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Import Penetration and Manufacturing Employment: Evidence from Africa

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Abstract – Exposure to import competition can either help or hurt domestic employment creation. There is, however, a dearth of cross-country empirical evidence assessing labor market effects of import penetration in Africa. This paper fills this gap. Using manufacturing industry and establishment-level data across 20 African countries and estimating a conditional and unconditional labor demand model, we find an unambiguous employment creation effect of intermediate good import penetration, whilst final good import penetration has a negative, or at best, an insignificant effect on employment. Splitting intermediate good import penetration into their origins, we find that intermediate good import penetration from developed (developing) countries is employment increasing (reducing). Further analyses reveal that the positive employment effects of intermediate import penetration from developed countries disproportionately benefit the skilled workforce. We also find that industries with higher absorptive capacity stand to gain more from intermediate good import penetration from developed countries, with the negative effects of intermediate good import penetration from developing countries also diminished for these industries. We discuss the implications of our findings.

Keywords: Import Penetration, Employment, Absorptive Capacity, Manufacturing, Africa
JEL: F11; F14; L25; L60

1. Introduction

The manufacturing sector has historically powered economic growth and accounted for a substantial share of economy-wide productivity and decent job creation, particularly, amongst the early industrializers (Kaldor, 1966). However, since the 1990s, the contribution of manufacturing to total economic output has been declining in both developed and developing countries (Szirmai & Verspagen, 2015; Owusu *et al.,* 2020). Particularly in sub-Saharan Africa (SSA), it has been six decades since the implementation of various industrial policies, but industrialization remains elusive. The manufacturing employment share remains relatively small in the region, and despite some countries in the region recording increases in the share of manufacturing employment, many countries in the region are yet to have successful industrialization (Rodrik, 2016; Hallward-Driemeier & Nayyar, 2018; Mensah *et al.,* 2018; Naude, 2018, Mensah, 2020; Owusu *et al.,* 2020; Diao et al. 2020). This has motivated a series of studies to find explanations for the lack of performance of the African manufacturing sector, while identifying new windows of opportunity to grow more jobs (Geda *et al.*, 2018; Mkandawire, 2001; ECA, 1989; Chang *et al.,* 2016; World Bank, 2020, Abreha et al, 2020).

Central to this and heavily discussed in the past three to four decades is the role of international trade via import penetration. Import penetration is arguably one of the key potential determinants of the performance of the manufacturing sector. On the one hand, import penetration could complement domestic production by providing higher quality intermediates and intermediates that were previously unavailable, as well as knowledge flows and opportunities for upgrading and employment (Bas & Strauss-Kahn, 2014; Bas & Strauss-Kahn, 2015). On the other hand, import penetration could substitute for domestic production. However, it is also not clear *a priori* whether this relationship is linear or non-linear as the direction of the economic effects of import penetration may depend on the type of imports (i.e., final or intermediate), their sources (i.e., from developed or developing countries), and industry characteristics (e.g., absorptive capacity, and capital and skill intensity) (e.g., see Autor *et al.,* 2013; Mion & Zhu, 2013). Particularly in developing economies, the benefit of global sourcing of imports might be outweighed by the costs associated with destroying local manufacturing jobs, especially where the developing country lacks manufacturing competitiveness and does not have a competitive advantage in its manufacturing exports (Krishna, 2009; Torreggiani & Andreoni, 2019). These potential adverse employment effects of higher import penetration might at higher levels be

mitigated by higher imports of capital and quality intermediate goods that might stimulate and increase manufacturing productivity and levels of output through the introduction of new product varieties and the increased production of existing products (Pahl & Timmer, 2019) that meet the standards of the international market, thus increasing demand and encouraging the subsequent hiring of workers to expand production capacity (Colantone *et al.,* 2020). Motivated by the importance of the manufacturing sector as an engine of growth and the role of international trade in determining industry and firm performance through access to new imported inputs, this paper uses manufacturing industry-level data across 20 African countries to provide novel evidence on the employment effects of import penetration.

Import penetration of final goods can negatively affect domestic labor by substituting labor used in domestic production, particularly when final goods import substitute for domestic production. While a similar substitution effect may be expected from imports of intermediate goods, imported intermediates offer some advantages over domestic intermediates, such as providing new technology, increasing productivity and allowing for intermediates not produced domestically. For this reason, the importing industries or firms directly use intermediate goods for further production, which is likely to expand its demand for labor. Furthermore, the employment effects of imported intermediate goods may depend on the technological capability of the importing industry as well as its skill structure. For instance, developing countries with inefficient technological capability can overcome this production constraint through access to quality intermediate goods from developed economies and thereby expand domestic labor demand. However, imported intermediate goods from other developing countries at a similar technological level may negatively affect domestic labor through a substitution effect. Against this backdrop, this paper specifically examines the employment effects of final and intermediate import penetration, further examining whether the employment effect of intermediate import penetration is conditioned on the origin of the imports. In an extended analysis, we further examine whether (i) the employment effect of import penetration is conditioned on the industry's absorptive capacity; and (ii) the effect of import penetration on skilled and unskilled employment by employing an industry-firm merged cross-sectional sample.

To preview our results, we find that import penetration of final goods has either a negative or at best an insignificant effect on employment, while import penetration of intermediate goods has a significant positive effect on employment. However, when we distinguish intermediate import penetration based on their origins, intermediate import penetration from developed (developing) economies has a significantly positive (negative) impact on employment. Drawing insights from extant studies (Bas & Strauss-Kahn, 2014; Bas & Strauss-kahn, 2015; Feng *et al.,* 2016; Colantone *et al.,* 2020)[1], we interpret the positive effect of intermediate import penetration from developed countries as a technology-enhancing effect that either facilitates an industry's efforts to upgrade or expands its production portfolios and thereby increases employment levels. Conversely, the negative impact of intermediate import penetration from other developing countries may be suggestive of a pro-competition effect given that both countries are at a similar stage of production and/or technological level. In the extended analysis, however, we find that the positive impact of intermediate import penetration from developed countries increases with higher industry-level absorptive capacity, while higher industry-level absorptive capacity attenuates the negative impact of intermediate import penetration from developing countries. These supplementary results suggest that while an industry's level of sophistication enables it to reap the benefits of higher quality intermediate imported inputs, it also enables it to diminish the pro-competitive effect of intermediate import penetration. Finally, our analysis using merged[2] industry-firm cross-sectional data for the sample shows that intermediate import penetration from developed countries has a significantly positive impact on skilled and unskilled labor employment, but disproportionately benefits skilled manufacturing workforce.

This paper contributes to the growing body of literature and policy discussion on the role of international trade in industrialization in Africa. Specifically, it contributes to the literature that relates changes in labor-market outcomes to changes in import penetration from different origins. To our knowledge, this is the first empirical cross-country cross-industry study investigating this in the context of Africa. Extant studies conducted in this line of research have focused on developed economies

[1] Ideally, these studies suggest that intermediate inputs sourced from developed countries are, on average, of higher quality when compared to those sourced from developing countries.

[2] We merge each firm observation in industry s at period with the corresponding industry-level import penetration variable. See page 19 for more details.

where the decline in manufacturing activities is attributed to rising imports from low-wage economies (Bernard *et al.,* 2006; Mion & Zhu, 2013; Autor *et al.,* 2013; Acemoglu *et al.,* 2016; Donoso *et al.,* 2015; Balsvik *et al.,* 2015) and in other developing non-African economies (Alvarez & Claro, 2009 (Chile); Paz, 2018 (Brazil); Mendez, 2015 (Mexico); Iacovene *et al.,* 2013 (Mexico)). Torreggiani & Adreoni (2019) is the only study done in Africa that comes close to our study but differs from our study in important ways. First, while we focus on cross-country industry aggregate data, using input-output tables that split imports into final and intermediate input imports, and examine multiple sources of such imports, Torreggiani & Adreoni used firm-level data from South Africa to investigate Chinese import penetration and employment of manufacturing firms in the country. Second, as done in some other studies mentioned, the authors also do not disentangle the effect when the import involves final goods and intermediate imports. Lastly, we also set out to test the relationship between import penetration and employment across parts of the workforce with different skill sets using firm-level data.

