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The Chinese are Here: Import Penetration and Firm Productivity in Sub-Saharan Africa

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ABSTRACT *This study presents the first micro-level analysis of the causal effect of Chinese import penetration on firm productivity in 24 sub-Saharan Africa (SSA) countries. We make key contributions to the literature by examining the heterogeneous effects of Chinese imports on firm productivity using data on transport infrastructure, and by distinguishing between import competition and import of intermediate inputs. Two instrumental variables, one based on exogenous geographic characteristic of ports and transportation technology shock, and the other based on a supply-side shock, are constructed to address the endogeneity of import penetration. The results indicate that imports from China impact positively on firm productivity, mainly through imports of intermediate inputs, and there is significant heterogeneity of these effects in terms of firms' proximity to ports and initial productivity level. Overall, our findings suggest that Chinese imports could be viewed as an opportunity for Sub-Sahara Africa firms to enhance their productivity. Furthermore, they highlight the need for developing countries to invest in transport infrastructure to effectively promote firms participation in international markets.*

KEYWORDS: Import penetration; productivity heterogeneity; trade infrastructure; sub-Saharan Africa; China

1. Introduction

The expansion of Sino-African trade relations in the last decades has been one of the most remarkable in the developing world. In sub-Saharan Africa (SSA) alone, imports of manufactured goods from China are more than 50 times larger since the accession of China to the WTO. While the share of imports from the EU and the US decreased from 10 per cent in 1990 to 3.8 per cent in 2018, China's share of total imports in SSA rose to 16.5 per cent from just 1.1 per cent over the same period (World Integrated Trade Solution, 2020). This has been accompanied by a change in China-SSA trade patterns, shifting from imports of products such as footwear and light manufactured towards more sophisticated and capital-intensive goods, making China the largest import partner for machines and electronics for the region (World Integrated Trade Solution, 2020). The emergent role of China in the continent can be viewed as a great opportunity to stimulate economic development, mainly through the exposure to new capital and intermediate goods. However, it may also present detrimental effects, such as the crowding-out of domestic firms. These contrasting predictions raise important questions about the impact Chinese imports may have on the region.

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A growing body of literature has examined the economic implications of China's emergence in the global economy, given the idiosyncratic characteristics of imports from China in respect to those from other low-wage countries (Mion & Zhu, 2013; Rodrik, 2006; Schott, 2008). Most of these studies assessed the implications for developed countries, mainly focusing on China's impact on firms' performance and labour market outcomes (Autor, Dorn, & Hanson, 2013; Autor, Dorn, Hanson, Pisano, & Shu, 2016; Bernard, Jensen, & Schott, 2006; Bloom, Draca, & Van Reenen, 2016; Donoso, Martin, & Minondo, 2015; Harrison & McMillan, 2011). For developing countries, most of the empirical evidence have focused on Latin America and Asia, showing adverse impact on employment growth, and a reallocation of resources both across firms and industries (Alvarez & Claro, 2009; Costa, Garred, & Pessoa, 2016; Eichengreen, Rhee, & Tong, 2004; Iacovone, Rauch, & Winters, 2013; Utar & Ruiz, 2013). Studies analysing the implications of Chinese imports in Africa are limited (Ademola, Bankole, & Adewuyi, 2009; Edwards & Jenkins, 2014; Maswana, 2009; Zafar, 2007), and especially at the micro level there is an evident gap in understanding the causal linkages between Chinese imports and firm performance in SSA.

Using rich firm-level panel data between 2003 and 2018, we present the first detailed micro-level evidence of the causal effects of imports from China on the productivity of manufacturing firms in 24 SSA countries. Our contribution is three-fold. Firstly, we disentangle two channels through which import penetration affects firm productivity: the direct import competition in output markets and the complementary effect of access to horizontal and vertical intermediate inputs. Secondly, we conduct further analysis on how accessibility to ports moderates the relationship between firm productivity and import penetration. This investigation provides further support to growing evidence that poor infrastructure networks is a key limitation for SSA firms to access productivity-enhancing inputs and foreign markets (Aggarwal, 2018; Iimi, Humphreys, & Mchomvu, 2017). Lastly, we investigate the heterogeneous impact of import penetration on firms by considering their initial distribution of productivity.

Our study is related to three different strands of the literature. First, the literature on trade liberalisation and import competition in the presence of heterogeneous firms, which predicts aggregate productivity gains within industry due to resource reallocation from the least to the most productive firms (Bernard et al., 2006; Bloom et al., 2016; Lileeva & Trefler, 2010; Melitz, 2003; Melitz & Ottaviano, 2008). Secondly, the literature establishing how access to cheaper, better quality and a wider variety of intermediate inputs from abroad are associated with greater firm productivity, higher mark-ups, and product quality improvements (Amiti & Khandelwal, 2012; Bigsten, Gebreeyesus, & Soderbom, 2016; Brandt, Van Biesebroeck, Wang, & Zhang, 2017; Topalova & Khandelwal, 2011). Finally, the literature on the importance of transport infrastructure in enhancing firm productivity and economic development through a decrease in the costs of interregional and international trade (Aggarwal, 2018; Asher & Novosad, 2020; Banerjee, Duflo, & Qian, 2012; Bernard, Moxnes, & Saito, 2019; Gibbons, Lyytikainen, Overman, & Sanchis-Guarner, 2019; Gollin & Rogerson, 2014; Redding & Turner, 2015).

Using two alterative instrumental variable approaches, we find a positive causal effect of Chinese imports on SSA firms' productivity, consistent with previous theoretical predictions. Rather than from import competition, the positive effect is driven mainly by access to horizontal intermediate inputs of production imported within-industry from China, possibly due to their relatively better quality compared to domestic goods and higher affordability relative to inputs imported from developed countries. In addition, we examine the moderating role of transport infrastructure and find that the positive effect of importing intermediate inputs from China on productivity is stronger for firms with better accessibility to ports. Finally, we show that the positive effect of imports from China is heterogeneous across firms, with initially less productive surviving firms benefitting the most from import competition, while the most productive firms benefit from the import of horizontal intermediate inputs. Overall, the results show that Chinese imports in SSA can be viewed as an opportunity for firms to increase productivity. These findings also further highlight the need for SSA countries to invest in transport infrastructure, in order to enable firms to engage effectively in international trade.

The remainder of the study is structured as follows. Section 2 provides the theoretical framework of the study presenting an overview of the related literature. Section 3 describes the data and the key variables used in the estimations. The empirical modelling and identification strategies are discussed in section 4, followed by a discussion of the results in section 5. The last section concludes by presenting some policy implications.

2. Theoretical framework

The overarching consensus in previous trade literature is that trade liberalisation, by expanding markets, stimulates productivity growth, mainly through the increase in aggregate demand, competition, and access to new specialised suppliers (Edwards, 1998; Grossman & Helpman, 1991; Krugman, 1979, 1991; Melitz, 2003; Melitz & Ottaviano, 2008). Focusing on trade openness and imports liberalisation, the micro-founded literature has underlined two main channels through which import penetration could increase productivity in destination markets. One strand of the literature highlights how higher competition from abroad could generate productivity gains mainly by reallocating resources from less to more productive firms (Melitz, 2003; Melitz & Ottaviano, 2008), but also within firms from one activity to another (Bernard et al., 2006; Pavcnik, 2002). The other strand of literature asserts that import penetration enables domestic firms to access a wider variety of cheaper and better quality intermediate inputs than those accessible in the domestic market (Amiti & Konings, 2007). Access to foreign inputs raises productivity levels (Bigsten et al., 2016; Topalova & Khandelwal, 2011), and generates additional gains from trade through higher mark-ups (Brandt et al., 2017), improvement in product quality (Amiti & Khandelwal, 2012), and creation of new product varieties (Goldberg, Khandelwal, Pavcnik, & Topalova, 2010). However, the effects of imports penetration may not be homogeneous across industries and firms, but could instead differ along the distribution of firm characteristics, such as technology and the efficiency of the production processes (Acemoglu, Gancia, & Zilibotti, 2015; Bloom et al., 2016; Crinò, 2012; Lileeva & Trefler, 2010; Lu & Ng, 2013).

Despite the gains from import penetration, low levels of industrialisation, trade exposition and technology among developing economies mean that some firms may be unable to enjoy the full benefits of imports liberalisation (Amiti & Konings, 2007; Bigsten et al., 2016; Bustos, 2011; Goldberg et al., 2010; Pavcnik, 2002; Reddy, 1999). Increasing import penetration is a key component of many market reforms in developing economies. However, any efficiency and productivity gains from this will depend partly on whether imports are substitutes or complementary to domestic production (Davis & Mishra, 2007). Since many firms in developing countries are less technologically advanced, and lack the capacity and resources to innovate, import competition could have detrimental effects on the performance and survival of firms, even for the most productive ones (Halpern, Miklos, & Szeidl, 2005; Van Biesebroeck, 2008). Where imported goods are instead used as inputs of production, they could result in reductions in production costs and increases in total output (Grossman & Rossi-Hansberg, 2006). Imports of intermediate inputs can enable domestic firms to change their input mix, mainly by substituting domestic inputs which are often more expensive, of lower quality and technological content than those imported (Kaplinsky, McCormick, & Morris, 2007; Kasahara & Rodrigue, 2008). In addition, the impact of imported intermediate inputs can also differ based on whether imported goods are *horizontal* (within industry) or *vertical* inputs (across industries). For developing countries in particular, it is plausible that firms may upgrade their input mix by attempting to adopt some of the production processes of foreign exporting firms, thus making horizontal imported inputs particularly beneficial. Following Feenstra and Hanson (1999) distinction between 'broad' and 'narrow' outsourcing of vertical and horizontal intermediate inputs respectively, several studies within the offshoring literature have examined how these two different channels impact productivity, finding positive effects on productivity from the import of both horizontal and vertical inputs of production (Amiti & Konings, 2007; Fernandes, 2007; Pavcnik, 2002; Topalova & Khandelwal, 2011; Wang, Wei, Yu, & Zhu, 2018).[1]

In this regard, it is particularly relevant to look at the impact of import penetration from China on the productivity of firms in developing countries. Existing studies, mostly on developed countries, have found mixed results of the impact of Chinese import competition and the import of intermediate inputs on employment growth, wages, and plants survival rates (Autor et al., 2013; Bernard et al., 2006; Donoso et al., 2015; Harrison & McMillan, 2011; Wang et al., 2018), firms' innovation, IT investment, patents and skills intensity (Autor et al., 2016; Bloom et al., 2016). Studies on developing countries have focussed largely on Latin America and Asia (Costa et al., 2016; Eichengreen et al., 2004; Utar & Ruiz, 2013). For instance, Alvarez and Claro (2009) find that increases in Chinese import competition has had an adverse impact on the employment growth of manufacturing firms in Chile, partly because of a lack of adequate human capital. Focusing on Mexico, Iacovone et al. (2013) find that the 'China shock' has caused a reallocation of resources both across firms and products, where larger plants benefited from access to cheaper imports of Chinese intermediate inputs. Studies that analyse the implications of Chinese import penetration for Africa have mainly been limited to South Africa, with results indicating adverse effects of import competition on exports (Edwards & Jenkins, 2014), and a negative impact on domestic production and employment (Edwards & Jenkins, 2015). Other descriptive evidence suggests complementary effects of China imports penetration in SSA (Kaplinsky et al., 2007). On the one hand, domestic manufacturers are impacted negatively by China import competition (Gebre-Egziabher, 2007; Kaplinsky & Morris, 2006, 2008). On the other hand, these have led to beneficial trade relationships mainly through import of cheaper manufactures (Zafar, 2007), access to a wider variety of final and intermediate goods (Ademola et al., 2009), including technology-embodied imports (Maswana, 2009). However, especially at the firm level, there is an evident gap in understanding the causal linkages between Chinese imports penetration and firm performance in Africa, owing partly to the lack of comprehensive micro-level data.

