations	15156	15156	15156
Adjusted R^2	0.664	0.664	0.663
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Value Added per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14 Trade, productivity and service intensity

	Sales per employee		
	(1)	(2)	(3)
Exporter	0.255***		
	(0.0672)		
Exporter × service intensity	− 0.0173		
	(0.0213)		
Importer		0.199***	
		(0.0416)	
Importer × service intensity		− 0.0115	
		(0.00842)	
2-Way trader			0.178***
			(0.0651)
2-Way trader × service intensity			0.0226
			(0.0189)
Observations	13730	13730	13730
Adjusted R^2	0.647	0.647	0.647
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Value Added per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15 Trade, productivity and service intensity

	Sales per employee		
	(1)	(2)	(3)
Exporter	0.441		
	(0.282)		
Exporter × service intensity low	− 0.00288		
	(0.00415)		
Exporter × service intensity high	− 0.00259		
	(0.00380)		
Importer		0.269*	
		(0.153)	
Importer × service intensity low		− 0.000351	
		(0.00223)	
Importer × service intensity high		− 0.00327	
		(0.00204)	
2-Way trader			0.0841
			(0.235)
2-Way trader × service intensity low			0.00208
			(0.00364)
2-Way trader × service intensity high			− 0.0000321
			(0.00348)
Observations	13730	13730	13730
Adjusted R^2	0.647	0.647	0.647
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Value Added per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

11. Excluding services only user firms

This sections replicates Tables 3 and 4 excluding firms that report all their inputs to be services in a given year. The estimates in Tables 17 and 18 confirm our main results.

12. Non-linear effects of services input intensity on trading firms' productivity

In this section, we assess if there might be a non-linear effect of using service inputs on the productivity of trading firms (Table 19). We accordingly add controls that interact the trade participation indicator with a square of the average service intensity measure (and the corresponding squared terms of low-skill and high-skill

Table 16 Trade and productivity: by firm sector

	Sales per employee (log)		
	Manufacturing	Primary	Other
Exporter	0.139*	− 0.0255	0.00843
	(0.0797)	(0.255)	(0.0428)
Importer	0.347***	0.659**	0.265***
	(0.108)	(0.271)	(0.0324)
2-Way trader	0.159**	0.279	0.0157
	(0.0784)	(0.251)	(0.0432)
Observations	3421	515	22683
Firm FE	✓	✓	✓
Year FE	✓	✓	✓

Dependent variable: Total Sales per Employee (in log). Results from separate uni-variate regressions by sector and trade mode. All specifications include Firm and Sector×Year effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(a) Exporter Status and Aggregate Service intensity - Aggregate
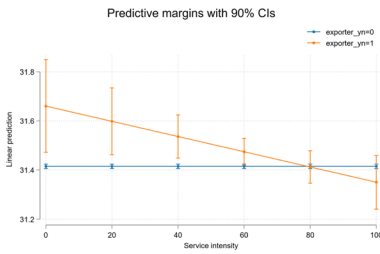
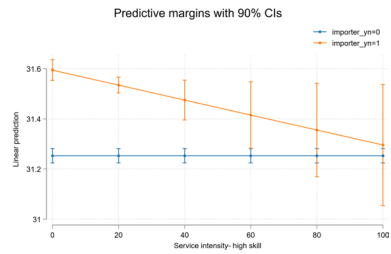(b) Importer Status and High-Skill Service Intensity

Fig. 6 Moderating effect of services input intensity on trading firms' productivity. *Notes* The figure plots the marginal effect of service input intensity on the productivity of trading firms that is estimated from Eq. 3

service intensity respectively). Results in Table 20 suggest that there might be some benefits from using low-skill service inputs more intensively.

13. Types of services, services input intensity and firms' productivity

In this section we further differentiate the low/high-skill services by their content: low-skill services that promote trade (logistics), domestic low-skill services, high-skill services related to innovation and finally high-skill professional services. In Tables 21, 21, 23 we assess how these sub-classified services affect exporters, importers and two-way traders. For exporters, the negative coefficient due to overall

Table 17 Baseline results: trade and productivity

	(1)	(2)	(3)
Exporter	0.0573		
	(0.0385)		
Importer		0.236***	
		(0.0311)	
2-Way trader			0.0717*
			(0.0386)
Observations	21425	21425	21425
Adjusted R^2	0.743	0.744	0.743
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 18 Trade, productivity and service intensity

	(1)	(2)	(3)
Exporter	0.0699*		
	(0.0395)		
Exporter × service intensity	− 0.0255		
	(0.0209)		
Importer		0.228***	
		(0.0318)	
Importer × service intensity		0.0161	
		(0.0105)	
2-Way trader			0.0653*
			(0.0395)
2-Way trader × service intensity			0.0119
			(0.0164)
Observations	21425	21425	21425
Adjusted R^2	0.743	0.744	0.743
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 19 Trade, productivity and service intensity

	Sales per employee		
	(1)	(2)	(3)
Exporter	0.336*		
	(0.190)		
Exporter × service intensity	− 0.00652		
	(0.00673)		
Exporter × service intensity squared	0.0000279		
	(0.0000574)		
Importer		0.464**	
		(0.200)	
Importer × service intensity		− 0.00517	
		(0.00665)	
Importer × service intensity squared		0.0000354	
		(0.0000522)	
2-Way trader			0.381**
			(0.193)
2-Way trader × service intensity			− 0.00804
			(0.00681)
2-Way trader × service intensity squared			0.0000444
			(0.0000581)
Observations	24880	24880	24880
Adjusted R^2	0.732	0.733	0.732
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 20 Trade, productivity and service intensity - By skill category