The remainder of the paper is organized as follows: Section 2 presents the theoretical background and related literature linking import penetration and employment. Section 3 specifies the model and describes the data sources used in the empirical analysis. Section 4 presents and discusses the results. Section 5 concludes.

2. Related literature

Theoretically developed around the framework of the Heckscher-Ohlin trade model of comparative advantage, trade literature that examines the causal link between import penetration from multiple sources and labor market outcomes generally treat import penetration as a function of relative factor endowments (Autor *et al.,* 2013). A key implication of this model is that developed economies with relative capital and skill abundance are expected to specialize and produce more capital and skill-intensive mix of products than less developed economies that are labor abundant. The relative difference in factor endowments and associated comparative advantage renders the production of capital and skill-intensive products in less developed economies on the one hand, and low-capital and skill-intensive products in developed economies on the other hand, unprofitable, hence the need to engage in trade for mutual gains (Bernard *et al.*, 2006; Lerner 1952; Leamer, 1987).

International trade allows both developed and less developed economies to trade and engage in the exchanges of goods. Whether producing capital and skill-intensive products in developed economies and labor-intensive products in less developed economies, producers in these two economies make the profit-maximizing decision of choosing an optimal combination of input shares that minimizes cost. These inputs can be acquired from either the domestic or foreign market. When the foreign market is used, importing inputs from the foreign markets could replace tasks previously done by domestic labor (Feenstra & Hanson, 1997; Hummels *et al.*, 2014). At the same time, inputs sourced from the foreign market may be of a higher quality or may not be available domestically, which could lower the marginal cost of production and increase productivity such that industries can expand and hire more workers (Amiti & Konings, 2007; Grossman & Rossi-Hansberg, 2008). This suggests that the impact of import penetration on the domestic labor market is *a priori* inconclusive and depends very much on other factors. Key amongst them is the type of inputs (intermediate and final) and the origin of imports.

Empirically, numerous studies have examined the nexus between employment and import penetration. While earlier studies found no significant statistical evidence (e.g., Krueger, 1980; Grossman, 1987; Mann, 1988)[3], later studies based on a larger set of industries have produced evidence that suggests a negative association between the two (Freeman & Katz, 1991; Sachs & Shatz, 1994). More recent studies have focused largely on import penetration from low-wage economies. For instance, Bernard *et al.* (2006) finds that between 1977-97, plants in the US manufacturing sector that were more exposed to imports from low-wage countries grew more slowly and were likely to exit the market. In a similar study, Acemoglu *et al.* (2016) find that import penetration from China, which surged after 2000, was a significant force behind the recent reductions in US manufacturing employment that was gained in the 1990s. Autor *et al.* (2013) analyzed the effect of rising Chinese import penetration between 1990 and 2007 on US local labor markets and found that rising imports from China caused higher

[3] Related to this but focused on offshoring, Hijzen and Swaim (2007) finds no effect or a slight positive effect of offshoring on sectoral employment. According to the authors, the finding suggests that the productivity gains from offshoring are sufficiently large that the jobs created by higher sales completely offset the jobs lost by relocating certain production stages to foreign production sites.

unemployment, lower labor force participation, and reduced wages in the local labor market. Mion & Zhu (2013) focused on manufacturing firms in Belgian and found that between 1996 and 2007, import penetration from China reduced firms' employment growth but had no effect on firm survival. Donoso *et al.* (2015) confirmed this in Spain, although the negative effect on employment in manufacturing reduction was compensated for by increases in non-manufacturing employment. In Norway, Balsvik *et al.* (2015) found that imports from China had a disproportionate negative employment effect on low-skilled workers. In Chile, Alvarez & Claro (2013) find a negative effect of Chinese import penetration on employment and survival rates of manufacturing firms.

Overall, these studies have found that import penetration from low-wage countries causes reductions in industry manufacturing employment due to the pro-competitive or substitution effect and less so when the industry exposure to imports comes from more developed economies (Bernard *et al.,* 2006; Acemoglu *et al.,* 2016; Autor *et al.,* 2013; Mion & Zhu, 2013). Import penetration from developed economies are considered to be of higher quality (e.g., Bas & Strauss-Kahn, 2014; Bas & Strauss-Kahn, 2015; Feng *et al.,* 2016) and therefore able to facilitate industry's efforts to upgrade and expand the production portfolios by introducing new product varieties and increased production of existing products to a level that meet the standard of the foreign market, thus increasing demand in foreign markets and the subsequent hire of more workers to expand production capacity (Colantone *et al.,* 2020; Goldberg *et al*., forthcoming).

3. Data and Methodology

3.1. Computation of Variables and Data Sources

To address our research question, we follow existing studies (e.g., see Bernard *et al*., 2006; Autor *et al.,* 2013; Mion & Zhu, 2013; Torreggiani & Adreoni, 2019) and compute the import penetration variables as:

$$Imp\_Pen_{ist}^{FIN} = \frac{Imp_{ist}^{FIN}}{Imp_{ist} + Q_{ist} - Exp_{ist}} \quad (1)$$

$$Imp\_Pen_{ist}^{INT} = \frac{Imp_{ist}^{INT}}{Imp_{ist} + Q_{ist} - Exp_{ist}} \quad (2)$$

where Imp_{ist} and Exp_{ist} are the respective values of total imports and exports by country *i* in sector *s* at time *t,* Imp_{ist}^{FIN} and Imp_{ist}^{INT} are the respective values of final and intermediate good import. $Imp\_Pen_{ist}^{FIN}$ is final import penetration, while $Imp\_Pen_{ist}^{INT}$ is intermediate import penetration, and Q_{ist} is domestic production. Following similar methods as in equations 1 and 2, in the extended analysis, we shall also consider intermediate import penetration from three sources: developed countries, developing countries, and China.[4] We source original data for constructing final and intermediate imports from the UNCTAD's EORA MRIO I-O database (Lenzen *et al.,* 2013; Aslam *et al.,* 2017). The dataset is a set of inter-country input-output tables covering 25 industries (excluding the industry on "re-export/import") in 189 countries[5] of the years 1990-2015. It has three components; the intermediate goods demand (matrix), final demand (matrix), and the value added (matrix). We extract data on intermediate and final demand from this database. Because these variables are expressed in basic nominal prices, we use US industry value added deflator to express them in constant terms. Our analysis focuses on seven broad manufacturing industries, including "chemical and non-metal products", "electrical and machinery", "food & beverage", "metal products", "textiles and apparel", "transport equipment", and "wood and paper" over the years 1990-2015[6].

We source employment, wages, and value added data from the UNIDO Industrial and Statistical Database (UNIDO INDSTATS 2, 2020). When there is no reliable benchmark or series from the UNIDO INSTATS 2, we use information from national accounts or industrial surveys from national statistical institutes (NSI). For example, Nigeria's value added series from 1997 to 2018 is not available in UNIDO INDSTATS 2. To obtain a series for Nigeria, we use detailed industry trends from the rebased national accounts data. The general approach we used in generating reliable series follows harmonization principles of Pahl & Timmer (2019). In this approach, the guiding principle is to ensure

[4] See Appendix 1 for the respective list of countries.