Another important aspect to consider in the analysis of the impact of imports penetration on the productivity of firms in developing countries is the role played by transport infrastructure. Transport infrastructure is often regarded as a key contributor to economic growth and development (Redding & Turner, 2015). This notion relies on the simple logic that access to markets and ideas are first required before any productivity gains can be observed (Banerjee et al., 2012). Many studies show that the poor trade performance of firms in SSA is related to weak infrastructures, which limit firms' access to productivity-enhancing inputs (Aggarwal, 2018; Iimi et al., 2017; Limao & Venables, 2001; Teravaninthorn & Raballand, 2009). Access to ports is particularly relevant for SSA countries, since they represent the primary trading connection with the rest of the world (Palsson, Harding, & Raballand, 2007). In fact, most trade flows in Africa take place with overseas countries, while intra-continental trade among contiguous countries represents a very small proportion of the continent's total trade (Coulibaly & Fontagné, 2006). In addition, formal manufacturing export activities are concentrated in the largest coastal cities, while firms located in hinterlands have very little exposure to international trade (Jedwab & Moradi, 2016). Previous studies have shown that better transport infrastructure can reduce the costs of interregional and international trade, thereby encouraging competition and facilitating firms' participation in international trade (Cosar & Demir, 2016; Donaldson, 2018; Shiferaw, Söderbom, Siba, & Alemu, 2015; Volpe-Martincus & Blyde, 2013). Better access to ports could therefore improve firms' productivity, not only by increasing the likelihood of exporting, but also by facilitating the penetration of imported inputs to hinterlands and increasing the pressure from foreign competitors (Behar & Venables, 2011; Herrera Dappe, Jooste, & Suárez-Alemán, 2017; Storeygard, 2016).

3. Data

3.1. Firm data

The main source of data is the World Bank Enterprise Survey (WBES), a survey that collects information on the business climate in developing and developed countries.[2] The survey provides detailed firm-level balance sheet data for a representative sample of private firms in each industry and country, using a stratified random sampling technique based on firm size, geographical region and business sector.[3] In particular, it provides information on firm location, age, number of skilled and unskilled employees, total sales, capital expenditure and costs of intermediate inputs of production amongst others.[4]

To construct our sample, we selected all countries in SSA that have been surveyed in at least two waves between 2003 and 2018.[5] By using firms' unique identifier, we create a panel dataset that consists of almost 2,150 unique manufacturing firms across 24 countries[6] and 7 industries.[7] While the data in every WBES is representative for each specific year and country, this does not translate to the panel component of each survey. To assess how this could impact our results, we test for differences in variables' distributions between the overall population and the estimation sample, as reported in Tables SM.1.3 and SM.1.4 in the Supplementary Materials. In summary, while we find that firms in the estimation sample are older and larger than those in the overall population, there are no significant differences in TFP or labour productivity. Furthermore, as the main trade variables are available at the country-industry level, we test for differences in the distribution of firms across industries at the country level. These are significant for only 2 of the 24 countries included (5.98% of observations) and excluding them from the analysis does not impact the results.[8]

Figure 1 shows the distribution of these firms by country. Kenya has the highest number of firms (11% of the total sample) followed by Zimbabwe with 10%. Other countries with a sizeable representation of firms include Senegal (8%), Mali (7.5%) and Ethiopia (6.5%). As shown in Figure 2, these countries also engaged the most in trade with China. Figure 1 further shows the distribution of firms in the sample across the seven manufacturing industries. Firms in food processing represent almost 30 per cent of the total number of firms, followed by the textiles industry (19%). Chemicals and minerals constitute around 14.3 per cent of the total number of firms.

3.2. Trade data

In order to capture the effect of access to imports for firms not directly involved in trade activities, we rely on two datasets to distinguish between the different components of import penetration, import competition and import of intermediate inputs. Data on total value of manufacturing imports from

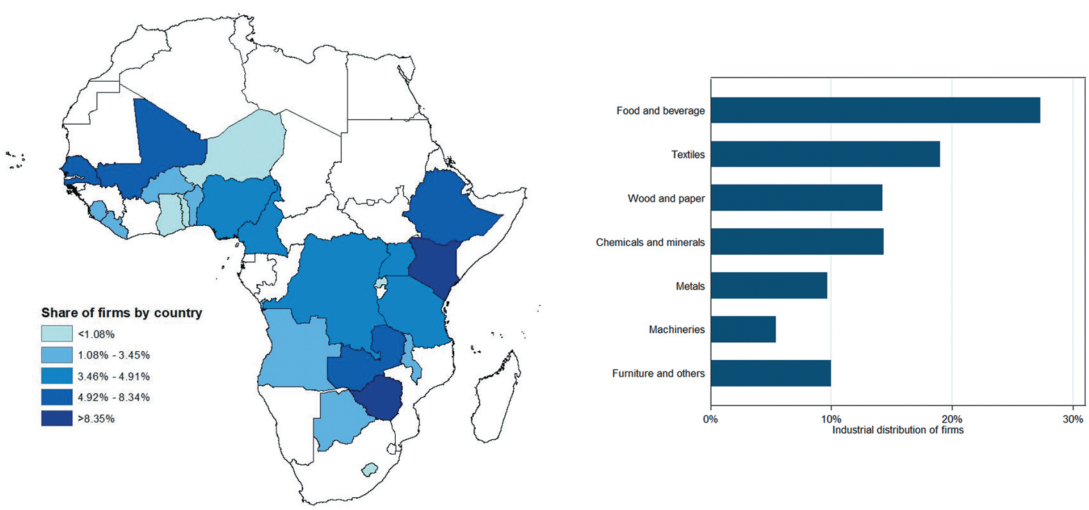

Figure 1. Distribution of firms in our sample by country and industry.

Notes: Elaboration based on the World Bank Enterprise Survey database. Broad industrial categories built aggregating SIC 2-digit level industries.

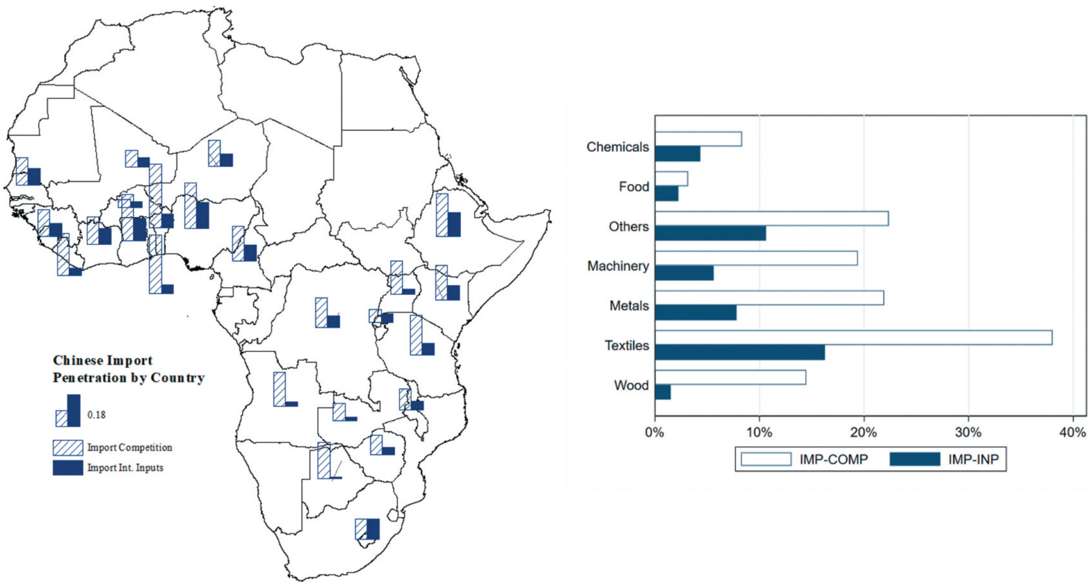

Figure 2. Distribution of import competition and import of intermediate inputs from China by country and industry.

Notes: Elaboration based on the UN COMTRADE and EORA-MRIO databases. Shares are measured as imports from China over total imports for each country and industry averaged over the sample period.

China at the country and industry level is obtained from the UN COMTRADE database. For each industry and destination country in our sample, we also use the EORA Multi-Region Input-Output (EORA-MRIO) tables to measure imports of intermediate inputs from China, considering both a 'narrow' measure of importing *horizontal* inputs from the same industry, and a 'broad' measure of imported inputs from other *vertically* integrated industries (Feenstra & Hanson, 1999). We derive a measure of import competition from China for each industry and country by subtracting the imports value of intermediate horizontal inputs from the country-industry total imports variable. In addition, we calculate total intermediate inputs value by summing imports of horizontal and of vertical inputs.[9]

Figure 2 illustrates the average distribution of Chinese import competition and import of intermediate inputs as a share of total imports across countries and industries. The share of import competition from China is higher for all countries compared with the share of import of intermediate inputs. There are noticeable differences in the distributions. Specifically, import competition from China is considerably higher in Benin (36% of total imports), Togo (33%), Ghana (26%), Nigeria (25%) and Ethiopia (24%). Nigeria (15%), Ethiopia (14%), Ghana (13%) and Senegal (10%) accounted for the highest share of intermediate inputs from China. In terms of sectoral distribution, textiles accounted for the largest share of both types of imports (around 38% of import competition). Metal products, machineries and other consumer products sectors also accounted for large shares of import competition and intermediate inputs from China over this period.

