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REORGANISE, REPLACE OR EXPAND? THE ROLE OF THE SUPPLY-CHAIN IN FIRST-TIME EXPORTING

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Modern trade theory models exporting as paying a fixed-cost in order to access a larger market. This simplification ignores an essential component of the export process: how does the decision to export cause firms to alter their supply-chains? In this paper I demonstrate that first-time exporting not only leads to growth in exporter output and productivity, but also influences the supply-chain in three main ways depending on the exporters size. First, new exporters replace unproductive suppliers with more productive domestic suppliers. Second, new exporters replace existing suppliers with imported alternatives. Third, exporting leads to pecuniary spillovers passed onto domestic suppliers, observed in higher revenue productivity. I use a unique, high-frequency Government of Uganda value-added tax administrative dataset motivated by a simple matching model to provide the first evidence on these effects. The model is identified by exploiting a natural experiment of a reduction in international transportation costs.

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The role of the supply-chain in first-time exporting

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October 16, 2017

Abstract

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Keywords: Learning by Exporting, Supply-chains, VAT data, Development and Trade

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1 Introduction

Transitioning from selling goods domestically to exporting for the first time is a key moment in any firm's development. Extant empirical research suggests that new exporters, when faced with international competitive pressures and with new demand for higher quality and larger markets, grow, become more productive, and invest in higher quality products (De Loecker, 2007; Bernard and Jensen, 1999; Van Biesebroeck, 2005; Bustos, 2011; Pavcnik, 2002; Kugler and Verhoogen, 2012; Lileeva and Trefler, 2010).

Modern trade theory models exporting as paying fixed cost in order to access a larger market (Melitz, 2003). This simplification ignores an essential component of the export process: how does the decision to export cause firms to alter their supply-chains? Unpacking this transition represents a rich untapped area of research.

In this paper, I use a unique Government of Uganda tax administration dataset to consider how first time exporting influences the supply-chain. I show that new exporters (a) replace less productive suppliers with new, more productive suppliers, (b) increase their foreign import usage, and (c) pass through revenue gains to suppliers observed through higher supplier productivity. I also show that exporting firm size is predictive of which of these mechanisms is used by the new exporter. I find that larger new exporters import and pass-through more to existing suppliers, while smaller new exporters search for more productive domestic suppliers.

Motivated by stylised facts in the data, I detail these mechanisms by way of a simple matching framework. In this simple model, final goods producers and suppliers produce using a supermodular production function on their respective productivities. Consequently, larger (higher-productivity) final goods producers match with higher-productivity suppliers, more suppliers and are more likely to export. The highest productivity final goods producers match with import suppliers which are assumed to be at the top of the supplier productivity distribution. Mimicking the empirical strategy, I then consider firm responses to an exogenous productivity shock pushing a firm to export. I show that exporting induces final goods producers to influence their supply-chain; large new exporters have already saturated the local market for domestic suppliers and so are more likely to look abroad for foreign imports, and to pass on revenue gains to their existing suppliers. Small new exporters instead choose to upgrade their domestic supply-chain via dropping less productive suppliers and bringing in higher productivity suppliers.

To consider these research questions requires detailed information on firm-to-firm transactions. The Ugandan government requires, for VAT purposes, that firms report every transaction with every other tax-paying firm in Uganda, the value of this transaction, the good transacted and the counterpart firm's tax identification number. In practice, this data amounts to a dynamic transaction-level firm-to-firm input-output matrix. Using the firm's tax identification number, I am able to link the firm transaction data, across firms and time, with the Government of Uganda's other tax administration datasets: firm balance-sheet data, firm employment information and transaction-level customs data. Together, this allows me to build a dynamic picture of the entire Ugandan formal economy from 2009 to 2015.

This detailed dataset is not normally made available to researchers in any country and, consequently, is very novel. Most research papers that consider firms rely on low-frequency manufacturing surveys which do not include details on the supply-chain nor detailed customs data. As far as I am aware, this is the first paper to link VAT transaction-level data with firm employee and customs data. This allows observations on the complete and dynamic picture of the formal economy of Uganda.

Uganda represents an excellent context in which to consider these research questions. Uganda is a small open economy which is heavily dependent on its export sector. It also has seen rapid growth in exports over the last ten years, driven by a stable macroeconomic climate and trade-supporting policy.

Besides a lack of network firm-level data, another reason for a lack of clear evidence in this research area is the endogenous selection of firms into exporting. New exporters tend to be the firms with more capital, higher wages, better management, and higher productivity (Bernard and Jensen, 1999). Consequently, it is problematic to argue that a new exporter 'learnt by exporting', when an alternative story is that the exporter's superior characteristics would have driven growth had it never exported. This concern also extends to observations of the exporter's supply chain.

To address this selection issue, this paper exploits a natural experiment, namely a policy-driven reduction in the time and cost to transport goods from Uganda to the rest of world. These reforms have included infrastructure improvements, removal of check-points, and single window customs administration (World Bank, 2016b). Moreover, they have driven entry into exporting in Uganda as firms who could not afford the expensive transportation costs are now able to export (TradeMark EA, 2017). Although transport costs vary over time, I do not observe them at the firm level. In order to obtain firm-level variation, I utilise a "Bartik style instrument" (Bartik, 1991) by interacting the value of the firm's product that fits inside a standard shipping container with the transport cost reduction. The intuition behind the instrument is that transport costs influence the cost to export all goods, but that some goods are more intensive in their transportation cost. For instance, transport costs make up a high proportion of the value of the final good for cement exporters. Conversely, for lightweight and relatively high value products such as tea, the percentage mark-up due to transport costs is much smaller.

Using the instrumental variables specification, I find large new exporters increase domestic inputs by 0.7 percent and imports by 14 percent. Whereas small new exporters increase domestic inputs by 7 percent and do not significantly increase imports.

Small new exporters are more likely to add and drop a supplier by 4 percent and 11 percent, respectively. Large new exporters are less likely to add and drop a supplier by 4 percent and 10 percent, respectively. This contributes to firms adding 12 percent more suppliers as a consequence of exporting. Suppliers added in the first year of exporting by small new-exporters are 11 percent higher productivity. Whereas, new suppliers added by large new exporters are just 1 percent higher productivity.

Finally, suppliers who were already matched with the exporter before it began exporting increased observed revenue TFP productivity by 16 percent. This could be a consequence of learning by exporting or a pecuniary spillover.

This paper is related to two major strands of the literature. First, there is a strong macroeconomic empirical literature which associates increased aggregate exports with increased aggregate productivity (See Edwards (1993) for survey). Trade theory has argued this could be down to within-firm productivity growth driven by learning-by-exporting, increased use of technology, or quality upgrading (Alvarez et al., 2013; Bustos, 2011; Kugler and Verhoogen, 2012; Caliendo and Rossi-Hansberg, 2012; Lileeva and Trefler, 2010). Alternatively, it may be a result of a reallocation of resources towards more productive firms which self-select into exporting (Melitz, 2003; Arkolakis et al., 2014).

A recent proliferation of empirical papers utilising newly-available firm-level data has sought to identify these effects. However, identifying causal effects is difficult due to the selection of firms into exporting based on unobservable characteristics. The literature has addressed this through a mixture of natural experiments, instrumental variables, randomised control trials and matching methods. Pavcnik (2002) and Trefler (2004) both use trade liberalisation events to show that shaking out unproductive firms leads to an overall significant rise in domestic manufacturing productivity. Bustos (2011) shows that trade liberalisation leads to increased research expenditure. De Loecker (2007) controls for self-selection into export markets and finds that export entrants grow faster than their domestic counterparts.[1] Atkin et al. (2016) run a randomised experiment, generating exogenous variation in access to foreign markets for Egyptian rug manufacturers, and find that exporting leads to higher profits, improvements in quality and improvements in technical efficiency. Caliendo and Rossi-Hansberg (2012) considers how exporting effects the boundary of the firm, finding that firms that export in response to trade liberalisation will increase the number of layers of management.

The second strand of the literature is the role of the supply-chain in firm production choices. Goldberg et al. (2010) and De Loecker et al. (2015) show changes in input prices substantially alter firms pricing, markups and firm's product scope. Antras et al. (2014) develop a quantifiable multi-country sourcing model in which firms self-select into importing based on their productivity and country-specific variables. Blaum et al. (2015) estimate the gains from input trade, finding in the case of France that consumer prices would be 27% higher in the absence of intermediary input trade. Lu et al. (2015) finds that Colombian manufacturing firms regularly shift their import varieties; this shift depends on firm's life-cycles and macroeconomic conditions, and is predictive of future sales growth. Kugler and Verhoogen (2012) extend the Melitz (2003) model to include endogenous choice of input

[1] See Harrison and Rodriguez-Clare (2010) for survey article

and output quality, matching empirical stylised facts in Colombia that larger plants pay more for inputs and charge more for outputs. In a related paper, Kugler and Verhoogen (2009) show that Colombian plants purchase higher quality inputs on the import market than on the domestic market. While Fieler et al. (2017) show that trade liberalisation event is associated with higher skill utilisation, imported input usage, and changes in domestic input usage. Connected to this literature, there is a growing research field highlighting the importance on interconnections between firms on macroeconomic outcomes (Acemoglu et al., 2012; Caliendo et al., 2014; Carvalho et al., 2016; Magerman et al., 2016; Bernard et al., 2015; Giovanni et al., 2017).

Another connected strand of the literature, but covered in less detail here, is the role of exporting in labour markets. Helpman et al. (2010) and Helpman et al. (2016) show that, in an economy with labour-market frictions, exporting can lead firms to increase the quality of their workforce through screening. Verhoogen (2008) and Frıas et al. (2009) show that quality upgrading to appeal to high-value export markets leads to high-skilled labour wage growth in developing countries.

As this research area is relatively undeveloped, I am not aware of any theoretical model that directly relates to the research questions of this paper. Perhaps the most connected model is developed by Halpern et al. (2015). The authors present a model of how firms optimal choice of foreign and domestic inputs influences productivity. Firms are assumed to have a love-for-varieties in intermediary inputs, while import costs are increasing in the number of imported inputs. I instead choose a matching framework in order to highlight the stylised facts identified in the data that buyers and suppliers exhibit positive assortative matching, that only the highest productivity firms import, and that exporters make more and higher productivity matches.

The remainder of this paper is organised as follows: Section 2 discusses the data and context of exporting in Uganda, Section 3 presents three stylised facts identified in the data, Section 4 presents a basic matching model which provides some theoretical predictions on how exporting influences supply choices, Section 5 displays results and Section 6 concludes.

2 Data and context

In this section I first describe the datasets used in this study and then present some descriptive statistics on exports, exporters and suppliers in Uganda.

2.1 Datasets

The data used in this paper comes from five linked datasets collected by the Ugandan Revenue Authority (URA), which are administered for taxation purposes. This data is confidential and is made available for the purposes of this research. All datasets have been anonymised by the URA, but arrived otherwise unchanged from the raw data submitted by the tax-paying firms. They each contain a unique tax identification number which allows the datasets to be linked across firms and time. The datasets contain the universe of firms paying tax in Uganda; consequently they are representative of the entire formal sector. It also contains the universe of direct-exporting firms[2], as all firms choosing to export must go through a customs office at the border, and must be registered to pay tax. This is probably the most interesting sample of firms to consider in Uganda as they are the largest, most technically adept, and employ the most people. Inference on the informal sector is outside the scope of this study.