[5] In this paper, we use manufacturing industry-level data across 20 African countries.

[6] We focus only on the manufacturing industry because comparable cross country-industry level data on labor productivity are only available for those industries. We also use aggregated manufacturing industry data because we only observe intermediate inputs at such an aggregated level using the available input-output table.

that the data is consistent over time, across variables (employment, value added, and wages), and across countries.

3.2. Model Specification

To study the employment effect of import penetration we follow Hijzen and Swaim (2007) and Foster-McGregor *et al* (2016) and estimate two models of labor demand: the conditional and unconditional labor-demand models. The conditional labor demand model allows us to estimate the technology or substitution non-output effect of import penetration by keeping output constant (controlling for output) is given by:

$$ln(emp)_{ist} = \alpha + \delta_1 lnV_{is,t-1} + \delta_2 lnW_{is,t-1} + \delta_3 lnImp\_Pen^{FIN}_{is,t-1} + \delta_4 lnImp\_Pen^{INT}_{is,t-1} + \gamma_{is} + \gamma_t + \mu_{ist} \quad (3)$$

The unconditional labor demand model, on the other hand, allows us to estimate the total effect of import penetration on labor demand by allowing output to vary based on the assumption that firms maximize profits, by choosing the optimal mix of input quantities and the level of output for a given input and output prices. The difference between the total effect and the technology or substitution effect gives an indication of the scale or output induced effect associated with import penetration. The complete unconditional labor demand model takes the form:

$$ln(emp)_{ist} = \alpha + \delta_1 lnW_{is,t-1} + \delta_2 lnImp\_Pen^{FIN}_{is,t-1} + \delta_3 lnImp\_Pen^{INT}_{is,t-1} + \gamma_{is} + \gamma_t + \mu_{ist} \quad (4)$$

where $\ln (emp)_{is,t}$ is natural log of employment in sector *s* in country *i* and at period *t*, α is the intercept. lnV_{ist} and lnW_{ist} are natural logs of real value added (output) and real sector wage per employee, respectively. In line with our research objective, $Imp\_Pen^{FIN}_{ist}$ and $Imp\_Pen^{INT}_{ist}$ are the measures of final and intermediate import penetration, respectively. We take a period lag of all the explanatory variables to minimize contemporaneous endogeneity. γ_{is} is country-industry pair fixed effects that take care of unobserved country-industry heterogeneities, while γ_t is year dummies to account for time effects that are common across countries. Finally, μ_{ist} is the error term.

We estimate equation 3 using the panel Fixed-Effects (FEM) method. However, one of the empirical challenges we face is that import penetration variables may be endogenous. While predetermined values of import penetration variables as specified in equation 3 reduce reverse causality, the variables may also be endogenous due to other confounding factors such as omitted variable bias. One such omitted variable would be to include a measure that captures the intensity of R&D. To the extent that R&D leads to labor-saving innovation, we would expect, an increase in R&D intensity to correlate with import penetration and impact on labor demand. R&D data is difficult to obtain for countries in Africa, particularly at the industry level. Faced with data limitation and to address this empirical challenge, we complement the FEM with a fixed effect instrumental variable (IV) method. For this, we utilize the Lewbel (2012) IV-Heteroskedasticity method (FEM-LB). The method identifies the endogenous variable in the absence of good external instruments by using heteroskedasticity present in the model to generate sets of instruments. In particular, identification is achieved by having regressors that are uncorrelated with the product of heteroskedasticity errors, which is a feature of many models where error correlations are due to an unobserved common factor (Baum *et al.,* 2013 p.13).

4. Empirical Results

This section proceeds in four steps. First, we present the results on the employment effects of import penetration, distinguishing between final and intermediate goods import penetration. Second, results on the effect of intermediate good import penetration while accounting for the origin of such imports are presented. The third section presents the results on the heterogeneous employment effects of import penetration based on the industry's absorptive capacity, while the final section shows the results on the effect of import penetration on skilled and unskilled employment using an industry-firm matched cross-sectional sample.

4.1. Baseline Results

Table 1 shows the baseline results on the employment effects of import penetration. Column 1 reports the regression results (unconditional labor demand model) when we regress employment levels on only the import penetration variables controlling for country-industry pair fixed effects and year dummies and average industry real wage. The estimated coefficient of total intermediate goods import

penetration turns out positive and statistically significant at the 1 percent significance level. The estimated coefficient of total final goods import penetration, on the other hand, is significantly negative at all conventional levels. The results indicate that a 1% increase in intermediate import penetration and final good import penetration is associated with an increase (reduction) in employment of 0.136% (0.236%) over the period 1990-2015. This is the total effect as explained above. However, to estimate the scale effect (full implication) of import penetration on labor demand we need to account for the technology effect by estimating a conditional labor demand model.

Column 2 reports the regression results (conditional labor demand model) of our baseline equation which include two additional industry time-varying characteristics – i.e., industry value added and average industry real wage. Including these variables results in the estimated coefficient of total final goods import penetration being statistically insignificant. By controlling for output (i.e. fixing output levels) in the conditional labor demand model, the effect of final goods imports on employment becomes insignificant. In other words, the negative effect of final good imports on employment could be due to a decline in final output domestically. This result is somewhat consistent with Mion & Zhu (2013), who do not find any significant effects of import penetration of final goods on employment growth in Belgium. However, the estimated coefficient of total intermediate goods import penetration remains significantly positive at the 1% level, although the size of the estimated coefficient is now somewhat smaller. In particular, the result reported in Column 2 indicates that a 1% increase in total intermediate good import penetration would increase employment levels by about 0.40%. Next, column 3 shows the IV regression results, where we endogenize the two import penetration variables using the Lewbel approach as discussed in section 3. We obtain results that are qualitatively similar to those reported in column 2, with the estimated coefficient on total intermediate goods import penetration indicating a significant positive effect on employment levels, whilst total final goods import penetration has an insignificant effect on employment. Hence, our results lead to the conclusion that manufacturing industries in Africa that are more exposed to imported intermediate inputs experienced an increase in employment levels. On the other hand, final goods import penetration has either a negative or at best an insignificant effect on employment. Coefficients on real wages per employee are negative and significant but the absolute value of the coefficients are smaller in the unconditional labor demand model than in the conditional labor demand model. This is not

consistent with theory but consistent with other existing empirical results (Foster-McGregor *et al.*, 2016).

Table 1. Employment Effects of Intermediate and Final Import Penetration

	$ln(employment)$		
	FEM		FEM-LB
	(1)	(2)	(3)
Intermediate Import Penetration (ln)	0.136*	0.399***	0.282**
	(0.072)	(0.065)	(0.125)
Final Import Penetration (ln)	-0.248***	-0.042	0.160
	(0.079)	(0.070)	(0.144)
Av. Real Wage Per Employee (ln)	-0.236***	-0.307***	-0.309***
	(0.010)	(0.009)	(0.012)
Real Value Added (ln)		0.251***	0.254***
		(0.009)	(0.014)
Observations	3,388	3,375	3,375
R-squared	0.19	0.36	0.36
Hansen p-value			0.07

*** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses.

Note: This table presents the regression results on intermediate and final import penetration on manufacturing industry employment in Africa. The period of the analysis is 1990-2015, covering 7 manufacturing sectors across 20 African countries. Estimation for columns 1 and 2 are achieved using the panel fixed effects method, while estimation in column 3 is achieved using Lewbel (2012) IV-Heteroskedasticity method. Each column in the table contains an unreported constant term and year dummies. Model 1= unconditional labor demand model; Model 2&3=conditional labor demand model.