4. Methodology

4.1. Baseline specification

To identify the impact of Chinese import penetration on firm productivity, we start by estimating the following baseline OLS panel model:

$$\ln(TFP_{it}) = \beta_0 + \beta_1 COM\_CHN_{cst-1} + \beta_2 INP\_CHN_{cst-1} + \beta_3 IMP\_OTH_{cst-1} + \beta_4 X_{it} + j_i + j_t + j_{cs} + j_{ct} + j_{st} + \varepsilon_{it} \quad (1)$$

where $\ln(TFP_{it})$ represents the natural log of Total Factor Productivity (TFP) of firm (i) at time (t), estimated following the methodology developed by Levinsohn and Petrin (2003).[10] The main variables of interest are import competition from China at the city (c) and industry (s) level, COM_CHN_{cst-1}, and import of intermediate inputs from China at the city (c) and industry (s) level, INP_CHN_{cst-1}. In additional regressions, we split the variable for imports of intermediate inputs into its two components: import of horizontal inputs from the same industry ($H.INP\_CHN_{cst-1}$) and of vertical inputs of production from other industries in China ($V.INP\_CHN_{cst-1}$). Because import data from COMTRADE and EORA-MRIO are at the country-industry level, and due to the lack of data on the final destination of products imported, we adopt a shift-share approach to create these variables (Adao, Kolesar, & Morales, 2019). We weight the original trade value variables with the employment share of a city (c) over the total employment of industry (s) at the country (k) level in the first year available in the WBES data (t_0)[11]:

$$\begin{aligned} COM\_CHN_{cst-1} &= \frac{E_{cst_0}}{E_{kst_0}} \times COM\_CHN_{kst-1} \\ INP\_CHN_{cst-1} &= \frac{E_{cst_0}}{E_{kst_0}} \times INP\_CHN_{kst-1} \end{aligned} \quad (2)$$

This suggests that city (c) would be more exposed to import penetration from China when it accounts for a larger share of the overall country-industry employment.

In addition, we control for import penetration from other foreign markets, including other African and OECD countries, and imports from the rest of the world (ROW). We also include a set of standard firm-level control variables, X_{it}, including employment size at time *t-2* (EMPL), export status (EXP), and firm age (AGE).[12] Finally, we include firm j_i, year j_t, and city-industry j_{cs} fixed-effects, as well as city-year j_{ct} and industry-year j_{st} time-trends in order to control for any other source of unobserved variability. Summary statistics of the firm-level variables are reported in Table SM.1.2 in the Supplementary Materials.[13]

Chinese imports penetration could have different effects on the productivity of firms along the distribution of some of their characteristics. We therefore analyse the heterogeneous impact of imports penetration by interacting the import competition and import of intermediate inputs variables with the quartiles of firms' initial productivity and proximity to ports (discussed in section 4.2.1).[14]

4.2. Instrumental variable approach

Previous literature on the impact of trade liberalisation on economic performance suggests that import penetration from China cannot be considered completely exogenous to firm productivity (Bloom et al., 2016). The potential endogeneity of imports stems from different sources, such as the reverse causality of more productive firms opening up to international trade, the self-selection of highly competitive firms into industries that are more affected by Chinese imports penetration, and the endogenous decision of firms to locate in cities with better accessibility to ports. In addition, the estimates may also be affected by unobservable characteristics that are correlated with both the exposure to imports from China and firm productivity. We follow recent contributions in the literature and develop two different instrumental variables.

4.2.1. Maritime transport shock IV. The first instrumental variable is based on the combination between an exogenous geographic characteristic, the presence of coastal features determining water depth in SSA ports, and a global shock to transportation technology, namely the increase in container ships size since the mid-1990s (Feyrer, 2009; Pascali, 2017).

Figure 3 shows that since the mid-1990s the maximum capacity of container ships has almost quadrupled, from around 4,800 Twenty-foot Equivalent Unit (TEU) at the beginning of 1990s to around 21,000 TEU in 2016, mainly due to the introduction of ‘Post-Panamax’ container ships (OECD-ITF, 2015).[15] With growing number of larger container ships, the average TEU capacity of world cargo fleet also increased from 1,250 to 4,500 TEU in the same period. Given the geographical distance and the lack of alternative transportation modes, it is plausible to assume that the relevance of container ships for China-Africa trade flows goes even beyond their global averages of 75 per cent of trade volume and 60 per cent of value (UNCTAD, 2019). Although the new ultra-large container ships are usually deployed on the main East-West routes, existing vessels previously used on these routes have been pushed to smaller trade routes through a cascade effect. The introduction of ‘Post-Panamax’ container ships on the main maritime routes has therefore had an indirect positive effect on the average size of ships operating on relatively minor routes, such as the case of African small ports (PwC, 2018). However, this may only be true if the water depth of SSA ports is sufficient to allow for the anchorage, unloading and loading of the potentially redeployed ships.[16] As such, the impact of the transportation shock will not be homogeneous across export destinations, but will depend on the exogenous geographic characteristic of ports, that is the presence of coastal features allowing for deep waters to accommodate larger container ships.[17] Based on these considerations, we construct the Maritime Transport Shock (IV_MTS_{cst}) instrument for Chinese imports penetration as follows[18]:

$$IV\_MTS_{cst} = \left(\frac{\sum_p \left(P_{cp} \times D_p \times S_p \times I_{ps} \right)}{N_p} \right) \times C_t \tag{3}$$

Data on the major ports in SSA were obtained from the 2005 World Port Index (WPI) dataset provided by the US National Geospatial-Intelligence Agency.[19] The database contains location, physical characteristics, facilities and services offered by major ports and terminals world-wide. We identified 180 main ports for the African continent, reduced to around 50 after removing harbours that are classified as very small or not deemed fit to host container ships. We use information on the depth of water at the anchorage point for each port (p) in 2005 (D_p), in order to exogenously set the depth of water in respect to the imports penetration from China.[20] We complement the WPI data by

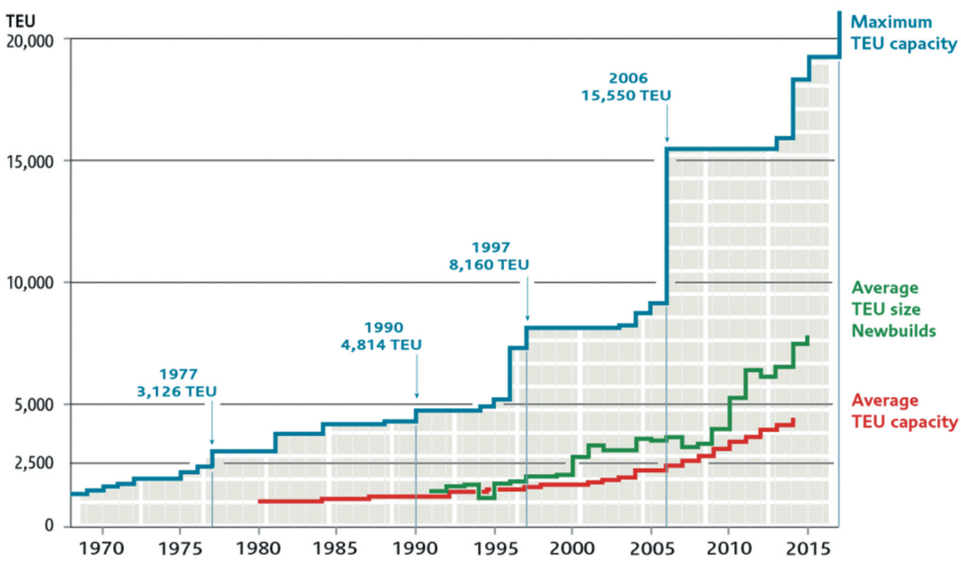

Figure 3. Evolution of containership maximum and average TEU capacity since 1970s.

Note: Elaboration based on data from Clarkson Research Services (OECD-ITF, 2015).

using satellite data on night-lights, available from the US Air Force Defence Meteorological Satellite Program Operational Linescan System (DMSP OLS) database, to estimate the size of SSA ports (S_p). Satellite data on light emitted at night have previously been used as proxy for income growth and economic activity of cities, regions and countries (Henderson, Storeygard, & Weil, 2012; Storeygard, 2016). Using these data allows us to estimate the dimension of ports p in 2005, and the intensity of their activity based on their luminosity at night.[21]

Secondly, we estimate proximity of cities to ports (P_{cp}) by measuring the distance between each city (c) and port (p) combination. We use ArcGIS O-D (Origin-Destination) network analysis tool to measure the driving distance between cities and each port using road network data. The road network data are provided by the Socio-Economic Data and Application Center of the Columbia University Center for International Earth Science Information Network. Figure 4 shows the geo-location of cities and of the main African ports included in our sample connected by the road network.

Based on this, we derived the driving time needed to cover each city-port pair distance, taking into account speed limits, classification and quality of roads.[22] Port proximity (P_{cp}) is measured as the normalised value of the inverse of the driving time between each city (c) and port (p) combination. As imports would be shipped to ports that are closer to final destinations, we restrict our analysis to city-ports combinations with a travel time below the 50th percentiles of the overall distribution, approximately close to 1.5 days of travel.[23] Finally, we consider the preparedness of the ports to handle goods of sector (s) imported from China. To do so, we weight by total import competition or import of intermediate inputs (total, horizontal and vertical) from China in sector (s) in the country of port (p) in year 2000 (I_{ps}), thus exogenously setting it before the beginning of our sample period and before the accession of China to the WTO. This also allows the instrumental variable to be industry-specific.

To summarise, our maritime transport shock instrument (IV_MTS_{cst}) for imports from China is a city-industry average given by the exogenous depth of water for each port (D_p), weighted by the port size (S_p), by the proximity between each city-port pairs within 1.5 day of travel time (P_{cp}), and by the handling capability of ports for sectoral imports from China (I_{ps}). This is summed across all ports and divided by the total number of ports (N_p) to get the average, and then multiplied by the exogenous time-varying average size of container ships (C_t). For the instrument to be valid, the variable should be directly correlated with the endogenous variable (the imports of manufacturing goods from China), and should have no direct effect on the outcome variable (for example the productivity of individual firms) after controlling for other covariates. The shock will increase Chinese imports flow relatively more towards cities that are closer to ports with deeper waters, as these are the only ones that can accommodate larger container ships. This therefore affects the productivity of firms only through the increase in the import flows of Chinese goods transiting these ports.