The first dataset is the most novel. Ugandan firms are required for VAT purposes to record every transaction with any other tax-paying firm from 2009-2015. This gives a line-by-line account of the good transacted, the value of the transaction, the date it took place, and the tax identification number of the linked firm. This dataset allows me to build a dynamic input-output matrix for the whole of the Ugandan formal economy.[3]

The second dataset contains trade data from 2005 to 2015. The dataset is transaction-level and includes variables of import origin, export destination, volume, value, and HS8 trade classification.[4] As the data is raw, I clean the dataset for obvious data entry errors.[5] I

[2]the alternative to direct exporting would be exporting through an intermediary. The dataset also allows me to observe this, but for brevity reasons, I do not consider it at this time.

[3]It also allows a product-specific calculation of inputs, although this is not done for the time being given the complexity of the data management process. Records are manually entered without product codes, in the short-run it may be possible to identify specific inputs for instance electricity.

[4]The Harmonised System of Tariff Nomenclature is the standardised trade classification system. 8 digits is the most disaggregated level displaying extensive detail on the types of goods imported and exported.

[5]As the dataset is raw and is entered by hand it contains numerous data-entry errors. One common error

identify each firm's date of first export and quantity of imports. I then winsorise the import value at the five percent level and take the natural log. Finally, data is collapsed to the annual level, for tractability and because effects are not expected to take place at a higher frequency.

The third dataset is monthly balance-sheet data from VAT records from 2009-2015. Ugandan firms are required to report monthly on their total sales, total inputs, and expenditure on capital goods. I again winsorise the three variables at the five percent level and collapse to quarterly changes.

The fourth dataset contains monthly labour information from 2009-2015 and is collected for Pay as You Earn (PAYE) taxation. The dataset includes wages and number of employees for each firm and is disaggregated by casual and permanent employees. I merge the casual and permanent employee variables to create a total employment and total wage bill variable. I drop a small number of observations where the number of employees exceeded 1000 and where the average salary was below 1000 USH (0.3USD per month). I then winsorise and take logs. Finally, I collapse the data to look at quarterly averages.

The fifth dataset contains descriptive details on the firm itself. This includes the ISIC industrial sector classification[6] and a more general description of its main operations.

All five datasets are merged into an edge-wise dataset of firm-to-firm transactions on a annual basis. I drop firms which do not start exporting before 2010 and those firms which begin exporting less than one year before their first tax records.

As far as I am aware, this is the first paper to link VAT transaction level data with firm employee and customs data. This allows observations on the complete and dynamic picture of the formal economy of Uganda. As research using tax data remains rare, one potential concern might be that the data is inconsistent with other datasets. In appendix D, I address this concern by comparing the tax data used in this study to other freely-available data sources on firms in Uganda. I also in section 3 show that descriptive statistics on exporters

is reporting the USD value of the traded good in the column labelled Ugandan Shillings (USH) and vice versa. In cleaning this dataset, I employ a cleaning strategy of comparing individual import values to the average HS8 valuation in the entire sample. I then use the valuation variable (USD or USH converted to USD) which is closest to the average HS8 valuation.

[6] Standard industrial classification of economic activities (ISIC) is a classification system for industry categories. The URA classifies firms at a 4 digit level.

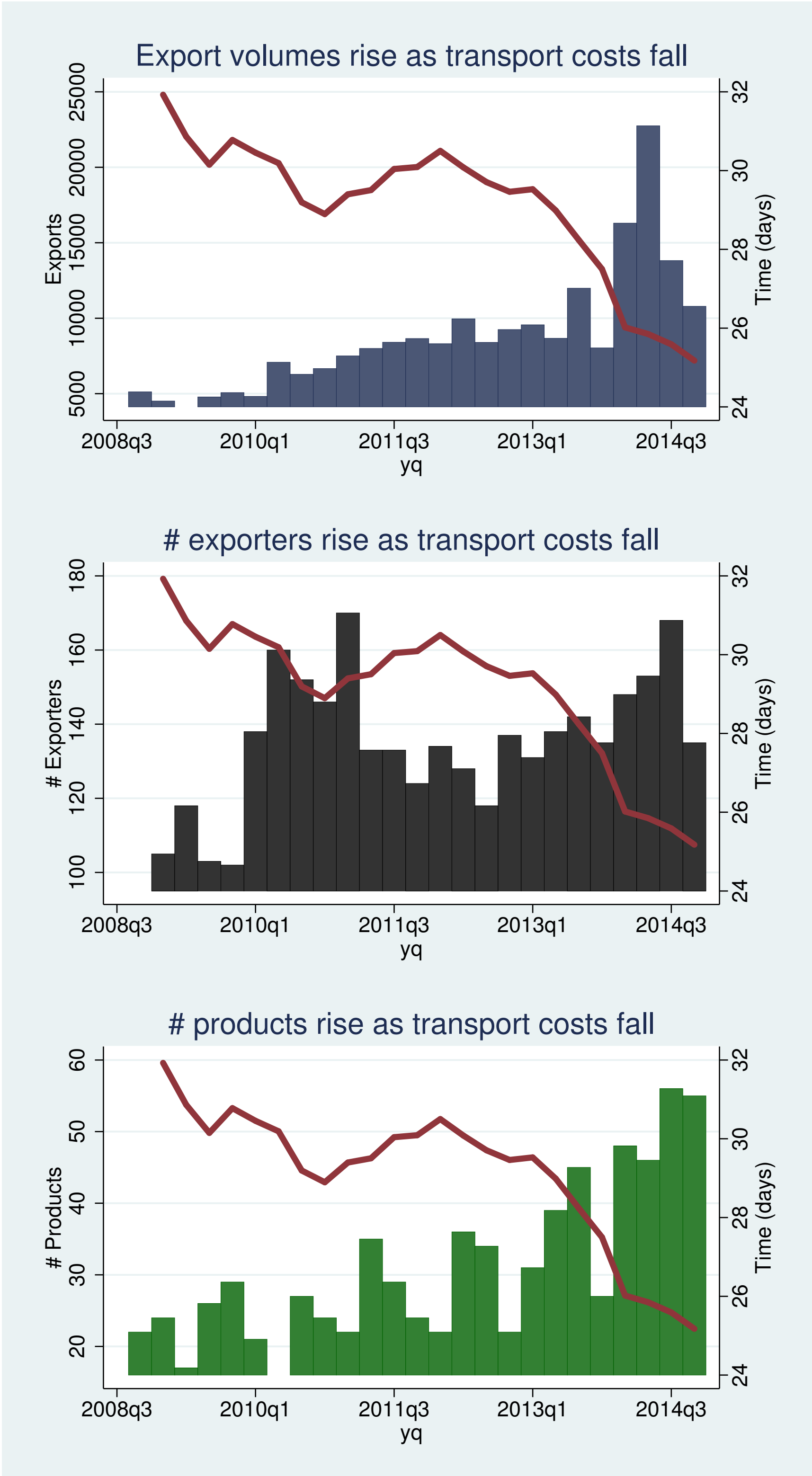
are consistent with other research papers using data from more traditional sources.

2.2 Context

Goods exports in Uganda have grown steadily over the last two decade, primarily led by unprocessed commodities (coffee, tea and minerals) but also entry into new product lines such as light manufacturing (building materials, metal products, fishing nets). This impressive export performance has been driven by macroeconomic stability, falling trade costs through integration into the East African Community (EAC), and a sustained trade-friendly policy. Exports of goods and services as a percentage of GDP have grown from 12 percent in 1994 to 20 percent in 2014 (World Bank, 2015).

Figure 1, presents three indicators of Uganda's export performance between 2009 and 2015 mapped against the time to export goods from the capital Kampala to the nearest port in Mombasa, Kenya. From panel (a) it is possible to see that export volumes have risen substantially in line with the fall in transportation times. From panel (c) you can see also that the number of unique products exported from Uganda has risen in line with transport time reductions. Most interesting, however, is panel (b) where you observe that the number of exporters from Uganda is extremely sensitive to the transportation time. A fall in transportation time is clearly associated with an increase in the number of unique exporters. This is consistent with a hypothesis that transportation costs are a binding constraint to exporting in Uganda and is the rationale behind the identification strategy discussed in Section 5.

Figure 1: Transport Cost and economic indicators



Panel (a) shows export volumes in 2011 RWF against the time to export on the northern corridor. Panel (b) shows the number of exporters against the time to export on the northern corridor. Panel (c) shows the number of products classified at the HS-4 digit level against the time to export on the northern corridor. Time to export is a weighted average of data from the Northern Corridor Transport Observatory and the World Bank Trading Across Borders index.

3 Summary Statistics and Stylised Facts

I now present descriptive statistics on the dataset and discuss three stylised facts.

Figure 2 presents a graphical representation of the complete network of tax paying firms in Uganda. Each node represents a firm and each connection indicates an input trade has taken place between two firms. This partitions the Ugandan economy into 83,000 firms and a total of 420,000 firm-to-firm connections.[7] Nodes are scaled by the number of firms connected to the node, helping to identify firms which are hubs. Finally, nodes are coloured red if they export at least once over the period. In total there are 3026 exporting firms, which can be linked between the network and domestic trade datasets.

The purpose of Figure 2 is to highlight the degree to which firms in a small open economy such as Uganda are dependent on one another. In trade economics, firms are often assumed to purchase intermediary inputs from an anonymous marketplace. Figure 2 instead demonstrates the complex web of connections that firms make and shows that we must consider firms influence on one another along a supply-chain. It also demonstrates the extent to which exporters play a crucial role in the economy as can be observed from their relative node size.

In order to keep analysis tractable, I now focus on a bipartite graph of buyers and suppliers. In doing this I demonstrate three stylised facts: (1) buyers and suppliers exhibit positive assortative matching (PAM) on productivity and size, (2) importers have higher productivity, among importers higher productivity firms import more products and from more countries, and (3) exporters are larger and more productive and have more suppliers, suppliers of higher quality and import more than non-exporters.

[7]The spatial location of nodes is driven by a force directed layout known as ForceAtlas2. This layout works like a physical system: nodes repulse each other like charged particles, while edges attract their nodes, like springs. These forces create a movement that converges to a balanced state (Jacomy et al., 2014).