4.2. Does Origin Matter?

The baseline result suggests a positive net employment effect of total intermediate goods import penetration. As argued in sections 1 and 2, however, employment levels may respond differently to intermediate import penetration from different country sources. Such heterogeneities stem from the cost of production and technology level in the source country, making the imported intermediate good act either as a complement or substitute for domestic labor. As discussed in section 2, a growing number of studies have found that import penetration from low-wage countries destroy local industry manufacturing jobs employment due to the pro-competitive or substitution effect (Bernard *et al.,* 2006; Acemoglu *et al.,* 2016; Autor *et al.,* 2013; Mion & Zhu, 2013). Import penetration from developed economies, on the other hand, are considered to have a complementary effect. They are higher quality and not readily available domestically (e.g., Bas & Strauss-Kahn, 2014; Bas & Strauss-Kahn, 2015; Feng *et al.,* 2016) and therefore able to facilitate industry's efforts to upgrade and expand the production portfolios by introducing new product varieties and increased production of existing

products to a level that meet the international market standards. The increase in demand in foreign markets means that more new workers are hired to expand production capacity to meet the demand (Colantone *et al.,* 2020; Goldberg *et al.*, 2010). In this spirit, we extend our baseline results in this section by considering different sources of intermediate import penetration, distinguishing between intermediate import penetration from developed and developing countries. Table 2 reports the regression results of this exercise.

Columns 1 and 2 show the results when we distinguish import penetration from developed and developed countries, with column 1 showing the panel fixed effect model results whilst column 2 reports the results of the Lewbel IV-Heteroskedasticity regression. Focusing on the latter, we find that intermediate import penetration from developed countries has a significantly positive effect on employment levels, while intermediate import penetration from other developing countries has a significantly negative effect on employment. In particular, the Lewebel IV-Heteroskedasticity estimates suggest that a 1% increase in intermediate goods import penetration from developed countries would increase manufacturing sector employment levels by 0.57%. Conversely, a 1% increase in intermediate goods import penetration from other developing countries would decrease manufacturing sector employment levels by 0.26%. Our results thus supports our conjecture in section 2 wherein we argued that intermediate import penetration from developing country impacts negatively on employment, while those from developed countries impacts positively. As argued in that section, because most developing countries are low-wage countries, intermediate import penetration from these countries causes reductions in industry manufacturing employment due to the pro-competitive or substitution effect (also see Bernard *et al.,* 2006; Autor *et al.,* 2013; Mion & Zhu, 2013; Acemoglu *et al.,* 2016). However, intermediate import penetration from developed countries is considered to be of higher quality (e.g., Bas & Strauss-Kahn, 2014; Bas & Strauss-Kahn, 2015; Feng *et al.,* 2016; Colantone *et al.,* 2020). For developing countries such as those in our sample, access to intermediate inputs from developed countries is therefore expected to facilitate industry's efforts to upgrade and expand the industry's production portfolios to a level that meet the standard of the foreign market, thus increasing demand in foreign markets and the subsequent hire of more workers to expand production capacity.

Thus far, our results only make a distinction between intermediate import penetration from developed and developing countries. However, a large body of literature examines the economic effects of imports penetration from China (Bernard *et al.,* 2006; Mion & Zhu, 2013; Alvarez & Claro, 2009; Iacovone *et al.,* 2013; Autor et al. 2013; Balsvik *et al.,* 2015; Mendez, 2015; Donoso *et al.,* 2015; Acemoglu *et al.,* 2016; Malgouyers, 2016; Paz, 2018). With the growing influence and prominence of China in Africa, a strand of this literature has also focused mainly on Africa (Haugen, 2011; Edwards & Jenkins, 2015; Torreggiani & Adreoni, 2019). However, this literature has either focused on a single African country or on total import penetration. Following China's accession to the World Trade Organization (WTO) in 2001, trade relations between China and countries in Africa have deepened rapidly. China today is the largest trading partner of Africa. In many countries in Africa, China has become the first export destination and largest supplier of imports. While intermediate import penetration from developed countries has declined, intermediate import penetration from developing countries and China increased across all sectors in our dataset (appendix Figure 1 & 2). For instance, intermediate import penetration from China into the food and beverage industry increased from 0.2% to 0.6% between 1990 and 2015; from 0.4% to 4.2% in textiles and wearing apparel; 0.4% to 2.2% in wood and paper; 1.1% to 4.2% petroleum, chemical and non-metallic mineral products; 1.4% to 8.8% metal products 0.4% to 3.3% electrical and machinery and 0.1% to 1.3 over the same time period (appendix Table A3). The composition of imports from China to Africa have usually gone to low-technology and labor-intensive sectors. This trend in the import composition, however, is evolving. For instance, as evident in Table A3 and noted in Torreggiani and Adreoni (2019), in South Africa, during the mid-1990s, China's imports to the country primarily went into traditional low-technology and labor-intensive sectors. However, by 2010 there was a shift and Chinese import penetration increasingly went to medium- and high-technology products such as electronics and machinery. The complete implication of the evolving composition of imports from China on local manufacturing employment in Africa is unknown although it is found to have a negative employment in South Africa (Torreggiani & Adreoni, 2019). To this end, we extend our analysis to study the employment effects of intermediate import penetration from China. Columns 3 to 4 of Table 2 report the results of this exercise.

Columns 3 and 4 show the results when we distinguish intermediate imports from China versus intermediate imports from the rest of the world, with column 3 showing the panel fixed effect model results while column 4 reports the results of the Lewbel IV-Heteroskedasticity regression. Both the panel fixed and the IV results in columns 3 and 4 indicate that intermediate good import penetration from China reduces the level of manufacturing sector employment, a result that confirms the findings of related existing studies.

Table 2. Sources of Intermediate Import Penetration and Employment

	$ln(employment)$			
	FEM	FEM-LB	FEM	FEM-LB
	(1)	(2)	(3)	(4)
Intermediate Import Penetration DC (ln)	0.499***	0.572***		
	(0.056)	(0.102)		
Intermediate Import Penetration LDC (ln)	-0.272***	-0.262***		
	(0.050)	(0.073)		
Chinese Intermediate Import Penetration (ln)			-0.143***	-0.089**
			(0.025)	(0.040)
Non-Chinese Intermediate Import Penetration (ln)			0.564***	0.334***
			(0.065)	(0.115)
Intermediate Import Penetration OLDC (ln)				
Final Import Penetration (ln)	0.093	0.185	-0.055	0.148
	(0.064)	(0.126)	(0.069)	(0.137)
Av. Real Wage Per Employee (ln)	-0.304***	-0.300***	-0.305***	-0.309***
	(0.009)	(0.012)	(0.009)	(0.012)
Real Value Added (ln)	0.247***	0.255***	0.249***	0.250***
	(0.009)	(0.014)	(0.009)	(0.014)
Observations	3,375	3,375	3,375	3,375
R-squared	0.37	0.36	0.37	0.36
Hansen p-value		0.13		0.36

*** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses.

Note: This Table presents the regression results on intermediate import penetration on manufacturing industry employment in Africa, distinguishing sources of intermediate import. DC means developed countries. LDC means developing countries, while OLDC means developing countries excluding China. The period of the analysis is 1990-2015, covering 7 manufacturing sectors across 20 African countries. Estimation in columns 2 and using Lewbel (2012) IV-Heteroskedasticity method. Estimations in the rest of the columns were achieved with the panel fixed effects method. Each column in the table contains an unreported constant term.