4.2.2. China comparative advantage shock IV. As robustness test, we follow an alternative instrumental variable approach developed by Autor et al. (2013). Specifically, we exploit the rising competitiveness of Chinese manufacturing industries during the period of our analysis together with the lowering of trade barriers faced by China after accession to the WTO in 2001. This provides an exogenous supply shock for SSA firms. We therefore modify our baseline specification by estimating the following model:

$$\Delta LP_{it} = \beta_0 + \beta_1 \Delta COM\_CHN_{cst} + \beta_2 \Delta INP\_CHN_{cst} + \beta_3 \Delta IMP\_OTH_{cst} + \beta_4 X_{it} + j_i + j_t + j_{cs} + j_{ct} + j_{st} + \varepsilon_{it} \quad (4)$$

where ΔLP_{it} is the change in firm i's labour productivity between time *t-2* and *t*.[24] ΔCOM_CHN_{cst} and ΔINP_CHN_{cst} represent the change between time *t-2* and *t* in the exposure to import competition and import of intermediate inputs (total, horizontal and vertical) from China respectively over the

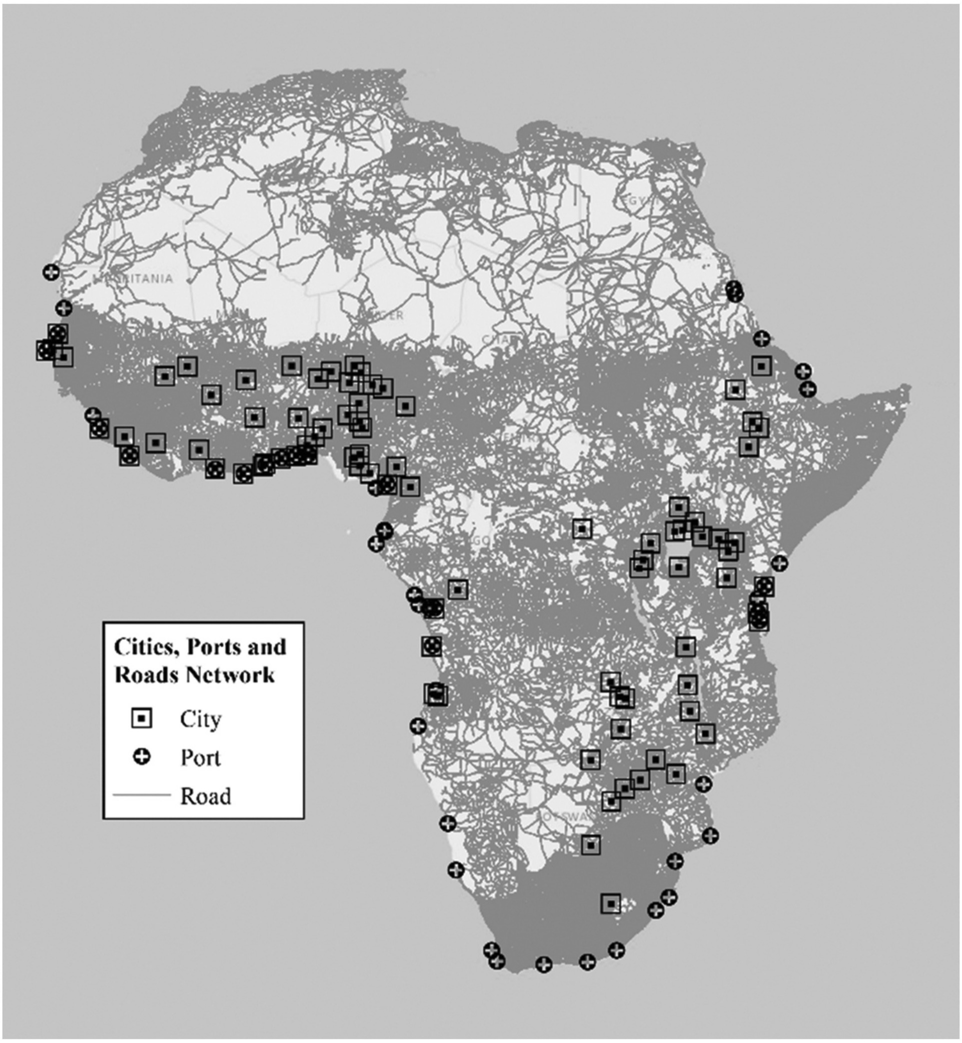

Figure 4. Location of cities, ports included in our sample and their road connections.

Note: Elaboration using the GIS O-D (Origin-Destination) network analysis tool of ArcGIS to measure the driving distance between cities included in our sample (represented by the black stars) and the location of the main African ports included in the WPI data (in red) using road network data provided by the Socio-Economic Data and Application Center of the Columbia University Center for International Earth Science Information Network.

same period for all firms located in city (c) and operating in the industry (s), as previously defined in equations (2). Similar to equation (1), we include the same set of control variables and fixed-effects.

We instrument the growth in Chinese import competition and import of intermediate inputs by using the contemporaneous composition and growth of Chinese imports in the same sector (s) but in other SSA countries (d). This enables us to identify the supply-driven shock of both types of Chinese imports. Specifically, we instrument the two measures of import penetration ΔCOM_CHN_{cst} and ΔINP_CHN_{cst} with:

$$\Delta COM\_IV_{cst} = \frac{E_{cst_0}}{E_{kst_0}} \times \frac{\sum_{d \neq k} \Delta COM\_CHN_{dst}}{N_d}$$
$$\Delta INP\_IV_{cst} = \frac{E_{cst_0}}{E_{kst_0}} \times \frac{\sum_{d \neq k} \Delta INP\_CHN_{dst}}{N_d} \qquad (5)$$

where ΔCOM_CHN_{dst} and ΔINP_CHN_{dst} are the growth in import competition and import of intermediate inputs (total, horizontal and vertical) from China respectively in each sector (s) for all other SSA countries (d) different from the country of interest (k). This instrumental variable strategy identifies the supply-side industry-specific Chinese comparative advantage component of the import growth, which should be exogenous and experienced by all SSA countries in our sample, while also taking into account the initial industrial composition of cities.[25]

5. Results

5.1. Main results

Table 1 presents estimates from the baseline OLS specifications and the 2SLS models that use the maritime transport shock (MTS) as an instrument. All estimates include firm, year, city-industry, city-year and industry-year fixed effects, which will capture most of the time-variant and invariant unobservable factors. Columns 1 and 3 report the estimated effects of import competition and import of intermediate inputs from China on SSA firms' TFP, while in columns 2 and 4 the effects of the latter are further separated between horizontal and vertical intermediate inputs.

Column 1 shows that only import of intermediate inputs from China significantly impacts firm productivity, while the effect of import competition is insignificant. A plausible interpretation of this finding is that the increased presence of Chinese goods in SSA markets may enable firms to change their input mix towards inputs that were not previously available (Kaplinsky et al., 2007). This is in line with previous evidence showing that access to a wider variety of cheaper and better quality intermediate inputs from China, relative to other domestic and non-Chinese foreign inputs, can enhance firm performance (Ademola et al., 2009; Bigsten et al., 2016; Crinò, 2012; Grossman & Rossi-Hansberg, 2006; Maswana, 2009; Sharma, 2013). Column 2 shows that both horizontal and vertical inputs have positive impact on productivity, with similar coefficients, although vertical inputs have a stronger significance than horizontal inputs.

While the inclusion of firm, year and city-industry fixed-effects, as well as of city-year and industry-year time trends, should control for much of the unobserved variability in our model, other potential sources of endogeneity might remain. For example, more productive firms could be more exposed to international trade, as they decide to locate in cities that have better access to international markets. Alternatively, highly competitive firms might self-select into faster growing industries that are more affected by Chinese imports penetration. In either cases, our OLS coefficients might be biased by reverse causality. To address this issue, columns 3 and 4 show results from the 2SLS estimations using the maritime transport shock as an instrumental variable. First stage estimations, presented in Appendix Table A3, show that all of the F-values for instruments' quality are above the critical threshold of 10, suggesting that our estimates do not suffer from weak-instrument bias. Column 3 of Table 1 confirms the significant impact of import of intermediate inputs, with a coefficient more than a magnitude higher than the OLS one. Given that we do not observe significant inter-sectorial reallocation within city over the period under consideration, we can interpret the estimated coefficients as the change in TFP as a result of a unit increase in imports from China. Thus, the results in column 3 indicate that a USD 1 million increase in import of intermediate inputs from China could roughly increase SSA firms' productivity by 0.59%. When we further differentiate between vertical and horizontal inputs (column 4), the results indicate that only the latter significantly impacts productivity, with a magnitude very close to the coefficient estimated for total intermediate inputs. Specifically, a USD 1 million increase in import of horizontal intermediate inputs within-industry from China stimulates a productivity growth of around

Table 1. Impact of imports from China on the productivity of Sub-Saharan African firms: OLS and 2SLS models using the MTS IV

	OLS		2SLS	
Dep.Var: ln(TFP)	(1)	(2)	(3)	(4)
L1.COM-CHN	0.000225	0.000233	−0.0055	−0.0016
	(0.00016)	(0.00016)	(0.0289)	(0.00495)
L1.INP-CHN	0.000147**		0.00592**	
	(0.00006)		(0.0023)	
L1.H.INP-CHN		0.000138*		0.0066***
		(0.00007)		(0.0016)
L1.V.INP-CHN		0.000161**		0.0084
		(0.00007)		(0.0180)
L1.IMP-AFR	0.000028	0.000028	0.00208	0.00581
	(0.00002)	(0.00002)	(0.0081)	(0.00321)
L1.IMP-OECD	−0.000141	−0.000141	−0.00435	−0.00446
	(0.00008)	(0.00008)	(0.0031)	(0.00981)
L1.IMP-ROW	−0.000018	−0.000012	−0.00285	−0.00181
	(0.00009)	(0.00009)	(0.00173)	(0.00454)
L2.Empl.	0.358***	0.358***	0.328**	0.367***
	(0.0435)	(0.0437)	(0.133)	(0.060)
Exporter	0.176	0.176	0.152	0.217
	(0.126)	(0.126)	(0.227)	(0.222)
Age	0.00794**	0.00794**	0.00570	0.0105
	(0.00316)	(0.00316)	(0.0127)	(0.00756)
Firm-Year FE	Y	Y	Y	Y
City-Ind FE	Y	Y	Y	Y
City*Year FE	Y	Y	Y	Y
Ind*Year FE	Y	Y	Y	Y
Clustered SE	City-Ind	City-Ind	City-Ind	City-Ind
Observations	3,054	3,054	3,054	3,054
R-squared	0.376	0.376	0.265	0.296

Notes: estimation based on the World Bank Enterprise Survey, the COMTRADE and EORA-MRIO data between 2003 and 2018. Models estimated using a panel OLS or 2SLS with firm fixed effects. Robust standard errors clustered at the city-industry level reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

0.66%. This evidence is in line with previous studies that find a positive effect of imports of horizontal inputs on firm productivity. That is, SSA firms might attempt to learn from similar Chinese firms operating within the same industry by importing intermediate inputs closely related to the final goods they produce (Fernandes, 2007; Pavcnik, 2002; Topalova & Khandelwal, 2011).