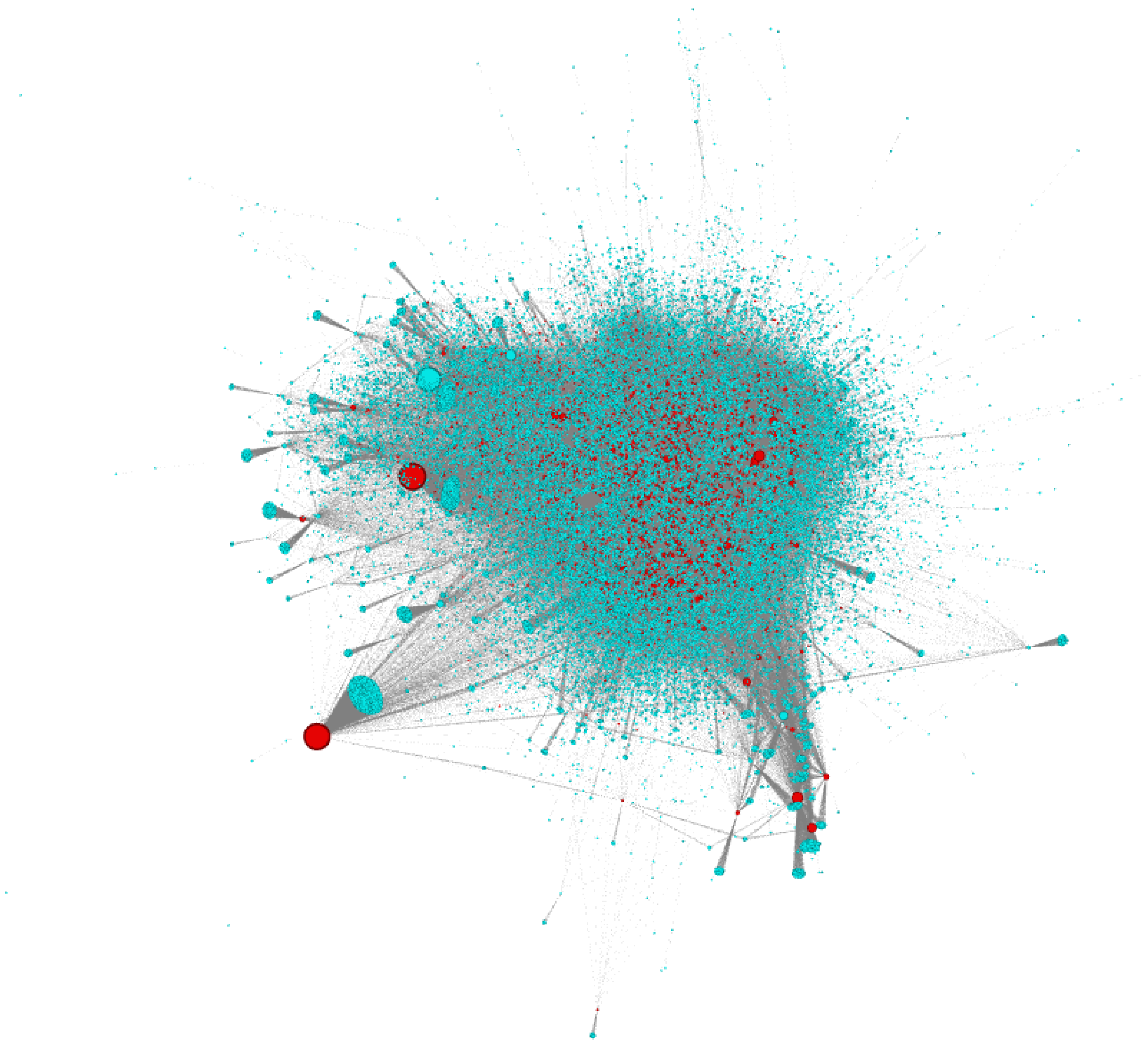


Figure 2: Graphical representation of Ugandan firm-to-firm connections (core) for the years 2009-2016. Each node corresponds to a firm and each edge represents an input-supply relationship between two firms. Nodes coloured red show exporters. Larger nodes show the firm has more connections, this helps to identify 'hub' firms. The layout of nodes is determined by ForceAtlas2 network layout algorithm. ForceAtlas2 is a force directed layout: it simulates a physical system in order to spatialize a network. Nodes repulse each other like charged particles, while edges attract their nodes, like springs. These forces create a movement that converges to a balanced state (Jacomy et al., 2014).

FACT 1: Buyers and suppliers exhibit positive assortative matching (PAM) on productivity and size

Stylised fact one states that suppliers and buyers exhibit positive assortative matching on productivity. This can be seen in Figure 3 where in both output per worker and TFP measures of productivity there is a clear positive correlation between buyer and supplier productivity. As shown in Table 9 in the appendix these correlations are significant at the one percent level even once controlling for industry fixed effects.

As far as I am aware, no paper has previously considered whether there is positive assortative matching between buyers and suppliers, however, this phenomenon has been heavily studied in labour markets where PAM is typically found (Abowd et al., 1999; Card et al., 2013).

If we believe there are complementarities in production between buyers and suppliers then positive assortative matching is the most efficient outcome. It is especially interesting in a developing country context where we might expect that firm heterogeneity is very high (Spray and Wolf, 2016). Consequently, the inefficiency loss from mismatch between buyers and suppliers would be large.

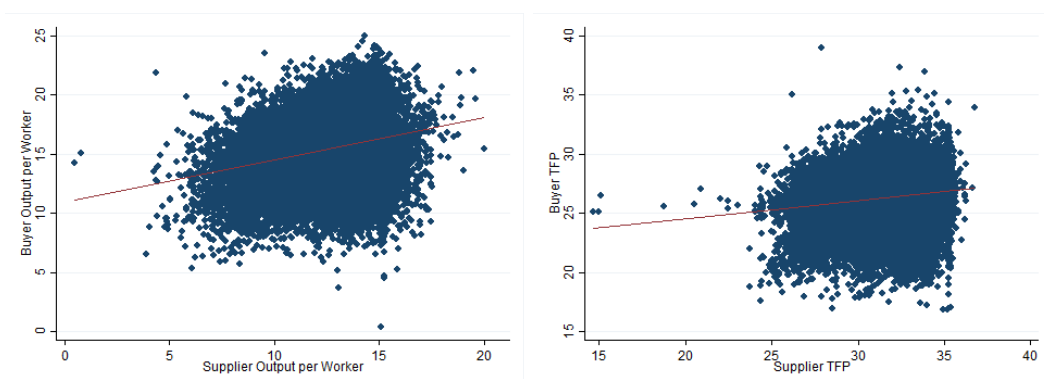


Figure 3: Scatter plot of buyer productivity and supplier productivity

FACT 2: Importers have higher productivity. Among importers, higher productivity firms import more products and from more countries

This fact can be seen in Table 1. The first column of Table 1 shows that importers have higher productivity than non-importers even once we control for industry fixed effects. A one percent increase in the productivity of a firm is associated with a 2 percent increase in the probability of being an importer. This is consistent with Halpern et al. (2015) which finds that Hungarian importers are the largest firms.

Columns 2, 3 and 4 of Table 1 show the correlation between firm productivity and intensive margins of importing. Higher productivity importers also import larger volumes, import more products, and from more countries. This is consistent with Antras et al. (2014) who document a positive correlation between firm size and the number of import origins.

Combining stylised facts 1 and 2, we can begin to build a picture of firms sourcing decisions. High productivity firms source multiple inputs from abroad, the best firms also source from the best suppliers domestically, while lower productivity firms source from lower productivity domestic suppliers.

Table 1: Importer characteristics

	(1) Importer dummy	(2) # import products	(3) # import origins	(4) Ln Import Value
Ln Output/Worker	0.0218***	2.134***	0.277***	0.220***
	(0.00760)	(0.542)	(0.0391)	(0.0298)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	29633	15547	15547	15547

Table reports coefficient results for correlations in productivity import variables. Industry fixed effects are at the ISIC 4 -digit level. Standard errors are clustered at the ISIC 4-digit level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

FACT 3: Exporters are larger and more productive than non-exporters and have more suppliers, suppliers of higher quality and import more

In Table 2, I consider how exporters differ to non-exporters within ISIC 4-digit industries. This framework is similar to that used in Bernard and Jensen (1999). In addition to the variables used in Bernard and Jensen (1999), I am also able to look at indicators of supplier productivity. Table 2 demonstrates fact 3 that exporters have higher productivity[8],

[8]Productivity measures are discussed in detail in the empirical strategy.

Table 2: Descriptive statistics for selected variables

	Beta Coefficient
Ln annual total output	1.905***
	(0.0373)
TFP (Levinsohn-Petrin)	0.440***
	(0.0220)
Ln output per worker	1.009***
	(0.0320)
Ln annual total intermediary inputs	1.916***
	(0.0289)
Ln annual total imports	2.000***
	(0.0400)
Ln number of suppliers	1.609***
	(0.00920)
Ln annual total pay	1.368***
	(0.0191)
Ln annual total employees	0.975***
	(0.0155)
Supplier TFP (Levinsohn-Petrin)	0.0673***
	(0.00904)
Supplier Ln output per worker	0.117***
	(0.0171)

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regression coefficients from $X_i = \alpha + \beta Export + c * Industry$.

suppliers of higher quality (including more importers), more suppliers, and higher profits than non-exporters. Also note from Table 2 that exporters in Uganda have on average more employees and have a larger wage bill than their non-exporting counterparts.

Indeed, exporter exceptionalism is a well-known result within the trade literature (Bernard and Jensen, 1999; De Loecker, 2007; Kugler and Verhoogen, 2012), although this is the first paper to show that this extends directly to the productivity of the supplier. Table 2 suggests that the firms in my dataset are consistent with datasets used in previous research. It also suggests that firms who become first-time exporters are likely to be different from their non-exporting counterparts, as discussed in my empirical strategy.

4 Theoretical Framework

In this section, I set up a simple theoretical framework to explain how final goods producers match with their suppliers and how this influences their export choices. Using this baseline specification, I show that with positive-assortative-matching the most productive firms will match with the most productive suppliers, match with more suppliers and export.

I then extend the model to consider the consequences of an exogenous shock to one firms productivity such that it becomes an exporter, and thereby mimicking the natural experiment. I then observe comparative statics on this firms supplier choices and pecuniary spillovers to the supplier.

I show that this exogenous productivity shock causes different supply-chain responses depending on the size of the exporting firm.

4.1 Model Set-up

Consider two types of agents: suppliers and final goods producers.

4.1.1 Suppliers

Suppliers, denoted $j \in S = \{s_1, ..., s_n\}$, have unit supply and zero costs. The set of suppliers is composed of international and domestic suppliers $S = S^I \cup S^D$. Suppliers have productivity ϕ_j drawn from a productivity distribution $G(\phi_j)$. All international suppliers are above all domestic suppliers in the productivity distribution.

4.1.2 Final Goods Producers

Final goods producers $i \in P = \{p_1, ..., p_n\}$, have productivity ϕ_i drawn from a distribution $F(\phi_i)$, and produce by matching with suppliers.

4.1.3 Matching Technology

Final goods producers and suppliers can mutually agree to match. A match is denominated by a many-to-one matching indicator function, μ, from the set $S \cup P$ into the set of unordered families of elements of $S \cup P$ such that:

1. $\mu(i) \in S \cup \{i\}$ for $i \subseteq P$,

2. $\mu(j) \in P \cup \{j\}$ for $j \in S$, and

3. $\mu(\mu(j)) = 1$.

Each final goods producer has a convex increasing cost on the number of matched suppliers which I assume for simplicity is quadratic,[9] while suppliers can only match with one final goods producer. Each supplier-producer pair yields a surplus given by a supermodular function on i and $j's$ productivity. The surplus from each connection is shared by Nash bargaining such that the profit function for suppliers and final goods producers is respectively,

$$\pi_j = \mu(j)(1-\beta)\phi_j\phi_i \tag{1}$$

$$\pi_i = \sum_{j \in S} \mu(i)\beta\phi_j\phi_i - \left(\sum_{j \in S} \mu(i)\right)^2 \tag{2}$$

where $(\beta, 1-\beta)$ are the Nash bargaining coefficients, ϕ_i is final goods producer $i's$ productivity, ϕ_j is supplier $j's$ productivity.