4.3. The Role of Absorptive Capacity

The literature on the labor market effects of import penetration has begun to examine the role of industry and firm characteristics. Two dimensions are considered in this analysis. The first dimension relates to absorptive capacity which argues that more productive firms and sectors can better take the advantage of import penetration and that has a broader consequence for employment, mostly positive. For instance, Torreggiani & Adreoni (2019) showed that in South Africa, manufacturing firms' response to competitive pressure from import penetration depends on their internal capabilities. In their study, the authors examined whether the impact of Chinese import penetration on South Africa-based manufacturing firms depends on a battery of firm-level capabilities-related proxies such as capital investment, expenditures in internal and external innovation activities. While they find that exposure to Chinese imports negatively affects the sales and employment of South Africa-based manufacturing firms, the negative impact of Chinese import penetration is partially mitigated by firm's internal and external innovation activities such as investments in capital, innovation, and skills development.

The other dimension relates to the capital and skill intensity argument. For instance, Bernard *et al.* (2006) and Mion & Zhu (2013) showed that capital- and skill-intensive plants in the United States and Belgium, respectively, are more likely to survive and grow in light of increasing import penetration. For instance, if capital intensive plants are the ones that thrive in the face of import penetration, then we would expect to see a negative employment effect (i.e., capital intensive plants survive, while labor intensive ones die, so that overall employment declines, even holding output constant).

In line with the foregoing, we extend our analysis by considering the role of industry characteristics, focusing in particular on industry relative absorptive capacity. Absorptive capacity serves as a key consideration for an industry's selection into import markets. It has also been found to be a key mitigating factor in how the labor market responds to import penetration (Chen & Kilinc, 2017). Higher industry absorptive capacity indicates that the industry is better able to identify and assimilate developed technologies embodied in intermediate inputs (Abramovitz, 1989; Cohen & Levinthal, 1989). Along this line, to the extent that intermediate import penetration from developed countries entails inflows of sophisticated and developed technologies, higher industry absorptive capacity plays

a complementary role in facilitating the absorption and assimilation of this embodied knowledge and technologies. Other things equal, this should expand the quality and scale of production and a subsequent rise in total employment[7]. Hence, we expect that the positive impact of intermediate import penetration from developed countries would increase as industry absorptive capacity rises. However, higher industry absorptive capacity can also signal an industry's level of technological sophistication. In this case, we expect that higher industry absorptive capacity would attenuate the negative employment effects of intermediate inputs sourced from developing countries that tend to have a pro-competitive effect. Other things equal, this occurs because industries with high absorptive capacity are relatively less affected by import penetration from low-wage economies since these industries are likely to produce relatively high capital and skill-intensive products and face low level of low-wage competition (Bernard *et al.,* 2006).

To test these conjectures empirically, we modify our baseline equation by introducing a measure of industry absorptive capacity and its interaction with the respective import penetration variables. Prior studies that empirically modeled absorptive capacity either used the proportion of skilled workers, relative productivity, or some innovation variable such as R&D (*e.g.,* Yasar, 2013; Foster-McGregor *et al.*, 2017; Torreggiani & Andreoni, 2019).[8] In the absence of having industry-level indicators on education or innovation variables for the countries in our sample, we use relative productivity as a proxy of an industry's absorptive capacity. Since absorptive capacity is about the ability of firms to improve their productivity (Harris & Yan, 2019: p.747), to the extent that industry productivity in a laggard country is closer to the productivity of the frontier, then it is likely that the industry has a higher technical ability. To this end, we set the US labor productivity in each industry per year as the global productivity frontier, and compute an index of industry relative absorptive capacity (RABC) as the ratio of the labor productivity of industry *s* by country *i* at time *t* to the global labor productivity frontier in that industry at time *t*. The higher the value of absorptive capacity, the closer the industry

[7] High industry absorptive capacity may also mean that the country or industry is able to produce high quality intermediates itself, so it could also be considered that domestic and foreign intermediates are more substitutable. While this relationship is possible, industries with high absorptive capacity are generally more productive and regardless of whether they substitute foreign intermediates with comparable domestic substitutes, they will be able to expand the production to a level that meets the market standards and demands. The increase in demand in both the domestic and international market will require that more new workers are hired to expand production capacity to meet the demand.

[8] For an extensive review of the literature on the measurement of absorptive capacity, see Harris & Yan (2019).

is to the labor productivity frontier. In the model that we estimate, we control for capital intensity, thus ruling out any attempt to use capital intensity as an argument. We extract sectoral capital data from the final demand matrix of the Eora MRIO input output table and compute capital intensity by dividing capital by employment at the sector level. We have to note here that the data from Eora allows us to only capture the contemporaneous investment in capital goods (our proxy measure of capital) and not capital stock. Increases in capital intensity will lower employment due to substitution effect of production inputs. Table 3 reports the regression results for the role of absorptive capacity.

Column 1 reports the regression results of the interaction variable consisting of total intermediate good import penetration and relative absorptive capacity. In line with our expectation, the estimated coefficient of the variables turns positive and is statistically significant at the one percent significance level. Columns 3 and 4 show the regression results of the respective interaction of relative absorptive capacity with either intermediate good import penetration from developed countries or developing countries. Consistent with our expectations, we find that the positive employment effects of intermediate import penetration from developed countries increase as industry absorptive capacity increases, while higher industry absorptive capacity attenuates the negative employment effects of intermediate import penetration from low-wage countries. Specifically, a one percent increase in the industry absorptive increases the employment effects of intermediate import penetration from developed countries by 0.364 percent (0.355 + 0.009) and diminishes the negative employment effects of intermediate import penetration from low-wage countries by -0.251 percent (-0.260 + 0.009). As expected, an increase in capital intensity lowers employment levels.

Table 3. Import Penetration and Employment: The Role of Absorptive Capacity

	$ln(employment)$			
	(1)	(2)	(3)	(4)
Intermediate Import Penetration (ln)	0.148***			
	(0.029)			
Intermediate Import Penetration DC (ln)		0.355***	0.309***	0.342***
		(0.024)	(0.022)	(0.025)
Intermediate Import Penetration LDC (ln)		-0.328***	-0.260***	-0.274***
		(0.020)	(0.027)	(0.027)
Intermediate Import Penetration (ln) × RABC (ln)	0.029***			
	(0.003)			
Intermediate Import Penetration DC (ln) × RABC (ln)		0.009***		0.009***
		(0.002)		(0.002)
Intermediate Import Penetration LDC (ln) × RABC (ln)			0.009***	0.008***
			(0.003)	(0.003)
Final import Penetration (ln)	-0.162***	-0.078***	-0.084***	-0.098***
	(0.029)	(0.026)	(0.027)	(0.027)
Av. Real Wage Per Employee (ln)	-0.069***	-0.065***	-0.063***	-0.065***
	(0.004)	(0.004)	(0.004)	(0.004)
Real Value Added (ln)	0.852***	0.849***	0.853***	0.849***
	(0.006)	(0.006)	(0.006)	(0.006)
RABC (ln)	-0.784***	-0.797***	-0.800***	-0.782***
	(0.007)	(0.008)	(0.008)	(0.009)
Capital Intensity (ln K/L)	-0.006***	-0.005***	-0.006***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	3,375	3,375	3,375	3,375
R-squared	0.89	0.90	0.90	0.90

*** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses.

Note: This Table presents the results on intermediate import penetration on manufacturing industry employment in Africa, distinguishing sources of intermediate import. DC means developed countries, while LDC means developing countries. The period of the analysis is 1990-2015, covering 7 manufacturing sectors across 20 African countries. Estimation in all columns was achieved using the panel fixed effects method. Each column in the table contains an unreported constant term.