Overall, these results provide robust evidence of the role of increased availability of intermediate inputs from China as the main channel affecting firm productivity, even after including an extensive number of fixed-effects and controlling for reverse causality and other sources of endogeneity. However, due to data limitation, we cannot explicitly account for firms' probability of survival, and hence we are unable to directly test if Chinese import competition might force the least productive firms to exit the market, triggering a within-industry reallocation towards more productive surviving firms (Bernard et al., 2006; Bustos, 2011; Dekle et al., 2007; Pavcnik, 2002). Thus, the insignificant coefficient of import competition could be due to the fact that we cannot capture market exit for the least productive firms. Nonetheless, the analysis of the heterogeneity of these effects across the productivity distribution presented in the next section could help understand this channel.

5.2. Heterogeneous effects

Trade liberalisation could have a heterogeneous effect on firms' productivity by affecting them differently based on the distribution of certain characteristics (Lileeva & Trefler, 2010). We therefore examine how both import competition and import of intermediate inputs, distinguishing between vertical and horizontal inputs, affect firms' productivity across the distribution of their initial level of productivity and proximity to ports. Figure 5 illustrates the estimated marginal effects from the MTS IV estimation on productivity across quartiles of these variables, where higher quartiles indicate higher values.

An initial look at the overall picture suggests some variation in the effects both across productivity and geographical proximity distributions, although the differences in magnitude are small. The analysis of the heterogeneous effects of Chinese imports across the productivity distribution could also help to shed some light on the role which firms' exit might play. Results in Figure 5 do indeed point towards the relevance of import competition for firms at the bottom of the productivity distribution (top left figure). This could be seen as evidence corroborating the hypothesis of a within-industry reallocation of resources from firms that have closed down to initially least productive firms that survived foreign competition. On the other hand, the graphs show that it is unlikely that not accounting for firms' exit could impact the results on intermediate inputs significantly, either for horizontal or for vertical ones, as the former do not seem to impact least productive surviving firms and the latter appears generally irrelevant. Overall, these results show that access to intermediate inputs is an important channel through which Chinese imports can affect the productivity of firms. While this is true for most firms, those with higher productivity benefitted most from an increase in Chinese imports of intermediate inputs.

The moderating role of access to ports is also confirmed by our results, although its impact changes depending on types of import. Specifically, we can see that the marginal effects from both import competition and vertical inputs penetration suggest that only firms furthest away from ports (Q1) benefit from the increase relevance of these types of Chinese imports. The opposite is true for horizontal inputs, which indicates a positive impact on firms that are in closer proximity to ports (Q3 and Q4). These findings are consistent with arguments that access to transport infrastructure matter in determining firms' ability to engage in international activities. For example, import competition might only matter for firms in remote location because only Chinese goods could be cheap enough to warrant transport to these areas, thus introducing an element of competition that was previously absent due to transport cost. On the other hand, firms more closely located to ports may have had to upgrade their production strategy to survive previous waves of import competition from other countries, and could hence be better positioned to exploit horizontal intermediate inputs imported from China. Thus, improving access to key trade infrastructures can enable more SSA firms to improve productivity through an increased pressure from foreign competitors and availability of intermediate inputs (Behar & Venables, 2011; Herrera Dappe et al., 2017; Storeygard, 2016).

5.3. Robustness tests

Table A4 in the appendix shows estimates using the alternative instrumental variable approach proposed by Autor et al. (2013), examining the effects of a growth in Chinese imports' exposure at the industry-city level on firm productivity. While we use these results as robustness check, it is worth pointing out that they refer to a closely connected but distinct measure of productivity than that used in the main results, that is value added per worker. Furthermore, given that the identification strategy proposed relies on using the contemporaneous composition and growth of Chinese imports in the same sector (s) of SSA countries other than the one under consideration, the dependent variable is measured as growth rather than level. However, this specification also enables us to identify the supply-driven component of Chinese imports comparative advantage more directly. The results are consistent with the earlier findings in Table 1, indicating that the increased availability of intermediate inputs from China has a positive effect on firms' productivity growth, although in this

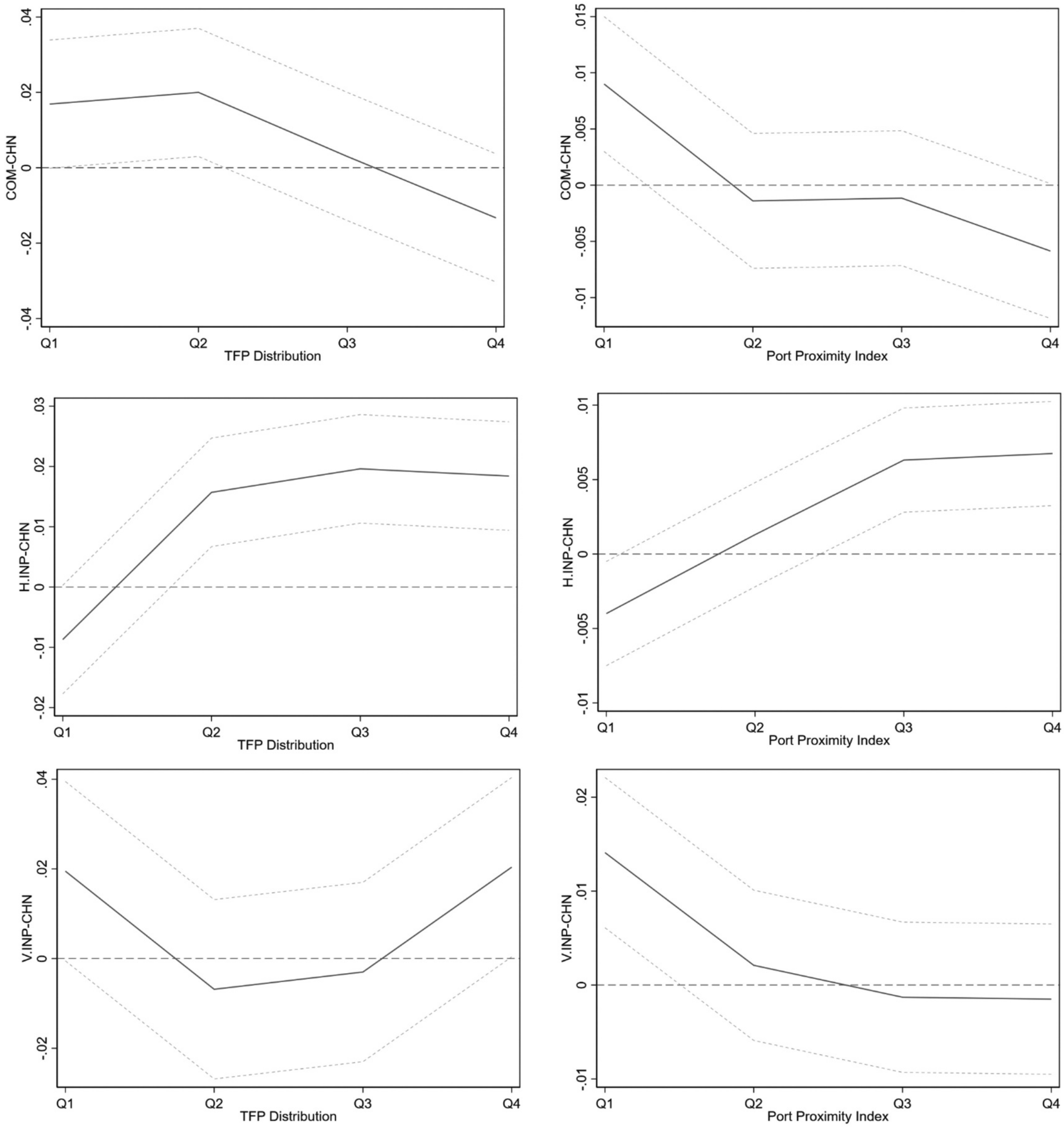

Figure 5. Heterogeneous impact of China imports penetration on the performance of Sub-Saharan African firms across the distribution of firms' productivity and proximity to ports.

Notes: estimation based on the World Bank Enterprise Survey and the COMTRADE and EORA-MRIO data between 2003 and 2018. Models estimated using a panel IV approach with firm, city-year, and industry-year fixed effects. Confidence intervals at 90% level reported as dashed lines. Marginal effects reported across the 4 quartiles of the productivity and port proximity distribution.

specification we are not able to significantly discern amongst impacts from horizontal or vertical inputs.

The results are also remarkably robust to several other sensitivity tests, namely the exclusion of countries for which the firms in the panel sample are statistically different in terms of productivity from the representative WBES sample; the use of different measures of port proximity; and, the estimation of productivity using alternative methodologies.[26]

6. Conclusions

This study is the first to use micro-level data for multiple countries to provide new insights on Chinese import penetration in SSA and its causal effect on firms' productivity, differentiating between import competition and import of horizontal and vertical intermediate inputs. A further unique contribution of this study is the consideration of the role of transport infrastructure in moderating the relationship between Chinese imports and firm performance. The results show robust and compelling evidence of positive effects of Chinese imports on productivity, acting mainly through better access to relatively cheaper intermediate inputs. For the average firm in our sample, a USD 1 million increase in import of intermediate inputs from China would lead to an increase in productivity of 0.6%. However, the results also indicate that Chinese imports did not have homogenous effects on firm performance, with all types of imports having heterogeneous impacts on firm productivity depending on their location and initial level of productivity. These findings highlight the importance of transport infrastructure in SSA countries.

A limitation of the current study is that the data available do not allow for an estimation of firms' survival rate. As such, we are unable to determine whether the effects that we observe could have wider implications. We find evidence that import competition has a significant and positive effect on firms at the bottom of the productivity distribution. These might be exactly those who have improved enough to survive such competition. Further empirical investigation is needed to better analyse this nexus, which has important implications for the overall welfare impact of the China-Africa trade relation. Concerns about labour displacement and possible firm closures may inhibit governments from encouraging domestics firms to engage in international markets. Nonetheless, it is also clear from our findings that firms' productivity improved as a consequence of increased imports from China, and this must be taken into consideration by governments when assessing the outcomes of trade liberalisation. Lastly, the results provide compelling evidence of the importance of improved infrastructure on firm performance. It is therefore important for SSA economies to invest in improving road networks and ports in order to encourage firms to engage effectively in international trade and to foster economic development also in remote areas.