[9] This cost can be considered as either the cost of matching with multiple suppliers, or the cost of producing more goods, as the unit supply assumption means firms can only grow by adding suppliers. This assumption is discussed further in section 4.3

4.1.4 Stable assignment

Stable assignment is defined according to the following two conditions:

(i) No final goods producer-supplier pair could increase utility by matching

$$\begin{gathered}\nexists\ i, j \text{ such that } \pi_i(\mu(i) \cup \{j\}) > \pi_i(\mu(i)), \text{ and} \\ \pi_j(i) > \pi_j(\mu(j))\end{gathered} \tag{3}$$

(ii) No other subset of suppliers can increase utility for i, and j benefits from matching compared to not matching at all.

$$\begin{aligned}&\text{For all } i, \pi_i(\mu(i)) \geq \pi_i(s)\ \forall s \subseteq \mu(i) \\ &\text{For all } j, \pi_j(\mu(j)) > \pi_j(j) = 0\end{aligned} \tag{4}$$

In order to obtain a stable assignment, I adopt the equilibrium concept from Roth and Sotomayor (1992) by allowing firms to pick suppliers sequentially in productivity order.

Theorem 1 *In a perfect information game a stable assignment can be found by ordering firms by productivity and letting them choose suppliers sequentially. This assignment yields each producer its highest ranked achievable suppliers and is weakly Pareto-optimal for suppliers (See Roth and Sotomayer, 1990 theorem 5.7, 5.8, 5.10).*

4.2 Export

Each final goods producer can choose to export or not with the highest productivity producer choosing first. Exporting has a fixed cost $f_X > 0$ which yields a higher price in the foreign market to the domestic market $\psi^X > \psi^D = 1$.

4.3 Discussion of Assumptions

To keep the model simple and parsimonious, I have made a number of simplifying assumptions that deserve further discussion.

First, I assume suppliers have unit supply. Although a strong assumption, this enables the model to focus on the extensive margin of adding more suppliers at the expense of the intensive margin of increasing supply from existing suppliers. In Uganda, it is plausible that suppliers are constrained in their output and so expansion by sourcing from multiple suppliers is not unrealistic.

Second, I assume that production is a multiplicative function of producers' and suppliers' output. Again, this is a strong assumption, but one that is common in the matching literature. Moreover, the same results can be derived from a weaker assumption that output is an increasing function of producer and supplier productivity. I make the stricter assumption for ease of exposition.

Third, I assume Nash bargaining between producers and suppliers. This is similar to the assumption made in Helpman et al. (2010), and is necessary in this setup to avoid consideration of prices. It is also realistic in a setting like Uganda, where firms may have market power. An alternative set-up would include prices and allow for more general equilibrium effects.

Fourth, I assume that firms sequentially choose whether to export. Firms that export receive a higher price for all of their output and pay a fixed cost. Fixed costs of exporting are common in the literature (see for instance Melitz (2003)) and represent some initial costs of changing your product to make it suitable for exporting - examples are costs of meeting phytosanitary standards and of gaining export-destination information.

4.4 Baseline Model: which firms export?

In the baseline model, I consider which final goods producers export and there subsequent supply-choices.

The model is a one-period game; suppliers and final goods producers observe their productivity, producers then choose sequentially in productivity order which suppliers to match and whether or not to export. Fixing the export decision of other firms, it is a best response for producer i to export if and only if,

$$\psi^X \sum_{j\in S} \mu(i)^X \beta\phi_j\phi_i - c\Big(\sum_{j\in S}\mu(i)^X\Big) - f_X > \sum_{j\in S}\mu(i)^D\beta\phi_j\phi_i - c\Big(\sum_{j\in S}\mu(i)^D\Big) \tag{5}$$

Under this set up there is a unique equilibrium where only exporters above a productivity threshold (ϕ_i^*) export. Other equilibriums exist if producers decide to export in a different order. For instance, if producers were to choose in reverse productivity order, a lower productivity firm could decide to export for the purpose of stealing a higher productivity firms' suppliers. I ignore these equilibrium as I am not interested in these types of strategic interactions.

Proposition 1 *If firms choose to export in productivity order, bigger and higher productivity firms will have suppliers of higher quality, have more supplier, and have higher profits, and export.*

Proof. In appendix C ■

The intuition for this result is consistent with the Melitz (2003) model and empirical research (Bernard and Jensen, 1999; De Loecker, 2007) in that only the best firms export. The additional result that these firms are also the ones with the best suppliers and have more suppliers is driven by the additional surplus available to exporters which yields positive assortative matching between producers and suppliers. This is consistent with Kugler and Verhoogen (2012), whose model also finds that larger firms have higher quality suppliers. Finally, the fact that export firms have higher quality suppliers also means that they will be more likely to have import suppliers, as import suppliers are at the top of the supplier distribution.

4.5 Comparative statics

In the extension to the baseline model, I add an additional period and consider the consequences of a shock to one firms productivity.

In period 2, one final goods producers receives an exogenous shock to its productivity (γ) if it decides to export. This mimics the empirical strategy as the reduction in transportation costs will make it now more profitable for some firms to export. The newly-exporting firm now has a higher surplus as it now has a higher productivity and its production is multiplied by a now higher price ψ^X. This then creates an incentive to switch suppliers.

Following the shock to ϕ_i, each final goods producer again chooses whether to export and which suppliers to match with.

The timing of the model is as follows:

1. One producer receives positive shock to productivity if it chooses to export

2. Producers choose whether to export in new productivity order, new producer-supplier assignment decided

The final goods producer's profit function is now given by:

$$\pi_i = \begin{cases} \psi^X \sum_{j \in S} \mu^X(i)\beta\gamma\phi_j\phi_i - c(\sum_{j \in S} \mu^X(i)) - f_X & \text{if export} \\ \sum_{j \in S} \mu(i)\beta\phi_j\phi_i - c(\sum_{j \in S} \mu(i) & \text{otherwise} \end{cases} \tag{6}$$

where $\gamma > 1$ if the firm receives a productivity shock and $\gamma = 1$ if not.

4.5.1 New Supplier Assignment

Following the productivity shock, it will now be profitable for some firms to become exporters for the first time. Consequently, there must exist a new equilibrium with a different set of exporting firms. Comparing these firms' supply decisions in period 2 to those in period 1, we get the following proposition.

Proposition 2 *First-time exporters weakly increase their number of suppliers and average quality of suppliers. Larger new exporters add imports while smaller producers add domestic suppliers.*

Proof. In appendix C ■

The intuition behind this result is that exporting causes firms to grow as there output now receives a higher export price. With this higher price they can attract higher quality suppliers and have a higher marginal return to adding suppliers. The fact that larger new-exporters match with imports is a consequence of imports being at the top of the supplier quality distribution. An intuitive rationale for this result is that larger new exporters have already exhausted the local market and so must look abroad. Smaller new exporters can benefit from adding higher quality domestic inputs.

4.5.2 Pecuniary spillovers

Finally, I now consider the consequence of being a supplier to a firm that becomes an exporter. As shown in proposition 1, relative to the case when the final goods producer just sells domestically, the joint surplus has increased. Given we have assumed that Nash bargaining shares are constant, suppliers that remain connected to the new exporters will have a new profit equal to $P^X\gamma$ times the profit if they were not connected to this new exporter.

$$\pi_j^X = \mu(j)(1-\beta)\psi^X\gamma\phi_i\phi_j = \psi^X\gamma\pi_j^D \tag{7}$$

Proposition 3 *Suppliers of new exporters will have increased output and increased revenue productivity. These effects will be increasing in the size of the first-time exporter.*

Proof. In appendix C ■

The intuition behind this result is that returns to exporting have increased the joint surplus some of which is passed to the suppliers. I refer to this as a pecuniary spillover. These pecuniary spillovers are increasing in the size of the exporter as the joint surplus is increasing in the size of the exporter. An alternative explanation is that suppliers are becoming more productive as a consequence of being connected to an exporter through a pass-through of learning-by-exporting. However, these explanations are observationally equivalent, given in the data I only observe revenue productivity.

4.6 Model predictions

In summary, the theoretical framework makes several predictions about which firms export and how exporters respond to first-time exporting.

Firstly, the model is consistent with other trade models in arguing that only the largest and highest productivity firms export. The model extends this result to show that exporters also have the best suppliers.

Secondly, exporting could lead to (a) switching from less productive to more productive suppliers (domestic search), (b) switching from less productive to import suppliers (international search), and (c) pecuniary spillovers to suppliers.

Thirdly, I show that larger and more productive firms will import, and have larger pecuniary spillovers to their suppliers. Smaller and less productive firms instead search for better suppliers domestically.

5 Empirical Strategy

The empirical strategy aims to identify if the predictions made in section 4.6 are consistent with the data and whether these predictions can be causally identified.

To answer these questions, the empirical strategy follows two stages. First, I present a baseline specification which utilises panel-data methods to observe the within-firm change in a vector of outcome variables upon becoming a new exporter. Second, I instrument for the decision to export using the intertemporal change in transportation cost to obtain a local average treatment effect of exporting on the same vector of outcome variables.

5.1 Baseline specification

The baseline specification aims to document the impact of exporting on a vector of outcome variables. Following the learning-by-exporting literature, I run the following two regressions using OLS:

$$Y_{it} = \beta_0 + \beta_1 Export_{it} + a_i + \delta T + u_{it} \tag{8}$$

$$Y_{it} = \beta_0 + \beta_1 Export_{it} + \beta_2 Export_{it} * big_i + \delta T + a_i + u_{it} \tag{9}$$

where subscripts i and t indicate firm and time, respectively, big indicates the firm has more than 50 employees in 2009, T is a vector of time dummies, and a_i is an unobserved time-invariant firm fixed effect. The fixed effects are included to consider within-firm variation, and to remove variation across firms of different kinds. Y is a vector of the exporting firm's outcome variables, which are discussed below.

Varying the independent variable allows me to consider each of the predictions outlined in the theoretical framework.

Proposition 1 stated that exporting is associated with increased output and higher productivity for the exporting firm. To test this empirically, I consider $Y_{it} = \{Exporter\ Output_{it}$ $, Exporter\ Productivity_{it}\}$.[10] If there is a positive effect from exporting, one would expect the β_1 coefficient to be positive. This would be consistent with the existing literature.

Proposition 2 stated that the largest new-exporter firms will search for suppliers abroad through importing, while smaller new-exporting firms will search domestically. This is empirically examined by letting $Y_{it} = \{Domestic\ Inputs_{it}, Imported\ Inputs_{it}, add_{it}, drop_{it},$ $Number\ of\ Suppliers_{it}\}$. $Domestic\ Inputs_{it}$ is the log of domestic input volumes, $Imported\ Inputs_{it}$ is the log of imported inputs, $add\ and\ drop_i$ is a dummy variable for whether a firm added and dropped suppliers in a given year; and $Number\ of\ Suppliers_{it}$ is the natural log of the number of suppliers firm i used at time t.