4.4. Firm-Level Analysis

In this section of the paper, we focus on examining the impact of import penetration within firms. In other words, the section examines whether firms that import intermediate or final goods have higher levels of employment and the skill composition of that employment. A caveat worth highlighting in the analysis in this section is that our approach here addresses a somewhat different question although still on employment. Thus far, our analysis has only considered heterogeneous employment effects of intermediate and final goods import penetration at the industry level resulting either from the origin of the import or the industry's absorptive capacity. At the firm level (given the data we have), we cannot talk about more general equilibrium effects (i.e., we cannot observe firms that die due to import penetration and what that means for overall aggregate employment levels, etc.).

If we also think about a value chain, using a hypothetical example of a car value chain. To produce a car, producers need to buy the tires from a tire manufacturer who in turn buy from a rubber supplier to secure the inputs in order to produce those tires. The analysis so far suggested that the impact of importing intermediate has an impact on employment in the same sector (the automotive sector) but it could be that it is actually affecting employment in the rubber sector or the tire manufacturing sector. However, at the industry level a counter argument would be that given that we have a fairly high degree of aggregation, this might not be a problem. For example, using the case of the iPhone where almost all the various intermediates inputs are imported from the same electrical sector. At the firm level, however, this problem will be accentuated.

For the reasons outlined, the hypothesis that guides the analysis at the firm level departs from the hypothesis at the industry level that attributes the employment effect of import penetration to pro-competitive or substitution and complementary effect. We expect the employment effect of import penetration at the firm level to be driven largely by other factors such as the productivity effect. Firms that are able to import better quality goods or a wider variety of goods become more productive, bigger and can employ more people. For instance, Kasahara *et al.* (2016) using plant-level data from Indonesia, find that while importing intermediate inputs increased the relative demand for educated workers substantially within each occupation, a similar consistent significant impact does not hold for the relative demand for the non-educated. Colantone *et al.* (2019) find evidence that new imported inputs lead to a positive selection of higher-skilled workers. They also show that imported intermediate inputs lead to the productions of high quantity and higher-quality products than previously produced, leading to stronger employment creation effect on skilled workforce as their services are needed more[9].

Against this backdrop, this section extends our analysis by examining whether firms that import intermediate or final goods have higher levels of employment and the skill composition of that employment.[10] To the best of our knowledge, empirical evidence on such a nexus focusing on Africa

[9] There is also evidence that imported intermediates tend to be complementary to higher skills, and thus tend to generate skill-biased technical change across countries (Burstein *et al.,* 2013).

[10]The classification is taken from question 14a and 14b of the World Bank Enterprise Survey questionnaire. Our measure for the skilled workforce is based on question 14a of the questionnaire that asks "At the end of last fiscal year, how many permanent, full-time individuals working in this establishment were skilled? The measure of the unskilled workforce is

is lacking. To explore this relationship, we employ an industry-firm merged cross-sectional sample. We source firm-level data from the World Bank Enterprise Survey (WBES). Because of the nature of the WBES, the sample used in this section is cross-sectional. We merge each firm observation in industry s at period t with the corresponding industry-level import penetration variable in period $t-1$.[11] The baseline empirical model that guides the analysis takes the form:

$$ln(emp)_{is} = \alpha + \delta_1 dumIMP_{is} + \delta_2 lnImp\_Pen^{FIN}_{is,t-1} + \delta_3 lnImp\_Pen^{INT}_{is,t-1} + \delta_4 dumIMP * lnImp\_Pen^{FIN}_{is,t-1} + \delta_5 dumIMP * lnImp\_Pen^{INT}_{is,t-1} + X_{is} + \gamma_{isr} + \mu_{is} \quad (5)$$

where $\ln(emp)_{is}$ is the natural log of employment (total workforce, skilled and unskilled) in sector *s* in country *i*. α is the intercept. $dumIMP_{is}$ is a dummy equals 1 if the firm imports inputs and supplies and 0 if otherwise. $Imp\_Pen^{FIN}_{ist}$ and $Imp\_Pen^{INT}_{ist}$ are the measures of final and intermediate import penetration, respectively. We take a period lag to minimize contemporaneous endogeneity. γ_{isr} capture country-industry and region fixed effects that take care of unobserved country-industry and region heterogeneities. X_{is} is a list of covariates we control or in the model such as foreign ownership (equals 1 if there is any foreign ownership in the establishment and 0 if otherwise); power outage (equals 1 if the firm has experienced a power outage and 0 if otherwise); internet (equals 1 if the firm uses internet and 0 if otherwise); Technology license (equal to 1 if the firm uses technology licensed from a foreign company and 0 if otherwise) and R&D (equal to 1 if the firm invests in research and development and 0 if otherwise). We also introduce an interaction between a firm importer dummy and the industry import variable to control for the fact that there should be no direct effect of importing on employment in those firms that do not import.

Table 4 shows the results on the skill structure effects of import penetration using the merged industry-firm level cross-sectional sample. Columns 1 to 3 show the results on the effect of total intermediate and final import penetration, with column 1 showing the results for the total workforce

based on question 14b of the same questionnaire that asks "At the end of the last fiscal year, how many permanent, full-time production workers were unskilled?

[11] Appendix 3 gives a detailed exposition on the data construction used in this section.

while columns 2 and 3 show the results for the skilled and unskilled workforce, respectively[12]. Consistent with our hypothesis, a 1% increase in intermediate import penetration increases total employment and skilled employment by 0.630 (0.556+0.074) and 0.436 percent (0.892-0.456), respectively, results that suggest that firms that import inputs and supplies are able to increase employment levels, but that skilled workers benefit disproportionately when compared to unskilled workers as measured by the size of the estimated coefficient and the significance level. Final goods import penetration, on the other hand, has a negative effect on the total workforce and skilled and unskilled employment levels of importing firms (columns 1-3).

Next, columns 4 to 6 show the results when we consider the origin of the imported intermediate goods. We find that firms that import inputs and supplies experience an increase in employment levels mostly benefiting the skilled workforce if the intermediate goods import penetration comes from developed countries, a result which may be suggestive of a structural shift in favor of skilled labor within importing firms when inputs are sourced from developed countries. These same firms, however, experience declining employment levels if the intermediate good import penetration comes from developing countries.

In general, results from the merged industry-firm data lend credence to our earlier results suggesting a negative employment effect of final goods import penetration and intermediate import penetration from developing countries, while intermediate good import penetration from developed countries has a positive employment effect. In addition to these, results from the merged industry-firm data further shows that intermediate import penetration from developed countries may lead to within-firm structural shifts that tend to benefit the skilled workforce more. Among others, this may be because such import penetration may induce technology upgrading, thereby increase firms' relative employment of skilled workers (Bloom *et al.,* 2016; Kasahara *et al.*, 2016).

[12] In the literature on firm-level studies on the effects of importing (and exporting), the near consensus is that "better" firms self-select into importing and exporting. Our data does not allow us to do address the issue with selection. Therefore, results in this analysis should be interpreted as association effect rather than causal.