Notes

1. See also Hummels, Munch, and Xiang (2018) for a review of the literature on offshoring and labour markets.
2. For a comprehensive review of the WBES data used refer to the Data Description section SM.1 in the Supplementary Materials.
3. For more detailed information on the survey methodology please refer to http://www.enterprisesurveys.org/methodology
4. All prices have been converted to 2011 levels using the GDP deflator obtained from the World Bank. This is then transformed into International US dollars using the Purchasing Power Parity (PPP) Index, also obtained from the World Bank.
5. WBES data collection does not take place in the same year for each country. This implies that different countries will have different number of waves. 15 countries have only two waves of available data, 8 have been surveyed in three periods and only one country has been surveyed four times. In addition, there are usually different time gaps between survey waves. The minimum number of years between waves is two and the maximum is eight. The average gap between surveys in our sample is five years. We take these differences into account by including in the estimations year fixed-effects, and city-year and industry-year time trends.
6. The countries included in our sample are: Angola, Benin, Botswana, Burkina Faso, Cameroon, Cote d'Ivoire, Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Lesotho, Liberia, Malawi, Mali, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, Togo, Uganda, Zambia and Zimbabwe.
7. For consistency across the different datasets used, we have aggregated the 22 2-digit ISIC manufacturing industries from the original WBES data into seven: 1) food & beverage (ISIC codes 15–16); 2) textiles (17–19); 3) wood & paper (20–22); 4) chemicals & mineral products (23–26); 5) metal products (27–28); 6) machineries (29–35); 7) other manufactures (36).
8. The countries are Ghana and Tanzania. Results available from the authors upon request.
9. The COMTRADE data report imports per country and product classification. We link each imported product to the producing industry using the correspondence tables between the HS products classification and the SIC industrial classification provided by Pierce and Schott (2009), and then aggregate them into our seven broad industries: 1) food and beverage (HS codes 1–24); 2) textiles (41–43 and 50–67); 3) wood and paper (44–49); 4) chemicals and mineral

products (25–40 and 68–71); 5) metal products (72–83); 6) machineries (84–89); 7) other manufactures (90–97). The EORA-MRIO data are instead classified into eight manufacturing sectors, similar to the classification we use, and we then combine 'Transport Equipment' and 'Electrical and Machinery' industries into sector 6 'Machineries'. The two sources of trade data have been harmonised using the same unit (USD millions) and transformed into constant USD prices.

10. We estimated TFP by industry and country using value added as a proxy for output. Included in the estimation are total employment (as measure of labour), total costs of intermediate input (a measure of costs of production), and total investment in tangible and intangible assets. To eliminate any effect of outliers, we removed the top and bottom percentiles after the estimation and logged all variables, without any significant loss of observations. As robustness tests, we repeated the analysis using different measures of productivity, including TFP developed by Wooldridge (2009), value added per worker, turnover per employee, total sales and total employment. Results were consistent and are available from the authors upon request.
11. In order to eliminate any selection bias, data from the general WBES sample, not just firms included in the panel sample, was used to build these weights.
12. In the WBES, firms are also asked to report total sales and employment at time *t-2*. No other variables are reported for this time period. Firms are classified as exporters if they exported at least 1 per cent of their annual production. All variables are included in the model as logged values except for EXP which is a dummy variable.
13. All variables included in the models have been winsorised to reduce the effect of outliers in the estimations, by setting all data below the 1st percentile to the 1st percentile level, and data above the 99th percentile to the 99th percentile level (Graham Clark, Kokic, & Smith, 2017).
14. Definitions of all variables included in this study can be found in Table A1 in the Appendix.
15. TEU is a unit of cargo capacity generally used to describe the capacity of container ships and container terminals. It is based on the volume of an internationally standardised intermodal container, 20-feet-long (6.1 m) and 8-feet-wide (2.44 m). No precise standard exists on height, although in general the most common height is 8 feet 6 inches (2.59 m), to fit into railway tunnels.
16. To further corroborate this evidence, we collected information on the average size of container ships calling at SSA ports in our sample in 2018 from the Marine Traffic website (https://www.marinetraffic.com). The average capacity of container ships calling at SSA ports was around 4,000 TEU, in line with the average TEU capacity of the world cargo fleet in 2016, according to the OECD-ITF (2015).
17. To accommodate the Panamax size vessels redeployed onto Africa's lower-volume routes, the draught of ports needs to exceed 12 metres. However, very few of the ports included in our sample have the required water depth, limiting the opportunities for redeveloping larger ships to African ports (Guerrero & Rodrigue, 2014).
18. See Appendix Table A2 for summary statistics of variables used in constructing the MTS.
19. We keep the port information fixed at the 2005 level because this is the first year for which the WPI data are available and in order to prevent issues related to endogenous change to ports' characteristics.
20. It is only very recently, and only in the most advanced African countries, that some large infrastructural investments have been undertaken to artificially increase the depth of waters in African ports, mainly in some North-African countries (Morocco and Algeria) and in South-Africa, while most of the other SSA countries still rely on ports infrastructures built before the 1960s (PwC, 2018; USITC, 2009). As shown in Appendix Table A2, the average depth of water at the anchorage point for our sample of ports has only marginally increased between 2005 and 2016.
21. Additional information regarding the use of nightlights to estimate ports size is available in section SM.2 of the Supplementary Materials.
22. The network data provide eight different roads classes for which the following speed limits have been assigned based on the information provided by the OpenStreetMap Wiki on 'Africa Tagging Guidelines': highways 90 km/h; primary 70 km/h; secondary 60 km/h; tertiary 50 km/h; urban 30 km/h; tracks 20 km/h; service road 20 km/h; unclassified 30 km/h (http://wiki.openstreetmap.org/w/index.php?title=East_Africa_Tagging_Guidelines&oldid=1534648). As a robustness test, we also used the Euclidian distance and driving distance as alternatives measures, yielding very similar results.
23. Driving time provides a reliable measure of proximity and accessibility and it is an improvement over previous studies that use Euclidian distance or driving distance (Boscoe, Henry, & Zdeb, 2012; Buczkowska, Coulombel, & De Lapparent, 2015; Goncalves, Goncalves, De Assisc, & Da Silvad, 2014). However, driving time does not take into account other elements that affects the connectivity of firms to ports, such as the presence of national borders. For this reason, if the route between a city and a port includes crossing a national border, we weight the distance by a factor equal to 3, the average elasticity of trade to national borders indicated in the literature (Havranek & Irsova, 2017; McCallum, 1995). Several findings and anecdotal evidence have shown that bottlenecks at ports and delays at borders rather than road quality are the main reasons for long shipment travel times in SSA. For instance, it could take more than 24 hours just to cross the Kenya-Ugandan border and around six days to cross the South Africa-Zimbabwe border (http://www.worldbank.org/en/news/feature/2008/06/16/landlocked-countries-higher-transport-costs-delays-less-trade). Another report from UNCTAD also shows that it can take more than 800 km and approximately 2 to 3 days for landlocked countries to get to ports (UNCTAD, 2013). We test the sensitivity of our results to this threshold by restricting the analysis to city-ports combinations with a travel time distance below the 25th and 75th percentiles, or alternatively by including all city-ports combinations. Results are consistent and available from the authors upon request.

24. As previously discussed, in the WBES questionnaire each firm is required to report total sales and employment both at time *t* and at time *t-2*, but unfortunately other variables needed to estimate TFP are not reported for time *t-2*.We therefore use added-value per worker, as a proxy for productivity, as dependent variable to estimate the first-difference model.
25. There could be concerns with the application of the Autor et al. (2013) methodology to the SSA case if the industrial composition of the countries in the sample at time t_0 is not a good predictor of their industrial composition at time *t*. However, using the sample weights provided in the WBES, we find evidence of relevant (greater than 10%) inter-sectorial reallocation over the period under consideration only for the 'textiles' (in 3 out of 24 countries) and the 'others manufactures' (in 4 countries) sectors. The average inter-sectorial shift is relatively low and close to 3.2%.
26. Further robustness tests results available from the authors upon request.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

Acemoglu, D., Gancia, G., & Zilibotti, F. (2015). Offshoring and directed technical change. *American Economic Journal: Macroeconomics*, *7*(3), 84–122.
Adao, R., Kolesar, M., & Morales, E. (2019). Shift-share designs: Theory and inference. *The Quarterly Journal of Economics*, *134*(4), 1949–2010.
Ademola, O. T., Bankole, A. S., & Adewuyi, A. O. (2009). China–Africa trade relations: Insights from AERC scoping studies. *The European Journal of Development Research*, *21*(4), 485–505.
Aggarwal, S. (2018). Do rural roads create pathways out of poverty? Evidence from India. *Journal of Development Economics*, *133*, 375–395.
Alvarez, R., & Claro, S. (2009). David versus Goliath: The impact of Chinese competition on developing countries. *World Development*, *37*(3), 560–571.
Amiti, M., & Khandelwal, A. K. (2012). Import competition and quality upgrading. *Review of Economics and Statistics*, *95*(2), 476–490.
Amiti, M., & Konings, J. (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia. *American Economic Review*, *97*(5), 1611–1638.
Asher, S., & Novosad, P. (2020). Rural roads and local economic development. *American Economic Review, 110*(3), 797–823.
Autor, D., Dorn, D., & Hanson, G. (2013). The China syndrome: Local labor market effects of import competition in the United States. *The American Economic Review*, *103*(6), 2121–2168.
Autor, D., Dorn, D., Hanson, G. H., Pisano, G., & Shu, P. (2016). *Foreign competition and domestic innovation: Evidence from U.S. patents* (NBER Working Papers 22879).
Banerjee, A., Duflo, E., & Qian, N. (2012). *On the road: Access to transportation infrastructure and economic growth in China* (NBER Working Papers 17897).
Behar, A., & Venables, A. (2011). Transport costs and international trade. In A. De Palma, R. Lindsey, E. Quinet, & R. Vickerman (Eds.), *A handbook of transport economics* (Chap. 5, pp. 97–115). UK: Edward Elgar Publishing.