In addition, I look to see whether firms pick new suppliers which are more productive by looking at measures of productivity for each supplier against a set of dummy variables for whether the firm first became a supplier prior to exporting, during the export year, or, a year or more after the export year.

$$Average\ New\ Supplier\ Productivity_i = \beta_0 + \beta_1 exportyear_i + \beta_2 exportyear_i * big_i + big_i + u_i \tag{10}$$

Proposition 3 stated that exporting resulted in larger firms passing through revenue gains to suppliers which would be observed in the supplier by higher revenue productivity. This is examined by letting $Y_{it} = \{Supplier\ Productivity_{it}\}$.

While panel-data methods control for time-invariant firm fixed effects, selection into exporting is endogenous and heavily driven by time-varying unobservables - more able firms decide to export, less able firms do not. I address this by using a natural experiment to instrument for first-time exporting.

5.2 IV Approach

To identify the causal effects of exporting on the supply chain I require a variable that is correlated with selection into exporting but not with any of the outcome variables except

[10] Productivity is calculated in two ways: output per worker and Levinsohn-Petrin productivity which is calculated separately for each industry. More details on this are provided in the appendix.

through the channel of interest.

In order to instrument for the decision to export I utilise a natural experiment of a policy-driven reduction in transport costs for international trade, which was targeted towards reducing export costs outside of the region. The cost and time to export goods from East Africa has fallen sharply since 2007 driven by Government reforms at the East African Community level. These reforms have included one-stop border posts, removal of role-in-motion weigh bridges, privatisation of weigh bridges, removal of police check points, port upgrading, improved road surfaces, and movement within the EAC to the Single Customs Territory including a regional bond and interfacing of regional customs systems. All reforms have been negotiated at the regional level by member states and are administered by the EAC trade and customs committee. Member states have committed to a matrix of reforms[11], which have been extensively monitored and implemented. Importantly, these reforms are likely to be permanent given the oversight of the regional body, allowing businesses to make long-term export decisions.

Transport costs have been shown in other research in Africa to severely constrict exporting (see Donaldson et al. (2017) for summary). As a landlocked country in central Africa, Uganda has some of the most expensive transportation costs in the world. In 2017, Uganda ranked 136 out of 190 countries on World Bank's Trading Across Border Index (World Bank, 2016a). This suggests the effects of reducing transportation costs may be substantial.

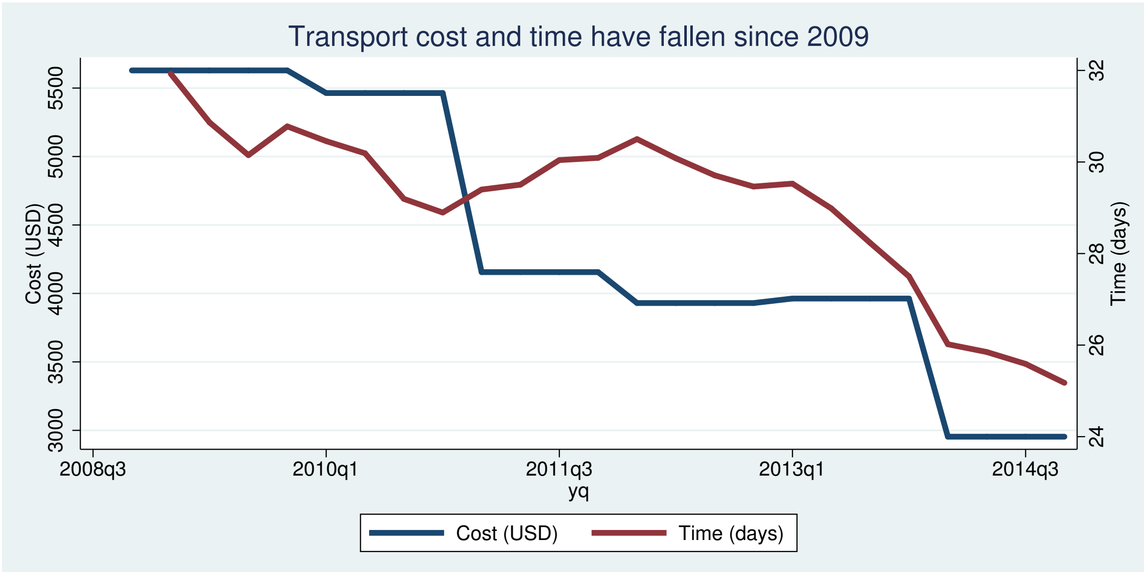
I use the transport time variable as a proxy for transport costs as this has been recorded more frequently than the transport cost variable and so maybe more accurate.[12] In the text I will use transport cost and time interchangeably.

The transport cost variable varies at the inter-temporal level but does not vary at the firm or product level. To address this I interact the transport cost variable with value of each firms' product which can be fit into a standard shipping container. The measure is produced by calculating the average value for each HS8 product category able to fit inside

[11] For an example of one of these reports visit http://www.eac.int/news/index.php?option=com_docman&task=doc_view&gid=407&Itemid=73

[12] As a robustness check I also use the transport cost variable as an instrument finding similar effects. These regressions are available from the author on request

Figure 4: Cost and time of exporting in Uganda has fallen



Source: Authors calculated based on a weighted average of data from the Northern Corridor Transport Observatory and the World Bank Trading Across Borders Index.

a shipping container. I then multiply this number by the average container transport time in a given year and weight by the proportion of this product in a firms' export basket. For firms which do not export I use the average value of this figure for firms in their ISIC 4-digit category. I also drop firms in the service sector as this instrument would not make sense for this industry.

The intuition behind the instrument is that transport costs influence the cost to export all goods, but that some goods are more intensive in their transportation cost. For instance, transport costs make up a high proportion of the value of the final good for cement exporters. Conversely, for lightweight and relatively high value products such as tea, the percentage mark-up due to transport costs is much smaller. This instrument was inspired by conversations with businesses in East Africa which have told the author that transport cost reductions make new types of products viable to export. For instance, bulky and low value building materials are now more profitable to export. Following Dieterle and Snell (2014), I include the instrument and its square as we might think that the instrument enters non-linearly.

While this is a plausible instrument, it might also be argued that the exclusion restriction is weak: for instance, consider that a reduction in transport costs for imported goods could mean a substitution away from domestic goods and towards imported goods. While this may be the case, anecdotal evidence suggests these reforms have affected exporters more than importers. For instance, reforms to customs procedures have primarily targeted exporting as this is a key policy goal of the countries in the region. This is supported by data from the World Bank trading across borders database which shows that both the cost to export and the time to export have fallen far more rapidly for importing than exporting.[13]

6 Results

In this section, I present results from the baseline OLS regressions and then consider results from the instrumental variables regressions. Results are organised into subsections which correspond to the main predictions from the theoretical framework: exporter growth predictions, exporter input choice predictions and influence on supplier predictions.

6.1 Exporter Growth

Table 3 presents results from OLS (panel A) and instrumental variables (panel B) regressions considering exporter output and productivity variables before and after exporting.

In the baseline specification, I control for firm and time fixed effects. As can be seen from column 1 of Table 3, output increases after exporting and is significant at the one percent level. This is consistent with my model and previous research that firms grow when they first export.

In column 3 and 5 of Table 3, results show that exporting is also associated with a statistically significant increase in productivity of exporting firms by 22 percent. This is also consistent with my model which argued that exporting would lead to an increase in productivity through better suppliers and higher international prices and with the wider literature which has found exporting increases exporting firm productivity (De Loecker, 2007).

[13]The time to export fell from 35 days to 30 days, while the cost fell from USD 5749 to USD 2954 per container. The time to import fell from 34 days to 33 days, while the cost to import fell from USD 5994 to USD 3561 per container.

In column 2, 4 and 5 of Table 3, I include an interaction term between the size of the exporting firm and the export dummy. Exporter size does not have a statistically significant differential impact on exporter growth or productivity as a consequence of exporting.

In panel B, I presents results from running the same baseline model but now instrumenting for the export decision of firms through the firm specific reduction in transport costs to estimate a local average treatment effect from exporting.

As can be seen in the first stage regressions in Table 8, the instrument is positive and significant. This is consistent with the intuition that goods with a lower product value per-shipment benefit more from a transport cost reduction. The negative quadratic term indicates that this occurs at a decreasing rate which is intuitive in that extremely bulky and low value items are unlikely to be exported at all. The instrument performs quite well at predicting export entry. This can be seen through the strong statistical significance on the IV, F-Statistics which are above 10, and high values in the Sanderson-Windmeijer Chi-squared and F-statistics tests for under-identification and weak identification, respectively.

Results in the IV regression are or a similar order of magnitude to those in the baseline specification but slightly smaller. Exporting increases exporter output by 9 percent and TFP productivity by 8 percent. This is consistent with time-varying selection into exporting causing a positive bias on OLS estimates. Results are also still statistically significant, although the t-stats are smaller.

These results suggest my findings on the exporter outcome variables are consistent with those from previous research into learning-by-exporting in developing countries. The increase in output and productivity is large and may represent the observation that new exporters in developing countries benefit more than those in developed countries (see discussion in Harrison and Rodriguez-Clare (2010)). I now turn to the main novelty of the paper by looking at the impact of exporting on input choices and export-supplier performance.

6.2 Exporter Inputs

Table 4 shows how exporting influences domestic and foreign input choices. Column 1 shows that exporting is associated with a positive increase in domestic input usage. This is significant at the 1 percent level in the OLS model and 5 percent level in the IV model. Column 2 shows that there is no significant difference between small and big firms in their increase in domestic inputs.

Column 3-6 consider firm foreign import choices. In columns 3 and 4 the dependent variable is the natural log of import volumes. Because of the large number of zero entries for imports[14] the sample size in logs is smaller. I therefore also include the results in levels in columns 5 and 6. From Columns 3 and 5, we observe that firms increase there use of imports as a consequence of becoming an exporter, although this is no longer significant in the IV specification. Interestingly, as seen in Columns 4 and 6 it is only the largest firms that increase there import use.

Table 5 presents results on firms decisions on the number of suppliers. Columns (1)-(4) consider the probability of adding and dropping a supplier in a given year. The results show that smaller exporters are more likely to add and drop suppliers when exporting for the first time. This is consistent with the hypothesis that smaller exporters are searching domestically for better suppliers while larger exporters look abroad. This is confirmed in the number of new suppliers added when firms become exporters as shown in column (5) and (6) of Table 5. Looking at the IV regressions, new exporters add an additional 12 percent more suppliers than before exporting. As shown in column (6), smaller new exporters are increasing their number of suppliers by a greater volume than larger exporters, which may even be decreasing the number of their domestic suppliers.

Table 7 presents results from specification 10 where I look to see whether firms pick more productive suppliers on average by looking at measures of productivity for each supplier against a set of dummy variables for whether the firm first became a supplier prior to exporting, during the export year, or, a year or more after the export year. From Table 7, we can see that on average larger firms have suppliers with higher productivity but that it is the smaller firms which bring in new suppliers of higher quality during the export year. This is consistent with my theoretical framework and suggests that these firms are the ones which stand to gain the most from upgrading their domestic supply-chain.