Table 4: Import Penetration and Skill Structure

	$ln(workforce)$	$ln(Skilled)$	$ln(Unskilled)$	$ln(workforce)$	$ln(Skilled)$	$ln(Unskilled)$
	(1)	(2)	(3)	(4)	(5)	(6)
Intermediate Import Penetration (ln)	0.556**	0.892**	0.366			
	(0.238)	(0.381)	(0.252)			
Importer (dummy=1) * Intermediate Import Penetration (ln)	0.074	-0.456	0.200			
	(0.214)	(0.320)	(0.227)			
Intermediate Import Penetration DC (ln)				0.668**	1.234***	0.229
				(0.283)	(0.451)	(0.287)
Importer (dummy=1) * Intermediate Import Penetration DC (ln)				-0.061	-0.780**	0.066
				(0.228)	(0.352)	(0.251)
Intermediate Import Penetration LDC (ln)				-0.497	-0.560	0.403
				(0.499)	(0.815)	(0.316)
Importer (dummy=1) * Intermediate Import Penetration LDC (ln)				0.334	0.046	0.396
				(0.407)	(0.662)	(0.303)
Final Import Penetration (ln)	-0.517**	-0.149	-0.799***	-0.287	0.130	-0.854***
	(0.210)	(0.334)	(0.226)	(0.353)	(0.559)	(0.229)
Importer (dummy=1) * Final Import Penetration (ln)	0.449**	0.010	0.583**	0.127	-0.066	0.624***
	(0.220)	(0.342)	(0.234)	(0.273)	(0.420)	(0.237)
Importer (dummy=1)	0.206	0.670**	-0.018	0.311***	0.668***	-0.049
	(0.189)	(0.286)	(0.200)	(0.114)	(0.184)	(0.203)
Age	0.082***	0.099***	0.094***	0.081***	0.099***	0.093***
	(0.010)	(0.016)	(0.010)	(0.010)	(0.016)	(0.011)
Age square	-0.001***	-0.002***	-0.001***	-0.001***	-0.002***	-0.001***
	(0.0003)	(0.0005)	(0.0003)	(0.0003)	(0.0005)	(0.0003)
Foreign Ownership	0.673***	0.495***	0.573***	0.669***	0.488***	0.578***
	(0.057)	(0.081)	(0.064)	(0.057)	(0.081)	(0.064)
Power outage	0.170***	0.165**	0.180***	0.167***	0.156**	0.179***
	(0.044)	(0.068)	(0.048)	(0.044)	(0.068)	(0.048)
Internet	0.521**	0.554*	0.379	0.499***	0.531	0.403
	(0.236)	(0.318)	(0.283)	(0.241)	(0.327)	(0.281)
Technology License	0.607***	0.432***	0.523***	0.609***	0.433***	0.521***
	(0.059)	(0.087)	(0.066)	(0.059)	(0.087)	(0.066)
R&D	0.483***	0.369***	0.283***	0.488***	0.369***	0.282***
	(0.055)	(0.084)	(0.061)	(0.055)	(0.083)	(0.061)
Observations	3,956	2,073	3,534	3,956	2,073	3,534
R-squared	0.37	0.33	0.30	0.37	0.33	0.30

*** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses.

5. Conclusion

The literature examining the employment effect of import penetration has to date mainly focused on developed and non-African developing countries. In this paper, we utilize manufacturing industry-level data across 20 African countries over the 1990-2016 period and firm-level data to provide novel evidence on the employment effects of import penetration in Africa. In particular, our study examines the employment effects of import penetration based on the type of imports (i.e., final and intermediate imports) and the source of imports (i.e., whether the import is sourced from either developed or developing countries). Our analysis reveals a significant positive effect of intermediate import penetration on employment. However, final good import penetration, has either a negative or at best an insignificant effect on employment. Splitting intermediate good import penetration into their origins, we find that intermediate import penetration from developed (developing) countries is employment increasing (reducing). The positive employment effects of intermediate goods from developed countries also disproportionately benefit the skilled workforce. Examining the role of industry absorptive capacity further reveals that the positive impact of intermediate import penetration from developed countries increases with higher industry absorptive capacity. In comparison, higher industry absorptive capacity attenuates the negative impact of intermediate import penetration from developing countries. From a policy perspective, our results underscore the importance of building technological capabilities and investing in skill upgrading within firms to benefit from the technologies embodied in import penetration from developed countries while overcoming the pro-competitive effects associated with import penetration from low wage countries.

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Appendix 1

List of African countries in the sample

Botswana, Cameroon, Algeria, Egypt, Eritrea, Ethiopia, Ghana, Kenya, Moroco, Madagascar, Mozambique, Mauritius, Malawi, Namibia, Nigeria, Senegal, Tunisia, Tanzania, Uganda, South Africa

List of developed countries used in constructing import penetration from developed countries[13]

Australia, Czech Republic, Portugal, Denmark, Austria, Lithuania, Korea, Iceland, Belgium, Latvia, Switzerland, Norway, Slovenia, Finland, Israel, Korea, Chile, France, Hungary, United Kingdom, Estonia, Germany, Slovakia, United States of America, Japan, Greece, Spain, Sweden, Luxembourg, Ireland, Poland, Netherlands, Italy, Canada, New Zealand.

List of developing countries used in constructing import penetration from developing countries

Afghanistan, Bermuda, Colombia, India, Libya, Myanmar, Vanuatu, Albania, Bhutan, Congo, Indonesia, Liechtenstein, Namibia, Venezuela, Algeria, Bolivia, Costa Rica, Iran, Madagascar, Nepal, Vietnam, Andorra, Bosnia & Herzegovina, Cote d'Ivoire, Iraq, Malawi, New Caledonia, Yemen, Angola, Botswana, Cuba, Jamaica, Malaysia, Nicaragua, Zambia, Antigua, Brazil, Cyprus, Jordan, Maldives, Niger, Zimbabwe, Argentina, Burkina Faso, DR Congo, Kazakhstan, Mali, Nigeria, Guinea, Armenia, Burundi, Djibouti, Kenya, Malta, Oman, Guyana, Aruba, Cambodia, Dominican Republic, Kuwait, Mauritania, Pakistan, Haiti, Azerbaijan, Cameroon, Ecuador, Kyrgyzstan, Mauritius, Panama, Honduras, Bahamas, Cape Verde, Egypt, Laos, Mexico, Papua New Guinea, Bahrain, Central African Republic, El Salvador, Lebanon, Moldova, Paraguay, Thailand, Bangladesh, Chad, Eritrea, Lesotho, Monaco, Peru, Togo, Belarus, China, Ethiopia, Liberia, Mongolia, Philippines, Trinidad & Tobago, Belize, Gabon, Sri Lanka, Tunisia, Montenegro, Singapore, Ukraine, Benin, Gambia, Sudan, Turkey, Morocco, Somalia, Uruguay, Uganda, Georgia, Suriname, Turkmenistan, Mozambique, South Africa, Uzbekistan, Guatemala, Ghana, Eswatini, Senegal, Russia, Sudan, Tanzania, Greenland, Tajikistan, Serbia, Rwanda, Sierra Leone

[13] For the classification, we only consider high-income OECD countries as developed countries.

Table A1. Basic Summary Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Employment (ln)	3,388	1.947	2.086	-3.772	6.702
Total Intermediate Import Penetration (ln)	3,612	-0.902	0.729	-4.001	-0.075
Intermediate Import Penetration from Developed Countries (ln)	3,612	-1.783	1.134	-5.803	-0.156
Intermediate Import Penetration from Developing Countries (ln)	3,612	-1.876	0.991	-5.289	-0.125
Intermediate Import Penetration from China (ln)	3,612	-4.658	1.329	-9.097	-1.340
Intermediate Import Penetration from all countries except China (ln)	3,612	-.952	0.754	-4.626	-.082
Intermediate Import Penetration from Developing Countries except China (ln)	3,612	-1.876	0.991	-5.289	-0.125
Total Final Import Penetration (ln)	3,612	-1.143	0.879	-3.742	-0.034
Relative Absorptive Capacity (ln)	3,375	-6.154	2.677	-17.407	4.848
Av. Real Wage (ln)	3,388	18.307	2.575	11.561	27.847
Real Value Added (ln)	3,444	7.875	3.046	-3.992	15.270

Table A2. Description of firm-level survey[14]

	Survey Year	Food & Beverages	Textiles & Apparel	Wood & Paper	Chemicals & Non-Metal	Metal Product	Electrical & Machinery	Transport Equipment
Botswana	2010	A	A	A	A	A	A	A
Cameron	2016	A	A	A	A	A	A	X
Ethiopia	2015	A	A	A	A	A	A	A
Ghana	2013	A	A	A	A	A	A	A
Mauritius	2009	A	A	A	A	A	X	A
Malawi	2016	A	A	A	A	A	A	A
Nigeria	2014	A	A	A	A	A	A	X
Senegal	2014	A	A	A	A	A	A	X
Tanzania	2013	A	A	A	A	A	A	A
Uganda	2013	A	A	A	A	A	A	A
South Africa	2014	A	A	A	A	A	A	A

Note: A= Available; X=Not Available. Table A2 describes the firm-level data used for empirical analysis in Section 4.4. To merge the data with the industry-level data, we take a period lag. For instance, we merged Botswana's firm-level data in 2010 with the corresponding industry-level data in 2009. Similarly, firm-level data for Ethiopia which is only available in 2015 is merged with the country's corresponding industry-level import penetration variables for 2014.
Source: Author's calculation based on the described dataset.