Bernard, A. B., Jensen, J. B., & Schott, P. K. (2006). Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of U.S. manufacturing plants. *Journal of International Economics*, *68*(1), 219–237.
Bernard, A. B., Moxnes, A., & Saito, Y. S. (2019). Production networks, geography and firm performance. *Journal of Political Economy*, *127*(2), 639–688.
Bigsten, A., Gebreeyesus, M., & Soderbom, M. (2016). Tariffs and firm performance in Ethiopia. *The Journal of Development Studies*, *52*(7), 986–1001.
Bloom, N., Draca, M., & Van Reenen, J. (2016). Trade induced technical change? The impact of Chinese imports on innovation, IT and productivity. *The Review of Economic Studies*, *83*(1), 87–117.
Boscoe, F. P., Henry, K. A., & Zdeb, M. S. (2012). A nationwide comparison of driving distance versus straight-line distance to hospitals. *The Professional Geographer*, *64*(2), 188–196.
Brandt, L., Van Biesebroeck, J., Wang, L., & Zhang, Y. (2017). WTO accession and performance of Chinese manufacturing firms. *American Economic Review*, *107*(9), 2784–2820.
Buczkowska, S., Coulombel, N., & De Lapparent, M. (2015). Euclidean distance versus travel time in business location: A probabilistic mixture of hurdle-Poisson models. In *ERSA conference papers*. Lisbon: European Regional Science Association.
Bustos, P. (2011). Trade liberalization, exports, and technology upgrading: Evidence on the impact of MERCOSUR on argentinian firms. *American Economic Review*, *101*(1), 304–340.
Cosar, A. K., & Demir, B. (2016). Domestic road infrastructure and international trade: Evidence from Turkey. *Journal of Development Economics*, *118*, 232–244.
Costa, F., Garred, J., & Pessoa, J. P. (2016). Winners and losers from a commodities-for-manufactures trade boom. *Journal of International Economics*, *102*, 50–69.
Coulibaly, S., & Fontagné, L. (2006). South–south trade: Geography matters. *Journal of African Economies*, *15*(2), 313–341.
Crinò, R. (2012). Imported inputs and skill upgrading. *Labour Economics*, *19*(6), 957–969.
Davis, D. R., & Mishra, P. (2007). Stolper-Samuelson is dead: And other crimes of both theory and data. NBER chapters. In *Globalization and poverty* (pp. 87–108). University of Chicago Press.
Dekle, R., Eaton, J., & Kortum, S. (2007). Unbalanced trade. *American Economic Review*, *97*(2), 351–355.
Donaldson, D. (2018). Railroads of the Raj: Estimating the impact of transportation infrastructure. *American Economic Review*, *108*(4–5), 899–934.
Donoso, V., Martin, V., & Minondo, A. (2015). Do differences in the exposure to Chinese imports lead to differences in local labour market outcomes? An analysis for Spanish provinces. *Regional Studies*, *49*(10), 1746–1764.
Edwards, L., & Jenkins, R. (2014). The margins of export competition: A new approach to evaluating the impact of China on South African exports to sub-Saharan Africa. *Journal of Policy Modelling*, *36*(1), 132–150.
Edwards, L., & Jenkins, R. (2015). The impact of Chinese import penetration on the South African manufacturing sector. *The Journal of Development Studies*, *51*(4), 447–463.
Edwards, S. (1998). Openness, productivity and growth: What do we really know? *The Economic Journal*, *108*(447), 383–398.
Eichengreen, B., Rhee, Y., & Tong, H. (2004). *The impact of China on the exports of other Asian countries* (NBER Working Paper no. 10768).
Feenstra, R. C., & Hanson, G. H. (1999). the impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979–1990. *The Quarterly Journal of Economics*, *114*(3), 907–940.
Fernandes, A. M. (2007). Trade policy, trade volumes and plant level productivity in colombian manufacturing industries. *Journal of International Economics*, *71*(1), 52–71.
Feyrer, J. (2009). *Trade and income: Exploiting time series in geography* (NBER Working Papers no.14910).
Gebre-Egziabher, T. (2007). Impacts of Chinese imports and coping strategies of local producers: The case of small-scale footwear enterprises in Ethiopia. *The Journal of Modern African Studies*, *45*(4), 647–679.
Gibbons, S., Lyytikainen, T., Overman, H. G., & Sanchis-Guarner, R. (2019). New road infrastructure: The effects on firms. *Journal of Urban Economics*, *110*, 35–50.
Goldberg, P., Khandelwal, A., Pavcnik, N., & Topalova, P. (2010). imported intermediate inputs and domestic product growth: Evidence from India. *The Quarterly Journal of Economics*, *125*(4), 1727–1767.
Gollin, D., & Rogerson, R. (2014). Productivity, transport costs and subsistence agriculture. *Journal of Development Economics*, *107*, 38–48.
Goncalves, D. N., Goncalves, C., De Assisc, T. F., & Da Silvad, M. A. (2014). Analysis of the difference between the Euclidean distance and the actual road distance in Brazil. *Transportation Research Procedia*, *3*, 876–885.
Graham Clark, R., Kokic, P. A., & Smith, P. (2017). A comparison of two robust estimation methods for business surveys. *International Statistical Review*, *85*(2), 270–289.
Grossman, G., & Helpman, E. (1991). Trade, knowledge spillovers, and growth. *European Economic Review*, *35*(2–3), 517–526.
Grossman, G., & Rossi-Hansberg, E. (2006). *Trading tasks: A simple theory of offshoring* (NBER Working Paper no. 12721).
Guerrero, D., & Rodrigue, J.-P. (2014). The waves of containerization: Shifts in global maritime transportation. *Journal of Transport Geography*, *34*, 151–164.
Halpern, L., Miklos, K., & Szeidl, A. (2005). *Imports and productivity* (CEPR Discussion Papers no. 5139).
Harrison, A., & McMillan, M. (2011). Offshoring jobs? Multinationals and U.S. manufacturing employment. *Review of Economics and Statistics*, *93*(3), 857–875.

Havranek, T., & Irsova, Z. (2017). Do borders really slash trade? A meta-analysis. *IMF Economic Review*, *65*(2), 365–396.
Henderson, V., Storeygard, A., & Weil, D. N. (2012). Measuring economic growth from outer space. *American Economic Review*, *102*(2), 994–1028.
Herrera Dappe, M., Jooste, C., & Suárez-Alemán, A. (2017). *How does port efficiency affect maritime transport costs and trade? Evidence from Indian and Western Pacific Ocean countries* (Policy Research Working Paper No. 8204). Washington, DC: World Bank.
Hummels, D., Munch, J. R., & Xiang, C. (2018). Offshoring and labor markets. *Journal of Economic Literature*, *56*(3), 981–1028.
Iacovone, L., Rauch, F., & Winters, L. A. (2013). Trade as an engine of creative destruction: Mexican experience with Chinese competition. *Journal of International Economics*, *89*(2), 379–392.
Iimi, A., Humphreys, R. M., & Mchomvu, Y. E. (2017). *Rail transport and firm productivity: Evidence from Tanzania* (Policy Research Working Paper No. 8173). Washington, DC: World Bank.
Jedwab, R., & Moradi, A. (2016). The permanent effects of transportation revolutions in poor countries: Evidence from Africa. *Review of Economics and Statistics*, *98*(2), 268–284.
Kaplinsky, R., McCormick, D., & Morris, M. (2007). *The impact of China on sub-Saharan Africa* (IDS Working Paper Series, 291).
Kaplinsky, R., & Morris, M. (2006). Dangling by a thread: How sharp are the Chinese scissors? Institute of Development Studies.
Kaplinsky, R., & Morris, M. (2008). Do the Asian drivers undermine export-oriented industrialization in sub-Saharan Africa? *World Development*, *36*(2), 254–273.
Kasahara, H., & Rodrigue, J. (2008). Does the use of imported intermediates increase productivity? Plant-level evidence. *Journal of Development Economics*, *87*(1), 106–118.
Krugman, P. (1979). Increasing returns, monopolistic competition, and international trade. *Journal of International Economics*, *9*(4), 469–479.
Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, *99*(3), 483–499.
Levinsohn, J., & Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, *70*(2), 317–341.
Lileeva, A., & Trefler, D. (2010). Improved access to foreign markets raises plant-level productivity … for some plants. *The Quarterly Journal of Economics*, *125*(3), 1051–1099.
Limao, N., & Venables, A. J. (2001). Infrastructure, geographical disadvantage, transport costs, and trade. *The World Bank Economic Review*, *15*(3), 451–479.
Lu, Y., & Ng, T. (2013). Import competition and skill content in US manufacturing industries. *Review of Economics and Statistics*, *95*(4), 1404–1417.
Maswana, J. C. (2009). A center-periphery perspective on Africa-China's emerging economic links. *African and Asian Studies*, *8*(1–2), 67–88.
McCallum, J. (1995). National borders matter: Canada-U.S. regional trade patterns. *American Economic Review*, *85*, 615–623.
Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate productivity growth. *Econometrica*, *71*(6), 1695–1725.
Melitz, M. J., & Ottaviano, G. I. P. (2008). Market size, trade, and productivity. *The Review of Economic Studies*, *75*(1), 295–316.
Mion, G., & Zhu, L. (2013). Import competition from and offshoring to China: A curse or blessing for firms? *Journal of International Economics*, *89*(1), 202–215.
OECD-ITF. (2015). The impact of mega-ships. In *Case-specific policy analysis*. Paris: OECD Publishing. Retrieved from https://www.itf-oecd.org/sites/default/files/docs/15cspa_mega-ships.pdf
Palsson, G., Harding, A., & Raballand, G. (2007). Port and maritime transport challenges in West and Central Africa (Sub-Saharan Africa Transport Policy Program (SSATP) Working Paper Series no. 84). Washington, DC: World Bank.
Pascali, L. (2017). The wind of change: Maritime technology, trade, and economic development. *American Economic Review*, *107*(9), 2821–2854.
Pavcnik, N. (2002). Trade liberalization, exit, and productivity improvements: Evidence from Chilean plants. *The Review of Economic Studies*, *69*(1), 245–276.
Pierce, J. R., & Schott, P. K. (2009). *A concordance between ten-digit U.S. harmonized system codes and SIC/NAICS product classes and industries* (Technical Report). Yale School of Management.
PwC. (2018). Strengthening Africa's gateways to trade: An analysis of port development in sub-Saharan Africa. Retrieved from https://www.pwc.co.za/en/publications/african-ports.html
Redding, S. J., & Turner, M. A. (2015). Transportation costs and the spatial organization of economic activity. In G. Duranton, V. Henderson, & W. Strange (Eds.), *Handbook of urban and regional economics* (Chap. 20, pp. 1339–1398, Vol. 5). Amsterdam: Elsevier.
Reddy, S. (1999). Dynamic comparative advantage and the welfare effects of trade. *Oxford Economic Papers*, *51*(1), 15–39.
Rodrik, D. (2006). What is so special about China's exports? *China & World Economy*, *14*(5), 1–19.
Schott, P. K. (2008). The relative sophistication of Chinese exports. *Economic Policy*, *23*(53), 5–49.
Sharma, S. (2013). *Imported intermediate inputs and workforce composition: Evidence from India's tariff liberalization* (Economics Program Working Papers 13-030).

Shiferaw, A., Söderbom, M., Siba, E., & Alemu, G. (2015). Road infrastructure and enterprise dynamics in Ethiopia. *The Journal of Development Studies*, *51*(11), 1541–1558.

Storeygard, A. (2016). Farther on down the road: Transport costs, trade and urban growth in Sub-Saharan Africa. *The Review of Economic Studies*, *83*(3), 1263–1295.