Together these results are consistent with my model's findings that bigger new exporters

[14] Many firms only import occasionally and some firms not at all

look for inputs abroad as this is where the highest quality inputs are available, whereas smaller new exports look domestically. This is elaborated on further in Tables 5 and 7.

6.3 Supplier Pecuniary Spillovers

Finally within this section, Table 6 looks for pass-through in revenue productivity from exporters to suppliers. Columns 1 and 3 show the impact on the average productivity of original suppliers before and after the exporting firm exported for the first time. We observe a positive and significant increase in productivity for suppliers as a result of having a purchaser who becomes an exporter. The mechanism for this productivity spillover cannot be discerned from this regression. However, it is consistent with a hypothesis of pecuniary spillover due to a higher joint surplus as identified in the model, or a knowledge transfer from the exporter to the supplier raising supplier productivity.

Columns 2 and 4 suggest that average supplier productivity increases more when the exporter is large. This is consistent with predictions from the model suggesting only larger firms are able to overcome the fixed costs of improving suppliers. It is also consistent with a hypothesis that smaller new exporters are searching for new suppliers domestically, while larger new exporters search abroad and improve the quality of there existing suppliers.

7 Conclusion

Previous research into the export transition has focused on the impact of exporting on final goods producers, this paper has provided for the first time a comprehensive picture of how first-time exporting adapts and influences the exporting firm's supply-chain.

Like in previous research, I find evidence of exporting being associated with increased output and productivity for the exporting firm. I go on to show that exporting is associated with upgrading of the existing supply-chain through adding more productive domestic suppliers and through foreign imports, and a pass-through in surplus to suppliers. I show that large new exporters increase their import usage and improve the quality of their existing suppliers. Small exporters search domestically for higher productivity domestic suppliers.

Exploiting a natural experiment, I show that exporting has a direct causal effect on these mechanisms.

These results have important policy implications in further encouraging government support to exporting firms due to their transformational effect on the rest of the economy. It is also consistent with a world in which inputs are crucial to the development of the export sector and we should encourage policy makers to target export support sectors.

References

Abowd, John M, Francis Kramarz, and David N Margolis, "High wage workers and high wage firms," *Econometrica*, 1999, *67* (2), 251–333.

Acemoglu, Daron, Vasco M Carvalho, Asuman Ozdaglar, and Alireza Tahbaz-Salehi, "The network origins of aggregate fluctuations," *Econometrica*, 2012, *80* (5), 1977–2016.

Alvarez, Fernando E, Francisco J Buera, and Robert E Lucas Jr, "Idea flows, economic growth, and trade," *NBER Working Papers*, 2013.

Antras, Pol, Teresa C Fort, and Felix Tintelnot, "The margins of global sourcing: theory and evidence from us firms," *NBER Working Papers*, 2014.

Arkolakis, Costas, Theodore Papageorgiou, O Timoshenko et al., "Firm learning and growth," *Technical report, mimeo*, 2014.

Atkin, David, Amit K Khandelwal, and Adam Osman, "Exporting and firm performance: Evidence from a randomized trial," *The Quarterly Journal of Economics, forthcoming*, 2016.

Bartik, Timothy J, "Boon or boondoggle? The debate over state and local economic development policies," 1991.

Bernard, Andrew B and J Bradford Jensen, "Exceptional exporter performance: cause, effect, or both?," *Journal of international economics*, 1999, *47* (1), 1–25.

_ , Andreas Moxnes, and Yukiko Saito, "Geography and firm performance in the Japanese production network," *NBER Working Paper No. 21082*, 2015.

Biesebroeck, Johannes Van, "Exporting raises productivity in sub-Saharan African manufacturing firms," *Journal of International economics*, 2005, *67* (2), 373–391.

Blaum, Joaquin, Claire Lelarge, and Michael Peters, "The gains from input trade in firm-based models of importing," *NBER Working Papers*, 2015.

Bustos, Paula, "Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on Argentinian firms," *The American economic review*, 2011, *101* (1), 304–340.

Caliendo, Lorenzo and Esteban Rossi-Hansberg, "The impact of trade on organization and productivity," *The quarterly journal of economics*, 2012, *127* (3), 1393–1467.

_ **, Fernando Parro, Esteban Rossi-Hansberg, and Pierre-Daniel Sarte**, "The impact of regional and sectoral productivity changes on the US economy," 2014.

Card, David, Jörg Heining, and Patrick Kline, "Workplace heterogeneity and the rise of West German wage inequality," *The Quarterly journal of economics*, 2013, *128* (3), 967–1015.

Carvalho, Vasco M, Makoto Nirei, Yukiko U Saito, and Alireza Tahbaz-Salehi, "Supply chain disruptions: Evidence from the great east japan earthquake," 2016.

di Giovanni, Julian, Andrei A Levchenko, and Isabelle Mejean, "The micro origins of international business cycle comovement," *The American Economic Review*, 2017, *forthcoming.*

Dieterle, Steven and Andy Snell, "It's Hip To Be Square: Using Quadratic First Stages To Investigate Instrument Validity and Heterogeneous Effects," *Mimeo*, 2014.

Donaldson, Dave, Amanda Jinhage, and Eric Verhoogen, "Beyond borders: Making transport work for African trade," *IGC Growth Brief Series 009*, 2017.

Eberhardt, Markus, Christian Helmers et al., "Untested assumptions and data slicing: A critical review of firm-level production function estimators," 2010.

Edwards, Sebastian, "Openness, trade liberalization, and growth in developing countries," *Journal of economic Literature*, 1993, *31* (3), 1358–1393.

Fieler, Ana Cecılia, Marcela Eslava, and Daniel Yi Xu, "Trade, Quality Upgrading, and Input Linkages: Theory and Evidence from Colombia," *The American Economic Review*, 2017.

Frıas, Judith A, David S Kaplan, and Eric A Verhoogen, "Exports and wage premia: Evidence from Mexican employer-employee data," *Mimeo, Columbia University*, 2009.

Goldberg, Pinelopi K, Amit K Khandelwal, Nina Pavcnik, and Petia Topalova, "Multiproduct firms and product turnover in the developing world: Evidence from India," *The Review of Economics and Statistics*, 2010, *92* (4), 1042–1049.

Halpern, László, Miklós Koren, and Adam Szeidl, "Imported inputs and productivity," *The American Economic Review*, 2015, *105* (12), 3660–3703.

Harrison, A and A Rodriguez-Clare, "Trade, Foreign Investment, and Industrial Policy for Developing Countries," *Handbook of Development Economics*, 2010, *5*, 4039–4214.

Helpman, Elhanan, Oleg Itskhoki, and Stephen Redding, "Inequality and unemployment in a global economy," *Econometrica*, 2010, *78* (4), 1239–1283.

_ , _ , Marc-Andreas Muendler, and Stephen J Redding, "Trade and inequality: From theory to estimation," *Review of Economic Studies, forthcoming*, 2016.

Jacomy, Mathieu, Tommaso Venturini, Sebastien Heymann, and Mathieu Bastian, "Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software," *PLoS ONE*, 2014.

Kugler, Maurice and Eric Verhoogen, "Plants and imported inputs: New facts and an interpretation," *The American Economic Review*, 2009, *99* (2), 501–507.

_ and _ , "Prices, plant size, and product quality," *The Review of Economic Studies*, 2012, *79* (1), 307–339.

Levinsohn, James and Amil Petrin, "Estimating production functions using inputs to control for unobservables," *The Review of Economic Studies*, 2003, *70* (2), 317–341.

Lileeva, Alla and Daniel Trefler, "Improved access to foreign markets raises plant-level productivity for some plants," *Quarterly Journal of Economics*, 2010, *125* (3).

Loecker, Jan De, "Do exports generate higher productivity? Evidence from Slovenia," *Journal of international economics*, 2007, *73* (1), 69–98.

—, **Pinelopi K Goldberg, Amit K Khandelwal, and Nina Pavcnik**, "Prices, markups and trade reform," *Fourthcoming, Econometrica*, 2015.

Lu, Dan, Asier Mariscal, and Luis Fernando Mejia, "Import switching and the impact of a large devaluation," *Working Paper*, 2015.

Magerman, Glenn, Karolien De Bruyne, Emmanuel Dhyne, Jan Van Hove et al., "Heterogeneous Firms and the Micro Origins of Aggregate Fluctuations," *ECARES Working Papers*, 2016.

Melitz, Marc J, "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica*, 2003, *71* (6), 1695–1725.

Nadiri, M Ishaq and Ingmar R Prucha, "Estimation of the depreciation rate of physical and R&D capital in the US total manufacturing sector," *Economic Inquiry*, 1996, *34* (1), 43–56.

Olley, G Steven and Ariel Pakes, "The dynamics of productivity in the telecommunications equipment industry," *Econometrica*, 1996, *64* (6), 1263–1297.

Pavcnik, Nina, "Trade liberalization, exit, and productivity improvements: Evidence from Chilean plants," *The Review of Economic Studies*, 2002, *69* (1), 245–276.

Roth, Alvin E and Marilda Sotomayor, "Two-sided matching," *Handbook of game theory with economic applications*, 1992, *1*, 485–541.

Spray, John and Sebastian Wolf, "Industries without smokestacks in Uganda and Rwanda," *Mimeo*, 2016.

TradeMark EA, "TradeMark East Africa Annual Report 2015-2016," *TradeMark East Africa Website*, 2017.

Trefler, Daniel, "The Long and Short of the Canada-US Free Trade Agreement," *American Economic Review*, 2004, pp. 870–895.

Verhoogen, Eric A, "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector," *The Quarterly Journal of Economics*, 2008, pp. 489–530.

World Bank, "Doing Business 2016 : Trading Across borders," *World Bank Group*, 2016.

_ , "EAC Common Market Scorecard 2016: Tracking EAC Compliance in Movement of Capital Services and Goods.," *East African Community Secretariat*, 2016.