	(1)	(2)	(3)
Exporter	0.490**		
	(0.192)		
Exporter × service intensity low	− 0.0149**		
	(0.00755)		
Exporter × service intensity low squared	0.000108		
	(0.0000691)		
Exporter × service intensity high	0.00392		
	(0.00600)		
Exporter × service intensity high squared	− 0.000134		
	(0.0000891)		
Importer		0.499***	
		(0.164)	
Importer × service intensity low		− 0.00911	
		(0.00612)	
Importer × service intensity low squared		0.0000899*	
		(0.0000538)	
Importer × service intensity high		0.00223	
		(0.00442)	
Importer × service intensity high squared		− 0.0000827	
		(0.0000643)	
2-Way trader			0.540***
			(0.188)
2-Way trader × service intensity low			− 0.0170**
			(0.00734)
2-Way trader × service intensity low squared			0.000129*
			(0.0000677)
2-Way trader × service intensity high			0.00541
			(0.00623)
2-Way trader × service intensity high squared			− 0.000139
			(0.0000952)
Observations	24880	24880	24880
Adjusted R^2	0.732	0.733	0.732
Firm FE	✓	✓	✓
Sector×Year FE	✓	✓	✓

Dependent variable: Sales per employee (Log). All specifications include Firm FE and Sector×Year fixed effects. Standard errors clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 21 Trade and productivity for exporters: type of services

	(1)	(2)	(3)	(4)	(5)
Exporter	0.125	0.0702	0.0403	0.0246	0.237**
	(0.0951)	(0.0446)	(0.0386)	(0.0441)	(0.118)
Exporter × LS Trade	−0.00176				−0.00314*
	(0.00175)				(0.00189)
Exporter × HS Innovation		−0.00288			−0.00497*
		(0.00270)			(0.00292)
Exporter × HS Skills			−0.00111		−0.00207
			(0.00355)		(0.00365)
Exporter × LS Domestic				0.00261	0.00225
				(0.00447)	(0.00454)
Observations	24880	24880	24880	24880	24880
Adjusted R^2	0.732	0.732	0.731	0.731	0.732
Firm FE	✓	✓	✓	✓	✓
Sector×Year FE	✓	✓	✓	✓	✓

Dependent variable: Total Sales per Employee (in log). LS Trade includes low-skill trade sectors, HS Innovation includes high-skill innovation sectors, HS Skills includes professional services and LS Domestic includes low-skill domestic services. All specifications include Firm and Sector×Year fixed effects. Standard errors clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 22 Trade and productivity for importers: type of services

	(1)	(2)	(3)	(4)	(5)
Importer	0.186***	0.331***	0.309***	0.319***	0.314***
	(0.0650)	(0.0379)	(0.0314)	(0.0365)	(0.0991)
Importer × LS Trade	0.00237*				0.000844
	(0.00126)				(0.00155)
Importer × HS Innovation		−0.00257*			−0.00196
		(0.00147)			(0.00172)
Importer × HS Skills			−0.0124**		−0.0123**
			(0.00548)		(0.00561)
Importer × LS Domestic				−0.00401	−0.00313
				(0.00307)	(0.00327)
Observations	24880	24880	24880	24880	24880
Adjusted R^2	0.733	0.733	0.733	0.733	0.733
Firm FE	✓	✓	✓	✓	✓
Sector×Year FE	✓	✓	✓	✓	✓

Dependent variable: Total Sales per Employee (in log). LS Trade includes low-skill trade sectors, HS Innovation includes high-skill innovation sectors, HS Skills includes professional services and LS Domestic includes low-skill domestic services. All specifications include Firm and Sector×Year fixed effects. Standard errors clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 23 Trade and productivity for two-way traders: type of services

	(1)	(2)	(3)	(4)	(5)
2-Way trader	0.161*	0.0837*	0.0594	0.0456	0.235**
	(0.0969)	(0.0442)	(0.0386)	(0.0446)	(0.118)
2-Way trader × LS Trade	− 0.00200				− 0.00296
	(0.00178)				(0.00190)
2-Way trader × HS Innovation		− 0.00191			− 0.00404
		(0.00288)			(0.00312)
2-Way trader × HS Skills			0.00246		0.00135
			(0.00377)		(0.00390)
2-Way trader × LS Domestic				0.00320	0.00267
				(0.00473)	(0.00482)
Observations	24880	24880	24880	24880	24880
Adjusted R^2	0.732	0.732	0.731	0.731	0.732
Firm FE	✓	✓	✓	✓	✓
Sector×Year FE	✓	✓	✓	✓	✓

Dependent variable: Total Sales per Employee (in log). LS Trade includes low-skill trade sectors, HS Innovation includes high-skill innovation sectors, HS Skills includes professional services and LS Domestic includes low-skill domestic services. All specifications include Firm and Sector×Year fixed effects. Standard errors clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

service intensity is driven by the use of low-skill trade or logistical services and by the use of high-skill innovation services. On the other hand, importing firms that use a higher amount of professional services experience a decline in productivity.

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