Teravaninthorn, S., & Raballand, G. (2009). *Transport prices and costs in Africa: A review of the international corridors. Directions in development: Infrastructure*. Washington, DC: World Bank.

Topalova, P., & Khandelwal, A. K. (2011). Trade liberalization and firm productivity: The case of India. *The Review of Economics and Statistics*, *93*(3), 995–1009.

UNCTAD. (2013). *Review of maritime transport, Chapter 6: Securing reliable access to maritime transport for landlocked countries* (Report by the UNCTAD secretariat, United Nations, New York and Geneva).

UNCTAD. (2019). *Review of maritime transport*, *United Nations Conference on Trade and Development, UNCTAD/RMT/ 2019*. New York: United Nations Publications.

USITC. (2009). Sub-Saharan Africa: Effects of infrastructure conditions on export competitiveness (Investigation No. 332-477 USITC Publication 4071).

Utar, H., & Ruiz, L. B. T. (2013). International competition and industrial evolution: Evidence from the impact of Chinese competition on Mexican maquiladoras. *Journal of Development Economics*, *105*, 267–287.

Van Biesebroeck, J. (2008). The sensitivity of productivity estimates. *Journal of Business and Economic Statistics*, *26*(3), 311–328.

Volpe-Martincus, C., & Blyde, J. (2013). Shaky roads and trembling exports: Assessing the trade effects of domestic infrastructure using a natural experiment. *Journal of International Economics*, *90*(1), 148–161.

Wang, Z., Wei, S. J., Yu, X., & Zhu, K. (2018). *Re-examining the effects of trading with china on local labor markets: A supply chain perspective* (National Bureau of Economic Research no. w24886).

Wooldridge, J. M. (2009). On estimating firm-level production functions using proxy variables to control for unobservables. *Economics Letters*, *104*(3), 112–114.

World Integrated Trade Solution. (2020). Sub-Saharan Africa imports, tariff by country and region. Retrieved from https://wits.worldbank.org/CountryProfile/en/Country/SSF/Year/2018/TradeFlow/Import

Zafar, A. (2007). The growing relationship between China and Sub-Saharan Africa: Macroeconomic, trade, investment, and aid links. *The World Bank Research Observer*, *22*(1), 103–130.

Appendix

Table A1. Definition of all variables included in the study

Variable	Definition	Source
TFP_{it}	Total Factor Productivity of firm (i) at time (t), estimated following the Levinsohn and Petrin (2003) methodology.	WBES
COM-$CHN_{cst\text{-}1}$	Value of total imports of manufacturing goods less imports of intermediate inputs from China by country (k) and sector (s) at time (t-1) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	COMTRADE, EORA-MRIO, WBES
INP-$CHN_{cst\text{-}1}$	Value of total imports of intermediate inputs from China by country (k) and sector (s) at time (t-1) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	EORA-MRIO, WBES
H.INP-$CHN_{cst\text{-}1}$	Value of imports of intermediate horizontal inputs within the same industry from China by country (k) and sector (s) at time (t-1) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	EORA-MRIO, WBES
V.INP-$CHN_{cst\text{-}1}$	Value of imports of intermediate vertical inputs across different industries from China by country (k) and sector (s) at time (t-1) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	EORA-MRIO, WBES
IMP-$AFR_{cst\text{-}1}$	Value of total imports of manufacturing goods from other African countries by country (k) and sector (s) at time (t-1) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	COMTRADE, WBES
IMP-$OECD_{cst\text{-}1}$	Value of total imports of manufacturing goods from OECD countries by country (k) and sector (s) at time (t-1) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	COMTRADE,WBES
IMP-$ROW_{cst\text{-}1}$	Value of total imports of manufacturing goods from the rest of the world by country (k) and sector (s) at time (t-1) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	COMTRADE, WBES
$EMPL_{it\text{-}2}$	Number of FTE equivalent employees by firm (i) at time (t-2).	WBES
EXP_{it}	Dummy variable equal to 1 if firm (i) has exported goods abroad at time (t) or 0 otherwise.	WBES
AGE_{it}	Age of firm (i) at time (t).	WBES
IV-MTS_{cst}	Maritime transport shock instrument measured as an average at the city (c) level of the depth of water for each port (p), weighted by the port (p) size, the proximity between each city (c) and port (p) within 1.5 day of travel time, by the handling capability of port (p) for sectoral (s) imports from China and then multiplied by the average size of container ships at time (t).	WPI, COMTRADE, EORA-MRIO
P_{cp}	Normalised value of the inverse of the driving time between each city (c) and port (p) with a travel time below 1.5 days of travel.	Columbia Data
S_p	Size of port (p) measured using satellite data on night-lights in 2005.	DMSP OLS
D_p	Depth of water at the anchorage point for each port (p) in 2005.	WPI
I_p	Value of total imports competition/imports of intermediate inputs from China by sector (s) of the country of port (p) in year 2000.	COMTRADE, EORA-MRIO,
C_t	Average TEU size of container ships world-wide at time (t).	OECD

(*continued*)

Table A1. (*Continued*)

Variable	Definition	Source
ΔLP_{it}	Growth in added-value per worker, measured as total sales net of labour cost divided by number of employees, between time (t) and (t-2).	WBES
$\Delta COM - IV_{cst}$	Growth in value of imports competition from China in sector (s) in all SSA countries (d) other than country (k) between time (t-2) and time (t) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	COMTRADE, EORA-MRIO, WBES
$\Delta INP - IV_{cst}$	Growth in value of imports of intermediate inputs from China in sector (s) in all SSA countries (d) other than country (k) between time (t-2) and time (t) weighted by the employment share of a city (c) over the total employment of industry (s) in country (k) in the first year available in the WBES data (t0).	EORA-MRIO, WBES

Table A2. Summary statistics for variables used in the construction of the MTS IV

	Mean	S.D.	Min.	Max.
Anchorage Depth (2005)	13.07	5.38	4.90	23.20
Anchorage Depth (2016)	13.82	5.54	3.40	23.20
Port Size (Night Lights)	35.62	15.62	5.80	63.00
TEU capacity in Port	4454.83	3812.03	150.00	20,000.00
Av. TEU world capacity	3542.31	855.95	2500.00	5000.00
Max. TEU world capacity	14,830.77	3408.92	8250.00	19,000.00
Driving Distance (km)	1554.63	914.28	1.00	4993.24
Travel Time (min)	2473.74	1568.28	1.00	8221.81

Note: Anchorage depth for 2005 and 2016 measured in metres provided by the World Port Index. Port Size (Night Lights) estimated following the methodology explained in the Supplementary Materials section SM.2 using the US Air Force DMSP OLS data. TEU capacity in Port measured using data from the https://www.marinetraffic.com website reporting the TEU-equivalent capacity of container-ships calling at the ports in our sample during the month of December 2018. Average and Maximum TEU world capacity measures provided by the OECD-ITF unit. The average driving distance in kilometres and travel time distance in minutes between cities and ports in our sample calculated using the ArcGIS O-D (Origin-Destination) network analysis tool and road network data provided by the Socio-Economic Data and Application Center of the Columbia University Center for International Earth Science Information Network.

Table A3. Impact of imports from China on the productivity of Sub-Saharan African firms: first-stages of 2SLS estimations

	(1) COM-CHN	(2) INP-CHN	(3) H.INP-CHN	(4) V.INP-CHN
IV-MTS				
IV-COM-CHN	1.852*	1.112	0.285	0.402
	(0.771)	(0.904)	(0.261)	(0.322)
IV–INP-CHN	3.721	2.990***		
	(3.225)	(1.032)		
IV-H.INP-CHN			2.160*	4.545
			(1.042)	(3.722)
IV–V.INP-CHN			2.228	4.71**
			(1.651)	(2.559)
Firm-Year FE	Y	Y	Y	Y
City-Ind FE	Y	Y	Y	Y
City*Year FE	Y	Y	Y	Y
Ind*Year FE	Y	Y	Y	Y
Clustered SE	City-Ind.	City-Ind.	City-Ind.	City-Ind.
F-Stat.	12.534	17.996	12.002	12.483
Observations	3,054	3,054	3,054	3,054
R-squared	0.129	0.135	0.092	0.147
IV-China Shock				
IV-COM-CHN	0.0098*	−0.004	−0.004	0.0016
	(0.005)	(0.003)	(0.002)	(0.001)
IV–INP-CHN	−0.0741	0.010***		
	(0.069)	(0.002)		
IV-H.INP-CHN			0.014***	−0.0021
			(0.003)	(0.002)
IV–V.INP-CHN			−0.011	0.006
			(0.008)	(0.004)
Firm-Year FE	Y	Y	Y	Y
City-Ind FE	Y	Y	Y	Y
City*Year FE	Y	Y	Y	Y
Ind*Year FE	Y	Y	Y	Y
Clustered SE	City-Ind.	City-Ind.	City-Ind.	City-Ind.
F-Stat.	15.231	16.551	14.649	10.061
Observations	3,054	3,054	3,054	3,054
R-squared	0.344	0.396	0.382	0.392

Note: Estimation based on the World Bank Enterprise Survey and the UN COMTRADE and EORA-MRIO data between 2003 and 2018. Models estimated using a panel 2SLS with firm fixed effects in the top panel, and a first-difference 2SLS method methodology in the bottom panel. Robust standard errors clustered at the city-industry level reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A4. Impact of imports from China on the productivity of Sub-Saharan African firms: 2SLS model following the Autor et al. (2013) approach

Dep.Var: D.Added-Value	(1)	(2)
	2SLS	
D.COM-CHN	−0.0202	−0.0240
	(0.0331)	(0.045)
D.INP-CHN	0.0367**	
	(0.0153)	
D.H.INP-CHN		0.0300
		(0.0483)
D.V.INP-CHN		0.0615
		(0.120)
D.IMP-AFR	−0.00191	−0.00199
	(0.00243)	(0.00292)
D.IMP-OECD	0.00200	0.00282
	(0.00140)	(0.00231)
D.IMP-ROW	−0.00389	−0.00362
	(0.00735)	(0.00769)
L2.Empl.	−0.0039	0.0031
	(0.024)	(0.0311)
Exporter	0.0227	0.0189
	(0.0704)	(0.0708)
Age	0.0018**	0.0015*
	(0.0009)	(0.0007)
Firm-Year FE	Y	Y
City-Ind FE	Y	Y
City*Year FE	Y	Y
Ind*Year FE	Y	Y
Clustered SE	City-Ind	City-Ind
Observations	3,054	3,054
R-squared	0.311	0.435

Note: Estimation based on the World Bank Enterprise Survey, the COMTRADE and EORA-MRIO data between 2003 and 2018. Models estimated using a panel 2SLS with firm fixed effects. Robust standard errors clustered at the city-industry level reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.