[14] Note that the countries that make it into this analysis are largely determined by data availability and having sectors that are comparable to those sectors in the EORA dataset.

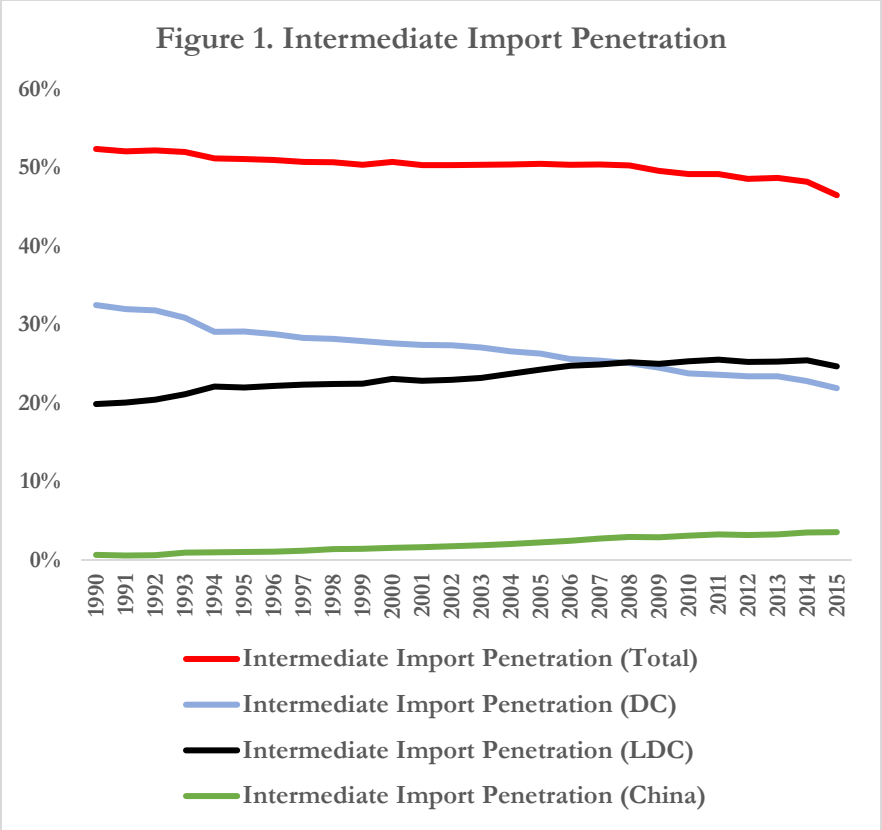
Figure 1. Intermediate Import Penetration
60%
50%
40%
30%
20%
10%
0%
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Intermediate Import Penetration (Total)
Intermediate Import Penetration (DC)
Intermediate Import Penetration (LDC)
Intermediate Import Penetration (China)

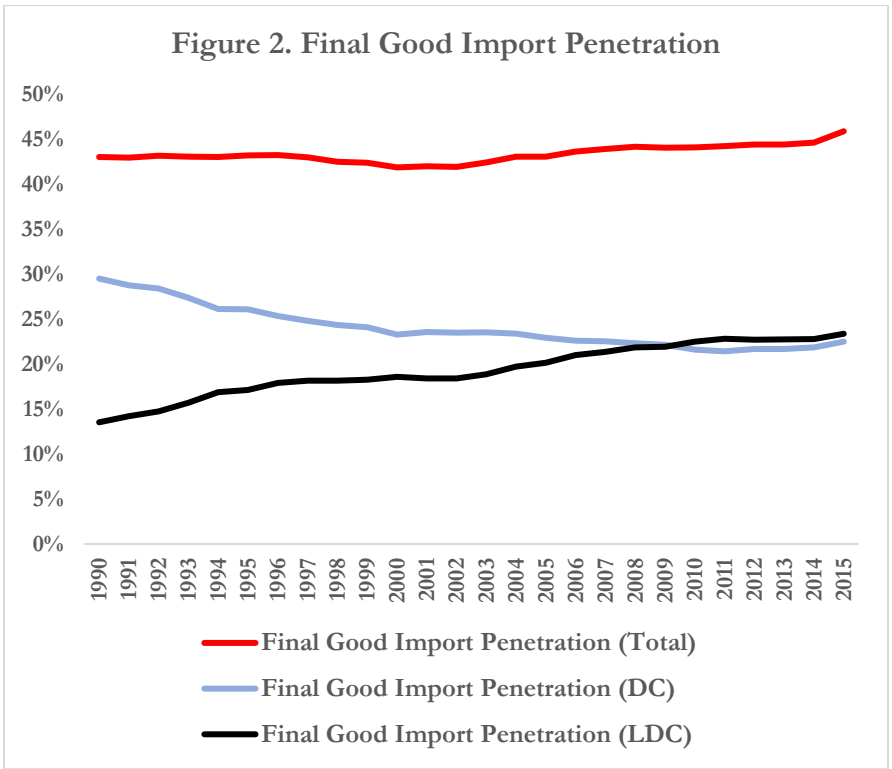
Figure 2. Final Good Import Penetration
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Final Good Import Penetration (Total)
Final Good Import Penetration (DC)
Final Good Import Penetration (LDC)

Table A3. Descriptive Statistics: Industry Level—Shares

Sector	Intermediate Import Penetration		Final Good Import Penetration		Intermediate Import Penetration Origin						Final Good Import Penetration			
					Developed		Developing		China		Developed		Developing	
	1990	2015	1990	2015	1990	2015	1990	2015	1990	2015	1990	2015	1990	2015
Food & Beverages	39.7	32.5	45.5	46.6	21.6	16.0	18.1	16.4	0.2	0.6	28.2	25.7	17.3	20.8
Textiles and Wearing Apparel	23.4	18.7	71.0	72.2	11.4	5.5	12.0	13.2	0.8	4.2	37.9	20.9	33.1	51.2
Wood and Paper	83.3	73.6	11.7	13.7	51.4	35.9	31.8	37.7	0.4	2.2	7.2	5.9	4.5	7.8
Petroleum, Chemical and Non-Metallic Mineral Products	67.9	62.4	29.9	33.9	41.5	28.6	26.4	33.8	1.1	4.2	19.2	16.1	10.7	17.8
Metal Products	84.2	80.1	12.5	14.9	49.7	34.2	34.4	45.9	1.4	8.8	6.9	5.5	5.6	9.4
Electrical and Machinery	45.7	39.9	53.9	59.4	34.9	22.1	10.7	17.7	0.4	3.3	43.6	34.3	10.3	25.0
Transport Equipment	22.7	18.4	76.6	80.4	17.1	10.7	5.5	7.7	0.1	1.3	63.6	49.1	12.9	31.3

Source: Author's calculation based on the described dataset.

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