A Regression Output

Table 3: Exporter Growth

	(1) Output Natural Log	(2) Output Natural Log	(3) Output/Worker Natural Log	(4) Output/Worker Natural Log	(5) TFP Natural Log	(6) TFP Natural Log
	Panel A: OLS					
export	0.478***	0.454***	0.222***	0.266***	0.230***	0.240***
	(0.0745)	(0.0822)	(0.0754)	(0.0835)	(0.0702)	(0.0778)
big * export		0.124		-0.232		-0.0502
		(0.183)		(0.187)		(0.176)
time and firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26837	26837	24164	24164	21972	21972
	Panel B: Instrumental Variables					
export	0.0908**	0.125**	0.0871*	0.134*	0.0787*	0.126*
	(0.0396)	(0.0607)	(0.0469)	(0.0692)	(0.0464)	(0.0687)
big * export		-0.0978		-0.138*		-0.136*
		(0.0662)		(0.0786)		(0.0780)
time and firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16819	16819	16819	16819	14120	14120

Table reports coefficient results for OLS (panel A) and instrumental variables (panel B) regressions on exporter outcome variables (output, output/worker and TFP). TFP is measured via the Levinsohn-Petrin method and is discussed in the Appendix. *Export* is a dummy variable for whether the firm is an exporter and *big* is a dummy variable for whether the firm had > 50 employees in 2009. Robust standard errors in parentheses are clustered at the 2-digit industry level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Exporter Input

	(1) Domestic Inputs Natural Log	(2) Domestic Inputs Natural Log	(3) Imports Natural Log	(4) Imports Natural Log	(5) Imports Levels	(6) Imports Levels
Panel A: OLS						
export	0.159***	0.145***	0.144*	0.0506	56.92***	18.14**
	(0.0512)	(0.0530)	(0.0843)	(0.0847)	(14.07)	(7.494)
big * export		0.0691		0.382**		196.5***
		(0.114)		(0.162)		(16.21)
time and firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20541	20541	9541	9541	20852	20852
Panel B: Instrumental Variables						
export	0.0626**	0.0703*	-0.0333	-0.127	33.17	-9.477
	(0.0314)	(0.0403)	(0.0567)	(0.0788)	(21.25)	(21.55)
big * export		-0.0627		0.137*		29.99
		(0.0384)		(0.0759)		(26.82)
time and firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14185	14185	4694	4694	14331	14331

Table reports coefficient results for OLS (panel A) and instrumental variables (panel B) regressions on exporter input variables (Domestic input usage and foreign imports usage). Foreign imports are reported with the natural log and the value in levels due to the large number of zeros. *Export* is a dummy variable for whether the firm is an exporter and *big* is a dummy variable for whether the firm had > 50 employees in 2009. Robust standard errors in parentheses are clustered at the 2-digit industry level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Exporter supplier search

	(1)	(2)	(3)	(4)	(5)	(6)
	add	add	drop	drop	Ln # suppliers	Ln # suppliers
	Panel A: OLS					
export	0.0270**	0.0342***	0.0847***	0.110***	0.245***	0.274***
	(0.0113)	(0.00941)	(0.0323)	(0.0320)	(0.0645)	(0.0487)
big * export		-0.0215		-0.0743***		-0.0838
		(0.0228)		(0.0245)		(0.0854)
Firm and time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21004	21004	22352	22352	22352	22352
	Panel B: Instrumental Variables					
export	0.0167**	0.0411***	0.0401**	0.108***	0.118***	0.282***
	(0.00739)	(0.00976)	(0.0188)	(0.0327)	(0.0415)	(0.0564)
big * export		-0.0406***		-0.0957***		-0.272***
		(0.0138)		(0.0211)		(0.0705)
time and firm fixed effects	Yes	Yes	Yes	Yes		
Observations	14460	14460	15351	15351	15351	15351

Table reports coefficient results for OLS (panel A) and instrumental variables (panel B) regressions on exporter search variables (add and drop). *add* is a dummy for whether the firm added a supplier, *drop* is a dummy for whether the firm dropped a supplier. *Ln#suppliers* is the log of the number of suppliers for firm i at time t. *Export* is a dummy variable for whether the firm is an exporter and *big* is a dummy variable for whether the firm had > 50 employees in 2009. Robust standard errors in parentheses are clustered at the 2-digit industry level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Supplier Productivity Spillovers

	(1) Output/worker	(2) Output/worker	(3) TFP	(4) TFP
Panel A: OLS				
export	0.140^{**}	0.0742	0.176^{***}	0.102
	(0.0708)	(0.107)	(0.0644)	(0.0959)
big * export		0.190^{**}		0.152
		(0.0968)		(0.102)
time and firm fixed effects	Yes	Yes	Yes	Yes
Observations	24737	24737	24737	24737
Panel B: Instrumental Variables				
export	0.150^{***}	0.152^{**}	0.157^{***}	0.186^{***}
	(0.0539)	(0.0766)	(0.0437)	(0.0577)
big * export		0.00216		-0.0533
		(0.0687)		(0.0599)
time and firm fixed effects	Yes	Yes	Yes	Yes
Observations	16194	16194	16085	16085

Table reports coefficient results for OLS (panel A) and instrumental variables (panel B) regressions on export supplier variables (supplier output/worker and supplier TFP). TFP for all suppliers is measured using the Levinsohn-Petrin method and is discussed in the appendix. Both productivity measures are an average of supplier productivity in each year for suppliers that exist before the firm becomes an exporter. *Export* is a dummy variable for whether the firm is an exporter and *big* is a dummy variable for whether the firm had > 50 employees in 2009. Robust standard errors in parentheses are clustered at the 2-digit industry level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Supplier Productivity before and after export

	(1) Output/Worker	(2) TFP
export	0.234***	0.106*
	(0.0350)	(0.0434)
big * export	-0.0949	-0.0913
	(0.0666)	(0.0724)
big	-0.0262	0.163***
	(0.0321)	(0.0291)
Constant	16.17***	7.672***
	(0.0391)	(0.0441)
Year fixed effects	Yes	Yes
Observations	8088	4653

Table reports coefficient results for OLS regressions on exporters new suppliers before and after exporting (supplier output/worker and supplier TFP). TFP for all suppliers is measured using the Levinsohn-Petrin method and is discussed in the appendix. Both productivity measures are an average of supplier productivity in each year for suppliers that exist before the firm becomes an exporter. *Export* is a dummy variable for whether the firm is an exporter and *big* is a dummy variable for whether the firm had > 50 employees in 2009. Robust standard errors in parentheses are clustered at the 2-digit industry level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Instrumental Variable First Stage

	(1) Export	(2) Export
product value * transport time	1.483***	1.414***
	(0.314)	(0.315)
$(\text{product value * transport time})^2$	-0.0691***	-0.0657***
	(0.0143)	(0.0147)
big * product value * transport time		-0.106
		(0.0878)
big * $(\text{product value * transport time})^2$		0.00510
		(0.00819)
time and firm fixed effects	Yes	Yes
AP F-Test	11.63	12.37
SW F-Test	11.63	6.960
SW Chi-sq	23.59	21.18
N	14185	14185

Table reports coefficient results instrumental variables first stage regression. Product value is measured as the weighted value of HS-8 product value for each firm that can be fit inside a shipping container. Transport time is the time to export a standard shipping container from Kampala to Mombasa. Big is a dummy variable for whether the firm had > 50 employees in 2009. Robust standard errors in parentheses are clustered at the 2-digit industry level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

B Estimating Productivity

B.1 Estimating productivity

In addition to the main identification strategy, simply estimating productivity remains an active research question.[15] For the purposes of this paper I will estimate three different measures of productivity.

The most rudimentary measure of firm productivity is labour productivity. Output per worker is calculated by dividing the firm's total revenue in a given period by the number of employees (summing wages for casual and permanent employees). Labour productivity benefits from being (i) easy to calculate and interpret and (ii) data is available for all firms in the sample for most periods, meaning I can reliably interpret results for the whole sample. On the downside, labour productivity ignores the contribution of other factors into production such as capital, intermediate inputs and technology.

The second measure of productivity is total factor productivity. Here I assume that each firm i has a Cobb-Douglas production function estimated separately at the industry level j.

$$y_{ijt} = \beta_{lj} l_{ijt} + \beta_{kj} k_{ijt} + \beta_{mj} m_{ijt} + \beta_{0j} + u_{ijt} \tag{11}$$

where y_{ijt} is log revenue for firm i in industry j in time t, l_{ijt} is log labour cost, k_{ijt} is log capital stock, and m_{ijt} is log of intermediary inputs.

The dataset does not have a value for capital stock. Instead, it includes a variable for 'capital goods bought', which can be interpreted as a flow measure of capital.

This measure has three problems: (i) I do not observe capital bought before the start of the period so I do not know the firm's true capital stock. (ii) It is likely that capital goods underestimates capital stock and may suffer from measurement error. (iii) It has a large number of zero values and many firms report no capital goods expenditure at all. To estimate the capital stock variable I use the perpetual inventory method and use a depreciation rate of 15 percent per annum[16].

[15] See for instance Eberhardt et al. (2010) for critical review

[16] This is in line with estimates of depreciation from Nadiri and Prucha (1996)

Returning to specification 11, Total Factor Productivity (TFP) is captured by a constant representing mean efficiency (β_0) across all firms in a given industry j and the error term u_{ijt}, which represents deviations from mean efficiency due to unobserved factors affecting output, measurement error and random noise. I estimate production functions separately for each ISIC section.[17]

As observed by Olley and Pakes (1996), this unobserved error term can lead to simultaneity bias. Following the exposition in Eberhardt et al. (2010), define u_{ijt} as

$$u_{ijt} = \omega_{ijt} + v_{ijt} \tag{12}$$

where ω_{ijt} is unobserved TFP. The problem with estimating productivity in this way is that firms are likely to make production decisions (l, k) based on the realisation of a productivity shock. Therefore, the error term is correlated with the independent variables and so there is an endogeniety bias on β_{lj} and β_{kj}. This is more of a concern if inputs can adjust quickly.

Levinsohn and Petrin (2003) structurally model the firm's production function using observed intermediate input choices to proxy for unobserved productivity. The model assumes intermediate inputs and labour choices are chosen at time t once ω_{ijt} has been realised. The production function is therefore,

$$y_{ijt} = \beta_{0j} + \beta_{lj} l_{ijt} + \beta_{kj} k_{ijt} + \beta_{mj} m_{ijt} + \omega_{ijt} + \epsilon_{ijt} \tag{13}$$

where m_{ijt} is the log of intermediate input choice. Demand for intermediate inputs is a function of capital and productivity.

$$m_{ijt} = m_{ijt}(k_{ijt}, \omega_{ijt}) \tag{14}$$

inverting the demand function and plugging into the production function,

$$y_{ijt} = \beta_{lj} l_{ijt} + \phi_{ijt}(k_{ijt}, m_{ijt}) + \epsilon_{ijt} \tag{15}$$

[17] Standard industrial classification of economic activities (ISIC) is a classification system for industry section. A section is the most aggregate category.

This first-stage equation yields consistent estimates of $\beta_l j$ and ϕ_{ijt}. To obtain estimates of $\beta_k j$ and $\beta_m j$, the procedure estimates

$$y_{ijt} - \hat{\beta}_l l_{ijt} = \beta_k k_{ijt} k_{ijt} + \beta_m m_{ijt} + g(\hat{\phi_{ijt-1}} - \beta_{0j} - \beta_k k_{ijt-1} - \beta_m m_{ijt-1}) + \gamma_{ijt} + \epsilon_{ijt} \quad (16)$$

where m_{ijt} is instrumented by the one-period lagged level m_{ijt-1}

C Proofs

C.1 Proposition 1

Proposition 1: bigger and higher productivity firms

1. suppliers of higher quality (including more importers)
2. have more supplier
3. have higher profits
4. export

C.1.1 Lemma 1.1: Suppliers of higher quality

Lemma 1: Bigger firms have suppliers of higher quality

This is true by assumption from the sorting algorithm ■

C.1.2 Lemma 1.2: Bigger firms have more suppliers

Proof. By contradiction: if not, then a smaller firm $i+1$ has more suppliers than a larger firm i.

Step 1: Order producers by size with 1 as the best and m as the worst, $\{\phi_1, \phi_2, ..., \phi_m\}$.

Let $n_i = \sum_{j \in S} \mu_i(j)$ equal the number of each producers' suppliers. Let supplier k_i be supplier $i's$ best supplier.

Consider supplier $k_i + n_i + 1$, the best supplier that i does not wish to match with, such that

$$\beta\phi_i\phi_{k_i+n_i+1} - [c(n_i + 1) - c(n_i)] < 0 \tag{17}$$

Given $k_i + n_i + 1$ is $i + 1$'s best supplier, $i + 1$ must want to keep the supplier

$$\beta\phi_{i+1}\phi_{k_i+n_i+1} - [c(n_{i+1}) - c(n_{i+1} - 1)] > 0 \tag{18}$$

Given $n_{i+1} > n_i$ and convex cost $[c(n_i+1)-c(n_i)] < [c(n_{i+1})-c(n_{i+1}-1)]$ and $\beta\phi_i\phi_{k_i+n_i+1} > \beta\phi_{i+1}\phi_{k_i+n_i+1}$. Therefore, equations (17) and (18) cannot hold simultaneously. Contradiction ■.

C.1.3 Lemma 1.3: Bigger firms have higher profits

Proof. By contradiction: if not there must exist a supplier $i + 1$ with higher profits than supplier i.

Step 1: compare marginal return of producer i from keeping its best supplier with firm $i + 1's$ marginal return from keeping $i + 1's$ best supplier. Compare the same marginal return for i and $i + 1's$ second best supplier and downward. From Lemma 1.1 and 1.2, we know producer i will have better suppliers and more supplier,

Producer i		Producer $i+1$		
$\beta\phi_i\phi_{k_i} - [c(1) - c(0)]$	$>$	$\beta\phi_{i+1}\phi_{k_i+n_i+1} - [c(1) - c(0)]$	$>$	0
$\beta\phi_i\phi_{k_i+1} - [c(2) - c(1)]$	$>$	$\beta\phi_{i+1}\phi_{k_i+n_i+2} - [c(2) - c(1)]$	$>$	0
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$\beta\phi_i\phi_{k_i+n_{i+1}} - [c(n_{i+1}) - c(n_{i+1} - 1)]$	$>$	$\beta\phi_{i+1}\phi_{k_i+n_i+1+n_{i+1}} - [c(n_{i+1}) - c(n_{i+1} - 1)]$	$\geq$	0
$\vdots$	$\vdots$			
$\beta\phi_1\phi_{k_i+n_i} - [c(n_i) - c(n_i - 1)]$	$>$		$\geq$	0
π_i	$>$	π_{i+1}	$\geq$	0

Therefore, firm i has higher return from each supplier, and more suppliers from which it derives positive profits. Contradiction $\blacksquare$.

C.1.4 Lemma 1.4: Bigger firms export

Proof by contradiction: If not there must exist a supplier $i+1$ which exports when supplier i does not.

From Lemma 1.3, we know exporting yields higher marginal return through increase in surplus from each of the first n_i^D matches and some weakly positive return from adding more matches.

Step 1: compare i and $i+1's$ marginal return from exporting from each of its suppliers.

From Lemma 1.1 and 1.2, we know producer i will have better suppliers and more supplier,

Producer i		Producer $i+1$		
$\beta(\psi^X \phi_i \phi_{k_i}^X - \phi_i \phi_{k_i})$	$>$	$\beta(\psi^X \phi_{i+1} \phi_{k_i+n_i+1}^X - \phi_{i+1} \phi_{k_i+n_i+1})$	$>$	0
$\beta(\psi^X \phi_i \phi_{k_i+1}^X - \phi_i \phi_{k_i+1})$	$>$	$\beta(\psi^X \phi_{i+1} \phi_{k_i+n_i+2}^X - \phi_{i+1} \phi_{k_i+n_i+2})$	$>$	0
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$\beta(\psi^X \phi_i \phi_{k_i+n_{i+1}}^X - \phi_i \phi_{k_i+n_{i+1}})$	$>$	$\beta(\psi^X \phi_{i+1} \phi_{k_i+n_1+n_{i+1}}^X - \phi_{i+1} \phi_{k_i+n_i+n_{i+1}})$	$\geq$	0
$\vdots$	$\vdots$			
$\beta(\psi^X \phi_i \phi_{k_i+n_i}^X - \phi_i \phi_{k_i+n_i})$	$>$		$\geq$	0
$\pi_i^X - \pi_i^D$	$>$	$\pi_{i+1}^X - \pi_{i+1}^D$	$\geq$	0

Marginal return on each of the first n_{i+1} matches must be greater for i than $i+1$. Marginal cost the same. Marginal return from any new suppliers must be greater for i than $i+1$. Marginal cost the same.

Step 2: Note that the fixed cost of exporting is the same for all firms such that firms with the highest marginal return from exporting will be the only exporters.

Contradiction ■.

C.2 Proposition 2

Proposition 2: First-time exporters weakly increase their number of suppliers and average quality of suppliers. Larger new exporters add imports while smaller producers add domestic suppliers.

Proof

Step 1: First-time exporters weakly increase their number of suppliers.

From Lemma 1.2 we know bigger firms have more suppliers. The new exporter will now have $\gamma\psi^X$ multiplied by its original productivity ensuring it is a bigger firm

Step 2: average quality of suppliers.

From proposition 1.1 we know that bigger firms have higher quality suppliers. As with step 1, exporting has increased the firms size.

Step 3: Larger new exporters add imports while smaller new exporters add domestic.

This comes trivially from the assumption that importers are at the top of the supplier distribution and from step 2 we know that new exporters increase the quality of their suppliers.

C.3 Proposition 3

Proposition 3: Suppliers of new exporters will have increased output and increased revenue productivity. These effects will be increasing in the size of the first-time exporter.

Proof. From proposition 2 we know new exporters have a higher joint surplus with their suppliers due to multiplying output by $\gamma\psi^X$. Given Nash bargaining shares are fixed the supplier must receive a higher return.

D Data comparison

Given research using tax data remains rare, one potential concern might be that the data is of low quality. This section addresses this concern by comparing the tax data used in this study to other freely available data sources.

Figure 5 shows a comparison between the raw export trade data used in this study and trade data from the WTO. From the graph it appears as if the WTO data is understating the actual export volumes. However, for the purposes of this study, the important fact is how closely the two lines track one another showing that the data is strongly correlated with the external source.

Figure 6 shows a comparison between the total output variable used in the tax data and GDP data from the World Bank. Unsurprisingly, the tax data is smaller than the GDP data given the tax data only observes formal sector firms. Importantly, like in 5, the correlation between the two lines is very strong again supporting the reliability of the tax data.

Finally, (Spray and Wolf, 2016) show the distribution of firms in each sector is consistent with those in the Uganda Business Census.

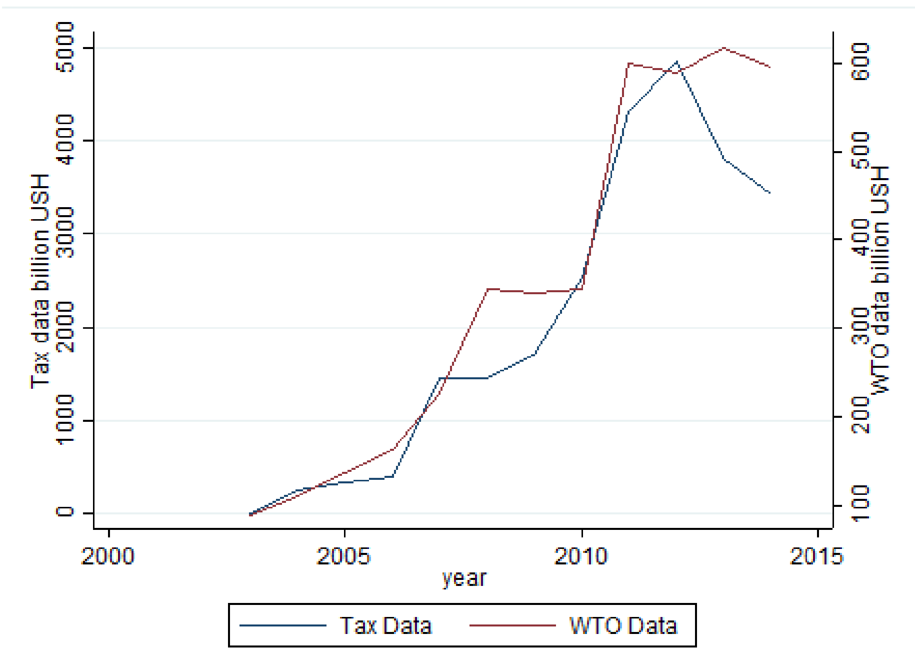


Figure 5: Exports data comparison

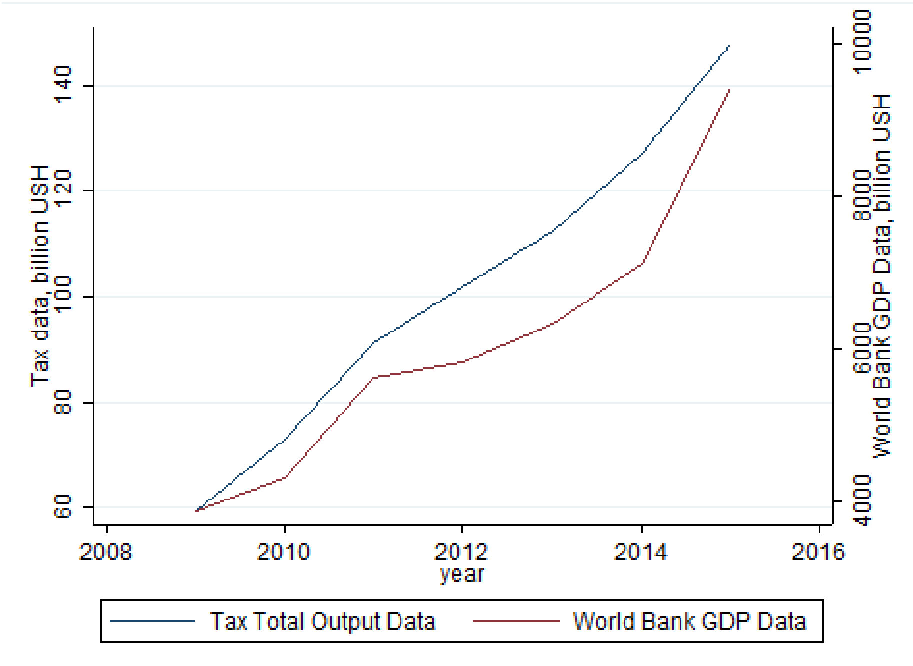


Figure 6: GDP and total output data comparison

E Appendix tables

Table 9: Positive Assortative Matching

	(1) Supplier Output/Worker	(2) Supplier Output/Worker	(3) Supplier TFP	(4) Supplier TFPr
Buyer Output/Worker	0.191***	0.176***		
	(0.0142)	(0.0118)		
Buyer TFP			0.168***	0.156***
			(0.0251)	(0.0209)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	No	Yes	No	Yes
Observations	26879	26879	23597	23597

Table reports coefficient results for correlations in productivity between buyer and supplier firms. TFP is measured via the Levinsohn-Petrin method and is discussed in the Appendix. Industry fixed effects are at the ISIC 4 -digit level. Standard errors are clustered at the ISIC 4-digit level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$